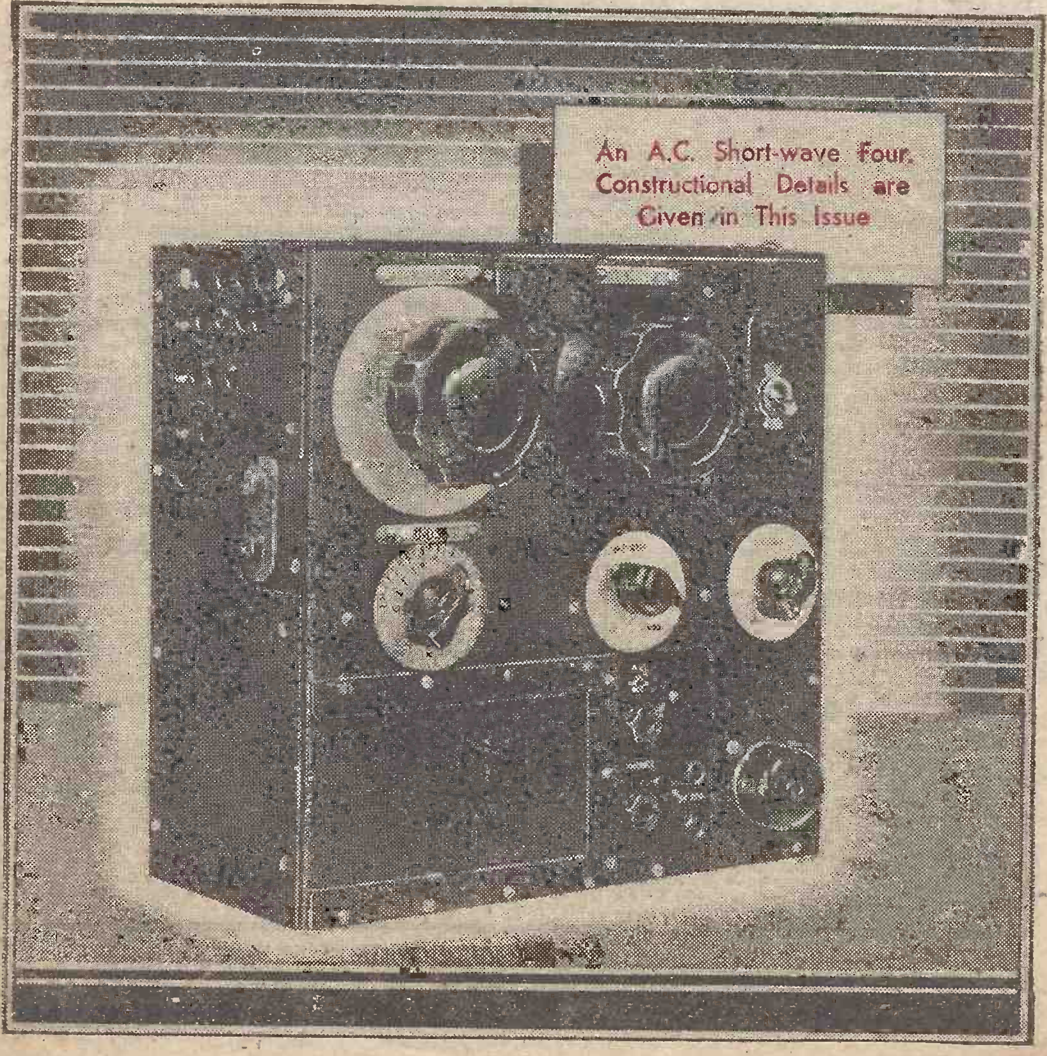
A DIRECTIONAL THREE-VALVER

Practical Wireless

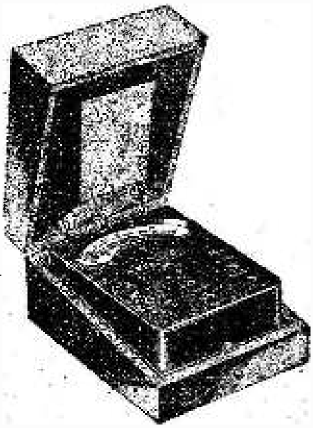
9D EVERY MONTH

Editor F. J. CAMM

Vol. 21 No. 470 NEW SERIES AUGUST, 1945



An A.C. Short-wave Four. Constructional Details are Given in This Issue



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SHORT-WAVE CONDENSERS. all brass, easily ganged, 15 mmfd., **2/11**; 25 mmfd., **3/3**; 40 mmfd., **3/3**; 100 mmfd., **3/11**; 160 mmfd., **4/8**; 250 mmfd., **5/8**; 2-gang, 160 mmfd., **15/-**; shaft couplers, **7½d.**; flexible ditto, **1/6.**

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SMOOTHING CONDENSERS. 50 mf., 12 v., **2/3**; 25 mf., 25 v., **2/3**; 50 mf., 50 v., **3/6**; 2 mf., 250 v., **3/9**; 2 mf., 350v., **4/6**; 4 mf., 450 v., **7/6**; 8+8 mf., 500 v., **8/6**; 8+16 mf., 500 v., **10/6**; 16+16 mf., 450 v., **12/6**; 16 mf., 150 v., **5/-**; 16 mf., 350 v., **6/6.**

SUNDRIES. 2 mm. Systoflex, **2½d.** yd.; resin-cored solder, **6d.** per coil or **4/6** per lb.; screened 2-pin plugs and socket, **9d.**; ditto, 8-pin, **2/-**; Octal sockets, **10½d.**; ditto, amphenol type, **1/3.** Morse buzzers, **1/11.** Valve screens, **1/2.** Knobs, **6d.** Pointer knobs, **1/1.** Crocodile clips, **4d.** "Gain" and "tone" indicator plates, **7½d.** Fuses, any size, **5d.** Fuse holders, **6d.** 6-volt vibrators, 4-pin, **12/6.** Crystal pickups, **£3 18s. 9d.**, including tax.

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Practical Wireless
and PRACTICAL TELEVISION
13th YEAR OF ISSUE
EVERY MONTH.
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Editor F. J. CAMM

COMMENTS OF THE MONTH BY THE EDITOR

Shops to Reopen

MR. OLIVER LYTTELTON, President of the Board of Trade, recently announced that licences to reopen closed retail businesses are now being granted to any ex-trader, whether he was or was not in the forces, whose name is in the Register of Withdrawing Traders or is eligible for inclusion in it.

He made the important announcement, also, that ex-traders who wished to open in a district other than that in which their original business was located, or even who wished to start some business other than that in which they were formerly engaged, will be permitted to do so, provided this will not be inimical to the interests of others who are on the register.

He did not state who was to decide this latter point, but presumably the Local Price Regulation Committee will do so. If this is indeed the case we wish to register a protest against it. In our view, Local Price Regulation Committees have not functioned fairly or satisfactorily. Many of those who serve on these committees are themselves retailers and have during the war raised selfish opposition under the pretext that they were protecting local trade. These committees have been virtually granted local monopolies by the Board of Trade and we should like to see their terms of reference considerably overhauled or the committees themselves abolished in favour of some independent tribunal, able fairly to assess the value of opposition to a new business.

It is, of course, vitally important to protect the interests of those who are still in the forces or who are engaged on war work to which they have been directed, and it would be grossly unfair to allow a new trader to start up in opposition before the original trader in a particular locality has had a chance to get going again. We must, however, be careful to see that we do not destroy the only safeguard against exploitation which the public possesses—namely, fair competition.

The feeling of the country is against cartels and monopolies, yet those loudest in voicing their opposition are those who almost in the same breath demand a local monopoly for themselves. The consumer always pays. There are unions for workpeople and trade associations for manufacturers. Either can agree to increase their prices which are always passed on plus a percentage to the consumer. He is without any protecting organisation, except the Government, which must be watchful to see that it does not create the very evils it wants to destroy.

Licences

LICENCES will be granted as hitherto to war disabled persons who were not formerly traders and also to persons who acquire the goodwill of an existing business or who remove to other premises in the same shopping area, with the important proviso that there must not be a change in the size and character of the business. Further licences will not be granted on the ground of essential public need, although sympathetic consideration will be given in those cases where personal hardship would result from a refusal to grant such licence.

As the 1939 level seems to be the datum upon which the Government is basing its rehabilitation plans, and this datum is deciding its policy in relation to the granting of licences, it should be pointed out that in 1939 there were many districts which were notoriously badly served from the point of view of radio servicing, and the inevitable shift of population during the war to new districts, a high percentage of which population will remain, has rendered the 1939 basis not only obsolete, but unfair. We suggest that the whole matter should be reviewed again when the General Election is over. Powers which the Government arrogated unto itself for the purposes of fighting the war should be taken from it now that the emergency has passed—unless, of course, the electors decide at the polls that it prefers the shackles of control to the freedom of enterprise.

Export Licence Relaxation

THE list of goods which require export licences has been considerably reduced by a new Order of the Board of Trade now in force. All the remaining countries are removed from the list of territories to which the export of all goods is controlled. Wireless receiving sets and a large range of electrical products may now be exported without licence. The full list can be obtained from the Board of Trade, Millbank, S.W.

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

ROUND THE WORLD OF WIRELESS

Dutch Gratitude to B.B.C.

IN a recent broadcast from the Dutch station, "Resurgent Netherlands," it was announced that "in order to show the gratitude of the Dutch nation for the splendid work of the B.B.C., a temporary committee has been formed to offer the B.B.C., as soon as this is possible, a tribute, a permanent memento. A suitable gift is thought to be a typical Dutch memorial window."

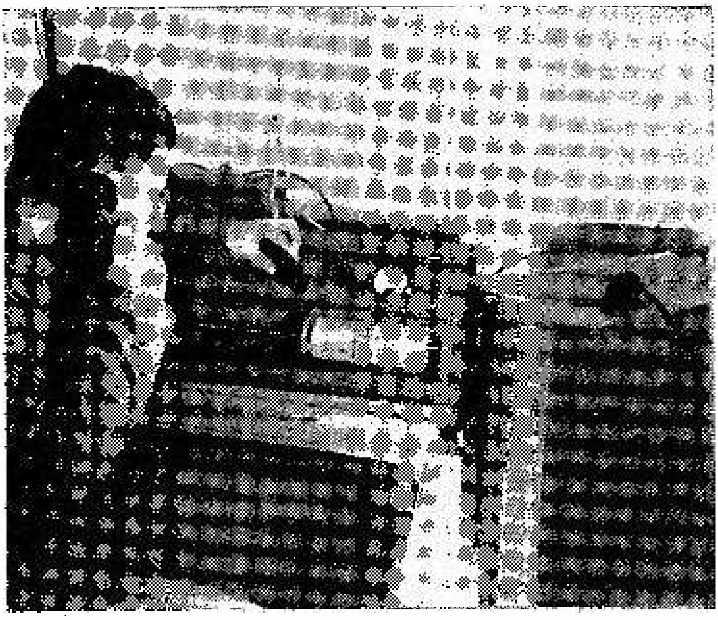
The temporary committee, it was added, consists of Herman Weldehof, of Amsterdam, who took the initiative, and Fritz Toch, of Baarn. Public subscriptions have been invited.

Secret Submerged Radio Stations

DETAILS were recently released of the secret German automatic radio and meteorological stations which were submerged far out in the Atlantic. These "stations" appear to have played an important part during the last four years of the European war.

The first "station" to be discovered was picked up off Slyne Head, intact and in working order, and was forwarded in sections to the Admiralty.

These submerged stations were about 300ft. long, and their main features included: Undersea moorings, gyroscopic control, automatic aerials with short-wave beam-sending apparatus, and an electric motor for raising the aerial mast to take observations at fixed times.



During the war in Europe, a once fashionable Paris Hotel played an important part as the nerve centre of all the news from the Western Front. The illustration shows a telephoto transmitter, installed in one of the hotel bathrooms, and being operated by a member of the U.S. Signals Corps. From this room news photographs were wirelessed to all parts of the world.

"Prom." Season at Albert Hall

THE B.B.C. announces that the 51st season of Promenade concerts will be given at the Albert Hall from July 21st to September 15th inclusive. The orchestras will be the London Symphony Orchestra and the B.B.C. Symphony Orchestra. Mr. Basil Cameron and Sir Adrian Boult will be joint chief conductors, and the associate conductor will be Mr. Constant Lambert.

Channel Islanders Listened on Crystal Sets

THROUGHOUT the years of the German occupation the voice of the B.B.C. kept the Britishers in the Channel Islands in touch with home, and gave them the courage to wait on quietly for the liberation which came to them last May. Almost every family daily heard the news from London and listened regularly on the Home Service and overseas wavelengths.

No wonder the word "crystal" is a magic word there. For in June, 1942, the Germans banned all radio sets and ordered that every one must be surrendered. Most of them were seized. Houses were searched regularly, and the people were told that to possess a radio or to listen in to the B.B.C. would mean death or imprisonment.

For a few days the islanders were without news. And then to the rescue of all came Mr. Louis Roche, of St. Helier, an electrician. He taught the islanders all about crystal sets. Not the crystal sets you knew in the early days of the B.B.C.; they were far too big and bulky when Germans were always outside the door and might walk in at any minute of the day or night.

The "Broken Clock" Receiver

THE Louis Roche crystal sets were in hundreds of shapes and sizes and disguises. On the mantelpiece in the home of Mr. B. Davies, of St. Helier, was a red alarm clock that was invariably wrong. "The clock is broken," he always told the Germans when they asked about it. Actually it was a two-valve receiving set. By attaching wires to the two winding screws, twiddling the screw which moves the hands, and listening through a small headphone from a telephone receiver, he received faint but clear the voice of London. Another two-valve set was built inside a two-inch tin. But most of the homes contented themselves with simply-made crystal sets. Some were built in matchboxes. The smallest of all was an intricate job inside a gramophone needle box.

Louis Roche charged a small price for each set he made, but wanted no profits. He spent all his spare time and leisure making them, or showing his fellow islanders how to make them. Once he was caught and spent several months in jail, but when he came out he set off at once to make hundreds of calls round the island to repair faulty crystals. The German Command were given almost daily a clue which might have led them to the secret of how the Channel Islanders were breaking their radio ban, but they never realised it. Every day there were complaints of ear-pieces being missed from telephones. These were the ear-pieces which, after a minor adjustment, were attached to the crystal sets, so that every islander could daily listen in and hear "This is London Calling."

"The Voice of Norway"

THE Norwegian poet and patriot, Nordhal Grieg, did much by word and deed to inspire his fellow-countrymen with a true love for their homeland and a belief in the ultimate triumph over the German invader. Many of the Norwegian fishermen and farmers have his poems by heart.

"All that is mine, demand," he wrote in allegiance to his country during the days of peace, and when war broke out he accepted the challenge and shared fiercely in the fight for freedom. He saw military service during hostilities in Norway and played an important part in the safe removal of the Norwegian gold reserves to this country. He later took part in the hazards of war by sea and air, and died in December, 1943, while taking part in an operational flight over Berlin.

To Nordhal Grieg such occasions as May 17th, Norwegian Independence Day, were always opportunities for reaffirming his faith in the land he loved so well.

This year on that date a special programme, "The Voice of Norway," about his life and his work, written and produced by Louis MacNeice, was broadcast in the Home Service. It included Norwegian music and translations of some of Grieg's poems by G. M. Gathorne-Hardy.

German Tribute to Radiolocation

IT is interesting to note that the Admiralty employs about 3,000 scientists in its various departments and laboratories, and has recently embodied them into the newly formed Royal Naval Scientific Service. This shows that the Royal Navy is alive to the importance of maintaining research in peace and war.

Early in 1944, Admiral Doenitz gave a talk to German Naval Officers in which he said:

"At the end of last year and the beginning of this, one development became very obvious which, long ago, even in peacetime, had been feared, that the enemy might deprive the U-boat of its essential feature—the element of surprise—by means of radiolocation. With these methods he has conquered the U-boat menace.

"The scientists who created radiolocation have been called the saviours of their country. So, it was not superior strategy or tactics that gave him success in the U-boat war, but superiority in scientific research.

"Germany made the great mistake of calling up her scientists into the armed forces instead of letting them continue their researches, and it was not until eight months later that the Reichswehr ordered the release and exemption of scientists from military service."

Britain did not make the same mistake. Her scientists were employed to the best advantage on research work both in and out of the Services.

"Radio Dick" Service

AMONG the most interesting souvenirs in the B.B.C. war archives are some hundred or so specimen copies of Service "Radio Dick" news-sheets. Some, elaborately set out cyclo-style productions of several pages, complete with cross-headings, maps and illustrations, showing the hand of the experienced journalist, others, neatly typewritten single page sheets; others again, hand-written, or block-printed pieces of paper of telegraphic brevity.

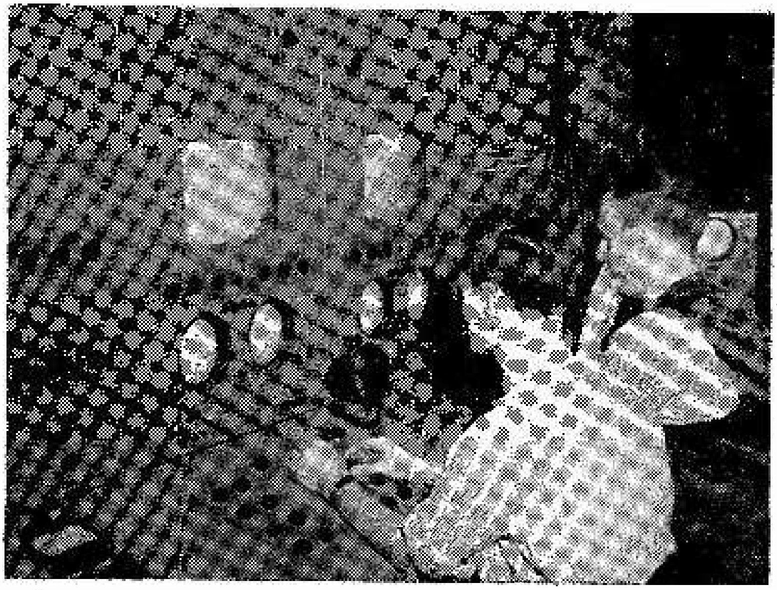
"Radio Dick" is the nickname given by the Forces to the men who take down the special News Bulletins broadcast by the B.B.C. at dictation speed for the Services overseas.

It has been a matter of surprise to many who have visited the fighting contingents, whether on the battle-fronts or at isolated outposts, that these news-sheets have always been a focal point of urgent interest to the Forces. As a fresh sheet appears, men in twos and threes will run to read, mutter the contents and race off to pass it on.

Appreciation from the Forces

THE B.B.C. started this bulletin on January 23rd, 1944, in response to a widespread wish for news read at a slow speed which could be written down by hand at the receiving end and passed on. The bulletin soon won great appreciation, and on September 5th, 1944, it was increased in length from 15 to 20 minutes.

The bulletin is introduced with the words: "This is London calling Forces everywhere and especially the Editors of Forces' papers and ships' papers." It gives brief, latest news headlines, read at normal speed, and is followed by news of the past 24 hours read at dictation speed.

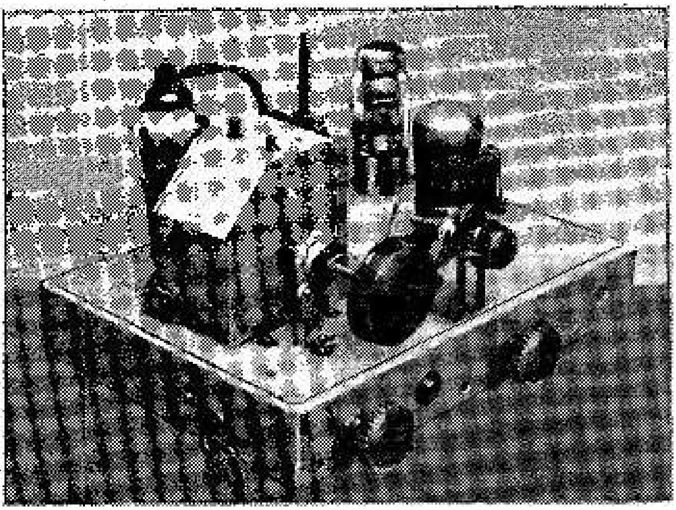


The Du Mont Television Laboratories, of New York, in conjunction with the Missing Persons Bureau, are conducting televised broadcasts as an aid in the tracing of missing people. Our illustration shows the engineers at the transmitting board with its many dials and screens from which the final control of density and light is made prior to and during the broadcast.

A Directional Three

Self-contained and Portable. By F. G. RAYER

THIS receiver has a rotating frame aerial fixed to the chassis and can thus be used anywhere, as no aerial or earth are needed, although the main advantage does not lie in this. Rather does it consist in taking advantage of the directional properties of the frame—not necessarily to bring up any particular station to full strength by setting it in line with the transmitter, but by removing interfering signals by setting it with its axis to the point where they originate. The frame is not of very large diameter, but gives a good pick-up, as it is in free space and not adjacent to batteries, etc., as in a normal portable.



The Completed Receiver.

Standard Circuit

The circuit (Fig. 1) is quite standard, an H.F. stage being followed by detector with reaction and one L.F. stage. Tuned anode coupling is used for maximum gain, and also a transformer coupled tetrode or pentode to give good L.F. amplification. This enables a small MC speaker, which will fit upon the chassis in the space shown to the right of the tuning controls, to be operated satisfactorily. VM volume control is used, which, combined with the judicious use of reaction and the directional properties of the aerial, enables most stations to be received free from interference. For long-distance reception phones can be used if desired.

The receiver is constructed upon a metal chassis, and the layout will be seen in Fig. 2. All parts relating to

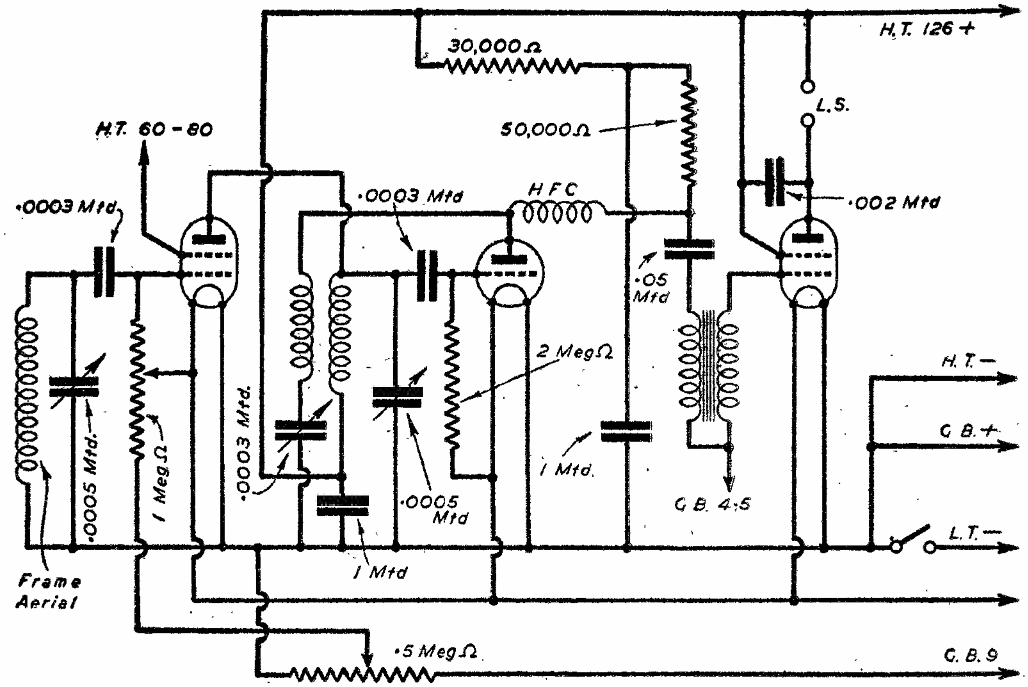


Fig. 1.—Circuit.

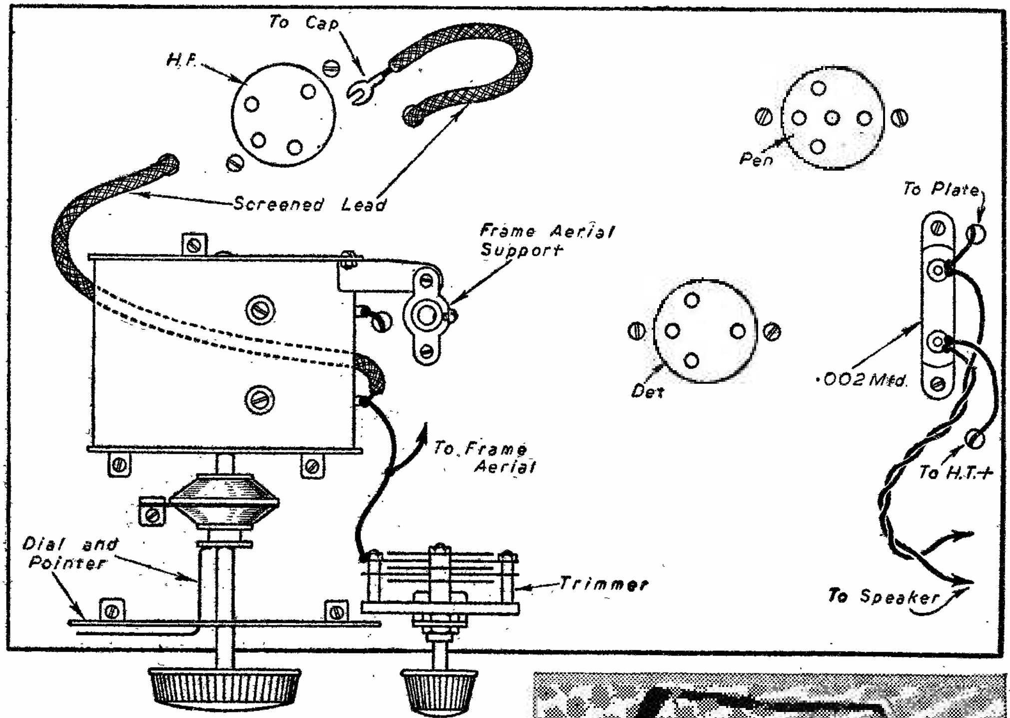


Fig. 2.—Top of chassis layout.

the detector stage are below chassis, and the coil does not need screening to prevent interaction with the frame. A manufacturer's surplus chassis was used, the top being covered with a sheet of zinc. This was for appearance's sake only and can be omitted, or even a sheet of cardboard may be used to cover the unwanted holes.

The frame turns upon a length of ¼in. diameter rod, fixed upright from the chassis by screwed rods and dismantled shaft-couplers. The rod is braced to the top of the gang condenser to make it quite firm. The earth return to the frame is taken through this rod, and the grid connection by means of a length of flexible wire. The latter is screened to prevent stray pick-up, as is the lead from the gang condenser to the grid of the H.F. valve (see Fig. 2). The trimmer and tuning condenser are earthed through the chassis, and the latter fitted with a reduction drive and scale.

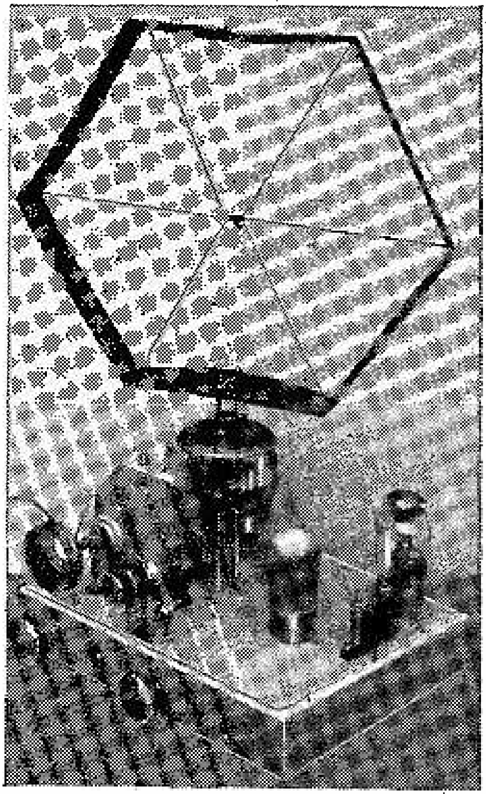
Leads to the speaker are taken from the upright .002 mfd. condenser mounted by the detector valve to the right of the chassis.

Layout of Components

Most of the components are underneath, and Fig. 3 shows the location of these. If the potentiometer is of the type which has the spindle connected internally to the slider, then it will be necessary to insulate the component with fibre washers from the chassis. Failure to attend to this will make the VM control inoperative.

There is not much wiring, but it should be run as shown to prevent instability, especially in the H.F. stage. The grid and anode leads of the H.F. valve are screened, as shown in Figs. 2 and 3, the outside brading being connected to the chassis.

Both the H.F.C. and coil are mounted on the front runner of the chassis, well apart. The L.F. transformer is upon the back runner. Lengths of flex are used for battery connections, these all going through a rubber grommet in the one side runner and being twisted together.



The frame aerial.

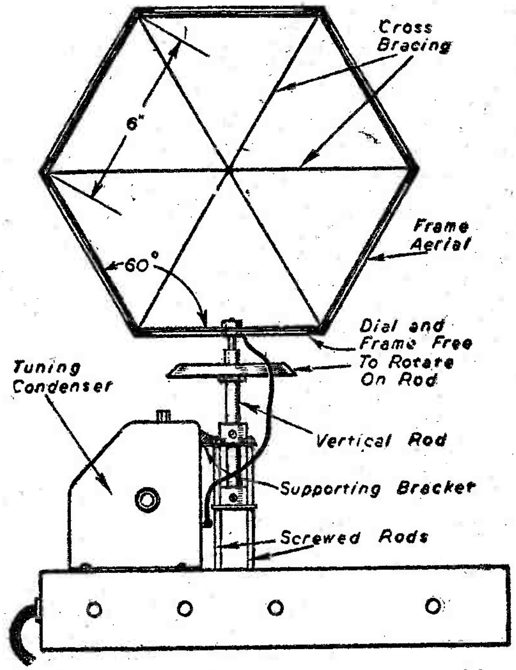


Fig. 4.—Front view, showing location of frame aerial.

Frame Aerial

The location and dimensions of the frame aerial will be seen in Fig. 4. Each of the six pieces comprising it are 6in. long and 2in. wide. Thin plywood is used, it being secured at the corners by an overlapping angle piece of thick cardboard. When adjusted to the proper shape, a cross brace of thin string is taken from each corner. All these are bound together in the centre; as a result the frame will be quite solid and cannot collapse or get out of shape, while being light and easy to make.

The bottom strip of the six is slightly wider in the centre, and this permits it being secured by two short screwed rods or bolts to a large dial of the old-fashioned type, the winding on the frame passing between the rods. The centre of the dial is fitted with a bush which will turn freely, but without wobble, on the upright rod secured to the chassis. Examination of the illustrations will make the general arrangement clear.

The frame winding consists of 55 feet of 24 D.C.C. wire, each turn being spaced slightly from its neighbour. One end of the winding is taken to one of the screwed rods which contacts the metal rod, and the other to the H.F. section of the tuning condenser. The wire should be wound on evenly, and as tightly as possible.

The tuning coil is also home-wound. A 1$\frac{1}{4}$in. diameter former is used. The grid winding is 90 turns of 32 enamelled wire, close wound. Approximately $\frac{1}{4}$in. from the bottom end of this winding is the reaction winding of 55 turns of similar wire pile wound. Connections will be seen in Fig. 3. The coil is secured to the front runner by a long screwed rod and cross piece as shown.

Ganging

It will be realised that the circuits must gang properly, and if there is any doubt about the gauges of wire, etc., used an experimental test should be made to

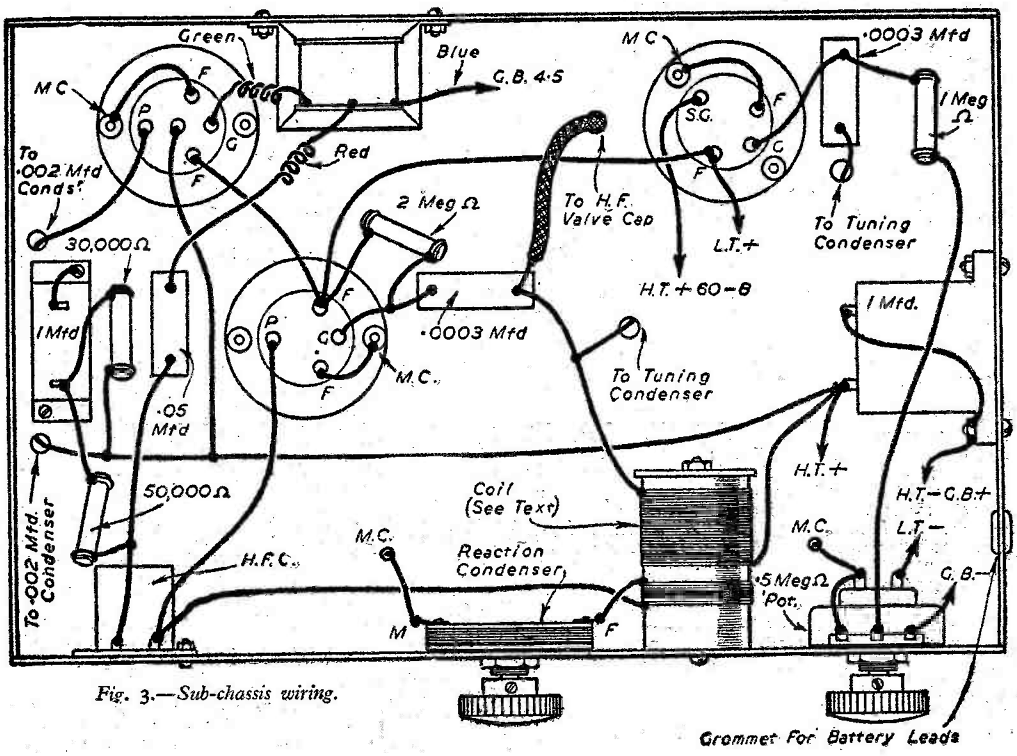


Fig. 3.—Sub-chassis wiring.

get the circuits in tune. The trimmer connected to the frame is of rather large capacity, and should not need much adjustment throughout the tuning range. Two separate tuning condensers were employed in place of the gang condenser and trimmer originally. This removed any ganging difficulties, but it was found later possible to use a twin condenser instead.

Stray capacities in the screened wires, and other things, will effect the tuned circuits, but it should be possible to adjust the trimmer to a definite peak for best results throughout the tuning range. If this is not possible, a temporary trimmer can be connected to each section of the gang condenser in turn to see which is tuning to the lower wavelength, and turns removed from the frame or coil as necessary to bring the circuits in line. If additional capacity across the detector circuit gives the desired effect it will be necessary to remove turns from the frame, and vice versa.

An ample H.T. voltage is recommended, and the battery can be fitted in the cabinet below the chassis. The frame is rotated as necessary, remembering that when it is in line with the transmitter pick-up is at a maximum, and when its axis is in line, at a minimum. If the leads and gang-condenser are screened, pick-up at the minimum position for any station will be practically zero, which is just the effect desired.

LIST OF COMPONENTS

Two 4-pin and one 5-pin chassis valve-holders.
Two .0003 mfd. mica fixed condensers.
.002, .05, and 2 1 mfd. paper condensers.
2-gang .0005 tuning condenser.
.0001 mfd. panel-mounting trimmer.
.0003 mfd. reaction condenser.
30,000, 50,000 ohm, and 1 and 2 megohm resistors.
.5 megohm potentiometer with switch.
Parafeed transformer, about 1 : 4 ratio.
Small high frequency choke.
Metal chassis.
Reduction drive and scale.
Wire for frame and coil; knobs, etc.
Valves: Mullard PM12H, Ever-Ready K30C, Mullard PM22A, or similar types.

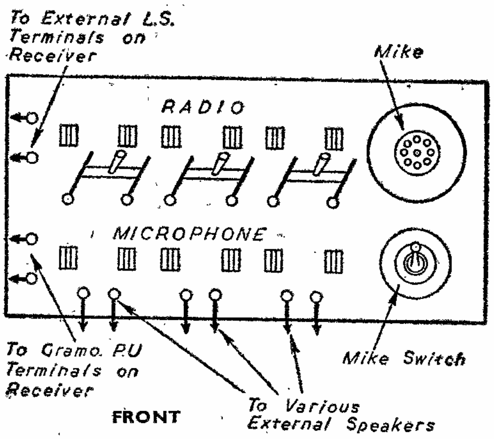
Two-way Communication Switchboard

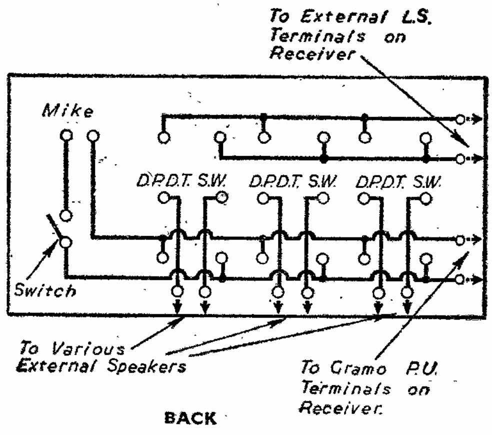
By N. D. FORD

THIS simply constructed switchboard allows you to relay radio programmes, operate a two-way communication system or listen in to any room in your house. Only an ordinary radio receiver with gramophone pick-up and extension speaker terminals, together with a few cheap speakers suitable for the set, a microphone or sensitive headphone, some double pole double throw switches and a tumbler switch are required. The speakers are fitted in various rooms as speaker, as the external speakers will act as mikes when spoken into.

To conduct two-way conversation, you only have to operate the room speaker switch, from *Radio* position when you speak, to *Microphone* position when the room occupant speaks. Also speech from one room can be heard in the other rooms on the speaker system by manipulation of the switchboard.

You can also listen into any room by putting receiver





The board is shown wired for three external speakers, but any number can be fitted, an extra D.P.D.T. switch, in parallel with the rest, having to be added for each L.S. A sensitive headphone may be used in place of the microphone, if desired.

desired and the microphone or headphone is mounted on the switchboard as shown. Cheap insulated bell wire can be used for the installation, which is wired as in the diagram, the switchboard being fixed close by the radio.

To relay radio programmes to any particular room, put the switch for that room up to *Radio* position. To speak to any room, switch the receiver control to *Gramophone*, put the switch for the desired room to *Radio* position, switch the microphone in circuit and speak into it. To receive reply, switch the room speaker to *Microphone* position and listen on the radio receiver control to *Gramophone*, switching the microphone out and putting the desired room speaker switch to *Microphone* position, when sounds from that room, provided they are sufficiently loud, will be heard on the radio receiver speaker or may be relayed to other rooms as desired. This is useful for locating the whereabouts of noisy children, playful dogs, snorers, etc.

This system is not confined to one house, as it may be run for short distances to friends' houses, workshops or sheds, but the outdoor wiring must be good. It is advisable not to use more than two external speakers on the output side of the receiver at the same time.

An Electric Guitarette

A Novel Musical Instrument to Construct

By "EXPERIMENTALIST"

THIS instrument is played like a Hawaiian guitar and sounds like one, but unlike such six-stringed instruments, it only boasts a single steel string, hence its unusual, if not apt, name.

A test model, designed and built by the writer, gave surprisingly good results. Theoretically, it was realised that by using an earphone as a reproducer unit the model would, or must, work, since—as we have seen in previous articles—an earphone piece has been made to serve as a reproducer for a pick-up, loud-speaker, etc.

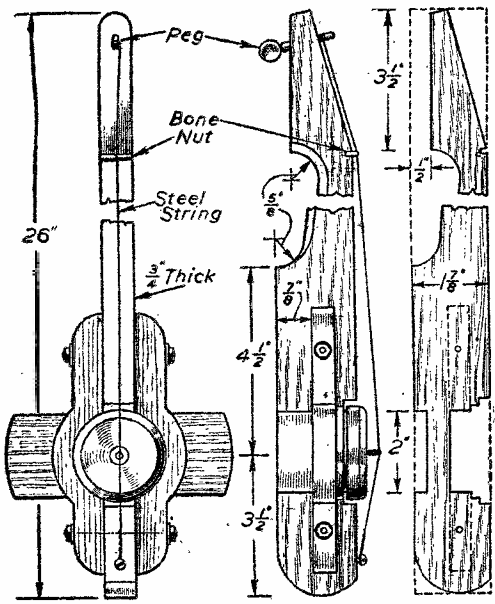


Fig. 1.—Shortened top and side view of instrument and handle.

The vibration of a tuned, steel string, supported upon the tip of a short metal post fixed to the special shaped 3/32in. thick mild steel diaphragm shown in these pages recently is more than sufficient to cause the instrument to work, and so it proved. Reproduction has to be heard to be believed; the familiar wailing notes come through the amplifier (any radio receiver having pick-up terminals or sockets) as clear as a bell, and, best of all, one does not need to be an experienced musician, especially a guitarist.

The smooth-playing "comb" used was the back of a penknife; the "plectrum" was the forefinger of the right hand, and the amplifier a straight two-valve set the writer employs for his many experiments. You will, with such primitive accessories, get as much of a "kick" out of the Guitarette as a proper, expensive model.

There is no harmony, of course, because there are no other strings for tuning in unison. The effect obtained is reminiscent of the sound obtained from a one-stringed fiddle, only the notes are louder, sharper and of longer duration. The notes can be prolonged if a celluloid plectrum is used and the *tremolo* (shake) put on the string as in mandolin playing.

The Handle

The handle piece, detailed at Fig. 1, is cut to size and shape from (preferably) $\frac{3}{4}$in. thick American whitewood. However, a cheap soft wood such as deal serves the purpose, or, in fact, any wood of a soft nature, easily cut with a fretsaw handframe fitted with a coarse toy-making blade.

The handle requires a piece of wood 26in. long by $1\frac{7}{8}$in. wide. A recess is cut for the earphone casing, as shown. The bottom side is checked 2in. long by $\frac{1}{4}$in. deep for the knee piece, the latter (see Fig. 2) being checked to make a groove allowing both parts to half-lap suitably together.

When cutting the handle to shape, note that the head end (for the string peg) is $\frac{1}{2}$in. narrower in width. The neck shape, when cut, is rounded at the underside with a spokeshave and rasp, then filed and glasspapered smooth. This is done more for appearance, since the instrument is laid across the knees, not held in the left hand, which is the case with most stringed instruments.

A $\frac{1}{8}$in. square notch, for the bone nut piece, is cut across the fingerboard surface, $3\frac{1}{2}$in. from the head end, then the latter cut to slope and planed neatly. Bore a 3/16in. hole for the peg about 1in. inwards from the head end; the hole is bored at right-angles with the head slope, as seen by the side view.

The nut piece, which is fitted and glued in position at this juncture measures $\frac{7}{8}$in. long by $\frac{1}{4}$in. wide by $\frac{1}{8}$in. thick. It may be cut from bone or any white composition, such as a piece of comb, for example. A light groove is cut or filed in the centre, at the top edge, to keep the string in place.

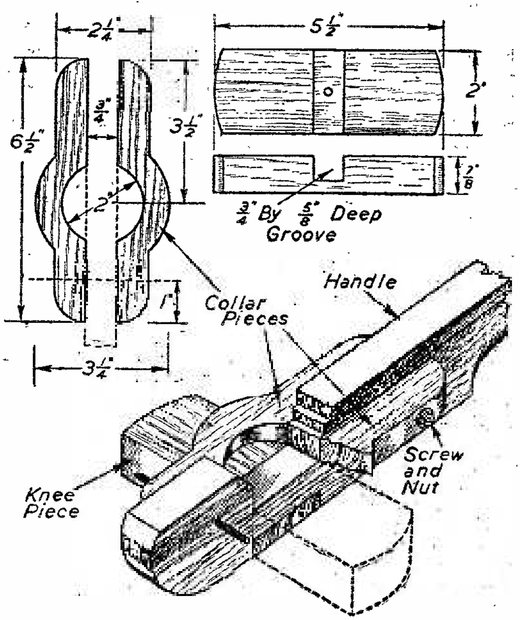


Fig. 2.—Shape and sizes of collar pieces and knee piece, with constructional detail.

Earphone Collar Pieces

Two "collar" pieces, to grip the base of the earphone casing, are prepared by marking out the shapes shown at Fig. 2, doing so on ½in. thick wood. Keep the shapes ¾in. apart, as this is the distance they will be apart when attached to the sides of the handle piece. The central, circular aperture is scribed according to the diameter of the earphone used.

Having cut the collaring pieces to shape, true up the side edges with a plane or by rubbing on a sheet of medium glasspaper thumb-tacked to a flat board. Alternatively, the collaring could be marked out along the planed edges of a piece of wood, thus avoiding the need for truing with a plane.

The collar pieces are affixed to the handle by means of 2½in. length of B.A. threaded brass rod about ⅛in. thick. In respect to the latter, the writer made use of old coil rods. Suitable holes for the entry of the rods are made with a 5/32in. drill at the ends of the collar pieces, about 1in. inwards. Similar holes, to correspond, are made in the handle.

The Assembly

Glue and screw the knee piece to the handle, then attach the collar pieces; the nuts on the fixing rods should be based with ½in. or ⅜in. diameter brass washers. A ¾in. by 6 mooring screw, for the string, is driven into the handle piece in the position shown by the enlarged side view at Fig. 3.

The peg used by the writer was a ukulele type, but a suitable one can be made from ¼in. wood, as shown. The finger grip may be left flat or made convex or concave by filing, as preferred. A very fine hole should be bored for the string near the tip.

Try the earphone in position. The casing should be a neat, tight fit. If a bit slack, a few shavings can be removed from the sides of the collar pieces or a short piece of insulation could be pressed around the base of the casing. By adjusting the tightness of the rod nuts, the writer could ease or tighten his reproducer unit. Slackness must be avoided, if possible, as it is apt to "deaden" some of the necessary vibration set up by the manipulated string.

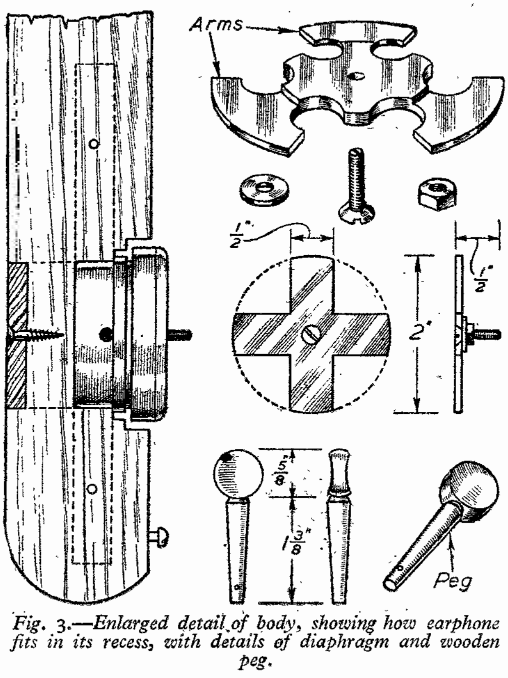


Fig. 3.—Enlarged detail of body, showing how earphone fits in its recess, with details of diaphragm and wooden peg.

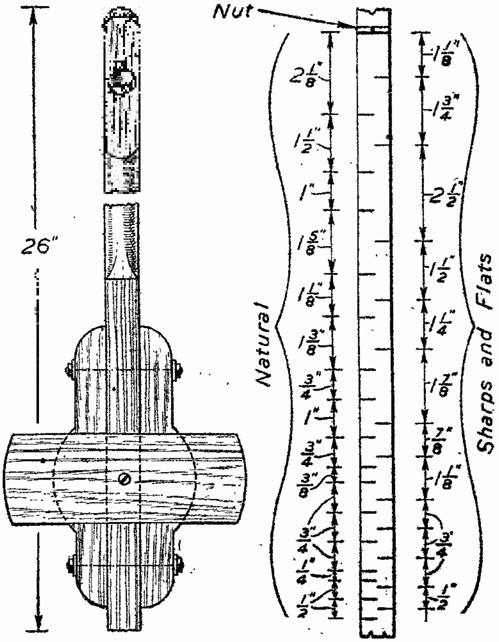


Fig. 4.—A back view and diagram showing how finger-board is marked to give the usual "fret" positions.

A Special Diaphragm

Readers who have made the 3/32in. thick diaphragm shown—greatly exaggerated in comparison with the other enlarged views at Fig. 3—need to file the three "arm" shapes to half thickness. A ⅛in. hole is drilled in the centre and countersunk on the reverse side for a ½in. long by ⅛in. thick bolt having a flat head.

A tiny nick (for the string) is made across the end of the bolt which is then inserted in the diaphragm by means of a suitable washer and nut. The bolt head needs to be filed flush with the surface of the diaphragm, should it project a trifle, or else the hole countersunk a little more.

An alternative diaphragm, cut from 1/16in. thick sheet iron or mild steel, is detailed. The shape is one easily cut with a hacksaw. It can, if necessary, be made more sensitive by filing the "arms" a trifle thinner.

The Steel String Used

The writer used a plain steel 2nd (A) mandolin string. It is "hooked" over the mooring screw and brought over the diaphragm post and nut to the peg, it being threaded through this and turned in an anti-clockwise direction to tighten it. Owing to the exceptional length in comparison with the fingerboard of a mandolin, the string is best tuned to middle C on a piano or organ.

Owing to the difficulty of obtaining steel strings for musical instruments in most districts, the strands of steel wire found in bicycle brake cables can be used as a temporary substitute. Such strands are finer and not so smooth as a proper "A" mandolin string, naturally. They are more like "E" mandolin strings, and as these may be used, too, such is better than nothing.

The Keyboard Fret Positions

Actual frets need not be fixed upon the fingerboard, which the writer has marked out as a piano keyboard. Only the fret positions need be marked, such positions being indicated at Fig. 4.

Along one edge the sharp and flat "key" positions are made, the natural key positions being marked along the opposite edge. Consequently, looking down on the instrument upon one's knees, a piano keyboard can be made out.

The natural notes are C (the "open" string note), D, E, F, G, A, B, C. That is one octave, and as there are two octaves, complete with sharps and flats, quite a useful range of melodies are possible.

By the way, always begin your tunes approximately in the middle of the fingerboard. This ensures a good compass of high and low notes and keeps the melody going at

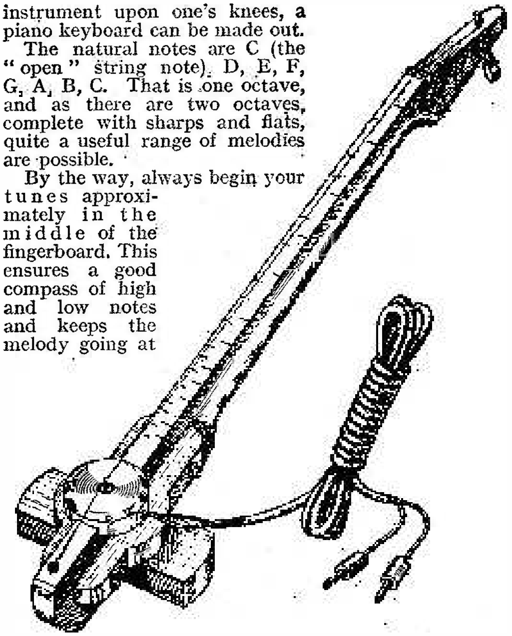


Fig. 5.—General view of the completed instrument.

an even rate, without sudden "jumps" to notes of a higher octave.

Final Hints

When using the steel comb or penknife, press on the string with it gently, but firmly. Pluck the string with the forefinger of the right hand for each note wanted. When a note is a breve or semi-breve (lasting for four beats to a bar in the first case, and two beats in the latter case), keep gliding the comb quickly from side to side to produce the proper sustained, wailing effect. You will find that you can glide up to certain notes with ease.

If, under test, reproduction is weak, the diaphragm is likely too far distant from the earphone pole pieces, or vice versa, in which case packing with 2in. rings of blotting paper is necessary. Volume can be controlled by adjusting the earphone cover itself. The tightness, or slackness, of the cover on the diaphragm also affects reproduction, either making it bad or improving it.

The writer had to "pack" his diaphragm between two rings of blotting paper. The surface ring (on which the cover screws) helped to cut out a slight harshness. Incidentally, it is rather odd to sit in one room and hear yourself playing loudly into another room.

A good long piece of twin flex is wanted, of course. For ordinary purposes, an 8ft. length should suffice. As a finish, the writer painted his model with ebony polish and marked the fingerboard fret positions with white paint.

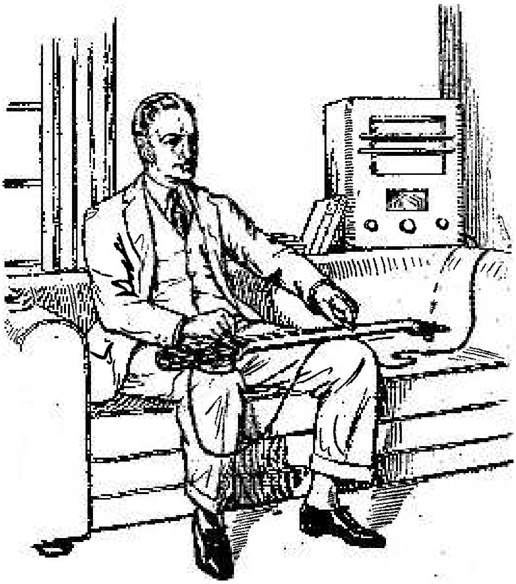


Fig. 6.—Sketch showing how the instrument is held and played.

ITEMS OF INTEREST

Mains Consumption

SOME listeners are rather anxious to know what their receiver consumes from the mains, and in an endeavour to work out the cost attempt to calculate the total load and transpose this into terms of watts. This is not usually possible, owing to the effect of the transformer in the case of A.C., although on D.C. supplies a more or less correct answer would be obtained. It should be remembered that an ammeter may be included in series with the mains lead and the load worked out from the reading given, or alternatively one of the special watt-meters may be joined to the mains input circuit. These were normally obtainable with two pins and two sockets so that they may be plugged into the mains socket and the receiver plug then inserted into the meter. A direct reading is given in watts for various mains voltages.

* * *

A Wiring Point

IN some receivers it is found that two or more wires need to be joined to a common point and difficulty is sometimes experienced owing to the fact that when the second wire is being connected the first becomes unsoldered. The simplest way of overcoming this difficulty is to twist the two wires together after tinning, but as this usually results in a clumsy and unsightly joint, a better plan is to use one of the special double-ended soldering tags and make certain that the iron is not so hot that the first joint is unsweated.

* * *

Anti-microphonic Valveholders

SOME years ago special vibrating valveholders were supplied in an endeavour to overcome microphony, and a case was recently investigated where excessive microphony was experienced in a receiver. The constructor had made a valveholder incorporating what he called "anti-microphonic" principles, but as he had a defective valve in which the electrodes were loose, the vibration from his speaker was setting this valve into violent movement on the rubber suspensions incorporated in the holder and accentuating the trouble. Although the valve should have been replaced, a rigid holder did not give nearly as much trouble.

Constructing a Ribbon Microphone

An Easily-constructed Instrument

MANY people, on seeing the interior of a ribbon microphone for the first time, express great surprise at the utter simplicity of its construction and frequently remark that it should be fairly easy to make one at home. That is perfectly true, but there are quite a number of very important points to which attention should be paid if a wide and level frequency response is wanted. It is the purpose of this article to enumerate these points and to suggest how to make a ribbon microphone with a fairly level frequency response from 30 c/s. to 9,000 c/s. It is perhaps well to point out at this stage, before the theory or construction are discussed, that this type of microphone gives a very low output indeed. It hence requires a high gain amplifier to follow it, before sufficient power is available to operate a quality amplifier or the A.F. section of a receiver. It is not the author's intention to give dimensioned sketches of all the parts from which the microphone should be made: much of that work will be left to the interested reader, although some very critical dimensions will be given by the author. If due attention is paid to all the points made in the article the constructor can be assured of success.

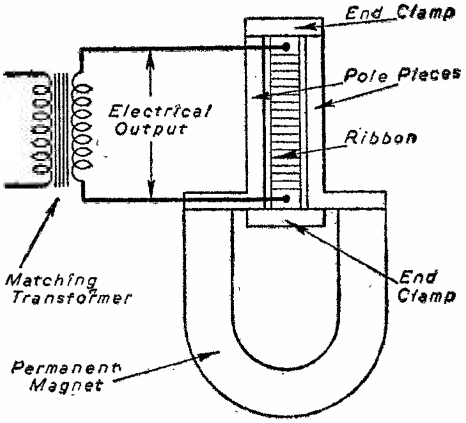


Fig. 1.—General view of the essential working parts of a ribbon microphone.

There are quite a number of types of ribbon microphone but the type to be described here operates on what is known as the "velocity" principle. In the U.S.A. such microphones as this are known as "velocity" types. The essential parts of the microphone are shown in Fig. 1 which is purely diagrammatic. The microphone consists essentially of a very thin conducting ribbon, which acts as the diaphragm, suspended in the magnetic field between two pole pieces attached to a permanent magnet. The ribbon vibrates in sympathy with the sound waves striking it and, in doing so, cuts the magnetic field and so generates an alternating E.M.F. across its ends, this constituting the output of the microphone. The mechanism of operation is, in actual fact, a little more complicated than is suggested in this explanation. Briefly, the theory is as follows. Since the ribbon is open to the atmosphere at the front and the back it moves as the consequence of the difference in air pressures. This difference in air pressure can be evaluated as shown in Fig. 2, which shows a plan view of the microphone. In this "d" is intended to represent the shortest distance between the front and back of the ribbon measured around the pole pieces. The pressure difference which moves the ribbon is exactly the same as that between any two points in the path of a sound wave which are separated by a distance "d" as shown in Fig. 3, in which a sinusoidal sound wave is drawn. Clearly, if we keep "d" constant and increase λ, the wavelength of the sound wave, the pressure difference and hence the voltage output will decrease. Conversely, if λ is decreased, the pressure difference will increase (and so will the microphone output) until "d" $= \frac{\lambda}{2}$. At this wavelength there will be maximum output and then the pressure difference will fall. Beginning with a very long wavelength, then, the output thus increases steadily as the wavelength is decreased until "d" $= \frac{\lambda}{2}$. Otherwise expressed, the output increases steadily with increase in frequency until we reach the frequency for which "d" $= \frac{\lambda}{2}$. Suppose we want an upper frequency limit of 9,000 c/s. For this frequency

$$\lambda = \frac{\text{velocity}}{\text{frequency}} = \frac{1{,}100 \times 12}{9{,}000} = \frac{13{,}200}{9{,}000} = 1.5\text{in.}$$

approximately so that we must make "d" = .75in. to give an upper frequency limit of 9,000 c/s. That is the first important point: the distance around the pole pieces must not exceed ¾in. If a response up to 4,500 c/s. is considered adequate then this distance can be doubled.

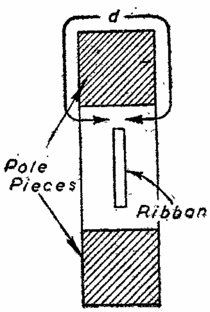


Fig. 2.—The frequency range of a ribbon microphone depends on the distance "d"

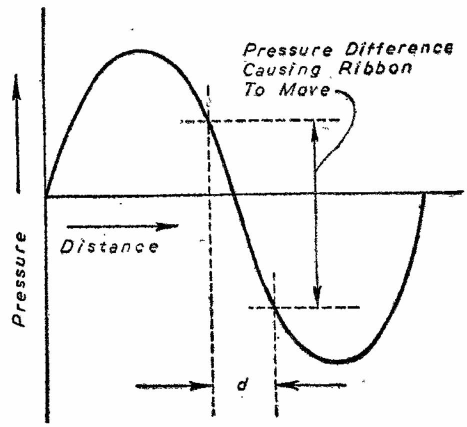


Fig. 3.—Illustrating principle of "Velocity" operation.

Constant Output

We have seen that the output rises with increase of frequency as a consequence of the velocity principle.

It is done by arranging that the ribbon itself resonates at a very low frequency, preferably about 20 c/s., so giving what is termed "mass control" over the audible frequency range. The resonant frequency of the ribbon depends on its weight and on its elasticity and by suitably choosing both the desired low resonant frequency can be obtained. This is important point number two: a very low mechanical resonant frequency. Provided these two essential points are attended to, there should be no difficulty in securing the desired frequency range.

Let us now turn to the actual assembly of the microphone. Possibly the most difficult part to get will be the horse-shoe shaped permanent magnet. Since the output of this type of microphone is very low and depends on the strength of the magnet it is advisable to get the strongest one possible, preferably one of Alnico or Ticonal or some other highly magnetic alloy.

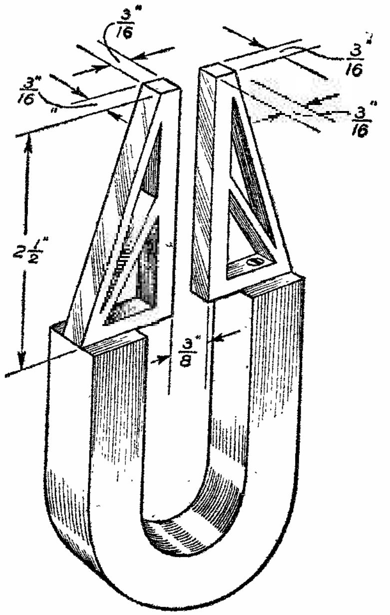


Fig. 4.—Suggested construction of microphone. Essential dimensions are given.

No dimensions are given in Fig. 4 for the magnet; it is best to use whatever size can be procured. The important point is to see that the pole pieces, which must be of soft iron, are of correct dimensions. It is not possible, therefore, to deviate very much from the dimensions of the pole pieces suggested in Fig. 4. These are of square cross-section, each side being 3/16in. long, and are secured to the magnet by screws as shown. The side pieces are not purely for mechanical strength; they also serve to lead the flux to the magnetic gap.

The Ribbon

The ribbon should be very light and should be a good conductor. Aluminium or duralumin will therefore be suitable material and it should be about .0001ins. thick or even thinner, 2ins. long and ¼in. wide. The aluminium foil used in some fixed tubular condensers is suitable. Foil as thin as this has a tendency to curl at the edges and to prevent this it is customary to corrugate the ribbon horizontally as shown in Fig. 4. A good way to do this is to pass the ribbon between two pinion wheels in mesh (Mecanno ones would probably be suitable, provided their teeth are more than the necessary ¼in. wide). There are one or two points to watch in mounting the ribbon in the gap. The end

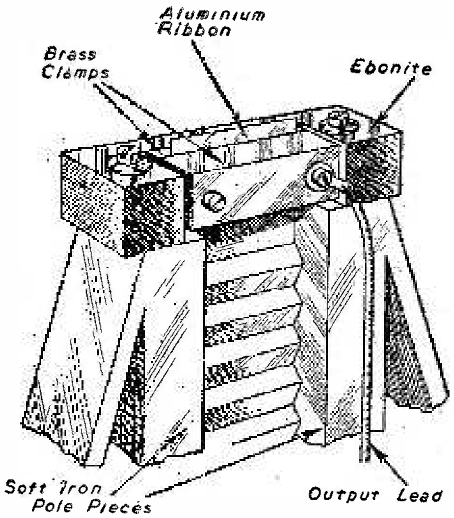


Fig. 5.—Suggested construction of end clamps.

clamps (a close-up of one is shown in Fig. 5) should be of non-magnetic material to avoid magnetic short-circuiting of the gap. Ebonite could be used for example. One method of clamping the ribbon to the ebonite is clearly shown in Fig. 5. It is simply gripped between two pieces of brass which are screwed tightly together and to the ebonite. The ebonite end clamps are screwed to the pole pieces as shown. Readers with some skill in mechanical engineering may like to make some form of adjustable tensioning device at the top or bottom of the ribbon so that it may be stretched slightly or released somewhat in order to adjust the resonant frequency to the required low value. If no variable tensioning device is provided, then this adjustment will have to be carried out by slackening off the clamping screws at one end and moving the ribbon slightly up or down. The ribbon should be quite slack so that it flops slightly when blown on gently. Connections are needed to each of the brass end pieces for the electrical output of the microphone. These leads are taken to a matching transformer, which may be located inside the case of the microphone underneath the magnet as suggested in Fig. 6. The purpose of this transformer is to step up the impedance of the instrument to a suitable value, say 600 ohms, for connection to a line. The impedance of the ribbon itself will be very small, and practically equal to its D.C. resistance, usually about a quarter of an ohm,

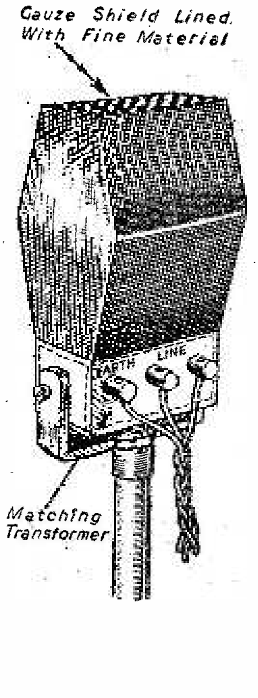


Fig. 6.—Outside appearance of typical ribbon microphone.

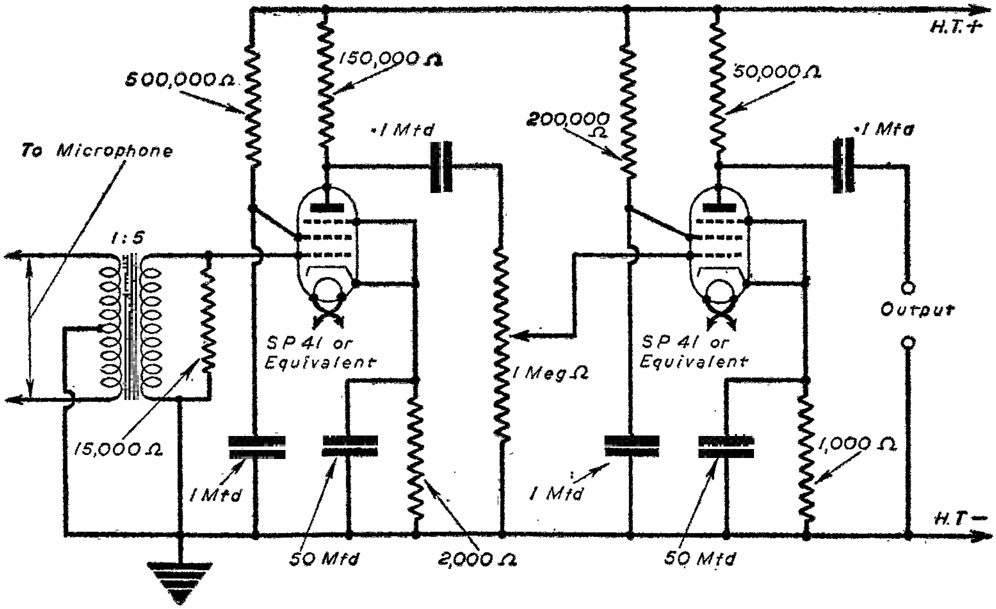


Fig. 7.—Suggested circuit diagram for microphone amplifier.

so that the matching transformer should have a step-up ratio of $1 : \sqrt{\frac{600}{.25}} = 1 : 50$ approximately. There seems to be no reason why a normal output transformer of a suitable ratio should not be used here with the small winding (normal secondary) used as primary provided its response curve is good and that the primary inductance is adequate to maintain the bass response.

Protecting the Ribbon

Some protection is required for the ribbon as it is so delicate and so easily blown out of the gap and it is usual to place one or more perforated metal screens around it lined with thin material such as fine silk georgette. Sometimes as many as three such screens are used, one inside the other. It is the outermost of these screens which gives the ribbon microphone its characteristic appearance.

For best results the source of sound should not be nearer than 18ins. from the microphone, otherwise accentuation of low frequencies occurs, and one should also be very careful not to place any sound reflectors near it otherwise a loss of bass results. The microphone should not, for example, be used near a wall.

The output power of a ribbon microphone is very small—so small, in fact, that it is below the threshold of hearing and so it cannot be heard if a pair of 'phones is connected directly across its output terminals. A circuit for a suitable microphone amplifier is given in Fig. 7. The output from this should be several volts and hence should be adequate for feeding into the pick-up sockets of most receivers, or for driving most high quality amplifiers.

Brig.-Gen. R. F. Legge

BRIG.-GEN. R. F. LEGGE, C.B.E., D.S.O., has been appointed to the board of directors of Britannic Electric Cable & Construction Co., Ltd. Britannic Electric Cable & Construction Co., Ltd., is a member of the Philco group of companies. Brig.-Gen. Legge is also chairman of British Mechanical Productions, Ltd., another member of the Philco group.

In addition, Brig.-Gen. Legge has wide electric power interests and is a director of a number of electrical power supply companies.

* * *

Radio Pictures from S.E.A.C. Area

AS part of their plans for the development of telecommunications in the S.E.A.C. area, Cable and Wireless, Ltd., are operating a direct photo-telegraph circuit between London and Colombo, Ceylon.

The circuit is working on an experimental basis and is not yet open for general Press or public traffic.

* * *

Record Number of Wireless Licences

THE number of wireless receiving licences in force in Great Britain and Northern Ireland has now reached the record high total of 9,710,850.

In spite of this, there are still wireless sets in use for which licences are not held, thus laying the users open to the risk of prosecution. During the last 12 months over 1,000 persons have, in fact, been prosecuted for this offence. Fines up to £10 have been inflicted, and, in several instances, the Court in addition ordered the confiscation of the offender's wireless set.

Owners of sets are asked to renew their licences promptly and to keep them handy for inspection.

* * *

Registered Abbreviated Addresses in Telegrams

CABLE AND WIRELESS, LTD. announce that registered abbreviated addresses may now be used in both the address and signature of telegrams, except Empire social telegrams (GLT), to all places in the British Commonwealth, excluding India and Ceylon, and to the U.S.A., Puerto Rico, St. Croix and St. Thomas.

Also, signatures are no longer essential in telegrams to these destinations.

As the use of registered addresses has been prohibited for nearly six years, senders are recommended to ascertain from their correspondents abroad what addresses are actually registered before using the restored facility.

An Economy Communications Superhet—2

Constructional Details of an Efficient S.W. Receiver

By P. STEARN

(Concluded from page 316, July issue)

WHEN the receiver has been made to function correctly, it may be advisable to make some small adjustments to the basic lay-out, before attempting some of the alterations to be described later. In all probability the I.F. transformers have been connected "out of phase," which encourages the circuits to oscillate when brought into line. It will be found on examination of a commercial superhet that the I.F. coils are both wound in the same direction, and that the outside wires or "finish" wire invariably goes to the anode and grid position, the inside wire, or start of the coil, must likewise be connected to the I.F. return channel, H.T. chassis or A.V.C.

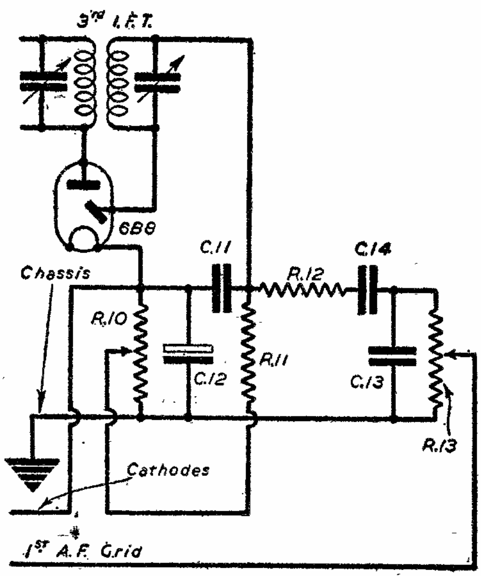


Fig. 1.—Modified circuit for the noise limiter.

The reason for this may readily be understood if it is remembered that the transformer is really a band-pass filter, with primary and secondary identical, and both tuned to the same frequency. A band-pass filter is, at its best, either completely screened in two separate cans, and capacity coupled externally, or else mounted in the same can and inductively coupled only, without any capacity existing between the two windings. Because this is virtually impossible, designers resort to winding the coils as described above, for by this method the effects of the capacity existing between the two coils are balanced out completely, giving almost pure inductive coupling. By this means a good band-pass curve may be obtained by means of an oscillograph and frequency-modulated oscillator, or by heavily damping the transformers with a resistance when aligning. Connected in any other way, a peaky, jagged curve would result, impairing the quality seriously.

Another point to notice is the way in which the trimmers are connected. It is advisable to wire the H.F. side of the coil to the underside plate of the trimmer; thus the top plate is at a low potential and acts as a shield. This is important in the oscillator circuit, where the capacity of the screwdriver will cause serious frequency drift on the short waves.

Little has been said about the valves yet, except a short description of each one. A list of equivalents is given, together with some near equivalents. Type 6K8 is very well replaced by 6J8, and this should be sought out as the first equivalent. Others are shown on the chart. Type 12B8 is easily replaced by 25B8, although the heater current is different. The other alternatives given will need a small change in the cathode circuits. All of the triode-pentodes are difficult to obtain, but are by no means impossible through the normal trade channels. Most experimenters have one or two to hand. Type 6B8 is made in fair quantities by a British manufacturer, and no trouble should be experienced from this quarter, or the rectifier and output valves. The magic eye tuning indicator to be described later is also in good supply, and may be obtained from some of the postal services.

It was stated previously that a fair amount of noise was amplified by the I.F. stages, and passed on to the speaker as a bad background hiss. In the following "hotting up" descriptions, the resistor and condenser numbers refer to those on the basic circuit diagram.

The Noise Limiter

To deal in part with this unwanted noise, a very simple modification is possible, similar to the silent tuning devices incorporated in many of the earlier commercial models. In operation, it delays part of the signal coming from the I.F. stages in exactly the same way as the A.V.C. voltage is delayed. All background noises may be tuned out by the extra control, which may be pre-set if desired. The simple modification is shown in Fig. 1. R10, the common cathode bias resistor, now becomes a potentiometer, and. R11, the diode load resistor, is tapped into the resistance, instead of being fixed to the high potential side. The potentiometer should be of the wire-wound type, and if unobtainable R10 may remain fixed as before, and the control may consist of a 10,000 ohm carbon volume control, with the outer ends in parallel with R10. The slider is then connected as before.

To set up the control, tune to a point of no reception, and adjust until the background noise just disappears. A delay equal to the noise level of the receiver has therefore been effected, and as a result no signal under this

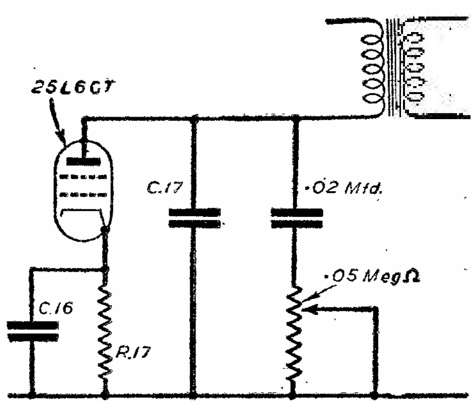


Fig. 2a.—Circuit for "top cut."

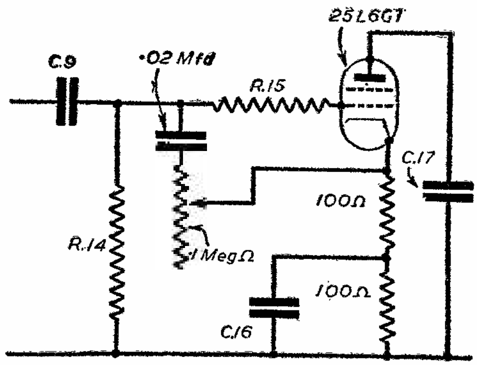


Fig. 2b.—Circuit diagram for "bass boost."

strength will be received. This is no real fault, however, as anyone who has tried to understand a programme amidst a plutter of atmospherics will realise. To cope with motor car ignition interference a more complicated system is usually required, but a useful idea is to bias the first L.F. valve back a bit, and then series a westector with the earthy end of the volume control, negative side to chassis. With a sudden burst of signal, the westector becomes non-conducting to negative voltage, thus building up a potential and cutting off the signals momentarily, through overbiasing the valve. A switch should be incorporated to short out the system when not required.

Tone Control

Tone control circuits are also an advantage when dealing with atmospherics and background noise, because most of the interference has a frequency above 7 kc/s. By sharply attenuating the high-note response, a fair proportion of the unwanted noise also disappears, whilst still leaving the programme intelligible, if rather muffled. The circuits suggested are quite conventional, Fig. 2a being the normal "top cut" arrangement, also useful for reducing heterodyne whistles. Fig. 2b is a simple form of negative feedback, or "bass boost." Component values need not be adhered to; the variable control may take the form of a variable R14, with the slider taken to cathode via a suitable condenser, .001/.02 mfd.

R.F. Circuits

The R.F. circuits in the basic model are quite good, but it may be felt that an extra waveband is desirable, or that extra H.F. selectivity would give some improvement. In the photograph of my model, an adaptation has been made to the original circuit. Medium wave coils have been fitted, and wave-change switch is provided to bring in the short waves again when required. Fig. 4 shows the essential components and the alteration to the wiring.

A more drastic alteration, Fig. 3, shows H.F. stage, with suitable switching to incorporate medium waves if desired. A triple gang tuning condenser should be obtained, less trimmers, and if possible with ceramic insulation. When planning the layout, a single point earthing system should be planned as before. A suitable valve to use is type 6J7, which is readily obtainable. As an alternative, 6K7 will do very well, although it is inadvisable to control the valve in this position with the A.V.C. bias voltage, as "over control" may take place during a fade in signal strength; that is to say, instead of signals staying constant (in the ideal case) or diminishing, during a fade, they actually become very much louder. This is partly due to the non-linear grid characteristics of the variable-mu valves.

It is as well to point out that better results may be obtained if the coil positions are reversed. As may be seen in Fig. 3, the medium wave primaries are at the H.F. side of the circuit. This means that when switched to short waves, some of the energy is absorbed by the medium wave primary and wasted, even though there is a by-pass condenser across it. If a high inductance primary winding is used, as on a wearite "Type P" coil, the positions should definitely be reversed. It is unfortunate that a suitable switch is hard to obtain, for a much better idea is to fit one of the three wafer switches which shorts across all coils not in use, and also provides for a switched primary. The small 4-unit three-way switches are in fairly good supply at the moment, and it is not such a great disadvantage to use it as I suggest. The oscillator circuit is as shown in Fig. 3 in both cases.

Tuning Indicator

A tuning indicator is desirable when medium waves are incorporated, for beside giving the normal "dead

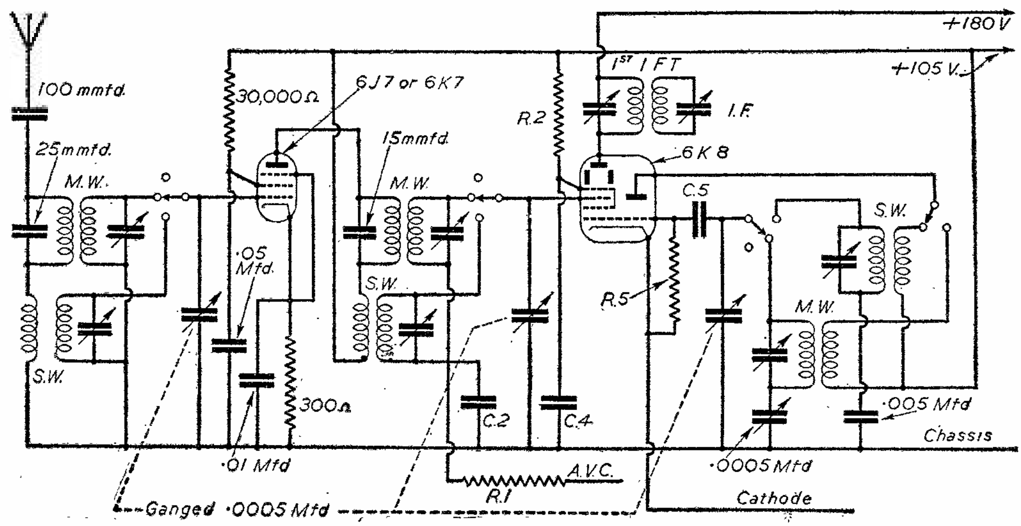


Fig. 3.—Circuit diagram, showing H.F. stage with suitable switching for medium wavelength.

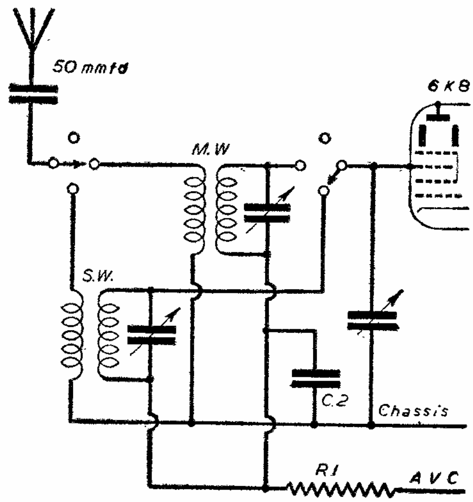


Fig. 4.—*Modified R.F. circuit.*

beat" indication, it gives a good check on fading and signal strength. Marconi/Osram Y63 "Magic Eye" valve is plentiful again, and is ideal for our purpose. The only additional components required are: 1 Y63 valve, 1 2-meg. ¼-w. resistor, 1 ½-meg. ¼-w. resistor, 1 octal valve holder. All components may be mounted on the valve-holder. Fig. 5 shows the theoretical circuit, which is extremely simple. In use, as the signal comes into tune, the area of fluorescence increases, causing the eye to "wink." Transmissions too weak to operate the A.V.C. system will not, naturally, have any effect on the eye.

The I.F. Rejector

A very irritating defect in many modern superhets is the little whistle sometimes noticed when tuning, and usually is noticed more on the sidebands of a weaker station than on a "local." Often the whistle is more powerful, and is heard on all stations, and punctuated with morse signals.

The cause is a station transmitting on or near to the intermediate frequency, and forming a beat note with the required I.F. signal. As the required signal is brought into tune, the frequency difference decreases, causing the whistle to drop in pitch, and at resonance the interfering signal disappears, to return again the other side of the carrier. This description of the symptoms must not be confused with the more serious whistles associated with I.F. instability, or "squegging" in the oscillator circuit. These faults require altogether different treatment, and guidance will be found in past issues of "P.W.", and a reliable text-book by the same publishers.

Obviously, to cure the break-through, the unwanted signal must be prevented from reaching the I.F. stages. Originally the receiver was designed for housing in a metal cabinet, and thus we have only to contend with signals introduced via the aerial system. A tuned circuit in the aerial lead is undoubtedly the best solution to the problem, and may be either series or parallel tuned. The latter is the easiest to construct, for it may consist merely of one winding salvaged from a surplus I.F. coil. This should be mounted in a screening can, with the adjustment in an accessible position. In some American receivers, I have found the filter in series with the F.C. mixer-grid lead, and it may be desirable to fit a filter in both positions, more so if the receiver is not to be operated in a metal screening cabinet.

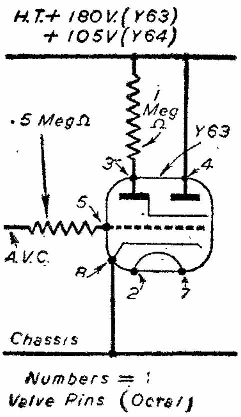


Fig. 5.—*Theoretical circuit of tuning indicator.*

To adjust the filters as shown in Fig. 6 set the service oscillator to the intermediate frequency, inject the signal into the aerial lead, and, at a point of no reception, adjust the filter for minimum response. Seal the adjustment, and do not touch again unless the I.F.'s are realigned.

Headphone Operation

A person who "burns midnight oil" would be very much out of favour with the rest of the family if it meant operating a loudspeaker in the small hours, listening to overseas transmissions. As a consequence, provision for headphones should always be kept in mind when designing a short wave receiver. Unfortunately, it is rather difficult to arrange on a mains set unless a separate output valve is used; for considering,

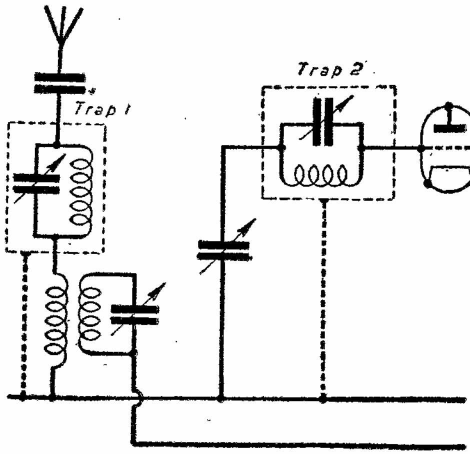


Fig. 6.—*Filter circuit.*

we can conclude: (a) That there is too much current flowing in the anode circuit of the output valve, and there is also too much power; (b) That there is insufficient power from the first L.F. anode; (c) That there is just sufficient power across the secondary of the output transformer, but nothing in reserve. Therefore, I have chosen the only other reasonable alternative method. Fig. 7 shows a three to one ratio intervalve transformer in series with the screen of the output valve, with a suitable switching device. The loudspeaker is muted when switched to phone, and the phones are inoperative when switched to speaker. This device has been used many times with great success, and I have not found the output valve damaged in any way. I can give no hard-and-fast rule as to the direction in which the transformer is used. Usually a step-down ratio is required with the normal 2,000 ohm (D.C.) phones. With the modern moving coil phones, however, the ratio will have to be calculated.

To conclude this article, I would like to impress upon the reader that this is not a complicated receiver. Every component serves a useful purpose. As a result, it is almost impossible to prune down the circuit without

(*Continued on page* 371)

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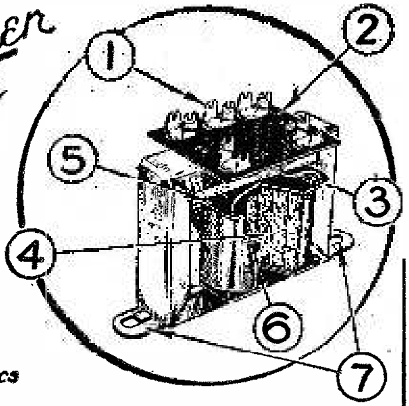

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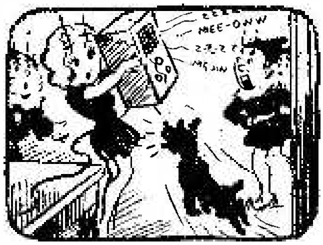

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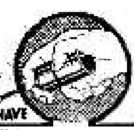

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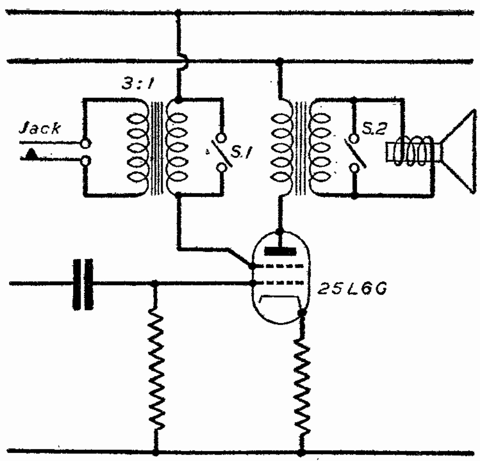

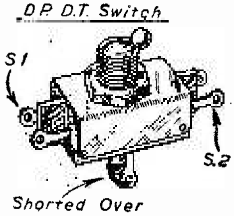

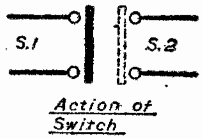

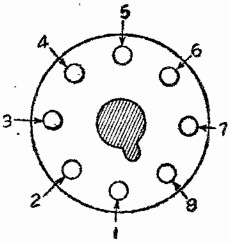

either impairing its efficiency or drastically altering the basic design. There is no need at all to build it on midget lines, as I have done. Improvement may result if the components are spaced out more widely, and no difficulty should be experienced in obtaining any of the parts. The coil matching data supplied by R. Linley in the January edition of this magazine may be helpful to those who would like to wind their own coils. If any amateur has any interesting experiences with this receiver, or any criticism to offer, I would like to hear of them, through the discussion page of this magazine.

Fig. 7.—Diagram of intervalve transformer and switching arrangements and diagram of base connections.

Valve Testing

To ensure accurate testing it is necessary to check all meters at frequent intervals. The usual procedure is to use a standard milliammeter with a long scale and obtain various voltage and current ranges by means of stabilised wire-wound shunts and series resistances. This standard—which carries a National Physical Laboratory certificate of accuracy—is kept in a safe place and sub-standard meters are compared with it daily. These sub-standards are carried round to the test boards and measurements taken direct from the valve holders. Any meters on the test boards found to be inaccurate are removed and adjusted in the meter room.

On some valves, particularly transmitters, the total electron current has to be measured. This is not possible by drawing the emission continuously from the cathode as the valve may become overheated and the cathode damaged. It is therefore necessary to provide for the anode voltage being applied sufficiently intermittently to avoid temperature changes in the valve during measurement. One method of doing this is to use a rotating interrupter run at a constant speed, working out mathematically the true value of the total emission read on the anode milliammeter.

A small percentage of each batch of valves is run continuously for 500 or 1,000 hours as a life test. The normal working voltages are applied and at the end of the period, when the valves are re-tested, the performance must remain substantially the same as at the beginning of the test. A reduction of 15 per cent. in anode current may be permissible.

Inspection

Each valve after testing is inspected to see that there are no loose particles in the bulb, no loose electrodes on the mount, no cracks in the bulb and that the base and top cap are not loose. The soldering of the pins also must be satisfactory. The glass is cleaned and polished with methylated spirits and then the type designation is marked either on the side or the top of the bulb. This marking is frequently indelibly etched into the glass either with silver nitrate or ammonium bifluoride. In the latter case a small amount of a resinous varnish is rolled out thinly on to a piece of plate glass. A rubber stamp of the design to be etched is lightly pressed on the glass and then applied to the valve. A camel hair brush is used to dust finely powdered ammonium bifluoride on to the varnish impression. Surplus powder is lightly brushed off and the bulb held momentarily in the flame of a spirit lamp. The heat burns out the varnish leaving the marking completely indelible.

A more modern idea is to print the type designation in white ink using a small electrically driven offset printing machine. Black or coloured ink is used for metallised valves. The impression, which requires a few hours for drying out, is not indelible but it is sufficiently durable to withstand normal handling during the life of the valve. Finally, the valve is packed. Those for retail sale are invariably packed individually with some indication of the type printed on the carton. Valves to be incorporated in sets are usually packed in multiple egg-box pattern cartons each holding fifty.

Gas-filled Valves

The valves already described in a recent series have had one thing in common—they have all been of the high vacuum type. There are, in addition, many specialised types of valves which are initially exhausted and then have carefully measured quantities of vapour or inert gas passed into them. One of these, called a voltage stabiliser, consists of a tubular cathode—rather like the anode in normal valves—inside which are two stiff wires comprising the anode. In the case of a voltage stabiliser, this after exhaustion, is filled with argon and helium and, in use, as the voltage applied across the cathode and anode reaches a certain value, the gas ionises with a purplish glow. This value depends on the gas mixture and may range from 110 to 180 volts. There are other types of voltage stabilisers filled with neon which ionise in the region of 170 volts.

Another type of gas-filled valve is the Thyratron which is filled with argon and has a purple glow. This valve—a triode—finds considerable use in cathode ray tube time base circuits as a saw tooth wave generator. An example of a vapour valve is the mercury rectifier which has metallic mercury inserted in the bulb after exhaustion. The mercury vapourises with a characteristic pale blue glow when the cathode is heated and it is usual to delay the application of anode voltage until ionisation has taken place.

Practical Hints

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

SPECIAL NOTICE

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Accumulator Economiser

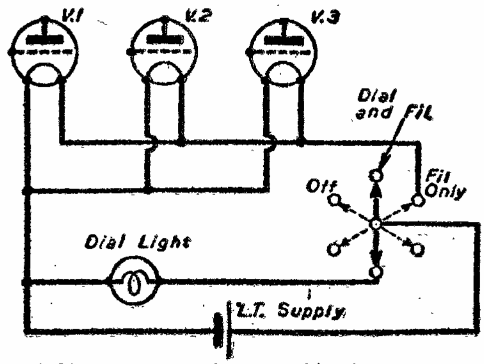
HAVING recently constructed a three-valve battery portable receiver with dial illumination energised from the L.T. supply, I found the single dial light to constitute a serious drain on the accumulator.

Not wishing to dispense with the dial light as the set is used considerably in bad lighting conditions, I devised the following simple solution which may prove useful to other constructors who experience the same difficulty.

I replaced the "on/off" switch with a rotary double-pole three-way switch and made the connections as shown in the accompanying diagram.

It will be seen that one set of switch contacts is left blank for an off position. With the switch in the second position the dial light and valve filaments are in parallel; this position being used while the station required is tuned in.

As the dial light is only required for tuning-in purposes, once the station is found, the rotary switch is advanced



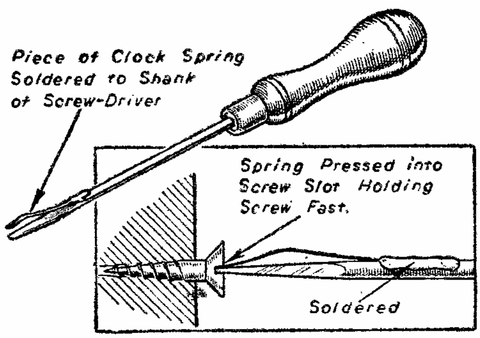
Switching arrangement for economising in accumulator current.

to its final position, which extinguishes the dial light, but at the same time leaves the valve filaments energised.

To re-tune, return the rotary switch to the second position.—D. LONG (Melksham).

Improved Screwdriver

I ENCLOSE a sketch of a handy addition to a screwdriver which can be made in a few minutes. It will firmly hold any screw in an awkward corner. A piece of clock spring is cut to the size required, and one end soldered to the shank of the screwdriver, as shown. The end of the spring is pressed close to the end of the blade before inserting it in the screw slot.—P. B. THICKETT (Tinsley).



Adapting a screwdriver for holding screws in awkward places.

L.F. Volume Control

AN L.F. volume control can be employed to advantage in most receivers. In sets using R.C. coupling between the detector and output valves the control can take the form of a 500,000-ohms or 1-megohm potentiometer. This should take the place of the fixed grid-leak in the grid circuit of the output valve. The coupling condenser should be connected to one end terminal of the control and the G.B.— lead to the other end terminal, the centre terminal being then joined to the valve grid. If transformer coupling is used, the end terminals of a 250,000-ohm potentiometer can be connected to the G. and G.B. terminals with the valve grid joined to the centre terminal. Another method is to use a potentiometer in place of the anode resistance of the detector or intermediate L.F. valve. Theoretically this is a better method than the connection of the control across the secondary of the transformer, but it is very difficult to obtain a potentiometer that is noiseless in operation when the anode current is passed through it.—L. STACEY (Hounslow).

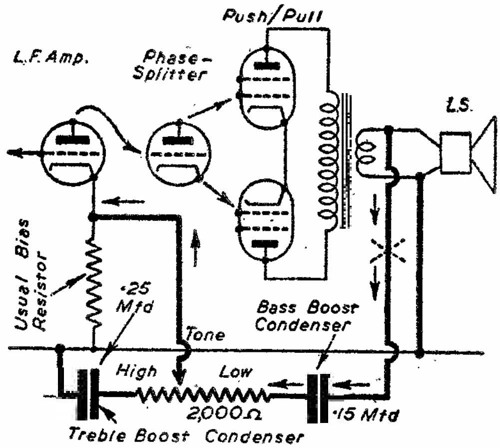
Negative Feedback Tone Control

THE accompanying circuit-diagram shows a negative feedback tone control arrangement.

The 2,000 ohms control gives a good range of bass and treble boost, and the circuit constants should be adhered to, although if more bass is required a larger condenser could be used, in which case the gain of the amplifier will be less.

If positive feedback takes place, and instability occurs, this can be checked by connecting a 3.5 volt flashlight bulb across the speaker secondary (bulb glows if unstable), then the connections to the speaker transformer should be reversed.

A potentiometer with built-in switch could be used for control and the circuit broken at "X" if desired.—R. JOHNSON (Lancaster).



Circuit diagram for negative feedback tone control.

ON YOUR WAVELENGTH

By THERMION

Some Correspondence Answered

IT is my practice to reply personally to those readers who from time to time write to me, and occasionally, when the subject is of general interest, I also deal with the matter in this feature. My correspondence is a mixed bag. A great amount of it is concerned with technical matters, a soupçon invokes my aid, and a smaller percentage are the inevitable critics, some carping, and some otherwise. Criticism is always a healthy thing, for it helps to improve the product. When the criticism, therefore, is offered in good faith I give more than ordinary attention to it. Anonymous letters suffer the ignominy of being dropped into the waste-paper basket.

One of the letters of helpful criticism arrived from Mr. A. F. Gowling, of Petts Wood, who thinks that in some ways certain of the features should be dropped. He would like to see the entire journal devoted to technical articles. That is his view, but I do not think for one moment that this view would be shared by the majority of readers. A journal which is 100 per cent. technical is as dry as dust. There must be some leavening of the pages by means of news features, criticism, correspondence from readers, and paragraphs concerning personalities.

During the war, unfortunately, with a rigid censorship, and with most firms manufacturing service equipment, with no new designs coming on the market, and a blanket of secrecy over all new scientific developments, plus the further handicap that the B.B.C. has restricted its programmes, and there is a shortage of components, it has not been easy to find the necessary ingredients with which to make the tasty editorial pie even once a month which we served up to our readers before the war once every week. Like everything else we have had to appear in utility dress, and the paper control has severely restricted editors in other ways.

So, if certain of the bright pre-war features have tended to lose a little of their lustre during the war, it must not be thought that it is due to any slackening off in the interest of contributors or staff who have been hard put to it to produce the paper at all. The "Round the World of Wireless" feature, for example, is intended as a general news feature on all that is moving in the radio sphere. The staff cannot manufacture news, and if the news is dull it must be dull. There are certain items which cannot fall into any other feature. When Mr. Gowling goes on, however, to criticise the quality of the paper, he is putting himself in the same class as the man who criticises the wartime fare allowed by the Ministry of Food. I must admit to having been a severe critic of those frightful wartime sausages myself, with their insanitary and unpalatable smell, redolent of some oleaginous mass taken from the bottom of a crankcase. I do not, however, criticise the paper on which my wartime newspaper or periodical is printed. I think the press has done a remarkable job in keeping going at all, especially in view of shortage of staff difficulties.

Mr. Gowling goes on to criticise the placing of the advertisements. He would like to see them collected together at the beginning and the end of the journal. This criticism has become a hoary old man of the woods. Periodicals to-day cannot be produced without advertisements unless the reader is prepared to pay very much more for his reading matter than he does to-day. Whilst advertisers prefer facing matter positions and have to pay a not inconsiderable sum for the space, as those who pay the pipers they are entitled to call the tune. There will be, therefore, no change in this respect. Advertisements are interesting and, in a technical journal especially, they are worthy of permanent record. I am glad to know Mr. Gowling agrees with me about crooners and similar peculiar people. I agree with him that when more normal times return we should use a slightly larger size of type.

G7 Station Suspended

THE R.S.G.B. wish to inform members that certain stations which have in past months been heard employing G7 call signs and apparently working as amateurs have, in fact, been serving a special purpose for which they received official authority. The working of this special service has now been suspended.

No amateur transmitting station in this country has, since the outbreak of war, been licensed to operate as such, although the restoration of amateur licences is under the active consideration of the authorities concerned.

The Short Wave Listener's Handbook

I HAVE received from the general secretary of the British Short Wave League a copy of the half-a-crown handbook entitled "The Short Wave Listener's Handbook," which they hope to make an annual one. It contains an up-to-date station list, codes and abbreviations, the amateur codes and a good technical section containing articles on short-wave coils, receiving aerials, formulæ, etc.

SILENCE!

[PRESS ITEM.—Sir Edwin Appleton, speaking to members of the Institute of Electrical Engineers, said: "If a very powerful sender could be erected, radio waves would travel a two-and-half-second journey to the moon and back." When asked why scientists are trying to contact the moon, he said that because of Government secrecy he was unable to give the reason.]

Quite right, Sir Edwin Appleton,
Our plans must be concealed.
The reason for these lunar trips
Must never be revealed.
In fact, so far as they're concerned,
We fear our lips are sealed.
So be careful that you do not blow the gaff.
We've found it most desirable
When public wants to know
To give no information
And firmly answer No!
And if they persist in asking,
We just tell them where to go,
So be careful that you do not blow the gaff.

The more we work in secrecy
The more our greatness seen.
P'raps we're out to prove that moon is made
Of cheese that has turned green.
If we give them that conviction,
Then upon it let them lean,
For we simply don't intend to blow the gaff.
In fact, good government consists
In "Hush-Hush! Keep it dark,"
And to look on all resentment
As a rather jolly lark.
With the public trained to foot the bill,
Their only proper part.
Here's our motto for all time: Don't blow the gaff!

"TORCH."

Our Roll of Merit

Readers on Active Service—Fifty-sixth List

V. R. Bailey (Cpl., R.A.F.).
J. Stuart (L.A.C., R.A.F.).
C. F. Warrew (L.A.C., R.A.F.).
D. G. Burt (A.C., R.A.F., M.E.F.).
D. Hope (L.A.C., R.A.F.).
J. S. Dickson (A.C., R.A.F., S.E.A.A.F.)
P. S. Ackhurst (Sgt., R.A.F.).
L. G. Jenkins (L.A.C.• R.A.F.).

An Introduction to Frequency Meters

A Brief Survey of the More Common Types in Use, and a Short Description of Their Practical Operation

By A. D. TAYLOR

A FREQUENCY meter (or in the older phraseology "wavemeter") is a device used for accurately tuning a transmitter or receiver to a given frequency. The two oldest types are the "buzzer excited wavemeter" and the "absorption wavemeter." The former is now too obsolete to merit description, but the latter will still often be found in use. The basic circuit is shown in Fig. 1, and consists of a coil, variable condenser and lamp. When the coil is brought near to the transmitter and the condenser varied to bring the meter into resonance, an R.F. current flows

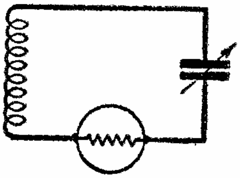


Fig. 1.—Simple absorption frequency meter.

through the meter circuit, causing the lamp to glow. The glow will be at a maximum when the transmitter and receiver are exactly in resonance, thus giving a simple visual indication of the fact. This type of meter can also be used for receiver calibration where a straight receiver is employed and only a small degree of accuracy required. The meter coil is loosely coupled to the receiver detector circuit coils, the receiver being adjusted so that it is just oscillating. The meter condenser is then revolved, and when the receiver and meter are in resonance the receiver will go out of oscillation. Provided the receiver and meter are *loosely* coupled, accuracy to within 30 kc/s should be obtained at frequencies in the neighbourhood of 7 mc/s. A much more modern version of this type of meter is illustrated in Fig. 2. It is intended for transmitter calibration and employs an indicating device consisting of a metal rectifier and micro-ammeter. Thanks to the excellent arrangements for reducing R.F. input to the indicating device to a minimum, very sharp and accurate resonance readings can be obtained.

Heterodyne Frequency Meter

The next type of meter to come into use, and the most generally used type to-day, is the heterodyne

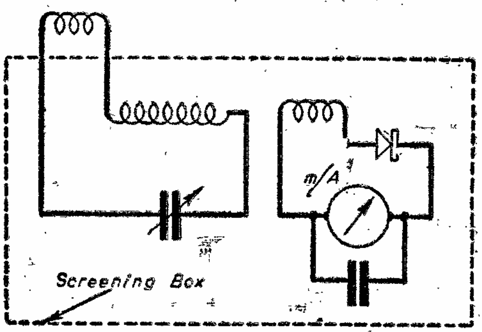


Fig. 2.—Modern absorption wavemeter.

frequency meter. In its earliest form, this merely consisted of an ordinary triode R.F. oscillator circuit, but this was soon superseded by much more stable and intricate oscillators using multi-electrode valves. There are various methods of calibrating these meters, but one of the most popular and satisfactory is the 100 kc/s crystal oscillator. This method was largely used by the amateur transmitting fraternity in pre-war days when 100 kc/s crystals were easily obtainable. These crystals were used in a small battery or mains operated oscillator circuit, and the method of calibration is as follows: The crystal oscillator, frequency meter and any available receiver covering the meter frequency range are set into operation. The desired harmonic from the crystal oscillator is then located on the receiver, and the frequency meter carefully adjusted until it is at "zero beat"

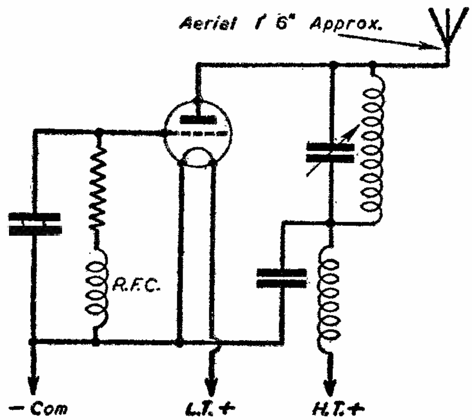


Fig. 3.—100 kc/s crystal oscillator.

with the crystal oscillator harmonic. (This is done by adjusting the meter until it heterodynes the crystal oscillator harmonic, then adjusting it to the "dead spot" where the two oscillations are exactly synchronised.) The meter dial reading is then entered on the calibration chart and the process repeated with the other crystal oscillator harmonics falling within the frequency range covered by the meter. In this way a very accurate calibration is obtained, while at the same time the crystal oscillator is always available as a checking standard for the accuracy of the meter.

When using this type of meter for transmitter calibration, an absorption type meter should also be available if possible. The transmitter is first roughly tuned with this meter, then the heterodyne meter is adjusted to the desired frequency and picked up on the receiver. The transmitter is then adjusted until it is at "zero beat" with the frequency meter. The reason for making the original rough calibration with an absorption meter is that otherwise there is doubt as to whether the second meter is being heterodyned by the transmitter fundamental emission or by a harmonic.

Heterodyne frequency meters are also constructed using telephones or a low range milliammeter to give an oral or visual indication of resonance, but there is little difference in the practical operation of these types from the one described above. This type of meter also forms the basis of the modulated test oscillator, the latter merely consisting of a heterodyne frequency meter having a source of tone modulation and some means of coupling its modulated R.F. output to the receiver under test. Typical circuits of a 100 kc/s sub-standard crystal oscillator and a heterodyne frequency meter are shown in Figs. 3 and 4.

Crystal Frequency Monitor

The last type of frequency meter to be discussed is hardly within the scope of the amateur, but it is finding increasing popularity in commercial and Service work where it is necessary to accurately adjust a self-excited transmitter to a number of "spot" frequencies, and circumstances are such that it is impossible to maintain a heterodyne frequency meter at full accuracy. This type of meter is known as the "crystal frequency monitor" and one variation of this circuit is illustrated in Fig. 5. It consists of a crystal oscillator having switched pre-set tuning for its three crystals, and a receiver having nine pre-set tuning positions. These cover the fundamental and the second and third harmonics of each crystal employed. As an example, if crystal A has a frequency of 3 mc/s, receiver setting A1 switches in a 3 mc/s circuit, A2 a 6 mc/s circuit (second harmonic) and A3 a 12 mc/s circuit (third harmonic). In this way nine "spot" frequencies can be covered with the three crystals. The operation is simple. The approximate setting for, say, 12 mc/s will be known on a commercial or Service transmitter. The set is therefore placed on this setting and the meter switched to "Crystal A" and "Tuning A3." This means that the receiver section of the meter is picking up the C.W. wave emitted by the oscillator section of the meter. If the transmitter now be started up and the controls varied slightly, the transmitter will beat with the crystal oscillator, producing an audible note in the meter telephones. The transmitter can then be adjusted to "zero beat" with the crystal oscillator and is then very accurately tuned to 12 mc/s. The writer has had some experience of using this type of meter with high power single valve self-excited H.F. transmitters, and the results obtained were excellent.

Finally, one word to the man who is about to embark on the practical operation of frequency meters. *Never let familiarity breed contempt!* It is the easiest thing in the world to make a mistake when adjusting a transmitter with a frequency meter, so always check and double check your results, taking particular care to see that it *is* the transmitter fundamental you are working with, and not a stray harmonic!

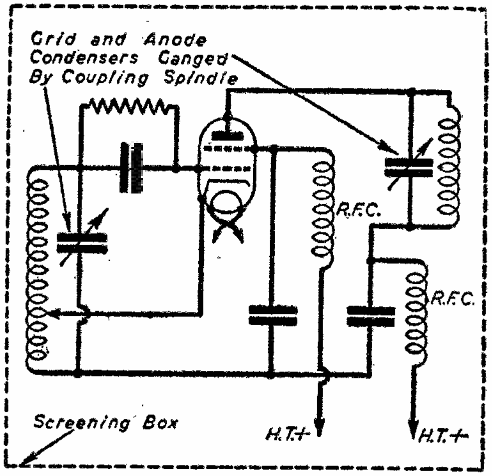


Fig. 4.—Heterodyne frequency meter.

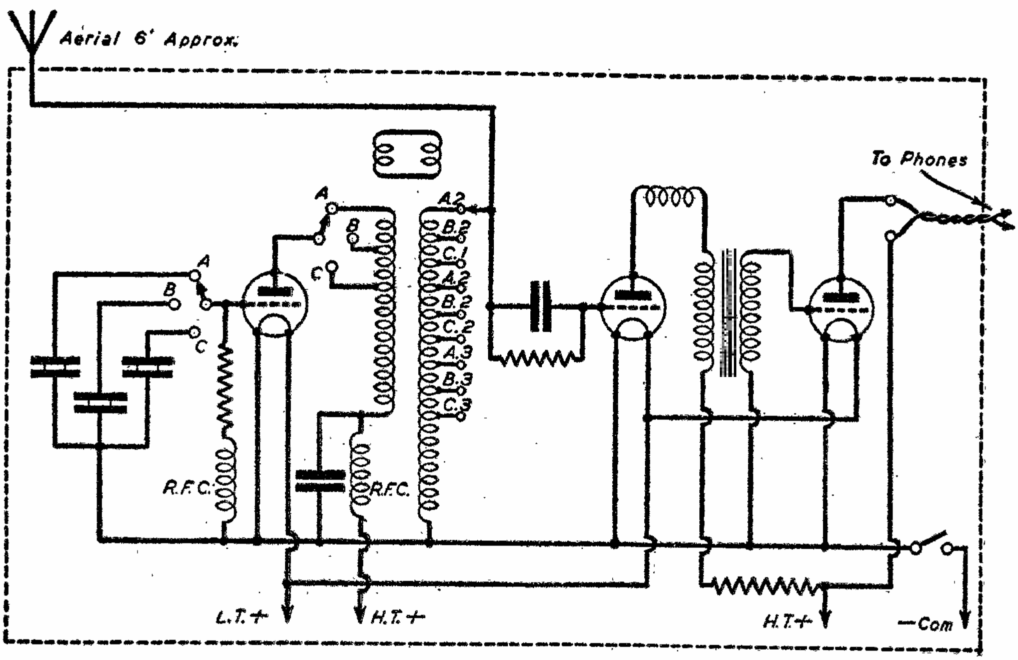
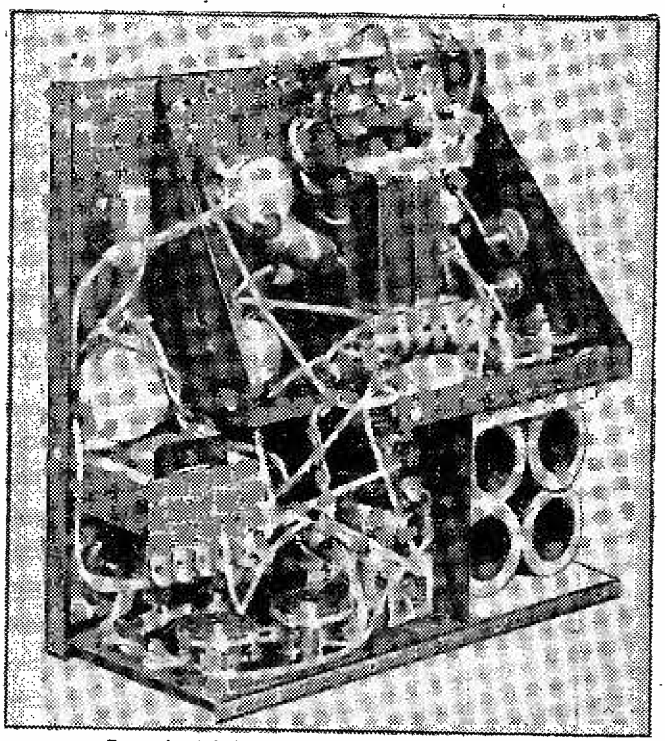


Fig. 5.—Crystal frequency monitor.

An A.C. Short-wave Four

Instructional Details of a Compact and Sturdy Receiver Suitable for Home or Overseas Use

By R. SHATWELL



Rear view of chassis, showing layout of components.

THE set here described was designed and built for use while overseas and is, therefore, of sturdy construction and quite powerful, but compact and easily carried about. Provision is made for the L.F. section to be used as a small amplifier for pick-up or microphone, and a 'phone jack is provided for solitary listening. If the 'phones are plugged into the microphone socket and used as a twin microphone, quite good results are obtained over the speech frequency, and this arrangement is quite useful for announcements, etc., if a microphone is not obtainable. No power supply is included in the set, and it requires 200-250 v. D.C. at 50-60 mA, and 6.3 volts at 3 amps for the heaters. The "P.W." Universal Power Unit will supply this, or a separate simple power unit can be made up.

Circuit

The circuit is straightforward in all respects and the controls cover practically all requirements that are likely to arise without materially affecting tuning, which helps logging considerably. Beginning at the aerial, the aerial coupling condenser is a 35 pF. stamp type trimmer, which is not adjusted after its final setting. The first stage is an untuned variable-mu one, using a 6K7, with its gain controlled by a 20,000 ohm variable resistance in the cathode lead. This is transformer coupled to the detector, which is a 6J7 H.F. pentode, with reaction controlled by a 50,000 ohm potentiometer. This gives really velvet-smooth reaction. So quietly does the detector burst into oscillation that on 'phones, at any rate, if no signal is present and the knob is turned too quickly, the operator is unaware that oscillation has commenced. Selectivity is varied by the H.F. gain control. The detector is resistance capacity coupled to the L.F. stage which uses a 6J5, upon which the L.F. gain control operates. This is also R.C. coupled to the output stage, a 6AG6 being used in this position which, fully loaded, is capable of 3.5 watts undistorted output. The amplification of this stage is very great, and a 50,000 ohm grid stopper is necessary to stop parasitic

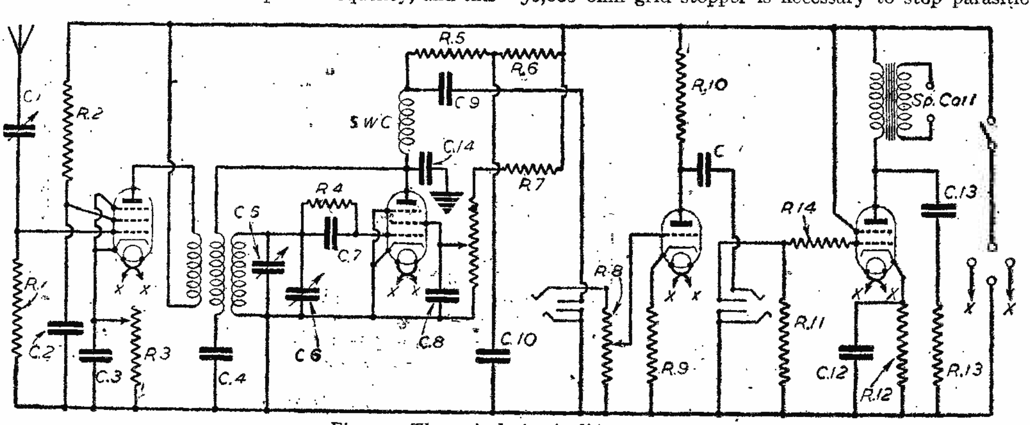


Fig. 1.—Theoretical circuit diagram.

oscillation. The pick-up jack, which automatically cuts out the radio, feeds in parallel with the L.F. gain control which is, therefore, operative on pick-up as well as radio. The 'phone jack is on the output side of the L.F. valve and cuts out the speaker. Fig. 1 is the theoretical circuit of the receiver.

Chassis

The chassis is of somewhat unusual design, which, while giving a neat front panel layout, makes for high efficiency and isolation of stages. All controls, together with power imput and speaker, 'phones and pick-up sockets, are on the front panel, which allows the whole set to be completed without connections having to be made and broken when the cover is fitted or removed. Only the aerial and earth connections are on the side of the set, but even there no connections need be disturbed. Damping from the metal case is negligible. Even on the shortest wavelengths tuning is only very slightly disturbed by the removal of the case. If possible the Eddystone tank condenser and bandspread should be used, as these give a very high degree of accuracy in logging stations, the tank or bandset being self-locating in ten .000014 sections, each of which is tuned by the .000014 bandspread. This system is not, of course, an essential, but merely a convenience. If these are used, it will be found that the minimum wave-

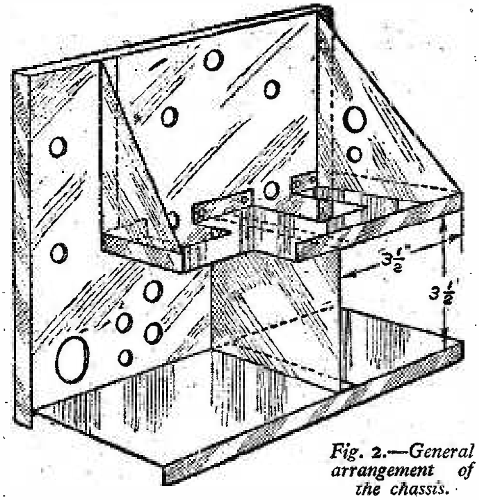


Fig. 2.—General arrangement of the chassis.

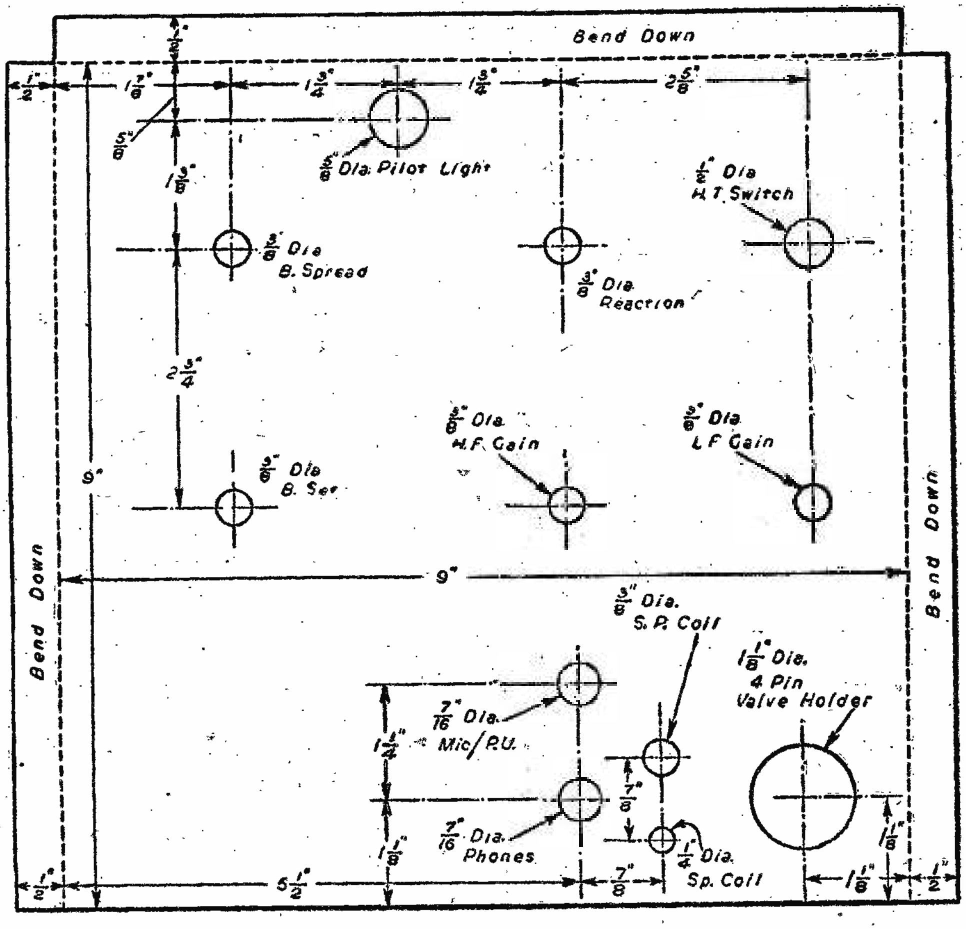


Fig. 3.—The front of the chassis, giving the spacing for the various holes.

length of the coils will be slightly higher than stated by the makers, as the tank condenser has a rather high minimum capacity. The Eddystone bandspread has an integral vernier, and, if another type is used, that does not include this, a straight through vernier drive should be fitted to it and the condenser mounted on a bracket stood off the front panel. A stowage compartment is provided for four coils which, with the coil in the set, will cover all the short-wave bands and the Home and Forces programmes. The total size of the set is 9in.×9in.×4in.

Fig. 2 shows the general layout of the chassis, which is built in two shelves, the lower being the L.F. section, and the top one the H.F. section. The whole set is of metal, and the front panel is an integral part of the chassis. 22 s.w.g. tinned steel is used for the whole set, and no difficult metal work is encountered in its construction. The valve holders, and coil holder if necessary, are mounted on ⅝in. distance pieces above the chassis, as this enables shorter wiring to be run. The front and back of the set are shown in Figs. 3 and 4. Fig. 5 shows the two support brackets for the H.F. shelf, together with the coil stowage division. The aerial and earth connections are made by sockets in the end support of the H.F. shelf. The earth connection goes direct to chassis, but the aerial connection is, of course, isolated, the ⅜in. diameter hole being for this purpose. Similarly, one of the speech coil sockets must be mounted on a piece of insulating material, and an oversize hole is provided in the panel for this reason. If the insulating material is made large enough to mount both sockets, and an

LIST OF COMPONENTS

C1—35 pF. stamp type trimmer.	R1—.5 ohm.
C2, C3, C8, C11—.1 mfd.	R2—25 k.
C4, C14—.0001 silver mica.	R3—20 k. variable
C5—.00014 bandset	R4—4 ohms.
C6—.000014 bandspread.	R5—100 k.
C7—.0002 mica fixing type or silver mica.	R6, R13—10 k.
C9, C13—.01 mica.	R7, R14—50 k.
C10—2 mfd.	R8—.5 ohm potentiometer
C12—25 mfd. 25 v.	R9—1,000 ohms.
1—.5 mfd.	R10—75 k.
	R11—1 ohm.
	(R1–R11: ½ watt.)
	R12—180 ohms 2 watts.

Output transformer; two 'phone jacks; two Raymart knobs, one with 3in. skirt; one Raymart 3in. dial and pointer; On/Off switch; three small pointer knobs; one S.W. choke.

Valves: 6K7 or KTW63; 6J7 or Z63; 6J5 or L63; 6AG6 or KT61.

Coils and coilholders: Eddystone or Raymart.

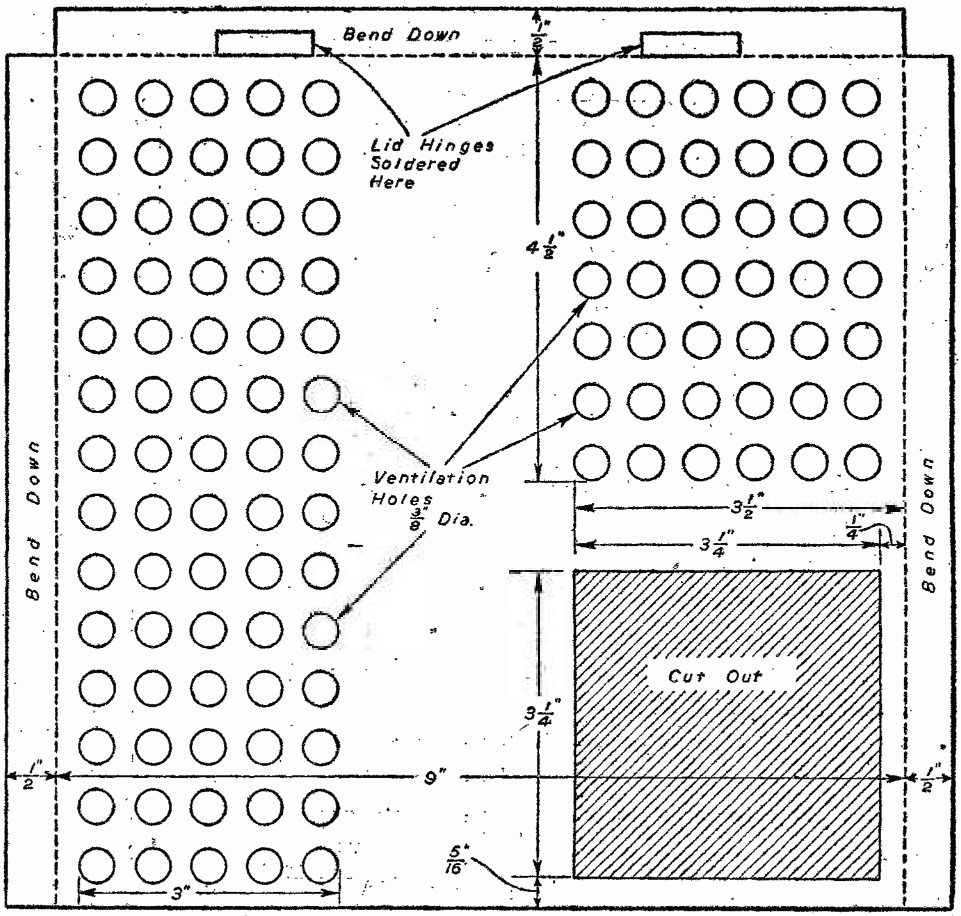


Fig. 4.—Rear view of chassis, showing ventilation holes.

additional piece placed behind the chassis on the isolated one, the earthed socket will anchor it firmly and prevent shouting which, while not serious, will, of course, result in a complete cessation of signals. Alternatively, one of the paxolin L.S. strips with sockets can be used instead of two separate sockets. This also applies to the aerial and earth sockets. The pilot light is fixed so that the glass bulb is outside the front, protected by the cover, which throws the light down over the front of the set, facilitating tuning in the dark, without being too easily damaged.

Chassis Parts

When making the chassis parts it is as well to work to a system that allows errors in workmanship to be corrected as you go. Check the fitting of the bandset into the slot in the H.F. shelf (Fig. 6), and modify the slot if necessary. As each piece is made and bent, check its measurements and, if necessary, modify the next piece to suit, provided, of course, the error is slight. Assemble the front and shelves, with supports and coil partition, and mount all panel components and position the remainder before fitting the back. This done, fit the back and check the overall measurements before making the sides.

It should be noted here that the top, back and sides are permanently bolted together after enamelling, and drop over the set, fixing by self-tapping screws, four down each side, two at the top front edge and four at the back of the bottom shelf. The lid is fixed by two small hinges soldered to it, and to the top tip of the back. The joggled portion required on the lid and coil stowage cover is merely a step in the metal which is quite easily obtained with two strips of metal and a vice. About 18 s.w.g. metal of any kind will do.

(To be concluded)

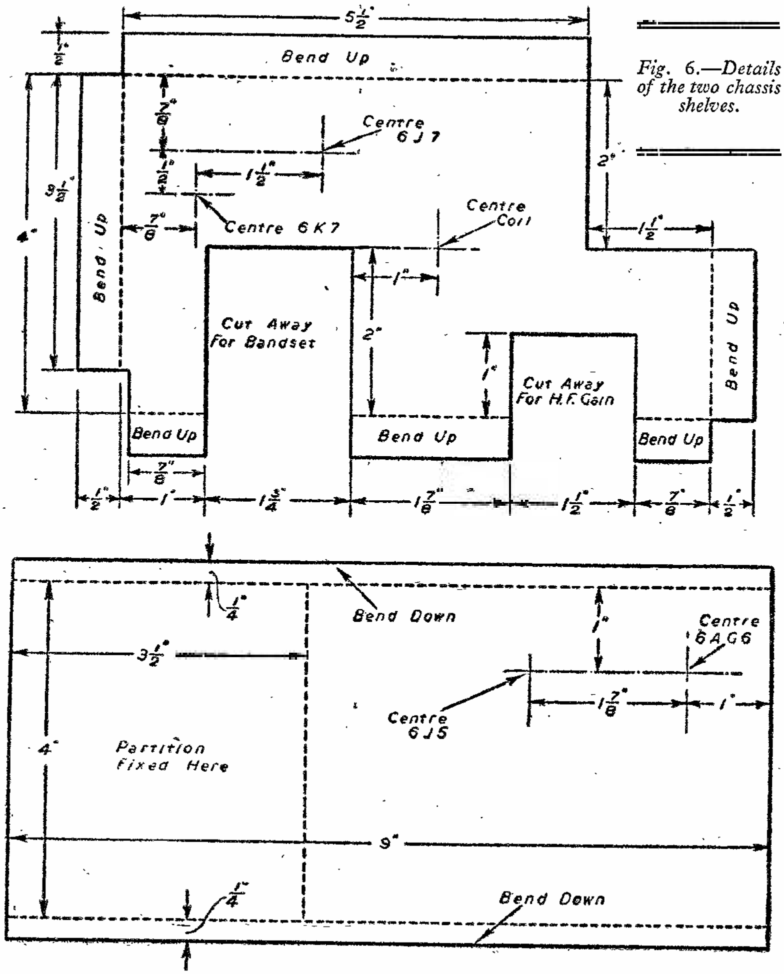


Fig. 6.—Details of the two chassis shelves.

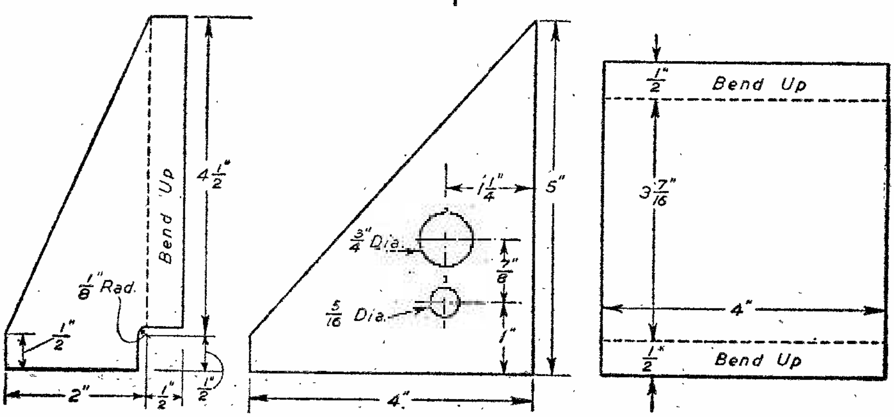


Fig. 5.—The two supporting brackets for the H.F. shelf, and the coil stowage partition.

A Multi-range Meter

Constructional Details of a Useful Unit for the Constructor or Service Engineer

QUITE a number of articles have recently been written about extending meter ranges, the popularity of this subject being due, no doubt, to the reappearance on the open market of an increasing number of meter movements. Indeed, at the time of writing, there is appearing in PRACTICAL WIRELESS a series, by 2CHW, on this very subject. The value of these articles is further enhanced by the fact that the purchase of a multi-range meter is now well-nigh impossible. Whilst this article is in no way intended to supplant the others, it is hoped that it will illustrate the practical application of the principles involved, and if the amateur constructor or service engineer cares to read on, he will find, at his disposal, the basic design of a versatile piece of workshop equipment. I use the word "basic" in preference to "specific," as it is highly improbable, during these times, that the original instrument could be duplicated in detail.

Most of the service engineer's requirements are adequately met by the now common 1,000 ohms/voltmeter, but, in keeping with the rest, it fails when one has to deal with A.V.C. voltages. For this branch of the work a valve voltmeter is essential and, realising this, the writer set out to build one. This instrument was to be built around a 0-1 mA. movement, and as this unit cost about £3 (and as the writer is resident in Scotland !), it was decided that it should really earn its keep! The result has been an instrument, without undue complications, providing the following ranges:

(1) *0-.1 v. D.C. ⎫
(2) 0-10 v. D.C. ⎬ @ 1,000 ohms/volt.
(3) 0-100 v. D.C. ⎪
(4) 0-500 v. D.C. ⎭
(5) 0-500 v. A.C. @ 1,000 ohms/volt.
(6) 0-50,000 ohms.
(7) 0-10 mA. D.C.
(8) 0-100 mA. D.C.
(9) 0-500 mA. D.C.
(10) 0-1 v. D.C. ⎫
(11) 0- 10 v. D.C. ⎬ @ 100,000 ohms/volt (valve voltmeter).
(12) 0-100 v. D.C. ⎭

* This is very approximate and only indicates that the meter movement is connected directly to the panel terminals. This provides the current range of 0-1 mA. D.C. and permits of the meter movement alone, being easily connected to other pieces of equipment.

Apart from consideration of cost, it is very handy to have all these ranges available at the "flip of a switch," nearly every measurement encountered in servicing being covered, which is much more convenient than having to resort to several different meters. The actual meter movement used was obtained from Messrs. Webb's Radio. It has a F.S.D. of 1 mA. and an internal resistance of 124 ohms, and apart from being clearly graduated in divisions of .02 mA., it also has an ohms scale marked from 0-50,000 ohms.

As was stated previously, a great deal has already been written on the subject of extending meter ranges, so no detailed description will be given here. However, a short explanation of each function might not be out of

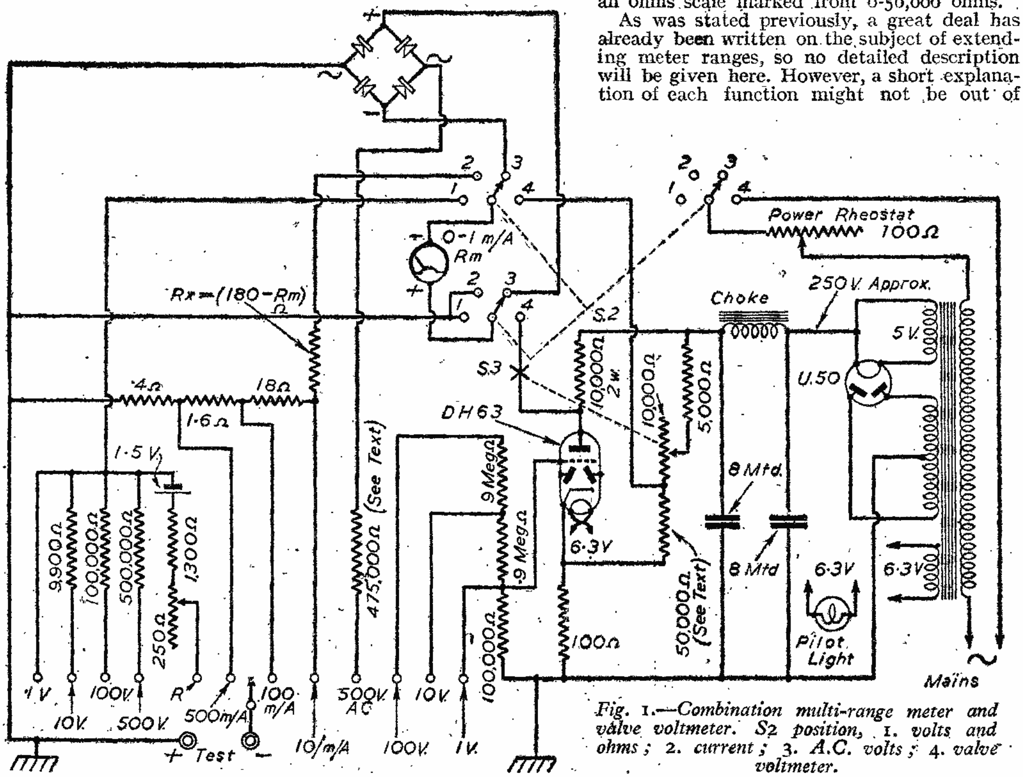


Fig. 1.—Combination multi-range meter and valve voltmeter. S2 position, 1. volts and ohms; 2. current; 3. A.C. volts; 4. valve voltmeter.

place and will, no doubt, help to clarify the complete circuit diagram.

D.C. Voltmeter

A resistance R is connected in series with the meter, the current flowing being a measure of the voltage applied. For a 1 mA. movement R is:

10,000 w. (inclusive of Rm) for a F.S.D. of 10 v.
100,000 w. for a F.S.D. of 100 v.
500,000 w. for a F.S.D. of 500 v.

The accuracy of the readings depends on the accuracy

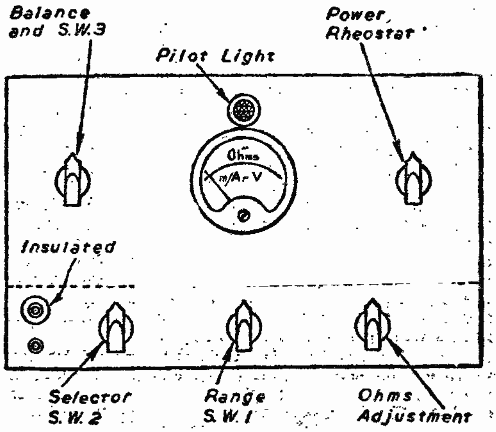


Fig. 2.—Panel layout.

of the resistors. The meter resistance can be ignored on the higher ranges.

In this case R must be chosen according to the metal rectifier used and using the manufacturer's data. Failing this, the value of R must be found experimentally (as did the writer) by comparing readings with those of an accurate meter such as the A.V.O. model 40. For the range 0-500 v. A.C., R was found to be approximately 475,000 ohms.

D.C. Milliampmeter

To obtain the current ranges the meter movement must be shunted, and in this particular instrument the universal shunt method has been adopted. This method does not seem to have received much attention in recent articles (unless it has escaped my notice), so it will be dealt with more fully here. It will be seen, from a consideration of the circuit diagram, that as the higher ranges are switched in so less resistance is shunted across the test terminals, and *simultaneously more resistance is included in the meter side.* This will be more clearly understood from the subsidiary figures A and B.

It will also be noticed that the total resistance "round" the meter (and inclusive of R_M) is always constant. Bearing this in mind, it is a good idea to make the total resistance $R_T=(R_1+R_2+R_3+R_4+R_M)$ have some arbitrary value from which to work. Since the meter in question has a resistance of 124 ohms this total resistance was chosen as 200 ohms. Now, by applying the formula appropriate to this method, the values of the various shunts can be derived.

(1) 500 mA. range: $R_4=\frac{R_T}{N}=\frac{200}{500}=.4$ *ohms.*

(2) 100 mA. range: $R_4+R_3=\frac{200}{100}=2$ ohms.

$\therefore R_3=1.6$ *ohms.*

(3) 10 mA. range: $R_4+R_3+R_2=\frac{200}{10}=20$ ohms

$\therefore R_2=18$ *ohms.*

From this it is obvious that R_1 should have a value of:

$R_1=200-(R_4+R_3+R_2+R_M)$
$=180-R_M.$

Tabulating these results, therefore, for the complete milliammeter

$R_4=.4$ ohms
$R_3=1.6$ ohms
$R_2=18$ ohms
$R_1=180-R_M$ ohms.

The chief advantage of the universal shunt is that switch contact resistance has no effect on the readings—an important consideration. Should any of the shunt resistors "open," then the total current being measured would flow through the meter. However, if those resistors are constructed of stout wire there is very little likelihood of such a catastrophe.

Ohmmeter

R_1 and R_2 are adjusted to approximately 1,500 ohms, so that the meter reads full scale (or zero resistance on the ohms scale) with x shorted. The inclusion of the unknown resistance at the point "x" causes the current to fall, and the value of the resistance is read directly on the ohms scale.

Incidentally, this is the set-up used to determine the internal resistance of the meter if this is unknown. With "x" shorted R_2 is adjusted, so that the meter reads exactly full scale. A rheostat is then shunted across the meter and adjusted so that the meter registers exactly half scale. The meter and rheostat resistances are then of the same value, and the value of the rheostat can be found in the conventional manner. *No ohmmeter or other measuring instrument should be connected directly across the meter.*

Valve Voltmeter

The fundamental circuit of the V.V.M. is illustrated here. It will be seen that the valve (the triode portion of a DH63—an H63 would, doubtless, be suitable) forms one arm of a balanced Wheatstone bridge. The

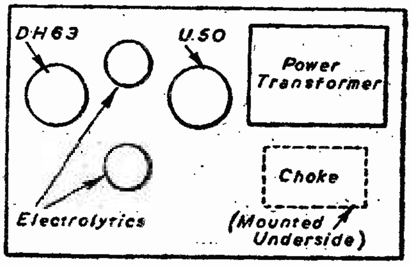


Fig. 3.—Chassis, showing position of main components.

application of the unknown voltage to the grid of the valve upsets this balance, the change being recorded by the meter. The constants of the circuit are so chosen that the application of 1 volt (—ve) causes the meter to read full scale. The three ranges (1, 10 and 100 volts) are obtained by using a voltage divider with $R_1=100,000$ ohms, $R_2=900,000$ ohms and $R_3=9$ megohms. R_B is the balancing control. All readings are at 100,000 ohms/volt.

These, then, are the various functions performed by the completed instrument, and now it only remains to be shown how, by means of suitable switching, they are all comprised in one unit. As it is anticipated that only experienced constructors will attempt the construction of this instrument no detailed drawings are being appended. From my own experience, the placing of the various components does not seem at all critical, so the constructor is left to satisfy his own fancy in this matter. All the necessary components, in my own model, are very "comfortably" housed in a 12in.×7in.×7in. metal cabinet supplied by Messrs. Berry's (Short Wave), Ltd. This instrument case is finished in black crackle enamel, which is most attractive, and lends quite a professional and distinctive appearance to the outfit.

Referring now to the complete circuit diagram, a few hints will be given on general constructional matters and the adjustment of the valve voltmeter.

Switch 1. The only type available at the time of construction were small 3-pole 4-way switches. However, after the removal of the two small stops, thus permitting complete rotation, and the removal of two of the wiping contacts (both simple operations), the result was a neat little 12-way stud switch. It is necessary to short the three soldering tags corresponding to the wiping contacts.

Switch 2. This is the same type as Sw.1 without any modification.

Switch 3. This is mounted on the balancing control and, in the "off" position, it isolates the meter whilst the valve voltmeter is warming up. This is necessary as the meter current rises to a value of about 3 mA. before settling down. After a minute or so the meter will register a "negative" current and the balancing control must then be adjusted so that the pointer registers zero.

With reference to the valve voltmeter itself, circuit values have been given and these will be found to be approximately correct. However, due to differences in valves, etc., each instrument will require individual adjustment. After the circuit has been set in operation an accurately known voltage of 1 volt should be applied to the test terminals whilst S1 is in the 1v. (fig 1.) (V.V.M.) position. The meter pointer should just reach full scale. If it falls short, the 50,000 w. resistor (connected to the cathode of the DH63) should be lowered. If it goes beyond full scale, the 50,000 w. resistor should be increased. The wattage rating of this resistor should be of generous proportions. In fact, in the writer's instrument, 6 ½ megohm 1 w. resistors are used in parallel. It was found that this combination gave just the required resistance and allowed operation without any trace of heating. (A little expensive, perhaps, but very efficient and no trouble is anticipated from this source!). The accuracy of the 10 v. and 100 v. ranges (V.V.M.) naturally depends on the accuracy of the .9 megohm and 9 megohm resistors incorporated in the voltage divider. To compensate for small variations in line voltage, a power rheostat has been included in the primary circuit of the mains transformer. For those interested in even more stable operation, a voltage regulation system could be incorporated in the power pack. However, as this instrument was built, more for the general investigation of faults in AVC circuits than the measurement of *absolute* values, this refinement was considered unnecessary. After all, will the average service engineer condemn an AVC circuit because his meter reads, say, 2 v. instead of 2.2 v.?

One final word about the shunts. The .4 w., 1.6 w. and 18 w. resistors should be very accurately wound, using heavy wire (the wire off an old filament rheostat will do). Rx should then be wound to a greater value than that calculated for the meter in question. By comparing readings (on any current range) with those of a reliable meter, Rx should then be reduced until the readings on both meters are identical. Provided that the construction of the low resistance section of the shunt has been accurately carried out, all the current ranges will be found to be "in line."

For a more detailed discussion of the principles of this valve voltmeter circuit (and nearly every other V.V.M.) the reader is referred to "Vacuum Tube Voltmeters," by John F. Rider.

Direct Disc Recording—8

Standard Characteristics—Equalisers—Main Amplifier—Monitoring

WE saw in the last article how it is necessary to apply a certain amount of pre-emphasis in the high frequency end of the scale as the recording approaches the centre of the disc. The distance from the centre at which this compensation should start can be fixed more or less definitely for all purposes as being at a groove diameter of some 5 inches for 78 r.p.m. recording and some 11 inches for 33⅓ r.p.m.

In actual practice it is hardly necessary, and seldom carried out, for normal 78 r.p.m. recording with direct discs, when a modern lightweight pick-up with properly shaped stylus is used for playback. It is not considered good practice to record at an inside diameter of less than 4 inches at 78 r.p.m. in any case, as we have already seen in a previous article.

The question of pre-emphasis, and how much to apply, depends a great deal on the type of recording being carried out and a number of other considerations, which are best left to the recordist concerned, as no hard and fast rule can be laid down in an article of this nature. In any case they are peculiar to the 33⅓ recordings with which the private user will not, if he is wise, attempt until he has become very thoroughly experienced with the more usual 78 r.p.m. methods. The exact method by which this pre-emphasis is carried out varies with the type of equipment. Usually it is done by means of a variable control linked to the feed mechanism of the cutter head, which increases the amount of pre-emphasis as the head approaches the centre of the disc. The actual amounts required can be set up beforehand by means of alterations to the tone control circuit used in the compensator unit.

Standard Characteristics

There have been many attempts to establish an "ideal" characteristic in the past, such as constant-amplitude favoured by the crystal enthusiasts, to several combinations of constant-amplitude cum constant velocity. Indeed, there are three characteristics being used in America at the present time and several professional equipments include the necessary compensation and switching for altering the overall response of the play-back equipment to suit any one of other of these three. For the home enthusiast it is still more difficult because he has to cater for the commercial pressings, which vary in themselves, and also his own direct recordings, with perhaps a sprinkling of other direct recordings of his friends or professional transcriptions, all of which vary in their characteristic. It will therefore be seen how necessary it is, and how useful it would be, for some universally fixed and used standard characteristic for all direct recordings.

An attempt at this has been made by the American "National Association of Broadcasters," who have published a list of proposed standards covering quite a large number of points dealing with electrical transcription work. The standard characteristic which they propose is shown in Fig. 1A and it will be seen that a rise of 15db at 10,000 c. p. s. is called for. This calls for a large power output amplifier, even if the cutter works from a low input, and will be found rather unnecessary for most private users. Indeed, in the author's opinion, it is too large a "lift" for any normal purpose and one has only to listen to the majority of American transcriptions to realise that it is, in fact, too much, the response being "edgy" to say the least. This probably accounts for quite a lot of the really terrible American transcriptions which are frequently broadcast over the American and B.B.C. transmitters. In the latter case it is quite probable that it is even worse, due to incorrect equalisation, not from lack of knowledge, of course, but due to the fact that the B.B.C. recording characteristic is nothing like the American.

It is, of course, very necessary for any large studio, commercial or private, to establish a characteristic of their own and keep to it, and it is, of course, quite possible for them to do it. The B.B.C. have their own standard which is very rigidly kept to, as the author happens to know, and as all their direct recordings are carried out to this standard no trouble arises. The commercial shellac pressings are also kept to a definite standard; or at least they are supposed to be, there is mounting evidence that quite considerable deviations have been made from time to time on some recordings; and it is certainly to the advantage of the private user if he aims at a definite standard characteristic. Small deviations will make very little difference, but it is desirable that some sort of standard should be aimed at. The author suggests a characteristic similar to that in Fig. 1B as being one which can be obtained with little trouble, using good quality, well-designed equipment and one which can easily be adapted to commercial pressings when this type are reproduced in the ordinary way.

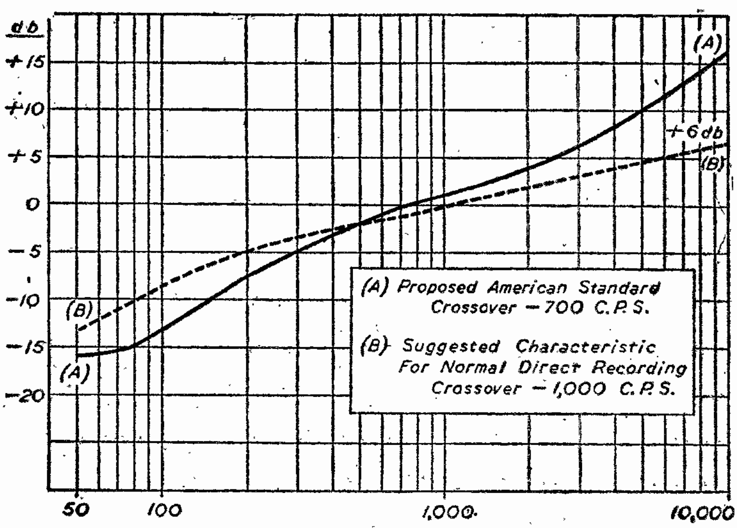


Fig. 1.—Characteristic curves for recording crossovers.

The author has used this standard consistently for a long period with excellent results on all types of recording. The equipment used both for recording and playback is capable of a really high degree of quality without any elaborate and expensive "gadgets." After all, the home user does not want to have to use special playback equipment each time he plays commercial pressings because his recording amplifier is fixed for some fancy characteristic which differs widely from the usual standards.

Certain rules have to be kept to in all cases, such as the modified curve below the region of 500 c.p.s. to prevent excessive amplitudes and the desirability of increasing the higher ends to get a better signal to noise ratio on playback. These, fortunately, do not cause quite so much trouble as one would imagine at first, chiefly because we are not concerned with recording sine waves, all the time of equal energy at all frequencies. The energy content of sounds with which we shall be most concerned with are greatest in the middle frequencies, falling off quite appreciably in the bass and treble registers.

We can therefore record at a higher level in both the bass and the treble than we could otherwise do, without fear of overcutting, or of presenting too steep a wave front in the higher end. This is doubly useful as we shall see. First, because it enables us to record at a slightly higher level in the bass, which means rather less boost will be required on playback, also a higher level in the treble so that on playing back we can afford to use a slight treble cut which enables us to cut out any background noise due to needle hiss, disc variations, etc. Secondly, it means that our overall characteristic can be more uniform throughout and the less compensation and faking we can use, the more likely are we to obtain really first-class quality on the finished record.

The final decision must be made by the user himself as to how much emphasis is used and where it is used, for no matter what the "experts" say the final answer is always "does it please the listener." If it does then it's right.

Equalisers

First, it is necessary to obtain a constant amplitude characteristic below about 400/500 c.p.s. for reasons already discussed. Equalisers for performing this can either be inserted in the main amplifier, or between the output transformer and cutter head. In the higher class cutter heads they are included in the head and no other equalisation is needed for all the more usual purposes. If they have to be put in it is perhaps the better practice to include them in the intermediate stages of the amplifier, rather than between the output and the head, as this can lead to quite severe distortion. A suitable bass attenuator can quite well be included in the tone control stage and has, in fact, several advantages if fitted in this stage.

Secondly, some form of treble boost must be provided for to lift the top end of the scale, so as to give a rising characteristic in recording which, when attenuated on playing back, gives a reasonably level response with a good signal to noise ratio, and an attack on speech and music which makes the recording "live," as though the orchestra were right in the room and not away back behind the loudspeaker. This again can be carried out in the tone control stage.

A properly designed tone control stage is an essential to any recording system and if one is used which is correctly designed it will fill all the requirements of the normal user. Special equalisers for experimental work, or for obtaining some special characteristic, can always be included at suitable points where desired, with a shorting switch to give the "normal" position.

Many tone control circuits have been published from time to time, the better class types are all good and suitable for our purpose, it is more a matter of general choice as to which one is used. Fig. 2 shows the type which the author recommends as being perfectly satisfactory as a basis to work on. Alteration of the condensers, resistances and choke can be made to give slight differences in the overall characteristic if desired, the basic circuit remaining the same. No originality is claimed for the circuit, it is quite a well-known standard type which has proved very reliable in use.

Most tone control stages of good design use a valve to compensate for the usual loss occurring in the circuit.

It is essential that this valve be carefully decoupled and that a really first-class free-from-ripple H.T. supply be provided. Tone control stages can be a very bad source of hum pick-up, and they should always

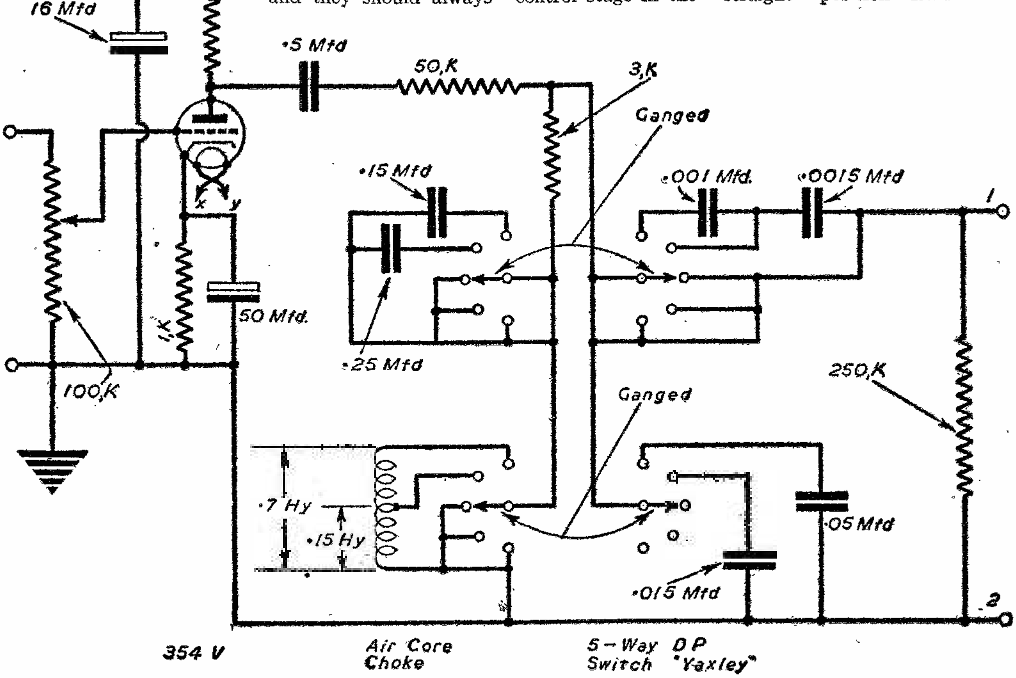


Fig. 2.—Tone control circuit.

be inserted well away from any A.C. component such as the mains transformer, particularly if they use, as most do, an air core choke for high frequency boosting. Whilst on this subject it might be as well to mention the question of suitable layout of the tone control/mixer stages and the main amplifier.

It is very desirable that the mains unit should be separate from the mixer and tone control stages. The latter can be in the form of a small unit with sloping panel close to the operator, whilst the output stages and power pack can be on another panel, probably rack mounted. Alternatively the mixer unit can be separate; the tone control stage, voltage amplifying stages and output stages can all be on the one chassis, with the power unit quite separate. The author's equipment is built like this and is absolutely hum-free in all conditions; it also has the advantage of very easy and clean construction.

The Main Amplifier

The main amplifier should be capable of providing the cutter head with sufficient power to operate efficiently; the output will depend upon how much power the cutter requires. In any case it is very desirable that at least three times the power required by the cutter is provided and in no case should it be less than 6 watts. There is no question that power triodes are the most suitable for recording work, and although good results can, and are, obtained with pentodes having plenty of negative feed-back, applied experience shows that the triode more than compensates, in final results, for the slightly extra driving power and associated trouble required.

An amplifier using two valves of the PX25 class in push-pull, together with a good quality cutter requiring something of the order of 0.6-1.5 watts, will produce really first-class results which will leave nothing to be desired.

The main amplifier—which should include the tone control stage in the "straight" position—should have as good an overall frequency response as possible, which should certainly be not worse than ± 1 db in the range 30 to 8,000 c.p.s. and could quite well be extended to 10,000 c.p.s. without much trouble. It should be absolutely hum free. This cannot be stressed too highly; the slightest hum should not be tolerated, as it will show up as a nasty rumble on the recording, besides upsetting the response as a whole. The complete equipment should be so hum-free that it is quite possible to "put one's head in the speaker" before it is apparent that the equipment is live.

Good quality components should be used throughout, especially for the coupling condensers, which should be mica for preference and have a really high insulation resistance. The output transformer should be as good as it is possible to buy, as it is the most important component in the amplifier. It is quite easy to obtain the above-mentioned response in pre-amplifier, voltage amplifying and output stages, but this will be no use if a badly designed output transformer is used.

Fig. 3 gives the circuit of the author's amplifier, which is quite a well-known conventional type. It is very doubtful if this can be improved in any way as regards quality and the reader can rely upon getting the very best possible results by using this circuit with good components. The only alteration which some may prefer is the input circuit known as the Schmitt circuit, after the designer, which gives a more true push-pull driver stage than the original. It has the merit of requiring two less 16 mfd. condensers and a bias decoupling condenser but, on the other hand, the cathodes of the

(*Continued on page 387*)

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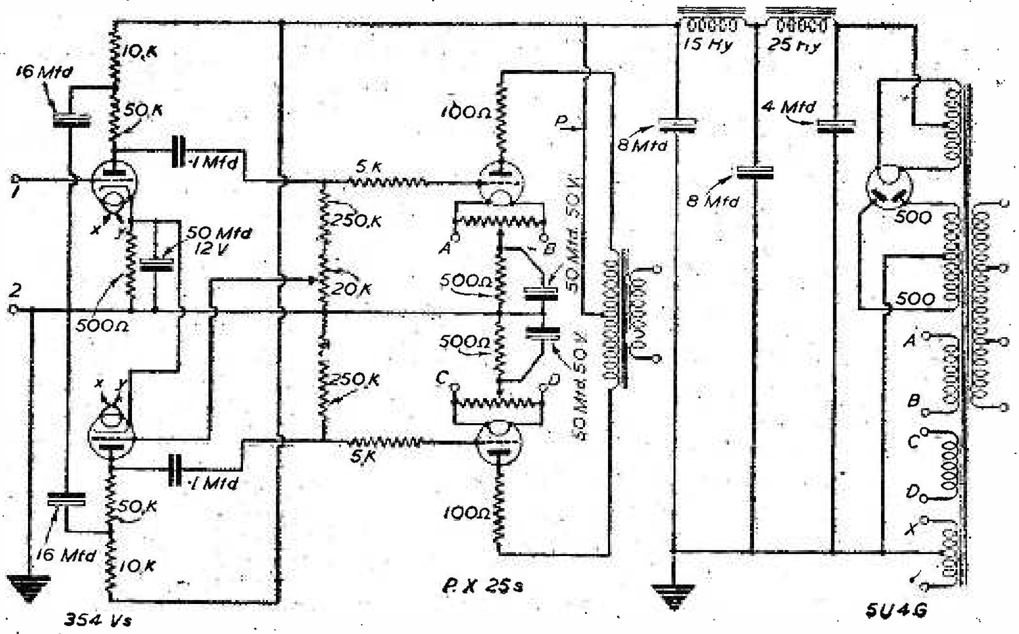

Fig. 3.—Circuit of well-known conventional type amplifier.

two input valves are some 70 volts up, which is not very desirable. It is a matter of personal choice which input circuit is used; either are excellent for our purpose.

The circuit lends itself to a very easy and clean layout and despite its excellence is quite cheap to produce. The mains unit should be well designed with two stages of smoothing; filament windings should be centre tapped and balanced to earth, with a separate winding for each output valve so that self-biasing can be used. Total harmonic distortion of this type of amplifier should be under 1 per cent. when giving full rated output. It is convenient for the tone control stage and the two driver stages to be mounted on the same chassis with the output valves. The former can all be fed from the same filament winding. Little need be said regarding the layout and wiring as ordinary general practice can be followed, always remembering that a recording amplifier must be as perfect as possible and that it pays a good dividend to put the best into it.

The tone control stage, together with the amplifier shown, is quite suited for use with either radio or pick-up input, but will require an extra stage of amplification if used with a microphone.

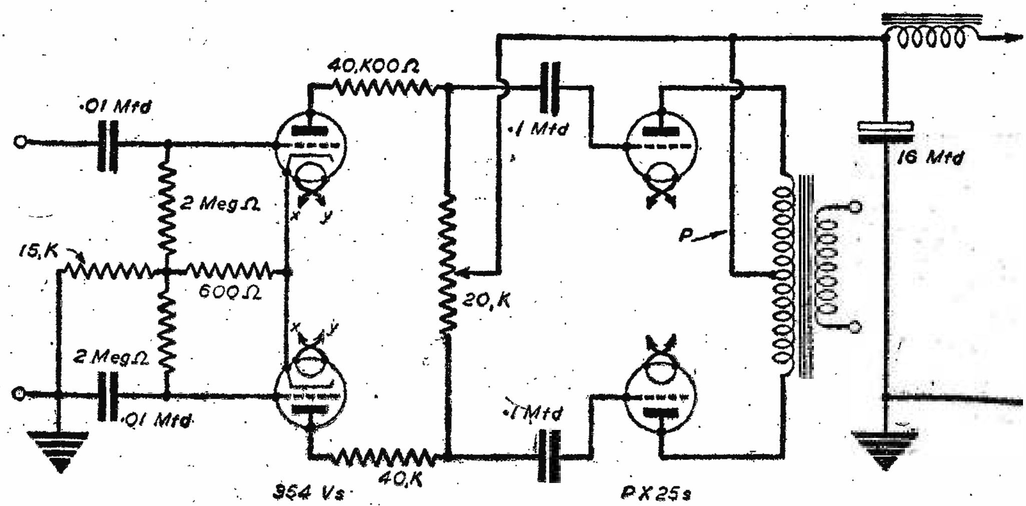

Fig. 4.—Alternative input (Schmitt circuit). To balance, in each case, insert 50 resistor at P. With 1,000 c.p.s. input balance 20 k. potentiometer to minimum signal—with 'phones across P.

Monitoring

It is essential that some form of monitoring should be provided if one is to obtain the best results. Several ways of doing this can be arranged—from the simple, high-impedance loudspeaker placed across a low mpedance head to the more elaborate monitoring iamplifier. The former method robs some of the power available to the cutter and is not easy from the point of view of controlling the volume of the monitor speaker.

Without doubt, the two best methods are: use of a separate small amplifier with its own bass and treble controls and fed from some point on the main recording amplifier, such as one side of the output transformer with suitable attenuator network. This method has the advantage that the volume can be controlled perfectly at will, without in any way affecting the output to the cutter head; at the same time it is possible to listen to the programme as it will be heard from the completed record, with the correct bass and treble adjustments. It is always desirable to monitor at a point as near as possible to the cutter head, rather than earlier in the chain. The above method can further be improved by using a pick-up on the disc being recorded and placed a groove or two behind the cutter head. By this method it is possible to actually monitor the recorded disc and although one must remember that there will be a small time lag one is actually hearing what is recorded, taking into consideration the cutting operations, which no other monitoring method can do.

If the expense of a small amplifier for this purpose can be met, then it is without question the best method. The valve or valves necessary (never more than two) can be fed from a separate winding on the mains transformer of the main power unit if desired. Another advantage of using the separate monitoring amplifier and pick-up method is that by using a change-over switch it is possible to listen to the incoming programme or the recorded disc in a matter of seconds and thus have a direct comparison of the original and the recording.

The next two articles will deal with playback; types of pick-ups, needles, compensating circuits, tracking, with photomicrographs showing needle wear and specially shaped stylii.

Television Broadcasting Practice in America

(Concluded from page 344, July issue)

PRESENT technical opinion in America holds that a channel wider than 6 mc/s is required for a colour television system if it is to be competitive with the present black-and-white images. Moreover, many problems remain to be solved in providing proper balance of colour under the wide variety of spectral distributions and brightness encountered in light sources. A non-mechanical method of introducing the colour sequence is also highly desirable. These problems will receive attention as soon as facilities for research are again available.

The long period of inactivity in television since America's entry into the war has obscured the future course of events, but there are indices which point to a post-war period of intense activity. One such index is the list of applications for commercial television station licences, now pending before the Federal Communications Commission. There are now 39 such applications, over four times the number of commercial licences at present in force. The geographical distribution of the proposed stations is shown in Fig. 25.

Another index of coming activity is the plan tentatively announced by the American Telephone and Telegraph Co. for extending the coaxial cable. The schedule, contingent on the progress of the war, calls for extensions of the present New York–Philadelphia link to Washington in 1945; to Boston and Charlotte, North Carolina, Chicago to St. Louis and Los Angeles to Phoenix, Arizona, in 1946; Chicago to Buffalo and the beginning of a southern transcontinental route in 1947. By 1950, at the completion of the present programme, the coaxial system will extend as shown in Fig. 26. This gigantic system of coaxial cable is not necessarily predicted upon television network connections; rather it is planned as normal extension of long-distance telephone circuits. But sufficient reserve facility is planned to accommodate television demands where they may appear.

A definite index of post-war plans is the review of standards recently made by the Television Panel of the Radio Technical Planning Board. This group of 30 experts voted unanimously in June, 1944, to recommend standards substantially the same as the pre-war standards, stating that "the proposed standards are the best on which to resume television activity, based on all presently available information."

The changes in the standards proposed by the R.T.P.B. Panel are simple. The alternative standards permitted by the F.C.C. and previously discussed in this paper are restricted to permit but one method in each case. Frequency modulation is no longer proposed for alternative use in transmitting the picture signal, and the alternative waveform shown in Fig. 11 is no longer recommended. Definite changes in the standards relate, strangely enough, only to the sound channel. Frequency modulation is retained, but the maximum frequency deviation is reduced from ± 75 kc/s to ± 25 kc/s, to reduce the difficulties associated with local oscillator drift on the channels at 200 mc/s and above, which are now proposed for active use. To compensate partially for the reduction in signal level brought about by the reduction in frequency deviation, it is proposed to increase the radiated power of the sound transmitter to the range from 1.0 to 1.5 times the radiated picture power, a maximum increase of three times over the prevailing standard. Finally, the time-constant of the audio-emphasis characteristic has been reduced from 100 μs to 50 μs, in the interest of more efficient operation of the sound transmitter.

The recommendation of the R.T.P.B. Panel which points most clearly to the expected level of post-war activity is a proposed allocation (Fig. 27) which calls for twenty-six 6-mc/s channels between 50 and 246 mc/s. Whether or not these facilities will actually be assigned remains to be seen. But the need is clearly apparent for a truly nation-wide service, comparable with the present standard broadcasting system.

In conclusion, a brief comparison between present American standards and the pre-war British standards is appropriate. Since the British standards are eight years older than the most recent revision of the American standards, the British standards might profitably be reviewed to take account of recent practice.

If this were done, comparison with the American standards would suggest that vestigial-sideband transmission be adopted in preference to the double sideband system, and that the number of lines be increased from 405 to some value between 500 and 600. The 25 per sec. frame rate should of course be retained; this allows approximately 10 per cent. more lines than the 30 per sec. frame rate. A suitable figure corresponding to the American value of 525 lines would then be 567 lines ($=3\times3\times3\times3\times7$). In all other respects, except polarity of transmission and equalising pulses, the American and British systems are closely similar. The method of modulation for the sound channel is a question on which much international discussion is still required, but the issue is not a major one in any event.

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

TO open the selection of H.M.V. releases for this month I cannot do better than draw attention to a truly delightful and equally brilliant recording by Jussie Bjorling (tenor) and Hjordis Schymberg (soprano) on *H.M.V. DB6119.* They sing in Italian two well-known duets—one being the rather haunting "O Soave Fangiulla" (Lovely Maid of the Moonlight) from Act 1 of Puccini's opera, "La Bohème"; and the second, "E Il Sol Dell'anima" from Act 1 of "Rigoletto," by Verdi. Of the two I like them best in "O Soave Fangiulla"; this is, no doubt, because I can always enjoy that duet, particularly when it is rendered in such a faultless manner as in the recording under consideration. Jussi Bjorling and Hjordis Schymberg possess voices of exceptional charm, quality and range; and, as duettists, their balance and understanding leave nothing to be desired. I strongly recommend this record to all who enjoy and appreciate singing in all its beauty.

Two more duettists who call for special mention are Jose Iturbi and Amparo Iturbi. In this case it is for their skill at the piano, and, so far as Jose is concerned, for the transcription and arrangement for two pianos of the ever popular "Rhapsody in Blue" by George Gershwin. The recording occupies four sides of two records, *H.M.V. DB6220* and *DB6221*, and it forms a very pleasing example of outstanding merit, of perfect co-operation between two pianists whose performance is rich in expression and technique.

An unusual record, and one which I would rather leave to the listener to judge, is "A Threnody for a Soldier Killed in Action," by Michael Heming and Anthony Collins. It is in two parts on *H.M.V. C3427*, and has been recorded by The Hallé Orchestra, conducted by John Barbirolli. As its title indicates, it is a solemn lamentation, or funeral dirge, for one who has given his life for his country and all that he holds dear. The next record strikes a very different chord. It is entitled "England, My England," and it forms a Pageant of National Songs, played and sung by Massed Symphony Orchestras, Organ, Dennis Noble, B. Bannerman and Chorus—the whole being conducted by George Walter.

This recording is, as one would expect, stirring and representative of the songs we all know and associate so closely with this island of ours. The soloists, Dennis Noble and B. Bannerman, give fine renderings of their songs, and they are most ably supported by a well-balanced chorus and a first-class accompaniment by the massed symphony orchestras and organ. Make a note of the number—*H.M.V. C3434.*

From the 10in. releases I have a very mixed bag. On *H.M.V. B9419* the well-known voice of Joseph McLeod can be heard reading "The Lord's Prayer" and "Psalm 23—The Lord Is My Shepherd." On *H.M.V. B9417* can be heard the "Bells of Westminster Abbey, York Minster, Coventry Cathedral, Bath Abbey and St. Mary's, Puddletown" as rung on Victory Day, May 8th, 1945. A fitting commentary is given by Frank Phillips.

John Gielgud, with Massed Choirs and Orchestras, can be heard on *H.M.V. B9420*, in the recording entitled "Fanfares; Excerpts from 'Richard II' and 'King John'"; "God Save the King." All profits from the sale of this record will be handed to King George's Jubilee Trust Fund. On the other side of *B9420* The B.B.C. Symphony Orchestra, conducted by Sir Adrian Boult, have recorded "Rule Britannia" and "The British Grenadiers."

As a distinct contrast "Hutch" offers "I'm Confessin'" and "Waiting" on *H.M.V. BD1104*; while on *H.M.V. BD1105* Dinah Shore renders "Like Someone In Love" from the film "Belle of the Yukon," and "Auld Lang Syne." In the latter she is accompanied by The Sportsman Quartet with Orchestra.

Columbia

"NORWEGIAN Dances," by Grieg, Op. 35, form the recordings on *Columbia DX1192-23.* This delightful work is played by the City of Birmingham Orchestra, conducted by George Weldon.

The dances are in four movements: No. 1, Allegro Marcata (in D minor); No. 2, Allegretto Tranquillo (in A major); No. 3, Allegro Moderato aller Marcia (in G major); and, finally, No. 4, Allegro Motto (in D major). Kathleen Ferrier (contralto), with Gerald Moore at the piano, has made a good recording on *Columbia DX1194* of "Come To Me Soothing Sleep" and "Spring Is Coming." Miss Ferrier has a voice of pleasing charm, and her performance is to be commended.

Another of the "Old-Time Dance Series," or rather, another two—Nos. 12 and 13—will be found on *Columbia DX1195*, on which Harry Davidson and his Orchestra have recorded "Excuse Me Waltz" (Eton boating song) and "Slow Waltz" (Songs d'Automne), two topping numbers for dancing.

In the 10in. series there is a spate of patriotic recordings. *Columbia DB2170* is entitled "National Anthems of Allied Nations," played by the regimental band of H.M. Grenadier Guards. The anthems included are those of Britain, France, Norway, U.S.S.R., Czechoslovakia and Holland.

On *Columbia DB2172* the same band has recorded "Star Spangled Banner," followed by "Liberty Bell," and, on the other side, "God Save the King," followed by "Pomp and Circumstance March No. 1."

On *Columbia DB2173* there is "La Marseillaise," followed by "March Lorraine" and "National Anthem of the U.S.S.R.," followed by "Song of the Plains." These are also played by the regimental band of H.M. Grenadier Guards.

Foden's Motor Works Band—conductor, Fred Mortimer—have a good recording of "Die Fledermaus Overture" on *Columbia FB3112*, both sides.

Victor Silvester and his Ballroom Orchestra have selected for their latest recording on *Columbia FB3117* "Love Is My Reason"—waltz, and "We'll Gather Lilacs"—quick-step.

Parlophone

"DREAMS of Yesterday" and "Coming Home," two delightful little numbers, are rendered on *Parlophone F2076* by Dorothy Squires, accompanied by orchestra conducted by Billy Reid.

Billy Thorburn's "The Organ, the Dance Band and Me," with, of course, Billy at the piano, have recorded "The Boy Next Door"—waltz, and "Down Our Way"—foxtrot, on *Parlophone F2074.*

Geraldo and his Orchestra offer two good foxtrots—"We'll Gather Lilacs" and "Robin Hood"—on *Parlophone F2073.* These are played and presented in true Geraldo style; and I recommend them to all dancers.

No. 67 of "Tin Pan Alley Medley," played by Ivor Moreton and Dave Kaye (on two pianos with string bass and drums) will be found on *Parlophone F2071.* It introduces "Ac-cent-tchu-ate the Positive," "I Promise You," "A Dream World is Waiting," "Sleigh Ride in July," "A Little on the Lonely Side" and "Don't Fence Me In."

Regal

HARRY LEADER and his Orchestra make the only recording I have for Regal this month; and they have selected "The Last Waltz of the Evening" and "Waiting"—foxtrot.

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).

Standardised Terms

SIR,—Much has been written recently and verbal debates have been conducted upon the standardisation of technical terms, more especially with regard to electrical and radio phraseology. The technical press in many cases is introducing, and rightly so, the more logical "capacitor" for condenser, "inductor" instead of coil, etc. Now surely we find our greatest revolutionary need at the basis of all electrical and radio theory in the incongruous description of a negative charge of electricity as an "electron," so named by its discoverer from the Greek "electra." Atomic nomenclature includes such freely used names, all self-evident, as the "positron" in describing the positive charge present in varying numbers in the proton. The "neutron" to describe the corpuscular mass also present in the proton, but instead of almost automatically speaking of the "negatron" as that negative charge we cling to the obsolete "electron"; may I then propose an increasing use of the more logical and descriptive term "negatron" amongst those of us whose business it is to control and use it. To conclude with a word of praise for PRACTICAL WIRELESS and the marked improvements in its articles. Its size, too, is more convenient, and all despite the rigours of war.—H. F. NORMAN (Reading).

"A Short-waver"

SIR,—I wish to make a correction to my S.W. Circuit that you published in your July issue. The correction is as follows: 1 mfd. coupling condenser should read .1 mfd., 1 megohm grid stopper should read 100,000 ohms or .1 megohm.—J. H. BRUNT (Beds).

"Deaf Aids"

SIR,—One of our Members has drawn our attention to the article by "Thermion" on page 245 of your May issue. Our Member refers to the fourth paragraph under the heading "Deaf Aids." Your Journal has rightly a wide circulation, obviously among thinking people, and we very much deprecate the derogatory terms applied to the profession of dentistry. Thermion suggests that little thought or care has been given by the profession to the prevention of dental disease. He is probably unaware that unlike other professions or callings, all dentists registered since 1921 have to pay an annual retention fee, part of the money of which is devoted to endowing professorial Chairs and other dental teaching appointments, and part to dental research. Very large sums of money have been expended since 1921 through the medium of the Medical Research Council in the cause of dental disease. The Dental Board of the United Kingdom, the statutory body concerned, has also expended large sums over the same period on educating the public in the means of prevention of decay and care of the teeth. That Thermion should not have seen the posters on the underground stations and other public places, possibly only rarely during the war, as poster propaganda has naturally had to be cut down, but certainly widely during peacetime, is unfortunate, but we would suggest that before making such statements he might have inquired from those best in a position to advise him.

He is quite right in his assumption that anyone discovering a talisman which would detect the true cause of dental decay would be hailed as the saviour of mankind, and the dental profession—if one is to understand the term "dental industry" used in the article, to connote the same thing—would be the first so to hail it, and would certainly not endeavour to suppress the means. We would be grateful if you would bring these considerations to Thermion's attention.—W. G. SENIOR (British Dental Association).

Mozambique

SIR,—In reply to F. J. Walters' request for information about Mozambique. CR7BE Lorenzo Marques broadcast every evening from 1830-2100 hrs. on 30.50 m. 9,710 kc/s giving news in English at 19.10 hrs. I quote further extracts from my log which may be of interest to readers: HEO4 29.02 m. 10,338 kc/s Berne with English programme for N. America at 19.25 R9, YU Belgrade 49.10 m. 6,110 kc/s with English news at 19.15 R7, PRL8 25.60 m. 11,718 kc/s with programme from 19.30 R8. A signal which is giving good reception here now, but I have not seen reported lately, is HCJB 24.08 m. 12,445 kc/s and 30.10 m. which is a good programme from 00.00 hrs. to 01.30 hrs., commencing with the news. SBO Motala 25.53 m. 11,705 kc/s with news at 15.00 hrs. R6.

VLC2 Shepperton 30.99 m. 9,680 kc/s with English feature programme at 16.15. This transmission is beamed to Great Britain. A station which I have logged is ST—Radio Omdurman Sudan on 22.52 m., 13,345 kc/s with one English programme a week, that is on Thursdays 17.30-18.00 R5. I think that's about the lot for now.

There is one small point I should like to make to readers. When they send information in about stations received or request information, why don't they give the time the station was heard and the wavelength; this would then be of use to other S.W. fans instead of just saying "25 m. band." etc.—B. HAYES (New Bradwell).

Stations Identified

SIR,—Re A. Bower's query in June issue of PRACTICAL WIRELESS:

VONH, 5,970 kc/s power 300 w., and VONF, 640 kc/s power 10 kW., operate between 22.30-03.30 G.M.T. VONG, 9,475 kc/s power 300 w., operates between 14.30-19.30 G.M.T.—R. ALLEN (Sydenham).

4-valve Short-waver

SIR,—I would like to point out an error in the letter of Mr. M. Bimford, when he states that because the 50,000 ohm potentiometer is permanently connected across the G.B. battery in the 4-valve short-waver, the latter will run down in a very short time. From Ohm's Law, the discharge is found to be not quite .2 mA. Calculating that in conjunction with the total anode current of the receiver shows that if the set is used on the average 36 minutes daily, the G.B. section of the battery will last as long as the H.T. section. Furthermore, according to the valve makers' recommendations, the G.B. on the output valve can be lowered to 3 volts with 120 volts on the anode, so that a drop in G.B. voltage (which will not arise normally until the H.T. voltage begins to fall), is of no consequence. If the set is to be left standing for long periods, one of the G.B. plugs can be removed, or a potentiometer with 3-point switch used in the normal way as Mr. Bimford suggests, as potentiometers with 3-point switches are now more generally obtainable.

I would like to take this opportunity of noting that the special resistors for the D.C. Multimeter, described in last month's issue, are now available. Premier Radio write they can supply any value accurate to 1 per cent. at 2s. 6d. each, and the slight extra cost is well worth while in this particular case.—F. G. MEYER (Glos).

(Continued on page 392)

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Air Cored 3 Henry inductance, for series connection, tunable approximately 6,000 to 10,000 c/s. Six taps for adjusting width of "dip." For radio whistle elimination or gramophone tone and scratch adjustment 25/-

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TYPE H.	200 ma.	Three L.T.s of 4v. and 4v. for rectifier. Ratings as required	47/6
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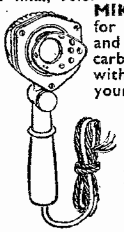

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Absence of L.T.

SIR,—I thank J. Shine (Bury St. Edmunds) for the rather attractive way he tells me I am wrong in the July edition, but would refer him to the comment given by the designer of the set in the June issue, i.e.: "*I should like to point out to anyone who has built this set, that it is standard practice to leave the H.T. applied to the valve anodes, and that this does not harm the valves in any way.*" And again, in the July edition M. Bimford (Macclesfield) states: "*I agree that in no way can the valves of a set be damaged by omission of a switch to isolate H.T. when the set is not in operation.*"

Now, I am in entire agreement with both those subscribers, and still maintain my own statement. Comments on this subject will be welcomed by me from other PRACTICAL WIRELESS readers.—F. BROOK (Maidstone).

CKXA

SIR,—I wonder whether you would print this letter? I should like to inform R. Williamson that CKXA, the Canadian station on 25.6 m., is, as far as I can gather, the sister station of CMTA, and is also at Sackville.

In reply to G. W. N., I have always understood NBB(C)? to be the "New British Broadcasting (Station) Company," and broadcasted at 17.30, 18.30, 20.30 and 22.30 D.B.S.T. for 15 minutes. I believe it was a German-operated station and also operated on the 31 m. band, but I have never received it there. Reception was very unreliable, sometimes being very loud and sometimes almost inaudible.

My set is based on F. G. Rayer's o-v-1 RX, of over a year ago. It is battery operated and several times I have had VLG2, (Shepperton), 30.99 m., at loudspeaker strength. It operates at 16.15 G.M.T. Also used is VLG5 on 25.27 m.

Radio Sicarto, Tokjeharta, in S.E. Java, is on 16.53 m. Very weak and fluttering signal and broadcasts in English at 14.15 D.B.S.T., but I am not sure how long it goes on.—R. C. OSBORNE (Chester).

Servicing Service Receivers

SIR,—Your italicised footnote to C. Pinnington's (Liverpool) letter, published in the July issue, which stated "Servicing Service receivers is not servicing," needs an explanation.

Service receivers are, in the main, of the superhet type, and are required to receive R/T and C.W. True, the quality of R/T required is much lower than in commercial practice. Besides receivers, Signals personnel are required to repair and maintain transmitters, amplifiers, rotary converters, etc., as well as the more advanced equipment peculiar to the Service. In the case of the R.A.F. Signals personnel, their responsibility includes both air and ground radio equipment.

Added to this, continual reference is being made in the Press to the unparalleled progress in radio since September, 1939, and it must be clear that the fruits of this progress have been handed, almost entirely, to the Services. As Pinnington points out, such refinements as "crystal gates," "noise limiter controls," are in common use (within the Service), whilst frequency modulation was incorporated in pre-war Service equipment.

A further point—during 1943 the largest Command in the R.A.F. sustained less than 0.1 per cent. of wireless failures, this achievement, despite the amount, and varying functions, of the radio equipment in multi-engined aircraft. This fact alone speaks volumes for the high standard of *Servicing* obtained in the Service, yet you decline to recognise this servicing.

What prospects, then, can the Service-trained mechanic, often of three years' training, hold out for that "paradise" known as Civvy Street.—J. P. COYLE (Stanton).

[*We repeat that ability to service Service receivers, according to the official system of testing, does not connote ability to service commercial receivers. Almost anyone could service Service receivers after a short course of training, without knowing much about radio. The system was devised for the purpose of permitting unskilled persons to do it; and in any case Service receivers are non-standard from a public point of view. The average Serviceman might be "lost" with a commercial receiver of different layout but employing the same circuit as a Service receiver.*—ED.]

Aspects of Volume Control

SIR,—The writer of "Some Aspects of Volume and Tone Control" has "dropped a brick" in describing the distortion of an output pentode as *second harmonic*.

His description of the human ear does not give a really clear explanation of its behaviour at various volume levels. Actually it is a non-linear apparatus, having a response which droops badly at low audio-frequencies and to a smaller extent at high frequencies. Thus, an amplifier giving an ideal response at all volume levels (say, a straight curve from 30 to 10,000 c.p.s.), will only sound correct when operated at exactly the same volume as the original signal.

At lower levels, due to the "droops" in the ear's response, there will be an apparent loss of "top and bottom." To compensate this we must spoil our amplifier's straight curve, by deliberately introducing frequency distortion in the form of bass and treble "lift."

As the majority of home receivers are operated at a volume considerably lower than the original, this aspect is of greater significance than the conditions of volume greater than original.

Fidelity enthusiasts are now agreed that the old by-pass condenser is the world's worst tone corrector. It merely chops off "top," much of which is wanted. The resulting "mellow" tone is nothing like the original.

But how many commercial sets were bought by gullible citizens for their "deep, mellow and powerful tone!" A sixpenny by-pass condenser became a wonderful selling point!!

If, as your writer asserts, harmonic distortion existed only between 10,000 and 15,000 c.p.s., the loud-speaker would eliminate it all, for but few respond to these high frequencies.

The most successful method of reducing pentode distortion is, of course, the use of negative voltage feed-back.—W. GROOME (Birmingham).

Colour Code Indexing

SIR,—I have several volumes of PRACTICAL WIRELESS and have decided to code, with coloured ink, the pages containing serial articles (such as "Television Practice," "Direct Disc Recording," and those old favourites, "Refresher Course," "Radio Exam. Papers," etc.). I would suggest a line down the outside margin of the page and at the bottom the number of the continuing page, all in the colour green.

When a series finishes, its colour could have a rest for a while and then be used again (if possible for something on the same theme). The index, when obtained, might be decorated with spots to correspond.—A. CLARK (Bristol).

A Matchbox Receiver

SIR,—I have just read in your pages (which I have read for years and not always agreed with, e.g., I like the Brains Trust, because they are such good conversationalists) that you would be interested in details of midget receivers. So I attach a photo of one made by me.

As you can see, by comparison with the ordinary matchbox, it is not very large. The valve is a Hivac midget, with 1.5 volt filament. The circuit is a normal triode detector, with reaction, a resistor being used in place of the normal H.F.C. The tuning coil can be seen. It is iron-cored, and tunes medium waves only. The two small terminals are one for 'phone (the other 'phone lead going directly to H.T. plus), and the other for aerial. Above is a twin trimmer, with short screwed rods in place of the normal screws; these are fitted with insulated heads from H.F. valves for adjustment by hand. By experimenting with the number of plates on the trimmer sections I found that I could arrive at a value which enabled the two Forces and two Home Service programmes to be tuned in with one coil. The tuning capacity is approximately .0001 to .0004 mfd. Of course, the high minimum capacity cannot be helped with a condenser of this kind. Reaction condenser is of slightly less capacity. The whole set pushes into a small case. There are two leads only from it—the L.T. connections. H.T. minus goes via these.

I have not given a wiring diagram, or circuit, as there is nothing unusual about these.

I thought perhaps you would find it of interest, to compare with other sets received. Actually, by using a coil into which the valve fits, and altering circuit and layout, I have reduced the size and built a new set rather smaller now. Unfortunately I have not a photo of it, and as I expect other readers will be able to make receivers as small I don't suppose you would be particularly interested in having a photo and details of this new receiver for publication.

Oh, this set has a throw-out aerial of flex, and a cell for L.T. H.T. is about 30 volts. The set works *almost* as well as a normal-sized triode one-valver.—F. G. RAYER (Glos).

(*We should welcome constructional details of this receiver, including circuit and wiring diagrams and list of components.*—ED.)

The "J" Calls

SIR,—With regard to the letter of Mr. B. G. Meaden, published in your April issue, I beg to inform him that the J calls originate from the British (and not from the American) Army Stations and that two such stations operate in the M.E., namely Station JCPA on 216 m., and JCLA on 277 m.—R. GOLDBERGER (Tel-Aviv).

A.F.H.Q.

SIR,—In reply to F. Armstrong's letter requesting information about A.F.H.Q. in Italy, its location is Rome, it is on the air at 10.00 G.M.T. for the Mediterranean communiqué, and at 14.05 for New York press agencies.

We think that your Polish Bing (?) may possibly originate from Lublin, which broadcasts in the 49 m.b.

Our latest logs include PRL8, HCJB, VLC3, VLC6, VLG, VUD3, Roumania, TAP, CHTA. Press—WQV, WQW, WCA, WCP, MCQ3, MCM3, MCN4, PWB, IRY, ICD, WJQ.

APH went south after the invasion last August and we think it has altered its call sign to MCI.

Could anyone give information on JEET which is called by WQV?

We would like to correspond with John A. S. Watson (Herts) and F. Armstrong (Cheshire).—D. GREAVES (Stockport).

Too Much Jazz and Crooning

SIR,—Your correspondent, C. G. Williams, of Sidcup, makes out a very poor case against Thermion and my humble self, and I cannot find in his letter the least justification for him constituting himself as the spokesman for the bulk of the licence-holders, and I think it can be taken as a fact that Thermion knows more about the B.B.C. and its antics than either Mr. Williams or myself. Mr. Williams claims that the B.B.C. goes to great trouble to discover what listeners want. What form do these great efforts take? A questionnaire to a small number of selected listeners who are assisted in filling it up by representatives of the B.B.C. itself. Further comment in this direction is not necessary!

The fact that the Brains Trust has been on the air for some years now only confirms two facts. The first is, that the ordinary listener has no power at all to have it deleted from the programmes, no matter what contempt he feels for its pronounced inanity, its irritating gigglings, and complete failure to answer concisely and intelligently the questions which are addressed to it. The second fact conducing to its retention is that it provides a regular weekly *bonne bouche* of £20 to a number of lucky B.B.C. "retainers."

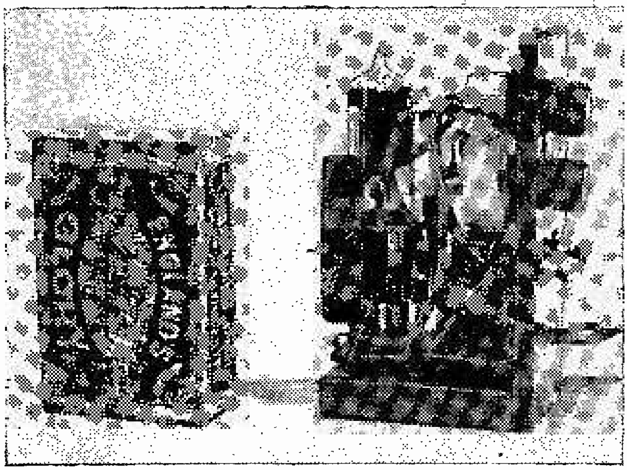
Mr. Williams's suggestion that those who dislike the present B.B.C. programmes should listen to foreign stations is particularly bland and naive, for if that was indulged in we should have handed our 10s. licence fee to the B.B.C. for exactly nothing at all. Mr. Williams need not inform me that the whole of our fees are not taken by the B.B.C., but a far too large amount by the Postmaster-General, for I am already aware of that exploitation. I would find these critics much more convincing if they would give us their sincere assurance that neither they nor any of their relatives or friends are in any direction, directly or indirectly, connected with the B.B.C. itself, or any of its dance-band leaders and crooners or any publisher of Tin-Pan Alley hits. The musical scores of these crude efforts are, in themselves, of the lowest possible description, but the addition of the ape-like croonings converts them into sheer outrages. If Mr. Williams is, like myself, a genuine "ordinary listener" and is not grinding anyone's axe for them, may I express a wish that in due course he will grow out of his present worship of such jungle-like cacophony. If I am in error, I crave Mr. Williams's pardon in advance, but his letters (to myself at any rate) have all the hall-marks of "inspiration" and I am sure he will wish to give us satisfactory proof to the contrary, lest others as well as myself may have the same conviction.—K. T. HARDMAN (Birkenhead).

Servicing

SIR,—Your correspondents, A. Levy and N. Backhouse, have taken me to task for things which I did not say. Levy put the words "unskilled, frowned upon, mechanics of the Forces" into quotation marks with the inference that they were mine, and Backhouse thinks I am earning 1s. 6d. an hour. In fact, I have been an Army radio instructor for almost five years.

Nevertheless, I am sorry that my words caused hurt to men for whom I have a sincere admiration. Surely my letter implied no slur on the *courage* of the Services' radio mechanics, nor did it set out to minimise the difficulties under which many of them are working.

If my letter is read carefully, it will be seen that I was doing no more than warning Army men of the pitfalls they may expect if they attempt to earn a living in the radio industry, a warning that has since appeared



F. G. Rayer's Matchbox Receiver.

at least twice in technical literature; once in the Post-war Report of the Brit. I.R.E. (Part II, para. 17), and again in the article "Finding a Job in Radio," which appeared in your May issue. Indeed, this last reference is largely an amplification of my own letter, stressing as it does the poor pay, the higher skill which is necessary, and the high proportion of female labour which is employed.

Incidentally, A. Levy speaks of "excellent technical training," whilst N. Backhouse says, "I entirely agree with Mr. Levy's answer," and then speaks of "a hurried course, with no chance of refreshers."—F. W. FIRTH (Bury).

SIR,—May I point out that Mr. Pinnington, in his letter in the July issue, made this statement and I quote: ". . . we deal with service receivers, some of them, especially the R.C.A. jobs, having such refinements as 'crystal gates' and 'noise limiter controls,' which to my knowledge have never yet shown themselves in commercial sets in this country." Now, both these features have for years been quite a common feature in commercial receivers of the "communications" type where high frequency bands are used, and I would commend Mr. Pinnington to his "Radio Theory" and ask him to consider how he can possibly associate the use of "crystal gates" with the "high fidelity" type of broadcast receiver of my original letter and I can only say that his reply only confirms the gulf that exists between knowledge of service communications type receivers and that of "high fidelity" broadcast receiver technique.—R. SKELTON (London, E.).

Voltage Dropping Condenser

SIR,—In the May issue of PRACTICAL WIRELESS there appeared on page 244 an article by C. E. Hedley, headed "Voltage-dropping Condenser."

This purports to replace with a condenser the voltage-dropping resistor in A.C./D.C. sets.

For the benefit of those readers who wish to try this, the correct value of capacitor may be obtained as follows:

By Ohm's Law the resistance of the heaters in series is found to be 229.6Ω, say 230Ω. Current required is .3 amp. Applied voltage is 230v. Therefore Impedance Z is $Z = \frac{230}{.3} = 766.6\Omega$. But $Z = \sqrt{R_2 + X_c^2}$ where $X_c = \frac{1}{2\pi fc.}$ Substituting values: $766.6 = \sqrt{(230)^2 + X_c^2}$ $\therefore$ $(766.6)^2 = (230)^2 + X_c^2 = (766.6)^2 - (230)^2 = X_c^2$ which comes to 534600. Taking the square root $\sqrt{534600} = 731.1\Omega$. $\therefore \frac{1}{2\pi fc} = 731.1$ and $C = \frac{10^6}{314 \times 731.1} = \underline{4.356\mu F.}$

I do not agree with Mr. Hedley's statement that the current builds up slowly to its correct value.

Taking the circuit as a whole, it consists of a resistance in series with a capacitance placed across an A.C. supply. The voltage across the condenser is found to be 219.33v., and that across the heaters is 69v., which is the required value. These two voltages are 90 deg. out of phase, and at every instant must add, to equal the applied voltage at that instant. The applied voltage is lagging on the current by approximately 72 deg. 30 min. The time constant of this circuit is short compared with the periodic time of one cycle, i.e., $C.R. = \frac{4.356 \times 230}{10^6} = .001$ sec., which means that the condenser charges up to .637 of its maximum value in .001 sec. The time for one cycle is .02 sec. Comparing these times it is easy to see that the charge and discharge of the condenser follows almost instantaneously the rapidly changing current. In other words there is no time lag. The foregoing must not be confused with the phase difference which exists as previously mentioned.

Now the resistance of the heaters at .3 amps is 230Ω, but when cold, the resistance is so low that it can be neglected in the expression for impedance. This means that at the moment of switching on, the impedance of the circuit is that of the reactance only, and the current will be above normal. In this case it is about .3146 amp. A peak value of .4447. At the same time a peak voltage of 325.2 volts appears across the condenser.

The appearance of a current building up is due to the fact that a voltmeter connected across the heaters will measure the voltage drop. If there is no resistance there will be no reading, even if a comparatively large current is flowing. As the heaters get warm, the resistance increases, and the meter reading increases accordingly, until it registers the R.M.S. voltage dropped across the heaters with a current of .3 amp flowing. At the same time the condenser voltage falls until it reaches its normal value of 310v. peak.

With a condenser of exactly 4μF. the surge is not so great, because the current is smaller, about .2889 amp., with .4084 amp. peak, but the valves are then being under-run; the normal current being .2775 amp.

The point of all this is to prove that there is a very definite surge of current and voltage at the moment of switching on, and if readers value their valves they will stick to the resistor method of voltage-dropping.—RANSOME C. L. BAKER (Mitcham).

Short-wave Reception

SIR,—In recent issues of PRACTICAL WIRELESS several letters have been published dealing with the reception of telegraphy signals. I am interested in such reception also the short-wave broadcast signals, and in view of the shortage of regular information I'd like to hear from anyone interested, with the view of exchanging information, etc. Recently I had a late night search for telegraphy signals between 20 mc/s and 12 mc/s and heard the following: from 21.00 to 22.30 G.M.T., LPH5, JNJ, KQF, KWJ, LSN5, HJY, VKS6, KWQ, CEC5E, VIS2/VKS2, CW1, ZXA6, KFK, CMA3, XDA, XOE. On the Bc. side I have nothing special to report, apart from hearing VLG5, 25.25 m. at 16.15 G.M.T. A "Radio France—Poste Nationale Française" near 24.75 m. was heard at 16.20 G.M.T. A loud signal from Madrid near 31.60 m. can be heard at 16.26 G.M.T. in English.—R. W. IBALL (Langold).

Tuned Aerial Circuits

SIR,—On page 328 of your July issue there is shown (Fig. 2B) the diagram of a coupled aerial circuit, and the last paragraph of the first column seems to indicate that with this arrangement an A.C. resistance of 100,000 ohms or so is thrown into the aerial circuit, this being the dynamic resistance of the tuned secondary.

It is not likely that the resistance thrown into the aerial circuit would even approach this value. What happens is that at resonance the impedance of the aerial circuit is increased by resistance reflected from the tuned secondary. This reflected resistance is easily calculated from (1) the frequency,)2) mutual inductance of primary and secondary, and (3) the series H.F. resistance of the tuned circuit, that is, in practice, of the coil. This reflected resistance combines with the (usually condensive) impedance of the aerial and primary, and results, with the usual primary of about a quarter of the secondary turns, in a total primary impedance of the order of 2,000 or 3,000 ohms; at any rate, much less than the dynamic resistance of the secondary. In fact, in many commercial receivers of about 11 years ago, having the old type screen grid valves, for frequency changers, a variable resistance of only 5,000 to 10,000 ohms placed across the aerial primary coil was commonly used as a volume control, there being this low resistance across the coil even at full volume; this low value would be fatal across 100,000 ohms.—A. O. GRIFFITHS (Wrexham).

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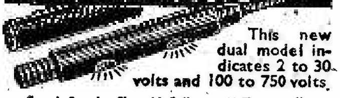

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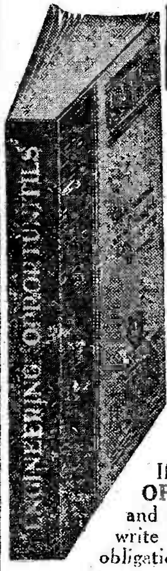

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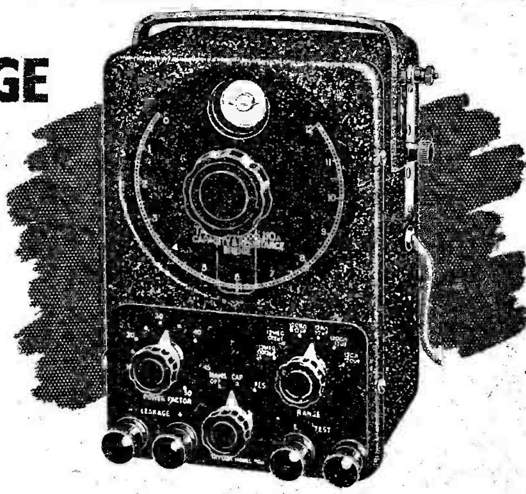

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