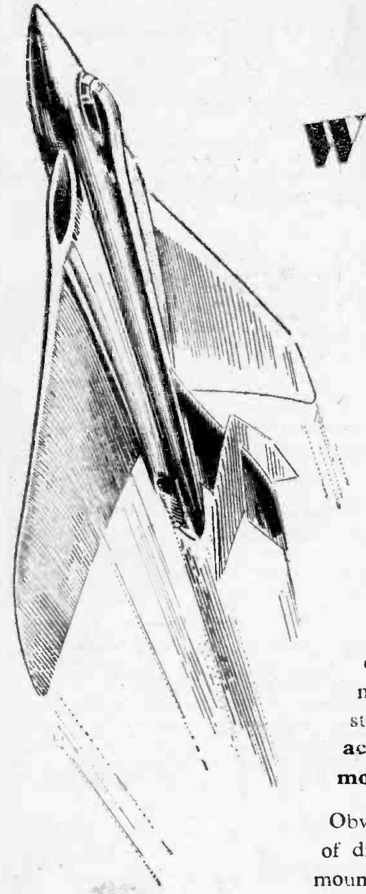
• A NOVEL C/R BRIDGE •

PRACTICAL WIRELESS

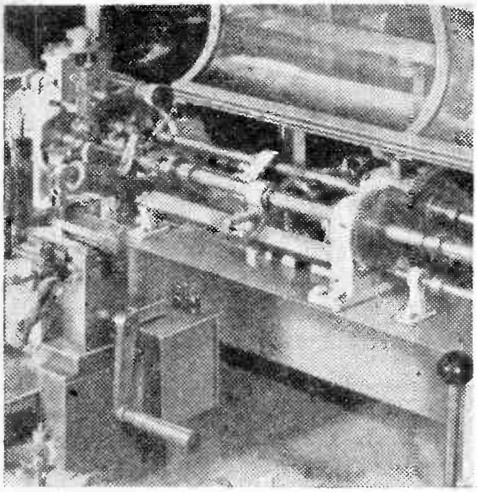
1/-

JANUARY 1956

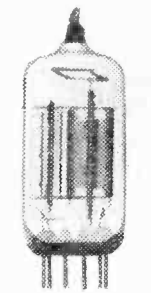
EDITOR: F.J.CAMM



MODERN MINIATURE VALVE PRODUCTION ... an Osram series



Grid winding machine



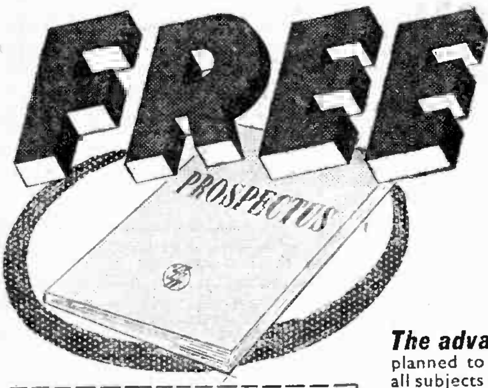
X-Ray photograph of modern miniature valve, Osram LN 309

Precision tooling

In high-grade miniature valve production, tooling is an art in itself. Closer clearances, finer gauge wires, even the electrodes themselves all require most careful handling. The assembly of Osram miniature valves is carried out by skilled workers under most favourable conditions. Every detail of production has been studied to make Osram miniatures pass the most exacting tests. This overall care — from raw materials to the finished product — results in these valves being specified by discriminating designers.

Osram VALVES — *characteristically good*

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, W.C.2



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SUBJECT(S) OF INTEREST ....

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The only Postal College which is part of a world-wide Industrial Organisation

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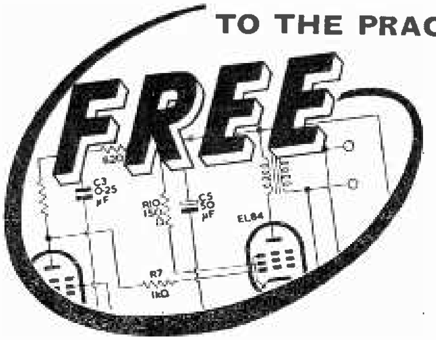
OSMOR offer an unique SERVICE

TO THE PRACTICAL WIRELESS ENTHUSIAST



Whichever published circuit you decide to construct, first ask Osmor for a practical wiring diagram with full lists of components required. We cannot provide diagrams for *all* circuits just yet, but in due course we will. We keep right up to date in building the latest circuits published in PRACTICAL WIRELESS—" Wireless World " and " Radio Constructor " and we stock the components specified, including a design for F.M. TUNER, BAND III TELEVISION CONVERTER, VARIOUS SUPERHET CIRCUITS (using some miniature valves), 5 & 6 valve superhets, 3 valve (plus rectifier) T.R.F. Circuit, Battery/Portable Superhet, T.R. 1196 Conversion, Coronet Four, Attache Case Portable, 3-speed Autogram, Amplifiers, Whistle Filters, F.M., A.M. Gram. Switching Circuit, and many others. *Send 7½d. in stamps for circuits, fully descriptive literature together with coil and coilpack leaflets, component lists, chassis drawings and templates. Osmor also offer a Free Advisory Service for enthusiasts—just write a letter to our Technical Dept. (See " Readers' Queries " below.)*

OSMOR BAND III CONVERTER

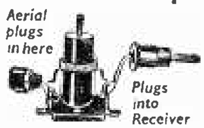
Designed to receive Band III Channel 9 and effectively reject Band I Channel 1. The design takes into account the very high power transmissions due to start on Band I Channel 1. Wiring diagrams, chassis templates and full details, 2/-.

MULLARD 3 valve 3 watt AMPLIFIER

(or quality back-end) on application. Circuit and wiring diagrams for Tuner in conjunction with above using Osmor coils, available on request.

SCRATCH FILTER. For Crystal or Low impedance Pick-ups. Complete Unit, 15/-.

OSMOR Station Separator



The problem of the overlapping station generally completely solved, and always minimised. Effective within the ranges stated. Fitting takes a matter of seconds.

Metres	Metres	Metres
141 to 250	319 to 405	1450 to 1550
218 to 283	395 to 492	410 to 550 Kc/s
267 to 341	455 to 567	7/6 each.

Special Separator to clear Radio Luxembourg **10/6.** *Also a special 90 Mc/s Unit to reject Band II (F.M.).*

T.V. Sound & Vision I.F. Unit

Wiring diag., circuit, coils, chassis and components, etc. Sound I.F. 38.15 Mc/s, Vision I.F. 34.65 Mc/s. (Available shortly.)
To convert your T.R.F. T.V. receiver to a superhet and avoid several forms of interference.

" MAKING A CAR RADIO "

Osmor Dual Range Superhet Coils Type QA170 and Q.O.S.170, 12/6 pair. As specified by PRACTICAL WIRELESS, Nov. 1955.

9 Kc/s WHISTLE FILTER

Three simple adjustments are made to obtain optimum rejection—the sharpness of response is adequate to reject the unwanted frequency.
Complete Unit, 20/-.

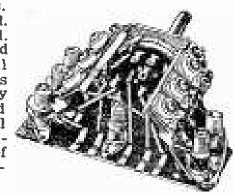
OSMOR miniature " Q " COILS

A complete range is available for all wavebands and purposes and ideally suitable for all circuit positions. All high " Q " values. Iron-dust cored. Easy connection tags. Simple " press home " fixing. " Q " of " Potted " types up to 300.

The success of Frequency Modulation receivers is due in no small measure to the efforts of Osmor technicians in co-operating in advanced coil designs. Technical Colleges, Universities and large-scale Manufacturers, also use Osmor Coils for research. COILS NOW AVAILABLE for Whistle and Scratch Filters, Tape Recorder Oscillators, Chokes, etc. List of coil types on application.

OSMOR " Q " COIL PACKS

Size only 1¾ x 3¼ x 2¼ with variable iron-dust cores and Polystyrene formers. Built-in trimmers. Tropicalised. Prealigned. Tested and guaranteed. All types for Mains and Battery Superhets and T.R.F. Ideal for the construction of new sets, conversions, etc.



Ultra Small Ceramic Neg. Tem. Co-eff. Capacitors for V.H.F., etc., from 1 pf ± 0.5 pf to 10,000 pf + 100% – 20%. 10d. each.

Small ½ watt Resistors 10Ω ± 10% to 10 m. ± 20%. 6d. each.

Full list of types, co-effic. and values on application.

READERS' QUERIES

Let us solve your problem!

Dear Sirs,
When I peak the I.F's there are no stations. When I detune them I get the main stations but poor sensitivity.
Probably I.F. instability. Further decouple H.T. line and try increasing value of I.F. and F.C. bias resistors.

Dear Sirs,
I have at times received signals on a crystal set from a Continental station. Can you explain the reason for this ?
A near-by receiver with reaction on the point of self-oscillation, the oscillations in the aerial are " re-radiated " and can be picked up in a crystal set.

Dear Sirs,
I have constructed the " P.W." Sensitive 2-Valver and now wish to add the L.W. Please advise coil types.
QA49 or QA91 (pot-coil).

Dear Sirs,
I am much troubled with whistles on every station. My I.F.'s are correctly aligned. Your help please.
Fit 465 kc/s Whistle Filter which may consist of one winding I.F. transformer between aerial and earth.

Dear Sirs,
I have constructed a s'het circuit which is good except for valve noise which I think comes from a 6K7, I.F. valve. Can you suggest a simple thing to try ?
Fit low-noise pentode (6A5).

OSMOR RADIO PRODUCTS LTD.

418, BRIGHTON RD., CROYDON, SURREY

Telephone: CROydon 5148/9

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXII No. 591, JANUARY, 1956

EDITOR : F. J. CAMM

24th YEAR OF ISSUE

COMMENTS OF THE MONTH BY THE EDITOR

Advice to Contributors

WE invite our readers to submit articles of a practical as well as technical nature for publication in this journal and our associated journal "Practical Television." These articles should not be more than 1,500 words in length, be accompanied by sketches and where possible photographs, where necessary a list of components and a list of sources of supply, be written on one side of the paper only and contain the author's name and address on the first folio. Articles of a highly theoretical text-book nature are not required. Preference is given to articles of a constructional nature, describing receivers or equipment which has actually been made. We do not want empirical designs. When submitting technical articles, submit details of your qualifications and experience. Payment is made on a generous scale for all articles accepted for publication, each manuscript is carefully considered and promptly accepted or rejected. Enclose a stamped envelope with all manuscripts. These brief instructions are given as a guidance to intending contributors because quite often we receive promising manuscripts which have to be rejected because they are either incomplete, omit important details, or are designed round a piece of apparatus or a component which is not readily available. In general, we do not accept articles which may be described as "special" to the contributor concerned, and making use of parts which involve a search around the radio shops. We do not require purely descriptive articles. All articles should live up to the title of this journal. We also welcome items of news for our "Round the World" feature, and letters of an interesting nature containing information or criticism will be published. Letters, however, should be kept brief—preferably not more than 200 words, as space is short.

ADVICE TO QUERISTS

WE should like also to offer advice to querists. We cannot, through our Advisory Service, undertake to prepare special designs for readers, nor to supply information which requires the preparation of an illustrated article. All questions must relate to subjects which can be dealt with reasonably by post. We cannot, moreover, undertake to modify designs for readers, nor to answer questions relating to designs published by our contemporaries, some of whom have not an advisory service. Such queries should be properly addressed to the journal concerned, and no telephone queries please! It is essential for every query to be accompanied by a stamped and addressed envelope and the query coupon cut from the current issue.

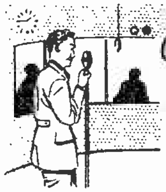
Our Advisory Service is free, and we are always delighted to help readers in difficulties, but we often receive a query which has been answered several times herein. We hope readers, whether they have their copies bound or not, will purchase the annual index which we publish at 1s. 1d., so that they can consult past issues before sending in a query.

A NEW VOLUME STARTS

INCIDENTALLY, this issue is the first of a new volume, and signalises our entry into our 24th year of publication and our 32nd volume. A volume consists of 12 monthly issues, and we shall shortly be publishing the index for Volume 31. An announcement will be made herein when it is ready.

AWARDS FOR TECHNICAL WRITING

THE R.I.C. scheme of annual awards to the authors of published material which it is considered enhances the reputation of the British Radio Industry abroad is an excellent one, but judging from past awards we wonder whether some of them have really achieved this object, and whether the R.I.C. is not insisting upon a too high standard of technical writing. Could not the awards be made for anything which enhances the reputation of the British Radio industry? It is possible that someone will invent some new piece of circuitry who is not an accomplished writer. After all, mathematical dissertations are not widely read either in this country or abroad, as the circulations of the journals in which they appear indicate. If the R.I.C. therefore wishes to pay honour to those who help to enhance our reputation in the foreign market it should go outside the sphere of technical writing, or enlarge it to include technical developments. It is an excellent scheme, but now that it has been in operation for a few years we think the terms under which the awards are made are in need of readjustment. At present they only appeal to those who have scholastic qualifications.—F. J. C.



Round the World of WIRELESS

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast receiving licences in force at the end of September, 1955, in respect of stations situated within the various postal regions of England, Wales, Scotland and Northern Ireland. The numbers include licences issued to blind persons without payment.

Region	*Number*
London Postal	1,441,502
Home Counties	1,390,807
Midland	1,119,500
North Eastern	1,471,958
North Western	1,130,331
South Western	916,094
Wales and Border Counties ...	577,472
Total England and Wales ...	8,047,664
Scotland	1,004,659
Northern Ireland	218,267
Grand Total	9,270,590

Licence Totals

BROADCAST receiving licences, numbering 14,154.439, including 4,883,849 for television, and 284,549 for sets fitted in cars, were current in Great Britain and Northern Ireland at the end of September, 1955.

Marconi Transmitters for Iraq

AN order has been received by Marconi's Wireless Telegraph Co., Ltd., for a complete new high-power broadcasting station, to be sited at Abu Ghraib, near Baghdad. The contract was placed by the Iraq Posts and Telegraphs Department.

Four Marconi 100 kW. air-cooled transmitters are included in the order, together with programme input equipment, automatic monitoring equipment and a 4-channel Super High Frequency music link for use between the Baghdad studios and the transmitting station. A 165-metre half-wave mast radiator and an H.F. aerial system forms another part of the order.

Two of the transmitters, Type BD.253, will operate on the high-frequency band and two, Type BD.206, on medium-frequency. The latter two will work in parallel.

Change of Telephone Number

BRITISH INSULATED CALLENDER'S CABLES, LTD., announce that as from November 2nd the telephone number of their Lincoln Branch Sales Office, 113, Canwick Road, Lincoln, has been changed to Lincoln 21351/2.

Mr. Butler to Open London B.I.F.

MR. R. A. BUTLER, the Chancellor of the Exchequer, is to open the British Industries Fair at Olympia on April 23rd. This B.I.F. will be the second held in London in 1956.

The first, in Earls Court, will be opened by Lady Eden, wife of the Premier, on February 22nd.

In accepting the invitation to perform the opening ceremony at Olympia, Mr. Butler said the B.I.F. performed a vital role in bringing British goods to the notice of overseas buyers and in furthering world trade.

He referred to the determination of the Fair's management to broaden the scope of the B.I.F. so that it would go from strength to strength in size and representation.

New Radio Telephone Service between Bahrein and Karachi

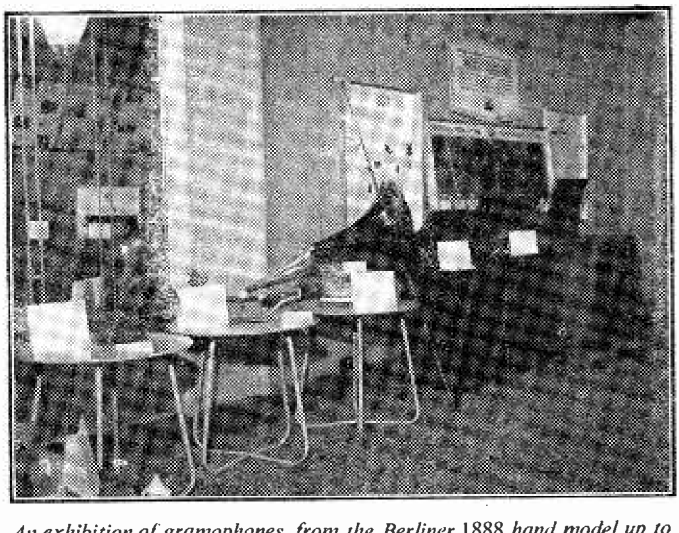
CABLE AND WIRELESS, LTD., announce that a new radio telephone service has been opened between Bahrein (Persian Gulf) and Karachi (Pakistan).

The service was inaugurated by Shaikh Isa Bin Sulman, eldest son of the Ruler of Bahrein, who spoke with the Postmaster General in Karachi.

The rate is 25 rupees (£1 17s. 6d.) for a three-minute call.

British Industrial Yachts at Copenhagen

THE Marconi Marine research and demonstration vessel *Elettra II*, representing the English Electric Group of Companies, was among the five British industrial yachts honoured by a visit from H.R.H. the Duke of Edinburgh at



An exhibition of gramophones, from the Berliner 1888 hand model up to the latest H.M.V. Model 3001. These were to be seen at an Exhibition of Entertainment at Wood Green.

Copenhagen recently. The yachts, which were in Denmark in connection with the British Trade Fair, were also privileged to go out to meet the Royal Yacht *Britannia* when she arrived off the port.

The 100th Mullard Film Meeting

SINCE 1953 Mullard Limited have been organising film meetings for Dealers at the invitation of and in co-operation with Trade Associations, Institutions and Radio and Television Societies.

On October 27th, the hundredth Mullard film meeting for radio and television dealers held in conjunction with R.T.R.A. took place at Caxton Hall, London.

Mr. C. H. Gardner, of the Mullard Valve Sales Department, speaking at the 100th Mullard Film Meeting at Caxton Hall in October.

It was appropriate that the Chair was taken on this occasion by Mr. H. A. Curtis, Director and Secretary of the R.T.R.A., who addressed the first meeting also held at Caxton Hall.

The Mullard film meetings are designed to provide a means of bridging the gap between the dealer and the manufacturer. From their inception they were acclaimed as a success. By February, 1955, the total attendance had passed the 10,000 mark.

B.I.R.E.

THE following meetings will be held during December:

London Section, *Wednesday, December 14th*, 6.30 *p.m.*, at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. "The Remote Presentation of Radar Information." G. J. Dixon and H. H. Thomas.

Scottish Section, *Thursday, December 8th*, 7 *p.m.*, at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow. "Automatic Control of Machine Tools." H. Ogden.

West Midlands Section, *Wednesday, December 14th*, 7.15 *p.m.*, at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. "Television Aerial Design, with emphasis on Band III problems." I. A. Davidson.

North-Eastern Section. *Wednesday, December 14th*, 6 *p.m.*, at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne. "The Metal Cone Loudspeaker." W. I. Heath, B.Sc.

New Type Radar for Chilean Warships

A CONTRACT worth more than £250,000 has been awarded to Marconi's Wireless Telegraph Co., Ltd., for the complete Radar and Communications equipment for two destroyers now under construction by Vickers-Armstrongs, Ltd. These warships, which are being built for the Chilean Government, will be among the most modern of their class in the world.

Our next issue, dated Feb. 1956, will be on sale on Friday, January 6th.

The radar installations have been designed to meet the stringent requirements of modern naval strategy. The radio communications installations are likewise to be of the very latest types.

Monaural Delay

TESTS which have been conducted in Ohio State University show that radio messages received under noisy conditions were 22 per cent. clearer when they were heard by one ear before the other. It is stated that the reason for this is not understood, but that a delay of .06 seconds in the reception of sound by one ear produces this greater clarity—presumably because the brain receives two impressions of the sound. To obtain the delay a tape recording device is used and splits the sounds fed to a pair of headphones.

Lamps Controlled by Radio

IN Coventry a system of lamp control by radio has been tested and found to be highly efficient. Each lamp is fitted with an 8in. aerial on the top, and inside the column a two-valve receiver is housed. By means of a small transmitter at the control station it is possible to switch on or off all lights which is more effective than existing systems. It is also claimed that the arrangement would permit traffic lights to be controlled, for instance by police in an emergency such as the pursuit of another car which could be stopped by placing all lights on the route being followed at red. The only snag at the moment is that the G.P.O. will not issue a licence for a *fixed* station. It could be operated by a mobile set-up.

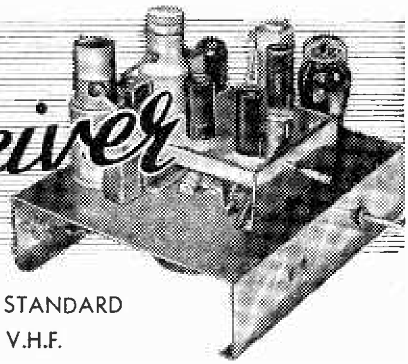
Tape Recorder Contest

GRUNDIG dealers are to co-operate in a music contest in conjunction with Selmers. Entrants have to submit a recorded performance of a Clavoline concerto, and where they do not own a Grundig, dealers are to be asked to co-operate.

No TV Relay at Brighton

AT a recent meeting Brighton Town Council rejected a recommendation that Relay Circuits, Ltd., should establish a wired TV service in the town. Rediffusion had also applied, and objection was made to the unsightly wiring which would result.

An 8 Valve A.M/F.M Receiver



A NOVEL DESIGN OF RECEIVER FOR THE RECEPTION OF STANDARD BROADCAST SIGNALS AS WELL AS THOSE ON V.H.F.

(Continued from page 761, December issue.)

Decoupling

CERTAIN decoupling components which are represented below the circuit diagram are for decoupling valve heaters. In this receiver one pin of each valve heater is connected to the earthing tag for that stage. In addition, the other heater pin of the oscillator, frequency changer and detector valve is connected to the earthing tag through a decoupling capacitor of ceramic or mica type. 1,500 pF is used for the diode heater, while 250 pF was found adequate for the F.C. and oscillator. The usual rule about shortest-path connections should be followed.

Circuit Omission

It should be noted that in the circuit, Fig. 1, in last month's issue the 'top' of the tuned circuit, L4, C11, C13 and C14, should be connected to V2 anode.

A.F. and Output Stages

These are conventional in character. A small amount of negative feedback is provided, sufficient to afford good quality of reproduction.

Alignment

For those who possess no signal generator a quickly hooked-up oscillator is essential. The circuit diagram of a suitable instrument is given in Fig. 6, and this may be modulated at 100 c.p.s. when necessary by returning R2, the grid leak, to the live side of the heater terminals. Another CV1065, connected as a triode, is used.

The following are the coil details.

Coils

Anode: 30 turns 32 s.w.g. enamelled wire, Aladdin former 0.4 in. diameter.

Grid: 10 turns 32 s.w.g. interleaved in earthy end of anode coil.

This signal generator does not need to be connected at all to the receiver, but a short length of wire (6in. or so) is attached to the grid cap of V4 to pick up the signal. It is first set to 10.7 Mc/s by using the short-wave band of a domestic receiver as an indicator. It may be necessary to put it in the next room to reduce the signal received to a handleable amount later on in alignment.

To align the receiver first remove the oscillator valve. With the signal generator set to 10.7 Mc/s and a voltmeter of 1,000 ohms per volt or better, 0-10 volt range, connected across C32, tune the I.F. amplifier for maximum output by adjusting the transformer cores. Rock the tuning capacitor of the generator a little each side of 10.7 Mc/s and observe the voltage across C32. The aim should be to get a response curve like that of Fig. 2. A peaked response may be due to feedback in the I.F. amplifier or to inaccurate I.F. transformer construction. The former can be dealt with perhaps by adjustment of wiring, checking over for "dry" joints, or by adding screening. The second trouble is difficult to eradicate without rewinding the transformers; but careful construction should result in no trouble from either source.

Remove the voltmeter from across C32 and connect across C33. With the generator set to 10.7 Mc/s and R19 in the middle of its travel adjust the core of the secondary of T3 to give zero voltage. Remove the voltmeter and reconnect across C32. Remove the 6in. aerial from the grid of V4 and re-align as above—by now the I.F. gain will obviate the need for any aerial and stray pick-up can be relied upon to give sufficient signal. Reconnect the voltmeter across C32 and replace the oscillator valve.

If a calibrated signal generator is available, A.F. modulated, connect to the aerial input and set to 100 microvolts at 85 Mc/s. Set the tuning gang to maximum capacitance and rotate the core of L3, L4 to tune in the signal. If the signal is found at two settings of the core use the setting giving least inductance. Adjust the core of L2 for maximum signal. Set the tuning gang at the minimum capacitance and the signal generator to 105 Mc/s. Adjust C13 to receive the signal and C7 for maximum output. Repeat the inductance trimming at 100 Mc/s—the capacitance trimming at 87.5 Mc/s, and using these frequencies readjust inductance and capacitance in turn until no further

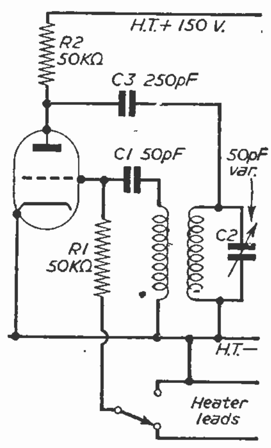


Fig. 6.—Circuit of a test oscillator which may be made up for alignment purposes.

improvement results. Finally, set the signal generator to give a small amplitude-modulated signal at 95 Mc/s and tune to it accurately. Adjust R19 until the modulation, as heard in the loudspeaker, disappears.

If a signal generator is not available proceed as follows. Prepare a dipole aerial the elements of which are 77 cms. in length. Place it horizontally (say, on the picture rail) and connect its centre terminals to the input of the receiver by means of a piece of 80-ohm coaxial cable or twisted flex. Set the test oscillator to 12 Mc/s by using the domestic set as before, and the receiver gang to maximum, screw nearly out all V.H.F. coil cones and set trimmers to half value. Adjust the core of L3, L4 until a signal is heard ; it should be the seventh harmonic of the test oscillator. Adjust the core of L2 for maximum output. Rotate the tuning gang until the next harmonic of the test oscillator is received, the eighth at 96 Mc/s. Adjust C7 for maximum output. Return to seventh harmonic, and while rocking the gang slightly tune C13 for best results. Repeat at eighth and seventh harmonic until no improvement results.

The foregoing method is at best a makeshift, but with care good results can be achieved. It is quite easy to get on the wrong frequency band altogether, and "second channel" complicates matters ; but if the V.H.F. coils have been constructed with care and minimum circuit "strays" introduced into the wiring, serious error can be avoided. After a preliminary alignment at each end of the supposed band a check should be made to see whether BBC signals can be heard. If not, and the transmitters are within range, a review should be made. Patience will be found to be a signal virtue! It is a pity that the harmonics of an oscillator cannot be conveniently labelled.

Finally, to adjust L1, either set the signal generator to 95 Mc/s or tune in to the Light Programme. Adjust the core of L1 until maximum output is received. Find a weak signal somewhere on the band and tune to it accurately ; the correct tuning point is shown by a silent spot between two regions of hiss—this will be unfamiliar to those having only experience of amplitude-modulated transmission. Adjust R19 for minimum background noise. If the signal is frequency modulated this will also be the position for best quality of reproduction.

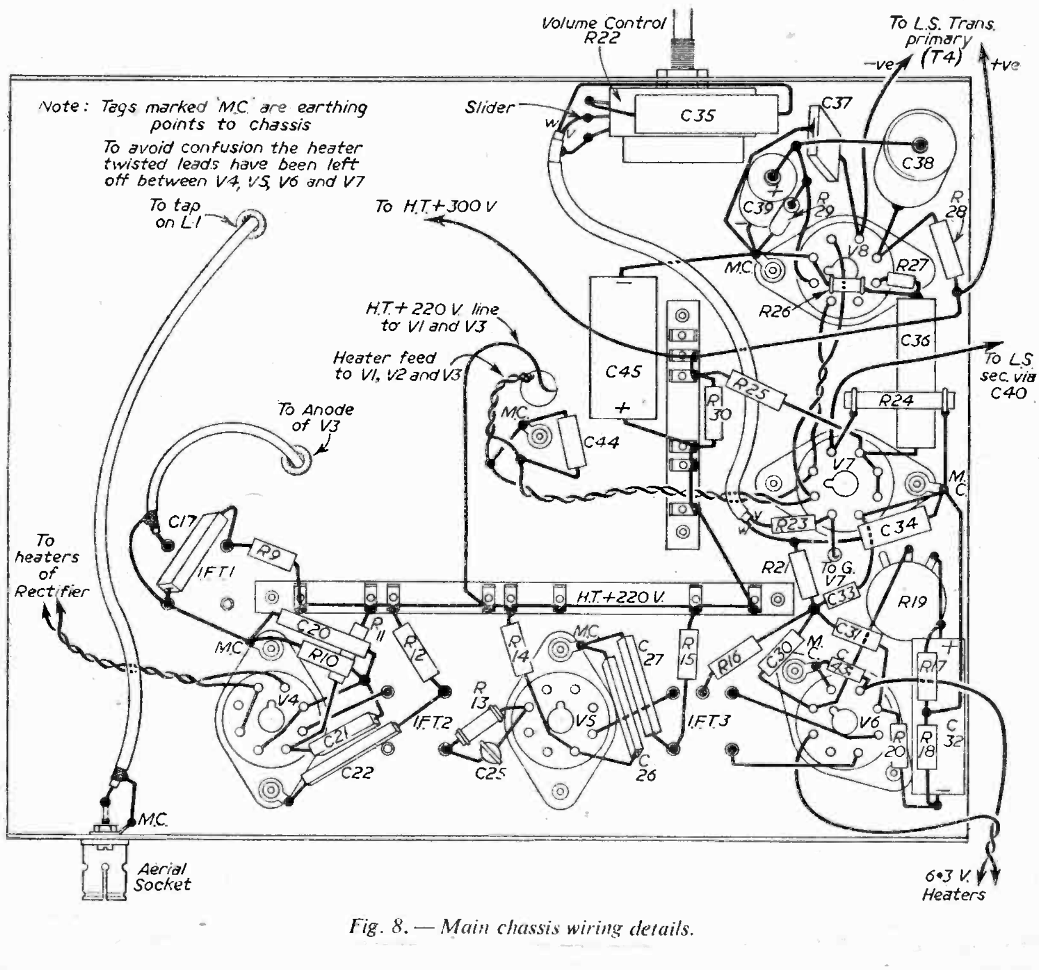


Fig. 8.—Main chassis wiring details.

Power Supplies

This receiver needs 300-315 at 100 mA, and 6.3 volts 3 amps. Good smoothing is needed, and it is also a good plan to decouple the mains input leads with 0.05 μF 1,000 volts, preferably mica capacitors. R30 should be mounted for free ventilation well away from any circuitry and above chassis level. Otherwise the power supplies can be of any convenient design the constructor chooses.

Note.—If by any chance you happen to receive a police broadcast on this receiver you are reminded that in no circumstances are you allowed to discuss what you hear with *anyone.*

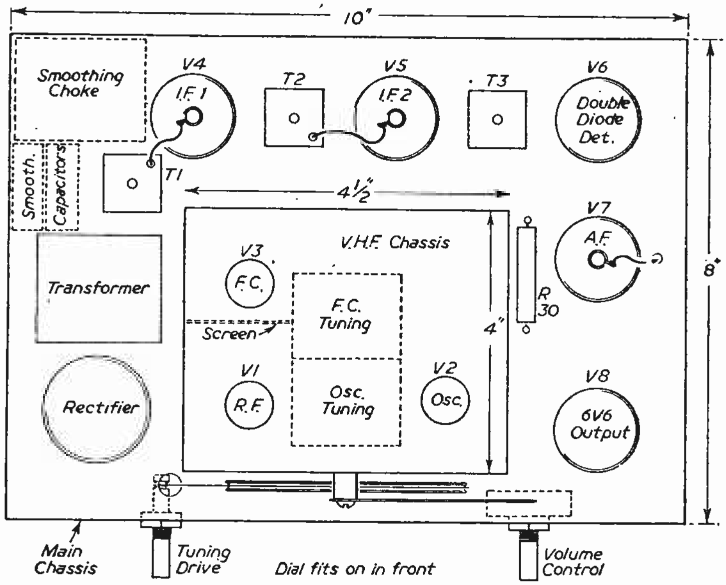


Fig. 7.—Plan of the layout showing valve positions.

A.M. Reception

So far, the emphasis has been on the alignment and construction for F.M. broadcast reception. For constructors who wish to receive any amplitude-modulated signals with this receiver, the following modifications are incorporated:

(a) The anode load resistor of V5 should be increased by placing in series with R15 another resistor of value 100,000 ohms. A switch should be arranged to short-circuit this for F.M. reception. At the same time, the lead joining C35 to the junction of R21 and C34 should be broken, and a single-pole double throw switch inserted as shown in Fig. 9 on the right.

(b) The loose end of C35 should be joined to the switch, and the two contacts to the junction of R21 and C34 on the one hand, and to the junction of R15 and C27 on the other. Fig. 9 makes this clear.

(c) The two switches referred to above can conveniently be of the Yaxley type, and ganged together.

By careful alignment of the R.F., F.C. and oscillator circuits the frequency range covered may be extended down to about 60 Mc/s, which includes some of the television "sound" frequencies.

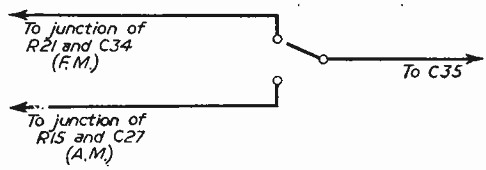


Fig. 9.—Switching to enable A.M. signals to be obtained.

Brema Monthly Survey

RADIO sales during September appear to have been affected by two opposing forces. During the early part of the month sales in all groups continued to be depressed as the result of the hire purchase restrictions imposed in July, whilst towards the end of the month sales of products in the higher price groups (radiograms and television) were stimulated as the result of the rumours of a possible increase in purchase tax.

The depressing effect of the hire purchase regulations was first noted in the August sales figures. Normally sales in September are considerably in excess of August, but, in fact, the figures for radio (79,000 sets) show that sales were only up 8 per cent. on the previous month. Radiogram sales rose from 11,000 to 19,000—a rise of 73 per cent. Television sales were lower than for last September.

Radio receiver sales at 756,000 from January/September, 1955, are 2 per cent. lower than last year, whilst radiogram sales are 2 per cent. up at 179,000, and television sales have increased by 12 per cent.

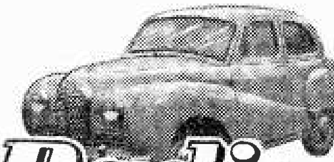
Ferroxcube Beads

THE inductance and H.F. resistance of a straight wire can be increased appreciably by threading it through a small bead of Ferroxcube. This fact is made use of in a variety of H.F. decoupling applications, including simple "grid stoppers" to prevent parasitic oscillation, and decoupling circuits in heater leads.

The use of Ferroxcube beads for decoupling heater wiring is particularly attractive in that there is no increase in resistance at D.C. or supply frequencies, though the H.F. resistance may be increased by an appreciable amount by the addition of a single 3 mm. bead. This large resistive component also reduces the risk of the decoupling elements themselves causing parasitic oscillation, since any tuned circuit formed by them will be heavily damped.

Two types of Ferroxcube bead are available from the Component Division of Mullard, Limited—type FX1666, which is suitable for applications involving relatively low radio frequencies, and type FX1667, for high-frequency circuits.

Making a Car Radio



DETAILS OF AN ECONOMICAL RECEIVER FOR THE CAR, INCLUDING NOTES ON ITS CONSTRUCTION AND INSTALLATION

By A. E. Pardy, B.Sc.

(*Continued from page 737, December issue*)

Preselector Tuning

MANY motorists prefer to employ preselector tuning in a car radio as this eliminates the need for accurate setting of the tuning condenser (which may move under a violent jolt) and, if all the components have to be purchased, the cost may actually be less.

The use of preset condensers for tuning a fixed inductance is not recommended because of vibration, but the use of tunable inductances offers a very satisfactory solution.

For preset tuning the adjustable inductances manufactured by E.T.A., Limited, appear the most suitable. The chassis drilling and cutting in the vicinity of the twin-gang should be modified to that shown in Fig. 9 and an aluminium bracket as shown should be cut to bolt over the opening and carry the inductances L4 to L9.

The inductances should be bolted in position by 2 B.A. bolts and the wiring to the tags nearest the adjusting screws carried out before mounting the bracket. Wiring can now be completed according to Fig. 11.

It is important when using these inductances to have C30 and C31 close tolerance to obtain full coverage of the waveband. C26, however, may need to be reduced in capacity to compensate for the capacity effects of the aerial and cable.

If a four station preselector arrangement is required it may be easier to buy a complete unit (TS42 is suitable) and wire it according to the diagrams supplied with it.

The manufacturers of these coils recommend that for better second channel reception the aerial should be capacity coupled by connecting it to the junction of R20 and L4, L5 and L6. This arrangement also reduces the capacity effect of the aerial and makes the receiver almost independent of aerial characteristics. It is a matter of experiment, therefore, to find the best arrangement.

The setting of the inductances is carried out by screwing the cores to approximately the position for the station required, remembering that each medium-wave coil covers 190 to 530 metres, each long-wave coil 850 to 2,000 metres, and that as the core is screwed out the wavelength decreases.

Thus when both induct-

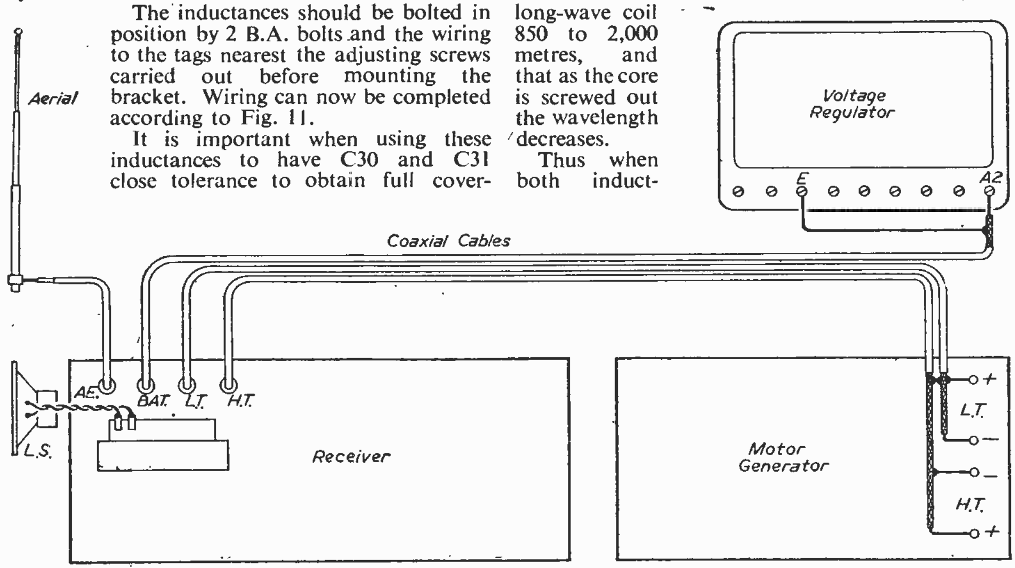


Fig. 8.—Complete installation wiring details.

ances for one station are approximately set the oscillator inductance (L7, L8 or L9) is adjusted to receive the required station at maximum volume and then the process repeated with the aerial coil (L4, L5, L6 respectively).

The required M.W. station with the lowest wavelength should be set first, and if the aerial coil fails to "peak" when screwed full out, then C26 should be reduced to a capacity which allows this coil to "peak" when screwed out approximately the same amount as the corresponding oscillator coil.

If possible final adjustment of these inductances should be made with the receiver installed in the car.

It must be remembered that the signal strength varies considerably from place to place, and a garage may be the worst place to carry out any tests or adjustments. If, therefore, results are not up to expectations it is advisable to carry out tests in a few open locations to see if the locality is the cause of the trouble.

It is recommended also, that the fuse be removed whenever the receiver is being taken out or inserted as accidental contact between the socket of the battery coaxial plus and the car chassis can prove costly in fuse replacements. The 12-volt receiver consumes 3 amperes and the 6-volt receiver 6 amperes.

The receiver has been evolved largely by trial and error and it is possible that further experiment would give rise to some improvement in performance. To avoid the duplication of these experiments the following sections indicate the trials which were made during the evolution of the receiver and the results of these trials.

1. Untuned R.F. stage omitted : This gave slightly less volume and considerably more variation in output.

2. Untuned—resistance coupled aerial stage : Not so much volume as the final design and heavy whistling on medium and long wavebands.

3. Acceptor tuned aerial stage : The same as arrangement (2), but considerable reduction in whistles.

4. A periodic coupling on aerial coil: This consisted of 40 turns of fine wire wound between the tuned section, but resulted in considerable loss of volume.

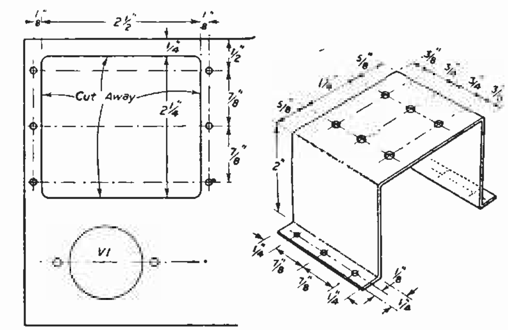


Fig. 9.—Details of the mounting bracket for preselector tuning.

5. Fixed bias on double-diode-triode : Loss of power on weak signals but better handling of very powerful signals.

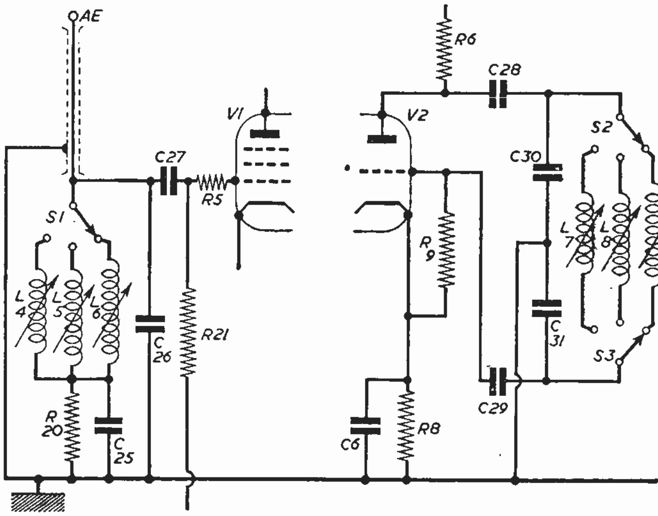


Fig. 10.—Wiring details of the preselector tuning.

6. A.V.C. on separate diode : Little difference, if any, but more components required and some instability experienced, resulting in oscillation.

7. Resistance R17 and condensers C19 and C22 omitted : Tendency to motor-boat at full volume.

8. Condenser C19 only omitted or C22 only omitted : Considerable background mush from rotary converter.

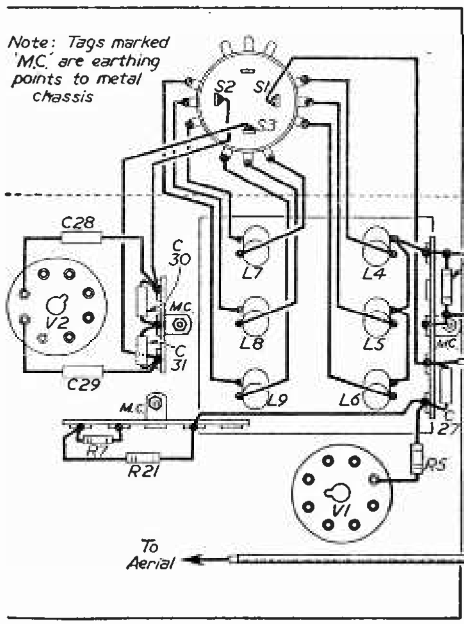
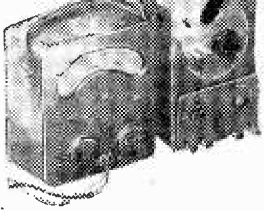
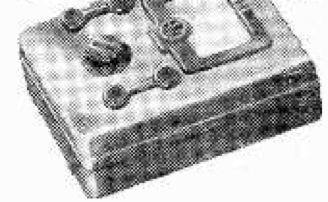


Fig. 11.—Practical layout of the Fig. 10 arrangement.

Using TEST INSTRUMENTS



Part 13 of a Series of Articles Dealing with the Practical Application of Standard Test Equipment



(Continued from page 774 December issue)

Phase Measurement (43)

IT will be remembered from our discussion of Lissajous' figures earlier in this series that the character of the more complex figures depends not only upon the frequency ratio of the two applied signals but also upon their relative amplitude and phase. We found that if the " X " and " Y " signals are of equal frequency and phase a straight diagonal line is produced. It was also illustrated that the diagonal line opens up to form an ellipse as the phase between the two signals alters, and that the width of the ellipse is a maximum when there is a 90 deg. phase angle between the two voltages. Moreover, it was shown that the width of the ellipse decreases as the phase angle further increases until the signals are exactly out of phase, when the diagonal line merely takes up the opposite slope.

This feature can be most useful for determining the magnitude of phase shift occurring, for example, in the phase-splitter stage of an audio amplifier. To check that the two signals appearing between the grids of the output valves are exactly out of phase, the " X " and " Y " plates should be connected between them, as shown in Fig. 50. The common earth terminal on the 'scope should be connected to the chassis of the amplifier and a signal, preferably a pure sine-wave, should be applied to the input of the amplifier in the usual way. If the correct phase shift of 180 deg. is taking place, then a straight diagonal line will resolve on the screen ; furthermore, if the line is set at an angle of exactly 45 deg. it means that an equal voltage is being applied to each output valve grid.

This principle can be applied to check the overall phase shift of an amplifier by connecting the 'scope as shown in Fig. 51. It will be appreciated, of course, that for tests of this kind it is necessary to switch off or disconnect the timebase from the " X " plates.

Fig. 51 shows that the output of the A.F. oscillator is connected direct to the " Y " plate terminal, and that the oscillator is connected to the amplifier input terminals, via a variable potentiometer P. The output of the amplifier is connected to the " X " plate terminal, ensuring that the amplifier is correctly loaded for resistor R.

The potentiometer should be adjusted until the " X " and " Y " voltages are approximately equal, the actual slope of an ellipse or a line indicating the ratio of the " X " to " Y " voltages. If the " X " and " Y " sensitivities are not equal, however, the difference will need to be counteracted by putting the " X " " Y " voltages slightly out of balance, by means of P, to correspond.

Zero or 180 deg. phase shift through the system will be revealed, as we have already seen, by the formation of a diagonal line on the screen. An ellipse indicates that a phase shift is occurring, and the magnitude of this shift can be calculated quite easily by centring the trace behind a graticule, as shown in Fig. 52. The sine of the phase angle will then be equal to Y1/Y2.

The phase shift may be taken over the entire audio-frequency range if necessary. Frequency distortion over the range will show as an alteration in the slope of the line or ellipse, while the presence of harmonic distortion will cause the line or ellipse to kink, provided, of course, that a pure sine wave is used to start with.

Testing with Square Waves (44)

Square waves are made up of a sine wave equal to the fundamental frequency plus a spectrum of frequencies, or sine waves, consisting of odd harmonics of the fundamental—that is frequencies three, five, seven, etc., times the fundamental. Since a perfect square wave consists of odd harmonics up to infinity it is never obtained in practice. Nevertheless, a good representation of a square wave is obtained provided harmonics of the fundamental

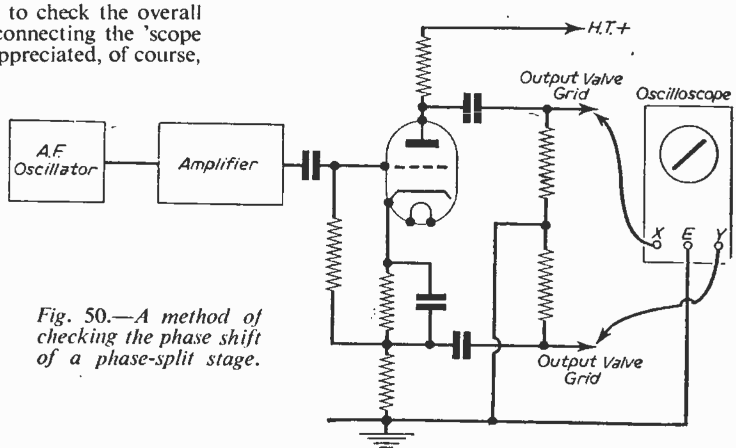


Fig. 50.—A method of checking the phase shift of a phase-split stage.

up to about 10 are present. Some idea how a square wave is formed is illustrated by Fig. 53. Here the effect of adding consecutive odd harmonics up to the seventh to a sine wave is shown. It will be observed that as each harmonic is added so the waveform resembles more closely a square wave.

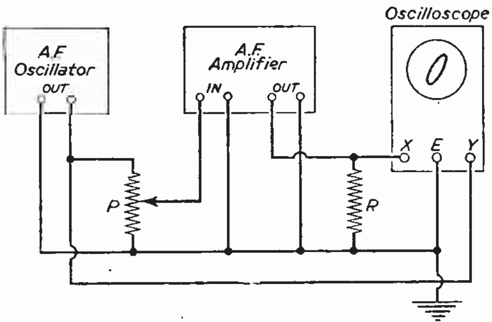


Fig. 51.—Checking the overall phase shift of an amplifier.

It will be seen that the " body " of the square wave is formed mainly of the lower frequencies and the sharply rising and falling leading and trailing edges occur as the result of the higher order harmonics. Clearly, then, if we use a fairly good representation of a square wave as a test signal and observe the signal on a 'scope after it has passed through a network of circuits, or an amplifier, we can get a good idea as to how the circuit or amplifier is behaving.

For example, if the circuit has a poor low-frequency response, instead of the square wave appearing as shown in Fig. 54, it will reflect such conditions by tilting as shown in Fig. 55(a). The concavities in the top of the wave, as illustrated in Fig. 55(b), indicate that, apart from a poor low-frequency response, the circuit is giving rise to a low-frequency phase shift.

Poor high-frequency response is revealed where the corners are rounded, as in Fig. 55(c); excessive attenuation of the higher frequencies is indicated when the wave deteriorates to that shown in Fig. 55(a).

Excessive high-frequency response in the circuit would produce a wave similar to that at Fig. 55(e), where " ringing " of the circuit is provoked.

Excessive low-frequency response in the circuit is indicated by the wave at Fig. 55(f). Such occurs in circuits which are designed to boost the lower frequencies and attenuate the higher frequencies.

Waveforms G and H show differentiation as the result of progressive worsening low-frequency responses, coupled with degrees of phase shift. This effect is, as is well known, purposely introduced into certain circuits, such as the synchronising section of a television receiver. In an audio-frequency amplifier, however, the effect might well be produced by one of the inter-stage coupling capacitors becoming very high in value, and thus permitting the passage of only the highest frequencies.

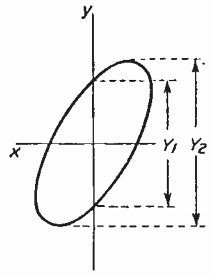


Fig. 52.—Measuring phase shift.

Test Precautions (45)

When a 'scope is used for square-wave testing it is essential in order to get a true picture of the resulting waveform to keep the capacitance between the 'scope test leads to an absolute minimum. We have already seen how attenuation of the higher frequencies can distort a square wave, and such attenuation is liable to result due to excessive shunt capacitance being introduced across the input terminals of the 'scope itself.

In this respect, therefore, the 'scope leads should be as short as possible and orientated for maximum separation. It is pointless to endeavour to obtain a true indication if the test instrument and wiring themselves are responsible for distortion. It is always best to secure mechanically the 'scope leads to the test points in the equipment under examination, as opposed to holding the leads with one's fingers, for this latter procedure often results in undesirable shunt capacitances which are liable to provoke misleading traces.

If the test demands rapid tracing round the circuit with the 'scope leads, then a low-capacitance probe unit should be connected to the high-impedance test lead so that the normal working of the circuit is not severely disturbed.

Unfortunately, these requirements often conflict with those necessary to minimise hum pick-up in the 'scope test leads. By hum in this respect is meant 50 c.p.s. mains voltage which is induced into the " Y " connecting lead, considerably magnified by

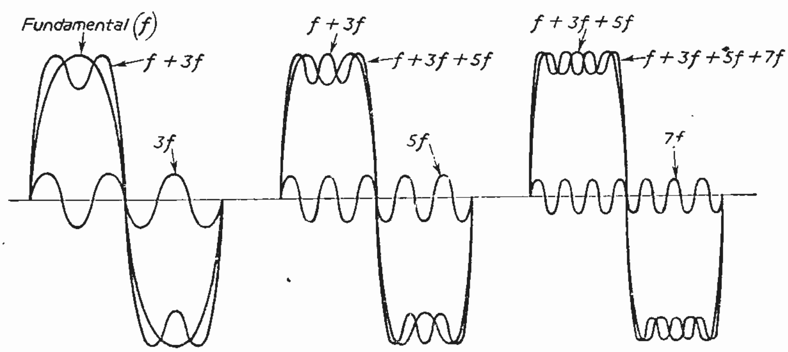


Fig. 53.—Curves showing the formation of a square-wave.

Fig. 54.—A good square-wave.

the deflection amplifier, and superimposed on the main image in various forms.

The effect is largely aggravated as the result of the high impedance input to the " Y " plate and deflection amplifier, and is well demonstrated simply by touching

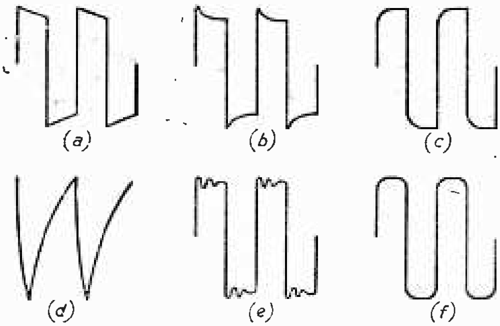


Fig. 55.—Distorted square waves.

the " Y " input terminal and turning up the gain of the deflection amplifier.

Any mains frequency picked up this way will cause a movement of the spot in addition to the deflection due to the main image. The waveform produced, therefore, will be the sum of these two waves. If the main image is below the frequency of the mains the presence of this ripple voltage will introduce harmonics which may or may not be an exact multiple of the waveform under examination. If the examination frequency is equal to the mains frequency mains hum might well introduce a distortion content to the waveform under examination and consequently give rise to very misleading results. When the examination frequency is slightly higher than the mains frequency, but still within the audio range, the amplitude of the waveform under examination will continually change at a rate depending on the beats between the two frequencies (see Fig. 56).

As the examination frequency rises the increasing beat between the two frequencies will result in a somewhat blurred image, in some cases two entirely distinct waves may resolve, and to add to the confusion each wave often bobs up and down with respect to each other (see Fig. 57.)

Disturbances of this nature are more prone to develop when the examination frequency is of very small amplitude, and when it is necessary to employ a high gain setting on the deflection amplifier in order to obtain sufficient vertical deflection of the trace.

In most cases it can be eliminated by using a screened lead to connect the 'scope to the test point in the circuit, but this, of course, conflicts with the previous stipulation we made regarding shunt capacitances. Nevertheless, a compromise can often be found in practice which reasonably satisfies both conditions.

Detecting Hum (46)

While we are on the subject of hum it is interesting to note that a 'scope can very successfully be employed for detecting and tracking down hum caused by

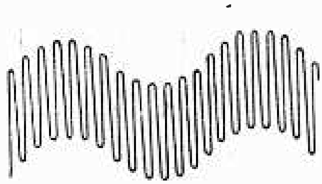


Fig. 56.—Showing the effect of 50 c.p.s. mains hum superimposed on an examination waveform.

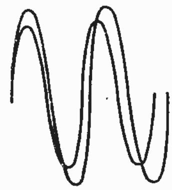


Fig. 57.—The formation of two distinct waves as the result of hum pick-up.

inadequate smoothing, leakages, inductive pick-up, etc., in a broadcast or television receiver.

For tests of this kind the 'scope should be properly earthed to the receiver chassis, and the " Y " terminal, via the deflection amplifier, connected, through an isolating capacitor, to various points along the H.T. line starting at the output or cathode of the H.T. rectifier. The effect of the H.T. filter circuits will be readily seen if the T.B. is adjusted to give two or three waveforms. The desirability or otherwise of adding additional smoothing components can be assessed without much trouble, and a defective component used in the H.T. smoothing circuits will be quickly revealed by this means.

The presence of modulation hum will be shown on the screen by applying an unmodulated signal from a service oscillator, or signal generator, to the aerial terminals of the receiver, and adjusting the tuning of the receiver to correspond to this frequency.

Figs. 58 and 59 respectively show full- and half-wave rectifier circuits together with ripple waveforms

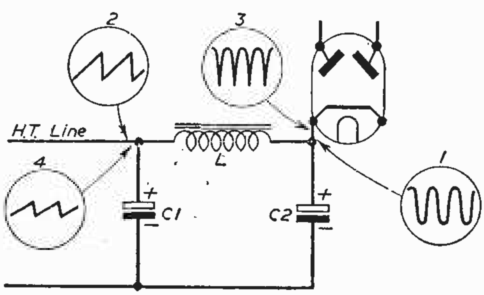


Fig. 58.—A full-wave rectifier circuit; waveforms 1 and 2 normal, 3 due to C2 becoming open-circuit and 4 due to L becoming open-circuit. Ripple frequency 100 c.p.s.

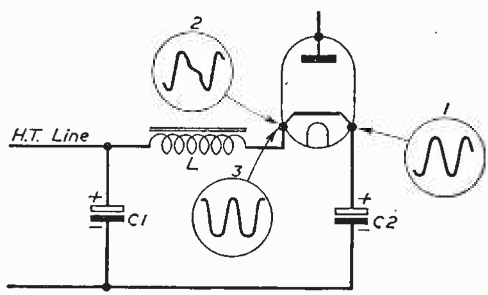


Fig. 59.—A half-wave rectifier circuit; waveforms 1 and 2 normal, and 3 due to L becoming open-circuit. Apart from the 50 c.p.s. ripple frequency, waveforms on the H.T. line are similar to those in the full-wave circuit.

to be expected at either side of the filter choke under both normal and fault conditions.

R.F. and I.F. Applications (47)

Apart from A.F. applications, the relatively high input impedance of the 'scope's deflection amplifier

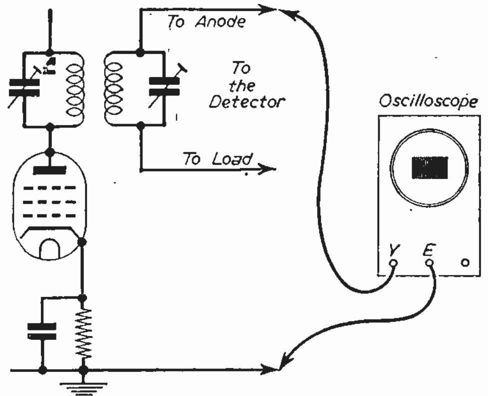


Fig. 61.—A method of connecting an oscilloscope for observing a modulated R.F. waveform.

makes the instrument ideally suitable for testing in the R.F. and I.F. circuits of a broadcast receiver. The instrument can be applied across the tuned circuits without imposing severe loading, and can thus be used to check R.F. stage gain by using a method similar to that already described.

As when making comparative R.F. measurements with a valve voltmeter, a certain degree of additional capacitance will be reflected across the tuned circuit, and for this reason the associated circuit may require adjustment when the 'scope is connected. It should, of course, be restored to normal after the test has been performed.

Owing to the higher frequencies involved in the R.F. section of a receiver, as opposed to the A.F. section, and the relatively low high-frequency response of the deflection amplifier in standard 'scopes, it is seldom possible to obtain a waveform representing one or two complete cycles of R.F. (I.F.). Also, in some oscilloscopes the maximum repetition frequency of the T.B. is insufficient to permit the resolution of less than about six complete waveforms at low R.F.

Nevertheless, even in its limited form the 'scope represents a valuable aid for checking at R.F., since observation of the R.F. waveform itself is of no particular importance. Indeed, it is generally desirable to adjust the T.B. to a frequency which is a submultiple of the actual *modulation* frequency so that the individual cycles of the R.F. signal are so close together as to appear on the screen as a rectangle of illumination. Then when the R.F. is modulated the modulation signal will appear as an envelope at the top and bottom of the R.F. signal, as shown in Fig. 60.

The modulated R.F. signal can thus be traced through the various stages of a receiver, and the final signal observed at the output of the final I.F. (R.F.) amplifier, with the 'scope connected as shown in Fig. 61. Ideally, the waveform should correspond to that at Fig. 60, but before it is concluded that distortion is occurring in the I.F. (R.F.) stages the waveform should be checked at the generator itself.

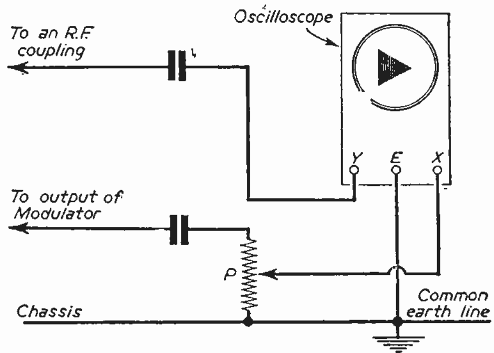


Fig. 63.—The circuit arrangement for checking modulation depth.

The trace at Fig. 62 (a) indicates distortion as the result of overloading of the I.F. (R.F.) amplifiers, possibly caused by faulty biasing or failure of the A.V.C. system. If the waveform has a rough saw-tooth edge on it, after the style of that depicted at Fig. 55(b), it can be assumed that the I.F. (R.F.) stages are oscillating, either as the result of faulty decoupling or screening.

Checking Depth of Modulation (48)

The C.R.T. provides a simple method of checking the depth of modulation of a transmitter or modulated oscillator. The T.B. is switched off and the "X" and "Y" plates connected to the circuit as shown in Fig. 63. The oscillator is modulated with a constant frequency in the region of 400 c.p.s. A trace whose dimensions may be modified by adjusting the potentiometer P will then form on the screen. Traces to be expected will be shown next month; the depth of modulation may be calculated from the expression $x-y \times 100$ per cent./$x+y$. Trace b shows 100 per cent. modulation, trace c over 100 per cent. modulation, and trace d severe modulation distortion as the result of over-modulation and non-linear operation.

(To be continued)

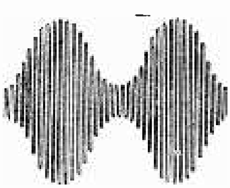


Fig. 60.—A modulated R.F. waveform (ideal).

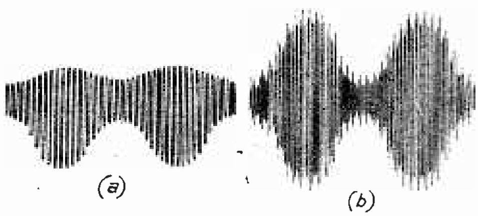


Fig. 62.—Showing a distorted modulated R.F. waveform at (a), and at (b) the waveform indicates R.F./I.F. instability.

R.S.C. MAINS TRANSFORMERS (FULLY GUARANTEED)

Interleaved and impregnated. Primaries 200-230-250 v. 50 c/s Screened.

TOP SHROUDED DROP THROUGH

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250-0-260 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a ... 16/9
300-0-300 v. 70 mA, 6.3 v. 2.5 a 16/9
350-0-350 v. 80 mA, 6.3 v. 2 a, 5 v. 2 a ... 18/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a ... 22/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a ... 22/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a ... 22/9
350-0-350 v. 100 mA, 6.3 v 4 a, C.T. 0-4-5 v. 3 a... ... ... 23/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v 3 a ... 29/9

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in. 17/6
350-0-350 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a. ... 19/9
250-0-250 v. 100 mA, 6.3 v.-4 v. 4 a. C.T. 0-4-5 v. 3 a 26/9
250-0-250 v. 100 mA, 6.3 v. 6 a, 5 v. 3 a, for R1355 conversion 31/-
300-0-300 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a 26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a. 23/9
350-0-350 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a. 27/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a. 33/9
425-0-425 v. 200 mA, 6.3 v. 4 a, C.T. 6.3 v. 4 a, C.T., 5 v. 3 a. Suitable Williamson Amplifier, etc. 49/9
450-0-450 v. 250 mA, 6.3 v. 6 a, 6.3 v. 6 a, 5 v. 3 a. 69/9

E.H.T. TRANSFORMERS

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ELIMINATOR TRANSFORMERS

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130 v. 50 mA, 6 v. 3 a 14/9

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All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a, **11/9**; 0-9-15 v. 3 a, **16/9**; 0-3.5-9-17 v. 4 a, **17/9**; 0-3.5-9-17.5 v. 4 a, **18/9**; 0-9-15 v. 5 a, **19/9**; 0-9-15 v. 6 a, **22/9**.

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150 mA 7-10-250 ohms 11/9
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Williamson type exact to spec. ... 85/-

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H.T. ELIMINATOR AND TRICKLE CHARGER KIT. Input 200-250 v. A.C. Output 120 v. 40 mA. Fully smoothed and rectified supply to charge 2 v. accumulator. Price with louvred metal case and circuit, **29/6**. Or ready for use, **8/9** extra.

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.02 mfd. 8,000 v. cans, **1/11**; .25 mfd. 4,000 v. Blocks, **4/9**; .5 mfd. 2,500 v. Blocks, **3/9**; .5 mfd. 3,500 v. cans, **3/3**; 1.5 mfd. 4,000 v. Blocks, **5/9**.

CONTROL PANEL with six position, 3 wafer Yaxley switch, pointer knob, 2 S.P.S.T. switches, various plugs and sockets. Only **1/6**.

EX-GOVT. BLOCK ELECTROLYTICS. 16-16 mfd. 350 v., **1/9**; 8-16 mfd. 550 v. **1/11**; 1,000 mfd. 6 v. Can with clip. **1/9**.

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ALL INPUTS. 230-250 volt. 50 c.p.s.

(1) 350-350 v. 150 ma. 6.3 v. 4 a., 6.3 v. 2 a., 5 v. 3 a. **30/-.**

(2) 350-350 volt 200 ma. 6.3 4 a., 5 v. 3 a. **£2.**

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(4) 350 v. 250 v.—250 v. 350 v. 6.3 v. 4 a., 4 v. 2 a. **£1.**

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5/- Carriage on all above Transformers.

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Outputs : 5, 11, 17 volt, 1½ amp. **13/6.**
Same output 4 amp. **£1.**

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38/43 m/c. "88" Set.
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Battery Boxes 10/- each.

On Your Wavelength

BY THERMION

What's in a Name ?

I OCCASIONALLY receive a letter from a reader who disagrees with my views, complaining that I hide behind a nom-de-plume. My view would be no different if they appeared under the name of Bill Smith, Dick Jones, or Harry Brown. You must presume, therefore. that my name is Thermion, and as the name is associated with an address, it is a misnomer to say that I write anonymously. Even contributions which are published without an author's signature can hardly be called anonymous contributions, since they appear under the sponsorship of the editor and publisher, and any correspondence ensuing is received and dealt with.

Anonymous letters, however, are in a totally different category. The slimy creatures who resort to the reprehensible practice of writing letters without a name or address or with a false name and address are those who really shield behind anonymity, and that is why their communications are always consigned to the waste-paper basket.

There is also the fierce critic who wants to let off steam and ends with the words, "I dare you to publish this." Such communications are never published. No one has a right to demand publication of offensive letters. Courteous letters receive courteous replies and courteous treatment in print. If you have the courage of your convictions, sign your proper name and address. Write in a calm frame of mind. To lose your temper is to lose your case. It is an old saying that, "if the cap fits, wear it," and those readers who like wearing caps should not suffer from swollen heads. I like to have letters of criticism and realise that not everyone will agree with my viewpoint. Discussion is stimulating, and both sides can be wiser after a friendly debate.

TV versus Radio

I AM not surprised that the number of people who listened to the radio between 6 and 11 p.m. from July to September last year was very much lower than in the corresponding period in 1954. According to the BBC Audience Research Department, only 11.6 per cent. of the adult population were listening at any moment compared with 13.6 per cent. the year before. "This decrease is partly due to a further flow of listeners to television." It is estimated that the average size of the listening audience is 23½ million in the July-September quarter, against 26 million the previous year. That is, of course, to be expected.

One outstanding fact, however, is this. The interest in experiment and the construction of receivers is as strong to-day as it ever was, and the circulation of this journal and the volume of business done by our advertisers provides ample evidence of it. Each year a new generation of constructors enters the field, and as a few drop out there is a corresponding influx of new recruits. The number of people building television receivers continues to increase. There are far more home-built television receivers in operation than is realised by the BBC. I do not think that sound radio will ever die out, but I think that within 10 years very much less listening will be done. The novelty, to a large extent, has worn off. The new generation was born to radio and television, and it is of little novelty to them. Their interest will be in space travel. How interesting it will be when the first radio signals are received from the moon—far more exciting and epoch-making than those famous first signals radiated between Poldhu and Newfoundland by Marconi in 1897. Indeed, it is radio which has made space-travel possible.

Unfair Competition

IT is said that the BBC television programmes are more than holding their own with ITA and, having looked in to some of the ITA programmes, I can well believe it. ITA are not finding it too easy to sell programme time. I think, however, that the BBC has an advantage over ITA in that it is able over the radio to advertise its television programmes, a facility denied to ITA. It is true that most newspapers to-day give the ITA programmes, but some of the latter have been poorly supported. Some of the viewers may have seen the Editor of this journal on a recent Saturday in a programme entitled "Winter Motoring." He was appearing as editor of our companion journal, *Practical Motorist and Motor Cyclist*.

Tape Recorders

INTEREST in tape-recording continues to increase judging from the number of letters we receive on this subject. It is still, however, an expensive instrument, and unnecessarily so, in my opinion. I can understand that in the early days, with a very limited demand, tooling and production costs had to be covered on a comparatively small output, but to-day the demand is large and it will grow even larger. The manufacturer of tape decks who takes the bold stroke of lowering his price will reach a large public and reap the benefit. Who will be the first to make the move ?

Midget Receivers

MY recent appeal for designs of midget receivers produced some ingenious designs, one of which has been published herein. They all, however, exhibited the usual defect—the power supply was altogether too large to make the receiver a real midget. Yet in America there are large numbers of really small commercial battery-operated receivers which can easily be slipped into the pocket. Cannot our battery manufacturers over here get down to this and produce a real midget layer-laid battery for L.T. and H.T. ? Cannot our valve manufacturers get down to producing some really tiny valves which require a very low voltage ? I can assure them that the demand for such a receiver, which can be very handy on special occasions, is enormous. This journal will undertake, I am certain, to issue a blueprint for such a receiver if the components are made available.

A NOVEL Phase INVERTER

ECONOMICAL CIRCUIT FOR CLASS B WORK

By Hugh Guy

THE rather unusual circuit about to be described was developed primarily for use with a portable and lightweight high-power public address system, in which the high-tension supply for the amplifier up to but excluding the output stage was of the order of 200 volts. Furthermore, to keep the weight down, intervalve transformers were ruled out in the design, coupling being purely of the resistance-capacity type throughout.

The output stage itself consisted of two medium power triodes working in push-pull, under Class B conditions, this class of working being superior to Class A or AB from an efficiency point of view.

Class B has one major disadvantage, however, particularly when applied to triode output stages, and this lies in the amount of drive required. Since under these conditions the valves are normally maintained at cut-off, the drive supplied must carry the grids from cut-off to within a volt or two of zero grid bias. This drive, of which only the positive excursions are utilised in the actual production of signal output, is normally supplied through a step-up transformer to the grids of the output valves, but as such transformers were taboo in the design in question it was necessary to resort to alternative means, a difficult problem with the limitations imposed by the low H.T. voltage.

The circuit finally produced, however, provides a neat way of overcoming the difficulties, and can in fact produce drive which exceeds the value of H.T. voltage. The circuit will therefore be of interest to builders of amplifiers working in Class B, particularly if the latter are to be used as modulators for amateur transmitters.

Phase Inverter

The circuit is a development of the simple phase inverter which uses equal anode and cathode loads. This basic circuit is shown in Fig. 1.

By using equal values of resistor for anode and cathode loads, the gain to the anode is the same as that to the cathode, and is approximately one. The signals appearing at the anode and the cathode are also 180 degrees out of phase with each other, and thus a push-pull drive is developed. As explained above, however, for Class B work that portion of the signal which is negative-going is not contributing any useful effort to the final output, being below cut-off in the final stage, and it could therefore be dispensed with. The available H.T. could then be utilised to the full in producing as much single peak positive-going drive as was formerly available as peak-to-peak drive.

Referring to the circuit of Fig. 1 again will enable the explanation which follows to be understood more clearly. If we label the anode and cathode loads RL and Rk respectively, then the gain to the anode is:

$$G=\frac{\mu RL}{(\mu+1)Rk+Ra+RL}$$

where μ is the amplification factor of the valve and Ra is the anode impedance.

Similarly the gain to the cathode is:

$$G=\frac{\mu Rk}{(\mu+1)Rk+Ra+RL}$$

It is thus easily seen why making the anode and cathode loads equal results in equal amplitude signals at the anode and cathode.

These formulae also make it apparent that if we could arrange for the loads to be switched off, as it were, each time a positive output becomes negative, then it would be possible to arrange that only positive outputs appeared, thereby dispensing with the unnecessary negative portion of the signal.

This discrimination between positive and negative outputs may be accomplished by means of a small diode, and in the circuit of Fig. 2 we see how this task is performed.

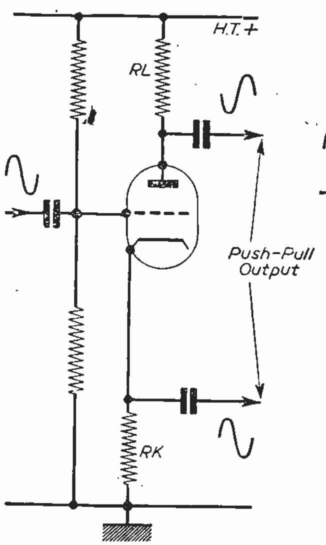


Fig. 1.—Basic phase inverter.

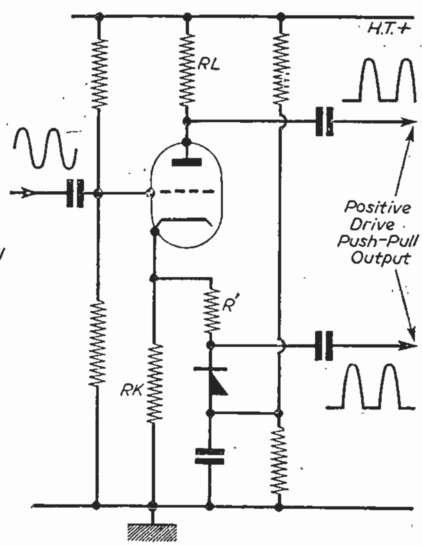


Fig. 2.—Modified phase inverter.

The cathode resistor is now two resistors, one of which (Rk) is about 10 times the value of the anode load RL, while the other, R', is approximately the same value as RL. A diode is in series with R' to a decoupled point and the cathode output is taken from the junction of R' with this diode.

The Action

For the sake of simplicity consider the action of applying a simple sine wave to the grid of the phase inverter. On positive excursions of the grid the current in the valve will increase, thus producing a drop in anode voltage and an increase in the voltage across Rk. No current will flow in R' and the diode, as the latter is non-conductive to positive signals in the manner in which it is connected at present. Now if the value of Rk is much greater than that of RL, then ten times as much signal will appear at the cathode as at the anode. To all intents and purposes, then, the anode signal is negligible by comparison.

On the negative excursion of the grid, however, the diode conducts and thus the output from the cathode will be shorted through the diode to the decoupled point, and will hence be zero. The effective cathode load is now R' in parallel with Rk, and is approximately equal to the anode load. Across the latter, therefore, will be developed nearly the same voltage as that across the cathode load.

If indeed Rk is made ten times the value of RL, then using the formulae the relative signals at the two outputs can be determined for the two conditions, expressing the anode and cathode loads in terms of RL.

When the input is positive-going the gain to the anode is:

$$G1=\frac{\mu RL}{(\mu+1)\ 10RL+Ra+RL}$$

while the gain to the cathode is:

$$G2=\frac{\mu 10RL}{(\mu+1)\ 10RL+Ra+RL}$$

The ratio of these two gains G2/G1 is seen to be the specified 10 to 1, and hence the unwanted output from the anode is only one-tenth of the useful output at the cathode.

Now when the input is negative-going the gain to the anode is:

$$G3=\frac{\mu RL}{(\mu+1)\ R'+Ra+RL}$$

and that to the cathode is:

$$G4=\frac{\mu R'}{(\mu+1)R'+Ra+RL}$$

Sticklers for accuracy will point out here that the cathode load is really the parallel combination of R' and Rk, but the expression for G4 is a good enough design approximation.

It is the ratio G2/G3 which we require to be as near to one as possible, since this ratio decides the relative amplitudes of the positive-going outputs from the cathode and anode respectively.

It will be seen that by equating G2 and G3 a value for R' can be found which makes the outputs equal. This value is given by:

$R'=RL-0.9Ra/\mu$ approximately.

Hence, having selected a particular valve, and chosen a convenient value for RL, the other values are determined from the formula and conditions set by it.

This information will enable the experimenter to design such a circuit using any triode, whilst for those who prefer a complete example a circuit is given below using the EC91 valve. This valve has a U.S.A. equivalent in the 6L34 valve, whilst on the surplus market the valve may be identified as the CV417.

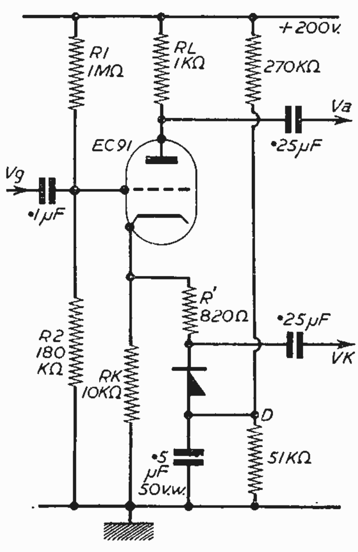
How it Functions

A value is selected for RL, 1 K ohms being suitable as it makes the calculations simple. The value of Rk is therefore made 10 K ohms, and on the Ia/Va characteristic curves for the valve is drawn this total load-line of 11 K ohms through the H.T. point of 200 volts. A suitable bias point is chosen by inspection; -1.5 volts will give an anode current of 3.2 mA. In turn, this current flowing through Rk will drop 32 volts across the cathode load. Hence, to maintain a grid-cathode bias of -1.5 volts, the grid must be biased to 30.5 volts. This is achieved by the use of two resistors, R1 and R2 in Fig. 3, of value 1 M and 180 K respectively. This working point on the curves gives an amplification factor of 90 and an anode impedance of 20 K ohms.

If R' is determined from its formula above it will be found that the nearest available value is 820 ohms, a value which gives only a slight inequality in anode and cathode gains.

Under no signal conditions no current is required to flow through R', and the decoupled point to which the diode is connected at D in the figure should therefore be maintained at the cathode potential of 32 volts. This voltage can be obtained using the two resistors R3 and R4 as shown. The by-pass condenser is included to decouple the point D to earth, thereby shorting out any A.C. signal passing through the diode.

The values of gains G2 and G3 may now be



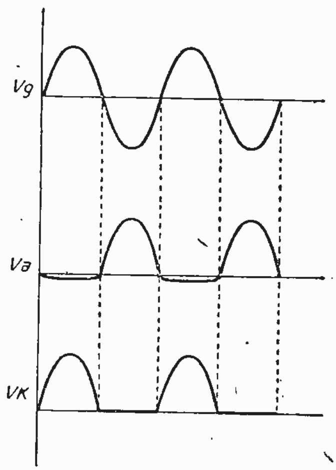


Fig. 3 (Left).—Practical Class B phase inverter. (Right).—Half sine-wave at anode and cathode for sine-wave at grid.

checked to see that there is no wide divergence between them, which would cause out-of-balance in the drive to the output stages.

The values used in this design give gains of 0.966 and 0.94 for G2 and G3 respectively. The out-of-balance resulting from so small a discrepancy is, of course, negligible. The maximum signal that can be obtained from each of the output terminals is of the order of 18 volts peak without undue distortion.

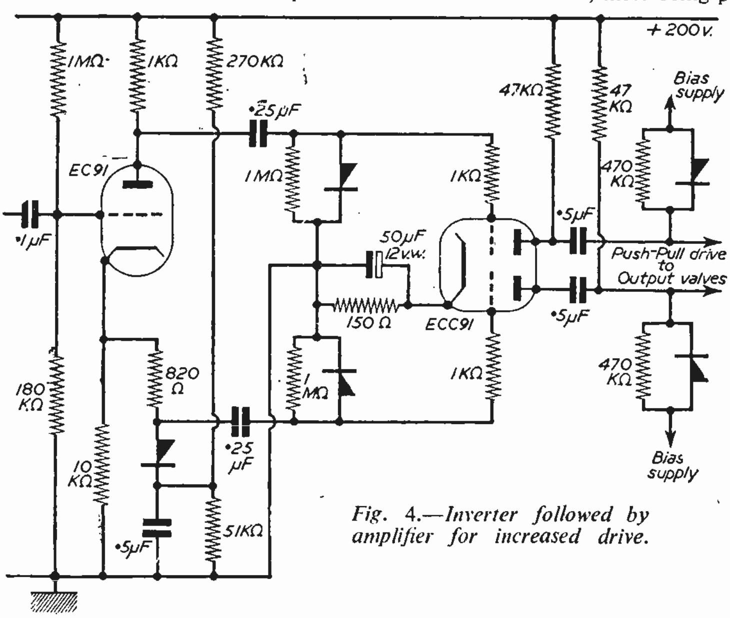


Fig. 4.—Inverter followed by amplifier for increased drive.

Producing More Drive

It was mentioned earlier that the circuit can be used to produce drive which can be in excess of the H.T. voltage available. This remark as it stands is perhaps a little misleading, what is meant being that if the two halves of a sine-wave produced in this manner are added to re-form the original sine-wave after amplification, then the peak-to-peak value of such a sine-wave could be greater than 200 volts.

With the circuit as it stands at present, the peak output of 18 volts, a limit imposed by the cramping of the grid voltage/anode current characteristic of the valve, may be insufficient for the larger type of output triode, where, to produce Class B drive, the peak signal may have to exceed 100 volts.

If this were the case, it would be necessary to interpose a stage of amplification for each of the two drives between the inverter and the two output valves. Since each of the two amplifiers would only be handling unidirectional drive, approximately twice the normal swing would be available at each grid of the output valves.

The circuit to achieve this result is shown in Fig. 4, where it will be seen that in addition to the double-triode amplifying stage following the inverter, a slight modification is necessary to the phase inverter. The amplifier produces an unwanted phase reversal at the output, and to correct this the outputs from the inverter must be reversed. This is the purpose of the modification, which consists merely of reversing the connections of the diode.

The valve used as the drive amplifier is the ECC91, a double-triode with a shared cathode, on a B7G base.

The standing current in each triode is made high by use of a low value of cathode bias resistor, in order that the drive to each grid will enable the maximum use to be made of the available grid swing. This results in a large positive-going half sine-wave at each anode, these being passed to the output valves.

The ECC91 in Fig. 4 is biased to -1 volt when, with an anode load of 47 K and an H.T. of 200 volts an anode current of 3 mA flows. By using a common cathode resistor the average value current from both triodes is made to maintain the grids at -1 volt with respect to the cathodes. Hence, a bias resistor of 150 ohms is used, this being the nearest practical value to the desired resistor. The by-pass condenser of 50μF gives effective decoupling down to about 20 cps.

With this circuit arrangement the signal output from each anode will be 100 volts peak for an input to the phase inverter of about 4.5 volts. Thus, the peak-to-peak output equals the value of the H.T. voltage.

If the input is increased to 6 volts, then a composite signal of 240 volts will be obtained, illustrating what at first seems to be the impossible in the way of drive from a transformerless driver.

Any tendency for either triode to give a greater output than the other can be compensated for by making the anode load to the inverter a 1 K potentiometer. The output is then taken from the slider to the grid of the appropriate triode amplifier. The potentiometer is then varied until no signal is heard in a pair of phones connected in series with the H.T. lead to the centre-tap of the output transformer in the power stage. This latter test procedure is, of course, the one normally applied to any push-pull stage for correcting out-of-balance working.

Only one feature of the circuit remains to be explained: the presence of the diodes across the input grid-leaks to the stages.

These diodes are D.C. restorers and are necessary to set the level of working of the half sine-waves. In the absence of these diodes the signal, which has now been "chopped in half" by the inverter, would tend to sit at its mean level at the following grids after passing through the coupling condensers. With the changing nature of the signal, which up to now for the sake of simplicity we have thought of as a sine-wave, the mean level will vary, and a lot of the unidirectional drive will be lost. By restoring the level at each grid to the "chopped-off" edge, however, the working level can never vary appreciably, and at all times the full unidirectional drive is utilised, regardless of the shape of the waveform.

The small crystal variety of diode, such as the CG-1-E, is quite suitable for all the diodes in the circuit.

Receiver Analyser/Valve Tester

A UNIT WHICH HAS WIDE APPLICATION IN THE WORKSHOP AND AMATEUR DEN

By "Experimenter"

WHILST carrying out repairs on radio receivers, the writer has often felt the need for a speedy means of checking the voltage or current of valves in their operating condition.

This has meant the removal of the chassis from the cabinet and breaking leads to valve pins or trying to measure voltage in difficult and inaccessible places.

The removal of a chassis can often be a tedious and time-wasting affair, and the breaking and subsequent repair of leads to valve pins almost impossible.

After some thought it was realised that the only solution to the problem was to construct an adaptor whereby the valve under test could be removed from the chassis and placed, still operating, in an easier and more accessible position.

The arrangement finally decided upon is shown in Fig. 1.

Design

The analyser consists of a panel of some insulating material such as paxolin upon which are set a number of valveholders of the type required by the individual constructor. These will be the actual test sockets into which the valve under examination will be plugged.

An input plug is mounted on the panel and is made up of the base of an international octal valve, firmly secured and with the pins upwards, ready to receive the lead which will connect the chassis under test to the analyser.

A lead is taken from No. 1 pin of this plug to No. 1 pin of the first valveholder on the analyser and from there to No. 1 pin of the next holder and so on until all the No. 1 pins are wired in line. The same procedure is followed with No. 2 pin and so on until all the test sockets are wired up.

A closed circuit jack is then inserted in series between No. 1 pin of the input plug and No. 1 pin of the first test socket and this is continued with each lead until all the valveholders have been provided with a jack.

A lead is then taken from pin 1 of the input socket to the first of a series of plug holes of the aerial/earth type and this is continued until each pin of the input socket is connected to one of the eight plug holes.

One final terminal must be provided which may be connected to the chassis of the set under test to provide a negative reference point for use with valves where no direct connection is made with earth through the valve electrodes.

A connector must be made for each type of valveholder provided for on the analyser panel and these are made up as in Fig. 2. The connector consists of a short length of multi-way cable terminating at one end in an octal socket made from a valveholder and at the other end in a plug made up from an old valve base of the type to be tested.

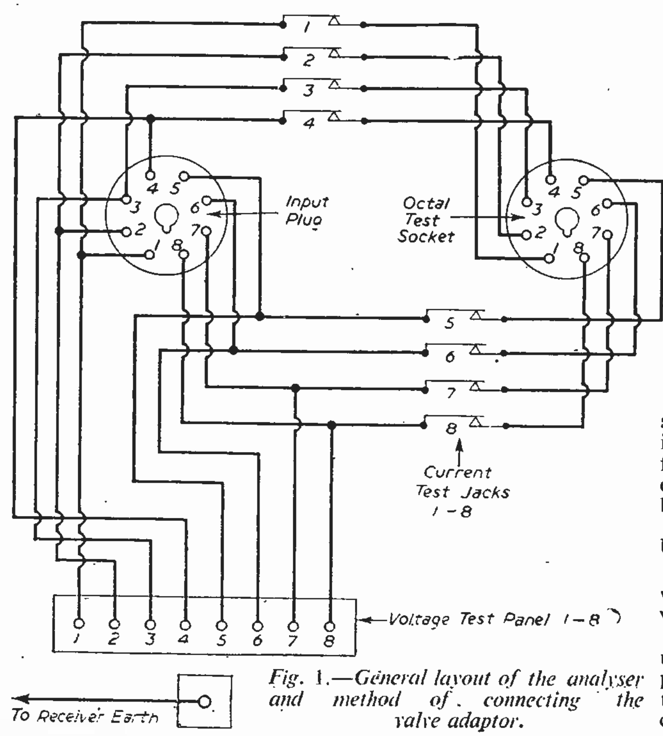
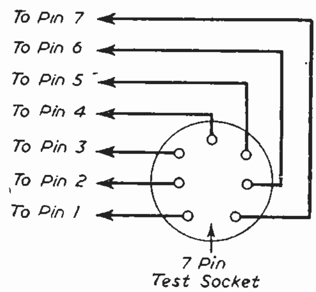


Fig. 1.—*General layout of the analyser and method of connecting the valve adaptor.*



Using the Unit

The analyser is used in conjunction with the service meter and any good valve reference book, as shown in Fig. 3.

The back is removed from the set under test and the rectifier removed and placed in the appropriate socket of the analyser. The analyser is then connected to the receiver by means of the multi-way lead inserted in the vacant valve base.

Voltage measurements are made from the earth terminal of the analyser to the plug hole corresponding to the number of the valve pin as given in the reference tables.

Current can then be measured in any of the valve leads by the insertion of a jack plug connected to the meter in the jack socket corresponding to the valve pin number.

This procedure is then followed with any or all of the remaining valves, each one being replaced in the set after test.

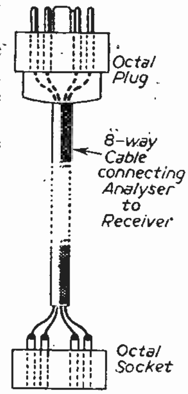


Fig. 2.—Details of the adaptor.

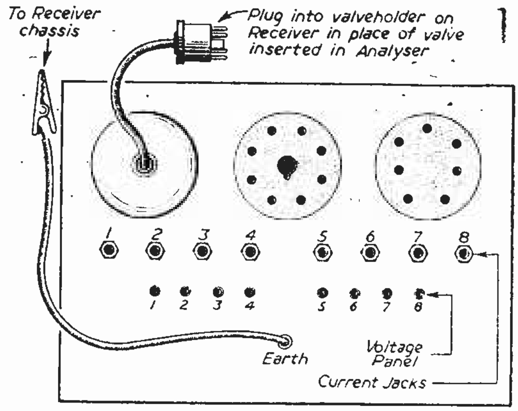


Fig. 3.—Panel layout of the instrument.

When testing valves with top cap grids it is not normally required to make the grid connection although this can easily be done with a crocodile clip on a short piece of wire.

Sound-reproducing Equipment on Show

A DISPLAY featuring a wide range of "Mimco" sound-reproducing equipment by Special Products Division of The Marconi International Marine Communication Co., Ltd., is on view in Marconi House, Strand, the site of London's old broadcasting station, 2LO. The exhibit embraces specimens of everything required for sound-reproduction systems on board ship or ashore, and illustrates how individual installations can be "tailored" to meet specialised needs, whether marine or industrial.

A typical central control for a medium sized installation feeding up to 60 loudspeakers is shown. This consists of a single cabinet containing an all-wave broadcast receiver, pre-amplifier, power amplifier and loudspeaker switching panel with built-in monitoring loudspeaker. A rotary switch selects any one of three independent microphone positions, or inputs from the broadcast receiver, a gramophone unit, or tape player.

For smaller installations supplying up to 10 loudspeakers the "Mimco" receiver, with built-in 10 watt audio amplifier, is available. The "Pantenna" communal aerial system is also shown. This permits the independent use of as many as 80 individual receivers from one common aerial, thus avoiding an unsightly array of personal aerials on board ship, where they may exert an undesirable influence on direction finding. It also enables broadcast programmes to be distributed to positions below decks where it would be impracticable to erect aerials. The "Pantenna" is also suitable for similar systems in large blocks of flats.

Tape Music Libraries

A new emphasis on "Music at Sea"—or ashore—is seen in the display of tape players and reproducers. For some years now gramophone record players have been available to provide music for ships' crews and passengers, but bad weather can have an adverse effect on record playing, despite "floating" turntables and other refinements—and also on brittle gramophone records. The "Mimco" display at Marconi House features different types of tape player and a more elaborate tape reproducer in a console cabinet which can be painted or polished to harmonise with the decorative scheme of a ship's smokeroom or lounge. The output from a tape player can be played over the loudspeaker system, while the tape reproducer, with its own built-in amplifier and loudspeaker, is a self-contained unit suitable for use in one public room.

With these instruments available, the Marconi Marine Company has introduced a new service. This is a library of 50 tapes, carrying a selection of orchestral and instrumental items to suit all tastes, which can be placed on board ship and exchanged or renewed after each voyage as required. Each tape gives an hour's playing—more than a long-playing record—and reproduction is of a very high quality with, of course, no surface scratch. This new service has only just been introduced, and the "Mimco" tape library will be expanded to include a still wider selection of musical items. Record playing units are, of course, still available, and there is one assembly composed of two record players and a tape player, providing full flexibility of choice for long or short items.

The well-known "Jericho" power megaphone and a variety of microphones, loudspeakers, loudhailers and ancillary equipment are on view.

Loudspeakers of the Past

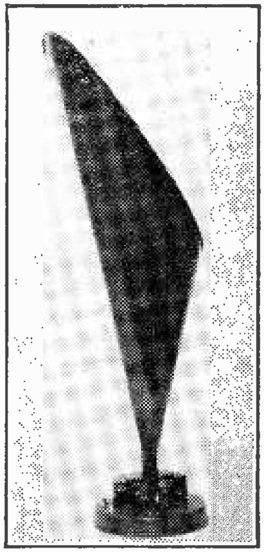
OUR CORRESPONDENT RECALLS SOME OF HIS EARLY EXPERIENCES

By C. H. Gardner

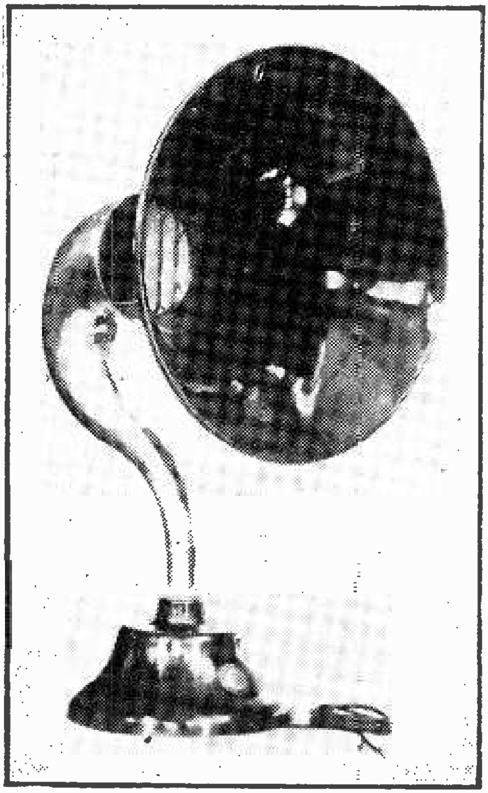
A RECENT note in a trade journal to the effect that the annual production of loudspeakers in this country was in the neighbourhood of 150,000, brought to mind some of the interesting, and in some cases amusing, types of loudspeakers which have been produced during the past 40 years or so.

The necessity for some form of loudspeaker became apparent to some of us as far back as 1912. At that time, with a long enough aerial and a sensitive crystal, it was possible to receive the morse signals from the Eiffel Tower at an appreciable strength. In order to introduce the wonders of wireless to our feminine admirers some method had to be found that would enable them to hear these signals without disarranging their hair with the elaborate contraption of metal headbands attached to the ear-pieces.

Eventually, it was discovered by quite a lot of people at the same time that by detaching one of the ear-pieces and laying it in the bottom of a pudding basin it provided quite an effective loudspeaker under conditions of deathly silence and with the listener's ear conveniently placed just inside the rim of the basin. However, not a great deal of development took place until after the conclusion of the first World War, when the advent of the valve dithered the diaphragm of the ear-piece sufficiently to warrant its being attached to some form of trumpet. An idea which extended beyond the amateur and into the hands of manufacturing concerns, who still further improved matters by increasing the diameter of the diaphragm and mounting the whole outfit on an artistic pedestal or legs.



An early Cone type speaker by S. G. Brown.



An early Horn by the B.T.H. Company. Note the gauze to prevent dust getting into the movement.

Somewhat fierce competition began to arise at this time and the search for efficiency got well under way. Efficiency at that time had nothing whatever to do with fidelity of reproduction, but was more intimately concerned with the total amount of noise a loudspeaker could produce.

I well remember a loudspeaker manufacturer, who later became world famous, bringing one of his prototypes to my radio den with a request that it should be tested against another well-known make. The test consisted of putting the two loudspeakers side by side at the open window and walking down the road in order to see which could be heard at the farthest distance. Memory seems to recall that the prototype beat the other by about five yards.

It was, however, much easier effectively to design the outward appearance of the loudspeaker than to increase its musical or electrical efficiency, with the result that some of those earlier speakers were really attractive and later caused considerable trouble with the feminine members of one's family, as a moving-coil loudspeaker and baffle was considered quite unsuitable in the drawing-room, appearing like an up-ended version of an article of domestic utility which I forbear to mention by name.

It is extremely difficult after this space of time to be chronologically accurate, but memory seems to tell me that really wealthy enthusiasts acquired a horn type loudspeaker with a battery-excited field. I seem to recall that this instrument originally came from the United States. It did, at any rate, produce a distinctly nasal twang to even the beautiful pronunciation of the BBC announcers of that period. Shortly after this a loudspeaker arrived from France. This consisted of a very artistically pleated paper diaphragm driven by a neat little magnetic unit. It was, however, somewhat fragile and, although much loved by the ladies, was not too greatly appreciated by the amateur radio engineer, being in appearance much more suitable for a boudoir than the amateur's radio den.

Cone Design

Quite a number of what were known at the time as "cone" loudspeakers then made their appearance on the market. These invariably consisted of a strong paper cone driven by a stylus from a balanced armature magnetic unit. Careful choice of material and choice also of the initial frequency of some of the component parts enabled these speakers to produce a certain amount of bass and this type of speaker was considerably used by the BBC for monitoring purposes.

There was a theory prevalent at the time that the larger the cone the better the bass reproduction, and in a determination to reproduce lower notes than my fellow enthusiasts I managed to acquire one no less than 6ft. in diameter. The trouble with this loudspeaker was that it had to be hung from the ceiling, and it was apt to cause a little disturbance to the normal passage of the occupants of the room in which it was used.

Unfortunately for me, having mortgaged at least a year of my radio hobby funds, the moving-coil speaker made its appearance at about the same time. But before bringing matters quite so up to date I must relate that a certain well-known manufacturer who produced quantities of these H armature cone speakers used them in a most ingenious way for a public address system, which was in very considerable demand. I cannot recall the exact number, but I think twenty-four of these cone speakers were mounted on a large baffle measuring some 6ft. square or more and a number of these baffles complete with speakers were erected by slinging them between large poles.

The procedure in the case of an air display or some other outdoor occasion requiring a public address system was for the van to arrive 24 hours or so before the event and the first evening would then be spent digging holes and erecting the required number of poles. On the day of the event the baffles were then hoisted between pairs of poles. It was, however, essential to ensure that all the speakers were in phase, and on one occasion when they had been wrongly connected the P.A. engineer decided to rectify matters by resting a ladder against one of the poles and mounting it in order to cross over the connections. Unfortunately the ground was soft and the supporting poles quite slowly leant over from a vertical to horizontal position.

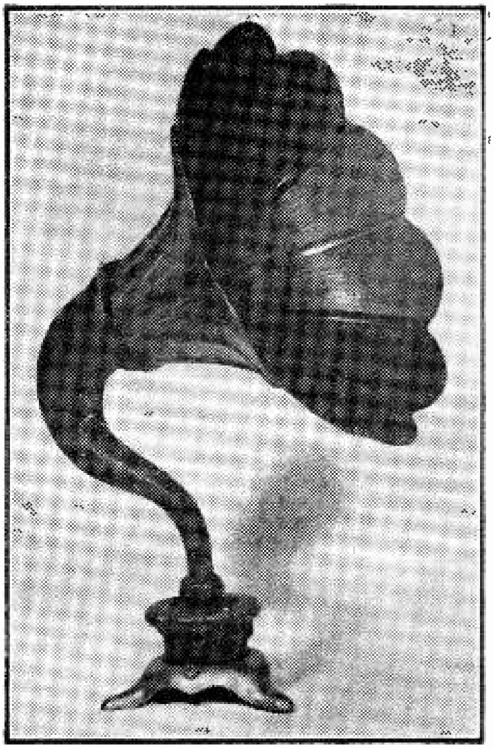
The leap for life which the engineer gave from the top of the ladder over a baffle of 20 loudspeakers had to be seen to be believed. Whether this was the cause or not I do not know, but very shortly afterwards he changed his job to the sales staff of the company concerned, and in fact is still operating on their staff and will no doubt be recognised by many of the readers of this article.

You, who to-day buy a moving-coil loudspeaker and mount it in a cabinet, have no idea of the trials and tribulations which beset those of us who tried to do the same with the earlier version of this type of speaker. Our amplifiers were by no means Hi Fi, nor were the speakers by any means free from resonant peaks. Rattles and dithers in the treble were a considerable difficulty, with the result that it was quite common practice to use top filters which made the music "mellow" but the speech almost unintelligible.

Mechanical Design

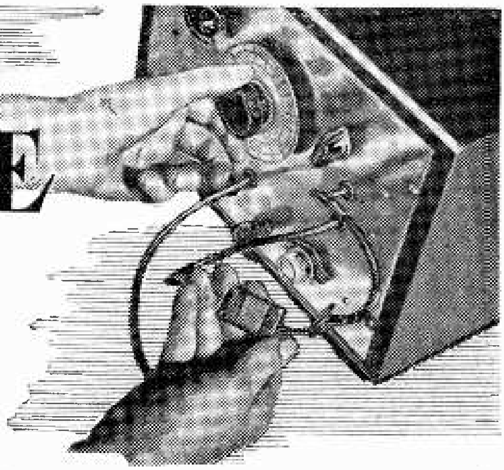
Mechanically the construction of the speakers could not keep pace with the number of watts which became available through the good offices of the valve manufacturer, and it was not uncommon for enthusiastic demonstrators to finish up with the cone hanging loose in the frame and the speech-coil parted from it lying somewhere up the magnet tunnel. The search for efficiency as determined by the ratio of noise output to watts input still became something of a fetish and once again I was called upon to take part in an "efficiency" test; only on this occasion the manufacturer's moving-coil loudspeaker was placed alongside a competitor's on the roof of his factory, and instead of walking down the road as on the earlier occasion this time we went for a ride in the manufacturer's car. The test concluded at a distance of half a mile from the factory. I might mention that the amplifier which fed the speaker was quoted as being one of 50 watts output.

I have no intention of bringing this article more up to date by discussing the various designs of speakers that have been produced within the last decade. It only remains to be said that the truly scientific and engineering approach which has been made to the problem has resulted in loudspeakers at a most ridiculously low price and capable, properly used, of giving H-Fi results which make it difficult to believe that much improvement is possible.



This Amplion had a wooden flare fitted to the cast throat and gave very good tonal balance for its period.

A NOVEL C/R BRIDGE



CHECK YOUR CONDENSERS AND RESISTORS WITH THIS NOVEL TEST INSTRUMENT

By F. W. Austin

ALTHOUGH the popular conception of a resistance/capacity bridge makes use of a "magic-eye" tuning indicator for indication of balance, the author felt the need for an instrument giving a more positive and definite indication.

To qualify this remark, if a small neon tube is employed as an indicator and reaches the point of extinction at the balance setting of the instrument, this indication is obviously more discernible to the average eye than the minute reduction in "shadow-angle" afforded by the cathode-ray tuning indicator. Moreover, the "region of doubt" of the latter is reduced so as to lie between the point of extinction of the neon at one side of balance and the "strike" of the neon as the ratio arms come out of balance on the other side.

Some people are more fortunate than others in this optical respect, but all can be certain between light and darkness; this arrangement is as simple as that and is suitable justification for its existence. The neon is also cheap and, in the arrangement employed, indestructible.

Features

Certain features are worthy of mention. The neon serves as a normal instrument panel warning indicator when actual measurement is not being undertaken. It is also used as a rough guide to condenser insulation at the plus and minus terminals when the bridge/insulation switch is operated and also discharges the capacitor when the switch is returned to the bridge position. It will be noted that no potential exists across these leads in the bridge position and the switch should not be turned to insulation until the condenser has been connected. (See circuit diagram below.)

In order to simplify switching and comprehension

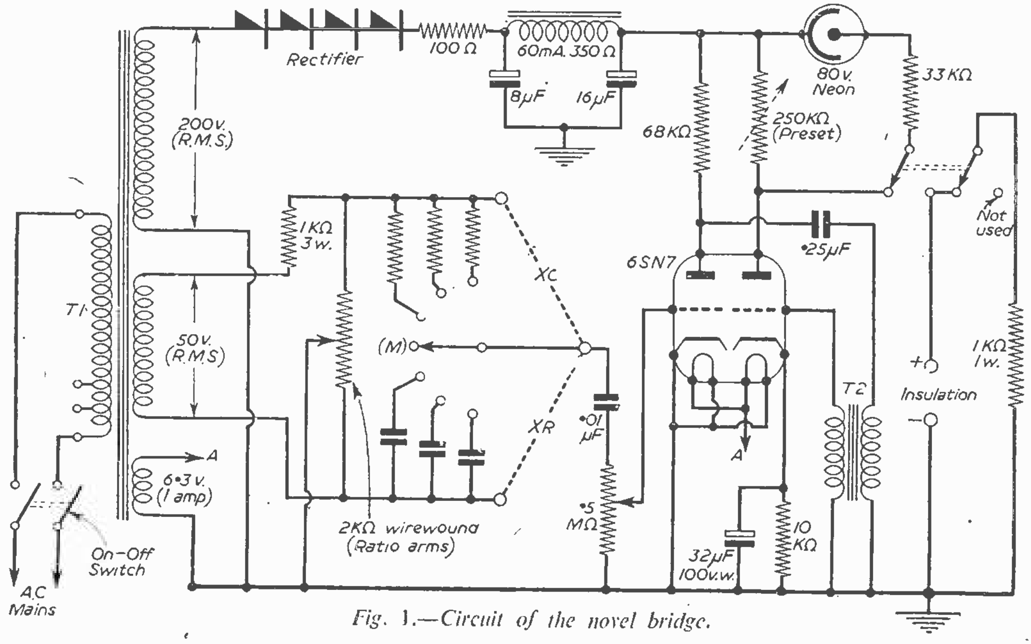
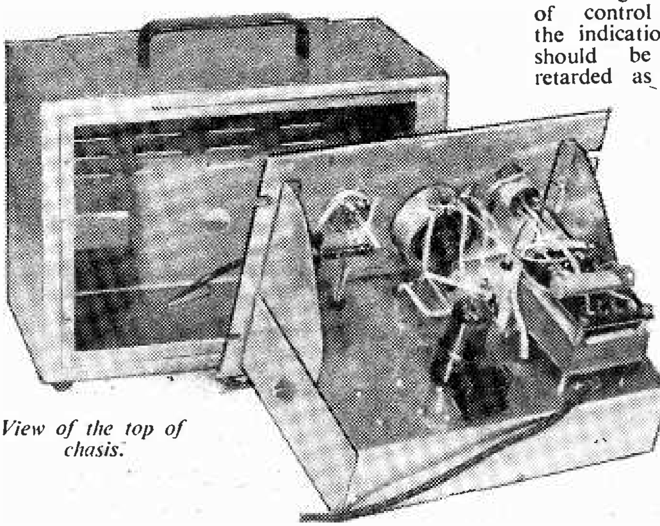


Fig. 1.—Circuit of the novel bridge.

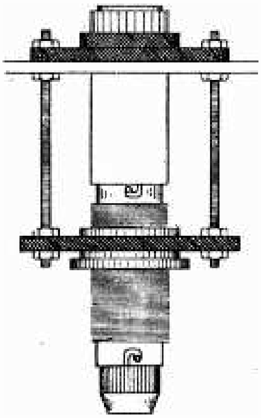
there are three test terminals set in pyramid formation. Resistor standards are taken to one end of the ratio arms and the condenser standards to the other end. The range switch is wired from smallest to largest condenser standard and the next position of the switch is left vacant (and vertical in relation to panel) for " match " position. Resistors in similar formation follow the vacant position. This enables us to use a single dial calibration for both condensers and resistors.

With the switch turned to the left of centre position, condensers are measured between the left-hand terminal and " apex " of pyramid, the other terminal being ignored. With the switch central any two condensers or resistors are matched by taking both



View of the top of chasis.

to the apex and connecting the free ends to the feet of the pyramid (one either side). In the case of *external standards* being employed the standard condenser is connected between the " R " terminals (see Fig. 2). A standard resistor, on the other hand, is connected between the " C " terminals ; the balance point on the dial then gives the ratio of the unknown " C " or " R " with respect to the standards used.



Sensitivity

It is only fair to state that the indication given on the 100 pF range is not so precise as that obtaining on other ranges, although it is

Fig. 4.—Details of the neon holder.

possible reasonably to determine stray capacities. This balance point has a slight " spread ", and when calculating small capacities it is advisable to take the centre reading of the spread and to subtract this quantity from the point of balance with the condenser under test connected to the bridge. The answer should approximate the value of the condenser. The sensitivity control has a large measure of control over the indication and should be kept retarded as much

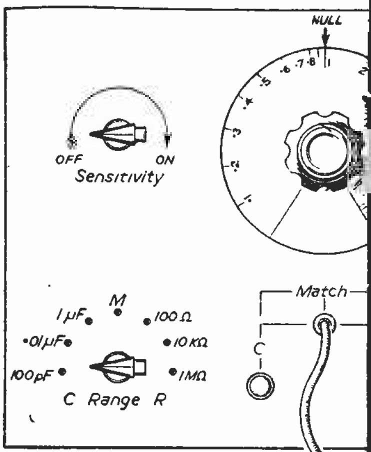


Fig. 2.—Panel lay

as possible consistent with sharp response from the neon. On some ranges the neon may not become extinguished unless this is done, owing to the larger signal available.

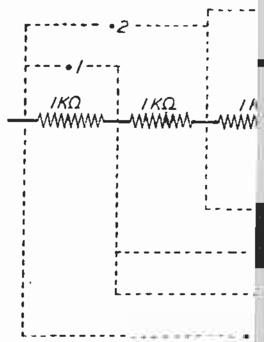


Fig. 3.—Alternative met
using resistors

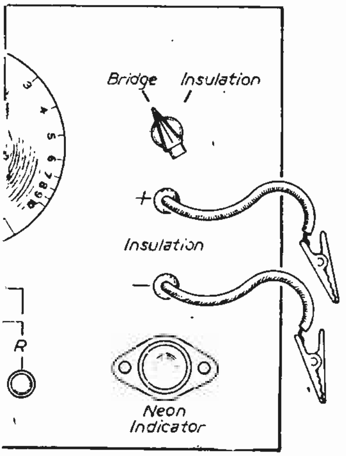
Construction

A layout of the components as used in the original model is given in Fig. 5. It will be noticed that a screened lead is

LIST OF C

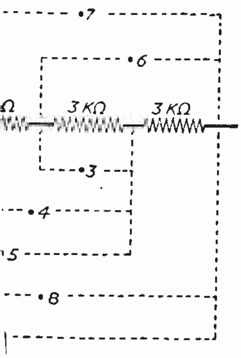
1 mains transformer—secondaries : 200 v. (r.m.s.) 50 mA, 50 v. (r.m.s.) 50 mA, 6.3 v. (1 amp.) : T1.
1 smoothing choke—350 ohms 60 mA.
1 Bulgin push-pull intervalve transformer ratio 1 : 4, List No. L.F.36 : T2.
1 valve 6NS7. 1 octal valveholder. 1 metal rectifier 60 mA.
1 electrolytic condenser 8-16 μF (350 v.w.).
1 w/w potentiometer 2 k ohms (ratio arms).
1 volume control with double-pole switch (half-megohm).
1 condenser .01 μF (350 v.w.). 1 condenser .25 μF (350 v.w.).
1 electrolytic condenser 32 μF (100 v.w.).
1 switch—1 pole 7-way. 1 switch—2 pole 2-way.

taken from the sensitivity control to the first grid of the 6SN7 valve. This is to guard against stray " pick-up " in the lead (in view of its length) and to ensure adequate operation of this control.



...ut details.

The parallel-fed transformer (T2) between the first anode and second grid of the 6SN7 was a surplus push-pull input component having high D.C. resistance windings, but a *high ratio* of secondary to primary turns is more important. The centre tap of the secondary winding is not used, the two outers going to grid and chassis respectively. Using a transformer of the constructor's own choice may necessitate adjustment of the anode resistor in the first section of the valve in order to obtain maximum voltage gain across the secondary winding. In the components list a fixed value is given and a commercial type transformer quoted which has been found suitable without modifications (Bulgin push-pull intervalve transformer ratio 1 : 4, List No. L.F.36). Some readers may be slightly puzzled about this, but the reasons are that we need amplification at *only one frequency* (50 c.p.s.) and not normal audio practice. Response on the smallest ranges is affected to quite an extent by this section, therefore " peak " must be the aim.



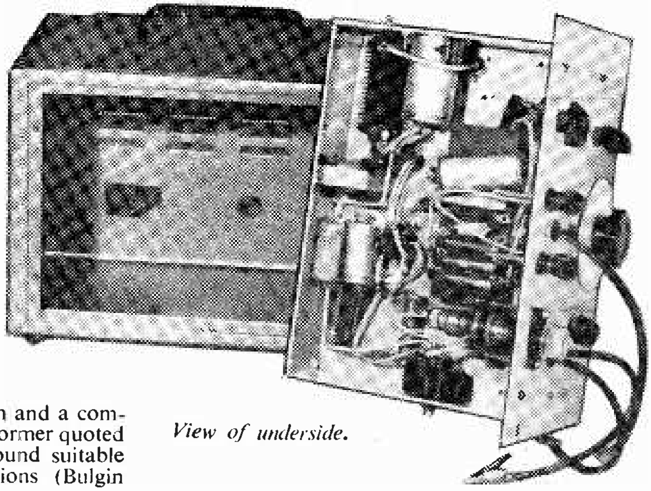
...d for calibrating scale (see text).

.1=182/1818	10=1818/182
.2=332/1668	9=1800/200
.3=460/1540	8=1776/224
.4=570/1430	7=1750/250
.5=666/1334	6=1715/285
.6=750/1250	5=1668/332
.7=824/1176	4=1600/400
.8=888/1112	3=1500/500
.9=946/1054	2=1334/666

Unity : 1=1000/1000

Internal Standards

These were removed from a partly assembled surplus bridge chassis and were 5 per cent. components of 100 pF, .01 μF, 1 μF, 100 ohms, 10 k, 1 megohm.



View of underside.

The 1 μF standard was of the waxed paper variety and was found to be leaking. A metal-clad hermetically-sealed component was substituted for this range. The scale was simply marked in tenths to unity and upwards to " ten times " the standard, giving range continuously from about 10 pF to 10 μF and 10 ohms to 10 megohms. These can be extended upwards if desired.

Calibration

It is possible to calibrate the scale by simple resistance measurement of the ratio arms, and if a good meter is at hand this is a cheap (and accurate) means to adopt. It is not possible to give a printed template of the scale as potentiometers vary a great deal in their arc of travel and the only point of accuracy would be at unity. In the table given, the

MPONENTS

1 resistor 68 k ohms (1 watt). 1 resistor 10 k ohms (1 watt). 1 resistor 33 k ohms (1 watt). 1 resistor 1 k ohms (1 watt). 1 resistor 1 k ohms (3 watt). 1 resistor 100 ohms (¼ watt).
1 variable potentiometer 250 k ohms. 2 insulated terminals.
1 neon 80 volts (surplus 10 E/6) with holder.
1 chassis 10in. x 6½in. x 2½in. 2 chassis angle brackets 3½in.
Panel and case (to suit individual), crocodile clips, heavy rubber-covered test lead, tag strips, screws, etc.
Internal standards (all 5 per cent. components) : 100 pF, .01 μF, 1 μF, 100 ohms, 10 k ohms, 1 megohm. (Condensers 450 v.w. if possible.)

figures from left to right indicate the ratio *in ohms*. The *total* figures, both left and right, equal the resistance of the potentiometer.

These figures must not be taken too literally but are given to show the relationship between the arms. An alternative method, for use with the bridge under operating conditions, is given in Fig. 3. Six close tolerance resistors are necessary, five being shown in the illustration. If the bridge is set to the 10k ohm range the chain of resistors will give balance points at the settings shown by the dotted lines. When the .9 calibration mark has been reached the sixth resistor (a 1k component) is used as an external standard between the "C" terminals and the switch turned to "match" position. The resistor chain then provides remaining markings from 1 to 9. For the "ten times" position the 1k resistor is removed from the "C" terminals and inserted in the "R" terminals. The switch is set to the 100 ohm range when the balance point will be found.

Neon Adjuster

It has been left until now to explain this control (pre-set 250k potentiometer) as it is of no moment until the instrument has been constructed and actual operating begun. This control will be found at the side of the chassis labelled "neon adjuster." The instrument should be switched on and the range switch set to 100 pF range. When warmed up turn the control in whichever direction may be necessary to extinguish the neon. The balance arms are then swung back and forth (with sensitivity at maximum) adjusting this side control so that the neon just extinguishes itself within a very small compass. This is the stray capacity of the instrument and all control necessary after this initial setting up should be within the scope of the sensitivity control on the front panel.

Bridge/Insulation Switch

It is felt desirable to advise the constructor that when purchasing the two-pole, two-way switch this should be of such type as will definitely break contact before making contact in the secondary position. No harm is likely even if this is not the case, but the neon will flash at each changeover of the switch. The isolating type will prevent this minor annoyance.

The Neon Holder

As the neon holder is of the single-pole bayonet cap variety it is important that the outer conducting rim be adequately insulated from the chassis, and Fig. 5 illustrates the method used by the author in the original model. Use was made of a commercial high quality (and high priced) chromium-plated product: this was fitted into a sawn-off ex-government inspection lampholder of plastic material with a screw-on perspex window which came through the front panel to serve as indicator. Since making the original model it has been discovered that the neon quoted in the parts list can be obtained *complete with an insulated holder* from some surplus component dealers.

Earth Connection

Finally, it must be realised that an earth connection is *essential* if hand-capacity effects on the lowest capacity range are to be avoided.

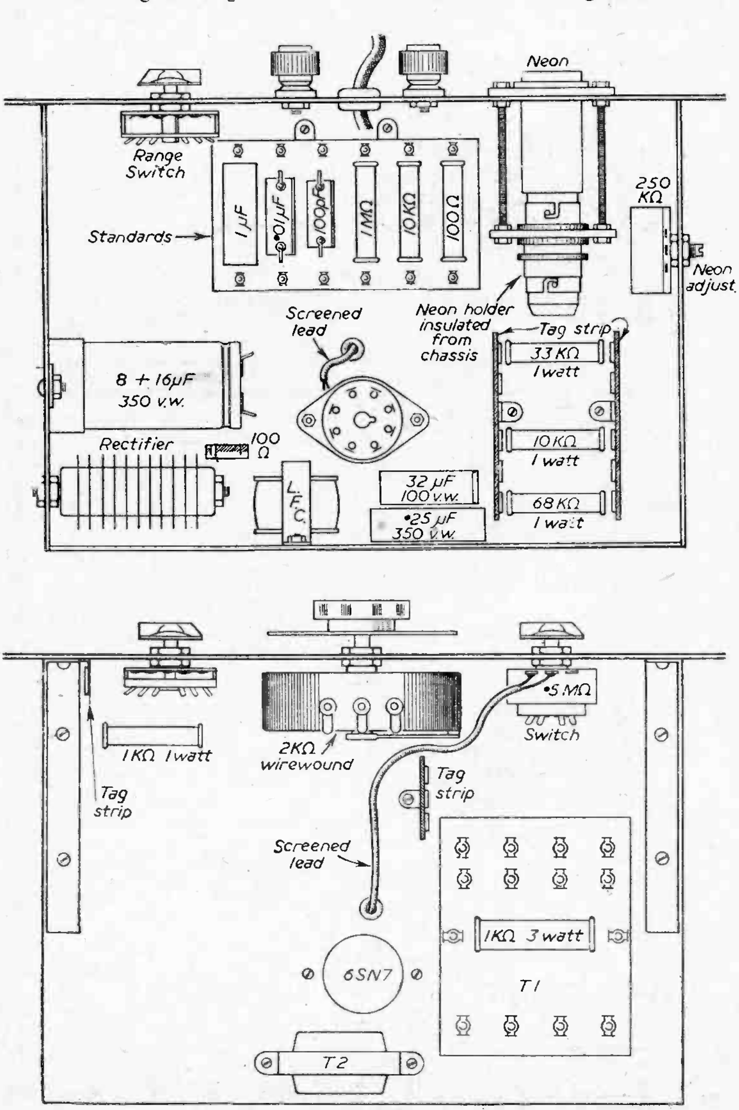


Fig. 5.—Above and below chassis wiring details.

FRAME AERIALS

DETAILS OF A MUCH NEGLECTED TYPE OF SIGNAL PICK-UP

By F. G. Rayer

FRAME aerials have two main applications, one based on their portability and one upon their directional properties. Their use in portable receivers is well known, as no external aerial or earth is required when a frame aerial is provided, so that the set can be operated anywhere at will. With both portables and fixed receivers the strongly directional effects of such aerials can also be of advantage. An example of such use arises with broadly-tuned "local station" receivers, where interference from European or other stations may cause whistles, etc. Such interference is becoming increasingly troublesome. As it is not feasible to increase selectivity with "quality" tuners, some other means of eliminating the undesired station is necessary. A directional frame aerial, set for minimum pick-up from the offending station, is one solution.

A frame aerial consists of a winding of such inductance that it can be used as the first tuned circuit, replacing the aerial tuning coil otherwise present. When the *axis* of the winding is directed at a station a similar signal is induced in all sections of the frame, and the signal output from the frame is theoretically zero. (In practice an ordinary frame aerial will not have an absolute zero position, due to stray pick-up in connections, etc.) When the frame is turned so that its side faces the station, a phase difference arises in opposite sides of the frame, giving maximum output. In use, therefore, the frame is turned so that one side faces a desired station, or so that its axis points to an undesired, interfering station.

For ordinary listening purposes there is no need to rotate the frame for each station, since pick-up is good in all directions other than those in line with its axis. However, it may be adjusted for maximum volume from a weak station, if necessary. Similarly, it may be adjusted for minimum signal from an interfering station, when required, and pick-up from such a transmitter may be very small indeed, with a flat frame having screened leads.

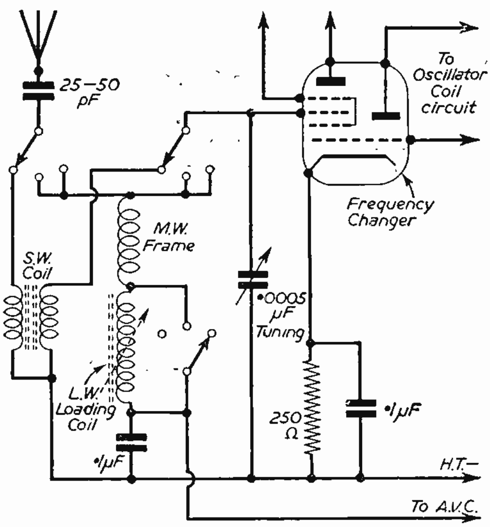


Fig. 2.—Typical all-wave circuit.

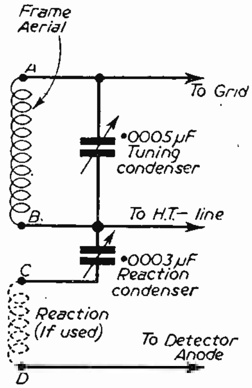


Fig. 1.—Connections for a M.W. frame aerial.

Other things being equal the larger the perimeter of the frame the greater its output, and this should be remembered when the receiver is of rather low sensitivity. Signal strength is also improved by keeping the frame windings away from any conductive or screening parts—chassis, batteries, loudspeaker, etc. Because of this, a free-standing aerial, gives maximum results. Almost equal in efficiency is the type of winding in the lid of suitcase portables, since this is well clear of batteries and metal parts. Aerials wound round the receiver case give slightly reduced signal strength, especially when near chassis or other metal parts.

In addition to the foregoing, it should be remembered that the frame winding should be situated vertically, or nearly so. Frame aerials cannot be used with crystal sets.

Medium-wave Frame Aerial

The circuit of this is shown in Fig. 1, and it consists of a single winding tuned by .0005 μF condenser. This winding replaces the M.W. aerial coil. With the R.F.-Detector type of set, the M.W. frame will tune with a M.W. coil in the detector stage. With a superhet without R.F. stage, frame aerial and oscillator coil will be used. In each case accurate ganging will be required. This can be achieved by employing a ready-made frame, such as supplied by various coil manufacturers, or by using an oscillator coil with adjustable dust core, and setting this to suit the inductance of the frame winding. Or a panel trimmer of about 100 pF may be used in parallel with the frame winding, to secure correct ganging at all points of the tuning scale. Alternatively, two separate condensers may be used for tuning, instead of a two-gang condenser. This introduces a further control, but avoids at once all ganging difficulties.

If the receiver is a "straight" type with no R.F. stage, no tuning coil at all will be used, and reaction will be added as shown. It is also possible to join points B and C, and wire the reaction condenser between D and the detector anode, though the condenser spindle and moving plates cannot now be "earthed" to the H.T.— line.

All-wave Operation

Both M.W. and L.W. tuning is often required, and may be obtained by having a long-wave loading coil in series with a frame wound for M.W. only, as in Fig. 2. Such coils may be purchased, and have adjustable cores so that the circuit can be ganged with detector or oscillator tuned circuits. To do this, the M.W. detector or oscillator coil should first be adjusted, by modifying its core position, until it gangs correctly with the frame, on the M.W. band. The set is then switched to L.W. and loading coil and detector or oscillator L.W. coil adjusted.

This type of circuit avoids the necessity for winding a L.W. section on the frame, but gives slightly reduced signal strength, on the L.W. band, compared with a frame wound for both M.W. and L.W. tuning. It is, however, the method used in most commercial portables of small type.

Where S.W. reception is required, any attempts to use a frame aerial will give poor results, and provision is usually made for attaching an external aerial, as shown in Fig. 2. With the popular M.W. and L.W. type of portable, the S.W. coil, 25-50 pF condenser and associated switching would be omitted.

The actual aerial may be made up in various forms, and Fig. 3 illustrates a simple box-type of aerial. This may be quite narrow, so that it can be accommodated in a shallow suitcase type lid, or it may be some inches wide, being inside the receiver cabinet. Connections are marked to agree with Fig. 1.

The number of turns required to tune the M.W. band will depend on the gauge of wire, spacing, and perimeter of frame. For fairly large frames, about 70ft. to 75ft. of wire will be required. The number of turns will be found by dividing the frame perimeter in feet into this. A slight space should be left between turns.

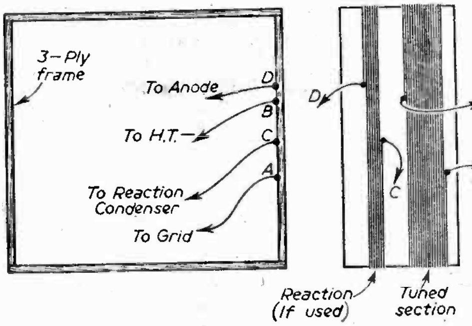


Fig. 3.—A medium-wave frame aerial.

As spacing and perimeter are reduced, less than 70ft. of wire will be required. Suggested M.W. tuned sections, for various frames, are as follows:

Frame size	*Wire gauge*	*No. of turns*
18in. x 18in.	24 d.c.c.	10 side by side
9in. x 9in.	26 s.w.g. enam.	18 side by side
6in. x 6½in.	32 s.w.g. enam.	23 side by side
5½in. x 6in.	26 s.w.g. enam.	25 side by side

Frames much smaller than 6in. square are best avoided as signal pick-up becomes relatively poor. To match up with existing coils, with ganged tuning, turns may be added to increase inductance, or removed to reduce it.

When reaction is used a space of about ¼in. should be left, and the winding put on, as shown in Fig. 3. About one-third the number of turns used on the tuned section will be satisfactory. As the reaction obtained will depend to some extent on the detector valve and H.T. voltage, a few turns may be removed if oscillation is too violent. But about one-third the number of turns on the tuned section will be satisfactory for all-dry type valves with 45 volts to 60 volts H.T. supply.

With a dual-wave frame, the M.W. section is put on as described, and a L.W. section added as in Fig. 4. For large frames, about 200ft. of wire will be required, somewhat reduced as the size of the frame falls. For the frame sizes already mentioned, suitable L.W. sections will be:

Wire gauge	*No. of turns*
32 s.w.g. enam.	32 side by side
34 s.w.g. enam.	52 side by side
34 s.w.g. enam.	60 turns pile wound
34 s.w.g. enam.	75 side by side

The L.W. section must be in the same direction as the M.W. section, as shown in Fig. 4. If reaction is used, the reaction winding must be very near the L.W. section, or reaction will be weak on the L.W. band. If required this can be overcome by using a few more turns on the reaction winding, and keeping it ½in. or so from the M.W. winding.

For M.W. reception the L.W. section is shorted out, as shown in Fig. 2. The wavechange switch is thus returned to point B in Fig. 4, which will go to H.T. − line or A.V.C. circuit, according to the type of receiver.

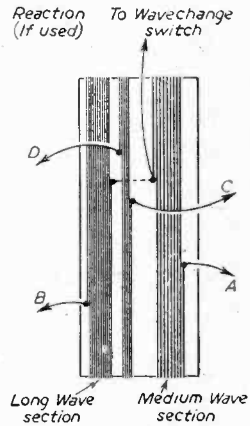


Fig. 4.—Disposition of windings on a dual-wave frame.

It may be necessary to choose the aerial winding to suit the winding width available, as well as the perimeter. The 18in. x 18in. aerial described would require about ¾in. winding width. The 9in. square aerial would require 2in. width, the 6in. x 6½in. aerial ⅝in. only, and the smallest perimeter aerial given approximately 2in. This is for dual-wave type with reaction. When reaction is not used at least ¼in. should be left between M.W. and L.W. sections, when practicable.

Other Forms

When space is limited a flat aerial such as shown in Fig. 5 can be used successfully, wound upon stout card or thin paxolin. This type requires very little width and may be fitted at the back of a cabinet or chassis. For a frame about 10in. by 5in. 21 turns

(*Concluded on page 66*)

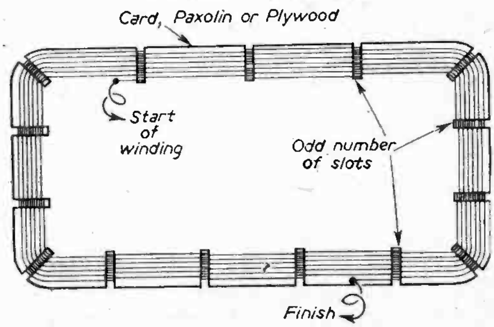
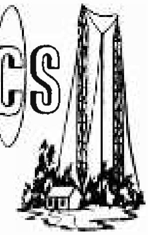


Fig. 5.—Details of a flat frame.

TRANSMITTING TOPICS



DESIGNING THE POWER PACK

By O. J. Russell, B.Sc.(Hons.), G3BHJ

IN the case of the choke input circuit we determine the ripple across a condenser connected to the output of the choke (Fig. 7). This means that we must multiply the effective choke inductance in henries by the value of the following condenser in microfarads and use this figure to determine the ripple from Fig. 7. If a swinging choke is used, clearly the lowest value of choke inductance (i.e., 5 henries) must be used to give the value of ripple at full load output.

It will be seen that the output ripple may be quite low at low output currents. However, for practical high-power outputs, the ripple must be reduced in both the choke input and the condenser input circuits. A filter circuit must be used as shown in Fig. 8. The addition of this filter to the condenser input circuit gives the familiar "power pack" circuit of Fig. 9. The result of adding a filter to the choke input circuit gives the less familiar circuit of Fig. 10. The ripple reduction possible with a single filter is shown in Fig. 11. Thus, once the rectified output ripple is determined from Fig. 6 or Fig. 7, according to the type of circuit used, the ripple reduction factor needed is chosen to reduce this to a given value. Thus, if we start with 10 per cent. ripple, and need a final ripple of 0.2 per cent., we need a ripple reduction factor of 50. The curve of Fig. 11 shows that the product of filter choke inductance multiplied by filter capacitance must be 90 to give the ripple reduction factor of .02 (i.e., one-fiftieth). Thus, a 9 μF condenser and a 10 henry choke might be used. Practically, a standard value of condenser such as 8 μF would be chosen, and this with a 12 henry choke would actually give a little greater smoothing action.

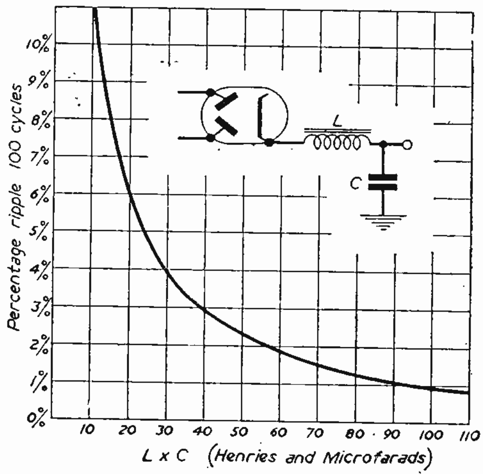
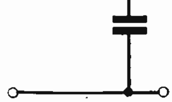


Fig. 7.—Ripple output of a choke input circuit across the following condenser. The product of L and C determines the ripple percentage.

It will be noted that if a great reduction of ripple is needed two cascaded filter stages (Fig. 12) may be used. Thus two cascaded stages giving each a ripple reduction of ·20 (i.e., a factor of .05) will together give a factor of .0025—a reduction of 400 times. Actually the use of two cascaded stages is a very economical means of achieving a high degree of smoothing. Thus, a single stage to give a reduction of 100 times in ripple needs a value of L.C.=180. So that approximately an 8 μF condenser and a 25 henry choke might be used. For heavy currents the choke would be quite expensive. Two cascaded stages of ripple factor 0.1, need each an L.C. of 20. Thus two 5 henry chokes and two 4 μF condensers would suffice to make a cascaded two section filter giving an overall reduction of 0.01 or 100 times. Two 5 henry chokes would be appreciably cheaper than one 25 henry choke, while two 4 μF. condensers cost about the same as one 8 μF condenser. It will also appear with a little use of Fig. 11 that when hum is appreciable, and a further reduction is needed, stepping up the filter condenser in value is an expensive way of effecting hum reduction. It will be found very much more effective to use an additional small filter with a small choke and condenser to effect a large hum reduction. This applies forcibly to high voltage packs, where cheap electrolytics cannot be used. In any case one hesitates to use electrolytics in the TX pack for fear of the disastrous results of breakdown—even although 900 volt (but *not* cheap!) electrolytics are now available.

Voltage Rating

This brings us to the voltage rating of the condensers. In the condenser input pack the output voltage at "no load" may soar to the A.C. peak value. Thus the *minimum* working voltage must be for safety at least 1.5 times the transformer voltage. Thus a pack using a



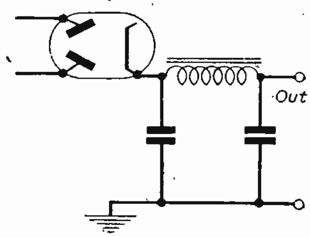


Fig. 8 (left).—A filter stage used to reduce hum. It follows the input circuit. Fig. 9 (right).—Adding a filter section to the condenser input circuit gives the familiar "power pack" circuit as used in many small power supplies.

600-0-600 transformer needs condensers of 900 volt working—or, say, 1,000 volt working for a good safety margin. In the case of the choke input circuit, provided the calculated bleeder resistance is used, the working voltage may be the nominal transformer voltage., i.e., for the above case 600 volts working. Thus it will now be apparent that the choke input circuit, if correctly used, has many advantages over the condenser input circuit. Incidentally, while a bleeder resistance is an integral part of the design of the choke input circuit it should also be used on *any* power pack. The bleeder resistance by discharging the condensers when the pack is switched off, acts as a very useful safety measure, as the filter condensers may hold enough charge to do serious damage—to equipment or operator. Good condensers may hold a charge for days, so that a serious shock might be received long after the pack has been switched off. The provision of a bleeder resistor obviates this difficulty.

There is one other trifling precaution to be noted in selecting filter components for a power pack design. It is advisable to select values of choke and condenser which do not resonate at ripple frequency. If resonance at ripple frequency occurs hum may be vastly exaggerated, or dangerous ripple voltages and currents may build up in the resonating components. The value of L.C. (where L is in henries and C is in microfarads) at which resonance occurs for 100 cycle ripple (as is obtained from a full wave rectifier on 50 cycle A.C. mains) is given by L.C.=2.53. This value, or values near it, should be avoided. It is, of course, a very low value of filter components, which, however, might be accidentally approached—say, by using a surplus 2.5 henry choke plus a 1 μF. condenser to add a little extra filtering. However, examination of Fig. 11 shows that these values would give only a very little reduction of ripple. The value is not shown on Fig. 11, but it does indicate it would be small—say, only cutting hum by a half. Due to the resonance effect, however, such values would probably increase hum! Here, again, then the danger of "hit and miss" methods is illustrated. The precise design to the last decimal dot is, of course, unnecessary, and the curves and data given have been intended to reduce the labour of designing a reasonable power supply of low ripple content to the minimum. If the material results in an overhaul of existing power packs it will also have been useful!

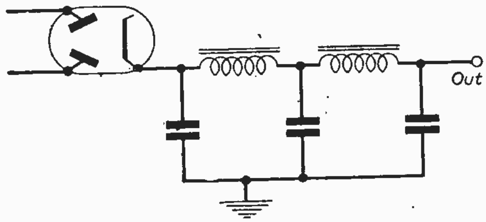


Fig. 12.—A condenser input circuit, followed by two cascaded filters for very great reduction of hum level.

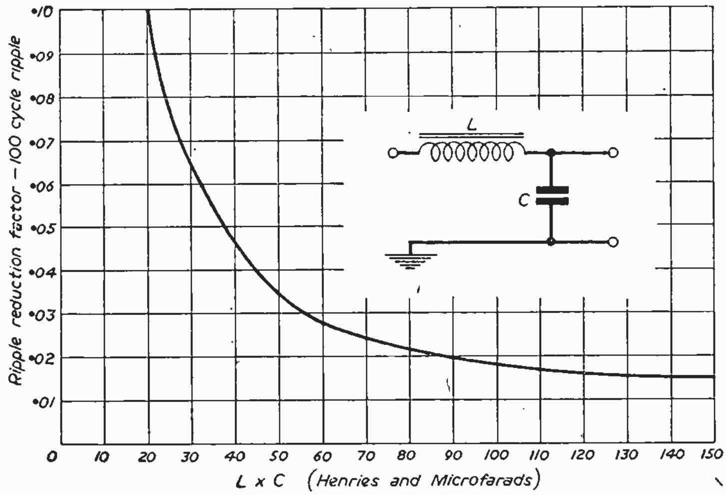


Fig. 11.—Ripple reduction factors for an LC filter stage.

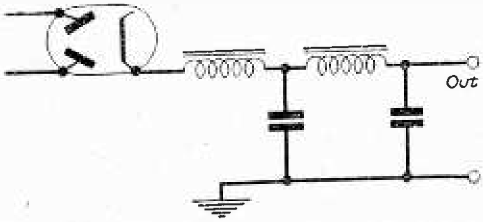


Fig. 10.—A choke input circuit followed by a filter stage gives a complete choke input power pack circuit for practical use.

Books Received

WIRELESS WORLD DIARY, 1956. Published October 7th, 1955, by Iliffe and Sons Ltd. Size 4½in. x 3¼in. 79 pages of reference material—plus the usual diary pages of a week to an opening: Leather 5s. 10d. (inc. 10d. P.T.); Rexine 4s. 1d. (inc. 7d. P.T.). Postage 2d.

ELECTRICAL ENGINEERING RADIO & TELEVISION DIARY, 1956. 92 pages technical information, including radio and television, road map section. 5s. 6d. leather; 4s. 3d. leather cloth, including postage. Published by H. O. Quinn, Ltd., 151, Fleet Street, E.C.4.

QUESTIONS AND ANSWERS ON RADIO AND TELEVISION. By E. Molloy. 148 pp. Illustrated. Published by Geo. Newnes, Ltd. Price 6s.

RADIO SERVICING POCKET BOOK. By E. Molloy and J. P. Hawker. 212 pp. With 188 tables and illustrations. Published by Geo. Newnes, Ltd. Price 10s. 6d.

Voltage Stability in Power Units

MAINTAINING CONSTANT OUTPUT IRRESPECTIVE OF THE CURRENT LOAD

By J. McCartney

ONE of the most deplorable faults in home-constructed power packs is the rapid fall-off of voltage as current is increased. This is due, as most people know, to the action of the reservoir condenser ; a surprising number of people are, however, ignorant of the basic principles which govern this action.

The reservoir condenser is connected directly to the cathode of the rectifier, and is, therefore, fed with fluctuating D.C. On an open circuit the voltage across the condenser rises immediately to the peak value, and stays there. If now, however, a resistive load is connected across the condenser, after one of the D.C. peaks has passed, it will start to discharge in the usual manner. It will, during this discharge, receive no further charge from the rectifier until the voltage from it becomes greater than the residual voltage on the condenser. When this happens the rectifier will pass a high charging current to the condenser until the rectifier voltage falls again. This state of affairs is illustrated in Fig. 1.

It can be seen, then, that as the current becomes greater in the load, the discharge rate of the condenser increases and the mean voltage level on it falls. A partial remedy for this trouble is, of course, to use a larger reservoir condenser ; but the greater the size of this component the shorter the time available in which to charge it, so the current supplied by the rectifier, instead of being a series of long, weak pulses, becomes a series of short, powerful pulses. Although the actual quantity of electricity passed is no greater, the R.M.S. value, which is the effective value of it for producing heat or other form of energy, rises considerably, and if too large a reservoir condenser is used the heat dissipated in the transformer and the rectifier becomes excessive and damages these components. (The maximum size of the reservoir condenser permissible is generally given with rectifier data in valve books.) The reservoir condenser should, however, be made as large as practically possible. The actual voltage obtainable from the conventional smoothing circuit may be calculated from the formula :—

$$V = Ep/\left(1 + \frac{1}{2RfC}\right)$$

where V is the voltage obtainable, Ep is the peak applied voltage, R is the load resistance in ohms, f is the rectified pulse frequency, and C is the reservoir capacitance in farads. This equation is not strictly accurate for small condensers, as the charging time is not allowed for, but it is sufficient for most purposes.

However large our R.C. factor is, however, the supply is still inherently unstable (a voltage drop of 20 per cent. on full load is considered good) and needs some further apparatus to stabilise it more efficiently. It is found that certain types of gas discharge tube—the gas is usually neon—possess the fundamental property of keeping a constant voltage across them when lit, to within plus or minus a volt or two. These are useful for many purposes which do not require an absolutely accurate stabilisation, e.g., they are often used in V.F.O's. As the circuitry involved is simple, and the cost is fairly low, they have gained much popularity. The basic circuit is shown in Fig. 2.

Basic Circuit

The operation of it is simple ; what current the load does not take the stabiliser uses, so that the total current taken remains constant and equal to the current taken by the tube with the load disconnected. Provided that the current taken by the load does not exceed this, and so extinguish the neon, the voltage will be almost constant except for a slight fall-off in voltage of about five volts for an average tube as the current increases to a maximum. This is, of course, much better than the normal arrangement.

The normal neon stabiliser does not take more than about 120 volts ; to obtain higher voltages it is necessary to connect two or more in series. This may be an advantage, however ; it enables one to tap off various voltages from the supply without having to use dropping resistors. There is a tube on the market, the Stabilivolt, designed specifically for this purpose.

The series resistor to the stabiliser is calculated so as to have the tube passing maximum current under no-load conditions (the maximum current will be found in a valve data book) according to the formula :—

$$R = \frac{V_{in.} - V_{stab.}}{I_{max.}}$$

where $V_{in.}$ is the voltage supplied from the smoothing circuit.

For more stable supplies, however, such as are necessary for D.C. amplifiers, neon stabilisers are not really good enough. An electronic stabiliser is then used.

These fall mainly into two divisions ; the series type, where a variable load is put in series with the supply in order to stabilise it, and the parallel type, where the variable load is shunted across the true load to take up any current it does not want, so to speak.

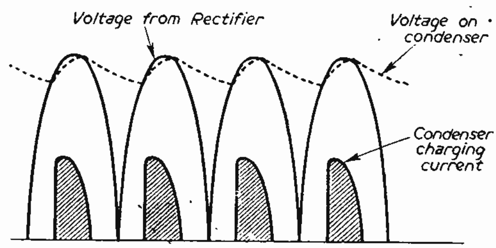


Fig. 1.—Rectifier and condenser charges.

The neon stabiliser is an example of the latter. Parallel stabilisers, unless carefully designed, are inclined to be more unstable than the simple neon, and are invariably difficult to design well, so the home constructor would be well advised to adhere to the series type.

Operation

The operation of it is as follows. An increase in the current taken by the load is followed by a decrease in the voltage across it, as explained previously. This produces a proportional drop in the potential divider R1 R2, which causes a decrease in the current in V1. This causes the grid of V2, which is connected to the anode, to become more positive with respect to its cathode, thereby lowering the resistance of the valve, and causing a greater voltage to be available at the cathode. As the output voltage rises, due to this effect, the grid voltage on V1 also rises, and the valve rapidly returns almost to its previous state. As, however, V2 must now be of a lower resistance, the grid voltage on V1 must still be slightly below its original voltage, and so, therefore, must the output voltage. If V1 is a sufficiently good amplifier, the decrease involved will be negligible. By substituting a D.C. amplifier for this valve, the decrease can be made still smaller if necessary, though this is rarely required. The action of the stabiliser is, of course, exactly the opposite for an increase in load voltage, and is instantaneous, although, for the sake of simplicity, it has been represented as a series of actions in the above description.

The reference voltage must be very stable, and be able to supply the current necessary for V1 at the same time. As the valve in question need only take a very small current, a neon stabiliser connected to the

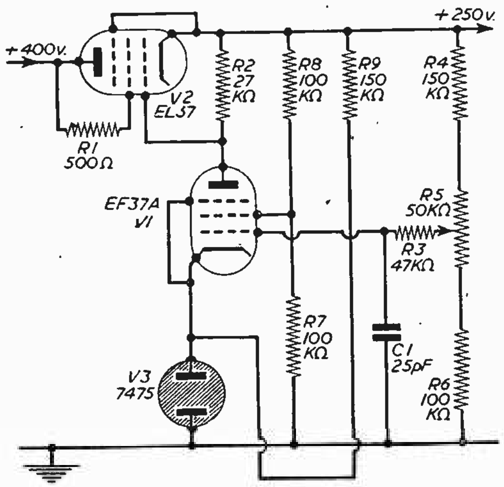


Fig. 4.—Final circuit.

stabilised side of the supply will generally be quite good enough. It should burn at minimum current when the valve is disconnected.

Typical Design

A typical design is shown in Fig. 4. This is arranged to give 250 stabilised volts from a supply of about 400 volts on full load. (It should work satisfactorily for a supply of 350 to 450 volts without alteration.) An EF37A is used for V1, as it has a very high amplification factor and takes little current, and an EL37 is used as V2 as it can easily take as much as 100 mA.

The normal bias on V1 is 3.4 volts, when it takes only .5 mA. This value should be adjusted accurately,

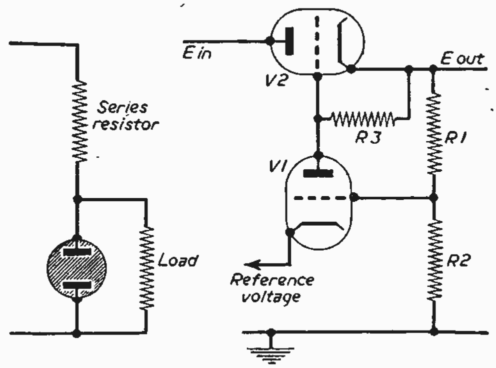
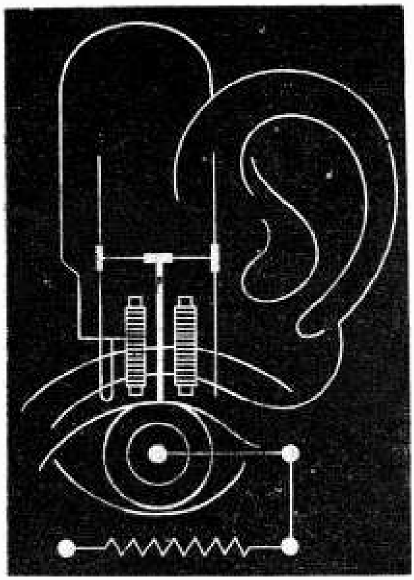


Fig. 2 (left).—Basic circuit, and Fig. 3 (right).—Basis of the new circuit.

by means of R5. The anode load, R2, is 27 kilohms, producing an amplification of about 70 in this valve, and a bias of −13.5 volts on V2 grid. This value should also be checked in setting up. The current taken by V2 should now be about 90 mA with the load connected. It is preferable that a 7475 stabiliser be used, but this may be difficult to obtain, and an ST11 may be used.



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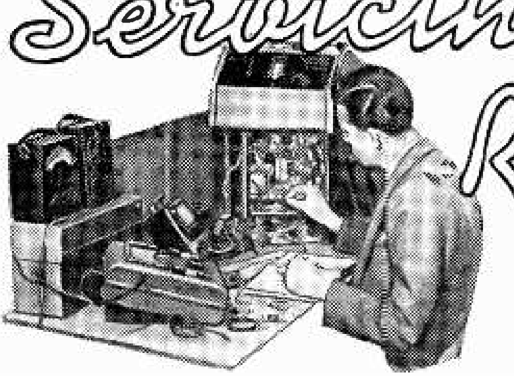

VIDOR PORTABLE CN396

By Gordon J. King, A.M.I.P.R.E.

THE Vidor Model CN396 comes under the category of an A.C. mains and battery suitcase portable. The whole of the receiver, the loudspeaker and the batteries, are housed in the case proper, while the frame aerial is installed within the lid. A unique feature of this model is a warning device which causes a loud buzz to emit from the loudspeaker if the lid is closed while the receiver is switched on.

Batteries

The correct type batteries for this receiver are: L.T. Vidor L5048 7.5 volt all-dry, and H.T. Vidor L5512 90 volt all-dry. It is impossible to connect the batteries the wrong way round, or inadvertently change their positions, owing to the type of sockets used, but extreme care should be taken to prevent the L.T. plug or wire coming into contact with the H.T. battery connections.

The Circuit

Full details of the circuit are shown in Fig. 1. From this it will be seen that the normal valve line-up is used, that is: V1-DK91—working as frequency changer; V2-DF91—as I.F. amplifier; V3-DAF91—as detector, a.v.c. and audio amplifier; V4-DL94—as output, and V5-EZ41—as full-wave H.T. rectifier.

The signals induced into the frame aerials (A1 by itself is for L.W. operation and A1 shunted by A2, by operation of S1, is for M.W. operation) are mixed in V1 with the local oscillator voltage and give rise to an intermediate frequency signal at 456 kc/s across the first I.F. transformer in the anode.

The aerial circuits are tuned by C1 section of the tuning gang and pre-tuned on L.W. by trimmer T1. The oscillator circuits are tuned by C2 section of the tuning gang, and pre-tuned on M.W. by trimmer T2; for L.W. operation the oscillator grid coil is shunted by a 540 pF capacitor through switch S3.

The I.F. signals appear on the control grid of V2 and in amplified form across the second I.F. transformer in the anode. These signals are demodulated by the diode in V3, and the A.F. content is developed across the 1 M. volume control R1. The mean D.C. level of the rectified I.F. signal is also reflected along the a.v.c. line connected to R2; this biases V1 depending on the amplitude of the signal. No a.v.c. bias is applied to V2. R3 and associated 100 pF capacitors form an I.F. filter circuit.

The A.F. signal is thus tapped off R1 and fed through the coupling capacitor C3 to the control grid of V3. This appears in amplified form across R4 and is fed through C4 to the control grid of V4, which is operating as an output valve and energises the loudspeaker in the usual way. Fixed tone correction is provided by C5 and negative feedback by means of R5.

Switch S4 operates the warning device and is brought into operation by the metal check-strap of the lid, making contact between two springs fixed on the inside of the case. This results in positive feedback, via C6, between the screen-grid of V3 and the anode of V4.

On mains operation H.T. is fed from the cathode of V5 through R8 and switch S8 to the H.T. line, and L.T. through R7, R6 and S7. Grid-bias for V4 is obtained from the H.T. volts drop across R9 in the H.T. negative circuit. H.T. and L.T. smoothing is performed by electrolytic capacitors C7, C8, C9 and C10. The filament resistors R12, R13 and R14 tend to provide an even distribution of voltage over the filament chain.

Removing the Chassis

It is first necessary to remove the batteries and also the clip which secures the mains lead to the right-hand front corner of the battery compartment. Next, the two large knurled-head nuts, located either side of the battery compartment, should be slackened, and the chassis-retaining brackets released. With some models the two metal feet beneath the carrying case also have to be unscrewed before the chassis can be withdrawn.

The chassis can now be taken from the case, but is

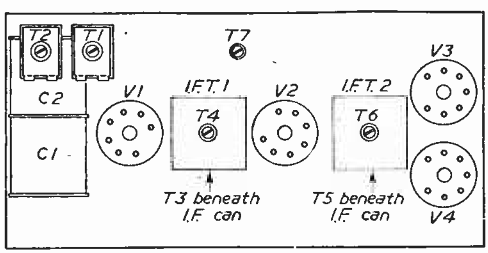

Fig. 2.—Top view of chassis showing trimmer positions.

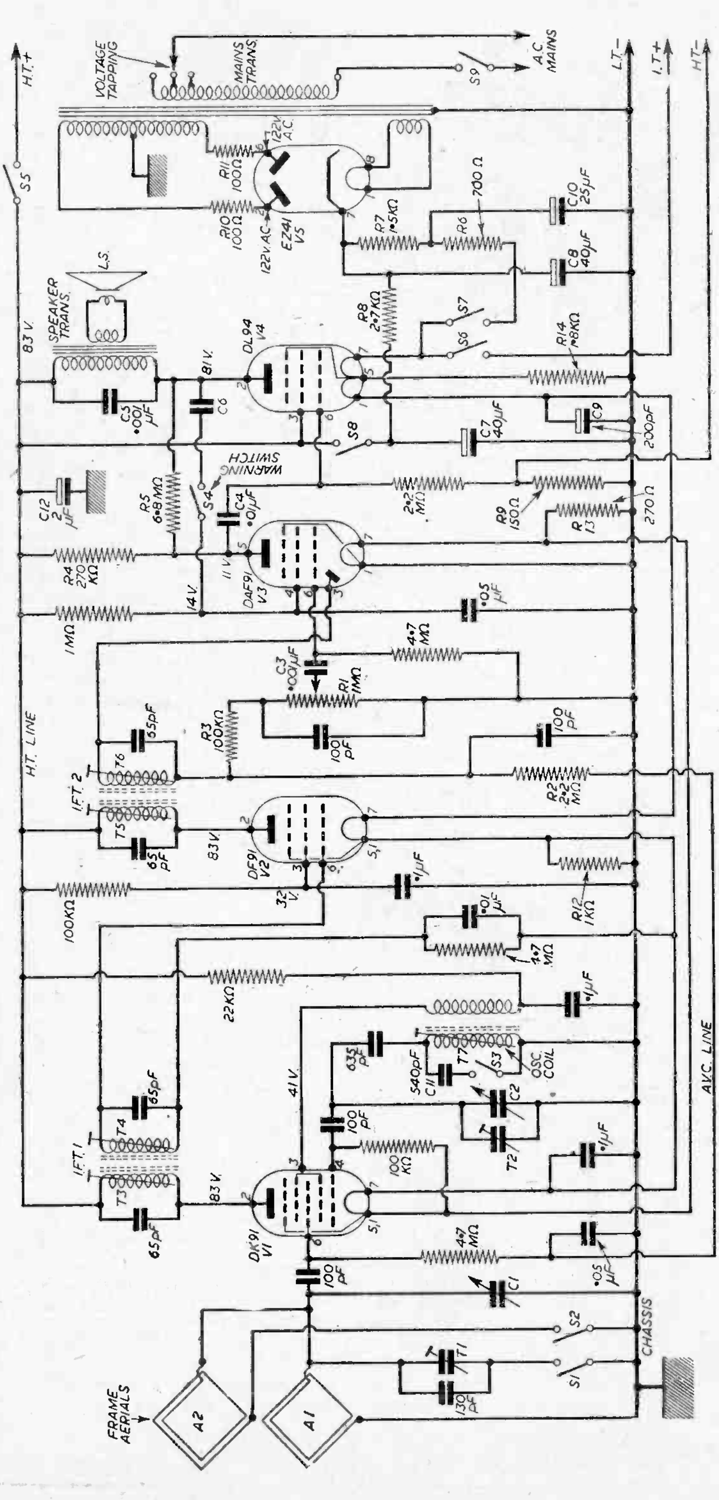

Fig. 1.—Theoretical circuit of the Vidor Portable CN396.

limited by reason of the frame aerial connecting cables. Therefore, in order to remove the chassis for detailed examination it is necessary to disconnect the frame aerial. This is best performed by prising out the frame aerial cover in the lid, after first removing the two metal clips, and then unsoldering the three connections inside.

Alignment Data

The I.F. stages should be aligned, or checked, before making trimmer adjustments in the R.F. and oscillator sections. The earthy side of the generator output should be connected to the receiver chassis, and the " live " side to pin 6 of V1 through an 0.1 μF capacitor. The local oscillator should be muted by shorting C2, and preferably an output meter should be used to indicate optimum trimmer settings. In order to avoid alignment error as the result of overloading and operation of the a.v.c. system, the smallest possible generator output voltage should be used for all adjustments consistent, of course, with usable deflection in the output meter.

A modulated 456 kc/s signal should be applied and trimmers T6, T5, T4 and T3 should be adjusted in that order for maximum output, reducing the input signal as the circuits approach correct alignment.

Next, the short across C2 should be removed and the signal generator output leads transferred to the region of the frame aerials to provide a degree of coupling without actually making a direct connection. After having ensured that the tuning pointer is operating properly, tune the receiver to 200 metres

(Continued on page 57)

R.S.C. ULTRA LINEAR 25 WATT AMPLIFIER

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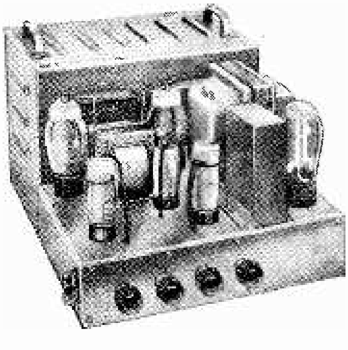
10 GNS.



Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c/cs. Outputs for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unapproachable value at 10 Gns. or ready for use, 2 Gns. extra. Carriage 10/-. If required, cover as illustrated can be supplied for 17/6.

R.S.C. 10 WATT "PUSH-PULL" HIGH-FIDELITY AMPLIFIER A3

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Complete with integral Pre-amp. Tone control stage (as A4 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. Six Negative Feedback Loops. Completely negligible hum and distortion. Frequency response ±3 db. 30-20,000 c.p.s. Six valves. A.C. mains 200-230-250 v. input only. Outputs for 3 and 15 ohm speakers. Kit of parts complete in every detail. Plus 7/6 carriage. Or ready for use, 45/- extra. Illustrated leaflet 6d. Cover as for A4 is suitable. H.P. TERMS ON ASSEMBLED UNITS. DEPOSIT 23/6 plus 10/- carriage, and nine monthly payments 1 gn.

7 GNS.

HIGH-FIDELITY MICROPHONES in stock. Keen cash prices or H.P. terms if supplied with amplifier.

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PLESSEY SINGLE SPEED AUTO-CHANGER. For A.C. Mains 200-250 v. 50 c/s. Plays mixed 10in. and 12in., 78 r.p.m. records. Fitted with crystal pick-up. Very limited number, new, cartoned. £5/19/6. Carr. 5/6.

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F.W. Bridge Type		250 v. 50 mA.	5/9
6/12 v. 1 a.	4/9	250 v. 80 mA.	7/9
6/12 v. 2 a.	8/9	250 v. 150 mA.	9/9
6/12 v. 4 a.	16/9	RM4 250 v.	
6/12 v. 6 a.	19/9	250 mA.	11/9
6/12 v. 10 a.	35/-		

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For mains 200-250 v. 50 c/cs.
To charge 6 v. acc. at 2 a., 25/6.
To charge 6 or 12 v. acc. at 2 a., 31/6.
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Above consist of transformer, full wave rectifier, fuses, fuseholders and steel case. Any type assembled and tested, 6/9 extra.

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and the generator to 1,500 kc/s, and adjust T2 for maximum output. Retune the receiver to 550 metres and the generator to 545.45 kc/s and adjust T7 for maximum output whilst "rocking" the receiver tuning slightly.

Finally, tune the receiver to 1,200 metres and the generator to 250 kc/s, and adjust T1 for maximum output.

Servicing Hints

In some districts heterodyne whistles may be experienced on M.W. stations; this can generally be cured by readjusting the I.F. tuning to 470 kc/s. This will, of course, necessitate retrimming the receiver, and in some cases it may be found necessary to alter the value of the L.W. shunt capacitor C11 to 515 pF.

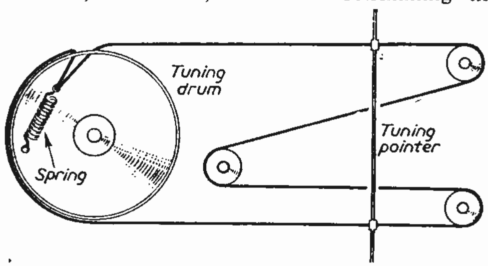


Fig. 3.—Details of the tuning drive arrangement.

Instability accompanied by low volume is often caused by deterioration of the 2 μF electrolytic capacitor C12—this should be checked on a bridge or by direct substitution.

Low volume and apparent lack of sensitivity, whilst remaining stable, the 65 pF I.F. tuning capacitors should be suspected of low "Q" or alteration in value; conclusive proof in this connection is if the I.F. tuning does not peak properly during the alignment process. If the transformers tune very flatly and the associated capacitors check normal, the windings themselves should be suspected for low "Q"—replacement is generally demanded in this case.

Low volume is also sometimes caused by V2 screen decoupling capacitor becoming low in value, V3 screen resistor becoming high in value, and R4 becoming high in value.

Excessive distortion is often provoked by C4 developing a very slight D.C. leak—this fault also causes the H.T. battery to run down quicker than normal.

On some specimens of this receiver a disconcerting mains hum at high volume settings with the receivers working from the mains was found to be caused by the close proximity of the mains transformer primary leads to the volume control—re-routing the leads solved the problem.

General fault checking for no signals can be aided by testing whether the warning signal can be produced by closing the lid. If it is not present, stages V3 and V4 should be carefully investigated—one of the valves may be faulty, or it may be found that the H.T. unit or batteries are responsible.

If, on the other hand, the warning signal can be produced, stages V1 and V2 should come under investigation, paying particular attention to V1. This valve often becomes soft and fails to oscillate when the L.T. voltage falls slightly.

General

Fig. 2 shows the top of the chassis and all trimmer positions as viewed from the battery compartment.

A plan of the tuning drive arrangement is shown at Fig. 3; for cord replacement approximately 30in. of nylon drive cord is required. Replacement can be carried out by removing the receiver chassis from the metal panel by extracting the control knobs and three 4 B.A. nuts and bolts. Care should be taken to ascertain that the pointer is reset to the 550 metre mark on the scale when the tuning capacitor is at maximum capacitance.

Hydrogen Thyratrons

By E. G. Bulley

THE hydrogen thyratron falls into the category of gas-filled types, and should not be confused with the conventional inert gas-filled designs such as argon, xenon or helium. They do, however, utilise oxide coated cathodes, and can be classified as grid-controlled gas-filled rectifiers.

The hydrogen thyratron was originally designed for use as a switching valve for pulsing magnetrons necessary in radar. They are, however, to-day, now being used in many fields, such as industrial research, etc., especially where precise triggering is required.

Fast Operation

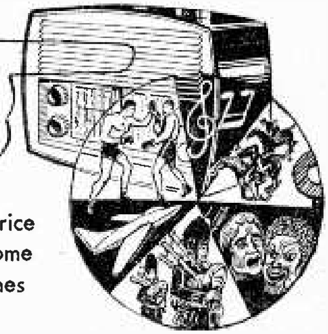
Hydrogen thyratrons have characteristics which make them preferred to the conventional type, these being their capacity of high peak currents, fast operation, positive grid control and a very wide ambient temperature range without affecting the electrical characteristics. These thyratrons, unlike other types, can be operated in more or less any position, and are found to operate at high altitudes under stringent conditions of repetition rates and high peak currents. Such operation naturally depends upon the actual design of the valve but, nevertheless, they have the advantage of very short de-ionisation times. This characteristic is the time required to bring about the de-ionisation necessary to regain control, and is dependent upon the anode voltage, grid voltage, temperature and instantaneous anode current. Such a characteristic is a factor which decides the maximum frequency at which these valves will operate.

Advantages

An advantage of these thyratrons is that they will operate without negative bias, thus they prove extremely useful in applications requiring zero bias with positive triggering pulses.

On the larger types of hydrogen thyratrons many designs include an integral gas reservoir, that is to say, they have a hydrogen reservoir incorporated in the valve. This ensures freedom from failure should the gas clean up, the reason being that any gas consumed during the operation of the valve is replaced from the reservoir.

Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

HENRY JAMES'S great novel, "The Golden Bowl," made an enthralling play on the "Third." Running, with a short interval, for three and three-quarter hours, it was treated quite spaciously by the dramatiser, Mary Hope Allen. Largely symbolical, it compared the lives of a father and daughter and her husband and step-mother with a golden bowl that turned out to be only gilt over porcelain, plus a crack. Whilst in existence, affairs seem about to crack, too. But as soon as it is smashed its influence ends and things come out all right.

Packed with James's insight into character and motive, it was sympathetically and knowingly handled by Irene Worth, Peter Wyngarde, Clare Austin, Barbara Couper, John Gabriel, Macdonald Parke and others. Leon Quartermaine compèred excellently.

"Put Out More Flags," by Evelyn Waugh, was another famous novel skilfully dramatised, this time by Christopher Sykes. Describing the reactions of various strata of society to the first world war, plus an evacuee scandal, it was amusingly and realistically acted by, amongst others, Mary Wimbush, Roger Snowdon, Felix Felton, Patience Collier, Betty Hardy, Hugh Burden, Joan Hart and Richard Williams.

Sunday Newsreel

"From our Correspondents," on Sunday mornings, whilst interesting, seems little other than a Sunday edition of Radio Newsreel, except for the fact that there is little or no home news in it and plus a vast amount of "calling up" and buzzing wires. Useful, perhaps, for those who cannot be "called up" during the week. Some of the telephoning from the farthest corners of the earth may sound very up-to-the-last-minute and dramatic, but it is sometimes very unclear and trying. Some of them could well be read in the studio.

"Antic Hay"

Aldous Huxley's novel, "Antic Hay," created something of a sensation when it first appeared in the disillusioned twenties. Chiefly concerned with the invention of trousers with pneumatic seats, plus much of the gay and shallow chatter of those days, the story, made into a play by Lance Sieveking for the Monday evening "Between Two Worlds" series, seemed to have dated and aged considerably: much more so than many of Wells's and Bennett's, which go back a decade or two earlier. A huge cast contained many well known names.

At the other end, one wonders how either "The Great Gatsby" or "From Morn to Midnight" found their way into this admirable series.

The Goons

"The Goon Show" remains the noisest, and "Take It From Here" the wittiest, of all the regular weekly features. When listening to the former, we seem to pass through a London Underground railway, a Clyde shipyard, the Elephant and Castle in the heyday of the tram, and heaven knows what else. I admit there are some laughs as well. But Denis Norden and Frank Muir remain the best comedy script writers, and whilst I, personally, get a little tired of the sameness of some members of the cast—as I do with all these shows—they are a pretty good team for getting the wit and sparkle of the thing over. There is plenty of this.

The "Third"

The "Third" regaled us with Wycherley's uproarious, promiscuous, libidinous and generally disreputable but very true to life comedy, "The Country Wife." It was great fun. What a time those Restoration folks must have had of it! For there is no doubt that, in his much smaller way and lacking Shakespeare's genius, Wycherley faithfully recorded the life of his times, just as W. S. did. Much the same caperings go on nowadays, but we seem to prefer space-ships and gangsters in our entertainment.

Politics

It has become a practice to engage an M.P. from each of the greater parties to "observe" the party conference and then "discuss" it for half an hour each evening while it is in progress. This year the two M.P.s were Mr. Enoch Powell for the Tories and Mr. Wedgwood Benn for the Socialists. Both give the impression of "agreeing to differ" for entertainment purposes; "but my dear Benn" follows "but my dear Powell" in regular sequence, with an occasional agreement that lends sincerity to the party divisions. All rather artificial and stagey. I wonder what the size of its listening panel is?

Space Travel

"Journey Into Space," in no fewer than twenty episodes, is one of those speculative, empirical things that Wells and Jules Verne so excelled in 50 or more years ago. But is the present spate of this sort of thing likely to appeal to such a wide range of ages as they did? Will the youth of to-day witness the same high proportion of correct forecast and assumption in 50 years' time as the youth of their day is now doing? "Increase your speed three thousand miles," "No. 6 ship be prepared to leave for Mars immediately" as well as "All change for Clapham Junction," show the wide range of both drama and cliché employed. One or two of the episodes made me feel all the more eager for "The Woodlanders" on Sunday evenings!

Experiences with Vibrator Supplies

A READER DESCRIBES THE RESULTS OF HIS EXPERIMENTS WITH MOBILE POWER SUPPLIES OBTAINED FROM VIBRATORS

By F. Neville Hart

THE writer, who travels around the country with a trailer-caravan, has to depend upon current supply from his car battery for all-wave listening on a five-valve superhet. The problem is slightly different from that of a car radio, however, because the "generating noise" in a car is not noticed, being drowned by the engine. Moreover, the short-wave bands are not normally used in car radio, whereas the caravan radio has to have a silent background from 13 to 2,000 meters, and it is surprising how difficult this is to achieve.

This quest has resulted in an extensive survey of methods of transforming 12 volts D.C. into 200 A.C. in a reasonable quantity of milliamps.

It was found that a dynamotor provided the least difficult current to smooth, but owing to the need to leave enough current in the battery to start the car on a frosty morning, this proved to take too much current, in the region of 4 to 5 milliamps. Besides, a dynamotor makes a considerable amount of aural noise, and although it could be mounted outside, that would call for a long H.T. lead, and also detract from portability of the radio, which is a desirable feature at times.

Noise

A number of commercial and surplus vibrator units were tried and others built from scratch. All tended to create "hash" on some part of the band, until by trial and error with the judicious addition of H.F. chokes and condensers, the hash was hushed! Synchronous vibrators were found to be inefficient and harder to silence.

Even a truly sumptuous vibrator unit gave trouble. It has two H.F. chokes (high current) in the L.T. lead, and two smoothing chokes in the H.T. plus, from the "bridge" of metal rectifiers. Presumably it was designed for a P.A. amplifier, where perhaps R.F. interference would not matter, for it gives an output of 300 volts at 100 milliamps. As can be seen from the circuit, only 8 μF condensers are used for smoothing, and despite the chokes, it is found that condensers around 20 μF are better.

Designers appear to think unidirectionally, that is, from L.T. to H.T. whereas H.F. interference tends to go the other way and gets into the receiver along the L.T. leads and the battery. Therefore, it is found an immense improvement to insert at least 100 μF across the input of the unit, as indicated by the dotted lines. It is also noticed that the A.V.C. circuits of receivers can pick up the "hash," and they should be well by-passed by large enough condensers.

It is not necessary, however, for such an ambitious unit to be used for normal reception, particularly if L.T. current must be kept down, for even a unit giving 200 v. at 50 mA consumes about 2½ amps at 12 v. For the same reason, metal rectifiers are preferred, in order to dispense with the heater current of a valve rectifier.

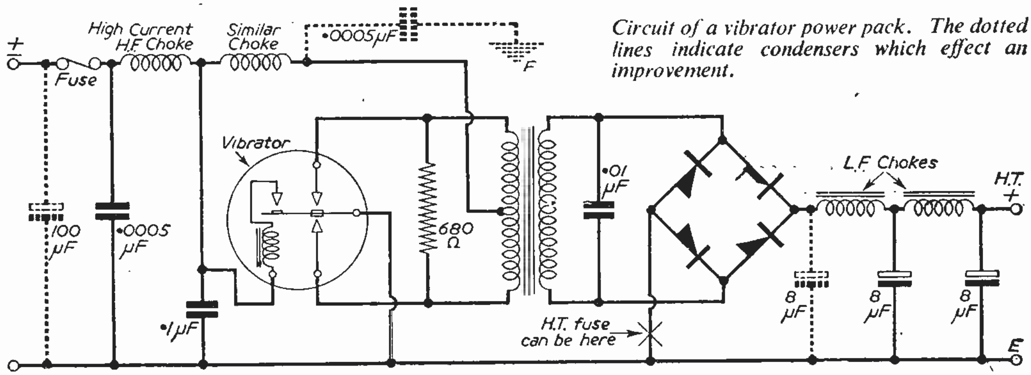
Chokes

Although one does not need more than one high current H.F. choke and one L.F. smoothing choke, an all-wave H.F. choke in the H.T. lead in front of the smoothing choke, by-passed with two .001 μF condensers, is found very effective.

It is possible to obtain smooth enough H.T. to feed a battery-receiver from a 2 v. vibrator unit. But it must be remembered that grid bias in the receiver is usually taken by a dropping resistor between the H.T. minus terminal and the L.T. lead which is connected to the chassis. Therefore, the H.T. minus of the rectifier circuit must not be connected to the vibrator unit chassis, as is customary when used with indirectly-heated valves, so it must be brought to a separate terminal.

Hum

In conclusion it must be said that the low-frequency hum generated by a vibrator, is easily smoothed, but the H.F. content, set up by the minute arcing of the vibrator contact points, is the main problem. Incidentally, it would be a boon if some inventor could design a means of providing A.C. from low D.C. voltages that consumed very much less current than at present possible. Perhaps some reader who has experimented in this connection could let other readers have the benefit of his experiences.



Circuit of a vibrator power pack. The dotted lines indicate condensers which effect an improvement.

BBC Audience Research

IN the tables below the July/September quarter, 1955, is compared with the corresponding quarter of 1954.

Sound

Table I.—Average level of evening (6-11 p.m.) listening *among the whole adult population* of the United Kingdom (approximately 37,600,000 persons).

	% of the adult population
July/September, 1955	11.6
July/September, 1954	13.6

Table II.—Average level of evening (6-11 p.m.) listening among the *sound public*.

	% of the "sound public"
July/September, 1955	15.7
July/September, 1954	17.3

It is estimated that the average size of the adult "sound public," i.e., those who live in homes where there is a sound, but not a television, receiver, in the July/September quarter of 1955 was approximately 23,500,000. and in the same quarter of 1954 was 26,000,000.

The level of evening listening during the period 6 p.m. to 11 p.m. was substantially lower in July/September, 1955, than in the corresponding quarter of 1954. Whereas on the average 13.6 per cent. of the adult population were listening at any given moment last year, this year the corresponding figure was 11.6 per cent. (see Table I). This decrease was partly due to a further flow of listeners to television, but there can be little doubt that the good weather this year also reduced listening. That the diversion of listeners to television was not the only cause can be seen from Table II, which shows that there was appreciably less listening in July/September of this year even amongst people who do not possess television sets.

All Services

Table III.—Average levels of listening and viewing among the whole adult population *during those evening hours when all BBC Services are on the air.*

	Sound %	Television %	Total %
July/September, 1955	10.3	11.2	21.5
July/September, 1954	12.3	10.5	22.8

During the evening hours of July/September this year, when TV was being broadcast, 11.2 per cent. of the adult population were, on the average, viewing and 10.3 per cent. were listening to either the Home, Light or Third Programme (see Table III). This means that rather more than a fifth of the population were either listening or viewing—48 per cent. of them listening and 52 per cent. viewing. In July/September last year the total number listening or viewing was somewhat greater, but of them, 54 per cent. were listening and 46 per cent. viewing.

News from the Clubs

SOUTH MANCHESTER RADIO CLUB (G3FVA)
Hon. Sec.: M. Barnsley (G3HZM), 17, Score Street, Bradford, Manchester, 11.

AT the Annual General Meeting all the officials were re-elected, i.e., Mr. N. Potter (G3GNC), chairman; Mr. M. Denny (G6DN), vice-chairman; Mr. N. Ashton (G3DQU), treasurer; M. Barnsley (G3HZM) as secretary.

The future programme will be as follows:
December 16th.—Junk Sale and Rag Chew.
December 30th.—Open Evening.
January 13th.—"Hints on Soldering," "How to Solder Aluminium."

SWINDON AMATEUR RADIO CLUB
Hon. Sec.: G. R. Pearce (G3AYL), 102, Kingshill Road, Swindon, Wilts.

A VERY successful first meeting was held and it has been decided to hold monthly meetings.

Weekly classes of instruction for the amateur radio licence examination are being held at the College, Swindon, with Mr. G. R. Pearce as instructor.

Dec. 9th.—Film evening. Showing of Mullard valve films and R.S.G.B. films.

CLIFTON AMATEUR RADIO SOCIETY
Hon. Sec.: C. H. Bullivant (G3DIC), 25, St. Fillans Road, Catford, S.E.6.

MR. R. J. SLAUGHTER of the Telegraph Construction and Maintenance Co., Ltd., came to the clubrooms in October to talk to members on radio frequency cables.

Programme for December:
9th and 23rd.—Constructional Evening and Rag Chew.
16th.—Christmas Party.
30th.—Junk Sale.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Road, London, S.E.14. Details of membershp can be obtained upon application to the hon. secretary.

STOKE-ON-TRENT AMATEUR RADIO SOCIETY
Sec.: A. Rowley (G3JWZ), 37, Leveson Road, Hanford, Stoke-on-Trent.

MEETINGS continue on Thursday nights at 7.30 p.m. Members are eagerly awaiting the day when the club's new TX goes on the air.

Morse lessons are given on Thursday nights to those interested from 7 to 7.30 p.m.

Future lectures include: Oscilloscopes, Amplifiers, Transistors and an Electronic Key.

WARRINGTON AND DISTRICT RADIO SOCIETY (G3CKR)
Hon. Sec.: J. Williams, 22, Ackers Lane, Stockton Heath, Warrington.

A SEPTEMBER D.F. contest was won by the club's youngest member Roger Dykis. Meetings are held 1st and 3rd Thursdays, Kings Head Hotel, at 7.30 p.m.

A winter programme of films and lectures is being arranged.

LOTHIANS RADIO SOCIETY
Hon. Sec. & Treasurer: John Good (GM3EWL), 24, Mansion-house Road, Edinburgh, 9.

RECENT lectures included "Building a Transmitter," "70 CM DX'peditions to Drumore" and "Model Control."

Morse classes are now being arranged for beginners.

Meetings are held at 7.30 p.m., at 25, Charlotte Square, Edinburgh. Visitors and new members welcomed.

EAST KENT RADIO SOCIETY
Hon. Sec.: D. Williams, "Llandogo" Bridge, Canterbury, Kent.

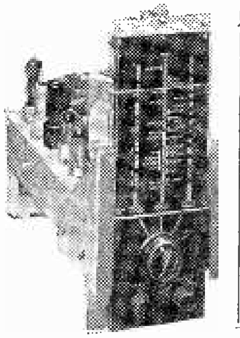
THE East Kent Radio Society still meets at The Two Brothers, Northgate Street, Canterbury, fortnightly at 8 p.m. Films, lectures, sales, swop nights, etc. New members welcome and visitors in the district.

PLYMOUTH RADIO CLUB
Hon. Sec.: Cyril Teale (G3JYB), 3, Berrow Park Road, Peverell, Plymouth.

THE club meets each 3rd Saturday in the month at 7.30 p.m. at the Tothill Community Centre, St. Judes, Plymouth (17th Dec.).

Newcomers welcome for a rag chew—nothing special laid on for the winter.

LASKY'S PAGE OF MONEY-SAVING OFFERS



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Uses 3 latest min. valves, U78, N78, DH77. Vol., bass and treble controls, ext. L.S. socket and internal L.S. switch. Indicator lamp mounted on wood baffle, size 14 x 4½in., speaker centralised. All top quality new components. For A.C. mains 200-250 v. Ideal for portable record players, input will match Monarch, RC54, RC3/554, etc. Price, complete with 3 new Osram valves, 7 x 4in. Goodman's elliptical Speaker, mains lead and knobs. **£5/9/6** Post and packing, 5/-.

ACOS CRYSTAL CARTRIDGES, complete with styli GP29. List 42/11. **LASKY'S PRICE** 18/6. Post 1/-.

LATEST COLLARO RC.54 3-speed High Fidelity Mixer Changer, Studio O crystal turnover p.u. **LASKY'S PRICE** £9/19/6. Carr. 3/6. Also supplied with Studio P crystal p.u. 15/- extra.

PLATED MICROPHONE FLOOR STANDS, telescopic, folding base, height 3ft. x 5ft. 3in. **LASKY'S PRICE** 32/6. Post 3/6.

ALUMINIUM CHASSIS. 18 S.W.G., undrilled, 4 sides, reinforced corners. Depth 2½in.

6 x 4	4/-	12 x 8	7/-	16 x 10	8/3
8 x 6	5/-	14 x 9	7/6	12 x 3	4/9
10 x 7	6/-	16 x 9	8/-	12 x 6	6/6

Post 1/- per chassis extra.

SPECIAL OFFER OF TAPE DECK CASES. Will take Truvox Desk with space for amplifier, feeder unit and speaker. Overall size, lid closed, 19in. x 14in. x 13in. **LASKY'S PRICE** 35/-. Carr. 5/-.

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COMBINED OFFER. Above Tape Deck Case together with Truvox Tape Deck, £24/10/0. Carr. paid.

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DENCO F.M. Feeder Unit. Complete parcel including valves, £6/7/6, post extra. Data Book, 1/6, post free. All components and valves available separately.
JASON F.M. Tuner. Special parcel containing chassis, data book, complete set of coils, tuning condenser, dial drive, front plate & knob, 68/9. Post 2/6.
This Tuner can be built for £6/15/0 plus 2/6 post. Book only, with our fully itemised list, 2/- post free. Full range of GORLER (Continental) F.M. Components.
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Contains everything to build a 4-valve, 3-wave superhet for 200/250 A.C. mains. Uses 6K8, 6K7, 6Q7, 6V6 valves. Attractive wood cabinet, walnut veneer, or plastic cabinet. Size 12 x 6½ x 5½in. deep.
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Contains everything to build a T.R.F. 3-valve set for 200/250 A.C. mains, med. and long wave. Uses 6K7G, 6J7, 6V6, and metal rectifiers. Neat plastic cabinet, walnut or ivory finish, or wood cabinet. Size 12 x 6½ x 5½in. deep.
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4-WATT A.C. AMPLIFIER.—Uses 1 each 6SL7, 6V6 and 5Z4. All components, chassis, valves, output trans., mains trans. **LASKY'S PRICE**, £4/5/-. Post & pkg. 2/6 extra. Instruction Book, 1/- post free.

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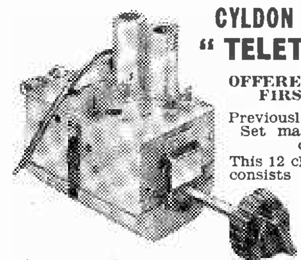
OFFERED FOR THE FIRST TIME



Previously supplied to Set manufacturers only.

This 12 channel Tuner consists of a turret having 12 clip-in aerial and mixer coil strips. When turret is rotated the appropriate strip locates on a contact panel providing the necessary connections to the valves, and circuit. Supplied with coils for Bands I and III London and Birmingham, BBC and ITA. (4 Sets of Coils.)
This type of tuner enables you to clip in prealigned coils for the reception of any station not already provided for in Bands I, II and III, while affording maximum gain, high stability and minimum noise, which are essential in a modern tuner. I.F. output 33-38 Mc/s. Easily modified to other I.F. outputs.
Valves used: PCC84, R.F. double triode, cascode R.F. amplifier. PCF80 triode pentode f.c. and mixer. Will work with most sets. Full instructions and circuit diagram supplied. Price **99/6**
Post 2/6. Knob, 3/6 extra.

TELETRON BAND III CONVERTER COIL SET for use with TRF and superhet Band I receivers. Uses 2 Z719. Circuit, wiring diagram, alignments with each set. **15/-** Post 1/6.

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Drilled Chassis only, 3/9. All components available separately.

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Famous make. Covers Bands I and III. Complete with valves EF80 and ECC81. Ceramic valveholders, finest quality components, precision made. Switch and fine tuning. I.F. output 20-25. Freq. coverage 50/87 Mc/s and 175-215 Mc/s. Supplied with full details and circuit diagram.
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IMMEDIATE DELIVERY All Types Band III Aerials

All Channels. 3-, 4-, 5- and 6-element outdoor, indoor and loft. A few examples:—
Wolsey Minor, indoor, 12/6.
King Pin, indoor, 7/6.
Aerialite 4-element loft, 42/6.
Wolsey Combined Bands I/III, 17/6.
Aerialite outdoor for fitting to existing mast: 3-ele., 30/-; 4-ele., 36/6; 5-ele., 42/6.
Chimney lashing and wall fitting equipment available, extra.
Co-axial Cable, semi-airspace, yd. 9d. Aeraxial, yd. 10½d. 300 ohms Feeder, yd. 9d.
Diplexes, 12/6. Wolsey Crossover Boxes, 15/-.
Co-axial Plugs, standard type, 1/4. Chassis mounting Co-axial Sockets, standard type, 1/-.

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The Editor does not necessarily agree with opinions expressed by his correspondents

Morse Practice Set

SIR,—I decided to build the L.F. oscillator as shown in your booklet, "Mastering Morse," and found to my surprise that if the circuit was changed to that below, the H.T. lead could be joined to the positive terminal of the L.T. supply; and, by adjusting the controls, the oscillator gave quite sufficient volume and clear tone for headphone use.

The modified circuit may be of use to morse fans who require a low current consumption oscillator, as the total drain from a three volt battery was .14 amps.—SYDNEY ALLAN (Jnr.) (Belfast).

A Radio Jack

SIR,—Re Rev. A. Morgan's request for article on Radio Jack for Tape Recorder, I, too, am anxious to see an article in PRACTICAL WIRELESS on this circuit, having made some experiments myself with Xtal diode and coil fixed tuned on the M.W. station (Third Programme being the choice in my case). But I find difficulty in obtaining crystal set results in this locality with miniature dust-cored coils. I cannot get anything like the sensitivity obtained with "Lissenagon" 60X coil of 1925 vintage, but, of course, this old favourite does not permit one to make a compact radio jack. I would be very much interested to see in PRACTICAL WIRELESS a compact radio jack, say switch tuned to 208 metres, 330 metres, and 646 metres that would load a tape amplifier in this district.—W. BINGHAM (Grantham).

[*We shall shortly be describing a Radio Jack using a crystal diode.*—ED.]

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of cover.

Atomic Power

SIR,—With reference to Mr. Benson's letter on Atomic Power in this month's "Open to Discussion."

I believe I am correct in saying that there are the two following objections to his idea :—

(1) As the air used to turn the turbine would have to be brought into close proximity to the highly radio-active pile, to ensure an efficient exchange of heat, it would become highly radio-active. It would therefore be impossible to allow it to enter the atmosphere. That is why a closed cycle is always used.

(2) The power and speed of the turbine depends on the amount of gas which strikes the blades and the force with which it strikes them. Therefore a light gas such as air would be inefficient unless moving at a high speed, which implies high temperature. A heavier gas such as steam, or as is being considered mercury vapour, would only need work at a lower temperature for the same efficiency.—R. TRING (16) (N.4).

SIR,—Surely Mr. Benson ("Open to Discussion," PRACTICAL WIRELESS, December, 1955), has presented nothing but an alternative method of heat exchange, and one virtually impossible at that; at least the utilisation of heat generated in the pile to drive a steam turbine has the advantage of simplicity.

By modern scientific standards any system which involves mechanical generation of electricity must be obsolete in terms of atomic energy which is in itself pure electricity.

Now a recent discovery has demonstrated the practicability for the first time of generating electricity in quantity without the use of power-driven generators.

I refer to the process of mixing oxygen and hydrogen which under certain conditions may be converted *directly* into electricity.

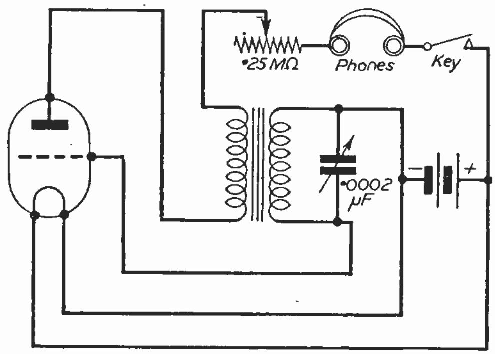
To my way of reasoning this is where the atomic pile can fulfil its true function. I refer to its ability to alter the atomic structure of materials.

If the pile can be used to convert, either by heat or atomic radiation, material (water most likely, consisting as it does of oxygen and hydrogen), a true utilisation of atomic energy is achieved, i.e., conversion of atomic energy into usable electricity without a single moving part.

I have no knowledge of the exact method used to mix the gasses, but I should very much like to know if anyone can oblige.—D. HANCOCK (Ashford).

A Recording Critic

SIR,—I am just contemplating taking the plunge into L.P. I have many 78 r.p.m. records which give me great pleasure, but several items which



The circuit referred to in Mr. Allan's letter above.

I should like to own, I find are available only on L.P. Looking through the advertisement pages of PRACTICAL WIRELESS, I find that, although I have the choice of dozens of three-speed changers, only one firm markets three-speed single players. Now the weakest link in the chain of music reproduction is the record itself. (By weakest I mean most likely to be damaged. Admittedly the needle is more vulnerable, but a needle replacement is much simpler and cheaper than the replacement of a favourite disc which has become damaged.) We take great care of our records, letting them live in dust-proof polythene envelopes and buying expensive lint—and grit-free cloths and cleaning solutions for their toilet—and then we let them fall Crash! Bash! on to others of their kind from an auto-changer. "Slip-starting" of records on to soft turntable surfaces does enough damage, goodness knows; how much worse will "slip-starting" on to a hard and abrasive surface like that of another record be? It seems, to say the least, a trifle illogical. Am I alone in this view, and if not, why are there so many changers on the market and so few single players?

Also, are sapphire styli all they are cracked up to be? I admit that I have had no experience of L.P., but I have used sapphires of several different makes on 78's in both heavyweight and lightweight pick-ups—the correct type for the pick-up in use in every case, I hasten to add. *In every case*, without exception, I have found that reproduction has deteriorated *and record wear has increased* to an alarming extent. I know I am not alone in this experience. Have I simply been unlucky, or are sapphires actually inferior to metal needles? If they are, why are sapphires used exclusively for L.P. reproduction? I know that the optimum combination of new L.P. record and new sapphire stylus is capable of magnificent reproduction; I must believe my own ears. The question is, how long will this state of affairs last? How long before my (very expensive) L.P.s will be worn to such an extent that they are painful to listen to, as I have heard 78s become very quickly under sapphires?—B. L. KERSHAW (Leeds, 16).

Car Radio

SIR,—In reply to inquiries I have received concerning the Constructional Car Radio, I should like to point out that the value of R12 has been omitted, and this should be 50K ohms.

Concerning the output valve on the six volt system, an omission has occurred on this, in that the valve should be 6AG6, which would probably give satisfactory performance, or alternatively the 6V6, which is the closest matching valve for six volt operation, and has a relatively low heater current. Some readers have queried the unusually high bias for this valve, but in actual fact this bias was determined by reference to the unit from which the valve was taken, namely the BC459 receiver. Probably experiments with bias values may effect an improvement over the six volt types, but I find that the 1.5 is satisfactory for the 12A6.—A. E. PARDY (Pengam).

Ex-Service Sets

SIR,—In answer to the query in the August issue of your magazine, I enclose the following frequencies of a few more ex-W.D. transmitters and receivers. Also, I would like to correspond with a radio enthusiast of my own age (thirteen).—M. C. SYKES, 32, Priory Road, Gloucester.

Rx.	Frequency.
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RF25 ...	... 40-50 Mc/s.
RF26 ...	... 50-65 Mc/s.
RF27 ...	... 60-80 Mc/s.
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Type 109	... 1.8-8.5 Mc/s.
Type 38	... 6-9 Mc/s.
Type RA10	... 150-300 kc/s, 16-5 Mc/s, 5-10 Mc/s.
Type 1403	... 2-9 Mc/s.
DST100	... 50 kc/s-30 Mc/s.
Type 58	... 6-9 Mc/s.
M361 ...	... 100 kc/s-8,500 Kc/s.
2C1-Mk. 1	... 35-150 m.
17-Mk. 2	... 40-61 Mc/s.
3547	... 45 Mc/s.
TX	Frequency
T1403 ...	... 2-9 Mc/s.
TX21 ...	... 4.2-7.5 Mc/s.
T1154B	... 10-5.5 Mc/s, 5.8-13 Mc/s.
T1196 ...	... 4-6 Mc/s, 6-8 Mc/s.

FRAME AERIALS

(*Concluded from page 42*)

of 24 s.w.g. silk-covered wire will be suitable for M.W. with 85 turns of 34 s.w.g. wire for L.W., if used. It is desirable to wind M.W. and L.W. aerials on separate formers, and keep them separated, or M.W. signal strength will be very poor with the adjacent L.W. section switched out.

With sensitive mains receivers the aerial may be very small—down to 3½in. in diameter being feasible. Such an aerial, made as shown in Fig. 5, but with a circular former, will require about 55 turns for M.W.

Other methods of arranging the windings will come to mind. Any *insulated* type of former or support is suitable. In the free-standing type of aerial illustrated, a simple wooden cross, jointed at the middle, is used, and pivoted so that it can be turned in any direction.

It should not be overlooked that all such frame aerials replace the first tuned circuit tuning coil. An aerial winding such as described, with one end left free and the other connected to the aerial terminal of the set, would have no directional properties, and would only give a signal similar to that from a few feet of wire in a "throw out" aerial.

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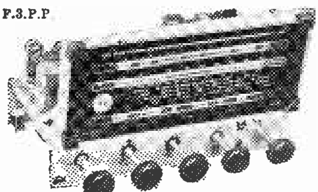

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PRACTICAL WIRELESS, Jan., 1956.

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