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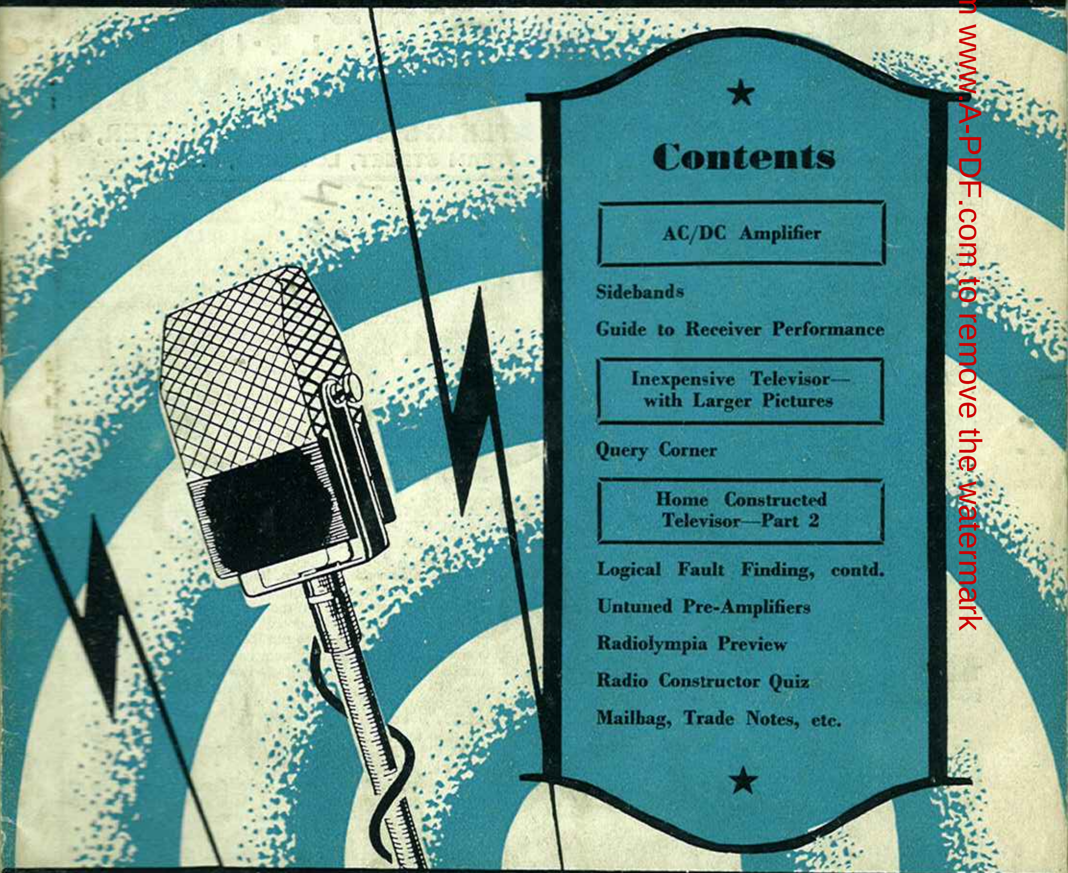
RADIO CONSTRUCTOR

1/3
Vol. 3 No. 2
SEPT. 1949

For Every Radio Enthusiast



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Contents

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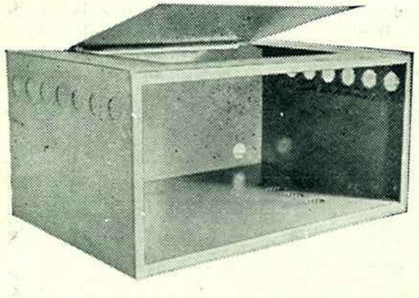

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Radio Constructor

Vol. 3, No. 2 **Annual Subscription 16/-** **Sept., 1949**

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Edited by: C. W. C. OVERLAND, G2ATV LIONEL E. HOWES, G3AYA

EDITORIAL

ONCE again Radiolympia is due, and in this issue we give a preview of interesting items for the benefit of those readers who are either going to the show, or else wish to know what is happening.

This year there seems to be no doubt that Television is going to hold the stage. Compared with ordinary sound broadcasting, and speaking in terms of licences, TV is an infant, but withal a very lusty infant. This, despite the stagnant period of wartime silence, and the handicap of lack of finance and facilities under which the BBC Television Service has laboured.

Now things are definitely brighter. On the transmitting side, Alexandra Palace has been receiving badly needed new equipment, and the keen interest of all the members of the staff—they are akin to the radio amateur in their devotion to their calling—has resulted in a service which is full of promise for future viewing.

On the receiving side, British manufacturers are proving to be as enterprising with TV as they have been with sound receivers. TV is capturing the imagination of the public, and the number of licences is increasing steadily each month. An extensive new market will be opened when the Sutton Coldfield station commences operations at the end of this year.

The radio constructor, too, has become fascinated by this medium, as is shown by the fact that nearly 30,000 copies of our booklet "Inexpensive Television" have been sold since last Christmas, and it is still selling steadily. Many of these receivers are operating successfully far outside the recognised service area, which indicates the general interest over the whole country.

Television is definitely growing up; it has ceased to be a new novelty, and is now a recognised form of entertainment—may it continue to prosper! G2ATV

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will redraw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

COMPONENT REVIEW. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6579.

Hogwash-Major calling !

The latest report from J. Jorum, Esq., describing the results of the Radio-Sonde experiments

Myrtle Cottage,
Hogwash-Major.
September, 1949.

Dear Sir,

You may remember in my last letter that I stated that the members of the Society for the Development of Electronic Research (Hogwash-Major) were preparing a balloon, using Radio Sonde principles, to investigate atmospheric conditions above Hogwash-Major. I now have pleasure in informing you that these experiments have been carried out.

The day chosen for the release of the balloon dawned very fine and fair, and the Society set about the task of getting the equipment ready in the pleasantest of moods.

It was first necessary to inflate the balloon. Master William Westinghouse, our Junior Section, here took over and proposed to manufacture the necessary hydrogen by treating zinc with sulphuric acid. Unfortunately, the only acid available happened to be concentrated. Our Treasurer, Lieut. Jonathan Needy (ex-R.N.) volunteered to dilute the acid and, saying with a merry laugh, "Just like the old charging-room days, hey ? " carried the bottle to the tap.

While the moaning Treasurer was gently laid on the floor, and our Female Member, Miss Lavinia Twittering, removed the pieces of glass from his hair with the aid of a pair of tweezers, Master William Westinghouse salvaged the remains of the acid and inflated the balloon.

Our President, Mr. Wellington Pitmarsh, had the honour of releasing the balloon. This balloon* was somewhat small in size, but nevertheless had sufficient buoyancy to carry the small transmitter constructed by our Junior Section. Miss Lavinia Twittering hurriedly tied the balloon to a stake in the ground whilst our ex-Naval member, now somewhat recovered, hobbled out to watch the ceremony. Unfortunately our Female Member had mistakenly used elastic and the balloon shot up immediately to some twelve feet from the ground, where it simply bobbed up and down like the weight on an inverted spring balance.

Whilst our flustered and blushing Female Member apologised for her mistake our Treasurer fixed her with a glance of demoniacal hatred and said through clenched teeth, " Oh, cut the damned thing ! "

This the President did, but unfortunately the released elastic shot back and caught our Treasurer with great force in the left eye.

With Miss Twittering covering her ears, the remainder of the Society repaired to the Workroom to check the transmissions from the balloon. For a short time it was found that all readings (those of pressure, humidity and temperature) remained constant. After a quarter of an hour, however, the temperature existing in the atmosphere to which our balloon should by now have risen suddenly increased at a high rate. This increase continued rapidly until, after a further ten minutes, transmissions suddenly ceased. It was decided that the only interpretation which could be given to these readings was that we had discovered a layer (situated directly above Hogwash-Major, of course) in which pressure and humidity remained constant, whilst the rays of the sun considerably increased the temperature. The Secretary was instructed to immediately communicate this very important discovery to the Air Ministry, to the Physical Society, and to the leading Press Agencies.

The members of the Society left their Headquarters in an excellent frame of mind. On reaching the village, however, they were extremely disconcerted to hear of a bomb-outrage occurring at the mansion of Major Hotton-Pepperleigh, our local J.P. Apparently, whilst seated in front of his fire, he had suddenly found it to be smoking badly. This phenomenon was followed by a loud explosion which shook all the soot from his chimney and caused great damage to his collection of big-game heads collected on South African *safaris.*

The local police had deduced that, as the chimneys of Major Hotton-Pepperleigh's mansion are somewhat wide at the top, the explosion could have been caused by the throwing of an infernal machine from the grounds, and they were already questioning people of dubious political views. The Major himself, furthermore, was apparently scouring the countryside with a shot-gun and a horse-whip.

The feelings of the Society were not enlivened at this stage by our Junior Section, who began to chant *sotto voce:*

" Little Willy's up aloft, he won't come down no mair,
" For what he thought was hydrogen was hydrogen and air ! "

For this he was soundly cuffed by our now speechless Treasurer and the meeting broke up very hastily. As he left the President was heard to mutter something about " preparing an alibi."

Next month, however, we hope to have much more felicitous news, particularly with reference to some data we intend to collect concerning industrial heating (R.F.) technique, and for which we have already obtained most of the apparatus.

With all good wishes to your readers,

I remain,
Yours sincerely,
J. Jorum, Esq., Hon. Sec. S.D.E.R. (H.-M.).

*Toddy's Toys and Novelties.

SIDEBANDS

A Simple Description of the Theory, written for the beginner by J. B. NUNN

The sideband theory states that if an RF of, say, F1 is modulated by an AF of, say, F2, then the resultant radiation from the transmitting antenna will consist of three unmodulated radio frequencies :—

1. The carrier at F1.
2. The upper sideband of F1+F2.
3. The lower sideband of F1—F2.

This means that the transmitter will occupy a bandwidth of 2 x F2, and this will limit the number of transmitters which can operate on a given waveband. For an ordinary musical broadcast where the modulation frequencies vary from 50 cps—4,500 cps, the bandwidth is not constant, since it is determined by the highest modulating frequency in use at any one instant.

The actual radiation mentioned is shown in Fig. 1.

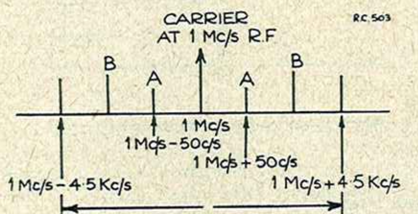


Fig. 1.

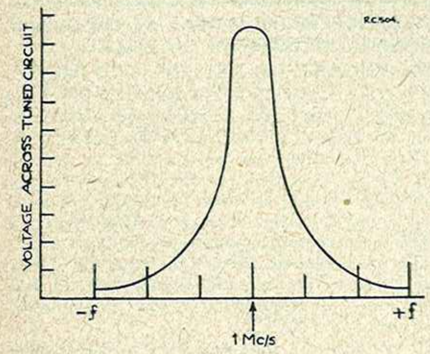


Fig. 2.

If the output of the receiver is to be a faithful reproduction of the sound producing the modulation, then it is essential that all sidebands should be treated in exactly the same way by the tuned circuit, *e.g.*, the loudness of a note is determined by the amplitude of the sidebands, therefore the sidebands for note A, Fig. 1, must be treated in the same way as Note B, if these notes are to be reproduced faithfully.

Sideband cutting will occur if a sharply tuned circuit is used to receive a modulated signal (Fig. 2).

Owing to the shape of the response curve, the amplitude for note A will be greater in proportion than note B. Therefore, note B will be less in volume compared with note A than it was in the original case, at the transmitter end. With a highly selective receiver the high notes are reduced to a very small fraction of their original loudness. This defect can be observed with some superhets, also in a few cases with a TRF receiver, and is known as " sideband cutting."

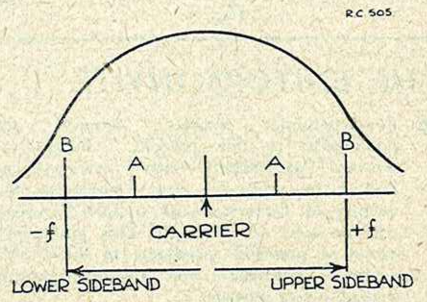


Fig. 3.

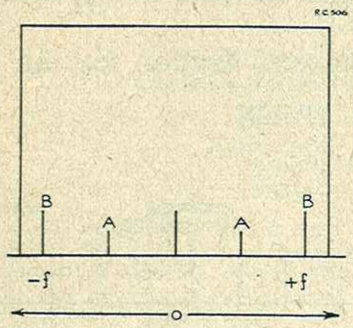


Fig. 4.

Band Pass Filter

Fig. 2 is for a highly selective tuning circuit, and will give serious sideband cutting. Fig. 3 is for an unselective tuning circuit, which will give very little "sideband cutting," but very poor selectivity. Fig. 4 is the ideal response curve. This will give equal treatment to all sidebands, and perfect inter-station selectivity, but unfortunately this curve cannot be achieved in practice. A close approximation is Fig. 5, which can be achieved by using a band-pass filter. This consists of two tuned circuits coupled together, either mutually or capacitively.

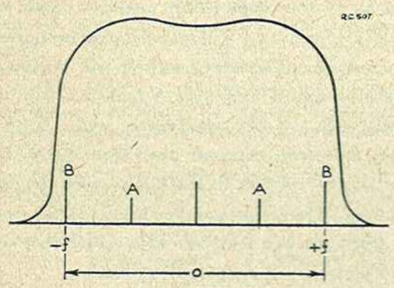


Fig. 5.

THE EDITORS INVITE . .

Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our "Guide to the writing of Constructional Articles" which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure!

"RADIO CONSTRUCTOR" QUIZ

Conducted by W. Groome

Allow us to introduce our pet "stooge," a gentleman named Brain. He is a composite character, combining the best and worst in us, enjoying sometimes our success, and sometimes our "flops." His activities will be reported from time to time in this column to try your knowledge, to warn and to inform you.

Recently Mr. Brain used the following method to test a "push-pull" amplifier.

He disconnected the 15 ohm speaker and in its place fitted a large wattage 15 ohm resistor, which ensured that the output valves were not run without load. He then inserted a resistor in the HT lead from the centre tap of the output transformer, and finally connected a pair of 'phones across the resistor. On hearing a fairly strong signal in the phones he concluded that the amplifier was correctly balanced. Now see questions (1) and (2).

(1) Was he using an effective test for balance?

(2) Was he right in believing that the audible signal indicated good balance?

(3) What piece of equipment may be described as an "acoustic transformer"?

(4) Beware, "catch" question! Which is the first tuned circuit in an average television receiving installation?

(5) Explain the resistor colour code and give the colours in numerical order from one to nought.

(6) What is contrast expansion?

(Answers on page 36)

PHILIPS SOUND EQUIPMENT AT THE ROYAL NATIONAL EISTEDDFOD OF WALES

The Eisteddfod was held this year at Dolgelley and as the Eisteddfod Pavilion had a seating capacity of over 8,000, a good sound system was most essential to the success of the proceedings.

The installation was very similar to the one that Philips provided for the Olympic Games, and which brought so much favourable comment from Sound Engineers in many parts of the world.

The main amplifier equipment consisted briefly of five microphones, three amplifiers, six special dual loudspeakers, six wide-throated metal flare horns and a number of small low-powered speakers.

Of the three 50 watt amplifiers in use, one fed the high audio frequency section of the six special dual assemblies, and another the lower audio frequencies.

The third amplifier fed loudspeakers outside the actual Pavilion. A point of interest is that inside the Pavilion the six special dual speakers were augmented by a number of small low-powered speakers to cover any blind spots.

The attendance for the week of the Eisteddfod was over 130,000 people.

THE INEXPENSIVE TELEVISOR

—with larger pictures—

Some notes on using the VCR131 cathode ray tube, with the necessary alterations to the televisor circuit, described by G2ATV

THE original televisor built by the writer—as described in earlier issues of this magazine—had been giving yeoman service for some months, when the opportunity arose to purchase a VCR131 cathode ray tube. This is a large screen affair, with a diameter of 11½ inches, and has a screen of the same colour and type as the VCR97 tube. Exactly the same base is used, too, except that the grid and cathode connections are transferred. The deflector plate sensitivity is higher, and is the same for both X and Y plates. The maximum final anode voltage is 6,000, and normal working voltage 4,000. The tube is so arranged that deflector plate cut-off occurs, so that it is impossible to "round off" the corners of the picture, which measures 9½ x 7½ inches. Altogether, quite a nice proposition. There is one drawback from the reader's point of view, in that these tubes are not too easily obtainable.

Power Supplies

The tube was first tried out with the existing power supplies, and it was found that it would be necessary to increase the EHT and the line amplifier voltages. Sufficient scan was forthcoming from the frame oscillator as it stood. After some experimenting, it was determined that a voltage of 1,000 to the line amplifier was necessary. With anode loads of 400 k ohms, the total current of both sections of the line 6SN7 amounted only to 2.5 mA. This leads to simplification of the power supplies, as it can be obtained from a tapping on the EHT transformer.

The final arrangement used is shown in Fig. 1. The transformer has a secondary rated at 5,000 V, tapped at 2,500 V, and this is used with two valve rectifiers to supply both EHT and line amplifier voltages. Two other secondaries supply the rectifier heaters, and a third the CRT heater. A USA ex-WD capacitor of 0.1-0.1μF 7,000 V wkg was purchased quite cheaply, and used as a two-section filter with 250 kΩ resistors gave a really hum-free spot.

The tapping of 2,500 V for the line amplifier supply was on the high side, but it did mean that higher value resistors could be used in the smoothing filter, so improving the efficiency. And absence of ripple in this supply is really important. The measured voltage of the output of this supply, on load, was 950 V. This means a drop across the smoothing resistors of some 1,500 V, and to avoid any risk of flash-over each section was composed of several resistors wired in series. The values of capacitance used here may seem odd, but were decided by the values which were to hand. C3 could be lower than shown; a similar value to C4

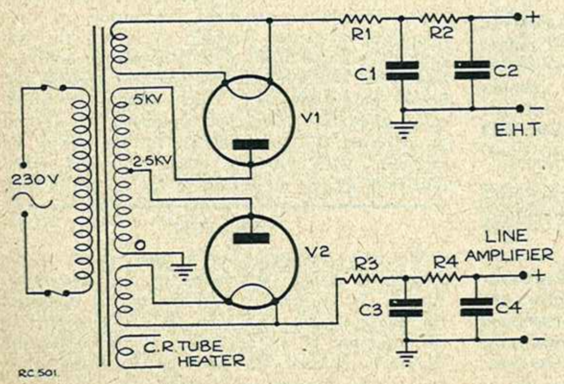


Fig. 1. Circuit of the Power Supply used.

V1, V2—HVR2, VU134 or suitable rectifier

R1, R2—250k Ω

R3—150k Ω total—see text

R4—250k Ω total—see text

C1, C2—0.1μF, 7kV wkg.

C3—2μF, 2.5kV

C4—0.25μF, 2kV

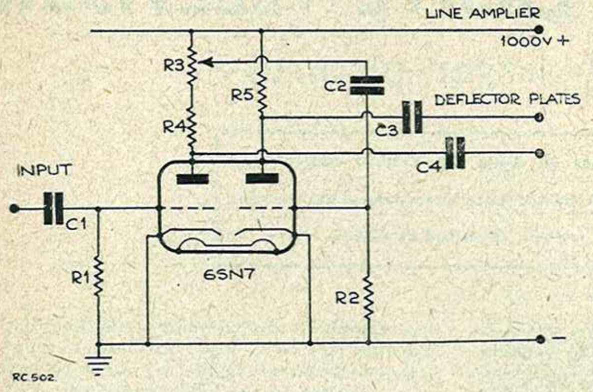


Fig. 2. The Modified Line Amplifier.

R1, R2—1M Ω
R3—50k Ω pot.
R4—400k Ω, 1W
R5—450k Ω, 1W
C1—0.1μF, 500V wkg.
C2—0.1μF, 2.5kV wkg.
C3, C4—0.03μF, 7kV wkg.

was tried, but proved too low—there is room here for experiment, and if higher values than C4 are not available, they can be tried in parallel, or in a three-section filter. A working voltage rating of 2,500 is safe in this part of the circuit.

With the higher EHT voltage in action, it became necessary to change the deflecting plate coupling capacitors for some with a sufficiently high voltage rating. Eventually a set were procured which were rated at 7,000 V, but the capacitance was lower than formerly, being only .03μF. When tried out, these worked quite efficiently, but it was found necessary to increase the deflector plate grid leaks from 2 M Ω up to 8M Ω. This value was not available in one resistor, so two resistors wired in series were used to make up the correct total.

With all these modifications made, a nice picture was obtained, but there were still two unsatisfactory points. The first was fold-over on the left-hand edge of the raster, and the second—and most important—was that the voltage between heater and cathode of the line 6SN7 was far too high to be safe. Both faults were overcome by using a different type of amplifier, the final version of which is shown in Fig. 2.

The same valve, a 6SN7, is employed, but the second triode is fed from the first in the normal manner, instead of by cathode coupling. The input to the second triode is controlled by taking the coupling capacitor, C2, to a potentiometer R3, which forms part of the anode load of the first triode. Neither triode is biased. Care should be taken to use a suitable rated capacitor for C2—the potential across it is some 1,000 volts. Also, the potentiometer R3 should be well insulated from the chassis, for the same reason.

ANSWERS TO THE QUIZ

(See page 34)

(1) Mr. Brain's method was right, although many would prefer to have a capacitor in one of the 'phone leads.

(2) His conclusion was wrong. The signals in each half of the primary are of opposite phase, and in a balanced stage they cancel each other in the HT lead. The signal in Brain's 'phones indicated that one valve was producing a stronger signal than the other, and cancellation was only partial. Perfect balance is indicated by no signal in the 'phones.

(3) A loudspeaker horn, which performs acoustically the same purpose as the transformer does electrically.

(4) The dipole.

(5) The main colour of a resistor indicates the first numeral, the colour on one end gives the second numeral, and the colour of the dot or band indicates the number of noughts following the first two figures. Quite often three-coloured bands appear and should be read from tip to centre. Commencing at " one " the colours are brown, red, orange, yellow, green, blue, violet, grey, white, black. As an aid for memorising, note that from two to seven the colours are in spectrum or " rainbow " sequence.

(6) Owing to practical limitations of disc recording it is not possible to record the full range of volume of an orchestra and the contrast has to be " compressed " so that the highest and lowest amplitudes may come within the useful range available. Contrast expansion is a system of restoring the lost contrast by the use of an amplifier with variable gain controlled automatically by the amplitude of the applied signal.

ERRATUM

We must apologise for a small error in the " Baby Watcher" described in our last issue, Vol. 3, No. 1, page 7. In the circuit diagram, the diode anodes of V2 are shown connected to the junction of C4/R5/relay. This connection should be ignored, the diode anodes being taken only to the junction of C3 and relay.

PREVIEW OF RADIOLYMPIA, 1949

(SEPTEMBER 28th to OCTOBER 8th)

RADIO RECEIVERS AND RADIOGRAMOPHONES

His Master's Voice (Stand 57) radio receivers include special models for the reception of FM transmissions. Others in the range include table models with twin loudspeakers and separate bass and treble controls. Autoradiograms will also be shown.

What is claimed as the smallest all-wave superhet in the world will be shown by *A. J. Balcombe Ltd.* (Stand 44).

In the range of receivers by *Marconiphone Ltd.* (Stand 48) will be a personal superhet about the size of a camera and weighing only 4 lbs., including batteries, and a transportable AC/DC receiver. Autoradiograms will have many new features such as the mounting of the gramophone mechanism in a special pull-out drawer for easy access, and new lightweight pick-ups.

"Plus-a-Grams," manufactured by *J. and A. Margolin* (Stand 102) will be seen in a new line of metal models in various colours.

A " handbag " type portable radio weighing 10½ lbs., to be shown by *Roberts' Radio Co. Ltd.* (Stand 96), has a detachable waterproof carrying cover with a zip-fastener. The set is claimed to operate satisfactorily even when being carried totally enclosed in the cover.

There is an increasing tendency to regard a radio as part of the design or furniture of a room. *R. N. Fitton Ltd.* (Stand 80) have produced a model combined with bookshelves. In their radiograms special attention has been paid to record storage, the cheapest model holding 150 records. The lightweight pick-ups, designed for high fidelity reproduction, put less than 1 oz. needle pressure on the records.

The *General Electric Company Ltd* (Stands 38 and 175) will be showing models in plastic or polished hardwood cabinets, and an export five-valve superhet model with six wavebands and bandspread tuning, working entirely from a six-volt accumulator.

TELEVISION RECEIVERS

Among the *Marconiphone Ltd* (Stand 48) television receivers will be combined radio models using aluminised cathode ray tubes, providing bright clear pictures that can be viewed in a room with normal lighting.

The *General Electric Company Ltd.* (Stands 38 and 175) range of receivers includes flat-ended cathode ray tubes, claimed to cut out distortion at the sides of the picture due to the curvature of the glass.

A model designed to fit into the corner of a room will be featured by *R. N. Fitton Ltd.* (Stand 80). Two new models, a table and console, with 12-inch cathode ray tubes will be released for the exhibition. They are designed for use within the high field strength area of the transmitter, but pre-amplifiers can be supplied to build up performance in areas of more difficult reception.

Bush Radio Ltd. (Stand 66) will be showing models adaptable for either the London or Birmingham television areas by changing the vision chassis which has been designed as a complete unit plugging into the main chassis.

Projection television receivers to be shown by *A. J. Balcombe Ltd* (Stand 44) provide an unusually large picture from a tiny cathode ray tube.

Metro Pex Ltd. (Stand 10) will be showing a range of optically correct magnifying lenses for fitting over the screen of a television receiver.

AERIALS

A new indoor television aerial which can be used either as a " V," inverted " V," " L," " T " or vertical dipole will be shown by *Wolsey Television Ltd.* (Stand 13).

Several aerials of special design will be exhibited by *E.M.I. Sales and Service Ltd.* (Stand 67), including anti-static types, radio relay aerials and equipment for providing central installations for blocks of flats and other large buildings.

Belling and Lee Ltd. (Stand 25) will show a comprehensive range of aerials including a newly designed multi-array television aerial for fringe areas.

Television and short-wave aerials for indoor and outdoor use, and car aerials are to be displayed by *Antiference Ltd.* (Stand 64). Aerials for FM reception will also be shown.

A range of television aerials by *Aerialite Ltd.* (Stand 62) are made by a simple method of assembly, claimed to cut labour, enabling them to be sold at a low price.

TELEVISION TRANSMITTING

A public demonstration of a television system will be given by *Marconi Wireless Telegraph Co. Ltd.* (Stand 174). Two Marconi Image Orthicon cameras will be in action, and visitors will see televised scenes from the exhibition in a monitor installed in a viewing tunnel.

COMMUNICATIONS

A reduced scale model of a microwave radio link to be shown by *Standard Telephones and Cables Ltd.* (Stands 60 and 173) will show a typical repeater station with a tower 200 feet high operating automatically with surveillance over a service channel, and monthly visits by maintenance personnel. Transmission is limited with type of equipment to "line of sight"—roughly 30 miles—but repeater stations can increase this range. The same firm will also show a UHF radio link and co-axial cables.

A wide range of communications equipment will be shown by *Marconi Wireless Telegraph Co. Ltd.* (Stand 174) including a demonstration of the uses of VHF radio. It will show how news stories and photographs are transmitted from the scene of a story to the news room of a national daily newspaper. Lightweight radio equipment for civil aviation services will also be shown.

SOUND REPRODUCTION AND RECORDING

Automatic record changers and record players will be shown by *Garrard Engineering and Manufacturing Co Ltd.*. (Stand 79), including a radio-gram unit floating on spring suspensions. A marine version of this unit will demonstrate playing a record with the unit tilted at angles up to 90 degrees. Battery-operated record changers will also be shown.

Gramophone motors to be shown by *A. R. Sugden and Co.* (Stand 207) are adjustable for speeds of 78, 45 and 33 1/3rd rpm. Complete recording equipment with moving coil cutter head for microgroove recordings will also be shown. The cutter head records on lacquer discs at 250 grooves per inch, and to fully modulate it only 1 watt is required.

A variable speed gramophone record reproducer to be featured by *Electrical and Radiological Instrument Co. Ltd.* (Stand 181) has speeds of 24, 33 and 78½ rpm. Intermediate speeds can be obtained by a micro-speed control which also takes care of any abnormal voltage vibrations. This unit can play any type of record from the standard 12-inch to the latest long playing microgroove recordings.

Birmingham Sound Reproducers Ltd. (Stand 81) will demonstrate a complete disc recording and control bay, including a new studio electronic mixing control console for professional studios.

Tape recorders will be shown by a number of firms including: *Lee Products (Great Britain) Ltd.* (Stand 157). *Wright and Weaire Ltd.* (Stand 63) and *The General Electric Company Ltd* (Stands 38 and 175).

A pick-up with a diamond point, based on an entirely new conception of converting mechanical vibrations into electrical energy, will be featured by *The Lowther Manufacturing Co. Ltd.* (Stand 165).

Feature of the *E.M.I. Sales and Service Ltd.* (Stand 67) display will be the Royal microphones, each engraved with the date and occasion on which they were used. They are usually kept in a fireproof safe and special precautions will be taken for their safety during the exhibition.

Celestion Ltd. (Stand 87) will show a selection of loudspeakers with chassis diameters ranging from 2½ inches to 18 inches, and handling power from ¼ to 40 watts.

The "Bafflette" speakers by *Richard Allan Radio Ltd.* (Stand 49) will include a new console model with an 8-inch loudspeaker to be released during the exhibition. It is a high fidelity model using a magnet of 14,000 lines per sq. cm. in a 0.45-inch gap.

Loudspeakers by *British Rola Ltd.* (Stand 87A) are fitted with a device for dustproofing the voice coil and magnet gaps.

Loudspeaker replacement cone assemblies by *A.W.F. Radio Products Ltd.* (Stand 203) are made in a range covering most popular commercial loudspeakers. Each assembly is complete with voice coil, spider, lead wires and fixing segments, and is mounted on an individual tray, colour coded for easy identification.

Equipment to be shown by *E.M.I. Sales and Service Ltd.* (Stand 67) ranges from three-watt mobile amplifiers to 200-watt rack types for industrial use, and a console for use in a concert hall.

A new amplifier by *Birmingham Sound Reproducers Ltd.* (Stand 81) is a portable 30-watt model with two microphone inputs, each with its own fader, and a separate gramophone input.

COMPONENTS

Suppression of domestic electrical appliances will be demonstrated by *Belling and Lee Ltd.* (Stand 25).

The new "Micromite" electrolytic capacitors, the smallest and lightest made by *The Telegraph Condenser Co. Ltd.* (Stand 75), are of non-corrosive, all aluminium construction, hermatically sealed and protected by a cardboard tube. The reduction in weight and size has been made possible by using high gain etched foil.

New miniature metallised paper capacitors for application with miniature valves will be shown by *A. H. Hunt Ltd.* (Stand 17). They are particularly useful for decoupling at frequencies up to and exceeding 100 Mcs. their effective inductance equalling that of a straight wire of equal length, and an approximate diameter of ⅛-inch. These capacitors measure 7/16-inch (11.11 mm) in length and 3/16-inch (4.75 mm) in diameter.

Capacitors for use in suppressing electrica equipment will be shown by *Dubilier Condenser (1925) Ltd.* (Stand 82), together with ear mounting drilitic capacitors available in a full range of the usual capacitance and voltage values in single, dual and triple forms.

RADIOLYMPIA OPENING

Electronic Bells will Greet Mr. Morrison

Mr. Herbert Morrison, M.P., Lord President of the Council and Deputy Prime Minister, is to open the 16th National Radio Exhibition ("Radiolympia") at Olympia, London, on the afternoon of Wednesday, September 28.

A peal of electronic bells will greet Mr. Morrison when he enters Radiolympia and he will afterwards be invited to operate them from a keyboard in the control room.

The Royal Navy, the Army and the Royal Air Force are to exhibit their radio and radar equipment at Radiolympia for the first time since the war. The Department of Scientific and Industrial Research, for which Mr. Morrison is the responsible minister, the various research establishments of the Ministry of Supply, the G.P.O. and the Ministry of Civil Aviation are all to give popular demonstrations and the Board of Trade is to have offices adjoining the Radio Industry Council's rooms for the reception of overseas visitors.

Many new models of radio and television receivers—some of the latter for the new Midlands station — are promised by manufacturers and the public will see rehearsals and performances in the B.B.C. television studio, or on the screens of television sets of every make which will be working side by side in communal viewing halls.

Mobile and "business radio," transmission of newspaper photographs by radio, the use of radar and other navigational aids and electronic industrial equipment will also be demonstrated by leading manufacturers.

Patron of Radiolympia is H.M. Queen Mary who, it is hoped, may visit the Exhibition on the special invitation day, Tuesday, September 27

Radio Components Exhibition, 1950

The seventh annual Exhibition of British Components, Valves and Test Gear for the radio, television, electronic and tele-communication industries will be held in the Great Hall, Grosvenor House, Park Lane, London, W.1, from Monday, April 17 to Wednesday, April 19, 1950.

Admission is by invitation of the organisers, the Radio and Electronic Component Manufacturers' Federation (22 Surrey Street, Strand, London, W.C.2).

Many members of the Federation are also exhibiting in the National Radio Exhibition ("Radiolympia") in London next month—September 28 to October 8, 1949.

AC/DC AMPLIFIER

A Cheaply Constructed Amplifier capable of giving good reproduction, described by H. J. LEWIS

THIS AC/DC audio amplifier should find a "universal" use around the shack, and especially for the reproduction of gramophone recordings, as the quality and frequency response are excellent. It is suitable for use with almost any type of pick-up, especially of the piezo-crystal or moving iron variety (magnetic). A moving coil or ribbon pick-up may be used with a suitable transformer, but it may be necessary to modify the input circuit according to the manufacturers' instructions to preserve the characteristics of the type of pick-up used. The power output available from an AC/DC audio amplifier is limited in many ways, and, especially, the low HT available restricts the power capabilities somewhat, and therefore it is necessary to use a valve of the high sensitivity "beam tetrode" variety, such as the KT33C or 25A6. Negative feedback must be employed to minimise distortion and reduce output impedance. Some believe the old cry that "negative feedback cures all ills." Slip-shod construction will lead to trouble, and it may even appear that the negative feedback is the cause of all the trouble. Negative feedback will not straighten out the kinks in the chassis; "wet" the dry soldered joints, or shorten those long leads. It is up to you, the constructor, to make a reasonable job of the construction. The accompanying photograph of this amplifier shows a 5 inch permanent magnet loudspeaker, but an external 12 inch loudspeaker with a suitable output transformer to match the 15 speech coil is used in conjunction with this amplifier. This latter speaker is mounted on an 8ft. baffle, and results are excellent. The input circuit, as shown in the circuit diagram, is via two isolating capacitors C12/C13. This is necessary to block the AC mains from the pick-up, as handling in the absence of these capacitors will result in a nasty shock, so "beware." R1 is the gain control, and may be adjusted accordingly. V1 is the first AF valve, a 6J7 or Z63 HF pentode. The input via R1 is to the top cap connection of this valve (control grid) and it is necessary to screen this lead completely, and to use a shielded top cap as can be seen in the accompanying photograph of this amplifier. R2/C2 form the cathode bias circuit, and R3 the negative feedback load resistor. R5 is the anode load resistor, and in conjunction with C5 forms part of the resistance capacity coupling to the second AF stage V2. R7 is the grid leak of this stage. R8-C7 are again the cathode biasing components, R9 the anode load. The signal is fed to the output valve via C8 and across the grid leak resistor R12. R14 is a grid stopper resistor, and is used to suppress any tendency towards parasitic or self-oscillation in the output stage V3. R15 and C10 are cathode biasing resistor and capacitor respectively. C17, C11, R16 form part of the tone control circuit, R16 being the variable tone control. T1 is the output transformer, and here lies the "heart" of the amplifier. Negative feedback is applied from the secondary winding of the transformer, via C9/R13, the phase correcting network to the cathode of the 1st AF stage V1. The use of a high quality component for T1 cannot be over-emphasised, as low leakage inductance, low winding inductance and low primary resistance, are but a few of the ideals one must attempt to attain for this component. If instability is encountered in this amplifier and everything points to the output transformer, do not throw the amplifier (complete with transformer) into the nearest lily pond. Try the following remedies one by one. Reverse the leads from the output transformer secondary winding to the loudspeaker and feedback circuit. This may effect a cure, but if not, increase the value of R13 by approx. 50-75%. This should cure all ills, should it not do so, try another output transformer. The negative feedback is of the order of 20-26 db. The value of R13 should be varied to suit various speech coil impedances, and a list is tabulated herewith, covering the speech coil impedances encountered in commercial practices.

Loudspeaker Impedance (Z in ohms)	*Value of R13* *in ohms*
15	560
10	470
5	330
2.5	220

R13 may be calculated from the following formulae :—

$$\text{where } R13 = 250\sqrt{\text{speech coil Z in ohms.}}$$

C9 is not too critical and may be varied between the limits of 0.001μF and 0.05μF.

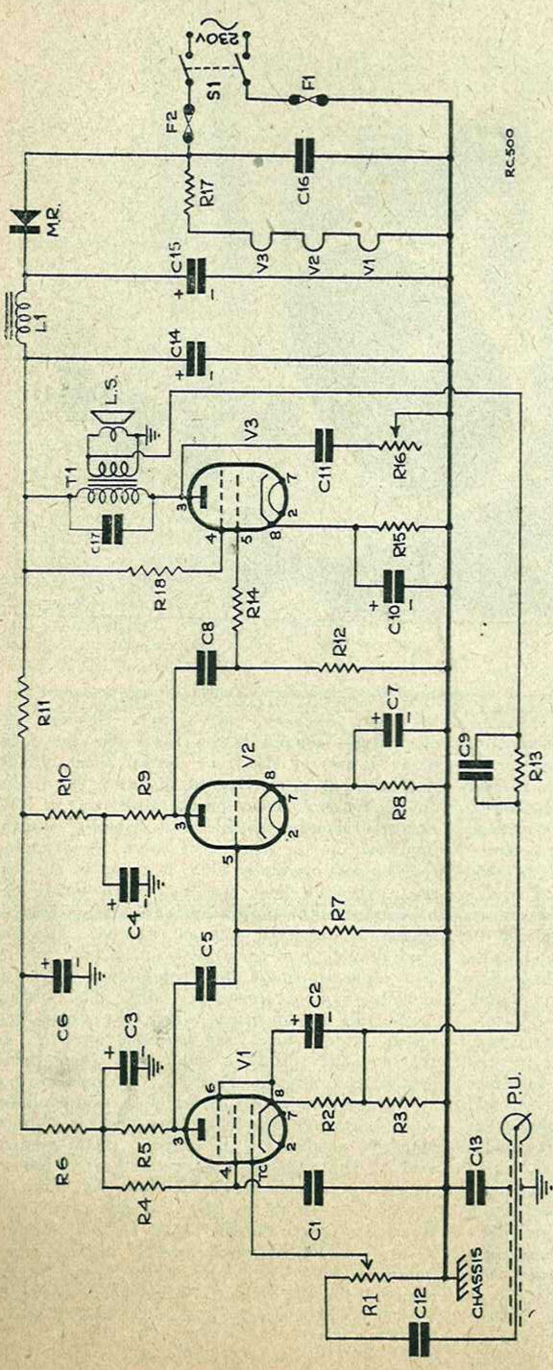
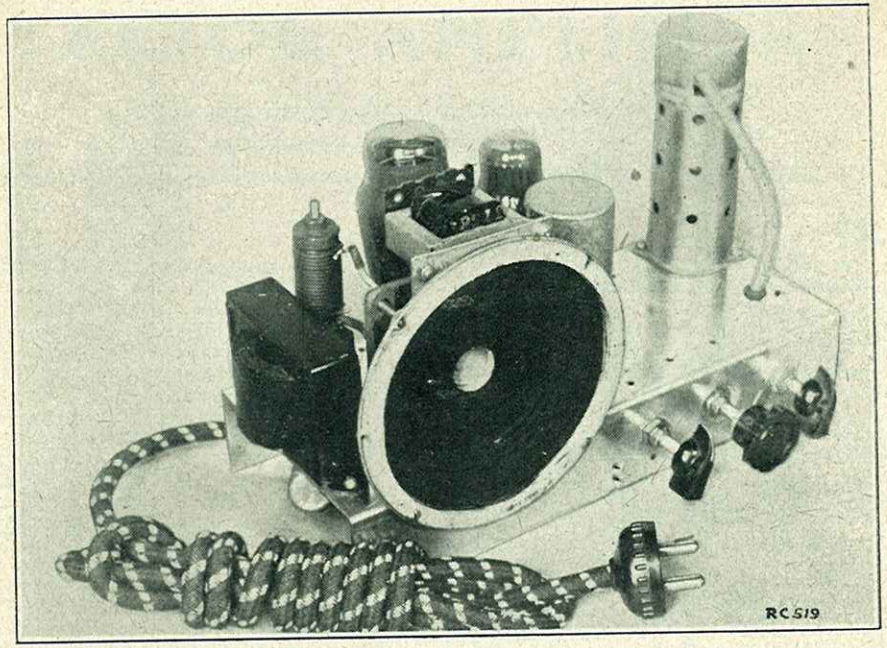


Fig. 1. Circuit diagram of the AC/DC Amplifier

Component List

C1, 0.25μF 350 V	C11, 0.05μF 450 V	R1, 1MΩ	R11, 15KΩ 1 W	L1, 20H 60MA
C2, 50μF 12 V	C12, 0.01μF 450 V	R2, 2.2KΩ	R12, 220KΩ	MR, 250 V 60MA
C3, 4μF 350 V	C13, 0.01μF 450 V	R3, 47Ω	R13, *see text*	S1, DPST
C4, 4μF 350 V	C14, 32μF 350 V	R4, 1MΩ	R14, 47KΩ	F1, F2, 1A *fuses*
C5, 0.05μF 350 V	C15, 32μF 450 V	R5, 220K	R15, 220Ω	PU, *see text*
C6, 30μF 350 V	C16, 0.01μF 450 V	R6, 15KΩ	R16, 20KΩ *Potentiometer*	
C7, 25μF 12 V	C17, 0.002μF 450 V	R7, 2.2MΩ		
C8, 0.1μF 450 V		R8, 1.5KΩ		V1, Z63, 6J7
C9, *see text*	T1, *to suit loudspeaker used (see text)*	R9, 22KΩ	R17, *see text*	V2, L63, 6J5
C10, 25μF 25 V		R10, 22KΩ	R18, 100Ω	V3, KT33C, 25A6



The frequency response approximates within 0.5 db at the extreme limits of the audio-frequency spectrum. An excellent transient response is attained, phase shift and distortion are almost negligible. Adequate damping of the loudspeaker, an essential to good frequency and transient response, is assured by the low output impedance of the amplifier brought about by negative feed-back. For the more technically inclined reader a few further notes of interest and importance are given herewith. Low leakage inductance in the output transformer has been stressed upon already, and should not be any higher than 75 mH. Full output of approx. 5 watts should be attained with an input of approx. 1.5 V RMS. The total distortion at full output is very low. Sine and square wave tests carried out in conjunction with an oscillograph on the amplifier gave indications of excellent linearity and response. Decoupling components included in many parts of the circuit are essentials for stable and trouble-free operation. C2, 3, 4, 6, 7, 10, 14 and 15 are all electrolytic capacitors, and the correct polarity must be observed when fitting these components. L1, the HT smoothing choke could be replaced by a field coil in an energised loudspeaker, if one desires to use this type. MR is the half-wave metal rectifier and is shown mounted vertically in the photograph. During initial running-up tests, MR should be inspected for overheating, and if this is suspected, switch off, and re-check the circuit. Suspect the electrolytic capacitors, as these are the most likely causes of short, or partial short circuit. As indicated in the circuit diagram, the mains on/off switch is shown on the mains side of R17, but this is only possible if a dropping resistor mounted on the chassis is used. A dropping resistor was originally used, but due to the fact that excessive heat was generated inside the cabinet when the amplifier was enclosed, a suitable length of line cord was substituted. The line cord should be of the three-way variety, having two separate single flex conductors, plus the spirally wound resistance wire. The author made this modification before the photo was taken, which shows the modified version. In this case, S1 will be a single pole single throw switch, and only one Fuse F1. No mention has so far been made of C16, which is used as mains filter to remove any extraneous noises that may attempt to enter via the mains. Little need be said of the general construction, as it follows normal practice. Keep all leads as short as possible, screen all the grid lead, and return grid leaks directly to chassis. R14, the grid stopper resistor should be wired directly at the valve-holder of V3. Take note of the heater wiring sequence for V1, V2 and V3, as shown in Fig. 1, with V1 at the earthy end of the heater chain.

(*continued on page 44*)

A Guide To Receiver Performance

THERE are a large number of radio constructors, including many capable of undertaking elaborate semi-original designs, whose knowledge of the short-wave spectrum is hazy, to say the least. Recently I asked a number of experienced constructors what they would expect to hear on certain wavelengths, how would daylight or darkness or the season of the year affect reception, and what distances would be considered by the enthusiast as "Dx." They were at first very vague and when pressed for an "estimate" the final replies were often wildly wrong. It is the hope of clarifying these doubts which decided me of the need for a brief outline.

Identification

The value of a particular waveband is not easily described. It is best understood by the experience of listening on it, but even so there are still many difficulties and, without being able to identify the stations reasonably quickly, it may take a long time to acquire experience. Many broadcast stations are far from easy to identify and considerable patience would be needed to await announcements. This is further complicated if the listener is without some knowledge of countries of "continental size" such as the United States, the number following the prefix represents the area.

By concentrating on the amateur bands over a period the listener is half-way towards being able to assess performance. The chief requirement now is to know the characteristics of each band to enable him to size up conditions.

Other Factors

It must be stressed that the following summaries are intended as a guide—there are no hard and fast rules in radio propagation. Conditions vary with the season of the year, hours of daylight and darkness, sunspot activity, etc. Sometimes the signal from a distant station comes "the long way round" the world instead of by the shortest path and this effect is by no means uncommonly noted by amateurs with beam aerials. Once one gets the "feel" of a band one instinctively notes just what other zones are being heard at the same time, the length of the "skip" (whether 2nd or 3rd skip, etc.).

There is, however, one thing that can be said with certainty. The more experienced the listener the less ready he will be to pass judgment on receiver performance without prolonged trial!

CENTRE TAP

Discusses the problem of Air-Testing-Receivers when constructed with particular reference to the Short Wavebands.

languages, but even so the station may well turn out to be a mere relay of unknown location. With the enormous amount of traffic at present on the air, accurate frequency measuring equipment would be required, to which very few constructors have access and still fewer own.

Stations such as ships or aircraft are mobile and may be anywhere at the time of transmission. Under such handicaps the study of the behaviour of propagation would be essentially a slow job but for the vast amount of amateur activity carried on in all parts of the world, day and night.

Zoning

The prefix of the call sign immediately identifies the country and the call sign is given at the beginning and end of each transmission. Call signs in the strangest of tongues present no great difficulty as they are usually given in phonetics.

Invariably the exchange of signal reports is followed by the actual town or district, and in

160 metres. Familiarly known as top band, but since the HF bands were opened to amateurs much of the amateur activity has dwindled. Even in the later pre-War years complaints of lack of interest were common, and to-day it is still more neglected. The band is regularly used for slow morse practice transmissions and a few enthusiasts, often in small "nets," are found there. It is at its best during hours of darkness when ranges of four or five hundred miles are fairly usual but reception over much longer distances are not uncommon when conditions are favourable. It seems unlikely that amateur activity will ever be much greater than it is at present. It is to be noted that on this band the power is limited to 10 watts.

80 metres. A useful band for consistency which can well be described as a "friendly" band and is largely used for regular "skeds." Extensively used for European contacts, invariably the listener will find something doing at all times without excessive crowding at week-ends and other popular times. Best during hours of darkness when trans-Atlantic contacts are frequent, but falls off in the summer months.

40 metres. Despite first impressions formed by listeners this IS a Dx band when it is at its best —after midnight. By day, contacts of several hundred miles are, with rare exceptions, easy. At night conditions vary and everything becomes possible. Unfortunately from the amateur viewpoint, broadcast stations have " usurped " a large part of the band and their number (with their attendant jammers) have recently again increased. During the SW broadcast hours (which sometimes seem to see the clock almost round) the amateurs are driven into absurdly narrow channels adding to the confusion. During the popular hours it sounds like the Crazy Gang running berserk in Bedlam. However, listeners should quickly get the feel of 40 metres and once having noted the skip changes during transition from day to night, etc., they will be able to predict with reasonable certainty just what would be heard if the " pirates " gave you a chance. The Dx is there when you get the opportunity to sort it out and a look-see in the wee sma' hours, especially the early morning, is well rewarded.

20 metres. Despite the narrowness of the amateur allocation this is a great band for great distances. It is subject to sudden changes but at most times there is something doing. The whole world at your finger tips, from two or three hundred to many thousands of miles.

10 metres. Folds up in the summer months when, with rare exceptions, only locals up to 35 miles or so can be heard. From Autumn to Spring all sorts of exciting things might happen. It is liable to even more sudden changes than 20 metres but when it is really open the Dx simply pounds in at great volume with a practically silent background. The 11 metre band, available to US amateurs is similar in characteristics, and they can often be heard working G amateurs cross-band on 10 metres.

2 metres.

In conclusion a few words regarding the 2 metre band—although this is hardly likely to be of much interest to constructors. VHF is, of course, a technique on its own, requiring a specialised receiver or a specially built converter. It is, generally speaking, reliable only at "visual" range although contacts beyond that distance are frequent. Reception at anything over 200 miles is something to write home about, and double that distance would break the existing record.

Note.—Dx—amateur abbreviation meaning long distance, applied equally to reception or transmission.

AC/DC Amplifier *(continued from page 40.)*

The reservoir capacitor C15 as specified in the component list should be capable of carrying the ripple current encountered at this point, and the type recommended is quite suitable. R17 is the voltage dropping resistor or line cord. The value of resistance necessary can be calculated from Ohm's Law, viz.: Take the sum of the heater voltages $(Vh1+Vh2+Vh3)$ which equals 37.6 volts from the mains voltage, which depends upon what frame of mind the Electricity Board are in. Say 240 volts, therefore this leaves us with 202.4 volts at 0.3 amp to dissipate across R17.

Divide 202.4 by 0.3 which will give us 675 Ω (to the nearest Ω) which is the value of R17. With line cord of the 0.3 amp variety the resistance per foot is usually 60 Ω, therefore 12 foot is necessary and with the usual trimming of ends the correct length should approximate 11ft. 4ins. Quite a length, admitted, but it keeps the heat away from the cabinet. A dropping resistor would most probably be cheaper, and there is another advantage of the dropper method. During cold spells (Electricity Board permitting) the amplifier will make an ideal electric toaster or heater. If a dropper resistor is utilised it will only be necessary to tap at 675 Ω by the variable slider. The resistance can be determined either by an ohmmeter or by ruler calculation.

CAN ANY OF OUR READERS HELP ?

I wonder if any of your readers could help me with the loan of the circuit of the 58 Canadian Walkie-Talkie, especially that of the power unit. Alternatively, I am willing to purchase same, or would exchange for any required circuit which I may have.

G. Patmore
16 Osborn Gardens, Mill Hill, N.W.7

I would like to enlist your aid in obtaining the original AM publication on the 1155 receiver. I would be pleased to hear from any reader of " Radio Constructor " who can assist me in this. I would gladly purchase, or exchange for other manuals which I possess.

J. Lewis
83 Duke Street, W.1

Query Corner

A " Radio Constructor " service for readers

"Can you please explain the mode of operation of the transitron oscillator of the type frequently used in the time bases of oscilloscopes and television receivers."

E. Rogers, Glasgow.

The principle of the transitron oscillator has been known for many years but in the form in which it existed prior to the war it was not capable of generating linear saw tooth waveforms of the type required for time base use. During the war the so-called Miller integrator circuit was discovered and the combination of this circuit with that of the old transitron has resulted in the production of a single valve oscillator circuit which is capable of producing a linear saw tooth waveform having a good degree of stability. The circuit of the present-day transitron is shown in Fig. 1, the letters shown on the diagram refer to the waveforms of Fig. 2. Before considering the operation of the circuit it is necessary to review the suppressor grid characteristic of a pentode valve, because it is upon this characteristic that the action of the transitron depends. Fig. 3 is a graph which shows the variation in anode and screen grid currents of the valve which occur when the suppressor grid voltage is varied. It will be seen that as the suppressor voltage is increased negatively the anode current is reduced whilst the screen current is increased. This is because as the suppressor becomes more negative it reduces the number of electrons which reach the anode, these electrons are consequently returned to the screen grid and increase the screen current. Now remembering the property of a pentode the mode of operation of the transitron will be considered.

Turning to Fig. 1 our investigation will commence at the instant when the suppressor and control grid voltage is zero and the capacitor C1 is fully charged. Under these conditions the screen current is at its minimum and hence the screen voltage is at a maximum, and the valve may be considered as operating as an amplifier. Now C1 gradually discharges through R1 allowing the voltage on the control grid, and hence also the anode current to increase, this resulting in a corresponding reduction in the anode voltage. This condition continues for a time, producing the linear stroke of the output waveform, but because R1 and R2 are of the same order and the change in anode current is greater than the change in screen current, the anode voltage decreases more rapidly than the screen voltage. As a result a point will be reached when the anode voltage is insufficient to attract its share of electrons which consequently return to the screen grid, and result

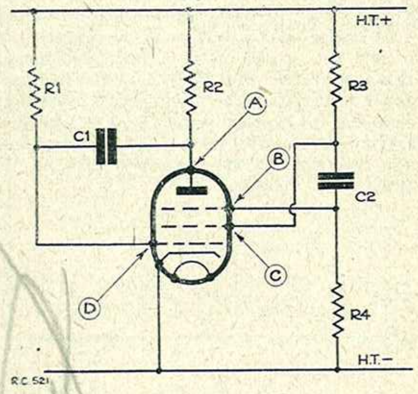


Fig. 1.

in a marked rise in screen current. This rapidly reduces the screen voltage, a reduction which is passed on to the suppressor grid via C2. Now this drives the suppressor negative and thus still further reduces the anode current whilst at the same time increasing the screen current (Fig. 3). The effect is cumulative and the anode current rapidly reduces to zero and a large negative voltage is built up on the suppressor grid.

This state of affairs brings about a rapid flyback and as the anode current is now at zero the anode voltage equals the total HT voltage. The sudden change in anode voltage is conveyed to the control grid by the capacitor C1 which drives the grid positive. A positive bias means that grid current will flow and C1 is therefore allowed to recharge through R1 and the grid to cathode path of the valve.

Whilst C1 is recharging C2 discharges through R4, the time constant C2/R4 being such that the voltage on the suppressor grid is very nearly zero by the time C1 becomes recharged. This means that the anode is again allowed to draw current, the screen current reduces to its normal value and the cycle repeats itself.

This explanation may appear a little involved when first read but if it is carefully considered in conjunction with the voltage waveforms shown in Fig. 2 no difficulty should be experienced in understanding the basic mode of operation of this interesting circuit. Some constructors may wish to make up the circuit and determine their own voltage waveforms with the aid of an oscilloscope in which case circuit values may be as recommended for the time base generators of the Inexpensive Television Receiver.

Finally a few notes upon the effect which various component values have upon the operation of the circuit. The speed or frequency of operation is governed mainly by the values of R1 and C1, increasing either value will decrease the frequency. Flyback time is controlled largely by the value of C1 and may be reduced by reducing the capacitance of this component. If this is done the value of R1 must be increased in order to maintain the product C1R1 constant. A circuit of the type shown in Fig. 1 is capable of providing a negative going output sawtooth whose amplitude is approximately 20% of the available HT voltage.

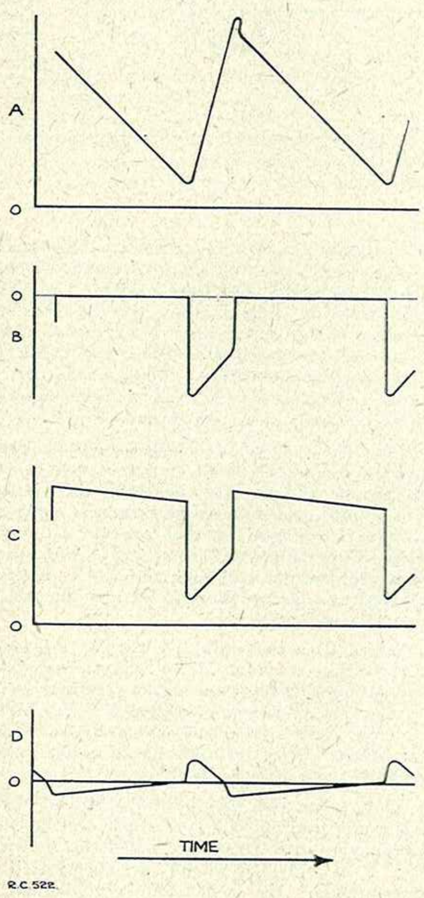


Fig. 2.

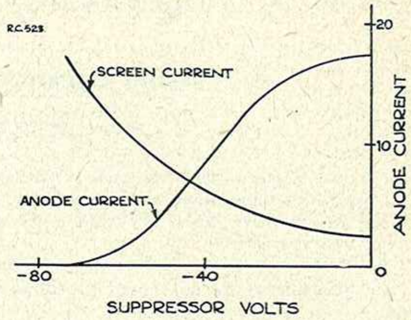


Fig. 3.

Self Bias for DH Valve

"*I wish to employ a directly heated output triode in an amplifier but I am not clear as to the method of obtaining the bias voltage for such a valve. If possible the use of a bias battery is to be avoided on account of its relatively large size and need for occasional replacement.*"

E. Evans, Cardiff.

Self bias, or cathode bias as it is more commonly called may be employed with directly heated valves in almost exactly the same manner as with indirectly heated valves. In other words a resistor connected in the cathode circuit of the valve provides a positive voltage at the cathode by virtue of the electrode currents which flow through it. With an indirectly heated valve the cathode is distinct from the heater, but with a directly heated valve the cathode and heater are virtually one and the same thing. Because of this it is necessary to make the heater of the directly heated valve positive with respect to its control grid in order to obtain the required bias. At the same time however, it is necessary to connect the heater itself to an LT supply.

The combination of these two requirements means that the LT supply from which the valve heater is fed must itself be raised by a positive potential equal to the required bias. The normal arrangement for achieving this is shown in the circuit diagram Fig. 4. In this circuit the anode current of the valve flows through the bias resistor R1 and produces the bias voltage. The capacitor C1 is a high capacity electrolytic, the purpose of which is to prevent fluctuation in the anode current due to the signal voltage from causing similar fluctuation in the bias voltage.

It is not good practice to feed the heater of one or more indirectly heated valves from the supply source used for a directly heated valve as any leakage between the heater and cathode of the indirectly heated valves will shunt the bias resistor.

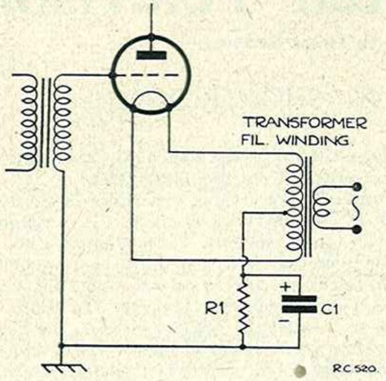


Fig. 4.

Mains Voltage Dropping Resistor

"*I am building an AC/DC superhet receiver and my problem is to calculate the value of the mains dropping resistor. The heater voltages of the valves are EF9—6.3 v, CBL1—44 v, CY1—20 v and ECH3—6.3 v, all have a heater current of 0.2 Amp.*"

D. H. J. Amphlett, Gloucester.

The voltage to be dropped by the resistor is the difference between the mains voltage and the sum of the individual heater voltages. Thus assuming that the mains voltage is 230 v, that across the resistor will be

$$230—(6.3+44+20+6.3)=153 \text{ v}$$

"Query Corner" Rules

(1) A nominal fee of 1/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with the more general interest will be reproduced in these pages each month.

Now this voltage must appear across the dropping resistor when it is passing 0.2 Amps; thus by Ohms law, Resistance $=\frac{153}{0.2}=760$ ohms.

The power that the resistor must be capable of safely dissipating is given by the product of the voltage across it and the current flowing through it. Or using figures: $153 \times 0.2=31$ watts.

The values calculated above have, of course, been taken to the nearest whole number.

RECEIVER CONTEST

As forecast in our last issue, we have great pleasure in announcing a further contest for article writers. This time, we invite our contributors to submit articles on the construction of receivers. As before, all articles published will be paid for at our usual rates, and in addition 2 guineas will be paid for what we consider the best article, and 1 guinea for the runner-up. When submitting, the following rules should be adhered to:—

(1) The Contest is open to any reader.

(2) Any number of articles may be submitted by any one contestant.

(3) The articles will be judged on their merits, taking into account ingenuity, practicability, and technical soundness.

(4) Receivers described may be either battery or mains types, and there is no limit to the number of valves or wavebands employed.

(5) Articles need *not* be typewritten, though this is preferable. This point will *not* be taken into account when judging. Articles should be written or typed on one side only of the paper, and all drawings must be on separate sheets apart from the text. Drawings may be rough but should be clear and legible, and will not themselves have any bearing on judging.

(6) All articles must be accompanied by a suitable S.A.E. for return or acceptance.

(7) The Radio Constructor does not accept any responsibility for MSS, which are submitted at owner's risk.

(8) The decisions of the judges—R.C. editorial staff—shall be binding.

(9) The latest date for entries is December 30 (last post).

Home Constructed Televisor

Using 45 Mcs. Strip (T.R.F.) as Vision Receiver

(PART 2) by W. SHORTRIDGE

Time Bases, Sync Separator, etc.

The circuit uses EF50's for phase inverter, sync separator, and line time base, and a 6J7 for frame time base (alternatively an EF39).

I think that probably the stability of the present set owes much to the fact that in all critical places variable resistors have been used. It may seem unnecessary to some, but I certainly recommend it. Once the correct position has been found it is unnecessary to touch them, and for months now neither the line nor frame frequency controls have required adjustment.

The circuit is in the main identical to that published in the articles by G2ATV and G3AYA, but I quote hereunder the differences.

R8—100,000 Ω
R7—10,000 Ω
R5—30,000 Ω (and additional 30,000 Ω from screen grid of sync separator to HT)
R6—100,000 Ω *variable*
R15—680,000 Ω
R31—50,000 Ω
R14—100,000 Ω *variable*
R16—5 megohms
C18—500μμF

It is obvious from above that experiment in values over a wide variation is worthwhile, so take my tip and use variables if on hand.

The Sound Receivers

The sound receiver is constructed in the metal case of the R1147B receiver. It is not a modified version of that receiver, however, but is a completely reliable job and merely utilises the metal cabinet for convenience. It consists of a quite straightforward circuit of 1RF stage (EF50) a reacting detector (any convenient triode) an audio amplifier and a metal 6F6 output. The tuning is by individual 50μμF variable capacitors, and a 50μμF reaction capacitor. Coils are 4 turn ½-inch diameter 16 gauge. No object would seem to be served by further description—it is quite straightforward.

A second sound receiver for use with the 3553 set, however, may be of interest. This uses an RF27 unit modified as per circuit shown. This modification is quite simple, and consists of removing the underchassis screen nearest the Jones plug, and re-wiring the ex-oscillator section.

On removing the screen and components associated with the oscillator stage, there is ample room to instal an EA50 as a diode detector, and re-wire the VR137 as an audio amplifier as per circuit. The output stage can either be constructed with the valve lying horizontally over the ganged tuning capacitor, thus making the unit self-contained (there really *is* room !) or it can conveniently be on the main 3553 chassis, fed by a screened lead from the Jones plug.

Originally, the tuning capacitors in the RF27 unit are in series with the coils. It is simple to parallel them instead. The original coils are easily removed, and can either be rewound or, as in my case, replaced by self supporting 4 turn coils, ½-inch diameter, 16 gauge. To those who wish to re-wind the original formers, the flanges should be carefully edged further apart, and nine turns wound on. The exact number must be found by experiment. Using the self-supporting coils mentioned above the sound is received at 40° on the dial in my own case.

Using the 1355 chassis, which must be "de-wired," thus obtaining a large number of useful components, the complete time bases, sync separator, etc., can be installed together with two power packs on the large chassis, and I now have this under construction as a second experimental television receiver. The power packs are already installed, the vision signal "heard" and the sound obtained using the RF27 unit described. All that remains is therefore to wire up the sync separator, time bases, etc.

Trying It Out

Before switching on for the first time it is advisable to test from HT+ to earth to make certain there is no short.

Also test that all the chasses used are connected together, and to the negative line (earth).

Make sure the CRT grid is connected. This must never be left free at any time, and it is advisable to permanently connect a 10,000 Ω resistor from CRT grid to earth, just in case of accidents.

Now switch on and allow half-a-minute for warming up, then turn up the Brilliance control very gradually.

If a single bright spot appears, neither time base is functioning. A long horizontal line indicates the frame time base or amplifier is not functioning, while a vertical line indicates the line time base or amplifier is not functioning. In any of these cases turn down the Brilliance without delay to avoid burning the screen.

A DC voltmeter will not indicate the correct EHT voltage, but is useful to indicate whether or not EHT is present. Try each side of each deflection plate capacitor. The meter will measure the voltage on the amplifier side of these capacitors, and will indicate that an EHT voltage is present on the CRT side. Assuming voltages are correctly present, and you are assured the time bases and amplifiers are correctly wired and connected to the X and Y plates, it is probabl e

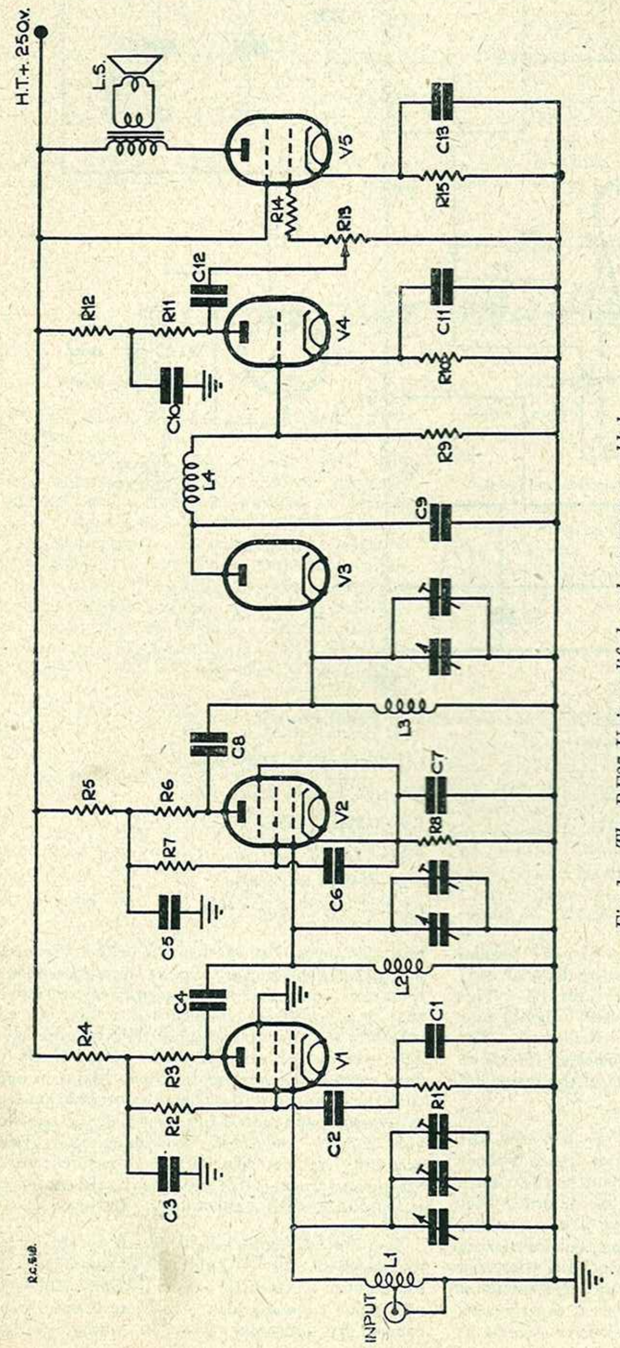


Fig. 1. The RF27 Unit modified, and output stage added.

The RF stages are not touched, except the coils and the coupling capacitor which is originally 100pF.

The components not marked are those originally contained at these points in the unit.

Component List.

R1, 150 Ω
R2, R3, 10k Ω
R4, R5, 2.2k Ω
R6, 50k Ω
R7, R9, 100k Ω
R8, R10, 1k Ω
R11, 30k Ω
R12, 20k Ω
R13, 500k Ω
R14, 5k Ω
R15, 470 Ω
C1, C2, C3, 0.001μF
C4, 50pF
C5, 0.1μF
C6, 25μF 12VDC
L1, L2, L3, see text
L4, VHF choke
V1, V2, VR136
V3, VR92 (EA50)
V4, VR137
V5, 6F6

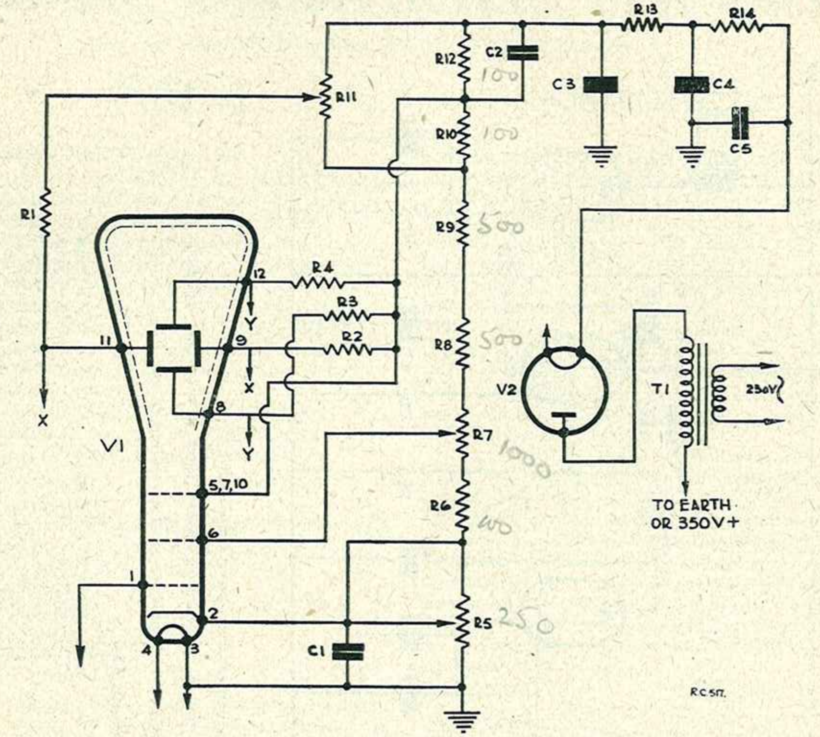


Fig. 2. Tube Network and Power Supply.

R1, R2, R3, R4—1M Ω
R5—250k Ω pot.
R6, R10, R12, R13, R14—100k Ω
R8, R9—500k Ω
R11—2M Ω pot.
R7—1M Ω pot.

C1, C2—0.1μF, 500V wkg.
C3, C5—0.1μF, 2.5kV wkg.
C4—0.25μF, 2.5kV wkg.
V1—VCR97
V2—HVR2 or similar
T1—see Pt. 1, Aug. 1949 R.C.

that the time bases or time base is not "oscillating." Try the effect of adjusting R14 or R31 and in the case of a line time base fault, R6. This should effect a cure and a "raster" should now be visible on turning up the Brilliance. The raster, of course, should appear whether television is on the air or not, and the effect of the focus and shift control can be noted.

When a transmission is on the air, and the sound of vision signal is heard on trying phones from CRT grid to earth (it is worth inserting a switch in the EHT negative line in order that EHT may be switched off for such a test) there must be a picture of some kind on the screen even if quite unrecognisable. Having held whatever is seen as steadily as possible by adjustment of line and frame frequency controls it is necessary to stagger-tune the vision receiver which is probably peaked at 45 Mcs. A peaked signal will not give a good picture, but it should be possible to obtain a quite bright and steady raster showing that it is correctly synchronised. Now try very carefully the effect of retuning the vision receiver. Try every other stage screwing in gradually the dust cores and counting the turns given in order that they can be replaced in the original position if necessary and watch the screen all the time and you will be rewarded by seeing the picture gradually come to life. Final adjustment to the tuning and the variable controls should enable you to obtain a really good quality picture.

The fault I found most difficult to cure was a fold-over, *i.e.*, the left-hand side of the picture was folded over on itself for about half-an-inch. This was prior to using deflection amplifiers, and is caused by incorrect fly-back timing. It was eventually cured by using the line amplitude potentiometer as a variable anode resistor (100,000) and taking the output direct from the anode. This meant the amplitude was no longer variable but without amplifiers the picture is unlikely to be too large. On installing amplifiers the 50,000 amplitude potentiometer was replaced, and there has been no fold-over trouble at all.

A final word on aerials. Interference was experienced when using the vision dipole upper limb for sound reception, and a separate indoor aerial was erected along the curtain rail. Later the set was moved further from the window, the coaxial feeder being extended (most incorrectly) by a couple of yards of twin flex. It was found by accident that on connecting the sound aerial input to the coaxial sheathing at the junction of the twin flex the volume increased appreciably, and that has been used as the sound aerial ever since, *i.e.*, the sheathing of the feeder some two yards from the earth, and there is no interference.

RADIO CONSTRUCTOR

. . . *from our mailbag* . . .

WAS THE QUIZ WRONG?

I do not agree with question 4 in the Quiz (July issue), *i.e.*, Why is the grid of an RF Pentode brought out via a top cap? The question implies that all RF Pentode grids are brought out via a top cap, whereas in fact no newly developed valves of the last 12 years have top grid connections. In making this statement I am thinking in terms of American valves, although without checking I believe this also applies to British valves. If I may reply to B. Rowell of Harrow Weald, I suggest that he purchases the RSGB publication "Service Valve Equivalents." This will take care of his troubles as far as service valves are concerned. The turns ratio of transformers he can measure, by feeding in a few AC volts, and measuring the input and output voltages. The ratio of volts one to another will also be the turns ratio.

In view of recent correspondence on diagrams and the newcomer, may I suggest to the new amateur four books which will give him a very good knowledge of radio. I regret to say all are American, but they are presented in a manner more easily understood than any British book which I have yet read :—

"Radio Physics Course" by A. A. Ghirardi. Murray Hill Books Inc.

"Modern Radio Servicing" by A. A. Ghirardi. Murray Hill Books Inc.

"Coyne Radioman's Handbook" by Coyne Electrical School, Chicago.

"Radio Test Instruments" by Turner. Ziff Davis Publishing Co.

The above books are just as equally suitable for the advanced amateur as for the newcomer. I believe all can still be obtained through Dale International Publishing Co., 105 Bolsover Street, W.1 (usual disclaimer).

A. W. J. Marsh
(Newport, I.O.W.)

CONTENTED WITH CONTENTS

With regard to recent correspondence on the desired style of your magazine, I think it is just right.

I like the attention to ex-service gear at the present time because it gives one a chance to do so much with so little money, and I personally have not yet been let down by unreliable components from this gear. Carry on with the good work.

H. Riding
(Wilmslow, Ches.)

ON THE RIGHT LINES

I am very pleased with your books and find them well-balanced. I am a learner feeling my way and find them very useful. I have not yet started on your television receiver, although I have the units at hand. I want more experience first, and as I am out of the normal range I require some instruments for initial setting up. I would like more articles on aerials, signal generators and waveform generators.

B. Blachford
(New Milton, Hants.)

AN EARTH PROBLEM

I am writing to ask if you could assist me with regard to the following: I have made a very small radio of four miniature valves for use in my pocket. Very excellent results are obtained from three stations, at good power, but only when I use an outside earth.

Can anyone suggest a method of earthing the set so that the outside earth can be done away with, and thus make the set function satisfactorily in my pocket.

H. J. Johnston
(Blackpool, Lancs.)

LOGICAL FAULT FINDING

The sixth in a series of articles to assist the home constructor in tracing and curing faults

By J. R. DAVIES

6: DISTORTION

THE word "Distortion," according to the dictionary, signifies a "misrepresentation." Therefore when, in this chapter, we consider the case of a distorted receiver, we are referring to a receiver whose output is a misrepresentation of its input. Of course, no receiver is capable of perfect reproduction of the sound picked up by the transmitting microphone, so let us qualify the previous statement by adding that the misrepresentation offered by the receiver has become so noticeable that pleasurable listening is impossible.

Distortion may be caused both by faults in the electrical circuits of the receiver and by incorrect functioning of the loudspeaker. For this reason some considerable space has been devoted to loudspeaker faults in this section, it being considered that, when subdividing the possible snags of a receiver into general sub-headings, those associated with the speaker fall very readily indeed under the title of "Distortion."

There are three main types of distortion which may be introduced by an amplifier :—

1. Frequency Distortion

This is the form of distortion which occurs when different frequencies are amplified unequally. Although it is an undesirable characteristic in an amplifier it is often present in the average receiver. It does not always make the reproduction of a set unpleasant to the ear ; in fact, those listeners who listen to the radio with the tone control turned all the way down, so that the bass is accentuated and the higher frequencies are almost non-existent, seem to prefer a certain amount of frequency distortion !

2. Amplitude Distortion

Amplitude distortion occurs when, in some part of the amplifier, there is a non-linear relationship between current and voltage. This is almost impossible to get rid of entirely as the Ia—Vg curve of any valve is never perfectly straight. It is, however, possible to work an amplifying valve so that the *straightest* part of its curve is used. Also, of course, unless the circuit is designed for it, the amplifying valve is so biased that grid current never flows. Amplitude distortion can often be the cause of bad quality in a receiver, particularly if the latter has only recently started to give trouble. The cause can only lie in an alteration of the valve constants or voltages. This is, in fact, one of the major causes of distorted output, as we shall see later.

3. Phase Distortion

Phase distortion results when the phase relationship between two or more frequencies is varied during the process of amplification. For instance a certain frequency and its second harmonic may be in phase at the input but the second harmonic may be somewhat displaced with regard to the fundamental at the output, this giving a different interpretation of the input signal.

It might make the matter a little clearer if we take a brief glance at the input and output waveforms of an amplifier which causes phase distortion. Fig 26 (*a*) shows the input, this consisting of a fundamental "a" and a second harmonic "b." The resultant waveform is shown by the curve "c." Fig 26 (*b*) indicates the altered appearance of the resultant waveform "c" when the second harmonic has changed its phase relationship to the fundamental. In this case the harmonic has undergone a displacement of 90. The effect is only noticeable when the time taken for the signal to pass through the amplifier is comparable with the duration or the frequency of the signal. A certain amount of trouble is taken to eradicate phase distortion in high fidelity amplifiers, particular care being devoted to the design of output transformers, etc., but, so far as the average domestic receiver is concerned, the AF amplifier has necessarily a restricted spectrum owing to the crowded broadcasting bands, and so the effects of phase distortion are not excessive.

Causes of Distortion

Let us now proceed from the more theoretical treatment of distortion and tackle the practical work of tracking down its causes and clearing them up.

Everyone has come across the sound of a distorted receiver. However, it is possible, especially by those with an experienced ear, to have a pretty good idea of the cause of the trouble even before the receiver is taken from the cabinet. The writer will do his best in this article to

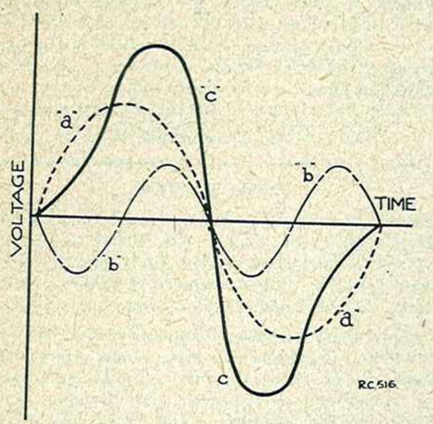


Fig. 26a.

illustrate how the different causes of distortion affect the output from the loudspeaker, but it must be appreciated, insofar as aural tests go, that no hard and fast rules may be laid down, and the probability of successful location by simply listening to the receiver is only about 75% (or, to put it more clearly, the odds are 3 to 1).

The causes of distortion are as follows :—

1. Distortion caused by the loudspeaker.
2. Distortion caused by a valve operating under incorrect conditions.
3. Distortion caused by near-instability (cf. See R.C. Vol. 2., No's 10 and 11. Logical Fault Finding).
4. Distortion caused by breakdown of components not directly connected with valve supplies.
5. Distortion caused by poor or antiquated design, by use of cheap or old-fashioned components, etc., and which requires an alteration in the receiver circuit to clear.
6. Distortion caused by overloading.

1. Distortion Caused by the Loudspeaker

Distortion caused by the loudspeaker is usually recognisable by the "mechanical" nature of the noise. The distortion also occurs above a certain volume level in the majority of cases and very often has a "rattling" character, the effect usually (with larger speakers) occurring at a relatively low AF frequency. Higher-pitched rattles or resonances are usually caused by the loudspeaker cabinet, this latter having loose mountings somewhere ; or perhaps by a loose dial scale or other accessory which is part of the receiver chassis. Resonances may also find their root in faulty speakers, in addition to certain cross-modulation effects in which a heavy bass note modulates the rest of the AF frequencies reproduced, this latter effect being particularly noticeable in small, over-loaded models.

Location is quite easy. Another speaker, which is known to be good, is connected in place of the suspected model, the latter being disconnected entirely. This usually simply necessitates the connection of the test speaker to the "extension LS" sockets of the set. The disconnection of the speaker in the set is necessary as, sometimes, its faults or resonances may be "reflected" into the testing loudspeaker. The speaker used for testing should be a well-made model and must be adequately baffled to ensure that all the bass notes are correctly reproduced : it may happen that negligible distortion is apparent when the test speaker is connected should this component not give full reproduction of the lower frequencies.

If it is found that the speaker is responsible for the distortion, then it must be taken out of its cabinet and examined. If no fault is apparent visually it should be connected to the receiver and again tested. Quite often faults are caused by the cone touching part of the baffle or something equally trivial. For this second test the speaker should be held against a baffle, although there is no need to mount it there. It should never be tested whilst it is laying, cone downwards, flat on the bench. Apart from the fact that the cone may catch and tear on any odd nuts and bolts, etc., that may be laying around, the very heavy damping imposed on the movement by the imprisoned volume of air will probably be sufficient to prevent any resonances or faults from occurring.

After having carried out these checks, let us now assume that the speaker is definitely at fault. The first thing to look at is the diaphragm or cone and its surround. The cone should be minutely examined for tears, and the surround should be checked to see that it is well fastened to the metal chassis of the speaker. If a tear is found in the

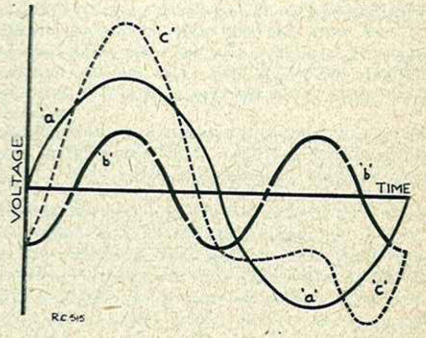


Fig. 26b.

cone it should be repaired very carefully. Fig. 27 (*a*) gives an idea of the thing to be expected, the tear running along two lines at an angle to each other, thus allowing a flap of cone material, hinged on the points A and B, to vibrate at certain frequencies. Due to this vibration, the tear gradually increases in size, until, in its worst state, the speaker is beyond economical repair.

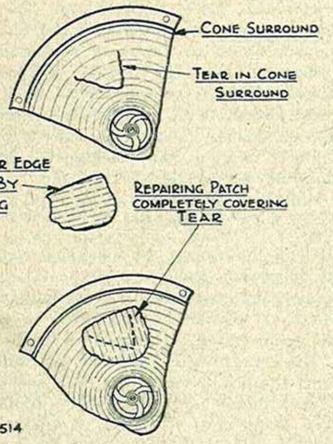


Fig. 27.

Many methods of repairing speaker cones have been advanced in the technical press, all of them fairly successful. The method used by the writer, after some experience, is to repair the tear by sticking over it a piece of material possessing as little stiffness as possible. The most easily obtainable material for this purpose is newsprint, on which newspapers and magazines are printed. Certain types of newsprint may be found rather stiff but a little care in selection will yield some that is definitely "soggy," and this should be used. A piece should be torn out (not cut), so that it is large enough to cover the tear and the cone material surrounding it. An irregular circumference on the repairing patch is necessary as a piece of material with sharply-cut straight edges will tend to peel back after some time has elapsed, and it will also strain the cone material more than would the paper with the torn edge.

The patch of paper is now stuck to the diaphragm as shown in Fig 27 (*c*). If the tear is large, paper may be stuck on both sides of the cone.

Of even greater importance than the material used for the repair is the choice of adhesive used. Most glues, after having dried, gradually set and shrink to a flint-like hardness which eventually succeeds in tearing the cone all over again, making things even worse than before. The ideal adhesive is one that hardens only to a putty-like consistency. Before the war it was possible to obtain a "tube-glue" in which a petroleum derivative was used as the solvent and which set to a rubbery hardness, but this does not appear to be available in Britain at present. Certain of the proprietary brands of glue sold nowadays may be used, but care has to be taken in their selection.

To be continued.

BOOK REVIEW

Introductory Radio, Theory and Servicing by H. J. Hicks, MS, Radio and Service Instructor at the Central High School, St. Louis, Missouri, and formerly Radio Engineer, Aircraft Laboratory, Wright Field, Dayton, Ohio.

This book has been especially designed for students, beginning at high school classes on radio. No previous experience of radio, electricity, or magnetism is required, and therefore it is ideal for the beginner. The "how and why" of radio servicing problems and construction is given in easy-to-read chapters. Difficult technical principles are explained in everyday language, and stressing the "learning by doing" approach. Chapter 1 covers the Elements of Magnetism and Electricity; 2, Fundamentals of Radio Construction and Repair; 3, Vacuum Tubes; 4, Audio Amplifiers; 5, Power Supplies; 6, Amplitude Modulated Receivers; 8, Test Equipment; 9, Loudspeakers; 10, Public Address Systems; 11, Antennas; 12, Television, and finally Chapter 13 covers miscellaneous projects such as Phototube relays, Transformer Design, Sound on Light Beam, High Gain 4.5W Amplifier, and other interesting items.

A useful appendix contains over 60 pages of tables and charts relating to all the chapters in the book. A complete Teachers' Manual is also available. Lavishly illustrated, with photographs and drawings throughout, we have no hesitation in recommending this book for the beginner. 393 pages on high quality paper. Cloth bound cover. Price 19/6 from the publishers, McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2.

L.E.H.

BINDING

Readers wishing to have their copies bound should send the twelve magazines, well packed and **including the index,** to the following address:—

J. R. Dunne,
19 Helmsdale Road,
Streatham, London, S.W.16.

Copies will be bound in cloth covered boards with the name and volume number printed on the front cover and spline. Covers of the magazines may be bound in or taken out as desired. Please remove covers if you do not wish them to be bound in with the volume. The price for binding is 8/- post paid.

How To Re-Build Your Friend's Radio

By H. DUDLEY STILTON

A FRIEND of mine accosted me in the street the other day. "Hi, Dud," he yelped, "How about doing me a favour, I've just built a four-valve battery set, but it wants lining up, will you do it for me?"

"Sure, sure," I replied magnanimously, "anything to oblige."

"How about now?"

He brought it to the house and laid it on the bench. Considering that he was only just a beginner in radio, it was a magnificent job, beautifully laid out and beautifully built.

He connected the batteries and I got the "Jenny" out and clipped the leads into place.

"We shall have to wait for about a quarter-of-an-hour, for the "Jenny" to warm up, otherwise we shall get frequency drift and that spells trouble," I enlightened him.

"Well, while we are waiting, will you give me the "gen" on fitting an RF stage?"

I explained, he listened. I drew diagrams, he got lost. I drew more complicated diagrams, I got lost.

We decided that the easiest thing to do was to build it. I took my jacket off, got the hand drill out, marked the places out to drill and gave it to him. Then I put my jacket on.

He had it all ready for me in about half-an-hour. I told him the best thing to do would be to just stick the parts in roughly to begin with, for one never knew with home-built sets, whether or not the whole thing would need rebuilding. He agreed.

As I worked I explained the reasons for each part, starting from the resonance of a tuned circuit feeding into the grid, being amplified and passing out from the anode to feed into the mixer valve. I pride myself that as I finished explaining, I also finished work. Very roughly, of course—very roughly!

"Righto," I said, "we'll line it up now." Once again I clipped the leads into place, connected the output meter and switched on. The silence that came from the loudspeaker could not have been bettered by Marconi himself.

"Hmmmm," I muttered sarcastically, "see what I mean about having to rip the set to bits?"

"Well I don't know about that," he grumbled, "at least it got the two local stations before I brought it across to you, and how do you know it isn't your work that's wrong anyway?"

I gave him a withering look and transferred the "Jenny" leads to the grid of the mixer. Still utter silence.

"That," I exclaimed with deep sarcasm, "proves that!!!"

I gave the wiring of the first detector a suspicious look, decided I didn't like it, ripped it out and re-wired it—roughly, of course.

Still utter silence.

I transferred the leads to the IF bottle and tried again—more silence. Cursing myself inwardly for not having tried that first, I took it out of my friend by mumbling something about amateurs not being able to build themselves a crystal set, let alone a superhet, and also gave him a lecture on detector circuits, whilst I probed around and very nearly built the circuit again—roughly, of course. I switched on and tried again—this time a deeper silence than ever reigned, for this time I was speechless, too.

He winced audibly as I viciously attacked the IF—by now the set wouldn't have fitted into a wardrobe, never mind a cabinet.

I needn't tell you that the result was utter and complete silence.

As I had now completely rebuilt the set and could no longer lay the blame on my friend's shoulders, I went through what remained of that set with a fine tooth comb. I might as well have gone through it with a hammer and chisel, in fact by now I was sorely tempted to do so. Everything was perfect—electrically anyhow.

I switched on and sorted through the maze of wires I had flung together, and very faintly I heard music. I trimmed and padded, went through each section, until suddenly a ghastly thought struck me—my signal generator wasn't working!!!

I worked frantically at the confounded mess that had once been a set, until one could actually distinguish the two local stations, talking all the time to distract his attention from the fact that I was no longer using the "Jenny." Bundled it into his arms, told him to build it up again neatly, and bring it back later, when I would line it up for him.

When he had gone I sat in my chair and shuddered—you see his set HAD only wanted lining up!!!

UNTUNED PRE-AMPLIFIERS

By C. L. CRANE

A Useful Feature for New Receivers and an Improvement for Old Ones

Introduction

USING the family receiver, amateurs are frequently dissatisfied with the programmes from the usual stations. Do you find in your excursions across the broadcast bands that the stations which might be most interesting are just too weak for comfortable listening? As you know, most broadcast receivers are not nearly as sensitive as they might be. But an untuned preamplifier connected in the aerial lead can greatly increase the gain of such receivers over the Long and Medium Wavebands and improve performance in other ways, too.

Untuned radio frequency stages were used in many early broadcast receivers. Their gain was low and when pentode valves and high-Q tuned circuits were designed the untuned RF amplifier was considered to be dead. The coming of television and radar required video amplifiers handling a frequency range from 50 cycles to several megacycles per second and high-slope valves like the well-known EF50 have been designed which enable a very high gain to be obtained from these amplifiers.

A straightforward amplifier stage in a position such as this has many advantages for the constructor. Its design is similar to that of an audio-frequency amplifier and not as difficult as the video amplifier of the television receiver. It can give a better signal-to-noise ratio than the hexode which generally appears in the first stage of a radio receiver, and intermodulation or cross modulation distortion is unlikely to cause any trouble.

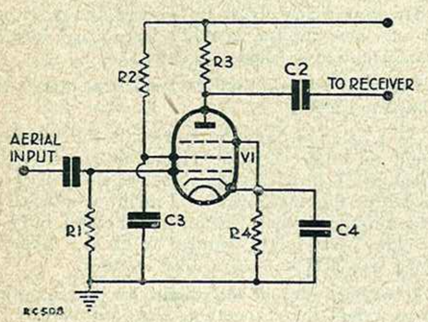


Fig. 1. Circuit of Single Stage Preamplifier.

Component values for Z77, Z90 or EF50:—

R1—470k Ω, ½W
R2—10k Ω, ½W
R3—33k Ω, 1W
R4—150 Ω, ½W
C1—10pF mica or ceramic, 500V
C2—100pF mica or ceramic, 500V
C3, C4—0.05μF, paper, 500V
HT—200-300V

Circuit Arrangements

One circuit for a preamplifier to a radio receiver which will give a useful amount of gain is shown in Fig. 1. The valve is a high-slope pentode such as Z77, Z90, 6AK5, EF50, SP41 or 6AC7. The output lead must be connected to a high impedance. Since the input impedance of most radio receivers is less than a few thousand ohms, the primary of the usual aerial transformer must not be used. The most suitable connection in receivers tuning only over the Long and Medium Wavebands is to the stator of the tuning capacitor in the RF stage.

Receivers which have one or more Short Wavebands are more difficult. A simple untuned preamplifier gives little or no gain at frequencies above four or five megacycles per second. At twenty megacycles per second it may introduce a severe loss.

Therefore, for simplicity, it is best to use the preamplifier only on Long and Medium Waves. If an addition is being made to an existing receiver which has Short Wavebands it is usually best to disconnect the aerial lead of the first Medium Wave coil and connect the output lead of the preamplifier to the secondary winding. The preamplifier and the receiver inputs are thus connected in parallel. With this arrangement the receiver works normally on all bands except the Medium, when the preamplifier is automatically switched in. Connections to be made in various forms of receiver circuit are shown in Fig. 2.

Two operating ranges may thus be required of an amplifier: Long and Medium Waves, 100-1,500 kcs, or Medium Waves only, 500-1,500 kcs. To prevent parasitic oscillation it is best to allow the preamplifier gain to fall rapidly outside the operating range. Coupling and by-pass capacitors must then be suitably chosen. The circuits in these diagrams were designed for the former range but if the latter only is required the values of coupling and by-pass capacitors should be divided by a factor of 5.

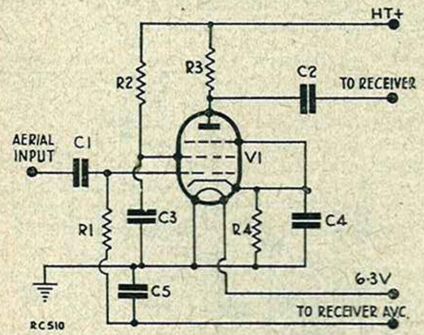


Fig. 3. Aperiodic Preamplifier with Variable-Mu Valve.

V1—W61 or W81
R1—470k Ω, ½W
R2—56k Ω, ½W
R3—56k Ω, 1W
R4—220 Ω, ½W
C1—10pF mica or ceramic, 500V
C2—100pF mica or ceramic, 500V
C3, C4, C5—0.05μF paper 500V
HT—200-350V

Maximum gain is the aim, so that the effect of shunting capacitances will cause a drop in gain at the higher frequencies. This varying gain characteristic is a small point which can be tolerated. Capacitances to earth from the anode circuit must be kept to a minimum however. If a variable-mu valve is used in the preamplifier stage the grid circuit can be connected to the AVC line of the receiver and the danger of overloading on strong signals is reduced. Fig. 3 shows the circuit of a stage which has been used with a variable-mu pentode.

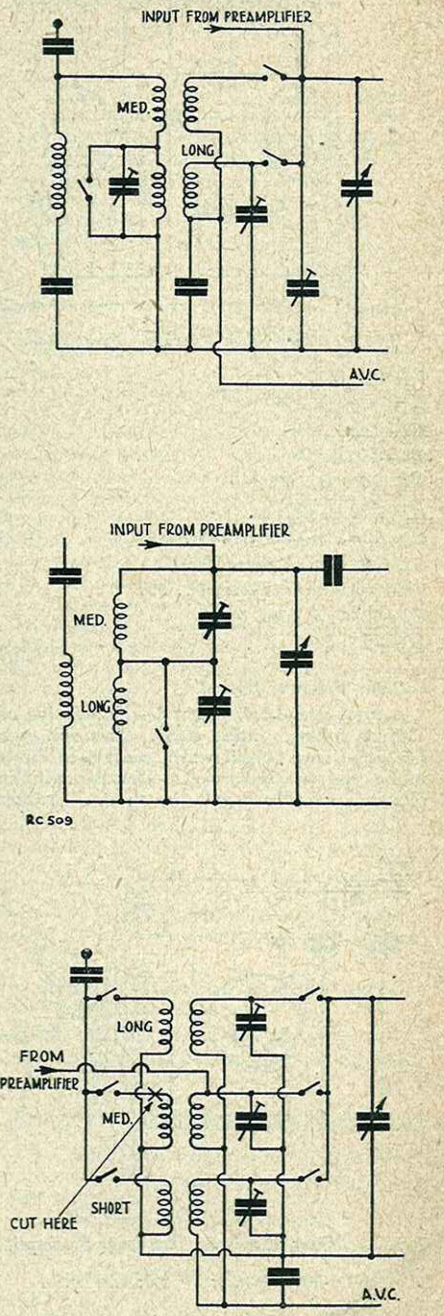


Fig. 2. How to connect a simple preamplifier to a radio receiver.

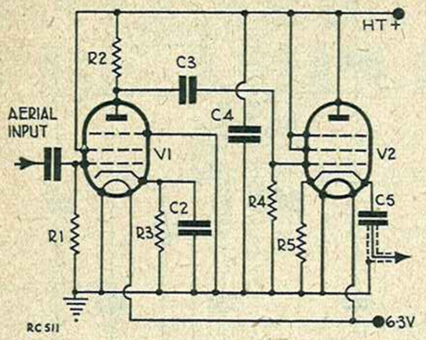


Fig. 4. Two Stage Aperiodic Preamplifier.

V1, V2—Z77
R1—470k Ω, ½W
R2—10k Ω, ½W
R3—150 Ω, ½W
R4—470k Ω, ½W
R5—150 Ω, ½W
C1—10pF mica or ceramic, 500V
C2, C4—0.05μF paper, 500V
C3—25pF mica or ceramic, 500V
C5—0.005μF mica, 500V
HT—220-280V

Cathode Follower Output

A most useful refinement is the addition of a cathode follower buffer stage. This will give a low impedance output which can be fed directly into a receiver aerial socket. The chances of hum pick-up or feedback will also be much reduced.

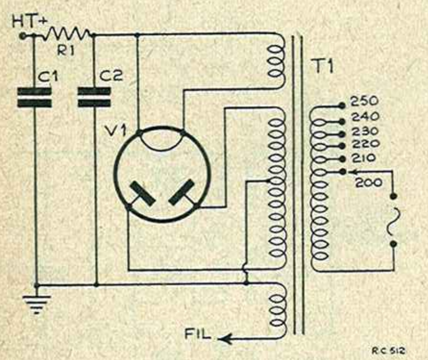


Fig. 5. Power Supply for Two Stage Preamplifier.

T1—300-0-300V 30mA; 5V 2A; 6.3V 0.6A
V1—U50
R1—2.2k Ω, 1W
C1, C2—16-32μF, 450V

If connection is to be made to a receiver having Short Wave bands it must now be to the primary winding of the first Medium Wave coil. Fig. 4, shows the circuit of a two-valve preamplifier which is now in use.

In making one of these preamplifiers care must be taken to separate and shield the control grid from the anode circuits and it is best to use screened cable for the output lead to the set. This lead should not be longer than about 18 inches, except with a cathode follower output, because of the effect of its capacitance.

If there is space the unit could be mounted inside the receiver cabinet. It may be possible to derive its power supply from that of the receiver. With an AC/DC receiver it would be necessary to have a separate transformer for the heaters and if the HT current requirements could not be met an HT supply would also be needed. A circuit for a complete supply is shown in Fig. 5.

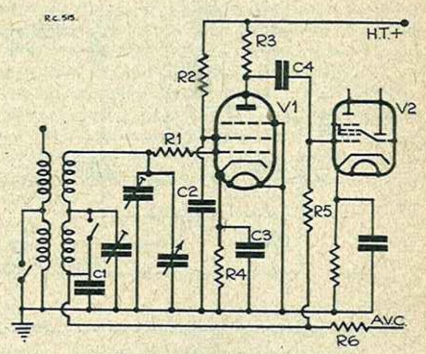


Fig. 6. RF Stage for Superhet Receiver.

V1—W61
V2—X61
R1—2.2k Ω, ½W
R2—47k Ω, ½W
R3—10k Ω, ½W
R4—150 Ω, ½W
R5, R6—470k Ω, ½W
C1, C2, C3—0.1μF paper, 500V
C4—500pF mica or ceramic, 500V
HT—230-270V

So far, the untuned stage has been spoken of as an addition to a receiver. It may find a place in a design for a new receiver, either as a first stage as in Fig. 6, or as an additional IF amplifier. In midget battery receivers, two IF stages, one of which is untuned and feeding the detector diode, show a useful amount of gain for a small amount of space.

Conclusions

At frequencies of less than 5 Mcs where gain without selectivity is required economically, this form of amplifier has many uses. Old broadcast receivers can be brought up-to-date and new ones improved. Increased gain and improved signal-to-noise ratio are the advantages.

RANDOM THOUGHTS

By G2ATV.

Panel Finishes

Quite a substantial proportion of amateur constructional work these days is in the conversion of ex-WD equipment. Nevertheless, most of the gear that is built still requires a panel, and it is here that the average builder seems to show little initiative. Too often is a nice job of work let down by a mediocre panel, yet little cost or effort is needed to turn the scale.

Take, for instance, an aluminium panel. When purchased, the metal has a highly polished and very pleasing surface. Alas, it is so easily marred by scratches, and scratching the surface is so easily done, even though the greatest care be taken. One way out is to give the metal a matt surface, which is not made unsightly by minor scratches, and which, incidentally, is much more easily photographed. Frosting is usually carried out by means of caustic soda, but the writer finds that he obtains much more even results with ordinary washing soda. The procedure is simple. First, clean off the metal so that it is free from grease and dirt, then immerse in boiling water in which a small quantity of soda has been dissolved.

If a more decorative panel is required, why not try mottling ? This is not quite so simple to do, so the reader is advised to practise first on some odd scraps of metal. Take a cork, or a piece of dowel, with an end of about ½in. or so diameter, and coat the end with fine emery or carborundum paste. Rotate this on the work so that a series of circular markings are made, each one overlapping the previous one. The greatest trouble will be found in getting the lines of circles straight, and parallel to each other. This can best be achieved by using a guide—say a strip of wood clamped on to the metal. Mottling by hand is rather tedious, and liable to make one's wrist ache, so why not use a length of dowel gripped in the wheelbrace. If a bench drill is available, and it will cover the required surface, the job is easier still.

What's in a Name

When the title "Radio Constructor" was chosen for our magazine, it seemed to be one which aptly described the nature of the contents, and yet would not be confused with other current periodicals. But what is a radio constructor ?

Actually, our readers are from all walks of life, are of all ages, and look at radio as a hobby from many angles. Some are also connected professionally with radio. Those readers who buy a kit of parts and build it according to plan—are they constructors ? Or would they be more accurately described as assemblers ? Surely not, because after assembling they also have to carry out the wiring and soldering processes—and maybe do a little fault finding in the bargain. Is the quality enthusiast debarred from being termed a constructor because he builds only the amplifier as a whole, and does not construct the pick-up, the speaker, transformers, and other individual components ? The average reader would doubtless be appalled at the awful thought that he would have to undertake such work—yet there are constructors who do so. We know of one enthusiast who spent three months building a dividing and engraving gadget in order to make a SW receiver dial capable of being read to a tenth of a degree !

Those readers interested in radio control must obviously be interested also in what is being controlled, model ships, aircraft, locos, or what have you. This is a case of two hobbies being combined. The dividing head reader mentioned above is also a model engineer, for instance. The radio fan interested in clocks may combine the two to produce an automatic time-switched radio set. The carpenter will naturally produce radio cabinets. The toolmaker would be expected to make tank cutters, countersink bores, and so forth.

We wonder how many of our readers actually do have more than one hobby ?

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 2d. per word, minimum charge 2/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/- will be made. Terms: Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

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