A SINGLE-VALVE PORTABLE

Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

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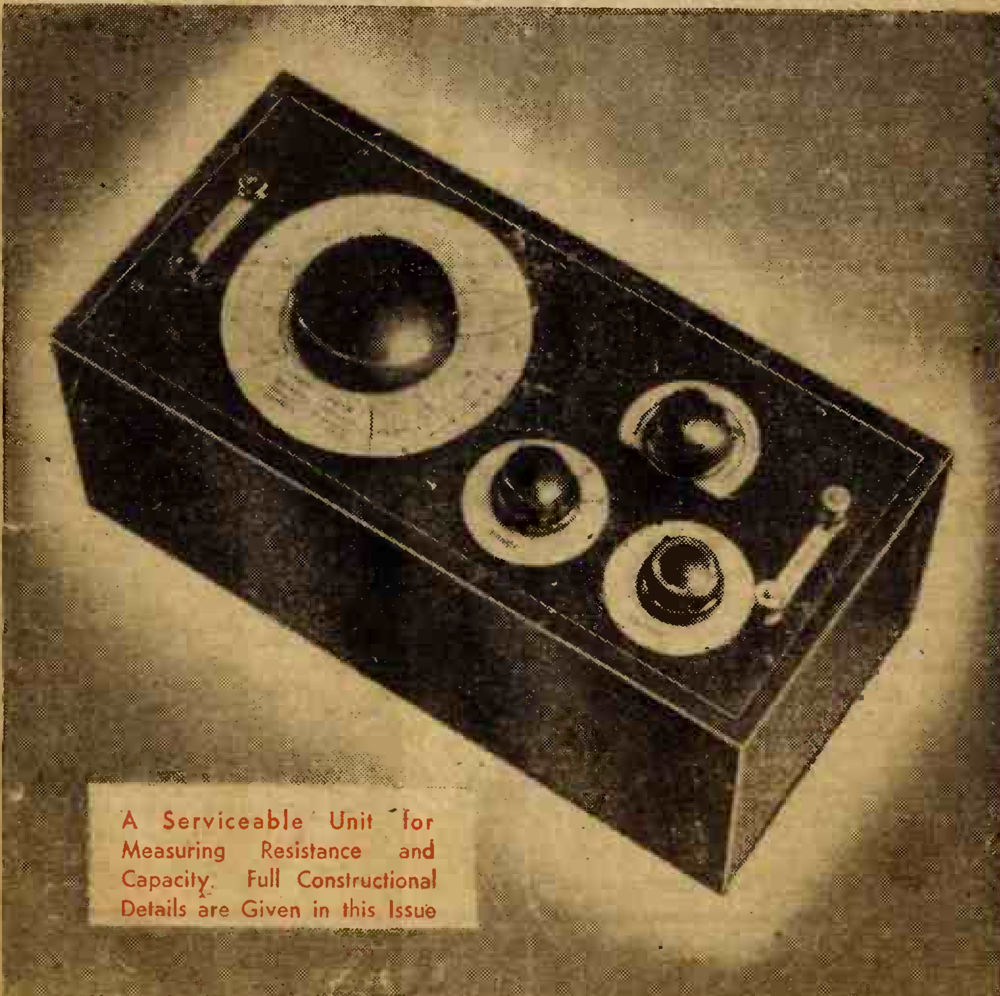

A Serviceable Unit for Measuring Resistance and Capacity. Full Constructional Details are Given in this Issue

Practical Wireless

and PRACTICAL TELEVISION

11th YEAR OF ISSUE

EVERY MONTH
Vol. XX. No. 451. JAN., 1944.

Editor F. J. CAMM

COMMENTS OF THE MONTH *BY THE EDITOR*

The B.B.C. Comes of Age

THERE is magic in a twenty-first anniversary. It is the age at which a man becomes a legal entity. He throws off parental control and is given the key to the door and not only of his demesne but of his future; he becomes, indeed, the captain of his soul and the master of his fate. It seems but yesterday that the B.B.C. was launched upon its career, 21 years ago at Savoy Hill, with call sign 2LO, after the famous weekly broadcasts from Writtle, call sign 2MT, every Tuesday for half an hour. The B.B.C. can be proud of much in its 21 years of history, if regarded as an experimental period. It is perhaps ungracious to suggest that there is room for criticism. Indeed, if we could have some assurance that within the next decade the B.B.C. proposes to profit from the experience of the past 21 years, the present occasion would be one for laudation. There can be no doubt that the B.B.C. is a model to the broadcasting technique of the world, but we must also bear in mind that comparisons between this and other countries do not really provide a measure for judgment. Some countries are satisfied with a 12-hour *mélange* of tinpan alley mush, others with a *montage* of melancholy music (*sic*) with lyrics about Alabam, fields of cotton, Mammy's arms, true, blue, love, above, perhaps leavened here and there by songs about trees, whispering grass, and nightingales in Berkeley Square. Unfortunately, the lowest Continental tastes have been imported into this country, and the B.B.C. has pandered to them. It has allowed alleged composers, who openly boast that they cannot read a note of music, cannot write a note of music, cannot play any instrument, to use the air, to pedal their elementary wares, with the inevitable result that for the past 20 years the youth of the country has become jazz soaked, and neurotic. A large percentage of the population will sway in rhythm to the sound of anything which savours of jazz or swing.

Educational Force

BUT in 21 years there is more on the credit side than on the debit. There can be no doubt that the B.B.C. has been a great educational force. It has brought the voices of the famous to the fireside, and inculcated an intimacy between the famous and the unknown. It has disseminated information on a wide variety of subjects, and the nation must have benefited as a result. But the surgeon does not inject a serum to benefit his patient and almost immediately inject another serum to cancel out the first. Because a section of the public, however large, wants jazz that is no particular reason in favour of giving it to them.

So, in the next 21 years, let us hope that the B.B.C. will become the largest technical institute in the country, and provide broadcasts on subjects at present taught at technical institutes. Such a scheme would save the individual travelling time and help to provide the technicians who will be needed to reconstruct the world.

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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.

Coming of Age Lecture

MR. STUART HIBBERD, chief announcer, gave a lecture on November 17th before the Royal Society of Arts, and he briefly surveyed the happenings of the past 21 years. Broadcasting was firmly established when he joined the British Broadcasting Company, as it then was. He has seen the dream of a wireless girdle round the world a proved reality. It was on January 1st, 1927, that the British Broadcasting Company became the British Broadcasting Corporation, with a Royal Charter and a State Monopoly. Within the next 21 years we shall see broadcasting as we know it gradually change over to television, and perhaps, when the B.B.C. celebrates its jubilee, Mr. Hibberd will be there to remind us of the present momentous occasion.

We must have sympathy with announcers, who are expected to pronounce strange names from script; according to Mr. Hibberd, one has to be particularly careful over the pronunciation of Scottish names. We do not know why. Perhaps for the same reason that every Scot will write to the editor of any paper so misguided as to print England or English instead of Britain or British. Mr. Hibberd recalled the first time he pronounced a Scottish name wrongly. He heard from every Scot who was listening at the time, including one from New York. Elsewhere in this issue we summarise the important dates in the history of the B.B.C., but we were interested to note Mr. Hibberd's personal views of the future. This is what he said:

"What of the Future?"

"AND now, what of the future? In attempting to answer this question, I must make it clear that I am stating my own personal view. Are we going to be satisfied with a reversion to the old pre-war system of two alternative programmes throughout the country? I think not. A third wavelength could be heard throughout the country, giving one an additional choice. Television, of course, must come into its own again. It was a thousand pities that, for security reasons, our transmissions were closed down when war broke out. I believe we shall find, when peace comes, that television has gone ahead by leaps and bounds, as a result of research carried out during the war years."

Let us hope that this suggested third programme eschews all jazz, and that the term *highbrow* is not used as a mark of derision.

ROUND THE WORLD OF WIRELESS

I.E.E. Paper

THE wireless section of the Institution of Electrical Engineers held a meeting in the Lecture Theatre of the Institution on November 24th, when a paper on "Enemy Airborne Radio Equipment" was read by Mr. C. P. Edwards.

Change of Address

WITH reference to our announcement in the December issue concerning the change of address of Multicore Solders, Ltd., the new address should read Commonwealth House, New Oxford Street, London, W.C.1.

Car Radio

THE Postmaster-General stated recently in a written reply to Wing-Commander Hulbert that the Government is considering the question of some relaxation on the restrictions of wireless receiving sets in motor-cars.

Sir William Noble

SIR WILLIAM NOBLE, a director of the General Electric Co., Ltd., died in London on November 9th at the age of 82.

Sir William was a native of Aberdeen and began work in the Post Office Telegraph Department of that town in 1874. At the age of 32 he was made Post Office Engineer for north-east Scotland. He was subsequently transferred to London and earned rapid promotion to various appointments until he became Engineer-in-Chief of the G.P.O.

He was one of this country's leading experts in telephony and gave a great deal of time to research and development in this subject both at home and abroad. He accompanied a number of missions to Europe, headed a commission on the subject of automatic telephones to the U.S.A., and for his help to the Belgian telegraph and telephone engineers in the last war he was made a Chevalier de la Croix Belgique. For his long and distinguished services he was awarded a knighthood in 1920. In 1922 he resigned from the Post Office.

On his retirement he joined the board of the General Electric Co., Ltd., where he gave his attention and the benefit of his great knowledge and experience to the company's telephone works.

He also continued to find outlets for his energy and talents in other directions. He was closely associated with the formation of the British Broadcasting Company and was, in fact, one of its first directors.

B.B.C. Collaborates With All-India Radio

"INDIA and the Four Freedoms" is the title of a series of six weekly discussions to be broadcast in the B.B.C. Eastern short-wave service.

The object of these discussions is to place, primarily before Indian listeners, some of the problems which the world at large, and India in particular, will have to face after the war. So far as India is concerned, the discussions centre round the problems which India will face when she has achieved full freedom.

B.I.R.E. Paper on Colour Television

ADDRESSING the Institution on October 28th, Mr J. L. Baird described the development of colour and stereoscopic television since he first demonstrated both colour and stereoscopic systems in 1928, when three-aperture spirals on disc were used in conjunction with colour filters and colour glow discharge lamps. His present system of three-colour stereoscopic 500 lines can be viewed directly and the 600 lines system requires the use of coloured glasses by the viewer.

Mr. Baird described the numerous experiments he had conducted during the past 15 years and stated that his systems were now sufficiently advanced to be used for public service if facilities were available. He considered that within five years after the war these systems would be extended to the whole of Great Britain by means of radio links. For television transmission he felt that for this new system no alteration in television receiving apparatus would be necessary and that only minor changes in the transmitters would be required. For the purpose of showing up-to-the-minute films of immediate public interest, Mr. Baird was of the opinion that when television broadcasting re-commenced cinemas would show regular television "news reels." Further, three-colour 500 lines system would, in Mr. Baird's opinion, be used in the television-telephone.

Mr. Anthony Eden, M.P., listening on the radio to a conversation between two tanks when he visited several units of British regiments while spending a few days at Cairo on his way to Moscow for the recent three-power conference.

Ekco Appointments

WE are advised of the addition of two directors to the board of E. K. Cole, Ltd. They are Mr. A. C. Allen and Mr. N. C. Robertson.

Mr. N. C. Robertson is director and general works manager and his headquarters are at head office, E. K. Cole, Ltd., Aston Clinton, Bucks. He has been with Ekco since 1930, and since the war has been works manager.

A further Ekco announcement names Mr. A. W. Martin as chief engineer of the company. Mr. Martin has been with Ekco since 1928 and, as assistant chief engineer, has been responsible for many important technical and design developments.

The B.B.C.'s Twenty-first Birthday

THE B.B.C. came of age on Sunday, November 14th. The occasion was marked in the day's programmes by the morning and evening religious services and by the presentation of "Twenty-one To-day," a feature programme broadcast in the Home Service after the nine o'clock news.

In the beginning the daily programme consisted of two and a half hours broadcast to listeners at home only. It was necessary for separate announcers to read the news in London, Birmingham and Manchester. Now the B.B.C. broadcasts for seven hundred and twenty-eight hours each week to the world, in the Home and Forces, Overseas and European Services, in English, Gaelic and Welsh as well as 45 foreign languages. What many regarded as an electrical toy in 1922 has become in 21 years a British public service of global dimensions.

"Twenty-one To-day" was a panoramic radio picture of events, covering the four phases in the history of the B.B.C. It was produced by John Glyn-Jones.

The first part dealt with the founding of the B.B.C. and the first of 7,671 consecutive days' broadcasting without a break. The second phase of "growing up"—from 1922 to 1932—was concerned with "bright ideas" that came to stay, famous first broadcasts, public prejudices, some fiascos, the B.B.C.'s first public service during the General Strike in 1926; the Relay stations which led to the Regional scheme; from "Company" to "Corporation"; B.B.C.'s tenth birthday which marked the closing of Savoy Hill, and the opening of Broadcasting House. The third part covered the period 1932-39 and the birth of two offspring—the Empire Service and Television; and the recording of World History, on the spot, at the time. The fourth part depicted the B.B.C. in wartime.

The "Underground" Press

FROM Belgium comes news of the response to a new series of broadcasts, specially directed to the clandestine press in Europe, which was started in the B.B.C.'s European Service last July.

That these broadcasts are proving useful and reception satisfactory is demonstrated by the editors themselves. For example, practically the whole of the first programme broadcast was published in "La Libre Belgique"; in August "La Légion Noire" announced that, in order to make full use of the material being broadcast, it would in future go to press fortnightly instead of monthly. "La Libre Belgique" and "L'Echo de Belgique" have printed most of the detailed statements of enemy and allied air losses broadcast in these programmes.

Three programmes are broadcast each week, and each is given in English, French, Dutch and German. The content of the programmes is principally facts and figures likely to be useful to the editors and information about the activities of their colleagues in other countries. The broadcast speed is sufficiently slow to enable a good shorthand writer to take down the more important passages verbatim.

Expansion of Overseas Services

ON November 21st further large expansions in the Overseas Services of the B.B.C. came into force.

The description "Overseas Services" refers not to the European Service of the B.B.C. but to the various services addressed to listeners in all parts of the Commonwealth and Empire, in the U.S.A., in Latin America, in the Near East, and in the Far East.

First the General Overseas Service, which is an English-speaking service intended largely for those who think of Great Britain as "home," is being expanded very considerably, both in programme hours and in coverage. It will be increased from 13 hours to 20 hours. In some parts of the world it will be made audible throughout the greater part of its length; while in most parts of the world it will be heard at different convenient listening times for several hours every day. To secure this it will be carried on some 24 different wavelengths.

This in turn will allow for further concentration on the services intended for specific audiences resident in different countries. The most notable of those new improvements will be in the Latin-American Service which is for all practical purposes doubled. A full and continuous service will now be given in Spanish and Portuguese simultaneously instead of the service changing constantly from one language to the other. The increase in actual broadcasting time is four and a quarter hours. More of the General Overseas Service will also be available in South and Central America than before.

B.B.C. in Toronto

WE understand that Mr. S. J. de Lotbiniere, who was previously in charge of the B.B.C. Outside Broadcast Department, and was recently Director of Empire Programmes, is shortly proceeding to Toronto, Canada, to open a B.B.C. office there.

Polish A.T.S. girls, in training at a Battle School in Scotland, are here seen working a field wireless set, spotting aircraft, and sending messages to H.Q.

American Radio Pioneer

JOHN S. STONE, who has just died at the age of 74, was one of the last of America's wireless pioneers. He was associated for many years with Dr. Lee de Forest.

This is the Army

IRVING BERLIN'S U.S.A. Army show, which packed the London Palladium, could not be seen by a fraction of the people who wanted to see it. Its limited season of two and a half weeks is to be followed by a short provincial tour, but before this, on November 25th, there was a half hour broadcast, given by Irving Berlin and the original cast, of the highlights of the show. These included Berlin singing the song he wrote when a recruit in the last war, "Oh, how I hate to get up in the morning!", and his latest song, "My British Buddy," already assured of success. All members of the cast were enlisted men in the U.S. Army and proceeds are being given to British War Charities.

A Single-valve Portable

A Small Receiver for Operating Entirely on Dry Batteries.

By A. P. CASPERS

RECENTLY I decided to build a small portable receiver which could be used during holidays, at places where no other wireless set was available.

Before commencing construction, I made out a list of all the desirable features that my finished set was to possess.

(1) The set really was to be portable (i.e., it had to be both small and light).

(2) The cost was not to exceed 30s. to 35s.

(3) The battery expenses were to be as low as possible. (The disadvantage of many a portable set is that nowadays 10s. to 15s. has to be spent each time the H.T. supply fails.)

(4) The range and selectivity had to be good.

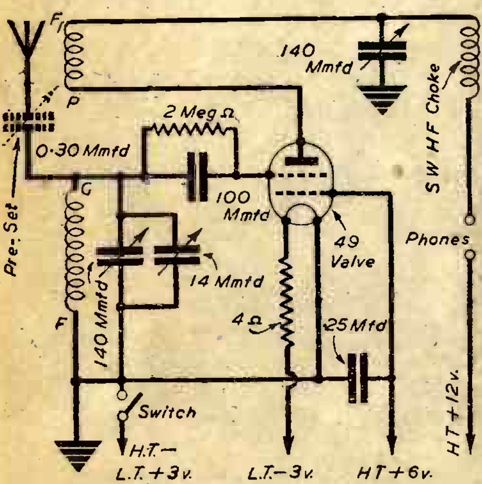


Fig. 1.—The theoretical layout of the receiver. The letters on the coils refer to pin connections on holder. See Fig. 4.

At first sight a combination of all these points appeared decidedly difficult to obtain until I hit upon the idea of making a short-wave space charge detector.

Valve and Batteries

The receiver uses an American type 49 valve which acts as a regenerative detector, and when a positive potential is applied to the inner grid of the valve, the space charge is partially cancelled and the valve will operate very efficiently from a 12-volt H.T. supply which can be made up from two G.B. batteries joined in series. The L.T. supply is obtained from a third G.B. battery, and by this means a complete renewal of batteries only involves the expenditure of about 3s. 9d. as opposed to the usual far higher amount.

The circuit diagram, Fig. 1, shows that very few parts are needed so that even if the parts are bought new, the total cost is still only about 30s.

It will be seen that a 14 mmfd. band-spread variable condenser is included to facilitate tuning, but even with this it is found advantageous to use a slow-motion tuning dial in conjunction with it. The inclusion of a pre-set condenser is optional. If it is omitted the aerial can be looped around the coil.

Construction

In the interests of lightness and compactness the set is housed in a 6½in. × 4¼in. × 8in. wooden cabinet, which is made of 3-ply, except for the side pieces which are of thicker wood in order to impart greater strength to the finished cabinet. The parts needed for the cabinet are:

Top and bottom :	2 pieces 3-plywood	3¾in. × 6½in.
Front and back :	2 „ „	6½in. × 8⅛in.
Sides :	2 pieces thicker wood	7⅝in. × 3¾in.

One of the 3¾in. × 6½in. pieces is drilled so as to hold a switch, and 4-pin valveholder. The latter acts as coilholder for the coil which is wound on the base of a defunct valve. The diagrams for drilling the top as well

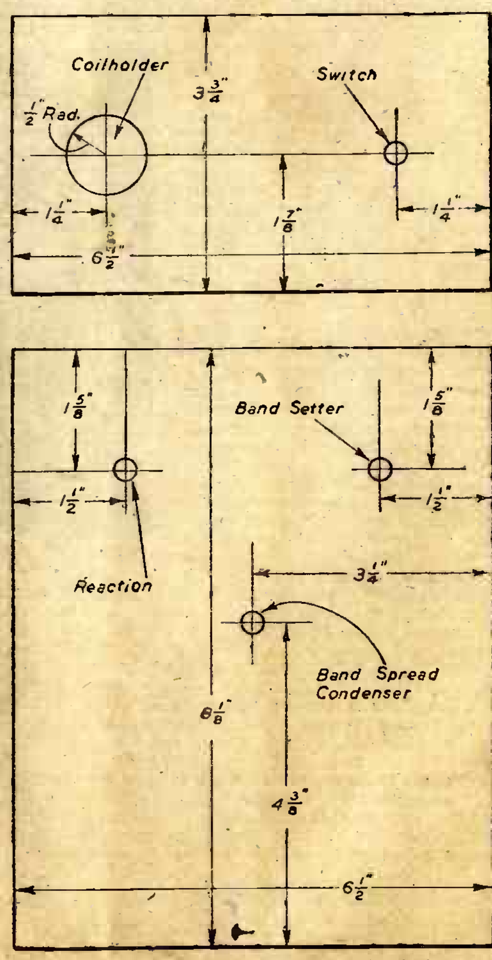


Fig. 2.—At the top is shown the dimensions for the horizontal panel. The lower diagram is that for the main or vertical panel.

as the front, which will carry the variable condensers, are shown in Fig. 2.

Next, a piece of metal is cut to fit behind the front panel, and then the three variable condensers and dials are fitted.

The position of the rest of the parts can be ascertained from Fig. 3. This arrangement keeps the wiring short, a very important factor in any short-wave set.

Also, don't forget to solder all parts, and join the ground connections to a single point on the metal panel at the front. In the interests of safety it is advisable to pad the valve with chamois leather or cotton-wool to prevent it breaking as a result of any sudden jar. At the same time four rubber stops could be fitted at the base of the cabinet for the same purpose, as well as preventing the set from becoming scratched.

The diagram of the holder (Fig. 4) for the 49 valve, showing the holder viewed from the *underside*, should clear up any troubles concerning this part of the wiring up.

As mentioned before, the coil is wound on a 4-pin valve base. The coilholder is shown viewed from the *upperside*, and the actual coil is wound with 26 D.C.C. wire. Oscillation is found easiest to obtain on 40 metres. Try winding a coil for this wavelength using the data given in the coil details below.

Since G.B. batteries are used for H.T. and L.T., it must be remembered that the −9 volts shown on the battery is to be taken as negative, −7½ volts as 1½ volts+, −6 volts as 3 volts+, and so on.

Tuning

The set tunes in a similar manner to any regenerative set. The band setter is first adjusted to the desired short-wave band, which is determined in conjunction with a suitable coil, and the reaction control is advanced until a soft hiss is heard in the phones. At this point the set is in its most sensitive condition and the band-spreader is rotated until the carrier wave of a station is heard. The reaction condenser is then eased off until this station is rendered intelligible. With some valves, it is found that a "fringe howl" occurs just at the oscillation point. This is counteracted by raising the H.T. voltage to 13½ or 15 volts, still keeping the inner grid voltage at 6 volts. If the breaking into oscillation is still not smooth, try experimenting with a different number of turns on the coil until the trouble ceases.

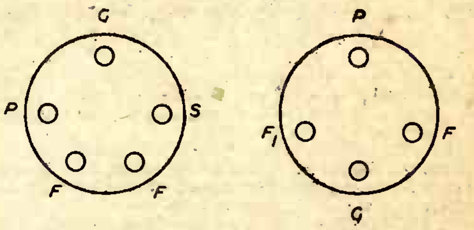


Fig. 4 (Left).—The pin connections for the 49 valve holder. (Right) Those applying to the coil and holder. The view of the valve holder is the underside but that of the coil holder is upperside.

This receiver brought us American, African and European stations on the first night that it was tried out: No earth was used at the time and the aerial was only 15ft. above the ground.

Since the set is so small it can be easily housed in a haversack along with plug-in coils, a pair of compact earphones and 25ft. of throw-out aerial. In the writer's case it was found that while the set alone weighed about 4lb., the total weight of the set and accessories did not exceed 5½lb.

Coil Chart

Twenty metres: grid 5 turns, reaction 4 turns; 40 metres: grid 10 turns, reaction 7 turns; 80 metres: grid 22 turns, reaction 11 turns; 160 metres: grid 45 turns, reaction 18 turns; 400 metres: grid 110 turns, reaction 44 turns.

COMPONENT PARTS

Two .00014 mfd. variable condensers.
One .000014 mfd. variable condenser.
One .0001 mfd. fixed condenser.
One .25 mfd. by-pass condenser.
One 2 meg. grid resistance (½ watt).
One 4-ohm resistance.
One short-wave H.F.C.
One 49 valve.
One valveholder for 49 valve.
One 4-pin valveholder (coilholder).
One switch.
One 0-30 mmfd. trimmer condenser (optional).

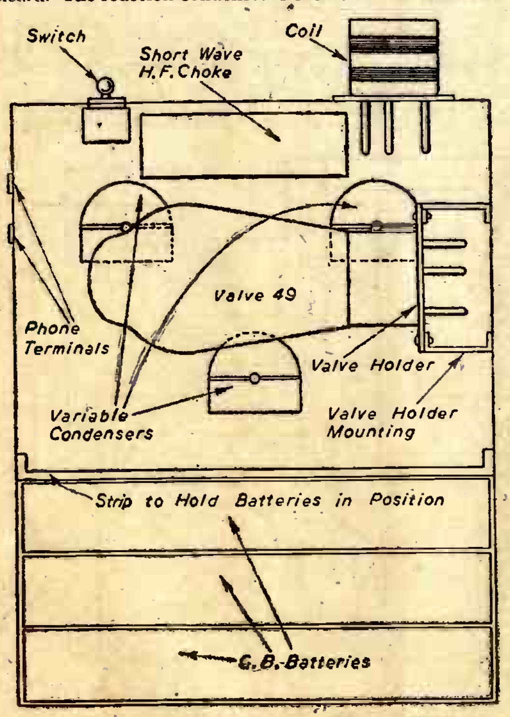


Fig. 3.—Rear view of the interior of the receiver, showing how the valve is mounted.

Making a "Transvertor"

A Reader on Active Service—Gnr. N. Hancox—has to Secure His Components from Debris in the Battle Zone, but in Spite of this He has, with Considerable Ingenuity and Patience, Constructed a Very Efficient Power Unit

IN these days of conservation of material and supplies, use has to be made of every small item and piece of scrap, and here in N. Africa, this applies even more so than at home.

Recently I was called on to make a D.C./A.C. convertor for the purpose of supplying power for an A.C./D.C. set. It was no easy job out here, but eventually I hit on a system of "reversing curreut," and as other readers of PRACTICAL WIRELESS may have a similar set for which they wish to make a semi-portable supply, I give the main details below.

The components used were odd parts picked up during my travels, and consisted of a few assorted condensers, a transformer, a thermal overload switch (Siemen's) and an old windscreen wiper, and, after some searching, I found an old commutator which completed my requirements.

The system of working is briefly this:

The motor is used to rotate the commutator, which is interconnected between certain segments (Fig. 1) and reverses the D.C. input at every alternate segment.

Thus the equivalent of an A.C. voltage is produced, the frequency being governed by the number of revolutions and the number of segments on the commutator, i.e., a 12-segment commutator at 1,000 revolutions per minute, connected as shown, will deliver a frequency of 50 c/s. This is then fed into the transformer filament windings which, in my case, were connected in series (Fig. 1). The original primary can then be utilised as the secondary, if tapped, giving out about six-tenths the rated output voltage.

The components were mounted on a sheet tin base cut from an old petrol tin and polished (Fig. 3). The smoothing circuit was mounted beneath the base. To obtain the requisite frequency of 50 c/s and to get the alternating current it was necessary to link every alternate odd segment of the commutator, i.e., 3-5, 7-9, 11-1. The even segments were "dissed" owing to the width of the carbon brushes used and to the possibility of them shorting adjacent segments.

The brush mounting block is simply a square block of wood, drilled to allow for the commutator. The brush

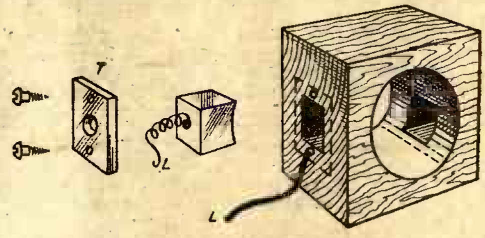


Fig. 2.—The mounting block for the brushes, and associated parts.

holders were made by drilling ¼in. holes in the appropriate positions and squaring with a small Swiss file.

Care must be taken that the brushes fit the holes easily and squarely without allowing too much side-play. The tension spring is held in place by the metal strap "T," in Fig. 2, which also serves as a connection block for the leads, "L."

The motor and the block are strapped to the baseplate with metal straps ½in. wide by $^1/_{16}$in. thickness. The block can also be held by two small woodscrews passing up from beneath the baseplate.

The transformer was an old mains type with a "dissed" H.T. secondary, and was screened by means

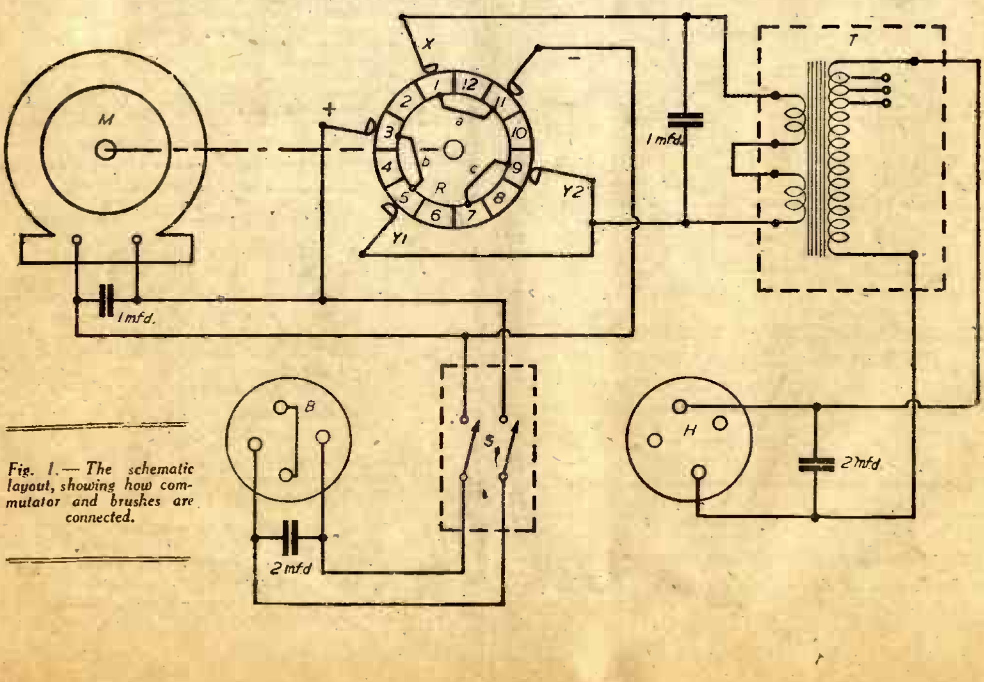


Fig. 1.—The schematic layout, showing how commutator and brushes are connected.

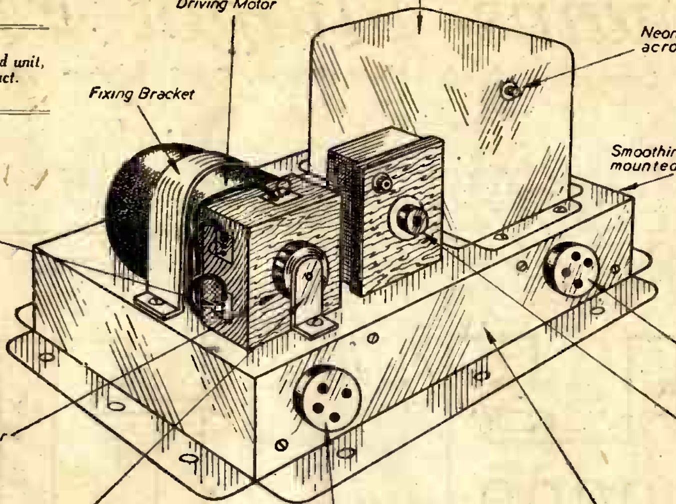


Fig. 3.—The completed unit, sturdy and compact.

of a can made from a piece of old tinplate and bolted securely to the base. For the battery and output connections, two old valveholders were used, and the connections were through four-pin adapter-plugs.

The on/off switch was, as stated, fitted with overload release. Failing the possession of this, protection should be given to the battery by inserting suitable fuses in the D.C. circuit.

Before putting the transvertor into action, the brushes must be "run in," and half an hour's running of the motor should do this, provided the load (transformer) is disconnected first. For final setting up and adjustments, the motor should be run on full load for about 20 minutes.

The 1 mfd. condensers should take up any slight sparking that may occur afterwards, and the two 2 mfd. condensers will effectually provide a smooth output from the set.

As a further precaution, the output leads should be screened and the whole bonded and earthed. The transvertor should then be placed at least 3ft. from the receiver requiring power.

The output under these conditions will be smooth and noiseless.

To operate, first see that receiver switch is OFF. Switch on transvertor and allow to run up to working speed before switching on the receiver.

Allowing a current consumption of two amperes for the motor, the efficiency of the transvertor is in the region of 50-75 per cent.

Forces and Their Families Linked by Radio

"HEARING your voice gave me a wonderful thrill." The reference is not, however, to the voice of a microphone personality. It comes in original letters, or in quotations from them, forwarded by wives and children, fiancées and parents, who have either broadcast in a "message programme" or have been broadcast to.

Members of the British and Empire forces thus hear the actual voices of their near ones, or themselves come to the microphone to greet their folks at home, either in this country or in the Dominions and Colonies.

What has grown into an all-round-the-clock programme service had a very small beginning. Back in 1940, during the blitz period, messages from some of the Canadians serving in this country were included in a programme in the B.B.C.'s North American Service to help to bridge the distance between them and their families across the Atlantic.

"What about our own men?" was a question that naturally followed. At the end of a six o'clock news bulletin the suggestion was broadcast that messages from near relatives would be included in overseas forces programmes. The invitation to would-be message senders to write in was to be repeated next night after the nine o'clock news. It wasn't! For, that morning, more than 8,000 letters had come from people eager to speak to men in India, in the Middle East, in the Far East and in Gibraltar and Malta. The small programme staff stood waist deep in them. So came about programmes "Calling—India," "—Hong Kong and Singapore," "—Gibraltar" and "—Malta," the "Middle East Magazine," "Over to You in Canada" (for men over there under the R.A.F. Empire Training Scheme), "Calling the West Indies," "Anzacs Calling Home," and many others, till, to-day, there is scarcely a part of the globe to which British radio does not carry those intimate family messages, often characterised as "so real that it seemed as if you were here beside me."

All-mains Midget Three

Completion of Constructional Details of this Handy A.C./D.C. Receiver. By JOHN JAY

(Concluded from page 24, December issue)

SANDPAPER the surface of the chassis around the holes drilled for earth tags, and use, if possible, split washers with every bolt and nut.

Aerial and earth terminal strips may be made by cutting across on old four-pin paxolin valveholders as shown in Fig. 3(C).

Condenser C_{16} is held in position by the proximity of T_1 and L_5, and by wiring.

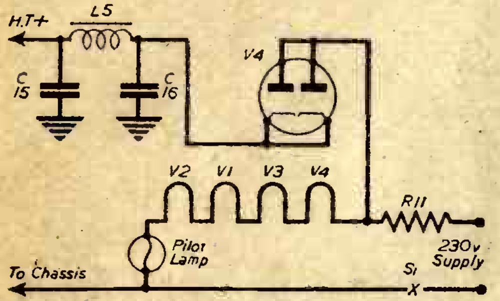


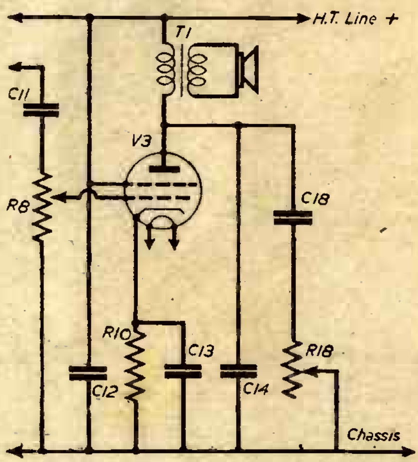
Fig. 9.—(Above) Modifications for low anode voltage valves.

Fig. 11.—(Right) A tone control added to the output stage.

Trimmers C_3 and C_9 should be attached to the condenser or in close proximity to the tuning coils.

Connections should not be soldered to R_{11} if a chassis mounting type of dropping resistance is used; small nuts and bolts should be used to prevent the possibility of soldered connections melting due to the heat.

C17 and C4 should be high insulation condensers of the mica type; C15, C16 and C13 are electrolytic condensers and care must be taken to see that their negative terminals are connected to the chassis.



If it is preferred the speaker may be mounted in the space left on the chassis, enabling the entire set to be withdrawn from its cabinet with the minimum of difficulty.

The base connections for the valves mentioned are given in Fig. 6. Figs. 7 and 8 show the wiring and

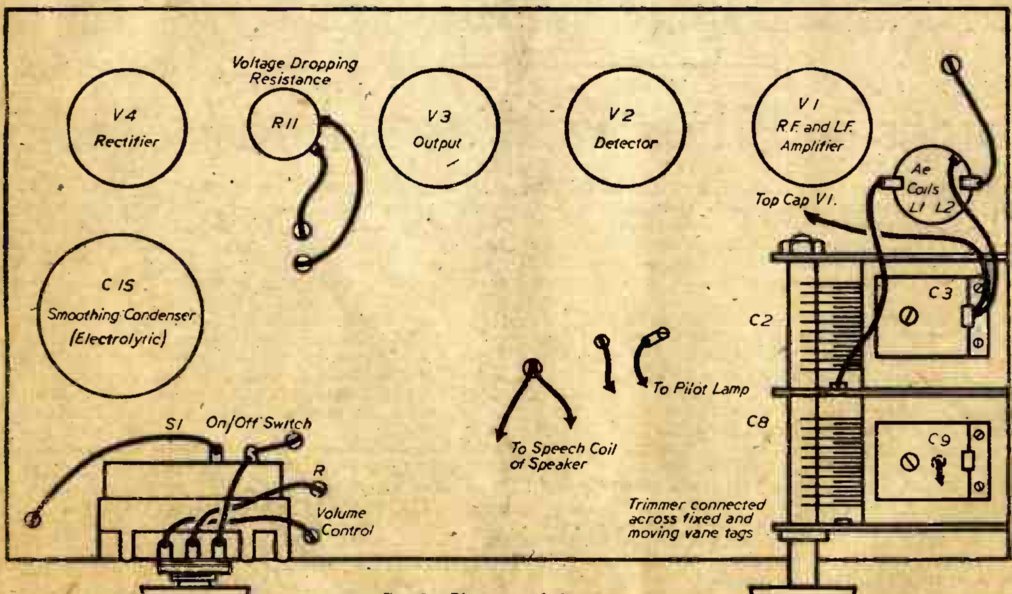


Fig. 8.—Plan view of chassis

component position for both underside and top of the chassis, the tubular condensers and resistances have been decreased in size to give greater clarity. All resistance except R_{11} may be ½ w.

Alternative Valves

In the event of the constructor finding difficulty in obtaining the valves stated, he may use high voltage heater valves, 25B8—Triode-Pentode (V_1); 12SK7—Pentode (V_2); 50L6—Pentode (V_3) and 35Z4—Rectifier V_4. R_{11} may now be used as a 2-way line cord of 1,000 ohms. This value of resistance for the line cord may be obtained in the following manner:

Voltage required for heaters and pilot bulb, is 128.3 volts, thus, if the receiver is to operate from 230 v. mains,

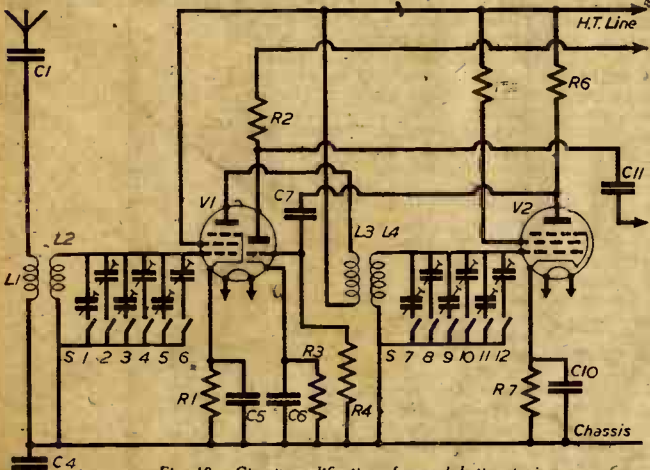


Fig. 10.—Circuit modifications for push-button tuning.

230-128.3 v. or 101.7 v. must be dropped across R_{11}, the heater current for these valves is 0.1 ampere, thus, by Ohm's Law,

$$R=\frac{V}{I}=\frac{101.7}{.1}=1{,}000\ \Omega \text{ (approximately).}$$

The connection from R_{11} to the rectifier anodes must now be taken from the other side of R_{11}, as shown in

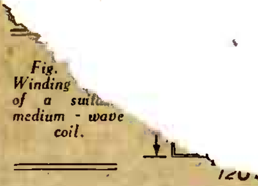


Fig. Winding of a suit... medium - wave coil.

Fig. 9. This procedure must b... these alternative valves have a lowe... missible anode voltage than the original ...

Push-button Tuning

The modifications necessary for push-button tuning are shown in Fig. 10. The trimmers should be mounted as close to the switching mechanism as possible. The tuning condenser is now replaced with a tone control consisting of a 0.002 μF fixed condenser in series with a 50,000Ω potentiometer, Fig. 11.

Coils

The coils used are "Wearite" types PA2 and PHF2, mounted as shown in Fig. 3 (B). Type PA1—PHF1 coils may be used, giving a range of from 250 to 750 metres; this may be adjusted to the normal broadcast band of from 220 to 550 metres (approximately) by the insertion of a 0.0005 μF fixed condenser in series with each tuned circuit.

If the constructor wishes to make his own coils, he may proceed as follows: Wind a strip of glued brown paper, 2in. wide, around a ½in. rod, slide the tube thus formed from the rod and allow it to dry. Drill four holes for stiff wire connectors about ⅛in. down from one end and two holes for mounting purposes ⅛in. up from the other end. Wind 120 turns of No. 38 s.w.g.,-d.s.c. wire ⅜in. up the former, taking the ends to two of the stiff wire connectors, soldered into the holes at the top of the former, the coupling coil comprises about 20 turns of the same wire, separated from the tuning-coil by 3/16in., its ends being soldered to the two remaining connectors. See Fig. 12.

Books Received

VALVES AND THEIR INTERCHANGEABILITY. By J. Bull. Published by V.E.S., Radio House, Melthorne Drive, Ruislip, Middx. 14 pages. Price 7d. post paid.

MANY constructors and all service engineers have experienced the difficulty of obtaining replacement valves during these days of restricted supplies. It is common knowledge that alternative types can be used, but unfortunately in many instances modifications have to be made to suit a valve base different from that of the original valve. The fitting of a new valveholder, plus possible alteration of the wiring, is not always convenient or speedy, therefore the ideal solution to the problem is to use a reliable make of adaptor which would allow, say, a Mullard side contact 1.4 volt valve to be replaced by one having an octal base, to quote but one example.

A wide range of adaptors are obtainable from Messrs. V.E.S., and the first part of the booklet lists the various types of adaptors available and describes their usefulness. The second part forms an index of valves which are or may be in fairly short supply.

AMERICAN SERVICE MANUAL. Vol. 1 and 2. Published by Champion Electric Corporation, Champion House, 84, Newman Street, W.1. 50 and 60 page respectively. Price 12s. 6d. per volume.

THE first volume deals with the Sparton-Emerson receivers, while Volume 2 forms Part 1 of the Crosley-Belmont series. The manuals contain comprehensive data covering the receivers concerned, and the theoretical and layout diagrams are of sensible dimensions which simplifies considerably their reading. Part numbers and component values are given, together with such essential information as aligning procedure, service notes, test frequencies and general pointers connected with the individual models.

For service engineers handling American receivers, etc., the Service Manuals will prove of great assistance.

We understand that in the near future the publishers hope to include manuals covering Air King, Stewart-Warner, Fried-Eiseman, De Wald, and Zenith products.

…ay Tubes—1

…ure and Testing. By LAURENCE ARTHUR

…ay tube was developed …arly as 1902, it did not come …until the advent of high definition …ew years preceding the war, and the …neous expansion in the use of cathode-ray oscilloscopes by radio manufacturers and service engineers. In the research laboratories of some of the leading valve manufacturers additional uses were being discovered, and many of these have since been put to valuable service by the Army, Navy and Air Force.

In brief, a cathode-ray tube is essentially a valve in which the emission from the hot cathode can be made visible and controlled. The visibility is produced by causing the emission to take the form of a beam which strikes a fluorescent screen on the inside of the glass bulb and the control, consisting of brightness, focus and deflection of the beam, is a result of the application of suitable voltages to the different electrodes. In the main, cathode-ray tubes are of the high vacuum type, but some have a filling of argon or helium. Another division of types is descriptive of the method of deflection—electrostatic when the tube has internal deflector plates; electromagnetic when external coils are used. Occasionally both types of deflection may be used on the same tube.

Research departments have accumulated a mass of data which is invaluable when new types of tubes are required. Much of this information was obtained through experimentation with demountable tubes in which components of different dimensions, and having differing spacings, could be tried. Now it is possible to predict mathematically the result of any change in electrodes. There is still considerable research on screens and methods of applying them, and one result of this will be post-war television of greater brilliance and finer grain than ever before.

Tube Shapes

The outline shape of various types of cathode-ray tubes is shown in Fig. 1. The "start" of all tubes is the flanged foot which begins as a short glass tube ¾in. to 1¼in. in diameter. Numbers of these pieces are fed into a rotating machine and heated by suitably placed gas jets. As the machine revolves a V-shaped tool is pressed into the white hot glass at one end, and automatically produces a flange. For those types using a flattened foot the other end of the tube is squeezed between two jaws until there is only a small gap remaining. This is shown in Fig. 2.

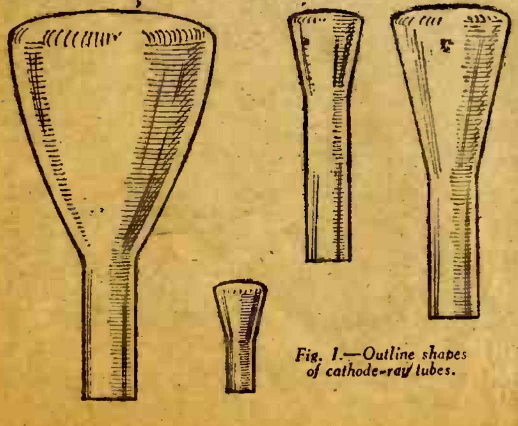


Fig. 1.—Outline shapes of cathode-ray tubes.

Footmaking

The next process, called footmaking, consists of sealing into the top of the flanged tube all the wires required for supporting the assembly and for making external connections. The number of wires needed is usually 10 or 12, and each wire consists of two or three sections joined together. Nickel is used for the support wires and copper for the external connections. Neither of these metals has the same coefficient of expansion as glass, and if either were sealed into the flange there would be a grave danger of the glass cracking on cooling, or the seal would not be vacuum tight. To overcome this difficulty a material called borated copper has been developed. This is a pure copper wire with a ruby-coloured coating, which fuses with the glass at a suitable temperature and provides a vacuum tight seal without imposing a strain. A normal footwire, therefore, consists of three sections, as shown in Fig. 3. A support wire not having an external connection consists of two sections only—the nickel and the borated copper.

Footwires are rapidly produced on an automatic wire joining machine in which nickel wire is fed from one side and copper wire from the other. Predetermined lengths are cut off and held the required distance apart. A short length of the borated copper is cut off and held by slender steel fingers exactly in the gap between the other two wires. Simultaneously two fine flames of hydrogen shoot out and weld the three pieces of wire into one length which is dropped down a chute into a neat pile.

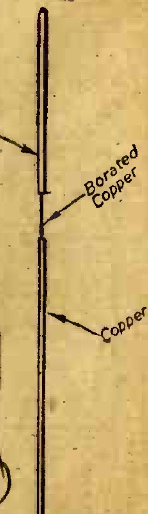


Fig. 2 (Left).—Flanged foot.
Fig. 3 (Right).—Construction of foot wire.

Sealing the Wires

There are three main types of feet used for cathode-ray tubes—flattened top, star-shaped and tubular. Taking

Fig. 4 (Left).—Star-shaped foot assembly.

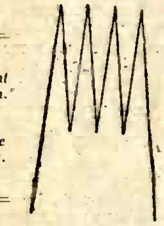
Fig. 5 (Right).—Circular oot formation.

the flattened one first, the flange is held in a ring on a rotary footmaking machine, the required number of footwires are threaded through the tube and held at accurate distances apart in a jig, and a short length of thin glass tubing slipped in a collar which holds it close to the inside shoulder of the flanged tube. As the machine rotates suitably placed gas jets gradually heat up the glass until it is almost melting when two steel jaws automatically come together on a level with the borated copper, effectively sealing the wires in the glass. At the same time a jet of hot air is blown through the thin glass tube or stem, which by now has become welded to the flange, causing a puncture in the shoulder. This puncture is of great importance when the time comes to evacuate the air from the bulb. To prevent stresses and strains in the glass it is very essential to anneal it or cool it off slowly and, after the foot has gone completely round the footmaking machine, it is placed in an annealing oven where the temperature is reduced very gradually.

In the star-shaped foot the principal difference is that four triangular shaped jaws are used to press out the flanged tube to the shape shown in Fig. 4. These two types of feet are only used for comparatively small cathode-ray tubes, say up to 4in. screen diameter. Almost all larger tubes use the tubular or circular foot. In this type there are two glass tubes with the footwires fused between them. The outer tube is flanged and the inner tube is welded to the stem which is frequently up to ½in. in diameter. The flange is held in a ring in the footmaking machine. The footwires are held correctly spaced by a jig and the inner tube and stem

Fig. 6 (Left).—Filament showing tungsten button.

Fig. 7 (Right).—Shape of tungsten wire heater.



are placed inside. Gas jets gradually heat up the glass and at the appropriate moment a steel plug enlarges the inner tube and fuses the footwires in place, as shown in Fig. 5. As before, the feet have to be carefully annealed before any further use can be made of them.

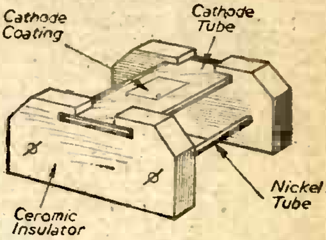
Component Parts

Before coming to the mounting of the assembly on to the foot it will be necessary to describe the various component parts and it is proposed to start at the bottom of the tube and work upwards. A few tubes use a directly heated source of emission. This usually consists of a hairpin-shaped filament of tungsten to which is welded a tiny flat topped cylinder of tungsten as shown in Fig. 6. The top of this cylinder is coated with a cellulose solution of the carbonates of barium and strontium. This is applied with a camel-hair brush and some skill is required for the process. If too little coating is applied it will have poor emissive qualities and too much gives a danger of cracking or flaking when the filament is heated. Before use, the coating has to be baked to drive out the cellulose.

The majority of cathode-ray tubes have indirectly heated cathodes and it will be advisable to consider the heater and cathode as one unit because the physical design of one governs that of the other. A type widely used consists of a flattened nickel cathode tube secured between two small ceramic insulators with the heater inside the tube. The heater consists of tungsten wire which is wound round fine pegs to the shape shown in Fig. 7. A number of these are fixed in a clamp and sprayed with a cellulose solution of alumina (one form of aluminium oxide). This coating, which is for insulation purposes only, is then baked at a very high temperature after which it has the appearance of porcelain.

The cathode assembly, Fig. 8, is made up by hand, the tube being fixed in the slots in the ceramics. Two round nickel tubes pass through the small holes and have their ends squeezed with pliers to give rigidity to the assembly. The flattened cathode tube is also slightly stretched at each end for the same purpose.

Fig. 8.—Cathode assembly.



A molybdenum connecting tail is electrically welded to the underside of the cathode.

The coated heater is carefully placed in the tube and the two ends are anchored to the thin nickel tubes by welding. Connections to the foot are taken from the other ends of the nickel tubes. The complete cathode assemblies are then fixed, a dozen or so at a time, in a hand clamp and sprayed with a cellulose solution of the carbonates of barium and strontium, each assembly being masked so that the coating can only reach the centre of the cathode tube. After spraying the assemblies are baked at a high temperature to drive off the cellulose. Before use the sprayed section is carefully trimmed to an area of four square millimetres and the coating critically examined for unevenness.

Another type of heater-cathode assembly consists of a nickel tube having a flat end on which is sprayed the cathode coating, the heater consisting of a spiralised winding fixed inside. Fig. 9 shows the idea. The method of making the spiral is of interest. The fine tungsten wire is wound closely round a mandrel wire of steel or molybdenum which is subsequently dissolved away in a bath containing a mixture of nitric and hydrochloric acids, the tungsten spiral being unaffected by the acids. The heater is sprayed with alumina, as previously described, and baked before use.

Modulator

The next component is the grid or modulator and in the finished tube its purpose is to control the brilliancy of the spot. It may consist of one or two parts, but in general it takes the form of a stamped cylinder with one end closed except for a very small hole in the centre. This component, like most of the other metal parts of a cathode-ray tube, is usually made from an alloy called ferry, for an interesting reason. The stream of electrons from the cathode is easily deflected or bent by a magnetic field and it is necessary to keep anything of a magnetic nature away from the beam or unstable results would ensue. Nickel, which finds such wide use in valve manufacture, is magnetic, but ferry, an alloy which looks like nickel and, in fact, contains nickel, is non-magnetic. The grid is designed to cover the cathode so as to completely control the emission and it is often dished on its upper surface. To prevent grid emission

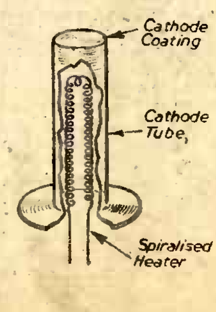


Fig. 9 (Left).—Circular tube cathode with spiralised heater.

Fig. 10 (Right).—Enlarged cross-section of grid hole showing prepared edges.

it is frequently plated with rhodium—a rare metal of the platinum group—and it is generally necessary to polish the grid hole as shown in Fig. 10. This is principally to ensure that no fine airborne fluff will adhere to the edges and obstruct the beam.

Anodes

The anodes of a cathode-ray tube are cylinders or pierced diaphragms made from ferry, and they serve two distinct purposes according to the voltages applied to them. Of primary importance is acceleration which causes the stream of electrons to hit the screen faster and produce a brighter result. Acceleration is obtained by applying to one or more anodes the maximum voltage for which the tube is designed. The other essential purpose is focus, without which accurate readings on the screen would be unobtainable. Focus is achieved by applying to one or more anodes a voltage which is only a fraction (say one fifth) of that applied to an accelerating anode. (This is not to suggest that any particular anode could be used either for accelerating or focussing by varying its voltage. The geometric design of the assembly decides the purpose to which the anodes may be put.)

The anodes are usually indicated as A1, A2, A3, A4, starting from the one nearest to the grid. This nomenclature can be very confusing because of differing designs. For example, many British tubes have A1 and A4 strapped together, both operating as accelerating anodes, and A2 and A3 strapped together, both used for focusing. Alternatively, A1 may be separated from A4 and run as a preliminary accelerating anode at a lower voltage (say two thirds) than that applied to A4. Many American tubes dispense with a preliminary accelerating anode in which case there might be A1 and A2 as focusing anodes and A3 as accelerating anode. Gas focused tubes may have one anode only. Instead of naming the anodes A1, A2, etc., the writer prefers that they be fully described according to the operation they perform, i.e., preliminary accelerating anode, focusing anode or anodes, and final accelerating anode.

(To be continued.)

Radio in Trinidad

A Constructor's Activities Under Adverse Conditions. By R. FRANKLIN

TWO years in Trinidad as a radio operator has not damped my enthusiasm for wireless construction. Desiring a small receiver beside my locker for use after lights out, I started to look around for parts and discovered that spares are very difficult to obtain. I was eventually fortunate in buying an old Hallicrafters "Sky Chief" for £4, and considered myself extremely lucky. The receiver was worn out, although the valves were O.K. Backlash on the dial and a few volume controls unserviceable. Anyway, the cabinet was far too large to pack away into a kitbag in case of emergency, so I decided to pull it to pieces and build a smaller set. Finding a piece of aluminium from a crashed 'plane, I soon bent up a small chassis. Having a pentagrid valve on hand, I decided to again have a superhet. When built the set worked very well; selectivity was good and second channel not too noticeable, using a mosquito net as aerial. The layout was: pentagrid as F.C., pentode as 2nd detector and pentode output. One unusual feature was reaction on the 2nd detector—a five-turn winding on the I.F. transformer. This idea worked extremely well for c/w, regen. controlled by the only serviceable volume control on hand. I also tried regeneration on the F.C., and many queer effects were obtained. It was difficult to arrange the amount of feed back, and the valve often went into oscillation. I am not sure what happened then, but I think it worked as an autodyne. All sorts of whistles appeared, and the same station was heard many times on different places of the dial. Volume was terrific, and I feel sure that if arranged correctly the idea is good.

Re-winding a Transformer

At that time I bought a small permanent magnet speaker which further helped to keep the physical dimensions of the cabinet small. Then one day a mishap occurred. A friend wanting to listen during my absence, plugged into 250v. mains—the transformer was rated at 115v. There was a flash, burst of heat and the transformer was gone. The heaters of the valves, strangely, were still intact. Nothing daunted, I tried re-winding the secondary, obtaining the wire from an old choke. A simple winding arrangement was built consisting of a drill placed in a vice, and the former, with a bolt through the centre, was placed in the chuck. As a winder it was successful, but the winding was not. At each test the transformer heated up. I wound and re-wound that secondary till all my wire was gone. So I once again scouted around, and managed this time to buy a transformer with 2.5v. heater, and a number of valves to match. This little purchase cost me 32s. Everything was second-hand. Having no suitable frequency changer among these valves (they were mostly pentodes), I decided this time to build a 3v. straight set—a 1-v-1. Once more finding a piece of metal from the same place as before, I built a chassis to accommodate the parts. The set was finished and switched on—and nothing happened! On checking, all connections were found correct, and a further test proved that every one of the valves was worn out, there was just a spark of life in the output valve. This was a terrible blow and for a time my activities ceased.

Two-valve Battery Set

Feeling the urge once more, and carefully considering the parts I had, I thought maybe among my 2.5v. valves there would be two that were still alive. Once again a chassis was bent up of even smaller dimensions than the others. As a two-valver it worked—just. The only signals were from powerful or nearby stations. Sensitivity was poor and the set was a failure. My enthusiasm was still high, however, and I decided to give my 6.3v. valves a chance, knowing that these, at any rate, had some life in them, and running the set from batteries. Again I built a two-valver, winding my own coils and choke, etc. Each time I had to travel three miles to a soldering iron, and did not feel like building a bigger set. This time I was lucky, and had a set that really worked. Wanting to move the set around, however, I found that shifting two H.T. batteries and three accumulators was too much. Feeling that I had been dealt a mean trick with mains valves, I turned in desperation to battery valves. On hand was a Cossor screen-grid and an American type 30 (triode). I had a valveholder for the 30 but no English four-pin holder anywhere—so I made one, using a piece of paxolin and a few rather shaky plugs. This set was under construction when I contracted malaria, so my antics, for the time being, are compulsorily finished.

All this work and I had no D/X at all. But the building of these sets caused me more pleasure than listening, and helped to while away a few hours.

Elementary Electricity and Radio—12

Aerials: Types and Characteristics. Polar Diagrams. Reflectors. By J. J. WILLIAMSON

(Continued from page 27, December issue.)

THE L.F. and R.F. potentials produced across R_4 act through the reaction circuit C_6 C_4 C_7 L_3 back to R_4; because of the values chosen for C_7 and C_6 this circuit will have a high opposition for L.F., thus R.F. currents will predominate. The magnetic field caused by the R.F. currents passing through L_3 will produce voltages in L_2 thereby feeding back energy to the grid circuit of the detector and thus achieving reaction. Adjustment to the variable condenser C_7 will alter the opposition of the reaction circuit to R.F. currents and hence act as a reaction control.

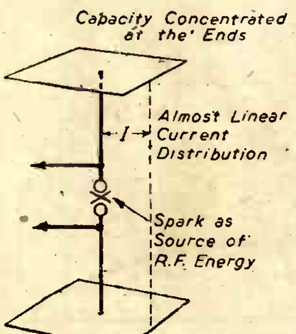


Fig. 68.—The Hertzian Doublet.

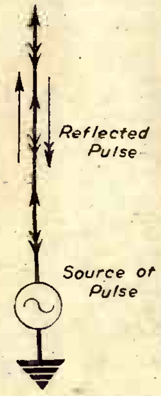


Fig. 69.—Reflection of voltage pulse.

As explained, we have L.F. voltages applied to the grid and filament of the L.F. amplifier (V_2), thus its anode current will be varying at L.F. rates (Fig. 67 (B)). This current in passing through R_5 will cause L.F. and direct voltages to be produced across it, these L.F. voltages being fed via C_8 to grid and C_9 to filament of the output valve (V_3).

The output valve has to produce L.F. power, thus its anode must be kept at as high a voltage as possible; therefore a transformer, the primary of which has a low resistance, is used, thereby preventing a loss of voltage across it. The L.F. rippling anode current passing through the transformer's primary will cause L.F. voltages to appear across the secondary coil thereby causing L.F. currents to pass through the telephones or loudspeaker to reproduce sound waves.

Biasing voltages are obtained by passing the current from H.T.– through R_7 and R_8; the paths through which these voltages act are shown by the dotted lines. The biasing of V_1, the detector is automatic, being obtained by the action of C_3 and R_1.

Decoupling is achieved by means of C_9, which by-passes L.F. and R.F. past the opposition of the supply. R_3 in conjunction with C_4 assist the by-passing action. C_{10} prevents the biasing voltage from "rippling" by by-passing the ripples past R_7 and R_8.

The student will be well advised to avoid recognising a circuit's function by its general layout, because as soon as the position of the components, etc., are altered, the circuit diagram loses its significance. The connections between components, etc., and the R.F. L.F., and direct current paths should be noted, then, knowing the general principles of the processes required of the circuit, the purposes of all components and connections will be clear.

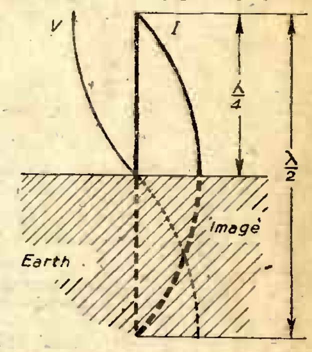


Fig. 71.—λ/4 Marconi (earthed) aerial.

General Examples—11.

1. At what frequency would the opposition of a 10,000 Ω resistance possessing a self-capacity of 20 μμF. begin to diminish?

2. An inductance of 20 H. has a self-capacity of 100 μμF. At what frequency would this inductance resonate?

Answers to General Examples for Article Ten.

1. An input meter or P.A. meter (P.A. adjustment). Neutralising meter in aerial circuit, or an M.O. meter. (Neutralising.) M.O. meter. (M.O. adjustment.)

Aerials, Types and Characteristics

Aerials have been mentioned in previous articles as condensers connected across the aerial circuit of a transmitter or receiver. Whilst an aerial is mainly capacitive, it also possesses inductance. Capacity must

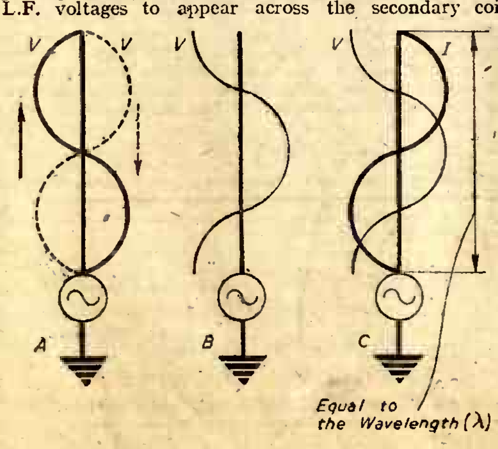


Fig. 72.—A, "Inverted L" aerial. B, "T" type aerial.

Fig. 70.—(Left) A, Travelling waves; B, Standing waves; C, Current and voltage distribution.

exist whenever a difference of potential is possible, i.e., every substance possesses capacity—except the mythical perfect conductor; also, whenever magnetic lines-of-force cut a material, the property known as inductance exists. It is obvious that if an aerial possesses inductance and

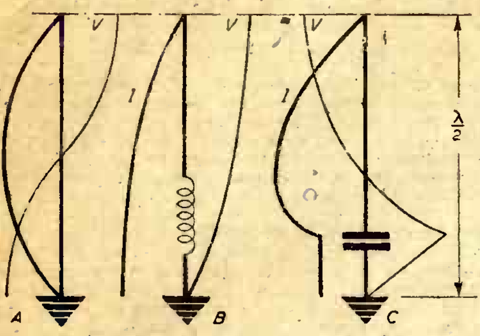


Fig. 74.—The Marconi λ/2 aerial. (A) Voltage and current distribution. (B) Effect of loading coil. (C) Effect of loading condenser.

capacity distributed throughout its substance, then it can behave as a tuned circuit, giving maximum results when its resonant frequency is equal to the frequency of the transmitter or receiver to which it is attached. As in the case of a tuned circuit, the aerial's resonant

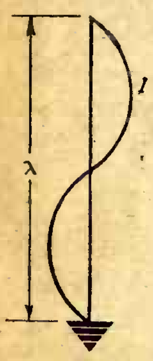
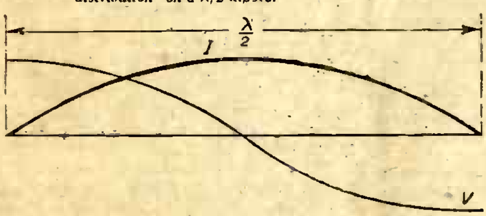
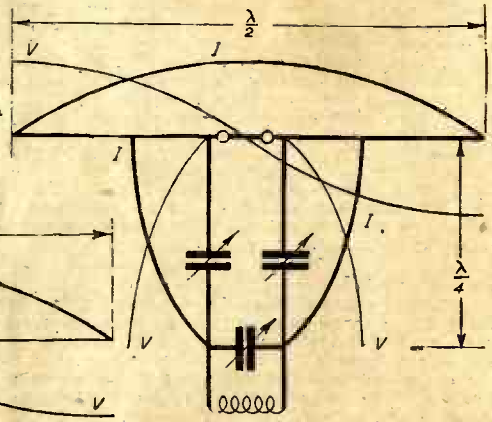


Fig. 73.—(Left) Cancellation of radiation when aerial length is a multiple of λ.

Fig. 76.—(Right) The use of a λ/4 resonant feeder for centre-feeding a λ/2 dipole.

Fig. 75.—(Below) Voltage and current distribution on a λ/2 dipole.





frequency can be adjusted by variation of its capacity or inductance. The main difference between an aerial and a tuned circuit (closed) is that whilst the aerial is designed for maximum radiation, the tuned circuit necessitates minimum radiation.

The Hertzian Doublet

Heinrich Hertz, in 1885, investigated electro-magnetic radiation and developed the Hertzian Doublet as an efficient radiator. He discovered that the more capacitive the radiator (aerial) the more efficient it became, also maximum radiation was obtained when the resonant frequency of the aerial was the same as the frequency of the energy supplied. The capacity of the Hertzian Doublet is mainly concentrated at the ends, thus giving an almost linear current distribution, and facilitating calculation (Fig. 68).

Standing Waves

Let us examine the properties governing the manner in which an aerial radiates.

In Fig. 69 we have a length of wire supplied with radio frequency energy. Consider a voltage pulse leaving the source of radio frequencies: it passes along the wire at a speed almost that of light, reaches the end of the wire, is reflected and journeys back again; thus an alternating voltage from the source would pass its effects up and—by virtue of reflection—down the wire. As shown in Fig. 70 (A) and (B), the two travelling waves would give rise to stationary or standing waves provided that the length of wire was a multiple or sub-multiple of the wavelength of the energy provided. Current waves will arise, the current being maximum when the voltage is minimum. Fig. 70 (C) shows the voltage and current distribution along a wire one wavelength long.

It can be seen that the position of the standing waves upon an aerial is governed by the length of wire in terms of the wavelength supplied, also that the position of the standing waves will influence the directional properties of the aerial.

The dipole aerial is an unearthed symmetrical aerial not having linear current distribution. (See Figs. 75, 76 and 77.)

Practical Considerations of Aerial Length and Wavelength

It has been stated that the more capacitive the aerial the more efficient it becomes, thus, whenever possible, it is advisable to tune the aerial by the use of a correct length rather than the insertion of an inductance. Obviously on short waves it is practicable to have the length of the wire λ/4, λ/2, etc., but on long waves such an aerial would have to be a mile or more in length and is out of the question. In such cases we have to resort to "loading" coils to effectively lengthen the aerial for maximum results with the wavelength concerned. Loading coils, however, are not to be desired, because of the reduction of the aerial's overall efficiency.

Marconi Aerials

Marconi discovered that if the dipole type of aerial was earthed at one end, it was possible to double the wavelength transmitted, because the length of wire required was reduced to half that of the dipole. Fig. 71

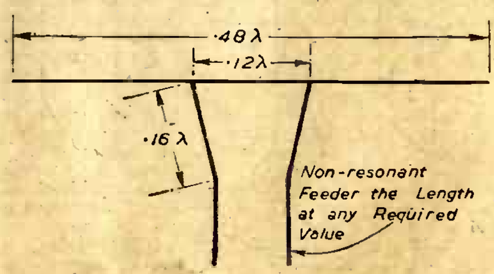


Fig. 77.—The use of a non-resonant feeder with a λ/2 (approx.) dipole.

shows a $\lambda/4$ Marconi aerial. Notice the aerial's "image," giving an effect the same as a $\lambda/2$ dipole—if the earth is a perfect conductor. Owing to the fact that the earth is not a perfect conductor, losses occur; these losses can be minimised by the use of a good earth conductor or a counterpoise system.

Inverted-L and T-type Aerials

It is sometimes advantageous to obtain added length of aerial for the longer wavelengths by bending the top

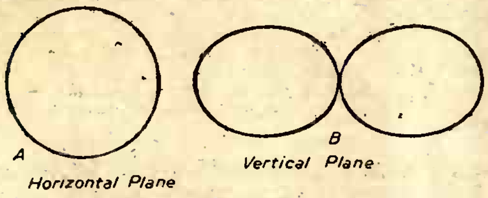


Fig. 78.—Polar diagrams of $\lambda/2$ dipole in free space.

of the aerial over, forming an inverted-L or a T-shaped system (Fig. 72 (A) and (B)). Also, because of the effect of the horizontal or "roof" portion of the aerial in concentrating capacity at the end of the vertical or "feeder" portion, the current distribution becomes almost linear and a larger current flows in the "feeder."

Examination of Fig. 73 shows that it is not advantageous to have the aerial length equal to one wavelength or multiples of a wavelength unless special precautions are observed. Radiation from adjacent $\lambda/2$ sections would oppose and cancellation result. In practice a little radiation occurs horizontally and a "funnel" exists at about 35 deg. from the earth around the aerial.

For the smaller wavelengths (higher frequencies) the aerial length required does not prohibit the use of a vertical aerial. Fig. 74 (A) shows a Marconi $\lambda/2$ aerial with its voltage and current distribution. Fig. 74 (B) shows how the $\lambda/3$ aerial can be effectively lengthened by the use of a loading coil for longer wavelengths, whilst Fig. 74 (C) shows the effect of placing a condenser in series with the aerial.

Dipole Aerials

Unlike the Hertzian Doublet the dipole aerial has its capacity distributed, causing the current to be maximum in the centre (Fig. 75). In order to supply energy to the $\lambda/2$ aerial it is obvious that maximum current may be supplied at its centre or voltage at one of its ends. An acceptor circuit (series resonant circuit) supplies large currents at resonance, whilst a rejector circuit (parallel tuned circuit) gives large voltages; thus an acceptor feeding into the centre or a rejector feeding into one end would be satisfactory. In order to bridge the distance between the aerial and the transmitter the use of feeders becomes necessary.

Resonant Line Feeders

In Fig. 76 a practical method of coupling the aerial and transmitter is shown. Notice that the length of the feeders is important. Examining the voltage and current distribution along the $\lambda/2$ feeder we see that for centre feeding the $\lambda/2$ dipole we would require an acceptor circuit at the transmitter end, whereas in the case of the $\lambda/4$ feeder to the $\lambda/2$ dipole a rejector circuit becomes necessary.

It is obvious that if an efficient feeder system is desired the wires must not radiate. Each wire has opposite voltage and current distribution, so that radiation from them is effectively cancelled — providing that the lines are equal in all respects. In order that the lines can be balanced, suitable condensers are inserted in each and adjusted until the currents are equal.

This method of feeding, the resonant line method, is satisfactory for comparatively short feeders, but becomes undesirable for long feeders because of the difficulty in preventing radiation and other losses in the lines.

Non-resonant Feeders

Radiation from aerials is due to the presence of standing waves, which, in turn, are caused by reflection of travelling waves from the ends of the aerial, thus if reflection was prevented then radiation would cease. Similarly, the prevention of the formation of standing waves upon feeder lines will make them non-resonant.

It has been proved that if the impedance (z) of the feeder has the same value as the impedance of the aerial then no reflection occurs. This is because energy is absorbed by the aerial at the same rate that it arrives from the feeders. There are several methods of obtaining this condition, one of which is shown in Fig. 77. The spacing of the wires, junctions, feeder lengths, etc., must be carefully adjusted to obtain a non-resonant condition in the feeder.

Directional Properties of Aerials

It has been mentioned that the manner in which standing-waves form upon the aerial governs its directional properties—with other factors. The formation of standing-waves depends upon the length of the aerial in terms of the wavelength to be employed.

The general structure of the aerial system; vicinity of houses, rivers, railways, etc., frequency, conductivity of the earth, height of the aerial above the ground, etc., all affect the directional properties of aerial systems.

Polar Diagrams

The directional properties of aerials are usually shown by the aid of polar diagrams.

A polar diagram indicates the field strength of the radiation (as a distance from the centre of the diagram) with relation to the direction of the radiation with respect to the aerial. As radiation occurs in both horizontal and vertical planes, two polar diagrams are necessary to show the full directional properties of the aerial concerned.

Let us consider a $\lambda/2$ dipole situated in free space, i.e., away from all influencing factors. Fig. 78 (A) and (B) shows its directional properties in a plane horizontal to the dipole and a plane vertical to the dipole, respectively.

If the aerials are of the earthed type (Marconi) then the directional properties are modified by the presence of the earth. Fig. 79 gives the vertical polar diagram of a $\lambda/2$ aerial, assuming that the earth is a perfect conductor, if, however, as is the case, poor earth conductivity is met with, the polar diagrams are modified as shown by the dotted lines.

If a dipole is suspended close to the earth, radiation reflected from the earth will influence the directional properties. Obviously, the reflected and reflecting waves will add or cancel in a manner governed by the relative positions or phase, thus, the height of the dipole above the earth is an important factor. But more about this next month, when reference to diagrams will help to illustrate this statement.

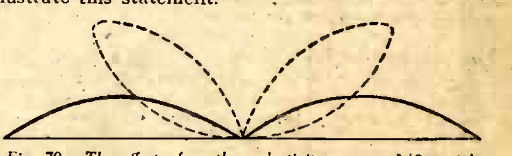


Fig. 79.—The effect of earth conductivity upon a $\lambda/2$ aerial.

General Examples—12

1. What value resistor would be required for H.T. biasing if 10v. bias is required when the receiver current is 20 m/a?

2. Draw a $\lambda/2$ dipole fed at one end by a $3\lambda/4$ resonant line and resonant circuit, showing clearly the voltage and current distribution in the system.

Answers to General Examples for Article Eleven

1. 795·38 kc/s.
2. 3·57 kc/s.

(To be continued.)

Secondary Batteries—5

The Charging Room. Its Layout and Equipment. By G. A. T. BURDETT, A.M.I.I.A.

(Continued from page 10, December issue.)

CAREFUL consideration must always be given to the selection of battery rooms. Space is often the primary factor, but too often battery rooms are just an odd corner in the workshop. Rooms should be divided into two or more separate compartments, and where generators or rectifiers are installed these should be housed in one of them. In small charging stations the rectifier and charging panels are one composite piece of equipment, and must, of necessity, be installed in close proximity to the charging bench. The equipment should not, however, be installed immediately above the bench or shelf where the batteries are charged, or they will soon corrode due to the spraying of electrolyte. Lead acid and alkaline batteries should be charged in separate compartments.

All charging boards other than those of composite type are fed from one rectifier unless, of course, more than one is installed. The main D.C. supply cables are then fed into both the alkaline and lead acid compartments. Should the number of alkaline batteries usually received for charging be a very low proportion of the total and not warrant a separate compartment in view of space restriction and cost, they must be charged and stored away from the lead acid batteries. On no account must they be "mixed" at any time, or damage will be sustained.

Ventilation, Heating, etc.

The battery room should be well ventilated without causing draughts. A constant temperature of about 60 deg. F. should be maintained. As no naked lights are to be brought into a charging room, some form of non-combustible heating may be necessary. The best form is thermostatically-controlled electric tubular or panel heaters. Unless the battery room is built in an exposed position, however, the heat emitted by the rectifiers and the batteries during charge is usually sufficient for this purpose, except in the most severe weather conditions.

Lighting

Good general lighting comprising bulk head or well glass fittings, with one or more inspection lamps, is desirable.

Floors

Concrete floors are subject to attack from sulphuric acid, but periodic swilling down with water and bi-carbonate of soda will help to preserve them. Wooden floors must be painted with anti-sulphuric paint, and frequently re-coated as they become worn. All exposed wood and metal must be painted with anti-sulphuric paint.

Water

A good supply of water is essential for cleaning out vessels and for use when acid and alkaline is spilled or splashed on the floor or on the body. Where possible install a deep sink supplied with mains water and connected to the main drains so that batteries may be easily drained. The sink should be of glazed porcelain or lead-lined wood. The latter preferably of teak or elm. Fig. 1 shows typical layout for charging room.

(Continued on page 63.)

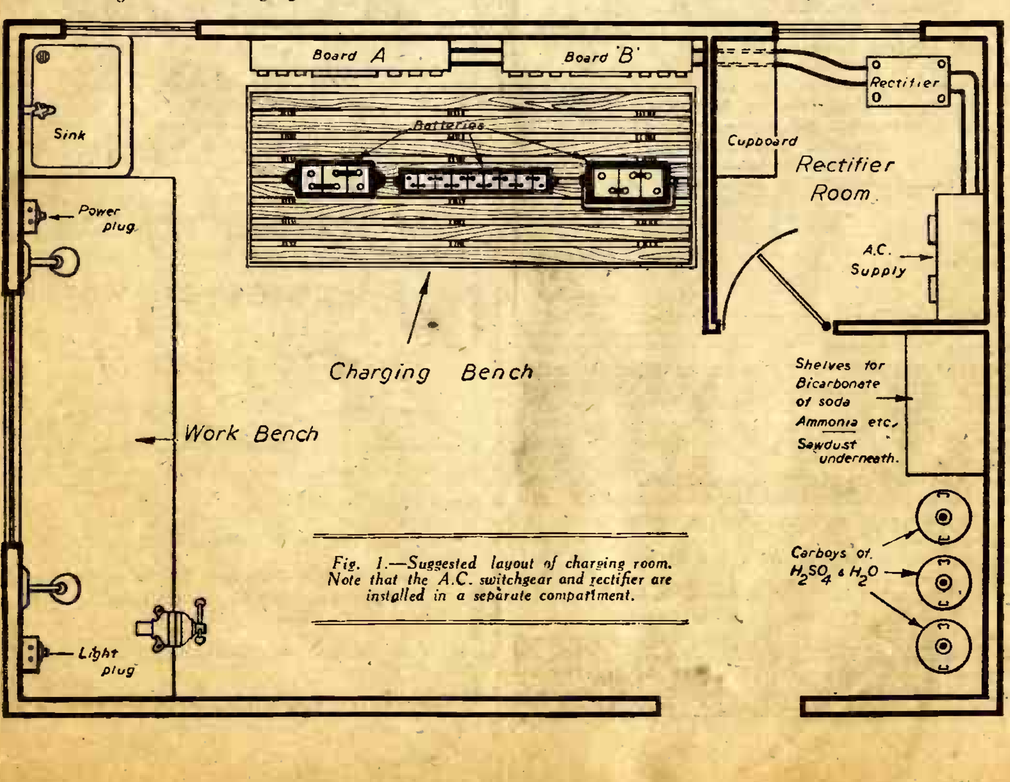


Fig. 1.—Suggested layout of charging room. Note that the A.C. switchgear and rectifier are installed in a separate compartment.

Charging Benches

Wooden benches of robust construction to withstand considerable weight are the most suitable type. At least two tiers should be provided, the top tier for charging the batteries and the lower one for stowing charged and discharged batteries — see Fig. 2. Construct the top tier of planks either butted or tongued and grooved. These should be surrounded with 2in.×½in. batten to form a tray. Where obtainable line with sheet lead treated with anti-sulphuric paint. If lead is not available apply a number of generous coats of the paint to the wood. Obtain a quantity of sawdust and fill the tray to a depth of approximately 1in. Mix with this a sprinkling of bicarbonate of soda. Upon this place battens constructed in the form of a duckboard and painted, upon which will stand the batteries during charge. The distance between the battens should not exceed ¾in. or small cells will not stand firmly upon them.

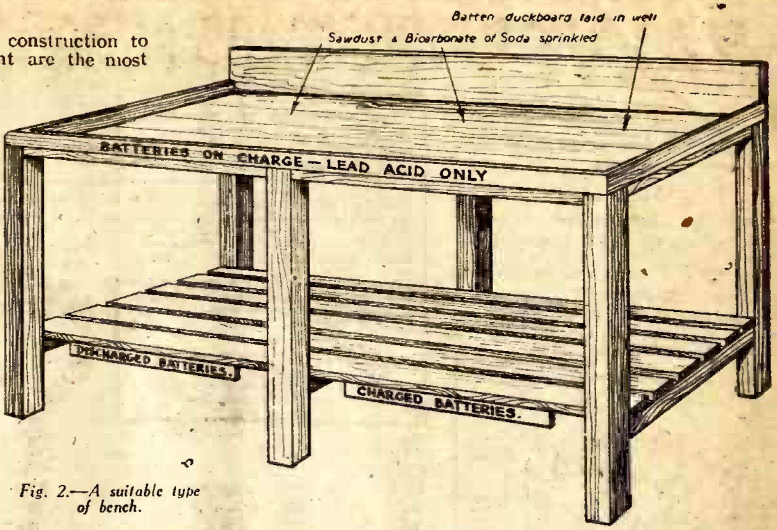


Fig. 2.—A suitable type of bench.

The lower tiers may be of duckboard construction entirely, using ¾in. to 1in. battens to withstand heavy batteries. Where portable car starting batteries are charged provision should be made for these in another part of the charging room fed from an independent charging panel. Fig. 1 shows typical layout of a small charging room for dealing with lead batteries only, but with provisions made for extending to alkaline. The rectifier and A.C. switchgear is installed in a separate compartment, which is also utilised as an office and store. One pair of cables feeds two charging panels, each of which has four sub-circuits, e.g., sets of terminals, each set controlled by a separate variable resistance. Fig. 3 illustrates this panel.

(To be continued.)

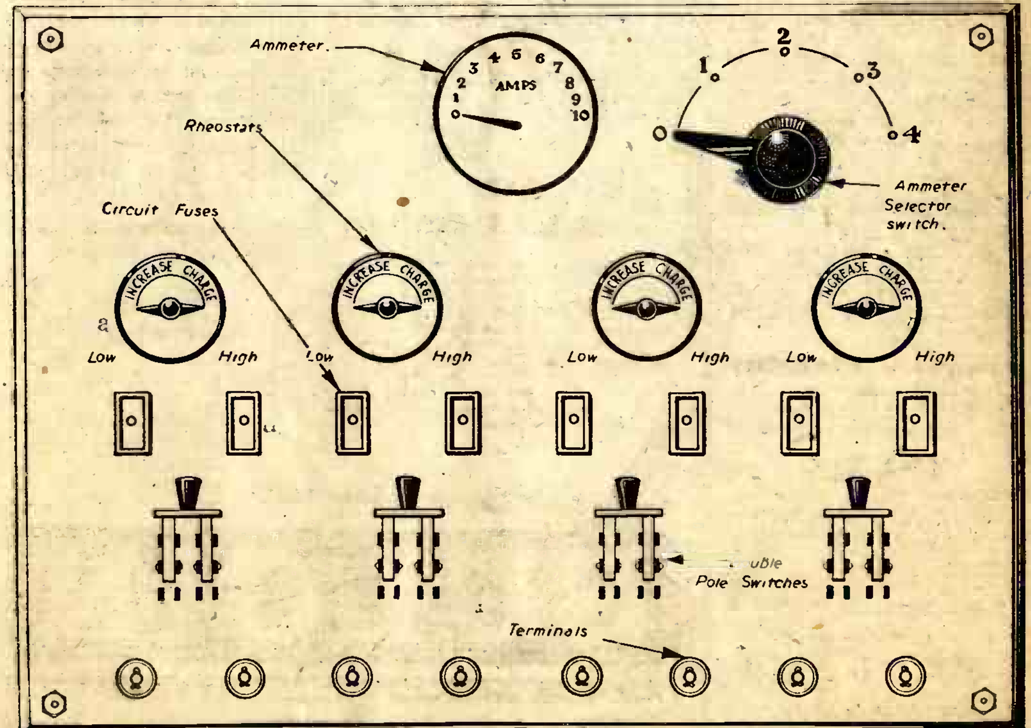


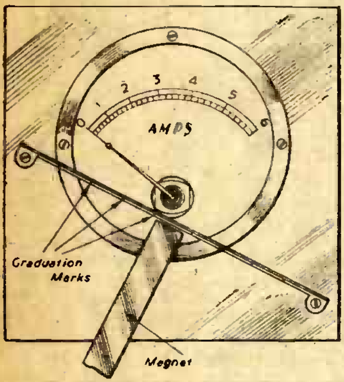
Fig. 3.—A four-circuit charging panel.

Practical Hints

A Magnetometer

NEEDING to match exactly two electro-magnets, I have devised the Magnetometer shown in the accompanying sketch.

Utilising a defunct moving-iron meter, I fixed diagonally across one corner of the face a small bracket or fence, with graduation marks along it. To test the relatively lower-powered magnets, I place one pole against the central graduation mark. The deflection of the needle will indicate the power of the magnetic flux. The magnet to be matched is placed on the same mark and its reading compared with that of the first. In the more powerful magnets, the reading can be taken farther out along the fence—so long as any comparative readings are taken from the same graduation mark.



A simple Magnetometer.

The relative factor existing between adjacent marks could be observed and tabulated for the comparing of weak and powerful magnets. The best position for the bracket could be found by trial and error. With my own meter, a repulsion type moving iron ammeter ranging 0-6, costing 5s., it was placed diagonally, near the movement. A non-polarised type is best for this particular purpose as it then does not matter which pole is applied for testing.—C. BURBRIDGE (Gravesend).

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>
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>
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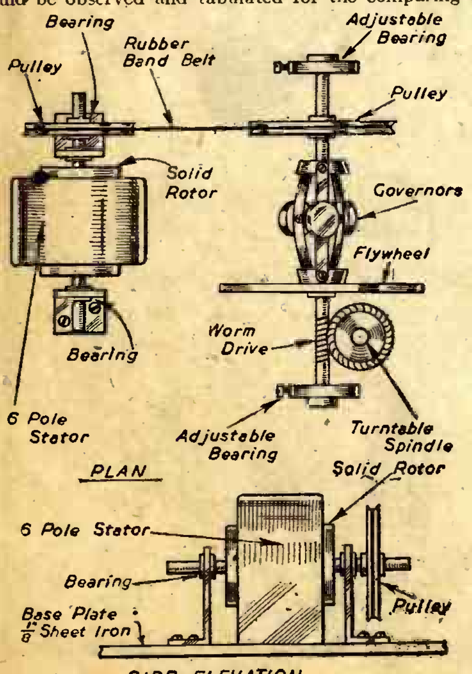
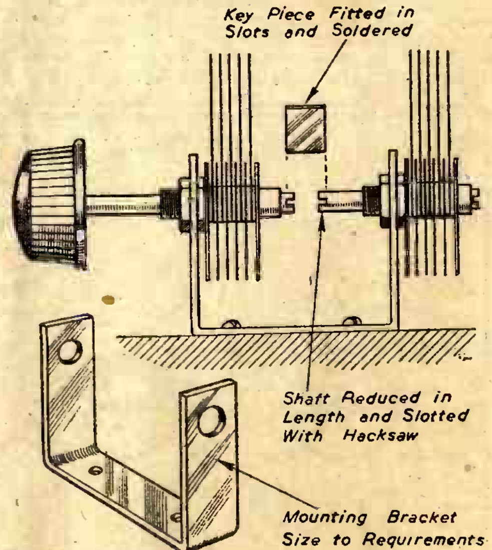
Electric Gramo. Motor

FOR some considerable time I have wanted an electric gramophone motor, and being unable to purchase one, I hit upon the idea described below, which has proved a great success.

An old cycle dynamo was stripped down, and mounted up as a small A.C. synchronous motor, being energised by 5 volts A.C. supplied by a bell transformer. This motor in turn drives the governor spindle of an ordinary clockwork gramo. motor. The correct speeds were worked out, but the trial and error method with various size pulley wheels from a mechanical toy was found to be best. Starting is not automatic, but a slight spin of the turntable sets it going, and it revolves at dead 78 r.p.m. —A. J. ALDWORTH (Huntingdon).



A converted cycle dynamo used as a gramo-motor.



Method of ganging two small condensers.

Two-gang Condenser Unit

THE accompanying sketch shows a useful two-gang condenser arrangement. As there is difficulty these days of obtaining a small two-gang component, I hit upon the plan of ganging two of the small compression bakelite dielectric condensers, now to be obtained through most advertisers in PRACTICAL WIRELESS. I have found all of these have the necessary slot at the rear of shaft, so all that is necessary is to cut a slot in the knob shaft of rear condenser. The key piece and U-bracket may be cut from any odd piece of strip metal.

I also found that successful ganging to suit coils may be accomplished by rocking either condenser up or down, and then locking with a nut at the best position.—R. D. SMITH (Chiswick).

ON YOUR WAVELENGTH

By THERMION

Twenty-one Years

SO the B.B.C. has reached the age of 21 years, but let us hope that it will not conform to the age-old custom, and "do as it likes." As one of those who has been closely associated with the early days of wireless development, I have seen the B.B.C. grow from a handful of enthusiastic technicians with soap boxes as seats to the vast corporation employing 10,000 people. I want to know that it proposes to apply the experience it has gained. In my view, it has no right to discourage education, and I am submitting that this is what it has done. What possible encouragement can there be for young people to study music with the hope of becoming, say, composers, when the B.B.C. will announce with a fanfare of trumpets a programme of alleged music, largely cribbed from the masters by someone who admits that he has had no musical education, that he cannot play an instrument, or read or write music? The B.B.C. should away with this slushy nonsense. To some extent, I blame the B.B.C. for our national ineptitude when the war broke out. Of course, it is difficult to please everybody, and I acknowledge that some may like one thing and some another. It was not until Sir John Reith left the B.B.C. that our doleful and dolorous Sunday programmes were brightened. Instead of miserable church music and lectures from parsons who are in the world but not of it we now have programmes which are brighter, and less hypocritical than those of former years. My greatest criticism of the B.B.C. during the 21 years of its existence (yes! I have been writing about broadcasting without break for the whole of that time) has been its tendency to plug jazz. Regular readers know my views on the subject, so there is no need for me to reiterate. It is my hope that the B.B.C. will take no heed of the noisy minority, many of them interested parties, who regularly write to them asking for more jazz. The whole of the jazz music industry has become a racket, with dance bands as pawns in the game. They are paid to plug, and paid to broadcast.

Well can I carry my mind back to 21 years ago. Everyone was talking radio. Everyone was anxious to build a receiver. Fortunes were made out of junk. I was haunted by editors for articles and books, and on one occasion I wrote a 30,000 word book on wireless over one week-end, and it was published 48 hours later. It went through 20 editions. Of course, when things are mellowed in retrospect, they take on a different hue to that in which they were originally seen, and it may be that the pleasant memories of to-day were the faceaches of yesteryear. As was to be expected, periodicals cropped up week by week until there were nearly 20 of them. It is natural that, as a journalist, I should have maintained close touch with all developments, and there are not many associated with broadcasting whom I have not met. It is equally understandable that I am well acquainted with all of the well-known designers and journalists. Of all the journals which flashed across the radio firmament but two remain—this and another. This journal, of course, was the last in the field, and it is, I think, the only occasion in periodical journalism where a newcomer has lived to see the demise of its older-established competitors.

My junk box is a museum of wireless history, and I could almost arrange the pieces in chronological order. The special crystal detectors, the variometers, the hedgehog transformers, the patent aerials and earths, the special valves. They are still there to remind me of the past. Many of those interested in radio to-day may find it difficult to believe that in those days we used 6-volt bright emitter valves which consumed half an ampere each, and blue glowed at a plate voltage above 60. We were assured by the experts that a soft valve made the best detector. Then came the economy valves, and I still have two of the better known—the Xtraudion and the Dextraudion.

After 21 years here we are on the threshold of television. Fortunes have been lost in developing this new technique. It takes a war to perfect it. I do not suppose that I shall live to see the jubilee celebrations of the British Broadcasting Corporation, for 39 years added to my present age takes me beyond the normal span of human longevity. I can, however, only hope that those whose task it will be to carry on this feature will continue to carry the banner of anti-jazz, and thereby serve the best interests of the State. If, in the passage of the years, my policy on this is proved to be wrong, I can only plead in advance *de mortuis nil nisi bonum*.

TWENTY-FIRST BIRTHDAY OF THE B.B.C.

(NOW LET IT BE ITS AGE)

The B.B.C. is twenty-one!
How quick the years have come and gone
And now, where do we stand?
What is the state of broadcasting
In this our native land?
Why, Tin Pan Alley rules the roost,
And all the awful punk they boost
Offends our suffering brains
And adenoidal crooners foul
Inflict their dreadful pains.
Discarding normal human speech,
They gurgle "Hi-de-doo,"
And then, since they must find a rhyme,
They warble "Bub-bub-boo!"
Which might have been in highest taste
When men lived up in trees;
But as we have advanced since then,
Ourselves it does not please.
Repeatedly towards the mike
Most awful slush they lug;
With dance band leaders all agog,
It pays so well to "plug."
Come, let us have an end to this,
It well has earned our rage.
The B.B.C. is twenty-one.
Now, let it be its age!
If Tin Pan Alley suits the taste
Of other lands than ours,
No reason this that native bards
Should not show forth their powers.
But B.B.C. denies them this,
And vested interests damn!
For Tin Pan Alley pays more bunce
Than works of Englishman.
P'raps callow youth was much to blame.
Now, here's a nice new page;
The B.B.C. is twenty-one
WELL, LET IT BE ITS AGE. "TORCH."

Our Roll of Merit

Readers on Active Service—Thirty-seventh List.

H. C. Wyatt (Cpl., R.A.F.).
J. Mosey (Sgt., Royal Corps of Signals).
K. M. Bailey (Ldg. Radio Mechanic, R.N.).
B. T. Hughes (A/C., R.A.F.).
J. Cornthwaite (L/Cpl., Royal Corps of Signals).
J. Gregory (Tnk. Trng. Wing).
R. J. Major (L.A.C., R.A.F.).
S. B. Plant (Cadet, O.C.T.U.).
F. W. Driscoll (P.O., R.N.).

YOUR SERVICE WORKSHOP—10

Resistance and

Constructional Details of a Unit Essential to

THE measurement of D.C. resistance, between approximately 100 ohms and 0.2 megohms is usually provided for by the "ohms" range of a universal test set, and for servicing purposes is accurate enough. When dealing with low value resistors matters are not quite so straightforward owing to the usually high current involved, and many ingenious arrangements are used commercially in an attempt to reduce it.

It often happens in service work that one requires to measure the resistance of a speech coil or perhaps a low resistance transformer winding.

Fig. 1 shows the diagram in theoretical and practical forms of a small unit which may be joined externally to the 100 milliamp range of a test set, or if a high reading milliammeter is available it could be shunted

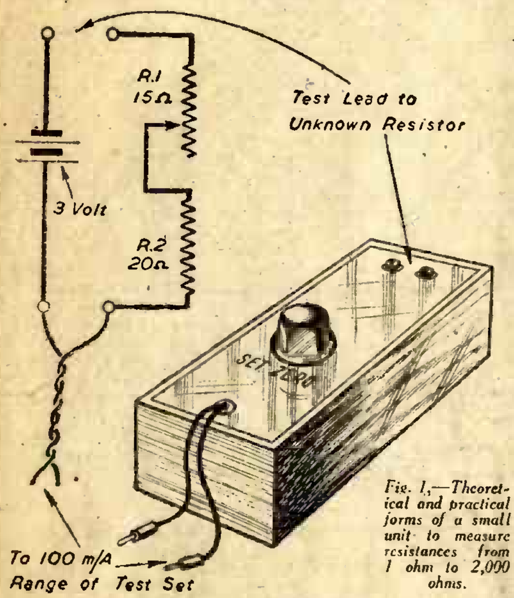


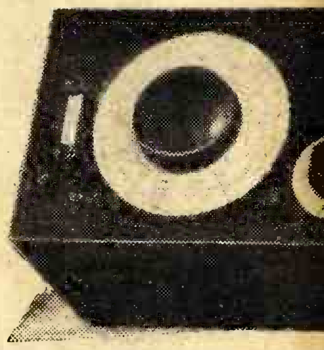
Fig. 1.—Theoretical and practical forms of a small unit to measure resistances from 1 ohm to 2,000 ohms.

to read 100 milliamps. R1 is the "set zero" control and obviously has to carry the full current in conjunction with R2, the limiting resistor. The 3 volt supply is made up of two cycle lamp batteries (type No. 800) wired in parallel so that the current does not cause any appreciable voltage drop. R1 may consist of one of the old type 15 ohm variable filament rheostats and is ideal for the job. One of 10 ohms or 20 ohms could also be used so long as the total resistance is adjusted to 35 ohms by increasing or decreasing the value of R2, as the case may be. The highest resistance measurable with this unit is 2,000 ohms, half scale reads 30 ohms and at the other end of the scale 0.5 ohms is definitely measurable, especially on a reasonably long scale.

The normal test set range of resistance measurement is also unsatisfactory above 0.1 megohms or 0.2 megohms, as the scale then becomes very crowded and although the needle will give a deflection when, say, a 0.25 megohm resistor is tested, one cannot be really sure whether it *is* 0.25 megohms or .5 megohms or even 1 megohm.

The usual method of overcoming this difficulty is to employ external batteries of a voltage that will move the meter needle well over the scale so that more discriminate readings are given. When dealing with megohms, this voltage may amount to some hundred or more which means keeping a high tension battery handy or providing the voltage in some other way; all of which is rather inconvenient.

A more simple method, and, incidentally a more accurate one, is to employ a bridge circuit similar to the familiar Wheatstone principle shown in Fig. 2. This works as follows: A voltage source is applied to points A, B, which travels along the resistance arms R1, R2 and R3, R4. If all these resistors are equal in value the current through each arm will be the same and no potential difference will exist across the points C, D to which are connected a meter for purposes of indication. The reading on this will therefore be zero and the bridge will be balanced. If now the value of either one resistor is made different from the rest the current through each arm will be unequal and a potential difference will be registered across the points C, D by the meter.



The completed unit takes

In practice the bridge would be arranged on lines similar to Fig. 3 where R3 is an accurately calibrated resistance box or a number of resistors arranged for selection by a switch. R1 and R2 are of equal value. Having regard to previous remarks it is obvious that any unknown value connected to the X terminals may, provided it falls within the range of R3, be balanced by the latter and the value found. Very satisfactory results may be obtained by this means, the accuracy being dependent upon the accuracy of the calibrated standard R3. It will be seen later that a further advantage of the bridge system is that by making the

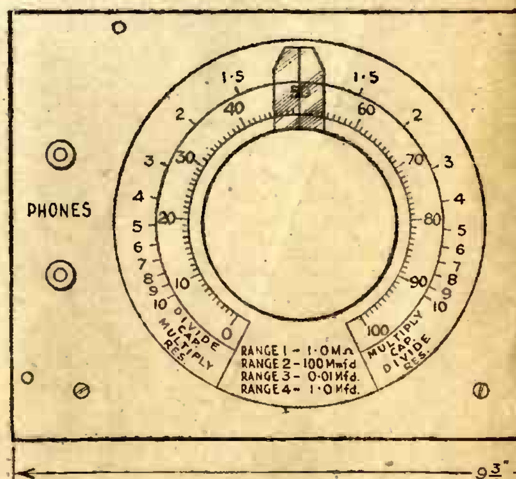


Fig. 5.—Showing the layout of the panel controls, and

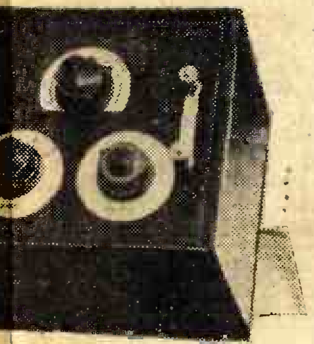
Capacity Bridge

...e Service Man. By STANLEY BRASIER

ratios between R1 and R2 variable the range of measurement of the instrument can be increased very considerably.

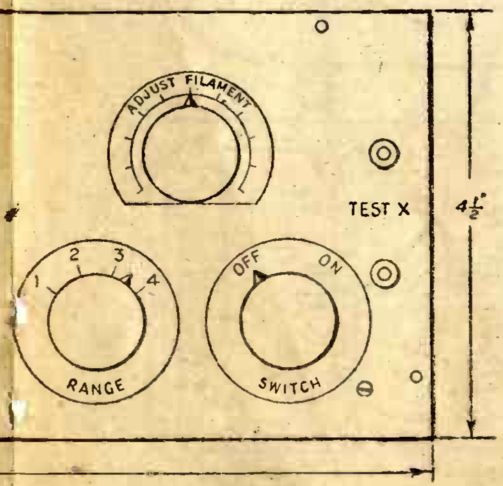
Measuring Capacity

The above principles may be adapted for the measurement of an unknown condenser value, a facility which is not normally provided for on the average test set. The occasion often arises in service work where one requires to know values of this nature, therefore the need for a reasonably accurate capacity bridge is felt sooner or later, and, in view of the shortcomings of the average test set where high resistance measurements are concerned, it is convenient to include facilities for this also.



...a compact and handy form.

The instrument illustrated on these pages measures resistance from 0.1 megohm to 10 megohms and capacity from .10 m.mfd. to 10 mfd., thus embracing an enormous capacity range and one which covers all the values normally used. Reference to the circuit diagram of Fig. 4 will show that this is made possible by the use of three fixed standards C1, C2, C3, in conjunction with variable ratio arms formed by the potentiometer VR1. The resistance range is covered by one standard R1 of 1 megohm in conjunction with VR1. The valve is made to oscillate at low frequency and thus provides an AF signal for the bridge circuit, telephones being used as the balance indicator. The instrument measures only 10in. × 5in. × 4½in., and is operated from self-contained batteries: it is therefore completely portable.



...hom the scale is calibrated in degrees and ratios.

Construction

There is nothing difficult about the construction of the bridge, in fact, it is extremely simple as no metal is used, except for the battery holders, which are bent up from odd pieces. The panel (Fig. 5) is of ebonite, to which is fixed a small baseboard of ½in. plywood. On this are mounted the L.F. transformer, valve holder, condensers, etc., according to positions shown in the wiring diagram (Fig. 6). The potentiometer VR1 forming the variable ratio arm

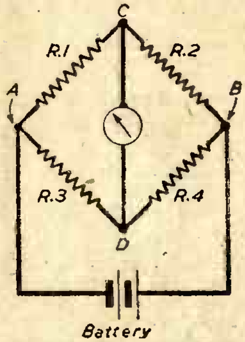


Fig. 2.—Basic circuit of the Wheatstone Bridge.

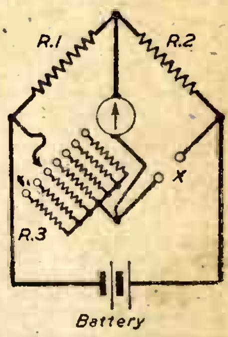


Fig. 3.—Practical circuit adaptation of Wheatstone Bridge principle.

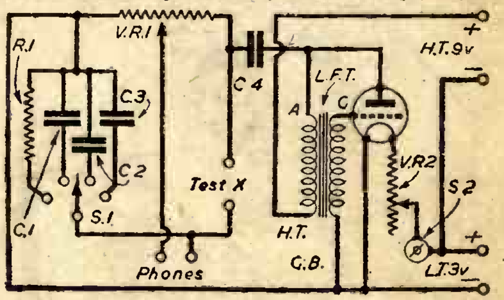


Fig. 4.—The circuit of the resistance and capacity bridge described by the writer.

must be of the wire-wound type and of good quality with a very smooth action, and its purpose requires it to be one of the ungraded type, i.e., resistance proportional to length of element, so that when the slider is at a point midway between each end, the resistance on either side is equal. This component is the main balance control, and is eventually calibrated. The 4-way switch, which selects the various ranges, should be one having good low resistance and positive contacts. VR2 is an ordinary 15 ohm filament rheostat of the old type, a good specimen of which is usually to be found in the junk box, or, at any rate, at a surplus radio stores. Filament voltage is supplied by a cycle lamp battery (type No. 800), and, as this is of 3 volts, VR2 is required to reduce it to a suitable value for the valve filament, and subsequent adjustment of it will allow for falling EMF of the battery. This resistance has, however, a further use, as will be seen in the operating notes. The L.F. transformer may be of any ordinary type, ratio 3-1 or 5-1.

Regarding the condensers C1, C2 and C3, these are the fixed standards against which the unknown is balanced, and it is therefore obvious that upon the accuracy of these will depend the accuracy of the complete bridge. Unfortunately, under present conditions, it is not possible to obtain from the various manufacturers condensers of a value accurate to a certain percentage figure, so that unless means are available for having them checked, all one can do is to use such components as are available, and hope that the value is as stated. The same applies to the 1 megohm resistor standard, R1. However, it is often possible to find in an unused chassis a condenser which has been checked and marked distinctively with a certain value. Particularly is this so in a superhet where certain condensers may have to be adjusted to a particular figure, and one may therefore be fortunate in finding at least the lowest capacity required which, after all, is the most important. Although, as has been pointed out before in these articles, the accuracy demanded in servicing is not that of laboratory standards, it is satisfactory to know that the apparatus one builds is correct and reliable. To return to condensers, the 0.0001 mfd. and the 0.01 mfd. should be good quality mica types, and for the 1.0 mfd. a paper type will be suitable. After connecting up the bridge according to the diagram with fairly thick wire (to ensure rigidity) a rough test should be carried out before calibrating VR1. Almost any 2-volt battery valve of the H.F., L.F. or general purpose type may be used, and the high tension is derived from a 9-volt grid bias battery. After plugging in telephones and switching on it should first be ascertained that a note is being produced by the L.F. oscillator—varying the position of VR1 if necessary. If no note is heard it is probable that the connections to one side of the transformer need changing around, after which no difficulty should be experienced. This system of using a valve oscillator is to be preferred to the buzzer method, because in the latter case the note is usually heard externally as well as in the phones, which is rather disturbing. The frequency of the note will be influenced by the type of transformer used, the type of valve, the adjustment of filament voltage and the H.T., although this is best left at nine volts anyway. The note should be of medium pitch, because if too low it is then not quite so easy to detect balance when dealing with the small values and when the slider of VR1 is right round to one end of the element. In this respect better results may be obtained by joining the secondary of the L.F.T. to H.T. and anode, and the primary to grid and L.T. Anyway, it is worth a trial.

(To be continued.)

LIST OF COMPONENTS

One ebonite panel, 9¾in. x 4½in.
One potentiometer, 2,000 ohms (see text).
One filament rheostat, 15 ohms.
One on/off switch.
One 4-way rotary switch.
Two terminals. Two sockets.
One base-board, 9in. x 4in.
One 3-volt twin cell battery, type No. 800.
One 9-volt grid bias battery.
One L.F. transformer, ratio 3-1 or 5-1.
One 4-pin chassis mounting valve holder.
One 1-megohm resistor.
One 0.0001 mfd. fixed condenser
One 0.01 mfd. fixed condenser (see text).
One 1.0 mfd. fixed condenser
One 0.01 mfd. tubular condenser.
Cabinet, pieces of ivorine for scale, etc.

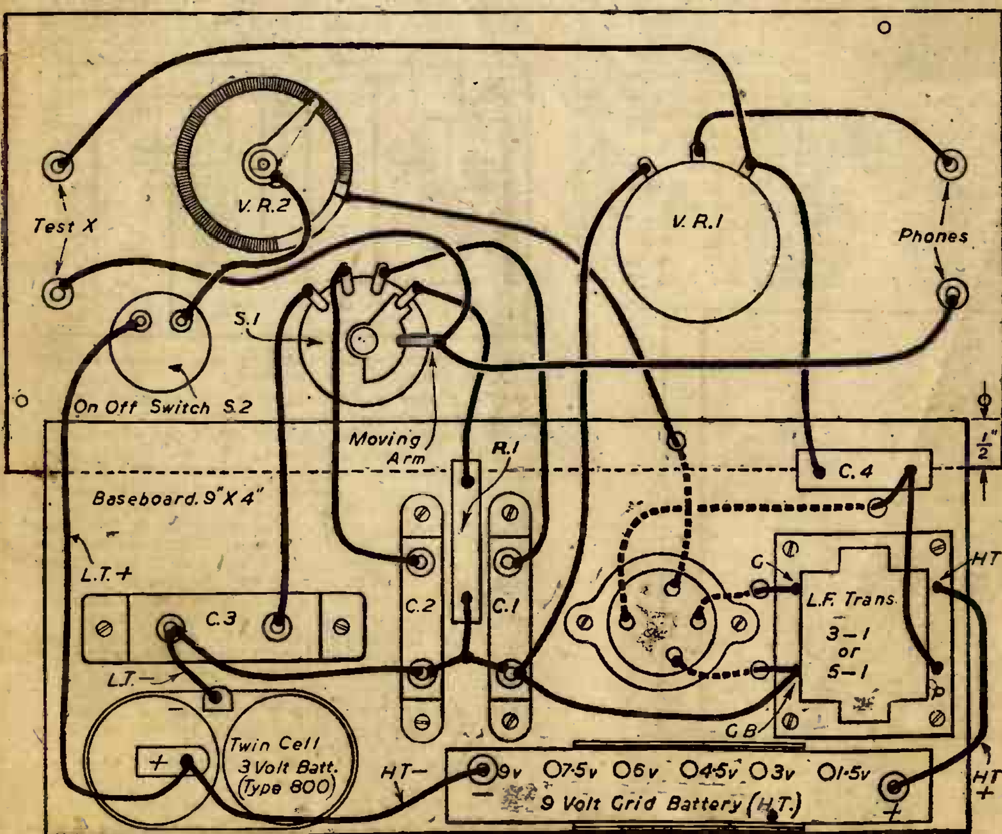


Fig. 6.—Layout and wiring of the component parts.

Radio Examination Papers—2[illegible]

Another Series of Self-test Questions With Suitable Answers. By THE EXPERIMENTERS

1. Super-regenerative Detection

A SELF-QUENCHING super-regenerative detector circuit is shown in Fig. 1. It will be seen that a triode is used in a conventional Hartley circuit. The connections are more like those of the oscillator of a transmitter, since the valve is required to oscillate more or less continuously at signal frequency. Nevertheless, some measure of control over oscillation is provided by the variable resistor in the H.T. positive lead.

It will be remembered that the principle of super-regeneration is that, although the detector valve is arranged primarily as a continuous oscillator, a means must be provided of causing the valve to cease and recommence oscillation at a very rapid rate—so rapid, in fact, that the frequency of cessation and recommencement of oscillation is above audible frequency; that is, higher than, say, 20,000 cycles per second. This quench frequency, as it is called, may be provided by means of a second valve, wired as a super-audio-frequency oscillator. If the H.F. output from this is fed into the grid circuit of the oscillating detector, the negative half-cycles may be arranged to bias off the detector and so cause oscillation to cease.

> **QUESTIONS**
>
> 1. *Draw the circuit of a self-quenching super-regenerative detector stage suitable for short-wave reception.*
> 2. *Explain, by means of a diagram, the usual method used for smoothing the H.T. supply in an inexpensive midget receiver of the A.C./D.C. type.*
> 3. *What is the resonant-line or parallel-line system of tuning as used for U.S.W. work?*
> 4. *How can H.F. voltages be measured, using a moving-coil meter?*
> 5. *Explain a simple method of reducing the effect of static on reception.*
> 6. *What is the principle of quiet automatic volume control, and how does it operate?*

The method of quenching illustrated in Fig. 1 is quite different, however, and is very simple in character. Quenching is provided by the charge and discharge of the .0005 mfd. pre-set condenser connected between the H.T.+ supply to the detector and earth. For the brief instant that this condenser is being charged the H.T. voltage on the valve anode will be very low, and the anode current will be insufficient to allow the valve to oscillate. Once the condenser has become charged, however, the valve will pass a surge of anode current and the condenser will start to discharge. Charging will recommence, with a consequent drop in anode voltage.

This process is repeated indefinitely, producing the desired quenching. The quench frequency is dependent upon the capacity of the condenser, the setting of the H.T. variable resistor and the value of the grid leak, which governs the "squegging" action. This circuit has proved quite satisfactory on wavelengths below about 15 metres, and can be used on longer waves.

2. Simple H.T. Smoothing

In the type of midget receiver referred to space is extremely limited, and difficulty may be found in fitting a smoothing choke. Additionally, of course, keen competition makes (or did make, when these sets were being more freely produced) cost of components an important factor. And H.T. voltage is usually at a premium in sets primarily designed for 100-volt working, and therefore the added resistance of a small choke becomes undesirable. There is insufficient H.T. current —as well as too low a voltage—to make the use of an energised speaker feasible.

As a result of all these limiting factors we generally come down to the circuit shown in skeleton form in Fig. 2. Here it will be seen that the only smoothing used for the H.T. applied to the anode of the output valve is that provided by a 16 mfd. electrolytic condenser, while the supply of the other valves is smoothed by means of a 2,000 ohm fixed resistor, also serving as a voltage-dropper, and a second 16 mfd. electrolytic.

It is because of this greatly simplified method of smoothing that a faint mains hum can generally be heard when receivers of the type under consideration are fed from an A.C. mains supply—and sometimes when operated from D.C.

3. Resonant-line Tuning

The use of tuning coils of normal type is out of the question on real ultra-short and micro-waves. A single turn of wire would often have too high an inductance, while a tuning condenser used in the normal manner would probably render the set unworkable. Use is therefore made of two lengths of wire or copper tubing, usually silver-plated to reduce skin resistance, parallel with each other and spaced by about twice the diameter

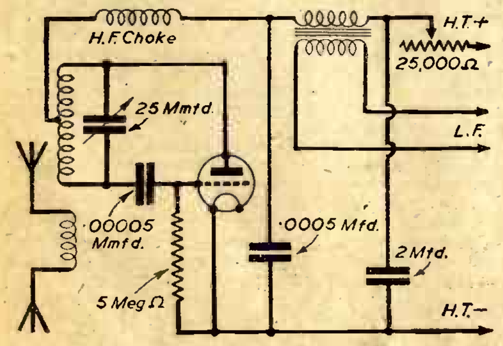


Fig. 1.—A self-quenching super-regenerative detector, suitable for U.S.W. reception.

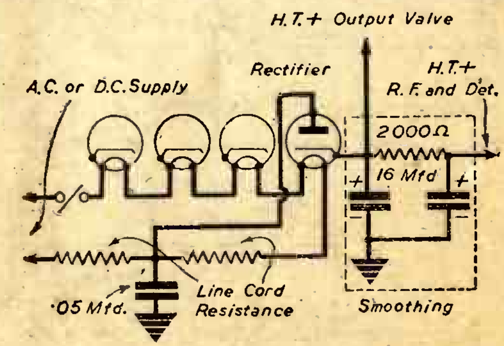


Fig. 2.—A typical H.T. smoothing circuit as used in midget A.C./D.C. receivers.

of the conductor, as illustrated in Fig. 3. The total length of the parallel conductors is in the region of one-half the wavelength to be employed. Theoretically, the length should be exactly a half-wavelength, but corrections have to be made for the lengths of the connecting leads (which are kept as short as practically possible), physical dimensions of valve electrodes and stray capacities.

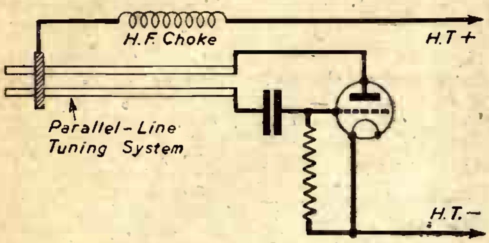


Fig. 3.—Resonant—or parallel—line tuning, which is most satisfactory for use with ultra-short and micro-waves.

Fine tuning is carried out by means of a shorting bar, which can be run along the parallel conductors. Coupling to the aerial may be arranged by means of a small "hairpin" loop of wire, or by tapping on to the "anode" conductor, through a low-capacity variable condenser.

This system of tuning an oscillator is often used in a push-pull circuit by employing a special double-triode valve with very low inter-electrode capacity, or by using a pair of low-capacity valves of the acorn or similar type, which have no base; the electrodes are simply connected to stubby leading-out wires, these being attached as directly as possible to the resonant or parallel-line circuit.

The parallel-line method of tuning is not new, and was used by pioneer experimenters in the early 'thirties. It will no doubt come into greater prominence with the development of micro-wave or centimetre-wave technique, which will probably be employed to an increasing extent after the war.

4. Measurement of H.F. Voltages

H.F. current can be measured by using a thermo-junction along with a moving-coil meter, as explained recently in this series. By a development of this method and measuring the current through a circuit of known resistance it is possible to measure H.F. voltage. This method is not a highly practical one, however, because it is not always easy to determine the H.F. resistance of the associated circuit at any particular frequency.

A more satisfactory method is to use a valve as rectifier or detector, and to use a milliammeter or

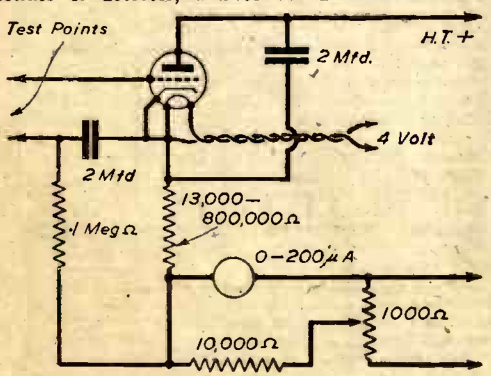


Fig. 4.—Circuit of an H.F. valve voltmeter using an Osram type A.577 valve.

micro-ammeter to measure the anode-cathode current of the valve. This current is proportional to the H.F. voltage applied to the valve, and the meter may be calibrated in H.F. volts (R.M.S. values). Special valves are made for use in a circuit such as that given in Fig. 4, which is that recommended for the Osram type A577 valve. By suitable choice of value for the bias resistor (between 13,000 and 800,000 ohms) the valve voltmeter can be used for reading H.F. voltages of maximum values between 5 and 150. The fixed and variable resistors 10,000Ω and 1,000Ω are used to back-off the circuit, the latter being used to set the meter to zero before connecting the voltage supply to be measured.

5. Reducing Static

Many methods have been tried in an attempt to eliminate atmospheric and other forms of static interference in the receiver. Most of them have met with little success, and it is generally necessary to be content with a diminution of the effect of static on reproduction.

As readers are aware, static normally takes the form of sudden surges of H.F. Static, although normally more pronounced on the longer wavelengths, cannot be eliminated by tuning. Instead, a means must be found of preventing the sudden surges from reaching the

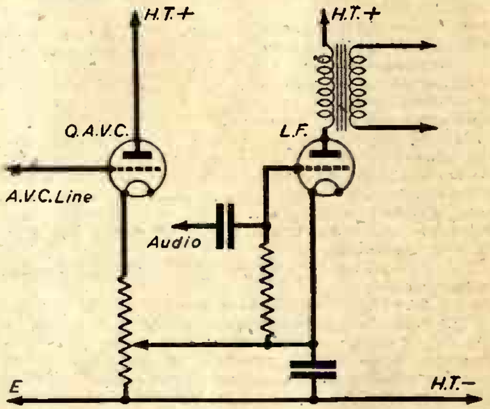


Fig. 5.—This diagram illustrates the principle of quiescent automatic volume-control.

output stage and the loudspeaker. One method which has met with a good deal of success consists of connecting a "Westector" between grid and cathode of the output valve. It is often found that the effect is more marked if two similar "Westectors" are wired in parallel in this position, the positive connection of one being connected to the negative connection of the other.

Normally, the rectifiers pass little or no current, but on sudden surges (of either polarity when the "twin" system is employed) the current through one or other of them rises more or less proportionately to the sudden rise in voltage due to the static "signal," thus partially shunting out the valve. Naturally, the rectifiers result in a certain loss of signal strength, but this is not of any serious proportions.

An alternative method of connecting the rectifiers is in parallel with the speaker or 'phones, when choke-capacity output coupling is employed.

6. Q.A.V.C.

Quiet, or quiescent, automatic volume control is employed to counteract one of the principal objections to normal A.V.C. It is known that one important result of A.V.C. is greatly to increase the R.F. gain of the receiver on weak signals. Thus, gain is at a maximum when the receiver is not tuned to any signal. In consequence, inter-station noise or "mush" tends to be emphasised when A.V.C. is employed.

The purpose of Q.A.V.C. is to eliminate, or greatly reduce, this inter-station noise. It operates by causing the L.F. amplification to be reduced when the set is off tune; that is, when R.F. gain is at a maximum. Once it is decided that signals below any particular level will be of no "programme" value, the Q.A.V.C. can be designed to eliminate them.

The method of reducing L.F. gain is to over-bias the first L.F. amplifier. This, it will be seen, is the reverse of the normal A.V.C. operation, because the L.F. stage has to be biased back on weak signals, while the R.F. and I.F. stages are biased back on strong signals.

Fig. 5 gives a simple outline of a method by which this can be accomplished, although this is by no means a complete diagram. An additional valve is employed for Q.A.V.C., this being virtually a D.C. amplifier. Its grid is connected to the A.V.C. line, its anode to an H.T.+ supply point, and the cathode, through a biasing resistor, to earth. When full A.V.C. bias is applied to the grid, the valve is near to cut-off, so that little or no anode-cathode current is taken. That means that the voltage drop across the bias resistor is that resulting only from the cathode current taken by the L.F. amplifier valve. But when the A.V.C. voltage falls the grid of the Q.A.V.C. valve becomes less negative, and therefore more H.T. current is passed by the valve. The voltage drop across its cathode resistor therefore rises and an increased bias is applied to the L.F. valve, so reducing L.F. gain.

In practice the Q.A.V.C. valve has to be chosen with care, and the most suitable operating point must be determined. By using a potentiometer as bias resistor the effect on the variation of bias to the L.F. valve can be altered to give the required amount of over-bias. The valve used for Q.A.V.C. should be of the high-mu variety; a pentode is often found to be most suitable.

Swinging Chokes

Their Characteristics and Operation Explained.

By G. P. WOODBINE, A.M.Brit.I.R.E.

THE Swinging Choke is an iron-cored choke, the inductance of which decreases as the D.C. component flowing through the winding increases. This definition applies equally well to all types of iron-cored inductances carrying D.C. The relationship between inductance and D.C. component is shown in Fig. 1.

The swinging choke is, however, a special case, and this property, which is a disadvantage in an ordinary iron-cored choke, is used to improve the regulation of power supply units called upon to supply widely varying loads. As the name implies, the value of the inductance swings from one value to another, as the D.C. component varies in the winding.

It can therefore be assumed that there will be two limiting cases:

(a) when the choke swings to zero inductance, and
(b) when the choke swings to maximum inductance.

In Fig. 2 (a) the choke with zero inductance is represented by R (the D.C. resistance of the winding). In the second limiting case, Fig. 2 (b), the choke is shown as an inductance, L.

Consider, first, the case (a), where the D.C. flowing in the winding is of such a value that the inductance of the choke is reduced to zero. This leaves only the D.C. resistance of the choke in circuit with a normal condenser input filter, Fig. 2 (a). In practice, R is small, and can be ignored for the purpose of this explanation. The output voltage waveforms of a full wave rectifier with condenser input are shown in Fig. 3. The condenser C charges up to the peak value of the rectifier

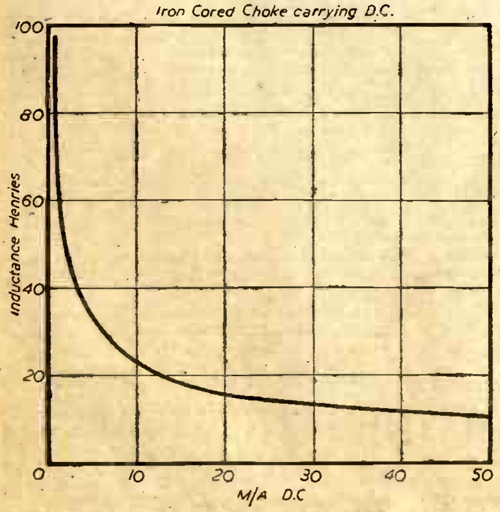


Fig. 1.—Curve showing the relationship between the D.C. component and inductance of an iron cored choke.

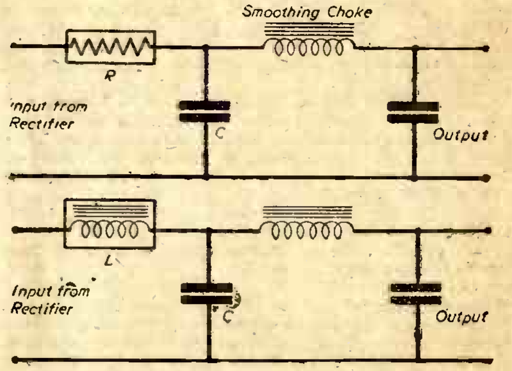


Fig. 2.—(a) (upper) Zero inductance is represented by R—the D.C. resistance of the winding. (b) (lower) The same choke shown as an inductance, L.

output voltage, and tends to remain at this value when the rectifier voltage has fallen to zero. On light load, the condenser discharges into the load circuit comparatively slowly, and its voltage falls only by a small amount by the time the rectifier voltage has again risen to its peak value. When the rectifier voltage falls below the potential of the charge in the condenser, the condenser discharges into the load, and maintains the voltage across the load at a mean value, slightly less than the peak voltage of the transformer secondary. The output voltage of a rectifier unit with a condenser input filter is therefore only slightly less than the peak voltage of the transformer secondary, provided the load on the unit is small.

Now to examine the second limiting case (b), when conditions are such that the choke has maximum inductance (when minimum D.C. is flowing). The condenser input filter with an inductance between it and the rectifier valve now becomes a choke input filter, Fig. 2 (b). The inductance of the choke tends to oppose any rapid changes in current through it. For this reason, the condenser C never becomes charged to the peak value of the transformer secondary voltage, but reaches a potential of slightly less than the R.M.S. value, as shown in Fig. 3.

We have therefore two cases:

(a) With the output voltage at nearly the peak value, and

(b) with the output voltage at slightly less than the R.M.S. value of the transformer secondary voltage.

These limits are not reached in practice with a filter incorporating a swinging choke, but the inductance of the choke does vary within certain limits with variations of load.

Operation

To sum up, the action of the swinging choke is as follows: On small load, the D.C. component will be at a minimum; the choke will therefore have a high value of inductance and the filter circuit will have the characteristics of a choke input circuit. As the load increases, the inductance of the choke falls, and with the decrease in inductance, conditions in the circuit approach those of the condenser input filter. Consequently, the voltage across the condenser C will rise.

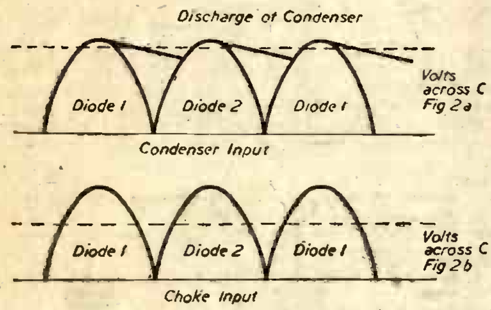


Fig. 3.—Output voltage waveforms of a full-wave rectifier with condenser and choke output.

If the values of inductance and capacitance are suitably chosen, the rise in voltage due to the discharge of the condenser into the load will compensate for the voltage drop caused by the increase in load. The circuit then becomes self-regulating.

Regulation Curves

The curves in Fig. 4 show the regulation of two types of power pack; (a) being the regulation curve of a unit employing a condenser input filter, and (b), a swinging choke. Both the packs are identical, except that the pack (b) incorporates a swinging choke. It can be seen from curve (a) that with condenser input the voltage is high on light load, but falls rapidly as the load increases. By increasing the load from 75 m.a. to 150 mA's a drop of 120 volts takes place. Curve (b) demonstrates the self-regulating effect of the swinging choke. The output voltage falls rapidly to the point X on the curve, but from this point the curve remains almost parallel to the axis. In this case, an increase in load from 75 mA's to 150 m.a. causes a drop of only 10 volts.

In order to make use of the self-regulating property of the unit, it is necessary to operate it on the flat portion of the curve. This is done by connecting a bleeder resistance in parallel with the load, of such a value that a constant load of 75 mA's is imposed upon the unit. Changes in load of as much as 100 m.a. over and above the constant load will have a negligible effect upon the output voltage.

A typical case where the use of a swinging choke power unit becomes necessary is the H.T. supply for a class B audio frequency stage, where the load varies rapidly within wide limits. Severe distortion would be experienced if the H.T. voltage fell to any extent when a large, sudden increase in current was demanded by the amplifier. It is therefore essential that the H.T. voltage be maintained at a constant level, irrespective of load.

The following points should be noted in the choice of components for the construction of a swinging choke power pack:

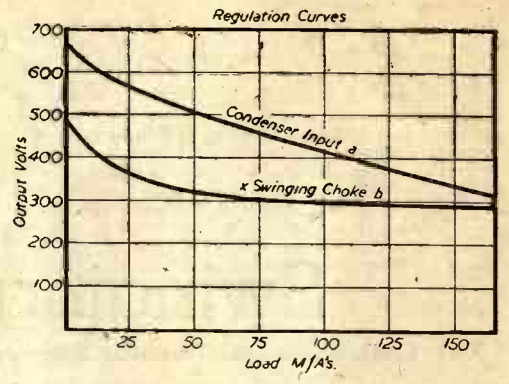


Fig. 4.—Regulation curves of two types of power pack.

1. The transformer must have good regulation.
2. Mercury vapour rectifiers should be used, as the voltage drop introduced by this valve is of the order of 15 volts only, and remains reasonably constant, irrespective of load.
3. The swinging choke must be of good design, with good insulation and low D.C. resistance.

PRIZE PROBLEMS

Problem No. 451.

BRADLEY decided to build a superhet and was fortunate enough to secure a set of coils and I.F. transformers of a well-known make. Many other components he found in his spares-box, including a good ganged condenser of the superhet type, or in other words, one having the moving-vanes of the oscillator tuning section specially shaped to provide proper tracking.

He built the circuit to a well tested standard design, and took considerable care with its construction and wiring, but, unfortunately, he could not obtain satisfactory tracking throughout the entire tuning range. He checked wiring and component values and found these to be in order. What was the trouble?

Three books will be awarded for the first three correct solutions opened. Address your solutions to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 451 in the top left-hand corner, and must be posted to reach these offices not later than the first post on Thursday, December 16th, 1943.

Solution to Problem No. 450.

Nash made the mistake of adding the extra resistor in series with the existing potentiometer thus increasing the total resistance of the network and consequently altering the value of the voltage applied to the screening grid. What Nash should have done was to replace the original resistors with others having the same resistance values but of higher *wattage rating.*

The following three readers successfully solved Problem No. 449, and books have accordingly been forwarded to them. O. S. M. Brown-Greaves, Hants; L. Tattum, 3, Hill View, Gwernaffield, Mold, N. Wales; G. W. Rackham, 26, Scales Road, Tottenham, N.17.

The B.B.C.'s Twenty-first Birthday

Some Significant Dates

ON November 14th, 1943, the B.B.C. celebrated its 21st birthday, and to mark the occasion, and to provide an interesting record of its progress, we give the outstanding dates in its career. From a humble and rather hectic beginning, the B.B.C. has risen to a national service of vital importance, providing a world-wide service second to none in the sphere of broadcasting.

November, 1922

14. Daily broadcasting service started from the London station of the B.B.C.
15. B.B.C. Birmingham and Manchester stations opened.
16. First B.B.C. printed programme on record. (Prior to this date programmes had been broadcast from London, Birmingham and Manchester stations under the auspices of the Marconi, Radio Communications, Metropolitan Vickers, British Thomson Houston General Electric and Western Electric Companies.)

December, 1922

5. Birmingham inaugurated a Children's Corner of 15-20 minutes' duration.
23. First Children's Hour from London (Marconi House). First general news bulletin broadcast from London (Marconi House). (According to a "Birmingham Weekly Post" cutting a news bulletin was broadcast from Birmingham from its opening night, November 15.)
    First Orchestral concert from London (Marconi House).
    First broadcast talk from London (Marconi House) given by Captain E. B. Towse, V.C.
24. Newcastle station opened.
    First religious address from London (Marconi House), given by Rev. J. A. Mayo, Rector of Whitechapel.

January, 1923

8. First Outside Broadcast: British National Opera Company, Act 1 "The Magic Flute" from Covent Garden.
14. First Chamber Music Concert.
18. Licence and Agreement between the Postmaster-General and the B.B. Company, Ltd.
23. First Military Band Concert: Band of H.M. Irish Guards.
30. First Variety programme broadcast from London (Marconi House).

February, 1923

2. Cardiff station opened.
9. First talk on Music, by Mr. Percy Scholes.
17. First broadcast appeal: Winter Distress League by Ian Hay.
20. First broadcast by Sir Oliver Lodge, entitled "Wireless Outlook."
22. First zoo talk by L.G.M. of the "Daily Mail."
    First Boys Scouts talk.
    First wireless debate: "That Communism would be a Danger to the Good of the People," proposed by Sir Ernest Benn and opposed by Mr. J. T. Walton Newbold, M.P.

March, 1923

2. Programme hours extended to mornings (11.30-12.30).
3. Glasgow station opened.
9. First short story reading (Gilbert Frankau).
26. First Dance Music programme.
    Inception of daily weather forecasts in the general news bulletin.

April, 1923

20. First Sports talk: "The Football Cup-tie."
21. First Summer Time warning talk: "Alter your clocks."

May, 1923

1. Opening of Savoy Hill studios.
   First of 10.0 p.m. evening talks inaugurated by Lord Birkenhead.
2. First of afternoon talks for women, inaugurated by H.R.H. Princess Alice, Duchess of Athlone.
28. First long play: "Twelfth Night" (Shakespeare).

June, 1923

21. First Symphony concert given by the augmented Orchestra conducted by Percy Pitt.

July, 1923

1. First broadcast studio address by the Rev. Dick Sheppard
11. First regular (weekly) film criticism by Mr. G. A. Atkinson.
16. First Request programme.
27. First regular (weekly) dramatic criticism by Mr. Archibald Haddon.

August, 1923

—. Report of the Sykes Committee on broadcasting.
4. First broadcast time signal.

September, 1923

3. First regular (weekly) literary criticism by Mr. John Strachey.
10. First S O S message.
28. "Radio Times" first published.

October, 1923

1. Supplementary Agreement between the P.M.G. and the B.B.Company, Ltd.
2. First broadcast by H.R.H. the Duke of Connaught at a dinner given by the Royal Colonial Institute.
3. First relay of late evening dance music from the Savoy Hotel.
10. Aberdeen station opened.
11. First complete studio opera, "Il Trovatore" (Verdi), from Birmingham.
17. Bournemouth station opened.

November, 1923

8. First programme broadcast in Welsh (Cardiff).
11. First broadcast Armistice Ceremony.
16. Sheffield station opened (First Relay station).

December, 1923

6. First broadcast of election results.
23. First broadcast of Handel's "Messiah."
30. First Continental relay (from Radiola, Paris).
31. First broadcast by His Grace the Archbishop of Canterbury.
    First broadcast of chimes of Big Ben—to usher in the New Year.

— Introduction of simultaneous broadcasting.

January, 1924

1. Week-day afternoon concerts introduced.
6. First religious service broadcast from St. Martin-in-the-Fields.
31. First adventure by A. J. Alan, "Jermyn Street."

February, 1924

5. Greenwich Time Signal inaugurated.
12. First French talk by M. Stéphan.

March, 1924
6. First poetry reading, by John Drinkwater.
28. Plymouth station opened.

April, 1924
4. First broadcast to schools by Sir Walford Davies.
23. First broadcast speech by H.M. King George V, and first London broadcast by H.R.H. the Prince of Wales. (Broadcast at the opening of the British Empire Exhibition, Wembley.)

May, 1924
1. Edinburgh station opened.
19. First broadcast of song of the nightingale from a Surrey wood.
23. First broadcast by H.M. the King (then Duke of York) at Empire Day Banquet.

June, 1924
11. Liverpool station opened.
30. First broadcast of Maline's Carillon relayed from Belgium by landline.

July, 1924
8. Leeds station opened.
21. First programme from Chelmsford 5XX high-power station.
27. First appearance of original (2LO) Wireless Military Band, conductor Dan Godfrey, Jnr.

August, 1924
15. Hull station opened.

September, 1924
15. Belfast station opened.
16. Nottingham station opened.

October, 1924
3. First O.B. from Zoological Gardens, London.
5. First broadcast by Chief Rabbi.
13. First broadcast election address from Glasgow (Rt. Hon. J. Ramsay MacDonald).
21. Stoke station opened.

November, 1924
10. First running commentary on the Lord Mayor's Show.
12. Dundee station opened.
20. First broadcast by Bernard Shaw (reading his play "O'Flaherty, V.C.").
26. First wireless relay from American station, KDKA, Pittsburg.
27. First wireless relay from Belgium station.
28. First concert relayed from pit bottom—1,500ft. deep—at the Whitewood Collieries, Normanton (Leeds).

December, 1924
12. Swansea station opened.

February, 1925
20. First weekly list of Market Prices for Farmers.

March, 1925
2. First experimental transmission for amateur wireless engineers.
10. First concert provided by a newspaper, the *Evening Standard*.
13. Special transmission to U.S.A. (1.0–2.0 a.m.).
15. First broadcast pianoforte recital by Paderewski.

April, 1925
3. B.B.C. represented at the first General Assembly of the International Broadcasting Union at Geneva.
22. First O.B. concert from a ship, Cunard Line s.s. *Samaria* in Dock at Liverpool.

May, 1925
3. First broadcast from York Minster (Military Sunday Service).
9. First O.B. Community Singing concert from Royal Albert Hall, London.
15. First broadcast from an aeroplane (Mr. Alan Cobham teaches Miss Heather Thatcher to fly).

June, 1925
5. First O.B. of Royal Tournament.
16. First broadcast from the Aldershot Tattoo.

July, 1925
17. First issue of *World Radio*.
27. Opening ceremony of new high-power station, Daventry 5XX (formally opened by the Rt. Hon. Sir W. Mitchell-Thomson, then H.M. Postmaster-General).

October, 1925
16. First special weekly broadcast to the continent (5XX).

November, 1925
5. Chaliapine's first appearance before the microphone.

December, 1925
23. First broadcast by Sir Harry Lauder.
30. First drawing lesson, by W. Heath Robinson.

1925
—. Formation of Wireless League.
International Broadcasting Union formed.
Advisory Committee on Music established early in 1925.

1926
—. Report of Crawford Committee of 1925 on Broadcasting.

January, 1926
7. First broadcast test for shorthand writers.
24. Inauguration of Sunday Week's Good Cause Appeals (Sir Charles Wakefield appealing for National Children's Home and Orphanage).
26. Inauguration of Daventry evening shipping forecast.

February, 1926
12. First broadcast by H.R.H. the Duke of Gloucester (from Civil Service Dinner, Connaught Rooms).
16. First broadcast by London Radio Dance Band, directed by Sidney Firman.

April, 1926
4. First O.B. Service from Norwich Cathedral—Address by the Dean of Norwich.
5. First broadcast dancing lesson.
First broadcast of Changing the Guard at Buckingham Palace.

May, 1926
4. General strike began. B.B.C. maintained close touch with official Government services of information, and were able by broadcasting news to keep listeners in touch with the situation.
26. First broadcast from House of Lords. Speeches at the banquet of the International Parliamentary Commercial Conference.

July, 1926
5. First broadcast from under the Thames by a diver.

November, 1926
—. Under Geneva plan, drawn up by the International Broadcasting Union, the number of wavelengths available to the B.B.C. were reduced; regional, as opposed to local, broadcasting the inevitable consequence.
9. Agreement between the Postmaster-General and the B.B.Company, Ltd., providing for transfer of the Broadcasting Service on January 1st, 1927.

December, 1926
9. First broadcast of the Ceremony of the Keys from the Tower of London.
22. First broadcast of the Nativity Play, "Bethlehem," from St. Hilary's, Marazion.
—. B.B.C. organised for the winter season a series of National concerts in the Albert Hall.

(To be continued.)

Valve Data Sheets

MULLARD

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U.X. BASE

Type	Description	Base	Bulb Finish	Working Conditions Vf	If	Va	Vg2	—Vg	Ia	Characteristics at Working Conditions Ri	G	S. or Sc.	Optimum Load
6A7	Heptode Frequency Changer	7-pin U.X. (76)	Clear	6.3	0.3	250	100	3.0	3.5	360,000	—	0.52	—
24A	H.F. Screened Tetrode	5-pin U.X. (70)	Clear	2.5	1.75	250	90	3.0	4.0	600,000	630	1.05	—
36	H.F. Screened Tetrode	5-pin U.X. (70)	Clear	6.3	0.3	250	90	3.0	3.2	550,000	595	1.08	—
6C6	H.F. Pentode ..	6-pin U.X. (72)	Clear	6.3	0.3	250	100	3.0	2.0	>1,500,000	>1,500	1.225	—
39/44	H.F. Pentode ..	5-pin U.X. (70)	Clear	6.3	0.3	250	90	3.0	5.8	1,000,000	1,050	1.05	—
77	H.F. Pentode ..	6-pin U.X. (72)	Clear	6.3	0.3	250	100	3.0	2.3	1,500,000	1,500	1.25	—
6D6	Vari-mu H.F. Pentode	6-pin U.X. (72)	Clear	6.3	0.3	250	100	3.0	8.2	800,000	1,280	1.6	—
78	Vari-mu H.F. Pentode	6-pin U.X. (72)	Clear	6.3	0.3	250	125	3.0	10.5	600,000	990	1.65	—
75	Double-diode Triode	6-pin U.X. (73)	Clear	6.3	0.3	250	—	2.0	0.8	91,000	100	1.1	—
42	Output Pentode..	6-pin U.X. (74)	Clear	6.3	0.7	250	250	16.5	34.0	80,000	200	2.5	7,000
47	Output Pentode..	5-pin U.X. (71)	Clear	2.5	1.75	250	250	16.5	31.0	60,000	150	2.5	7,000
43	DC/AC Output Pentode	6-pin U.X. (74)	Clear	25.0	0.3	180	135	20.0	38.0	40,000	100	2.5	5,000

Type	Description	Base	Bulb Finish	Heater Rating Vf	If	Anode Voltage (R.M.S.)	Rectified Output (mA)
80	Directly-heated F.W. Rectifier	4-pin U.X. (69)	Clear	5.0	2.0	350—0—350	125
25Z5	Indirectly-heated Multiple Rectifier	6-pin U.X. (75)	Clear	25.0	0.3	125	100

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MULLARD EQUIVALENTS OF AMERICAN TYPE VALVES

Cossor	Ferranti	Mullard	Marconi-Osram	Brimar
—	—	5U4G	U52	5U4G
—	5Y3G	5Y3G	U50	5Y3G
—	—	5Z4G	—	5Z4G
—	—	5V4G	—	5V4G
6A8EG	6A8G	6A8G	X63	{6A8G, 6A8EG}
—	—	6C5G	—	6C5G
6F6EG	6F6G	6F6G	KT63	{6F6G, 6F6EG}
—	—	6U5/6G5	—	—
6J7G	—	6J7G	KTZ63	6J7G
6K7EG	6K7G	6K7G	KTW63	{6K7G, 6K7EG}
6H6G	—	6H6G	D63	6H6G
—	—	6L6G	KT66	6L6G
—	—	6L7G	X64	6L7G
6Q7G	6Q7G	6Q7G	DH63	6Q7G
6R7G	—	6R7G	—	6R7G
—	—	6V6G	—	6V6G
—	—	25A6G	—	25A6G
—	—	25Z6G	—	25Z6G

Cossor	Mullard	Brimar
6A7E	6A7	6A7E, 6A7
—	6C6	6C6
—	6D6	6D6
24E	24A	24E, 24A
25Z5	25Z5	25Z5
36E	36	36E, 36
39/44E	39/44	39/44E, 39/44
42E	42	42E, 42
43E	43	43E, 43
47E	47	47E, 47
75	75	75
77E	77	77, 77E
78E	78	78E, 78
80	80	80

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SPECIAL TYPES

Type	Description	Base	Bulb Finish	Working Conditions Vf.	If.	Va.	Vg2	—Vg.	Ia.	Characteristics at Working Conditions Ri.	G.	S. or Sc.	Optimum Load
AT4	Acorn Triode	—	Clear	4.0	0.25	200	—	6.0	4.5	12,500	25	2.0	—
AP4	Acorn Pentode.. ..	—	Clear	4.0	0.2	250	100	3.0	2.0	3,500,000	5,000	1.4	—
4671	Acorn Triode	—	Clear	6.3	0.16	180	—	5.0	4.5	12,500	25	2.0	—
4673	Acorn Pentode.. ..	—	Clear	6.3	0.15	250	100	3.0	2.0	1,500,000	2,100	1.4	—
DA1	Amplifying Triode for Deaf Aids	Small 4-pin	Clear	2.0	0.05	40	—	0.25	0.25	80,000	32	0.4	—
DA2	Output Triode for Deaf Aids	Small 4-pin	Clear	2.0	0.05	40	—	2.15	1.25	13,600	6.9	0.5	—
DA3	Output Triode for Deaf Aids	Small 4-pin	Clear	2.0	0.05	40	—	2.8	1.8	7,600	4.7	0.62	—
DAS1	Amplifying Tetrode for Deaf Aids	Small 4-pin	Clear	2.0	0.06	120	60	2.7	1.5	500,000	—	0.58	—
DC51	Amplifying Triode* ..	Small 4-pin	Clear	1.5	0.067	45	—	0	0.34	66,000	< 25	0.38	—
DF51	Amplifying Pentode* ..	Small 4-pin	Clear	1.5	0.067	45	13.5	0	0.125	—	—	0.17	—
DD51	Output Triode* ..	Small 4-pin	Clear	1.5	0.067	45	—	3.0	1.74	10,000	< 5	0.5	—
TSP4	High Slope H.F. Pentode for Television	7-pin (20)	Met.	4.0	1.3	250	250	3.0	10.5	750,000	—	—	—
TSE4	Secondary Emission Valve for Television	7-pin (57)	Met.	4.0	1.1	250	150	2.5	8.0	100,000	—	14.5	—

* These types are specially designed for use in Deaf Aid Apparatus.

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SPECIAL TYPES—(Continued)

Type	Description	Base	Bulb Finish	Working Conditions Vf.	If.	Va.	Vg3	-Vg.	Ia.	Characteristics at Working Conditions Ri.	G.	S. or Sc.	Optimum Load
EE50	Single-ended Television Secondary Emission Valve	All (58) Glass	Metal Shield	6.3	0.3	250	250	3.0	10.0	250.000	—	14.0	—
EF50	Single-ended Television H.F. Pentode	All (59) Glass	Metal Shield	6.3	0.3	250	250	2.0	10.0†	1,000,000†	75†	6.5†	—
T4D	Single-diode for Television	—	Clear	4.0	0.2	50	—	—	5.0	—	—	—	—
EA50	Single-diode for Television (replaces T6D)	—	Clear	6.3	0.15	50	—	—	5.0	—	—	—	—
HVR1	High Voltage Rectifier	4-pin (6)	Clear	2.0	0.3	6,000 RMS	—	—	5.0	—	—	—	—
HVR2	High Voltage Rectifier	4-pin (7)	Clear	1.0	0.65	6,000 RMS	—	—	3.0	—	—	—	—
1878	High Voltage Rectifier	Edison	Clear	4.0	0.7	10.500 RMS	—	—	2.0	—	—	—	—
GT4H	Gas Triode	P (52)	Clear	4.0	2.4	1,000	—	—	§10.0 Average	—	—	—	—
EC50	Gas Triode (replaces GT6H)	P (52)	Clear	6.3	1.3	1,000	—	—	§10.0 Average	—	—	—	—
EL50	Output Pentode ..	P (45)	Clear	6.3	1.35	375	275	17.5	48	28,000	—	7.5	—

† Vg3 = OV. § 750 mA. Peak.

Valve Data Sheets

MULLARD

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CATHODE RAY TUBES

OSCILLOGRAPH TUBES

Type	Description	Base	Dia. m/m	Length m/m	Vf.	If.	Va1.	Va2	Va3	-Vg	N1	N2
E40-G3 } *A40-N3 }	Oscillograph Tube	P	75	150-165	4.0	1.0	140-220	500-800	—	0-30	0.30-0.22	0.24-0.14
*A41-G4/ B4,N4	Oscillograph Tube	Special 9-pin	103	326-349	4.0	1.0	400	1,000	—	0-40	0.4	0.31
E42-G6/B6	Oscillograph Tube	Special 12 Contact	167	425-450	4.0	1.0	200-400	1,000-2,000	—	0-35	0.64-0.32	0.52-0.26
E46-G10/ B10	Oscillograph Tube	Special 12 Contact	258	570-595	4.0	1.0	250	1,400	5,000	0-60	0.17	0.14

NOTE.—The letters following the hyphens in the type numbers denote fluorescent colour—G = Green; B = Blue; N = Green (long persistence). N1 = Deflection sensitivity of plates nearest cathode. N2 = Deflection sensitivity of plates nearest screen. * = Asymmetrical Plate System.

PICTURE TUBES

Type	Description	Base	Diameter m/m.	Length m/m.	Vf.	If.	Va1.	Va2
E46-10	Electrostatic ..	Special 12 Contact	258	570-595	4.0	1.0	250	1,400
E46-12	Electrostatic ..	Special 12 Contact	310	630-660	4.0	1.0	250	1,400
MS11-1	Projection Tube Magnetic ..	V.	114	341-354	4.0	1.0	500	25,000
MW18-2	Magnetic	4-pin Br. Octal	185	304-372	2.0	1.2	4,000	—
MW22-1	Magnetic	P.	226	360	4.0	1.0	250	5,000
MW22-3	Magnetic	4-pin Br. Octal	217-223	352-360	2.0	1.2	4,000	—
MW22-5	Magnetic	P.	225-231	368-376	6.3	0.6	125-250	5,000
MW31-3	Magnetic	P.	310	460	6.3	0.6	125-250	5,000
MW31-6	Magnetic	P.	302-308	455-465	6.3	0.6	125-250	5,000

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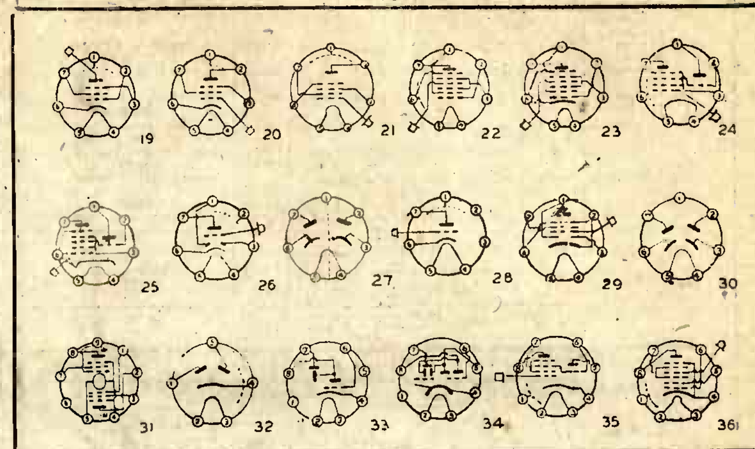

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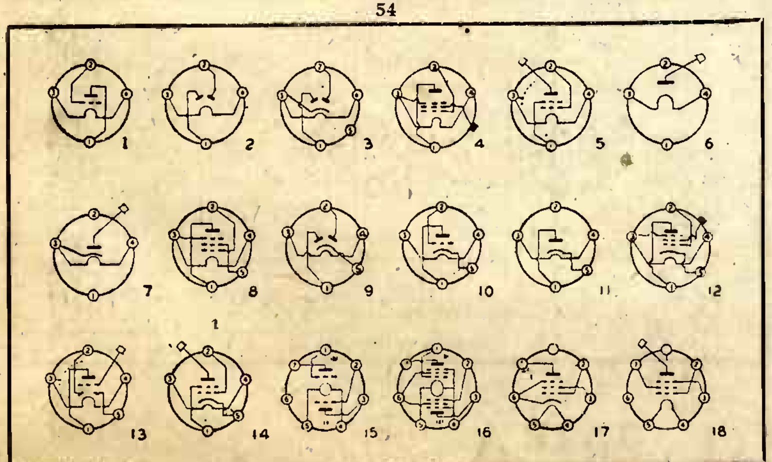

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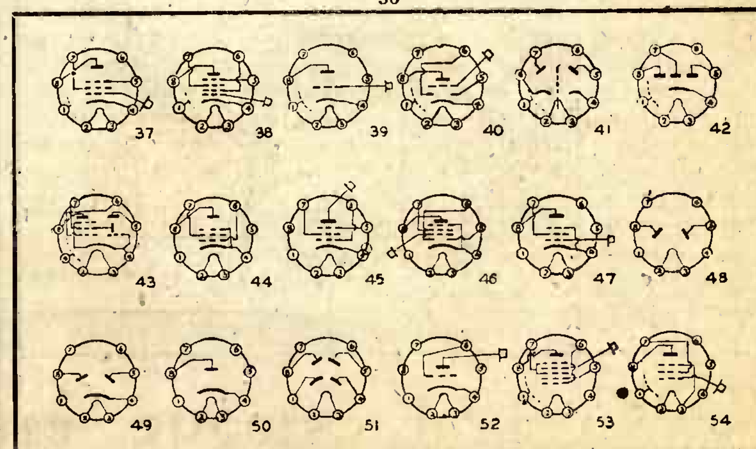

Low-frequency Amplifier Design—4

Push-pull, Class B, Quiescent Push-pull and Paraphase Amplifiers are Dealt with in the Fourth Article of the Series

UP to this point only amplifiers of the simpler types, and having a single valve in the output stage, have been dealt with in this series. We shall ater return to that type of amplifier in order to consider ways and means of modifying its characteristics. In the meantime, consideration will be given to the question of obtaining improved reproduction by simple and inexpensive means, especially when high-tension voltage and/or current are limited.

There are various forms of push-pull amplifier, the simplest of which may be regarded as having two similar valves connected in series-parallel. The circuit of a push-pull stage following a triode intermediate amplifier is shown in Fig. 1. It will be seen that the two valves in push-pull are shown as tetrodes; these could be replaced by triodes and pentodes without making any material alteration to the connections.

Low H.T. Voltage

The principal advantage of this type of circuit is that good amplification and an appreciable output can be obtained when using comparatively small valves operated from an H.T. voltage up to about 250. The power output available is equal to approximately two-and-a-half times the output of one of the push-pull valves used separately, while the amplification is comparable with that of a single tetrode. If a single triode were used which were designed to give the same output as the push-pull stage, it would necessarily be one having a fairly low amplification factor. Additionally it would generally require a high-tension voltage in the region of 400 volts.

The underlying principle of the form of amplification under discussion is that the grids of the two valves are out of phase; that is, while the negative half-cycle is being applied to one, it is the positive half-cycle which is being applied to the other. In this respect, the system may be compared to a full-wave rectifier. A notable advantage of this is that even harmonics tend to be cancelled out, with corresponding improvement in reproduction. The chief disadvantage is that, in the normal way, a special input transformer having a centre-tapped secondary is required. This transformer is marked T.1 in the circuit diagram.

In most material respects, the design of the transformer primary is the same as that for the usual type of low-frequency transformer previously explained. For any given ratio, the secondary winding has twice as many turns as for the ordinary transformer, since the effective step-up ratio is that between the primary and each half of the secondary. Thus, for a one-to-three transformer for push-pull the secondary would have six times as many turns as the primary. The Miller Effect, as applied to the primary of the transformer, is halved, since the grid-cathode capacities of the two valves are in series, across the transformer secondary.

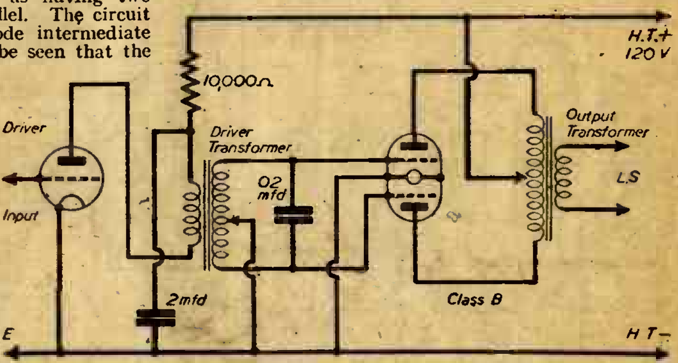

Fig. 2.—Driver and Class B stages of a battery amplifier suitable for an output in excess of one watt.

Output Transformer Ratio

A centre-tapped transformer (marked T.2) is also required for the output feed to the speaker, since the anode-cathode circuits are also, in series, and the H.T. positive supply is applied to the centre-tap on the primary winding. In determining the step-down ratio of the output or speaker transformer, the method is exactly as for a single output valve, with the exception that the load impedance required is twice the optimum load for one of the valves. For example, if the two valves each have a rated optimum load of 6,000 ohms, the load to be considered in calculating the required step-down ratio is 12,000 ohms.

The two valves in push-pull are biased normally; that is, they are given the same bias voltage as if they were operating singly. This bias is sufficient to ensure that the valves will not pass grid current, which means that it is sufficient to keep the grid negative at the

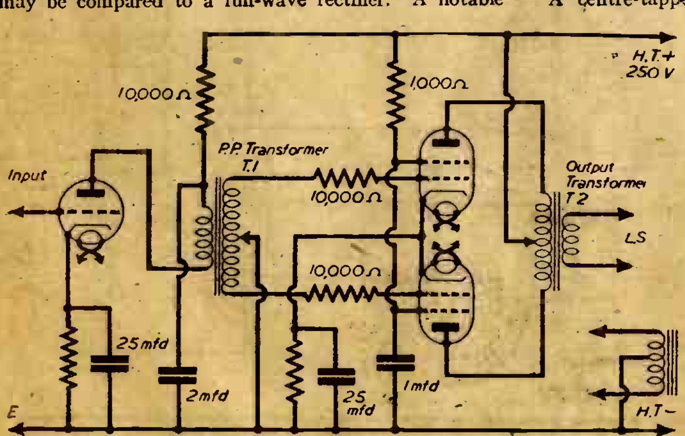

Fig. 1.—A tetrode push-pull stage following a triode amplifier. The latter may be the triode portion of a double-diode triode.

maximum positive audio-frequency half-cycle. In the circuit shown, the cathodes of the two tetrodes are connected together through a common bias resistor. In estimating the correct value for this resistor, the method is exactly the same as previously described for a single valve, except that the current passing through it is the total cathode current (anode plus screen current) of both valves. Thus, the resistance would be one-half of that required for one of the valves operating in the same conditions of anode and screen voltages.

It will be noticed that a resistor is included in each grid circuit. This may be described as a stopper, but its purpose is merely to "iron-out" slight differences in characteristics of the two valves. Thus, if the valves were accurately matched, the resistors could be omitted without affecting the operation of the amplifier in the slightest degree. The value shown (10,000 ohms) is not critical, but is generally found most satisfactory. Since, in the ordinary course of events, the resistors do not carry any current they can be of ½-watt rating.

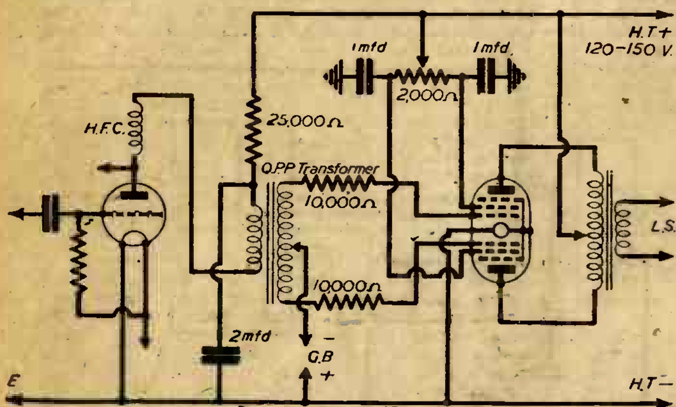

Fig. 3.—A Q.P.P. stage following a leaky-grid detector.

Class B Amplifiers

Class B amplification is invariably used with a pair of valves in push-pull, and there are two principal forms which it may take. In one of them, grid current is allowed, while in the other (generally described as quiescent push-pull or Q.P.P.) grid current is not allowed to flow. Because of this, reference is often made to "with grid current" and "without grid current" when referring to class B amplification. The forms of amplification previously described are described as class A, which indicates that the bias applied is such that the valve operates on the straight part of its characteristic, and is normally biased to a point near to the lower end of the straight part. There is another form of amplification which is becoming increasingly popular which is known as class A-B, due to the fact that the valves in push-pull are biased beyond the bottom bend of the characteristic, but not beyond the point of anode-current cut-off. In other respects, this form of amplification may be regarded as similar to ordinary push-pull.

We will consider first the best-known type of class B amplification, as used with twin-triode battery valves designed especially for this purpose, and which are for battery operation. The circuit is shown in Fig. 2, where it will be seen that the class B stage is preceded by a triode, which in this case is known as a driver. The twin-triodes are not biased, but have an impedance in the region of 10,000 ohms and pass a very small anode current until the grids become positive due to half cycles of audio-frequency input. An average figure for the "standing" or quiescent anode current of both triodes does not generally exceed 5 mA, and is often no more than half that figure.

Low Average H.T. Current

When the grids are supplied with an audio-frequency input, however, the current rises in proportion to the audio voltage. Thus, the anode current is proportional to the volume of reproduction provided by the speaker; if the volume level is low, the anode-current consumption is low; if it is high, the current is also high. In fact the peak current on the loudest note of a passage may reach as much as 30 mA. But the average current over a period would seldom be greater than about 12 mA. And since a valve of this type is capable of providing a maximum undistorted output of well over 1 watt, it will be seen that operation is very economical. That, in fact, is the chief advantage of class B.

In building an amplifier of this kind there are several points which require attention. The first is that, since the class B valve takes grid current, the driver valve must provide *power*—not merely voltage. This means that a small power valve (the driver) capable of an output of about 100 mW. is required. In turn, this means that the anode current of this valve will be not less than 5 mA when the output stage is to be fully loaded. Another point arising out of the fact that the class B valve passes grid current is that the secondary of the so-called driver transformer must have a fairly low D.C resistance. In practice, it is found that the secondary resistance should not exceed 300 ohms if serious power loss is to be avoided. The ratio of the transformer depends to a certain extent upon the particular class B valve chosen, but two-to-one (to each half of the secondary) is general. In order to determine the correct ratio of the output transformer, precisely the same method is followed as for ordinary push-pull.

Probably the greatest objection to class B is that it

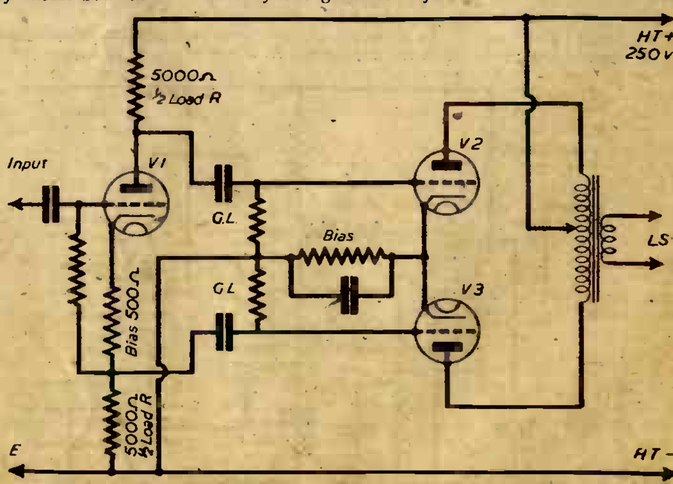

Fig. 4.—Outline circuit of a paraphase amplifier where valve V1 takes the place of a push-pull transformer, and acts as a phase-splitter, while V2 and V3 behave as normal push-pull valves. The valves shown are purely nominal, and are intended primarily to show that resistors of equal value are used in anode and cathode circuits.

has a tendency to produce a certain "shrillness" in the reproduction. More than this, there is often an audible "whine" if certain precautions are not taken. The difficulty may be partly overcome by fitting a condenser-resistor tone compensator across the output, as previously described in this series in respect of pentodes. A more suitable method is to connect a fixed condenser of about .02 mfd. across the secondary of the driver transformer, as shown in Fig. 2.

H.T. Supply for Class B

Despite the fairly low average value of high-tension current taken by a class B amplifier, the use of a low-capacity H.T. battery is not desirable. The reason for this is that the current drain varies over a wide range and fluctuates rapidly. In consequence, the D.C. resistance of the supply must be low; and resistance is lower when the cells forming the battery are of increased size. When using an eliminator, the rectifier must be of low resistance for the same reason. A valve rectifier is normally suitable, but when using a metal-oxide rectifier one of special low-resistance type should be chosen.

Also, because of the fluctuating H.T. current, it is not normally satisfactory to employ automatic grid bias, with which the bias applied is proportional to the current passing through a resistor in the H.T. negative lead.

Quiescent Push-pull

The chief advantage of Q.P.P. over class B is that a driver stage is not used, since grid current does not flow. This means that the total H.T. current drain may be rather lower than with class B. On the other hand, two pentodes or a twin (Q.P.P.) pentode may be regarded as a necessity for a battery amplifier. This type of valve is somewhat expensive to produce, especially since the two halves must be fairly accurately matched.

A Q.P.P. amplifier circuit is shown in Fig. 3, where the amplifier comes directly after the detector stage. There is little difference between this circuit and that shown in Fig. 1; the main difference is simply in connection with the bias voltage. This is sufficiently high to reduce the anode current of the twin pentode almost to cut-off in static, or no-signal, conditions. For an average valve of this type the static anode current for each pentode would be around 3 mA, while the peak current would be in the region of 10 mA. These figures would be expected when using an H.T. voltage of not less than 120 and a bias voltage of about 7.5. Different valves vary to a certain extent, and the makers' instructions should be closely followed.

The input Q.P.P. transformer would normally have a step-up ratio of one-to-three (to each half of the secondary), but ratios up to one-to-six may be used if the transformer is a well-made one with low winding self-capacity. In determining the ratio of the output transformer exactly the same method is adopted as for all forms of push-pull. Bearing in mind the usual anode-to-anode load resistance—around 30,000 ohms—it will be seen that a fairly high-ratio step-down transformer is required. A good component of low self-capacity is essential for optimum results.

In some cases it is found that the two halves of the valve can better be balanced if the screening grids are fed from a 2,000-ohm potentiometer, the slider of which is connected to H.T.+, as shown in Fig. 3. The grid-circuit resistors can often be dispensed with when this matching arrangement is used. Alternatively, it is often found sufficient to include a single resistor of about 25,000 ohms in the grid-bias lead from the centre-tap of the input-transformer secondary winding.

In general, conditions are similar to those for class B as far as automatic bias is concerned, but it is possible to use this form of bias if maximum undistorted output is not required. That is, if the valve is not fully loaded. The maximum undistorted output is generally between 1.0 and 1.5 watts, which is similar to that of a class B stage.

Paraphase Amplifiers

Another system of push-pull is that known as paraphase amplification. Its most obvious difference from the forms of push-pull already considered is that it operates without the need for an input transformer. Instead, a valve is used for "phase-splitting"; that is, for providing for the application of a positive half-cycle to the grid of one valve while a negative half-cycle is applied to the grid of the other. A simple form of paraphase circuit is shown in Fig. 4, from which the first principles will be clear. Further details of this useful system of amplification will be given in the next article of this series.

High Voltage

High Voltages are Often Present in Mains-operated Sets and Amplifiers, and Here is a Little Advice for the Inexperienced

WHAT is a high voltage? From the point of view of danger to life the answer must depend to a great extent on the susceptibility of the victim to electrical shock. Also the state of health and the skin, whether dry or damp from perspiration or other causes, has a lot to do with it.

The fact that persons have been electrocuted through tampering with mains receivers, draws attention to the potential danger of such equipment when not approached in the correct manner. The following advice is therefore offered in the hope that it will prevent accidents.

In the case of home-built apparatus, the receiver and its wiring should be so arranged as to eliminate the risk of shock. A carelessly built mains-operated receiver or amplifier is a source of danger to all who handle it. Beware particularly of grub screws in knobs, if the spindle of the component is "alive," which is bad practice to begin with. Remember that the chassis of an A.C./D.C. set may be alive with respect to earth, and that the same can also apply to the *aerial*.

Don't touch any of the components without first switching off the current, unless you know positively what you are about, even then it is safer and wisest to switch off. When the mains are switched off, it is still possible to sustain a nasty shock from charged condensers, so it is as well to discharge them by shorting the terminals with a screwdriver having an insulated handle before making adjustments, or otherwise tampering with the circuit. If you must make an adjustment while the set is in operation, *keep one hand behind you*. This prevents you from receiving a shock from one hand to the other, or, in other words, from providing a path across the body and heart, which is likely to be most severe.

If you are inexperienced in the servicing of mains receivers, always have someone with you when tackling them. You should also make yourself familiar with the first aid treatment for electrical shock. It may enable you to save a life in such circumstances.

Don't attempt to hurry too much if a companion is unable to extricate himself. Act *quickly* but not without deliberation, or you may be in as bad a fix as the person you are trying to help. Do not touch the victim with your bare hands if he is wet. Try to grab him by a fold of loose clothing, or throw a dry rug or blanket over him and then remove him. Switching off the voltage is simpler, and should be done where possible; but rather than run around looking for the switch it may be quicker to pull the person from the points of contact.

I hope I haven't given the impression that a wireless set is a highly dangerous article. It isn't. But so long as fools rush in where angels fear to tread there must inevitably be some risk.—W. M.

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

RECORDINGS of the great Toscanini conducting Beethoven's 1st, 3rd, 4th, 5th, 6th and 7th Symphonies, on H.M.V. records already are available, and with the latest releases the completion of the whole nine is brought a stage nearer. The new records to which I am referring are *H.M.V. DB*6160-2, which consist of superb recordings of the N.B.C. Symphony Orchestra—conducted by Arturo Toscanini—performing the "little symphony" as Beethoven so often called it, or as it is more generally known, "Symphony No. 8 in F Major (Op. 93)." There are three records, the first being the 1st Movement—Allegro vivace e con brio—the second, the 2nd and 3rd Movements—Allegretto scherzando—and Tempo di Menuetto respectively, while the last record completes the symphony with the 4th Movement—Allegro vivace.

The Boston Promenade Orchestra—conducted by Arthur Fielder—have made a fine recording of "Dances from Glanta," which were composed for the 80th Anniversary of the Budapest Philharmonic Society, 1934, by Zoltan Kodaly.

The dances, which although composed as separate numbers, run on continuously, and they possess some rather beautiful melodies. At times, the music reaches what I can only describe as a whirling pitch of excitement; this is particularly noticeable near the end, when the tempo reaches its peak, and then there is a sudden cut-off—silence—and once again the binding theme, which links all the dances together, leads up to a striking close. The Boston Promenade Orchestra give an outstanding performance of this melodious and exciting music. *H.M.V. C*3367-8 (two records).

To complete my selection of 12in. H.M.V. records, I recommend *C*3369, which consists of two recordings which in their class rank with those mentioned above for perfect performances and artistry. On one side, that charming soprano Gwen Catley, with the Hallé Orchestra under the baton of Warwick Braithwaite, sings "Dearest Name" (Caro nome) from "Rigoletto" (Levy-Verdi). On the other side, Webster Booth (tenor) and Dennis Noble (baritone) render "In a Coupe" (Ah! Mimi, false, fickle-hearted) from Act 4 of "La Boheme" (Pinkerton-Puccini), also with the Hallé Orchestra and Warwick Braithwaite.

I have five 10in. H.M.V. records to bring to your notice this month, the first being by "Hutch" (Leslie A. Hutchinson), who has recorded "You Happen Once in a Lifetime" and "Pale Hands" (Kashmiri Song), which is featured in the film "Hers To Hold." These two numbers are on *H.M.V. BD*1060.

The New Mayfair Orchestra has made two good recordings on *H.M.V. BD*5820, from "I Love to Sing," which is featured in the film "Rhythm Serenade," and "Close to You," both with vocal refrain.

Ivy Benson and her Girls' Band have selected "The Home Coming Waltz" and "We Mustn't Say Good-bye"—waltz and foxtrot respectively, for their two numbers on *H.M.V. BD*1061. These are two good tunes well orchestrated and played, and Ivy herself takes a turn at the saxophone in each recording.

Glenn Miller and his Orchestra put up a fine show with "Melancholy Lullaby"—foxtrot—linked with "Blue Moonlight," which is in the same tempo. Nice numbers for dancing. *H.M.V. BD*5822. In the Swing section, I have selected one which I feel sure will have a wide appeal to all swing fans. It is *H.M.V. B*9349 (Nos. 545 and 546 of the Swing Music Series, 1943), the numbers being "Oh! Lady Be Good"—featured in the film "Lady Be Good," and on the other side of the disc is "Rose Room." They are played by Sidney Bechet and his New Orleans Feetwarmers, and "Pops" Bechet warms things up considerably with some of his famous vibrato playing.

Columbia

TO open up my selection of Columbia records for this month I have chosen one by The Columbia Broadcasting Symphony Orchestra, conducted by Howard Barlow, for the outstanding recording they have made of "The Bartered Bride—Three Dances"—Smetana. The music, in keeping with the entrancing airs and gay rhythm of the Bohemian folk tunes in which the score of the opera is rich, is lively and its rhythm infectious. The Three Dances consist of 1, Polka, 2, Furiant—characterised by alternating rhythm and increasing tempo—and 3, the rather quaint Dance of the Comedians. *Columbia DX*1130.

Outstanding amongst contemporary singers of Negro spirituals is Rowland Hayes, one of America's greatest Negro tenors, who returned to this country a few weeks ago to lead a choir of 200 Negro soldiers of the U.S. Army at the Albert Hall. I say returned to this country, as he was over here in 1921, when he took London by storm and was commanded to sing before the King and Queen. Columbia have just released *DX*1132 which contains fine recordings of Rowland Hayes giving a perfect rendering of "Hear De Lambs a-Cryin'" and "Plenty Good Room." both Negro spirituals, and, on the other side of the record, "Were You There," a spiritual unaccompanied.

Although the subject is different, this is a fitting place to introduce another great Negro singer, namely, Paul Robeson, who, on *Columbia DB*2125, makes his Columbia debut by recording two popular Russian ballads, "Song of the Fatherland" (Land of Freedom) and "Song of the Plains" (Red Army Song), in English and Russian. Both of these songs are stirring and virile and Robeson, with his rich, finely-controlled bass-baritone voice, makes the most of them and gives us two recordings perfect in every detail.

"Caprice Italien," Part 1 and 2, is the title of *Columbia DB*2126, which takes the form of a piano duet by those famous and gifted ducttists, Rawicz and Landauer. Tschaikowsky's composition is, in itself, very delightful, but its charm is enhanced by the skill and interpretation of these two very popular artists.

A record which I recommend to all, for good light entertainment, is *Columbia DB*2127. It is by that ever-popular and polished comedian, Jack Buchanan, who sings two of his numbers from "It's Time to Dance." They are entitled "I'm Looking for a Melody" and "Everything Happens to Me," and the accompaniment is provided by the Winter Garden Theatre Orchestra, conducted by George Windeatt. Jack is a master of light comedy and his latest record is simply top-notch.

Monte Ray has selected "Star of Love" and "O Lovely Moon" for his recording this month on *Columbia FB*2963. Two good songs, well presented.

Carroll Gibbons and the Savoy Hotel Orpheans have made a fine record out of "I Left My Heart at the Stage Door Canteen," linked with "There's No Two Ways About Love," both being foxtrots. Recommended for dancing, the number being *Columbia FB*2967.

"If You Please," which is featured in the film, "Dixie," and "There's a Ship Rolling Home," form the selection of Jimmy Leach and the New "Organolians," with H. Robinson Cleaver at the Hammond Organ and Rita Williams taking the vocals. These are on *Columbia FB*2969.

Parlophone

I USUALLY top my Parlophone selection with Richard Tauber's latest record, and I am making no exception this month, as his two latest recordings have particular appeal. They are "The Post," with piano accompaniment by Percy Khan, and "To Music," with String Sextet, both songs being sung in English. *Parlophone RO*20525.

(*Continued on page 85.*)

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Open to Discussion

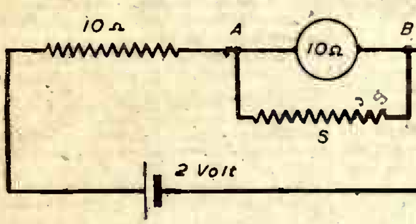
The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Radio Exam. Papers

SIR,—In connection with the answer given to question number 6 in the Radio Examination Papers 24 (November issue), I think, that your contributors have omitted to mention the fact that the method quoted of obtaining the value of an ammeter shunt when the instrument resistance is unknown, is only an approximate one which might give rise to serious error in some cases.

Referring to the answer mentioned, it will be seen that to obtain a shunt to give double scale readings, an unshunted reading is halved by addition of a suitable shunt, and the assumption tacitly made that the original current flowing remains unaltered. This assumption, however, is a false one, as the addition of a shunt resistance must lower the total resistance, and hence increase the current. Thus if an original reading of 10 mA's were halved by a shunt, the current would become some value in excess of 10 mA's, but on an adjusted scale the shunted instrument would read 10 mA's and would therefore be in error. The magnitude of the error would depend on the instrument and the particular scale change involved, but would always be present.

I would suggest that the only safe way to shunt an instrument when its resistance is unknown and cannot be measured, is to find the value of the shunt by trial



Circuit used by Mr. A. J. Croft to illustrate the points raised in his letter.

and error with a true reading instrument of appropriate F.S.D. in series.

The sketch and notes given indicate how serious the error may be in a particular case.

Let an instrument resistance 10Ω, F.S.D. 100 mA's be supplied with 100 mA's from a 2 volt cell, their series resistance needed is:

$$\frac{2}{.1} - 10 = 10\Omega$$

so that total resistance is 20Ω.

Now let a shunt S ohms halve the reading, then the current through the instrument is 50 mA's = .05 amp. The diagram now represents the state of affairs.

$$\text{Then total resistance} = 10 + \frac{10S}{10+S} = \frac{100+20S}{10+S}$$

$$\text{and} \therefore \text{total current} = \frac{2}{\frac{100+20S}{10+S}} = \frac{20+2S}{100+20S} \text{ amp.}$$

but current through instrument = .05 amp., and

$\therefore$ P.D. on AB = 10 × .05 = .5 volt

$$\therefore \text{current through } S = \frac{.5}{S}$$

$\therefore$ since total current is the sum of that through S and that through the instrument:

$$\frac{20+2S}{100+20S} = .05 + \frac{.5}{S}$$

$\therefore$ $20S + 2S^2 = 5S + S^2 + 50 + 10S$

$\therefore$ $S^2 + 5S - 50 = 0$

$\therefore$ $(S-5)(S+10) = 0$

$\therefore$ S = 5 (rejecting the negative root).

$\therefore$ Shunt resistance is 5Ω

Hence total current now becomes:

$$I = \frac{2}{10+\frac{10\times5}{10+15}} = \frac{2}{10+\frac{50}{15}} = \frac{2}{13\frac{1}{3}} = .15 \text{ amp.}$$

So that for an adjusted scale reading of 100 mA's the actual current flowing is really 150 mA's—A. J. CROFT, (Menai Bridge).

THE EXPERIMENTERS reply:

"You are correct in what you write, but you do not follow the requirements of the question as put; always a mistake in an examination.

"One would hardly be likely to connect a milliammeter of unknown resistance across a two-volt cell with only a 10-ohm resistor in series. If that *were* done, as you propose, the resistance of the meter would be obvious. There would then be no necessity to adopt the expedient described in our reply and the question would be without point.

"In radio work, a milliammeter is almost invariably connected in a circuit which includes a relatively high value of resistance. For example, if a meter were used to measure the anode or cathode current of a valve of, say, 15,000 ohms internal resistance the total resistance in series with the meter (internal resistance plus anode load resistance) would lie between about 16,000 and 75,000 ohms, according to the form of coupling used. In such a case, the meter resistance is always—and quite rightly—ignored, since it is a negligible part of the total circuit resistance.

"It will be seen that in our reply we stated that the meter should be connected in series with a *battery* and a resistor. Even if a G.B. battery of only 9 volts were used, the series resistance would be approximately 2,000 ohms. Consequently, the inaccuracy involved when shunting a typical 50-ohm meter with a resistance of 50 ohms in order to double the full-scale reading would be little more than one per cent. And a meter of such quality that it was not marked with its resistance would not read to such a high degree of accuracy as that. If it did, a finely-calibrated scale would be called for—and a good magnifying glass would be necessary when reading it!

"The suggested alternative method of calibration would be quite satisfactory *if* a 'true reading instrument of appropriate F.S.D.' were available. But how many readers have such an instrument in addition to the less expensive one to be shunted?

"If you had suggested that it might have been better to qualify the word 'battery' in our reply by making it an 'H.T. battery' we should not disagree."

B.O.T. Selling Licences

SIR,—Many small practical wireless dealers are debarred from selling radio parts because they have been unable to obtain appropriate licences from the

Board of Trade. This position is brought about by the opposition of larger established dealers who oppose all applications for licences.

These small practical men give not only satisfactory service, but their personal attention to the requirements of their customers. The large dealers in components generally have no practical knowledge of wireless repairs. They are simply sellers of new valves and other parts, and do not want to service their customers' sets.

The position is, that a practical man who is willing to repair sets is debarred from selling new valves and other parts over the counter to his customers who want to repair their own sets, whilst another trader who does not want to do repairs can sell new valves and parts over the counter because he holds a Board of Trade licence. When the first trader applies for a licence his application is opposed by the second trader, usually successfully.

On account of this a large number of anomalies have arisen, and some strong action should be taken to get the position reviewed.—J. W. LISTON (Manchester).

SIR,—I note with some satisfaction in the editorial of the December issue of your very excellent journal a timely castigation of a very undesirable element that is insinuating itself into the field of radio repairs. Unfortunately, however, your remarks are hardly likely to reach the eyes of those to whom it is of most concern, as they do not appear to be the type to which a technical journal such as yours will have much appeal. To put it mildly, these people are no more nor less than sharks of the worst order, preying on an ignorant yet at the same time financially attractive public. It would not be so bad if these mushroom repair organisations were to put some good material into the work for which they so glibly charge such fantastic prices, but as far as I can see, so long as they can get a set to function long enough for you to hear it going in the shop, they are quite content, and should anything subsequently go wrong, due to faulty components that they have supplied, no claim can be made against them, as they appeared all right when you left the shop.

Surely there could be the same periodical checks made by the Board of Trade on those firms to whom they have issued repairing licences, as the Ministry of Food and local Price Regulating Committees conduct on establishments under their control.

However, you ask for details of specific experiences, so here is my tale.

Just over nine months ago while changing a very worn resistance cord on an American midget receiver for one rather less frayed, I got the connections mixed, and when I switched on I blew the rectifier (25Z6). This, however, I only suspected at the time as the filament was still intact, but I had seen some sort of a blue flash from that valve. I took the set to a firm in Holloway to be repaired, including the fixing of a new line cord. The following week I called for it, only to be told that three of the valves were blown, that they (25Z5, 25A6, 6K6) were completely unobtainable, and that I had better shelve the set until after the war. I knew that all the filaments were intact so I had all the valves tested separately at another shop, at which I was told that only the 25Z6 was blown.

Being on D.C. at home (Highgate) I decided to see if the set would work there, but before connecting up I thought it just as well to glance underneath the chassis to see that all was in order, and lo! the electrolytic block condenser (32 x 8 mfd.) was missing. I took the set back to the Holloway firm, demanded an explanation, but the only satisfaction I could get was that it must have been faulty anyway, and the man who had done the job had just been called up. They could find no trace of the missing part in the shop. However, they undertook to repair the set, providing that I could obtain a new 25Z5. About three weeks later I took this valve to them, and then called in fairly regularly each fortnight only to be told on each occasion that they had not yet been able to get a condenser small enough to fit into the set. After about four months I called in a shop that had just opened at Paddington, and inquired whether they had a midget 32 x 8 mfd. condenser. Certainly they had, but they were very sorry the B.O.T. did not allow them to sell components over the counter, but if I would bring along my set they would fix it. So a few days later I transferred the set to the latter firm, who were to fix a new line cord as well as a new condenser. About ten days later I called in for the set, and to my great joy it was functioning again after some five and a half months of silence. How much would that be, please? Two pounds fifteen shillings. Now this needed a little closer investigation, so I asked for a more detailed account, whereupon the man, taking a look at the set from the back, started off—there is one new valve, two new condensers and a new line cord. On pointing out that the new valve was my own he proceeded to make out a fresh itemised bill on the back of the one he had just given me. Line cord, 9s.; 2 condensers at 9s. 1d. each, 18s. 2d.; time, 5s.; total, £1 16s. 2d. This sum I paid, not noticing until I got home that the arithmetic was not all that it might have been. So in the afternoon I called back and got a 4s. refund. About a month later the receiver went wrong again, and so it remains to this day, with great suspicion falling on the 8 mfd. condenser which I suspect of intermittent shorting.

Now, while fully appreciating the needs of priority services, I do think that if components are to be made available for the use of the public, they should be capable of being purchased over the counter by someone desiring to carry out his own repairs. Of course, some form of control may be necessary to prevent abuse of these facilities, perhaps something similar to the signing of the poisons book when buying dangerous drugs at a chemist's shop.—D. M. MONTGOMERY (Paddington, W.2).

Impressions on the Wax

(Continued from page 82.)

The Organ, the Dance Band and Me, or, in other words, Billy Thorburn (piano), H. Robinson Cleaver (organ) and Helen Clare (vocalist), play (and sing) "What Do You Think These Ruby Lips Were Made For" and "Say a Pray'r for the Boys Over There," both foxtrots, on *Parlophone F*1997. A good record, with a pleasing style and orchestration.

"Tin Pan Alley Medley—No. 58," on *Parlophone F*1992, introduces a fine selection of popular melodies, including "Comin' In on a Wing and a Prayer," "Take It From There," "Better Not Roll Those Blue, Blue Eyes," "You Rhyme With Everything That's Beautiful," "With All My Heart," and "Sunday, Monday or Always." As usual, Ivor Morton and Dave Kaye, on two pianos, with string bass and drums, put up a very good performance.

Harry Parry and his Radio Sextet, in The 1943 Super Rhythm-Style Series, No. 114, offer us, in their inimitable style, "Rosetta" and "Ida, Sweet as Apple Cider," on *Parlophone R*2889.

Regal

REGINALD DIXON, at the organ, has recorded this month "Dixontime (No. 16)" on *Regal MR*3713, in which he introduces "Johnny Zero," "Comin' In on a Wing and a Prayer," "Silver Wings in the Moonlight," "If You Please," "You'll Never Know," and "In My Arms." It is a fine record.

The Black Dyke Mills Band, conducted by A. O. Pearce, contribute "The Impresario—Overture" and "Rendezvous—Gavotte," on *Regal MR*3714, and I recommend it to all who enjoy a good brass band of undoubted ability.

Harry Roy's supporters will welcome *Regal MR*3716, as this is the latest recording by Harry Roy and his Band; and it consists of "There's No Two Ways About Love" and "Sunday, Monday or Always," which Harry and his boys play with all the style, gusto and rhythm for which they are noted.

Replies to Queries

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons :—

(1) Supply circuit diagrams of complete multi-valve receivers.

(2) Suggest alterations or modifications of receivers described in our contemporaries.

(3) Suggest alterations or modifications to commercial receivers.

(4) Answer queries over the telephone.

(5) Grant interviews to querists.

A stamped, addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

Requests for Blueprints must not be enclosed with queries, as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The coupon on page iii of cover must be enclosed with every query.

Mazda A.C/P.1 Matching

"I have a Mazda A.C./P.1 super power valve, and would like to know the resistance needed in the anode circuit. I am using an output transformer with a 9,000Ω primary. Is this suitable?"—H. G. D. (Leeds).

THE Mazda A.C./P.1 super power valve has an optimum load of 10,000 ohms. The D.C. resistance of the primary of the matching transformer does not bear a direct relation to the optimum load, as one is more concerned with the reflected impedance or resistance of the primary, which is imposed on it by the loading in the secondary circuit, i.e., the impedance of the speech coil and the ratio of the transformer.

Service Oscillator

"In your issue of June, 1943, you published details of a Service Oscillator, by S. Brasier.

"I am constructing this unit and would like to make it an A.C./D.C. job. Shall I be correct in assuming that the only alterations necessary would be a universal mains unit instead of the present A.C., and a condenser to break the coupling coil junction (and earth) to the centre tap of the tuning coil and negative line?

"Are there likely to be any snags?"—T. M. (Swindon).

THE designer of the instrument has not tried an A.C./D.C. version, but we see no objection in the circuit being modified provided reasonable precautions are taken in the smoothing of the H.T. line and wiring of the heaters.

We assume that you intend using high voltage filament valves and connecting the filaments in series in the usual A.C./D.C. manner. It would be advisable to insert a condenser having a capacity of .0001 mfd. in series with the R.F. output lead and another condenser of .05 mfd. capacity between the chassis and the actual earth.

Incorrect Readings

"I have an Ekco A.C.12 eliminator. The H.T. + should be 120/150 volts, and there is a terminal for 70/80 volts and one for screen-grid. The voltage as measured by a voltmeter is 70, 30 and 30 respectively. Can you tell me any way I can get the correct potential from the eliminator?

"Also, can you suggest a good form of aerial for short-wave reception which can be erected in the roof of the house?"—J. L. B. (East Ham).

IT would appear that the voltage readings were taken with a voltmeter having a low resistance as this would account for the misleading readings obtained. If it is possible for you to make fresh measurements with a meter having a resistance of, at least, 1,000 ohms per volt, we would advise you to do so as we think you will find that the voltages are slightly above those specified by the makers when no load is being imposed.

The type of aerial which can be erected in the roof of a house is governed to a great extent by the layout of the house and the space available. In the majority of cases, however, a good inverted "L" type of aerial is usually most satisfactory. The horizontal portion can be erected under the roof and the down-lead brought out under the eaves and down the side of the house provided it is kept, at least, two to three feet away from the wall.

Overheating

"I had a mains transformer rewound recently. After I had it assembled in the receiver I switched on, and almost immediately the transformer started to buzz and vibrate; two or three minutes later the grease started to run out from the windings. On touching the transformer I found that it was boiling hot. Could you please tell me what is wrong?"—R. F. (Glasgow).

THE fact that a pronounced buzzing noise was produced when the mains transformer was brought into circuit indicates that the laminations were loose and that they were vibrating within the winding bobbin. If the winding became very hot it is quite possible that the insulation between one or more layers of winding has broken down.

It would also be advisable to test for any leakage between primary and secondary sections and the frame of the transformer. If the component was rewound locally perhaps it would be possible for you to have it tested.

Medium-wave Coil

"I have just completed a normal 3-valve straight, consisting of a V/M R.F. amp., triode det. and a tetrode output.

"In both aerial and R.F. amp. circuit I am using tuned grid, but due to the fact that I cannot obtain the right amount of inductance my selectivity is very poor and, consequently, the main tuner acts as a bandspreader.

"What I require are the turns for the aerial coil, grid and aerial and H.F. coil, anode and grid. Also the position of the first coil on the former relative to the second, using 1in. diameter former and 38 S.W.G. enamelled wire."—Sgt. D. (R.A.F.).

USING a 1in. former and a .0005 mfd. tuning condenser you will require approximately 100 turns of 38 S.W.G. enamelled wire for the grid winding. The aerial coupling coil can consist of, say, 40 turns of the same wire, but the actual number is best determined by experiment as it governs not only the sensitivity of the receiver but also the selectivity. The same applies to the primary winding for the H.F. stage.

It is best to cover the centre of the grid coil with one or two layers of insulating material such as Empire cloth, and wind over that the primary winding.

Pick-up Tracking

"Could you please tell me the correct way to set a pick-up regarding needle tracking. Should the needle point touch centre of turntable spindle?

"I have tried fixing pick-up in different places, have had vibration noises of needle, and scraping noises through speaker, but clear reproduction in either case.

"Also, which is the best pick-up connections, grid and earth, or grid and grid bias?"—W. McG. (Coventry).

TO secure correct tracking of the tone-arm, it is necessary to see that the needle in the pick-up rests on the centre of the turntable spindle when at its innermost point of travel.

One or two experiments should be made before screwing down the base of the tone-arm to try and secure a position which will produce the above and allow the pick-up head to keep at right-angles to the sound track on the record during the whole of the playing period.

It is sometimes necessary to return one side of the pick-up to a low value of negative grid bias; the actual value must be determined by experiment as it depends on the type of valve in use.

Car Radio Receiver on A.C.

"I have a car radio, Crossley make, which I would like to use off the electric main A.C. supply. It is a 6-volt supply set; could I by using an ordinary mains transformer and correct smoothing do this? At present it is fed by a 6-volt vibrator, transformer, and a full-wave rectifier 6X5. If you could supply me with a suitable circuit I would be very much obliged as I could then use the set in my hut."—W. S. R. (R.A.F.).

IT is not sufficient to use a mains transformer to feed the input to the car radio receiver. The input must be D.C., therefore it will be necessary to employ some form of rectifier in conjunction with the mains transformer to convert the A.C. supply to D.C.

A better arrangement is to use a 6-volt accumulator and to keep the accumulator fully charged by means of a small L.T. charger, which is simple to construct and economical in operation. Messrs. Westinghouse Brake & Signal Co., Ltd., of Pew Hill House, Chippenham, Wilts, can supply details of suitable metal rectifiers in their handbook, entitled "The All-Metal Way," price 3d.

COULPHONE Radio, New Longton, Nr. Preston. New goods only. Tungsram valves. English and American Rectifiers 10/6. Mains Transformers : 350 v. 100 m.a., 4 v. 6 a., 4 v. 2½ a., 32/6 ; 350 v. 120 m.a., 6.3 v. 3 a., 5 v. 3 a., 33/6. Rola P.M., less transformer, 5in., 20/- ; 6½in., 22/- ; 8in., 24/- ; 10in., 29/6. 8in. Celestion P.M. with Transformer, 30/-. Cored solder, 4/6 lb. Tinned copper wire, 2/3 ½lb., 2 mm. systoflex, 3d. yd. Barretter resistors, 6/-. Line cord replacement resistors, 800 ohm. 2 adjustable tappings, 6/9. Parafeed L.F. Transformer 4 : 1, 5/- ; 50 mfd. 12 v., 2/- ; 25 mfd. 25 v., 2/-. Erie resistors, 1 watt, 9d. ; ½ watt, 6d. ; ¼ watt, 4d. Pushback wire, 100ft., 6/-. Switch cleaner, 2/3 bottle. Power Pentode Output transformer, 7/6. Bell transformer, 6/6. Valveholders, 1d. per pin. Stanelco electric soldering irons, 21/-. Tubular and silver mica condensers, all sizes. Volume controls with switch, 5/9. Less switch, 4/9. 450 watt iron elements, 2/3. S.A.E. for stock list.

SOUTHERN RADIO'S WIRELESS BARGAINS

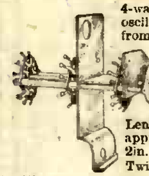
SCREWS and Nuts, assorted gross of each (2 gross in all), 10/-.
SOLDERING Tags, including Spade Ends, 6/- gross.
PHILCO 3-point Car Aerials, excellent for short-wave and home aerials, 7/6.
LIMIT Tone Arms, universal fixing for all types of Sound Boxes and Pick-up Heads, 10/-.
ACE "P.O." Microphones, complete with transformer. Ready for use with any receiver. 7/-.
CIRCULAR Magnets, very powerful, 1½in. diameter by ⅜in. thick, 1/6 each, 15/- per doz.
ERIE Resistances. Brand new, wire ends. All low value from .8 ohms upwards. A few higher value are included in each parcel, ¼, ½, 1 and 2 Watt. 100 resistances for 30/-.
MULTICON Master Mica Condensers, 28 capacities in one from .0001, etc., etc., 4/- each.
SPECIAL ASSORTED PARCEL FOR SERVICE MEN
100 **ERIE** resistances (description above), 24 assorted Tubular Condensers ; 6 Reaction Condensers, .0001 ; 12 lengths Insulated Sleeving ; 75ft. Push-back Connecting wire ; Soldering Tags, Screws, Wire, etc., 65/-. All brand new.
CRYSTALS (Dr. Cecil), 6d., with catswhisker, 9d. ; complete crystal detectors, 2/6 ; 75ft. wire for aerials, etc., 2/6 ; 25 yds. Push-back wire, 5/- ; Telsen Reaction Condensers, .0001, 1/9 each ; Telsen large disc drives, complete with knob, etc. (boxed), type W 184, 2/6 each ; Insulated sleeving, assorted yard lengths, 3/6 doz. ; single screened wire, doz. yards, 10/-.
LOUD Speaker Units, unshrouded, Midget type, 4/- ; Metal case condensers, .1 + .1 + .1, 2/6.
POWER Rheostats, Cutler-Hammer, 30 ohms, 4/6 each ; Pointer Knobs, instrument type, ¼in. spindle hole (Black or Brown), 1/- each ; Push-button Switches, 3-way, 4/- ; 8-way, 6/- (complete with knobs) ; Bakelite Escutcheon Plates for 8-way P.-B. Switches, 1/6 ; Hundreds of other Bargains.
SOUTHERN RADIO SUPPLY CO., 46, Lisle St., London, W.C. Gerrard 6653

FRED'S RADIO CABIN

BRAIDED SLEEVING, 2 m.m., 6d. per yd. length, 5/6 doz. ; 3 m.m. 8d. yd. length, 7/- doz.
PLUGS AND JACKS complete 3/6.
COPPER WIRE, TINNED, 18, 20 gauge, 1/- ¼lb. reel.
T.C.C. CONDENSERS, .1 mfd. 5,000v. wkg. 5/6.
CLIX, 2-pin 5 amp., plugs, 8d.
TWIN TRIMMERS, ceramic 250 m.mfd., 6d. each, 5/- doz.
COPPER WIRE, heat resisting, 6d. coil.
PAXOLIN PANELS 9in. x 6in. x ⅛in. 2/3 each.
CONDENSERS, straight, 3-gang, large spindle, 2/6 each.
MAINS DROPPERS, 0.2 amp., 3/6, .03 amp., 4/6.
PUSH BUTTON UNITS, 7-way, 2/9, 8-way, 3/-, 9-way, 3/- ; knobs, 2d. each.
CONDENSERS, "Plessey" 4-gang screened 6½in. x 3½in., 4/6.
"HENLEY" Electric Soldering Irons, new. Straight bit, 13/6 each. Pencil Bit 14/6 each. Resin-cored solder, 4/- lb. reel.
T.C.C. TUBULARS, brand new, 25 mfd., 12v. ; 50 mfd., 12v., 1/3.
SOLDER, 1lb. reels, fine all-tin instrument solder, 3/6 lb., or ½lb reel, 1/-.
Postage must be included. No C.O.D.
FRED'S RADIO CABIN FOR BARGAINS, 75, Newington Butts, S.E.11. Rodney 2180.

LONDON CENTRAL RADIO STORES

YAXLEY TYPE SWITCHES



4-way, 3-bank, with shielded oscillator section. Length from stop plate approx. 5in., spindle 2in. **6/-**
5-way, 6-bank with 3 screened sections, adaptable to many uses. Length from stop plate approx. 6½in., spindle 2in. **7/-**
Twin bank, 4-position, with screw **5/-**
Oak Switches, 2½in. spindle, comp. with knob, 4-way, 2-bank with connecting block **5/3**
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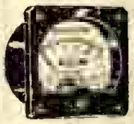

Ferranti moving coil milliammeters. 0–5 milliamps. Panel mounting, size 2 3/16 × 2 3/16. A fine instrument, brand new, and packed in original cartons **63/6**

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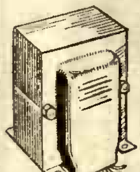

Brand new well made heavy duty mains transformers. Exceptionally robust. 200/250 v. A.C. 50 v. 1 Phase. 400-0-400 v., 250 m.a. 4 v., 5 a., C.T., 4 v. 2 a., C.T., 2 v. 2 a., 4 v. 3a. Size 4½ × 5 × 3½ deep Weight 12 lb. **59/-**
200/250 v. A.C. 1 Phase 300-0-300 v., 250 m.a., 4 v. 5 a., 4 v. 2 a. Size 4½ × 4½ × 3½. Weight, 10 lb. ... **46/6**

No Extra Charges for Postage, etc.
See also our classified advertisement on p. 87.

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REWINDS.—Mains and Output Transformers Field Coils. Pick-up Heads—Promptly executed. Phillips D.C. Converters bought, sold, exchanged. Valves, B.V.A. Brand new, good selection. Send S.A.E. for price list.—A.D.S. Co., 261-3-5, Lichfield Road, Aston, Birmingham, 6.

FOR SALE.—4 four-pin S.W. coils, 11-180 metres ; one .0001 mfd. ; one .00015 mfd. condenser ; one S.W. choke ; 17/- the lot.—Wilkinson, School House, Gt. Preston Woodlesford, Leeds.

RADIO Operators. Unique postal course for 1st or 2nd class Certificates with occasional optional attendance. North London, 2 minutes station. — BCM/Radioperts (3) W.C.1.

MORSE made easy using the "Autocode" Designed by Professional Telegraphist. You make it yourself from simple instructions. Drawings and templates supplied. Send 3/- (to include postage, etc.) and receive the Autocode Manual.—Hardy BCM/HAFT, London, W.1.

MAKE your own Table Model Torch Battery Cigarette, Pipe and Fire Lighter from easily obtainable materials. Cost about 4/6. Reliable and fool-proof. Lasts 6-8 months. Very saleable. Well tested diagrams and clear instructions, 3/-. Element included Free.—W. Barham, "Hilltop," Bradmore Green, Coulsdon, Surrey.

WANTED.—Premier S.W. S.G. 3 Batt. Kit or Assembled.—D. Allsop, 31, New Street Halesowen, Nr. Birmingham.

VALVES.—Include CY1, URIC, 1A7G, IN5G, 1H5G, IC5G, R2, PenA4, MKT4, 25Z6G, 5Z4G, U50, AC2PenDD, Pen4DD, 80, S.A.E. for inquiries. C.O.D. orders accepted.—L. W. Lawrence, Station Street, Saffron Walden, Essex.

MIDLAND INSTRUMENT CO. offer **PRESS BUTTON UNITS**, midget 5-way electrical, with buttons, 2/6 ; ditto, less locking device, 1/6.
TAYLOR METER type, insulated plug and socket sets, red and black, 1/- pair, 10/- doz. pairs.
POTENTIOMETERS, high-grade wire-wound 5-watt, 5,000 and 20,000 ohm., 5/- each.
INSTRUMENT WIRE, 22-s.w.g. D.C.C., 4/6 lb. ; 26-s.w.g. D.C.C., 5/- lb. ; 25-s.w.g. S.C.C., 3/6 lb. ; 30-s.w.g. S.C.C., 4/- lb. Smaller quantities 3d. extra pro-rata. Reduction for quantity.
ROTARY SELECTOR SWITCHES, 4-way, 4 M. and B., small, fitted pointer knob, 2/-.
PRESS BUTTON SWITCHES, twin s.p.d.t., bakelite enclosed, 2/-.
CRYSTAL SET KITS, all parts circuit, etc. (less box) for constructing an highly efficient set, 6/6.
CRYSTAL DETECTORS, adjustable vertical type unmounted, 1/3, 12/- doz. Genuine Russell's Hertzite Crystals with 6 spear-point Catswhiskers, 9d.
ELECTRO-MAGNETS, 1st quality 3-ohm single, 9d. ; 7/6 doz. Twin, 1/6 ; 15/- doz.
TELEPHONE BELL BOXES, G.P.O. type, consists of A.C. bell, microphone transformer and 2 mfd. condenser in teak box, 7/6.
SPARK COILS, 50,000 volt, ½in. spark, fitted trembler, adjustable gaps, 6-volt working, bargain, 12/6 each.
TERMINALS, brass telephone type, 4 B.A., require cleaning, 1/6 doz., 12/- gross.
FUSEHOLDERS, porcelain, 10 amp., 1/- pair, 5/- doz.
SINGLE EARPHONES, super quality job, fitted leads, 3/6 each.
ERICCSON'S TELEPHONE HANDSETS, telephone and microphone, 7/6 set. Two make an efficient telephone, circuit supplied, 14/- pair.
SWITCHES, standard mains 5-amp., all bakelite, 1/3, 12/- doz. boxed. Ditto porcelain base, 1/6, 15/- doz. boxed.
RELAYS, G.P.O. type, 200-ohms, twin make, 4/6. Exide 10-volt accumulators, 6/6 each. Graham Farish "Muni" mains interference suppressors, 1/6.
WANDER PLUGS, standard fitting, red and black, 2/- doz.
HOME CHARGERS complete, charges 1-accumulator from 200/250-volt A.C. mains, 12/6 each.
SELECTOR SWITCH ARMS, 4-laminated copper N.P. fitted knob panel bush, etc., 9d. Studs, 10 for 6d.
TRANSFORMERS, mains 200/250-volt, output 4-volt at ½-amp., 5/-.
MICROPHONE insets (not buttons), 2/9.
LUCAS AERO SWITCH BOXES, 8 switches in line, d.p.d.t., d.p.s.t. and 6 s.p.s.t., 5/-.
SAMPLE BOXES of radio and electrical parts to offer over 40 parts, 2/6.
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