CONVERTING T.R.F. TO SUPERHET

1/-

Vol. 30. No 572

JUNE, 1954

EDITOR: F.J. CAMM

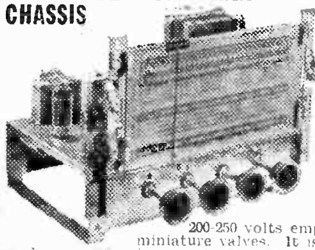
PRACTICAL WIRELESS

A Comprehensive Test Unit

IN THIS ISSUE:

- AUDIO AMPLIFIER DESIGN
- SURPLUS VOLTAGE DOUBLERS
- RADIO SERVICING EXAMS.
- MAKING A START ON THE SHORT WAVES
- GERMANIUM RECTIFIERS

A COMPLETELY ASSEMBLED "ALL-WAVE" SUPERHET CHASSIS



MODEL B.3—A 5-valve 3 waveband Superhet Receiver for operation on A.C. mains 100-120 volts and 200-250 volts employing the very latest miniature valves. It is designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both Gram and Radio, making it the ideal replacement Chassis for that " old Radiogram," etc.
Brief specifications:—Model B.3—Valve line up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Waveband Coverage: Short 16-50; Medium 187-550; Long 900-2,000 metres. Controls (1) Volume with on/off; (2) Tuning (flywheel type); (3) Wave change and Gram; (4) Tone (3 position switch operative on Gram and Radio).
Negative Feedback is employed over the entire audio stages. Chassis size, 11in. x 7¼in. x 8¼in. high. Dial size, 9¼in. x 4¼in. Price, complete and READY FOR USE excluding speaker, **£12 12/-** (Carr. and Pkg. 7/6 extra.) Or H.P. Terms **£4/4/-** Dep. 12 Months at **15/9**.
MODEL B.3. P.P.—This model is the B.3. Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price **£15 15/-**. (Plus 7/6 carr. and ins.) or H.P. Terms **£5 5/-** Dep. 12 months at **18/9**.

MODERNISE YOUR OLD RADIOGRAM FOR £23

We offer this Auto-changer complete with Model B.3 3-waveband as advertised together with 10in. p.m. Speaker for **£23** plus **10/-** carr. and ins., or H.P. Terms **£7 15 6** Dep. and 12 months of **£1 9 2**, or with B3PP Model for **£26**. plus **10/-** carr. and ins. or H.P. Terms **£8 16 6** Dep. and 12 months of **£1 13 1**.

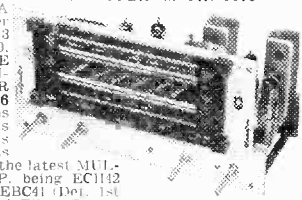
A GENUINE SPECIAL OFFER!

The COLLARO 3RC/521 3-SPEED AUTO-CHANGE UNIT

£9/19/6. H.P. Terms **£3 6/-** Dep. and 10 months at 15/-. (plus 7/6 carr. and ins.) Normal price **£18 10/-**.

- These units will auto-change on all three speeds, 7in., 10in. and 12in.
- Incorporating Hi-fi Crystal "Turnover" Head.
- They have separate sapphires for L.P. and 78 r.p.m. which are moved into position by a simple switch.
- Minimum base-board size required 13¼in. x 12¼in. with height above 5¼in. and height below baseboard 2¼in. A bulk purchase enables us to offer these BRAND-NEW UNITS, including mounting instructions, at this exceptional price.

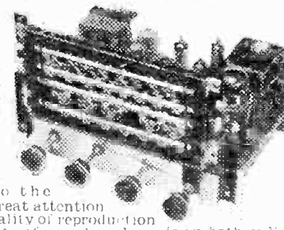
A REPLACEMENT RADIO-RADIOGRAM CHASSIS



● **MODEL AW3-5.** A 5-Valve Superhet Receiver covering the standard 3 wavebands, 16-50, 190-550, 900-2,000 metres. PRICE COMPLETELY ASSEMBLED AND READY FOR USE **£10 10/-**. (Plus 7/6 carr. and ins.) H.P. Terms **£3 10/-** Dep. and 10 Months at **15/9**. This receiver is for operation on A.C. Mains 200-250 volts. It contains the latest MULLARD VALVE LINE UP, being ECH42 (Freq. Ch.), EF41 (I.F.), EBC41 (Det. 1st Audio), EL41 (Output) and EZ41 (Rect.).
It incorporates Negative Feedback and delayed A.V.C., the four controls being (1) Tuning, (2) Wavechange and Gram Switch, (3) TONE, (4) VOLUME-OFF. It provides really good reproduction on both Gram and Radio and gives an exceptionally good range of station selection. Overall size 13¼in. x 7in. high x 6in. deep. Dial aperture 10in. x 4¼in.

A NEW DESIGN FOR HOME CONSTRUCTORS

The STERNS "SUPER SIX"

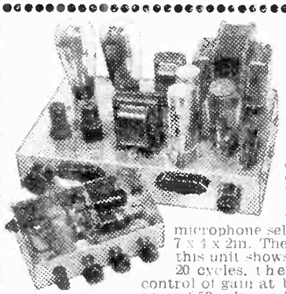


A compact and highly efficient Superhet Radio-Radiogram Chassis of outstanding quality, far above any other design yet offered to the HOME CONSTRUCTOR. YOU can build it for **£10/7/6** It is designed to the very latest specification, great attention having been paid to the quality of reproduction which gives excellent clarity of speech and music on both radio reception and record playing. A few brief details:—

- Covers 3 Wavebands 18-50 metres, 190-550, 800-2,000 metres.
- Employs 6 Valves having PUSH-PULL for 5-6 watts OUTPUT
- DELAYED A.V.C. on all WAVEBANDS.
- PRE-SELECTIVE FEED-BACK.
- 4 POSITION TONE CONTROL
- REAL QUALITY ON BOTH RADIO AND GRAM.
- PROVIDES INDEPENDENT MAINS SUPPLY FOR RECORD PLAYER (if required).
- FOR A.C. MAINS SUPPLY 200-250 Volts, 50 Cycles.
- Size of assembled CHASSIS 12in. long x 8in. x 8in. Dial Aperture 8¼in. x 4¼in.

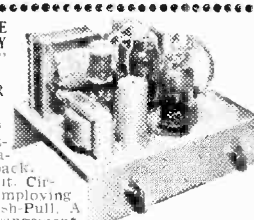
THE ASSEMBLY MANUAL IS AVAILABLE FOR 2/-. This gives very detailed practical drawings and layouts and includes a component price list.
THE COMPLETE RECEIVER CAN BE BUILT FOR £10 7 6 with the OCTAL VALVE LINE UP or for £12 7 6 with Miniature Valves.

COMPLETE KIT for 12 WATT HIGH FIDELITY "Push-Pull" AMPLIFIER



Designed for A.C. mains 200 to 250 volts, employs 6 valves plus rectifier, with negative feed-back, and comprises a main amplifier chassis and a remote controlled Pre-amplifier and Tone Control Unit, incorporating four controls—bass, treble, main volume or mixing control, and a radio, gram, microphone selector switch. This control unit measures only 7 x 4 x 2in. The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore, that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps. and 30 mA. H.T. is provided for tuning unit, etc. Price of complete kit, Amplifier and Control Unit, including drilled chassis and valves, **£14**. Complete specification and layout 2/-. We can also supply completely assembled and ready for use at **£17**. Hire Purchase Terms (Assembled Chassis only) **£5 13 3**. Deposit and 12 months of **£1 1 4**. Please add 7/6 carr. and insurance. THIS AMPLIFIER COMPARES WELL WITH THE WILLIAMSON AND SIMILAR DESIGNS AT A FRACTION OF THE COST

A 4-VALVE QUALITY "Push-Pull" 6-8 watt AMPLIFIER for A.C. mains



Incorporating Negative Feedback, Filter Input Circuit and employing 6V6s in Push-Pull. A simple arrangement is provided to enable either a magnetic crystal or lightweight pick-up to be used, and is suitable for use with Standard or Long-playing records. A tone control is incorporated, and the 10-watt output transformer is designed to match 2 to 15 ohm speakers. The overall size of the assembled chassis is 10in. x 8in. x 7¼in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, **£6 17 6**. Price of assembled chassis, supplied ready for use, **£8 12 6**. Full descriptive leaflets are available separately for 1/-.

"PERSONAL SET" BATTERY ELIMINATOR

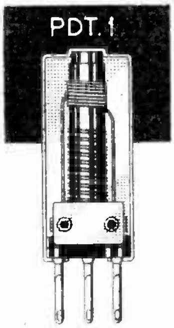
A complete kit of parts to build a Midget "All-dry" Battery Eliminator, giving approx. 69 volts and 1.4 volts. This Eliminator is for use on A.C. mains and is suitable for any 4 valve Superhet receiver requiring H.T. and L.T. voltage as above or approx. to 69 volts. The kit is quite easily and quickly assembled and is housed in a light aluminium case, size 4¼in. x 1¼in. x 3¼in. Price of complete kit with easy-to-follow assembly instructions, **42/6**. In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled Unit 7in. x 2¼in. x 1¼in. Price 47/6 (Plus 1/- carr. and ins.)

STERN RADIO Ltd.

109 & 115, FLEET STREET, E.C.4.
TELEPHONE: CENtral 5812/3/4

MAXI-Q F.M. COMPONENTS

REGD.

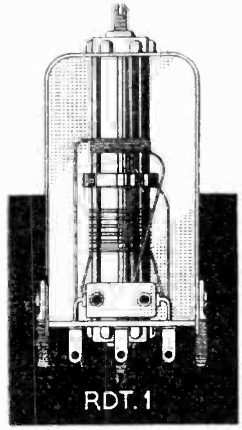


RATIO DISCRIMINATOR TRANSFORMER 10.7 M/cs. Ref. RDT. I

A 10.7 Mc/s. transformer for use in ratio discriminator type circuits. Can size 1⅜" square x 2¼" high. Secondary winding of bifilar construction. Iron dust core tuning, polystyrene former and silver mica condensers. Price 12/6 each.

PHASE DISCRIMINATOR TRANSFORMER 10.7 Mc/s. Ref. PDT. I

A miniature 10.7 Mc/s. transformer for use in requency modulation detector circuits where the limiter/Foster-Seeley type of circuit is employed. Designed for carrier deviation of ±75 kc/s. Qk.—1.5. Wound on black bakelite former, complete with iron dust slugs and two 6 B.A. threaded fixing holes on .532" centres. Screening can ; 1⅜" x 13/16" square. Price 9/- each.



I.F. TRANSFORMER IFT.11/10.7

A miniature I.F. Transformer of nominal frequency 10.7 Mc/s. The transformer is primarily intended for the I.F. stages of frequency modulation receivers and convertors. The Q of each winding is 90 and the coupling critical. Construction and dimensions as PDT.1. Price 6/- each.

I.F. TRANSFORMER IFT.11/10.7/L

As above but with secondary tap for limiter input circuits. Price 6/- each.

Full constructional details for building an F.M. Feeder unit are given in our TECHNICAL BULLETIN (DTB.3). Price 1/6 each

Send 9d. for General Catalogue.

DENCO (Clacton) LIMITED, 357/9 Old Road, Clacton-on-Sea, ESSEX.

BRITISH MADE

BRIMAR VALVES

More Reliable than EVER!

Brimar's long experience in the manufacture of special quality TRUSTWORTHY valves is now being reflected throughout the entire Brimar range.

Improved production methods, new and better assembly jigs, tighter control on the composition of materials, and the closer supervision of vital processes have resulted in valves with more uniform characteristics, greater mechanical strength and a higher standard of reliability as shown in the 12AT7.

The 12AT7 is a very reliable frequency changer and is widely used in modern TV receivers, VHF and UHF communications equipment. It is also frequently employed in industrial equipment, computors, navigational aids and test equipment.

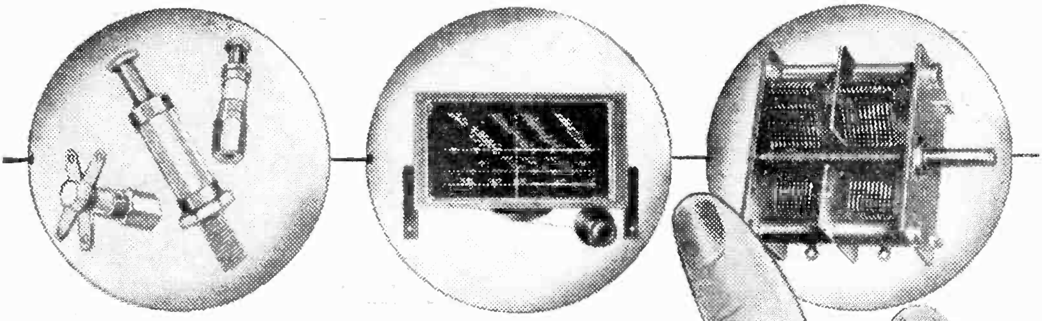
Use the BRIMAR **12AT7**—with improved performance —at NO EXTRA COST

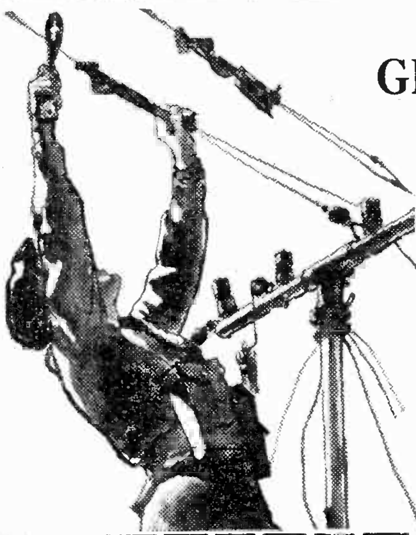
now is the time to

BRIMARIZE!

BRIMAR	MULLARD	MARCONI OSRAM	COSSOR EMITRON
12AT7	ECC31	B152 & B309	12AT7

Standard Telephones and Cables Limited FOOTSCRAY, KENT. FOOtscray 3333





...more than you BARGAIN FOR!

IT'S a step in the right direction when you fit one of these powerful compact Osmor units. Giving quality and performance right out of proportion to their midget size and modest cost, Osmor 'Q' Coil packs have everything that only the highest degree of technical skill can ensure—*extra selectivity, super sensitivity, adaptability.* Size only 1¾" x 3½" x 2¼", with variable iron-dust cores and polystyrene formers. Built-in trimmers. Tropicalised. *Prealigned,* receiver-tested and guaranteed. Only 5 connections to make. All types for Mains and Battery superhets. and T.R.F. receivers. Ideal for the reliable construction of new sets, also for conversion of the 21 Receiver, TR1196, Type 18. War-time Utility and others. Send to-day for particulars !

4/- EACH

SEPARATE COILS

A full range is available for all popular wavebands and purposes. Fully descriptive leaflet and connection data available. Just note these 5 star features :—

** Only 1in. high. * Packed in damp-proof containers. * Variable iron-dust cores. * Fitted tags for easy connection. * Low loss Polystyrene formers.*

We keep stocks of many radio components for use in published circuits, including :

"PRACTICAL WIRELESS"

Coronet "FOUR," Beginners' Superhet. Modern High Power Amplifier 2 ; Attache Case Portable ; R1155 Converter ; A.C. Band-pass 3 ; Modern 1-Valver ; 3-Speed Autogram, etc., etc

"WIRELESS WORLD"

No Compromise T.R.F. Tuner. Midget Mains Receiver. Sensitive 2-Valve Receiver ; Television Converter, etc.

MATCHED COMPONENTS

Various types of OSMOR Dials, Chassis, I.F.s, Speakers, Transformers, etc., to match our coils and coilpacks are all listed.

*Dear Reader, We can't mention all our products here, but shall be glad to receive your enquiries **for Chassis, Tuning Condensers, Switches, Volume Controls, and all other Radio Components.** If it's top quality components and a speedy, courteous service you are looking for—try Osmor. We really shall do our best for you.*

Trade Enquiries Invited

FREE! *Send 5d. (stamps) for fully descriptive literature including the really efficient 5-valve Superhet Circuit and practical Drawings, 6 valve ditto, 3 valve (plus rectifier) T.R.F. circuit, Battery portable superhet circuit, Coils and Coilpack leaflets, Chassis Cutter leaflet, and full radio and component lists, etc., etc*

OSMOR radio products ltd.

(Dept. P48), 418, Brighton Rd., South Croydon, Surrey. 'phone CRO 5148/9

MAINS TRANSFORMERS
3-way Mounting Type.

MT1. Primary 0-210-230-250 v. Secondary 250-0-250 v 80 mA., 6.3 v. 4 amps., 5 v. 2 amps., with taps at 4v. on filament winding. Price **17/3** each

MT2. Primary 0-210-230-250 v. Secondary 250-0-250 v. 80 mA., 6.3 v. 4 amps., 5 v. 2 amps. Both filament windings tapped 4 v. Price. **17/6** each.

MT3. 30 volt 2 amp. tappings as follows: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 v. **17/6** each.

HAND MICROPHONE BY "REGENT"

complete with screened lead and plug—Crystal insert, nickel chrome plated head, listed at 2 gns. Our price, 21/- each.

✲✲✲✲✲✲✲✲✲✲✲✲✲✲✲✲✲

JUST A FEW LEFT . . . BUY NOW AT THIS LOW PRICE

RECEIVER 1132A

Contains EK32, 4 EF39, 6H6, 6J5, 3 SP61, P61, in good condition. Fitted with tuning meter, slow-motion drive and dial. Complete, with Circuit Diagram, 45/- each, carriage, etc., 7/6.

THE ALPHA AMPLIFIER —3 valves (6B8G, 6V6G.T., 6X5G.T.). A.C. mains fully isolated, neg. feed back (voltage and current), controlled volume and tone, dual input network, for modern crystal or Hi-Fi mega. Less than 1 per cent. total 2nd and 3rd harmonic distortion at 5 watts output from 1,000 C.P.S. Complete ready for use, 79/6. Post extra.

FOR SETS OF ALPHA VALVES

10 EF50 Valves (Ex New Units), 45/- per set.
6K8G, 6K7G, 6Q7G, 6V6G, 5Z4G, 37/6 per set.
1R5, 1S5, 1T4, 1S4 or (3S4 or 3V4), 30/- per set.
7S7, 7B7, 7C6, 7C5, 7Y4, 42/- per set.
ECH42, EF41, EBC41, EL41, EZ40, 50/- per set.
UCH42, UF41, UBC41, UL41, UY41, 50/- per set.
12K8, 12K7, 12Q7, 35Z4, 35L6 or 50L6, 37/6 per set.

AERIAL RODS

Copper-plated Tubular Rods 12in. long. Will plug into one another to make any length Rod Aerials ... **3d.** ea.

TELEROD AERIALS

Indoor TV. Aerials. Complete with Co-Axial Lead for Kirk-O-Shotts frequency. Price 29/6 Our Price **13/11** ea.

BALL DRIVES

Epicyclic Friction Drive ratio 8 : 1 ... ... **1/6** ea.

Epicyclic Friction Drive with Brass Drum. For use with Steel Dial Drive Wire ... **1/9** ea.

COILS AND COIL PACKS

Pair of T.R.F. Coils with Circuit ... ... **5/6** pr.

Weartite Coil Pack 705, 3 waveband. Normal price 53/4 ... Our Price **37/6** ea.

CHOKES

Relyance 20H. 250 Ω, 60mA., clamp construction ... **6/-** ea.

Relyance 10H. 200 Ω, 90 mA., clamp construction ... **9/3** ea.

Relyance 10H. 200 Ω, 150 mA., clamp construction ... **13/-** ea.

Relyance 5H, 250 mA., 200 Ω, fully shrouded ... ... **18/3** ea.

Relyance 10H, 300 Ω, 40 mA., midget clamp construction **5/3** ea.

Cast Iron Case, Pitch Impregnated, 5H, 250 mA ... **8/6** ea.

Standard Choke, Pitch dipped **5/-** ea.

H.F. Pile Wound Choke ... **1/-** ea.

Bulgin Choke, 10 mA., 18H, total resistance 3,700 Ω with tap at 1,800 Ω ... **1/9** ea.

Midget Choke, 25H, 500 mA., 15 Ω ... ... **2/-** ea.

Midget 10H, 250 Ω 10 mA. ... **2/6** ea.

VOLUME CONTROLS
WIREWOUND CONTROLS

5 Ω, 200 Ω, 2K Ω, 5K Ω, 10K Ω, 10K Ω Double, 20K Ω, 25K Ω, 50K Ω, 30K Ω. All **2/4** each.

COLVERN CLR901, 1,000 Ω. **1/9** each

COLVERN SLIDER TYPE CLR801, 3K Ω and 5K Ω Double Unit, **1/9** each ; 20K Ω, 10K Ω, 20 Ω, **1/3** each.

CONTROLS WITH DOUBLE-POLE SWITCH

25K Ω, 2 Meg Ω, ½ Meg Ω, 1 Meg Ω Log, ½ Meg Ω, 1 Meg Ω, 50K Ω, 20K Ω. All **4/9** each.

EX-GOVT. CONTROLS. ALL CARBON TRACK

500 Ω, 600 Ω, 1,500 Ω Double type, 2K Ω, 5K Ω, 10K Ω, 20K Ω, 25K Ω, 50K Ω, 200K Ω, 100K Ω, ¼ Meg Ω, ½ Meg Ω, 1 Meg Ω, 2 Meg Ω, 25K Ω Double type, 50K Ω Double type. All **1/2** each.

VOLUME CONTROLS SINGLE-POLE SWITCH

500 Ω, Wirewound, **2/10** each.

5K Ω, 10K Ω, 100K Ω, ¼ Meg Ω, ½ Meg Ω Log, ½ Meg Ω, 1 Meg Ω, 1 Meg Ω Log, 2 Meg Ω. All **3/9** each.

STANDARD CONTROLS (LESS SWITCH)

50K Ω, ½ Meg Ω, 1 Meg Ω. All **2/8** each.

RELAY.—American relay type No. A20545, 45 ohms, complete with bracket and leads, **2/3** each.

You can turn your portable gramophone into a record player for use in conjunction with your radio with the Goldring pick-up head. (Type 112.) Complete with lead, 15/- each.

GARRARD PICK-UPS.—2,000 ohms A great bargain, 25/- each

(See our full page advert for terms)

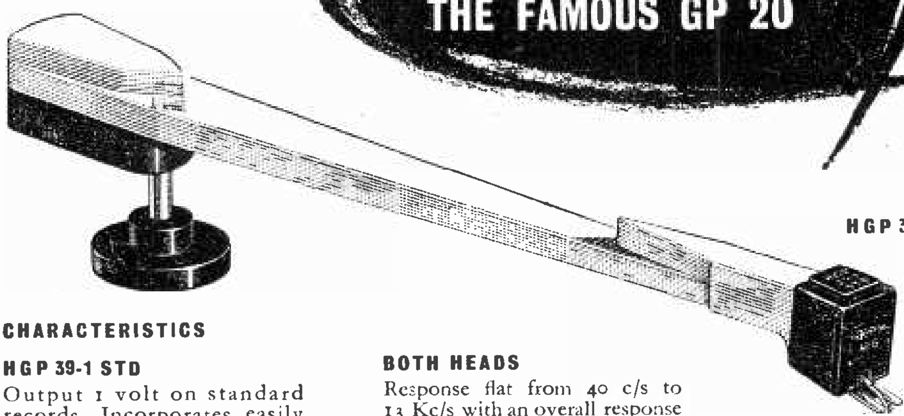
WHEN ORDERING PLEASE QUOTE "DEPT. P.W."

ALPHA RADIO SUPPLY CO.

5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

"Pick-ups and cartridges incorporating the ACOS Regd Hi-g development will track with ease all present day records — and those of the foreseeable future too"

...and NOW YOU CAN GET ACOS Hi-g HEADS FOR THE FAMOUS GP 20



HGP 39 STD

OR

HGP 39 LP

CHARACTERISTICS

HGP 39-1 STD
Output 1 volt on standard records. Incorporates easily changeable 0.0025" sapphire stylus.

HGP 39-1 LP
Output ½ volt on microgroove records. Incorporates easily changeable 0.001" sapphire stylus.

BOTH HEADS
Response flat from 40 c/s to 13 Kc/s with an overall response from 20 c/s to 17 Kc/s. Tracking weight 8 grammes.

PRICE
STANDARD OR LP HEAD ONLY
£1 · 12 · 0 (Plus 10/3 P.T.)

G.P. 20 Hi-g COMPLETE PICK-UP WITH EITHER HEAD £2 · 12 · 0 (Plus 16/8 P.T.)

always well ahead

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COSMOCORD LIMITED · ENFIELD · MIDDLESEX

Practical Wireless

EVERY MONTH
VOL. XXX, No. 572, JUNE, 1954

Editor: F. J. CAMM

22nd YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

The New Amateur Licences

THE new amateur licences which are to be issued as from June 1st, 1954, will be known as The Amateur Sound Licence, The Amateur Sound Mobile Licence and the Amateur Television Licence. The terms of the latter are not yet known, nor have the new fees been announced.

These new licences disclose a more generous outlook on the part of the G.P.O. than has been shown hitherto. A holder of an Amateur Sound Licence is, subject to certain provisions, licensed to establish an amateur sending and receiving station for wireless telegraphy, not only at the main address (the station) or at any premises or location in the United Kingdom (referred to as the temporary alternative address or location) for separate periods none of which shall exceed four consecutive weeks; but at any premises in the United Kingdom provided that the General Post Office Telephone Manager for the area in which the premises are located is notified in writing, in advance, by the licensee of the postal address at which the station is to be established. The holder may also use the station for the purpose of sending to and receiving from other amateur stations, as part of the self-training of the licensee, messages in plain language which are remarks about matters of a personal nature, in which both receiver and sender are directly concerned, and signals (not in secret code or cipher) which form part of or relate to the transmission of such messages.

Limitations however apply. The station must not be established, or used, on the sea or within any estuary, dock or harbour, or in any moving vehicle, vessel or aircraft, and it must be used only with emission specified, and within the frequency band relating to those types of emission. The power is also prescribed. The station must be operated only by the licensee personally, or in the presence of, and under the direction of the licensee or any other person who holds the Wireless Telegraphy Licence issued by the Post Master General, or who holds a P.M.G. Amateur Radio Certificate.

Messages must not be broadcast to amateur stations in general, but only to amateurs with whom communication is established separately and singly, or to groups of particular amateur stations with which communciation is established collectively. The holder of the licence must observe and comply with the provisions of the Telecommunication Convention. A satisfactory method of frequency stabilisation shall be employed in the sending apparatus. Equipment for frequency measurements shall be provided, capable of verifying that the sending apparatus is operating with emissions within the authorised frequency bands. The apparatus comprised in the station shall be so designed, constructed, maintained and used, that the use of the station does not cause any avoidable interference with other amateur stations or any interference with any other wireless telegraph. When telegraphy (as distinct from telephony) is being used, arrangements shall be made to ensure that the risk of interference due to key clicks being caused to other wireless telegraphy is eliminated. At all times, every precaution shall be taken to avoid over-modulation, and to keep the radiated energy within the narrowest possible frequency bands, having regard to the class of emission in use. In particular, the radiation of harmonics and other spurious emissions shall be suppressed to such a level, that they cause no interference with any wireless telegraphy. Tests shall be carried out from time to time to ensure that the requirements are met. The use of "spark" sending apparatus is specifically forbidden.

A record must be kept in a book (not loose-leaved) showing the date, time of commencement of calls made from the station, the call signs of the stations from which messages addressed to the station are received, or to which messages are sent, times of establishing and ending communication with each such station, the frequency or frequencies and class or classes of emission in each case, and the time of closing down the station. No gaps must be left between entries, which must be made at the time of sending and receiving.

There can be no doubt that the terms of the new amateur licences are on a more generous and understanding scale than hitherto. The amateur, it can be said, has at long last been recognised and has come into his own.—F. J. C.

ROUND the WORLD of WIRELESS

The Queen's Visit to Ceylon

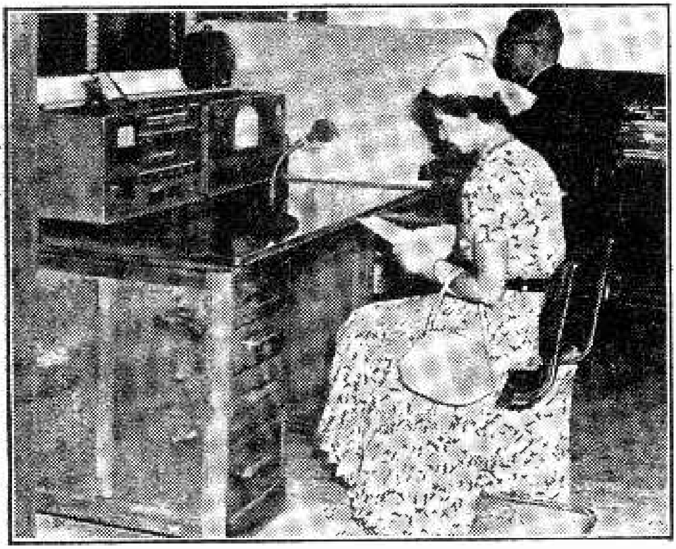
RADIO Ceylon made exceptionally comprehensive outside broadcast arrangements to cover various functions and ceremonies during the visit of Her Majesty the Queen to the island between April 10th and 21st. For the State Drive through Colombo alone no less than thirty-three commentators posted at 11 vantage points described the scenes in Sinhalese, Tamil and English for listeners of the three main linguistic groups of Ceylon's eight million population. Four Marconi O.B. units were in attendance at the War Memorial when Her Majesty laid a wreath there in honour of Ceylon's heroes of two World Wars.

BBC Orchestra Goes Abroad

THE BBC Symphony Orchestra is giving a series of concerts on the Continent this month, under the conductorship of Sir Malcolm Sargent, conductor-in-chief.

The Orchestra will leave London on June 13th, and give its first concert on the following day in Düsseldorf. The remaining concerts will be given in Hamburg on June 16th; in The Hague on June 18th; in Amsterdam on June 19th: in Maastricht on June 20th; in Brussels on June 21st, with a special studio concert for the Belgian Broadcasting Service in Brussels on June 23rd.

The BBC Symphony Orchestra has previously made three visits to the Continent—in 1935 for a single concert in Brussels, in 1936 and 1947, when Sir Adrian Boult was conductor-in-chief.



During the Royal Tour of Australia, Her Majesty The Queen broadcast from the Flying Doctor Base at Broken Hill, New South Wales, over a radio network covering half-a-million miles of Australia's outback.

High-power Radiotelephony

A NEW "Oceanspan" transmitter, providing high-power facilities for long-range radiotelephony as well as morse communication, has been designed by The Marconi International Marine Communication Co., Ltd. The production of the new transmitter means that owners may now have in one set all the advantages of the original "Oceanspan," including all the marine high frequencies for telegraphic communication plus high-quality speech communication enabling ship's personnel to speak direct to their offices through the medium of the land telephone services.

Broadcast Receiving Licences

THE following statement shows the approximate number of sound receiving licences issued during the year ended, February, 1954. The grand total of sound and television licences was 13,350,136.

Region	*Number*
London Postal ...	1,629,489
Home Counties ...	1,439,306
Midland	1,247,757
North Eastern ...	1,633,447
North Western ...	1,270,256
South Western ...	1,010,057
Wales and Border Counties	631,471
Total England and Wales	8,861,783
Scotland	1,095,371
Northern Ireland ...	219,958
Grand Total	10,177,112

A "Brain" on Board

HALF a mechanical "brain" was among cargo that left London for Australia recently in the s.s. *Esperance Bay*. It is part of equipment which has been developed by Cable and Wireless Ltd. to detect and correct errors in wireless messages caused by atmospheric interference and will be installed in Sydney. The other half of the "brain" will be installed in the Post Office's London Telegraph Station and tests will shortly be carried out over the London-Sydney telegraph circuit.

The "brain," which is about the size of a portable typewriter, detects mistakes in coded and cipher messages which could not be detected by a human operator. It has been developed by a team of engineers, headed by Mr. R. L. Saunders, of Sunbury-on-Thames, Middlesex, in Cable and Wireless Ltd's workshops at Radio House in the City of London.

New Director Elected

MR. N. C. ROBERTSON, C.M.G., M.B.E., deputy managing director of E. K. Cole Ltd. has been formally elected a director of Ekco Electronics Ltd.

A wholly-owned subsidiary company of E. K. Cole Ltd., Ekco Electronics Ltd. was formed last year to handle the marketing, installation and maintenance of Ekco electronic and nucleonic equipment.

Installations for R.A.F. Hospitals

IMPORTANT new contracts secured by the Sound Amplification Division of E.M.I. Sales and Service Ltd. are for radio systems in nine R.A.F. hospitals throughout the country and for the installation of a comprehensive sound amplification system in the great hall of the Royal College of Surgeons. Each of the hospital installations has provision for dual-programme operation, and individual programme selectors and volume controls are fitted by each bed.

Patients are supplied with lightweight headphones and loudspeaker systems are fitted in the Day Rooms, Duty Rooms, and Isolation Wings of the hospitals.

Philips Increase Factory Space

PHILIPS announce that factory capacity devoted to radio production has, this year, been appreciably increased in order to meet the heavy demands which, it is anticipated, will be made upon it. The new range of receivers embodies all the latest technical features and the usual high standard of design and finish is well maintained.

Home Service Coverage

THE BBC has installed a new low-power transmitter at its station at Scarborough, Yorkshire. This is a further step in the plan to make local improvements in the coverage of the Home Service.

The new transmitter took over the service from the present temporary transmitter on Sunday, April 11th. It has a power of 2 kW, eight times that of the existing transmitter, and it is expected that this will extend the area of improved reception to include Filey, Hunmanby, Wykeham, Hackness, Harwood Dale and Ravenscar.

The new transmitter will for technical reasons share the same wavelength (261 metres) and radiate the same Home Service programmes as the North-east England and Northern Ireland transmitters.

Ekco Radio Sales Manager

MR. ROBERT WRATHALL joined E. K. Cole Ltd. on Monday, April 5th, as radio sales manager.

For many years sales manager of Philips Electrical Ltd., Mr. Wrathall is well known in the trade and only recently relinquished the post of general sales manager of Vidor Ltd.

Marine Dollar Export Order

THE Marconi International Marine Communication Co., Ltd., has received an order through the Canadian Marconi Company to supply radio communication equipment and aids to navigation for the 12,400 ton bulk alumina carrier under construction at the Lauzon, Quebec, yard of Davie Shipbuilding Limited. The vessel is being built for Sun Steamship Limited and has been bareboat chartered to Saguenay Terminals Limited of Montreal. Installation of the radio equipment will be carried out by the Canadian Marconi Company.

European Tour

THIRTY-FIVE editors from American newspapers and radio and television stations arrived back in the United States by air recently from a 32-day tour of Europe and the Middle East.

Among the principal cities visited by the party were Frankfurt, Berlin, Cologne, Vienna, Belgrade, Athens, Istanbul, Teheran, Rome, Paris and London.

Controlling the Crowds

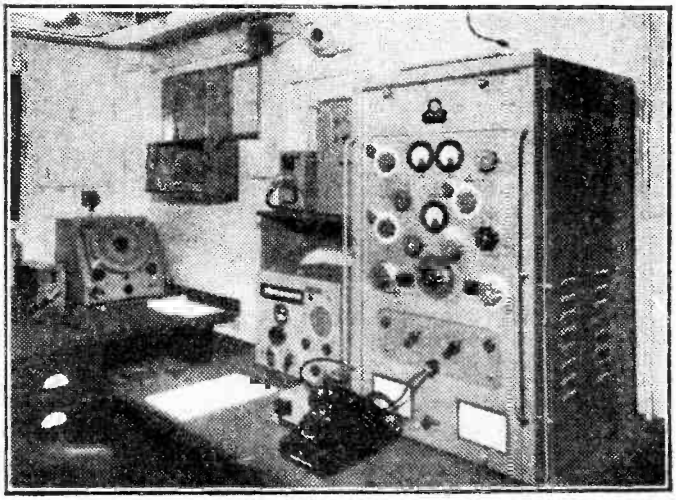
TWO-WAY radio was employed by London Transport to control buses taking racegoers to the Epsom meetings last month.

Two short-wave radio vans were stationed on the Downs and at Epsom to keep contact with inspectors on the bus routes by walkie-talkie and to control the vehicles on the crowded roads leading to the course.

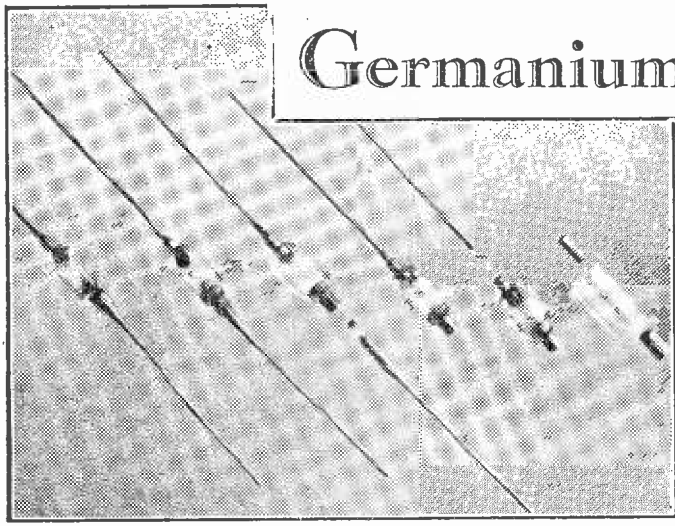
Fewer Home Listeners

FEWER people are listening to the Home Service programmes than in November and more are tuning in to the Light Programme.

This is revealed in an audience-research survey conducted on behalf of Radio Luxembourg, who found that the average number of listeners to the Home Service in February was 10,520,000, to the Light Programme 18,840,000, and to Radio Luxembourg, 6,920,000. Since November of last year, the average daily Home Service audience has decreased by 1,360,000 and the average for the Light Programme has increased by 560,000. Over 16,000 people, all adults, were interviewed during the survey, which was conducted on the same lines as those used by the BBC.



The bench-mounted version of the new "Oceanspan" radiotelephony and telegraphy transmitter on board the new P. & O. liner Arcadia.



Germanium Rectifiers

SOME INTERESTING DETAILS OF THE MANUFACTURING PROCESS AND TESTING OF THESE USEFUL RADIO COMPONENTS

RECTIFIERS based on the properties of the non-linear conduction between a metal and a semi-conductor were widely used in the early days of radio. Whilst being quite efficient they were very unreliable electrically and unstable mechanically, and were soon superseded by the thermionic diode.

Later, more robust and stable rectifiers were introduced for power and audio-frequency applications, the main materials used being copper-oxide and selenium. However, the high self-capacitance, due to the large area of contact between the metal and semi-conductor, made this type of rectifier unsuitable for use at high frequencies.

With the introduction of radar during the war, which called for detectors at frequencies of thousands of megacycles per second, a rectifier was needed with even lower self-capacitance and high conductance than the thermionic diode. This requirement led to the development of the modern version of the silicon rectifier, in which a point-contact was used as in the early days, but the device was made much more stable by improved technique. Its inability to withstand large transient surges and its low voltage-handling capacity were the main limitations of the silicon crystal. Although silicon is still used universally at centimetre wavelengths, germanium is now generally used in point-contact rectifiers designed for operation at wavelengths of one metre or more.

Germanium diodes, in many instances, have ousted the thermionic diode, over which they have several advantages :

1. High forward conductance.
2. Low self-capacitance.
3. Small size and robustness.
4. Absence of heater supply and hence freedom from troubles due to R.F. feedback and hum.

The main disadvantage of the germanium diode compared with the thermionic diode is its finite back resistance. This, however, can be overcome in most cases by the correct choice of circuit and by taking into consideration the individual characteristics of each type of rectifier.

Germanium diodes, as manufactured by the G.E.C., can be divided into two fundamental types :

1. High back voltage.
2. High forward conductance.

The high-back-voltage types incorporate very pure germanium and are graded—

(a) for turnover voltage (i.e. voltage at which the reverse dynamic impedance is zero) which governs the magnitude of the peak inverse voltage that can be applied and

(b) for the reverse resistance which governs the impedance of the circuit in which the rectifiers will operate satisfactorily. The mean forward

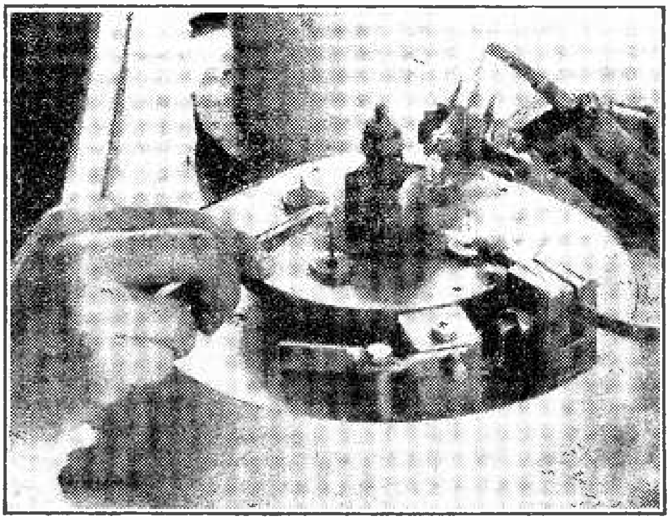


Fig. 1.—Fusing the glass capsule of the G.E.C. germanium diode to the alloy tube. An oxy-coal-gas flame is used and the machine is semi-automatic.

current measured at +1 volt is approximately 8mA.

In the high-forward-conductance types the germanium is deliberately poisoned by the addition of a carefully controlled amount of antimony. These rectifiers are sub-divided into two main categories :

1. Diodes which have a low self-capacitance. These have been designed for use as mixers and low-level detectors in the H.F. and V.H.F. band. The mean forward current at +0.5 volt is 8mA.

2. Diodes which have a self-capacitance of the order of 30 pF but in which the forward resistance is very low. These are restricted in use to application at low frequencies (i.e. as modulators in telephone circuits, meter rectifiers and any application needing very high forward conductance at low voltage levels). The mean forward current at +0.3 volt is approximately 8mA.

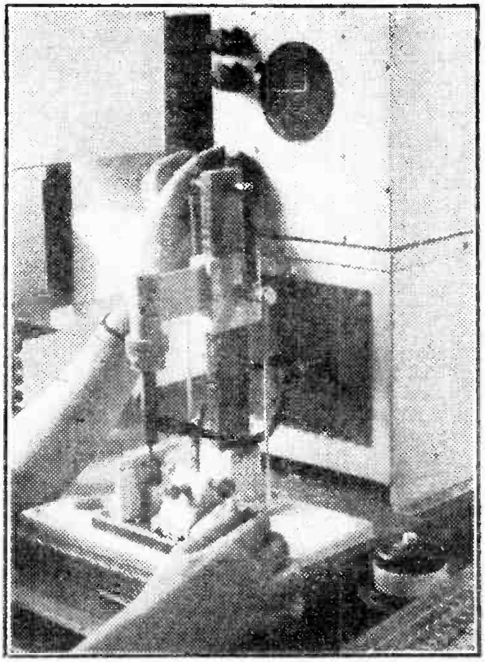


Fig. 3.—The method used for mating crystal and whisker in a G.E.C. germanium diode. The crystal is advanced by a micrometer adjustment until it contacts the whisker and is then further advanced to obtain the correct contact pressure. The static characteristic is displayed on the cathode-ray oscilloscope.

Germanium

The bulk of the germanium now used for the manufacture of rectifiers in England, is extracted from the flue dust obtained by burning certain types of coal. The method of extraction, developed jointly by the G.E.C. and Johnson Matthey, Ltd., yields from ½–1 per cent. germanium oxide from the dust. The oxide is reduced to germanium metal powder by heating in an atmosphere of hydrogen. The powder is then melted in an inert atmosphere to form germanium ingots. These operations have to be controlled very carefully if germanium of the purity required for rectifiers is to be obtained. The germanium, however, must include a small amount of arsenic or antimony, the optimum value being of the order of 1 part in 10,000,000. If the amount is appreciably less than this, the rectifiers have very high forward resistance. On the other hand a larger proportion of arsenic or antimony reduces the turn-over voltage. Uniformity of characteristics thus requires accurate control of the very low impurity content. The only method of attaining this, is first to reduce the impurity to a level well below that finally required and then to add controlled amounts. New techniques have been developed to attain pure germanium, and the material now used in production is probably in a form more pure than that of any other material.

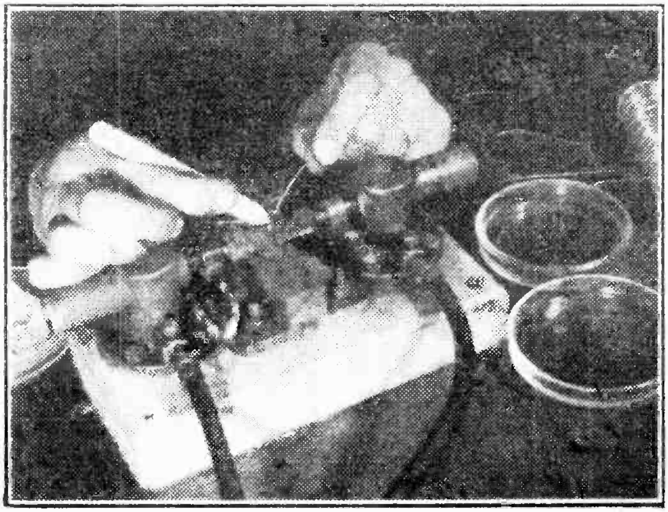


Fig. 2.—The germanium cube used in a G.E.C. germanium diode is mounted on the stub with a high melting point solder.

Construction and Manufacture

The various stages in the manufacture of the G.E.C. rectifier are shown opposite. The body of the rectifier consists of a glass envelope fused to two tubes of different diameters in an alloy of nickel and iron. The tubes and the special glass have been selected to give good sealing. That is, the thermal expansion of the metal and glass must be such as to give a strain-free seal in order to withstand the severe conditions to which the rectifiers will subsequently be subjected. The glass capsule is formed on a semi-automatic machine by fusing the two ends of the rotating glass and alloy tubes by means of an oxy-coal gas flame (see Fig. 1). The table on which four sets of parts are mounted is rotated when the glass-to-metal seal is complete. Considerable experience is required in order to determine the exact amount of heat required ; too much will cause the glass to collapse and too little will not produce a good seal. A successful seal depends on the oxide formation between the alloy tubes and the glass. This oxide must be removed from the exposed parts of the tube so that a satisfactory weld can be made to it in a subsequent operation. The capsule is therefore chemically etched to remove the oxide. An annealing process is then carried out on the capsule in order to remove any strains in the body of the glass.

The whisker and germanium are both mounted on nickel rods or stubs which have been swaged to form the connecting wires.

The whisker wire, which is of a springy platinum alloy 0.004in. in diameter, is welded to the whisker stub and crimped to the required length and form. It is important that the platinum wire is cut in such a way that a sharp point is presented to the germanium. The whisker stub is then welded into the smaller of the two alloy tubes. If the glass-to-metal seal is not to be damaged during this welding operation, the weld must be carried out in a very short time ; special welders have been developed which perform the operation in one-hundredth of a second.

Wastage

The germanium which, as mentioned earlier, is prepared in ingot form, is cut into 0.03in. cubes. The wastage in the operation is quite considerable, despite the use of the thinnest of cutting wheels. Because of the high price of germanium all the sludge from this operation is re-claimed for further processing. The germanium cube is mounted to the stub with a high melting point solder (Fig. 2) and the surface is ground and polished to form the rectification area. This area is then etched to form a suitable surface for the whisker contact.

The glass capsule with the whisker mounted in it and the crystal soldered to its stub are now ready for assembly. The next operation, which is the most critical, is the mating of the crystal and the whisker. The equipment used is shown in Fig. 3. The crystal is advanced by the use of a micrometer adjustment until it makes contact with the whisker ; it is then further advanced to obtain the correct contact pressure. An A.C. voltage is applied between the crystal and the whisker and the static characteristic is displayed on a cathode-ray oscilloscope. If this characteristic is considered satisfactory a forming current is passed through the rectifier, and the crystal stub is welded into its sleeve.

The characteristic of a germanium rectifier is sensitive to the presence of water vapour, which makes it necessary for the capsule to be hermetically sealed. This is carried out by soft soldering the two ends. However, before this can be accomplished the oxide formed during the welding process has to be removed, by means of a rotating scratch brush. To ensure that the contact is not moved by vibration, the face of the germanium is coated with a plastic cement immediately before assembly. This cement is subsequently polymerised by heating so that the whisker is held firmly on the face of germanium. Finally, the lead-out wires are tinned to facilitate the soldering of the rectifier in service, and the body is cleaned to remove any grease or flux.

Grading and Testing High Back Voltage Types

The rectifiers are first segregated for turnover voltage by the use of a circuit which displays on a cathode-ray tube the characteristic curve of the rectifier under test.

The diodes are then graded according to their reverse and forward resistances at various voltages by passing a fixed current through the crystal in the forward (easy-flow) direction and measuring the voltage drop. This method is employed in preference to measuring the current at a fixed voltage owing to difficulties in obtaining current meters whose resistance is low compared with that of the rectifiers. The reverse resistance is measured by applying a fixed voltage in the "no-flow" direction and measuring the current passing through the rectifier. Diodes intended for use at high frequencies, e.g., television sound and video detectors are given a rectification efficiency test at 45 Mc/s, since D.C. measurements do not always predict accurately the behaviour at high frequencies.

Typical grades supplied, for example, to the Services, are as follows :

Type	Turn-over voltage	Current at +1 volt	Current at −10 volts	Current at −50 volts
CV 448	100 min.	3 mA. min.	—	100μA. max.
CV 425	80 min.	4 mA. min.	—	1,000μA. max.
CV 442	30 min.	3 mA. min.	1,000μA. max.	—

High Conductance Types

Such rectifiers have been designed for use in applications where the applied voltage is low, so that the forward and reverse currents are measured at lower voltages than for high reverse voltage types. In the forward direction the voltage for a current of 5 mA. is measured, and in one type, primarily intended for use in telephone modulators, the rectifiers are graded to have a very small voltage variation.

The following table indicates the type of characteristic obtained from these high-conductance rectifiers :

Type	Voltage to produce a current of 5 mA.	Current at −1 volt	Self-capacitance
GEX 66	0.5 max.	50μA. approx.	1 pF.
GEX 64/3	0.30 max. 0.285 min.	160μA. approx.	May be as high as 30 pF.

Inspection and Quality Control

To ensure that the rectifiers are suitable for operation under severe climatic conditions all rectifiers are placed in a humidity cabinet for a period of seven days. The temperature inside this cabinet varies cyclically from 35 deg. C. to 50 deg. C. and the relative humidity rises from 50 per cent. to 99 per cent., which represents more severe conditions than are likely to be experienced in the tropics. Quality checks and life tests are carried out on a percentage of the rectifiers produced (from day to day) by laboratory personnel, thus ensuring the high standard of reliability expected.

Typical tests are :

1. Stability with time.
2. Stability after overload.
3. Stability after temperature changes and humidity cycling.
4. Life tests, in which hundreds of rectifiers are continuously operated under typical circuit conditions. These tests take a period of years to complete.

The Beginner's Guide to RADIO

The Fourteenth Article of a Series Explaining the Fundamentals of Radio Transmission and Reception. This Month the Detector Valve is Considered

By F. J. CAMM

WHAT we do then is to cut off all the current in one direction by means of a detector valve. The remaining currents are thus all in one direction. Obviously, they are still moving quickly, but instead of rising to their maximum value in one direction and, after dropping to nothing, rising to an equivalent value in the opposite direction and so giving an average effect of no current, they now rise to full value in one direction, drop to zero, and again rise in the same direction.

It is the average current referred to last month to which the loudspeaker responds, and it is also this average current which alters in strength with every fluctuation of the transmitted music or speech. Thus it is that the cone of the loudspeaker vibrates in sympathy with these fluctuations and so reproduces the sound from the studio.

The Detector Valve

Having explained the reason why a detector valve is necessary, we may now consider how it works. In the centre of the glass envelope is a filament similar to that of an electric lamp, except that it does not glow brighter than a dull red. It is a *dull emitter* unlike earlier valves which were bright emitters. Surrounding the filament is a spiral of wire called the grid and surrounding the grid is a metal sheath known as the plate. Figs. 60, 61, and 62 given last month illustrate the normal electron flow inside the valve and the signal electron on the grid and grid condenser. It will be understood that it is difficult to illustrate the filament, grid and plate in their true relation surrounding one another, so they are shown one above the other.

Now let us consider what takes place inside the valve. The filament is heated, either by a battery or from the mains by means of a heater surrounding the filament. As soon as the filament is hot it gives off a stream of electrons and these fly off in all directions. Most of them pass between the wire turns of the grid and are attracted to the plate. Or, put another way, there is a steady flow of electrons from the filament to the plate—in other words a flow of electric current. The plate is connected to the positive terminal of the battery and so is made positive, and this has the effect of attracting the electrons from the filament and ensures that as few as possible escape. This attraction is due to the principle that like attracts unlike, or in this case that positive attracts negative. Conversely, likes repel, such as two negatives or two positives.

So far then we have two distinct electric currents flowing in the receiver. One, the high-frequency current pulsating in the aerial circuit, and the other the plate current flowing steadily from the filament to the plate of the detector valve. We have already seen that the currents in the aerial circuit are due to the pulsating movement of the electron. They travel along the wire and crowd up against one of the plates of the condenser. These repel some of the electrons on the opposing plate of the condenser (like repels like) and sends them along to the grid. The electrons on the grid have a marked effect. Being in the path of the electron stream flowing from the filament to the plate, they repel some of the latter and so reduce the plate current. This means that when the current in the aerial circuit flows one way it reduces the plate current and when the aerial current flows in the other direction the opposite happens.

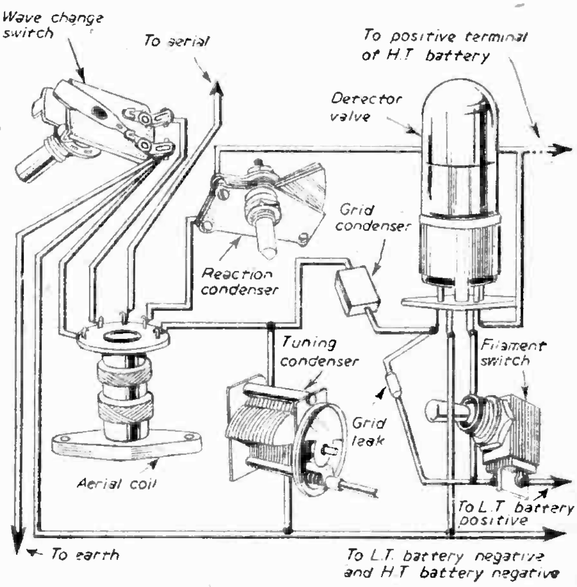


Fig. 63.—A typical detector stage in pictorial form.

As there is a deficiency of electrons on the left-hand plate of the grid condenser, electrons on the grid immediately rush along to the right-hand plate of the condenser, attracted by the positive state of the other plate (positive attracts negative). This rush of electrons away from the grid leaves it positive and now attracts the electrons coming from the filament instead of repelling them. Indeed, it actually helps them across to the plate, and so increases plate current. Thus every fluctuation is in the plate current, and it is the latter which is passed on via the other two valves to the speaker as it is more powerful than the aerial current.

What happens is that every time the grid becomes positive, it attracts a few of the electrons as they rush from filament to plate. These remain on the grid and so assist in the repelling action that it has when it is negative, and in this way the grid has more effect on the plate current when it is negative than when it is positive. This means that instead of the average effect on the plate current being zero or nil, as it would be if the attraction and repulsion were equal, the average effect is now a reduction of plate current below normal. The amount of reduction depends upon the intensity of the rapid changes of the grid from negative to positive, and this in turn depends on the strength of the current in the aerial circuit which, of course, varies with the fluctuations of the speech, music or other sounds being transmitted.

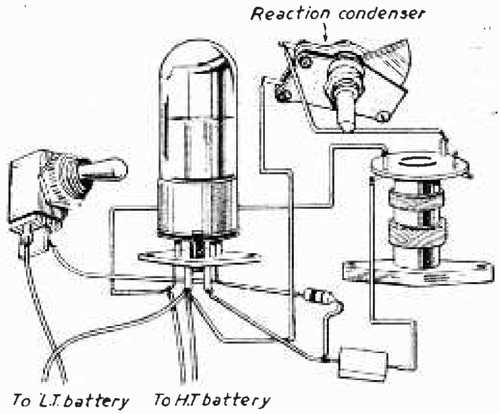


Fig. 66.—The reaction circuit.

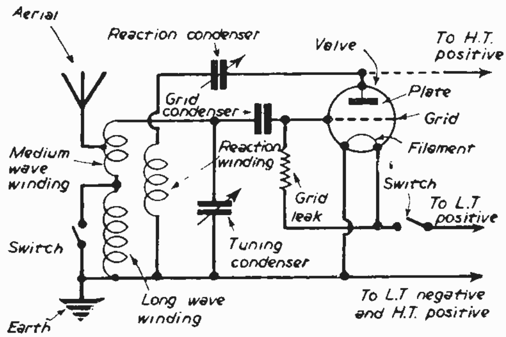


Fig. 64.—Circuit of a detector stage.

The Grid Leak

The grid leak is connected with the grid of the valve to prevent too many electrons remaining on it. As its name implies, it provides a path of escape for them—a means for them to leak away.

We do not, of course, pass the current in the aerial circuit through the loudspeaker. It is the plate current which is used. Now let us consider how a detector is connected into the circuit. At the base of the valve are the legs, and in the simple three-electrode type there will be four such legs. Two of them are for connections to the battery or the mains for purposes of heating the filament, one is for connecting to the plate, connected as we have already seen to the positive of the source of H.T. supply, and the other is the grid connection. It will be noted that the valve legs are unequally spaced to ensure that the valve is not inserted in the wrong valve leg sockets. Fig. 63 is a practical wiring diagram showing how the detector valve is connected up, whilst Fig. 66 shows how reaction is added. Fig. 64 is the theoretical circuit of the detector portion of the receiver and Fig. 66 shows battery connections.

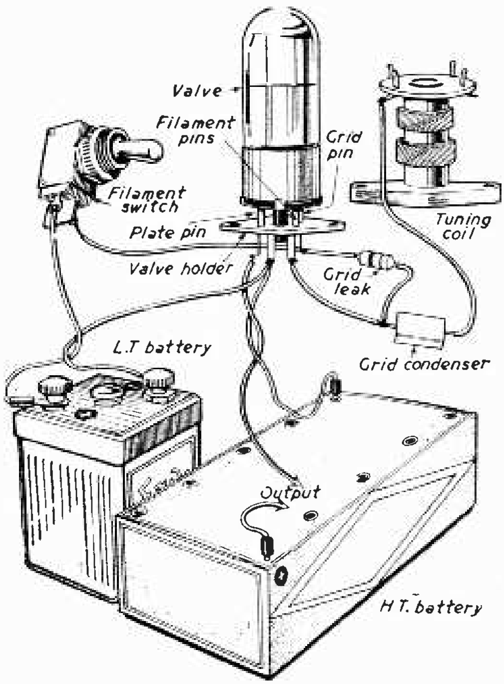


Fig. 65.—Battery connections.

Reaction

Reaction, which is a short term meaning regenerative amplification, is a method of strengthening or boosting up weak signals. We have seen that the rapid oscillating currents in the aerial circuit acting on the grid, cause corresponding oscillations in the plate current and that the latter is stronger than the aerial current, since it is derived from the H. T. source and is not dependent on the power of the incoming radio waves, which gradually get weaker as their distance from the transmitter increases. Therefore, some of the plate current is allowed to pass through a coil of wire somewhat similar to the aerial coil and this coil can be wound on the same former as the aerial coil, the effect of this being to induce a current in the aerial coil which helps to strengthen the original oscillations. In modern receivers this practice is not always adopted. There is always some loss in the strength of the aerial current due to resistance of the wire in the aerial coil and the placing of the reaction coil near it has the effect of neutralising any resistance.

Reaction Condenser

The effect of the reaction coil can be varied at will by means of a reaction condenser, which is a component similar to the tuning condenser and thus acts as a volume control. When the plates or vanes are right in, reaction is at a maximum and, of course, at a minimum when they are all out. One practice is to wind the reaction coil between two aerial coils on the same former. One is cut out of circuit by means of a switch, while the other is in use. The reason for the two aerial coils, of course, is that they each cover a different range of wave lengths. By the aid of the tuning condenser, one of the coils will cover, say, from 200 to 500 metres, while the other will cover a range of between 1,000 and 2,000 metres. Modern multi-wave sets of course cover other ranges.

(To be continued)

News from the Clubs

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: L. H. Webber (G3GDW), 43, Lime Tree Walk, Newton Abbot.

AT the Annual General Meeting, presided over by G2GK, the Minutes were read by the Secretary (G3GDW) and were adopted.

The Chairman (G2GK) referred to the excellent state of the Society, and the good work performed during a successful year, culminating in the excellent result of the "Hamfest" held last October.

The Treasurer (G2GM) produced his report for the year, and all the officers of the Society were thanked by the chairman.

Congratulations were given to our President (G5SY) on his reaching 44 years in Amateur Radio. In answer to this, G5SY recalled that many years ago, his 28 Mc/s CW signals were the first heard in New Zealand from any British Amateur station.

The officers of the Society were re-elected for 1954, with the addition of G4RD as Hon. Auditor.

At the next meeting of the Society, the proposal to form a "T.V.I." Committee will be discussed.

The Hon. Secretary (G3GDW) asked members to listen for his son (now doing his National Service in Cyprus), who has been granted his call ZC4LW, and will be operating 20 watts CW on 14020 kc/s most afternoons.

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: N. Miller, 10, Rom Crescent, Romford.

MEETINGS of the Society have continued on every Tuesday evening at 8.15 p.m. at R.A.F.A. House, 18, Carlton Road, Romford. Attendances at meetings are encouraging but new members will be warmly welcomed.

In conjunction with the British Amateur Television Club a lecture and demonstration of a live TV camera will be given by D. Wheele (G3AKJ).

The club transmitter (G4KF) is on the air from the above QTH and the morse classes continue. Steady progress is being made with the equipment and arrangements for NFD.

SOUTH MANCHESTER RADIO CLUB

Hon. Sec.: M. Barnsley (G3HZM), 17, Cross Street, Bradford, Manchester, 11.

IMPORTANT forthcoming dates are: May 21st—Demonstration of a Portable Transmitter, by B. O'Brien (G2AMV). June 4th—Clamp Tube Modulation, by M. Denny (G6DN). June 18th—Transistors, by W. L. Robinson.

A D.F. contest will be held on May 23rd.

For the benefit of those people who are just taking up the hobby of amateur radio the club is arranging a series of very simple lectures to be given prior to the main lecture of the evening and any readers who would like to take the opportunity of these lectures will be welcome.

COVENTRY AMATEUR RADIO SOCIETY

Hon. Sec.: K. Lynes (G3FOH), 142, Shorncliffe Road, Coventry.

MEETINGS continue on alternate Mondays at 9, Queen's Road, Coventry, commencing at 7.30 p.m.

The Club Station is active on 80 metre CW telegraphy.

Recent activities have included "An Introduction to Amateur Radio" contributed by a number of members including G5GR and G2FTK, a valued talk by David Harries, G3RF on Tuned Circuits, and the popular "Club Night on the Air" on the 1.8 Mc/s band when nine stations took part from their own shacks.

BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: T. J. Huggett, 15, Waverley Crescent, Brighton, Sussex.

THE club T.X. under the call sign G3EVE, is on the air on CW and phone on 80 metres and top band. A large quantity of radio components has been acquired, and it is proposed to commence an "assisted constructional scheme" to help the younger members to build their own equipment. The recent "Junk Sale" proved very popular, and a repeat performance has been arranged. Mr. E. Bannister's talks on Radio Maths are now a regular feature, together with talks and demonstrations by members, about equipment that they have made. Meetings are held every Tuesday at 7.30 p.m. at the Eagle Inn, Gloucester Road, Brighton.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: C. H. Bullivant, 25, St. Fillans Road, Catford, S.E.6.

ONE of the marvels of modern science is plastics and Mr. D. S. Mahon, B.Sc., from Bakelite, Ltd., recently gave an interesting talk on this very wide subject. Mr. Mahon's talk and the two films which were shown explained clearly both the chemical and manufacturing processes involved and the evening was undoubtedly one of the best ever held at the Clifton.

A number of visits to places of interest have been scheduled and in addition to the visit to Deptford Power Station the club has been fortunate in receiving an invitation from the BBC to visit their Receiving Station at Tatsfield in June.

Meetings of this Society are held every Friday at 7.30 p.m. at the club rooms, 225, New Cross Road, S.E.14, where visitors and new members are assured of a warm welcome.

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

THE Society meets at the Abbey Gateway, Reading, on the second and last Saturdays of each month at 7 p.m. All those interested in the construction of amateur radio receivers, transmitters, television, tape recorders, etc., are very welcome. Junk sales are frequently held. Further details from the Secretary.

WARRINGTON AND DISTRICT RADIO SOCIETY (G3CKR)

Hon. Sec.: G. H. Flood, 32, Capesthorne Road, Orford, Warrington.

DURING April exhibits and lectures on home constructed equipment were presented by A. Rigby (G3FGI)—"A Car Radio"; and G. Leigh (G2FCV)—"A Grid Dip Oscillator."

Future events include: on June 1st, "Demonstration of Club Field Day Equipment."—L. Williams.

Newcomers are cordially invited to meetings in the club room at the King's Head Hotel, Winwick Street, at 7.30 p.m., on the first and third Tuesdays in each month.

CONVERTING T.R.F. TO SUPERHET

DETAILS FOR CARRYING OUT CIRCUIT MODIFICATIONS TO EXISTING RECEIVERS

By F. G. Rayer

IN general, the superhet has a number of advantages over the "straight" or tuned radio frequency receiver, the most important being the increased selectivity obtainable. Many T.R.F. receivers of the R.F.-detector-output type are insufficiently selective for present-day medium wave reception, in particular, and much interference may be experienced, especially during the hours of darkness. In view of this, the constructor and experimenter may feel that the modification to superhet working is worth while, and this is particularly feasible in home-constructed receivers. Generally, the gang condenser, tuning dial, and most of the other components may be retained. If space exists for the addition of a further valve, a very great improvement in results can be obtained. If, however, cabinet or chassis dimensions make this impossible, an improvement may still be achieved without increasing the number of valves. Various methods of changing the circuit are possible, and those to be dealt with may be used with success. Though mains circuits are shown, the same arrangements may be adopted with 2-volt or 1.4-volt battery type valves.

R.F. to I.F.

Fig. 1 shows a typical T.R.F. radio frequency stage, followed by an anode-bend detector of the type used in most small A.C./D.C. receivers and also in many A.C. receivers. The actual form of coupling may be dissimilar in any specific receiver, as tuned anode, bottom-end, or choke-capacity coupling may be used instead of the primary winding. Both coils are tuned by means of a gang condenser. This is usually of .0005 μF. capacity and is equally suitable for superhet tuning.

When the coils and gang condenser are disconnected and two intermediate frequency transformers substituted, intermediate-frequency and detector stages suitable for superhet working are obtained, as shown in Fig. 2. (The detector stage is not yet of the type most generally found in superhets, but is nevertheless quite satisfactory.) The wiring changes are very few, and the I.F. transformers should be for 465 kc/s operation, and may be either trimmer or dust-core tuned.

The detector coil (with reaction condenser, if present) should be wholly removed. The aerial coil may usually be retained, since dust-cored oscillator coils can usually be adjusted to align with almost any ordinary tuning coil. This means that the station dial may be retained. (In some cases it may be necessary to use new aerial coils, however, as will be explained.)

The circuit shown in Fig. 2 only requires the addition of a frequency changer stage, and it is here that the majority of the new constructional work will arise. Should the T.R.F. detector have a grid leak and grid condenser, it is best to remove these and convert to anode-bend rectification since the signal reaching the detector will now be of considerably increased strength. For anode-bend detection, a cathode resistor of 10,000 ohms is usually required, and the low value used with the same type of valve in R.F. stages is not suitable.

F.C. Stage

The complete frequency changer stage is shown in Fig. 3, the I.F. transformer being the first of the pair in Fig. 2. Component values given are for a 6K8 or similar valve, and this valve may be used in A.C./D.C. receivers with a .3 amp heater chain, or in A.C. sets with a 6.3-volt heater supply.

Assuming that the receiver originally tuned long and medium waves, then long and medium wave oscillator coils are used (the T.R.F. detector coil will *not* be suitable). Coils with adjustable dust cores are best, since their inductance may be adjusted to suit the aerial coils. The padder capacities of 300 and 3,000 pF for long wave and medium wave coils may not be applicable to all oscillator coils, so that the

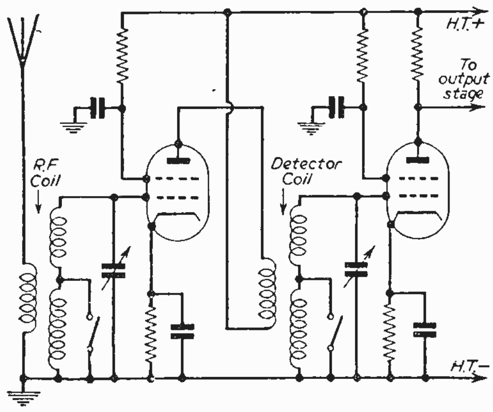


Fig. 1.—Typical T.R.F. R.F. and detector stages.

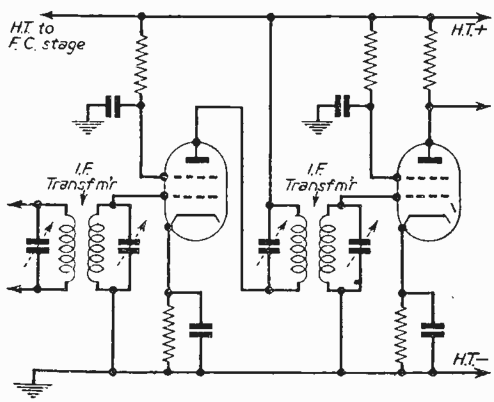


Fig. 2.—Circuit modified for superhet.

capacities recommended by the coil maker in his circuit or data should be used, here.

If the present wavechange switch is not suitable, a rotary switch with suitable contacts may be used to replace it. Whether this is necessary or not depends upon the circuit used in the T.R.F. receiver.

If it is subsequently found that the aerial coil is not suitable for the modified circuit, a modern coil can be substituted. The possibility of extending the usefulness of a long and medium wave receiver by adding a short-wave band should not be overlooked, and the simplest way to do this is to remove the old coils and switch and substitute a modern three-waveband coil-pack. Space for this can frequently be found, except in very small receivers.

With A.C./D.C. receivers, the 6K8 heater is wired in series with the other heaters, near the end of the heater chain which terminates at the chassis. With A.C. receivers, it should be wired in parallel with the other heaters. If the heater voltage or current is other than that mentioned, a suitable valve should be chosen for operation with the other valves in the receiver.

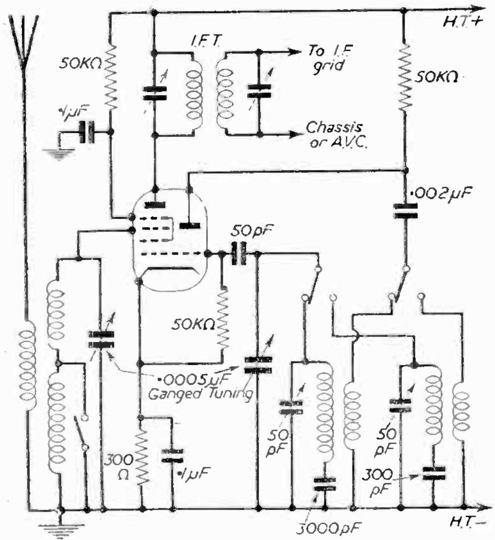


Fig. 3.—A 6K8 frequency changer stage.

When the F.C. stage has been built in, the conversion is completed in that superhet reception is now possible, with a very great increase in selectivity.

Detector and Output

The constructor may subsequently feel that the usual type of superhet detector, with A.V.C., should be adopted. The usual T.R.F. detector and output stages are shown in Fig. 4. In the superhet so far arrived at, these stages remain unchanged, the grid of the detector being taken to the I.F. transformer secondary. It is possible, however, to remove the detector and use a double-diode-triode for detection, L.F. amplification, and automatic volume control, as illustrated in Fig. 5. (Here, the A.V.C. has for the moment been omitted.)

Again, component values are for a typical valve found in A.C./D.C. and A.C. sets—the 6Q7. With other valves, the bias resistor value and value of the anode resistor may need to be modified. A number of small components have been added, including a .5 megohm volume control. The output stage itself remains unchanged.

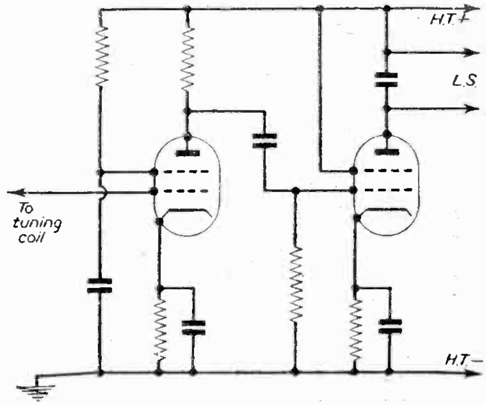


Fig. 4.—T.R.F. detector and output stages.

When the wiring has been modified in accordance with this diagram, volume will be improved, as will quality of reproduction. Except for the addition of A.V.C., the receiver has now become a standard superhet of the four-valve (plus rectifier) type, and should have a good degree of selectivity and sensitivity.

Alignment

Maximum results will only be obtained when the circuits are aligned, and this does not usually present much difficulty. A station about one-third from the high-wavelength end of the medium wave band should be tuned in, and the oscillator coil carefully adjusted for maximum volume. A station near the low-wavelength end of the band is then tuned in, and the trimmer adjusted for maximum volume. The I.F. transformer cores or trimmers should then be adjusted, one at a time, for maximum volume. An insulated tool is desirable for all adjustments, which should be repeated a number of times, with weak stations. When the medium wave band is aligned,

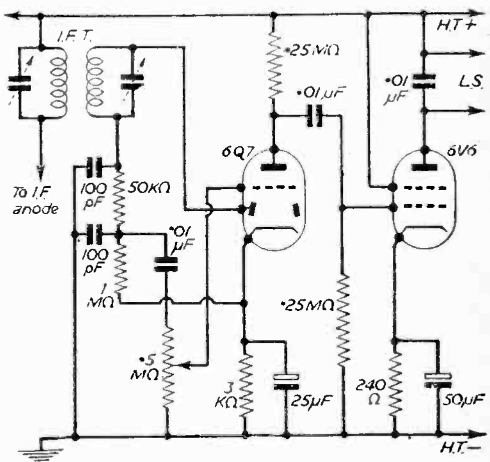


Fig. 5.—A D.D.T. and output stage for a superhet.

the long wave band is similarly treated, the I.F. transformers being left untouched. When no further adjustment of any core or trimmer improves volume, alignment is complete.

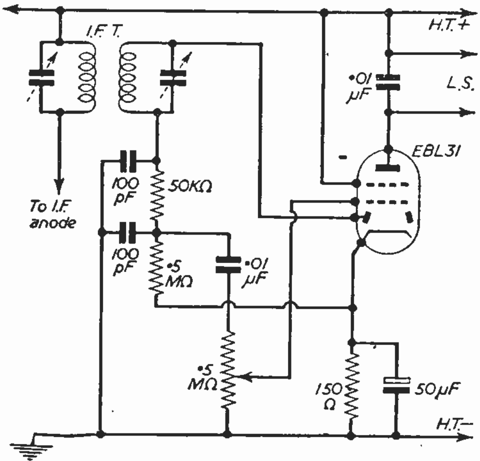


Fig. 6.—A combined D.D. and output stage.

If any doubt arises about the existing aerial coil, a pair of aerial and oscillator coils intended for use together should be used, or a coil-pack fitted, as mentioned.

Three-valve Superhet

If no space exists for an additional valve, a combined output valve of the type shown in Fig. 6 may be used. This can give excellent results, though volume on the weaker transmissions is less than with the circuit in Fig. 5, which has a further stage of amplification. (The triode section of the D.D.T. valve.) However, a superhet employing F.C.-I.F. and D.D. Pentode stages will be superior in several ways to the T.R.F. receiver using R.F.-Det.-Pentode stages, so that much has been gained, even though the number of valves is not increased.

Another possibility is to use a WX6 or similar metal rectifier for detector, following this with the original output stage. This enables the original output valve to be retained. If space permits, however, the circuit in Fig. 5 is recommended, since the original output valve is still made use of, and additional gain obtained. (The popular 6V6 is shown in this circuit, but if a different valve type is present it is, of course, retained.)

Layout Considerations

So far, the circuits alone have been considered, but a few points of a practical constructional nature need to be kept in mind. The I.F. transformers should be close to their associated valves, so that short leads are possible. If oscillation arises when the I.F. transformers are aligned, this may be prevented by screening anode and grid leads, the metal braid being connected to the chassis.

As the tuned circuits of the F.C. valve operate on dissimilar frequencies, trouble seldom arises here. However, reasonably short and direct connections should be maintained between coils, switch, gang condenser and F.C. valve. If the I.F. and D.D.T. stages occupy the original R.F. and detector valve positions, the F.C. valve may usually be positioned

(*Concluded on page* 378)

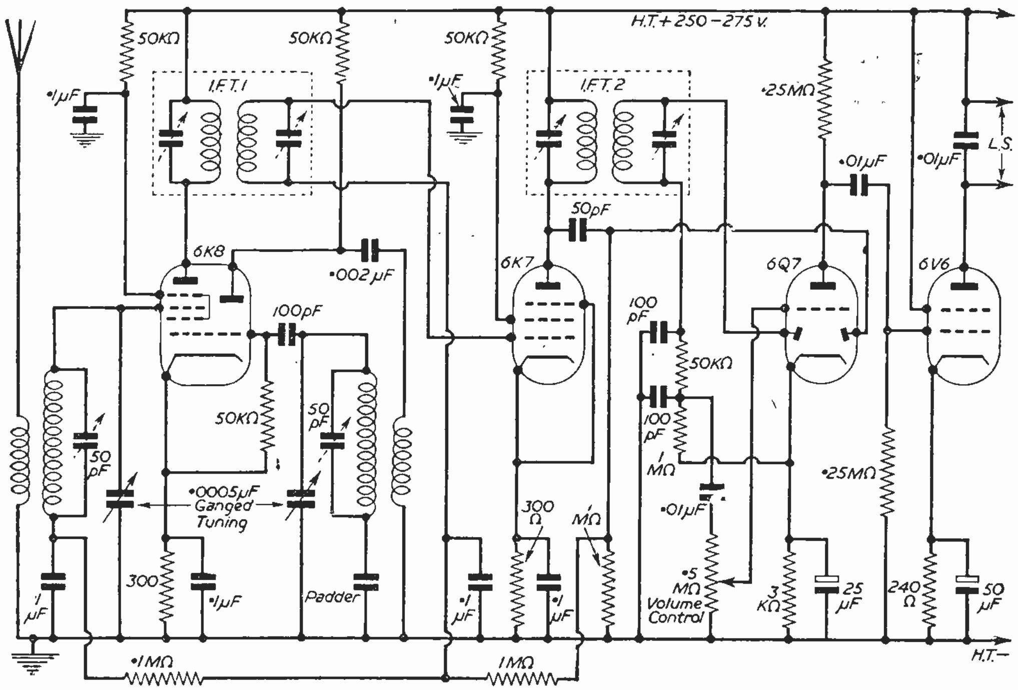
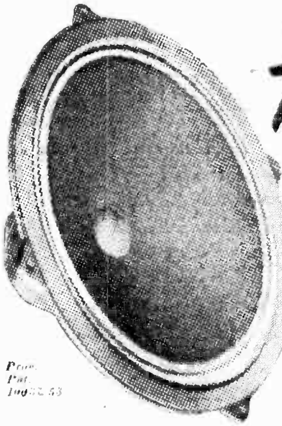


Fig. 7.—A typical full superhet circuit with A.V.C.



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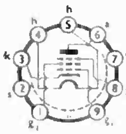
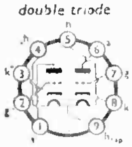


V_h	6.3V
I_h	0.2A
V_a	250V
V_{g2}	140V
g_m	1.35mA/V
V_{hum}	1.5μV
R_{g1-k}	=470Ω

Base B9A

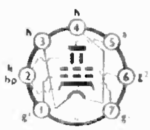
Tone correction and intermediate stages B309
double triode



V_h	6.3V
I_h	0.6A
V_a	250V
g_m	5.5 mA/V
r_a	10 kΩ

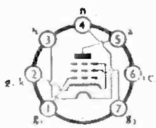
Base B9A

Output and bias oscillator N727/6AQ5 or N78



V_h	6.3V
I_h	0.45A
V_a	250V
V_{g2}	250V
I_k	50 mA
V_{g1}	−12.5V
P_{out}	4.5W

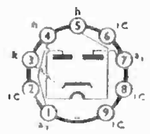
Base B7G



V_h	6.3V
I_h	0.64A
V_a	250V
V_{g2}	250V
I_k	40 mA
V_{g1}	−5V
P_{out}	4W

Base B7G

Rectifier U709
full-wave rectifier



V_h	6.3V
I_h	0.95A
V_{h-k}	450V (max.)
V_{in}	350 rms (max.)
I_{out}	150 mA

Base B9A

The heater-cathode rating of the U709 permits operation from a common 6.3V heater winding

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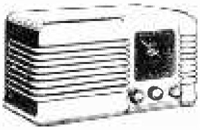

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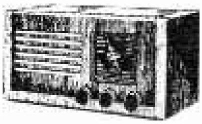

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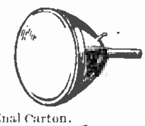

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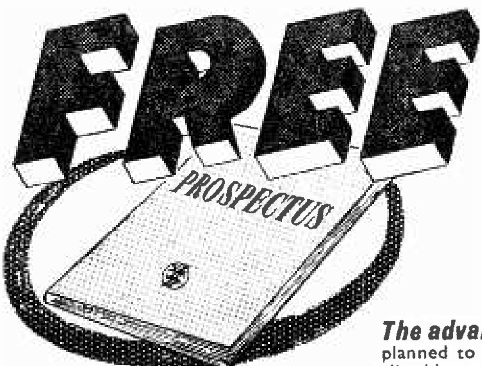

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AMPLIFIER DESIGN

3.—UNTUNED AMPLIFIERS—CONTINUED

By R. Hindle

(*Continued from page 268, May issue*)

A Short Series of Articles Dealing with the Theoretical Considerations of Amplifier Design, and Containing at a Later Stage Constructional Features of Various Types of Amplifier.

BUT supposing that the amplifying stage is being designed to be followed by a power output stage for which the grid resistor has to be kept down to 220 KΩ. This would reduce the gain, by applying the above formula, by a half to 7.5 times. Now try a lower value for RL, say 100 KΩ, for which a curve is also given in Fig. 11. This characteristic is straight between the limits of $Eg = -3\frac{1}{2}$ volts and $Eg = -8$ volts, giving a mean bias of $-5\frac{3}{4}$ volts and allowing a maximum peak to peak signal of $4\frac{1}{2}$ volts. The anode current at this working point is 1.2 mA and ra is 21,000 ohms, μ being 18. From these figures the cathode bias resistor becomes :

$$Rk = \frac{5\frac{3}{4} \times 1000}{1.2}$$

$$= 4700 \text{ ohms approx.}$$

The stage gain is (from the formula previously used) :

$$\frac{18 \times 100000}{100000 + 21000}$$

$$= 15 \text{ (the same as before).}$$

Now a following Rg of 220 KΩ will give an actual amplification of

$$\frac{15 \times 220}{100 + 220} \text{ (all resistances in K}\Omega\text{)}$$

$$= 10 \text{ times.}$$

The maximum signal input for the latter case was 4.5 volts and the gain proved to be 10 times, so the maximum output voltage is $4.5 \times 10 = 45$ volts peak to peak. In the previous case with a load of 220KΩ and a following Rg of 1 MΩ the maximum input was 5 volts and the resulting gain 12 times, giving a maximum voltage output of 60, peak to peak. These are quite useful figures, probably more than would generally be required. They represent maximums—the input signal can always be reduced to provide smaller outputs according to circuit needs and distortion is thereby reduced, as there will be a smaller effective curvature in a shorter section of the characteristic.

Pentode Connection

A considerably larger gain is obtainable by connecting the valve as a pentode, but pentode characteristics are less linear than their triode counterparts and some distortion is unavoidable unless the input signal is made less than was found permissible with triode connection. The procedure is, as before, to select a suitably straight part of the characteristic, though an added complication arising is the choice of screen voltage, and curves for different screen voltages have to be inspected for a suitably linear section. It is seen from Fig. 13 that in the case of the 6BR7 a signal input of .25 volts peak to peak can be handled without trouble. Supposing an anode load of 220 KΩ is chosen. Inspection of the characteristics given in Fig. 13 shows that there is a sufficiently extensive straight portion of the curve for screen volts = 60 v. with a centre bias point of −2 volts allowing a .25 volt peak-to-peak grid swing without curvature, the anode current at the centre point being .8 mA. and the screen current .2 mA. The total cathode current is thus 1 mA. and the cathode resistor to give the 2 volts steady bias will be :

$$RK = \frac{2 \times 1000}{1}$$

$$= 2000 \text{ ohms.}$$

The screen resistor has to drop $250 - 60 = 190$ at .2 mA. and so will be :

$$Rsg = \frac{190 \times 1000}{.2}$$

$$= 1 \text{ M}\Omega \text{ approximately.}$$

The anode current swings from .75 mA. to .95 mA. over the agreed working range of grid voltage, a difference of .2 mA., which in a load of 220 KΩ produces a signal, as given by Ohm's Law, of :

$$\text{Signal out} = R \times I$$

$$= \frac{220000 \times .2}{1000}$$

$$= 44 \text{ volts peak to peak.}$$

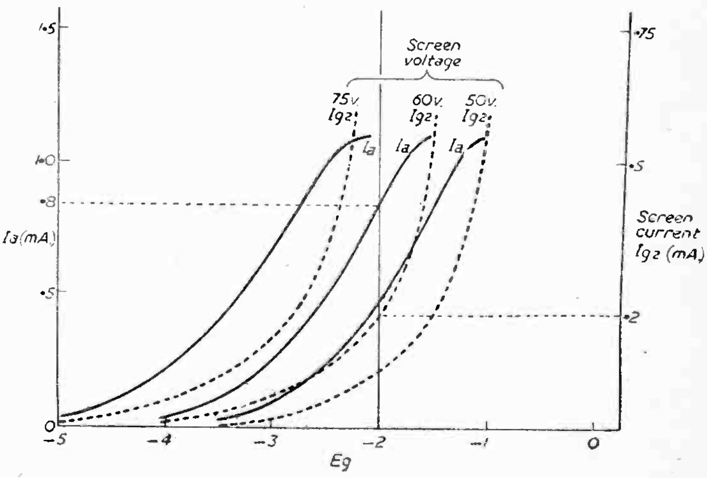


Fig. 13.—Dynamic characteristic curve of a 6BR7 pentode-connected valve. RL=220K and H.T. 250 v.

But the signal in was specified as .25 volts peak to peak and therefore

$$\text{Gain} = \frac{44}{.25}$$
$$= 176 \text{ times.}$$

It is again necessary, however, to take into consideration the reduction in true load caused by the grid resistor of the following valve and gain will, in fact, be reduced to :

$$\text{Actual gain} = 176 \times \frac{Rg}{RL + Rg}$$

and taking RL as 220KΩ and Rg as 1 MΩ gain becomes

$$\frac{176 \times 1}{1.22}$$
$$= 144 \text{ times.}$$

The reason for choice as between pentode and triode operation is now clear. There is not a great difference between the maximum amplitude signal given by the two methods of connection ; if the problem is to amplify further a signal of some amplitude such as would be too much to be accommodated on the straight portion of the pentode characteristic then obviously a triode connection will be used. If the aim is, however, to amplify a small signal, then pentode connection will be chosen. The latter is, of course, the more common case.

It should be pointed out that the effect of giving a valve a variable-mu characteristic is to accentuate the curvature of the characteristic, making it less easy to find a straight section over which to operate and these valves should be used for audio work only if a very small signal is to be amplified and if the variable-mu characteristic is specifically needed, as perhaps for some sort of audio expansion or contraction circuit. The two circuits as now designed are given in Fig. 14.

Anode Load

The sizes of anode load used above were somewhat arbitrarily chosen. The course taken was to follow the lines of the recommendations of the valve manufacturer on the basis of which he has naturally produced the curves that he supplies. It will do no harm, however, to ponder over the theoretical requirements for a load resistor. The voltage amplifier presents a problem quite different from that of designing a power amplifier and the requirements should not be confused. The basic purpose of an amplifying valve is to produce a current fluctuating with the input signal and the load resistor has the duty of developing a fluctuating voltage from the current. The voltage produced across a resistor by a given current is proportional to the value of the resistor. So, at first glance, it would seem that the load resistor should be as large as possible. This would be quite right if the H.T. voltage actually at the anode was sustained at the same level as the anode load was increased. This gives a clear indication of procedure when a very high gain and a large output signal are required. The H.T. should be increased so that a large load resistance can be used.

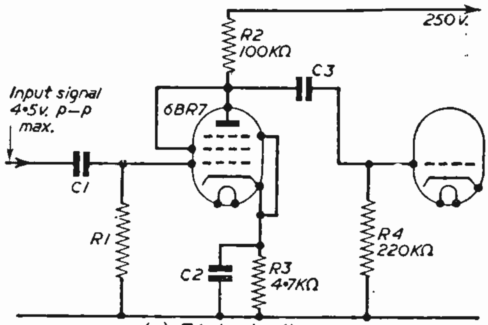
Generally, however, the voltage of the H.T. supply is fixed by other considerations and it is a question of making the best of what is available. How can maximum gain be assured? Starting with a small anode load, an increase in its size gives an increase in gain, but the increase will not be so great as it would otherwise be because of the resulting reduction in H.T. at the anode of the valve. Continuing to increase the load, the improvements in gain will become less and less until, beyond a peak point gain will actually decrease with further increase in load. The modern valve works on a small anode current basis and so the tendency with the newer valves is to use a larger load than was the case with their forebears. Particularly is this noticed with triode connection.

The equation for stage gain is :

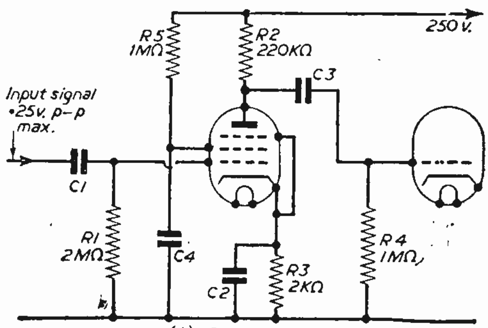
$$\text{Gain} = \frac{\mu \times Req}{Req + ra}$$

where μ is the amplification factor and ra is the valve anode impedance. Both these so-called constants vary according to the working conditions of the valves—the single figures quoted in abbreviated valve data lists cannot be used in the formula as they apply to only one static set of circumstances. The correct figures are derived, as shown above, from the dynamic data relating to the actual working conditions. Req is the effective load, i.e., the equivalent of the anode load resistance and the following grid resistance in parallel.

The above formula is used for triode amplification where ra is small compared with the anode load. With regard to the pentode, however, the value of ra is considerably higher ; the effective load resistance Req is usually only a fraction of ra, commonly a tenth, and so Req has little effect on the denominator of the above gain formula which consequently simplifies for the pentode case, i.e.,



(a) Triode circuit



(b) Pentode circuit

Fig. 14.—Complete single-stage circuit.

$$\text{Gain} = \frac{\mu.\text{Req}}{\text{Req} + \text{ra}}$$
$$= \frac{\mu.\text{Req}}{\text{ra}} \text{ approximately.}$$
$$= \frac{\text{gm. Req}}{1000} \text{ approximately}$$

because $\frac{\mu}{\text{ra}}$ is the same as the mutual conductance (gm) of the valve. The denominator arises because gm as usually quoted is measured in mA/Volt and has to be converted into basic units, i.e., amps. and volts. The figure for gm must be that applying to the conditions under which the valve is actually working, and is not necessarily the figure quoted in valve lists which generally refer to quite different operating

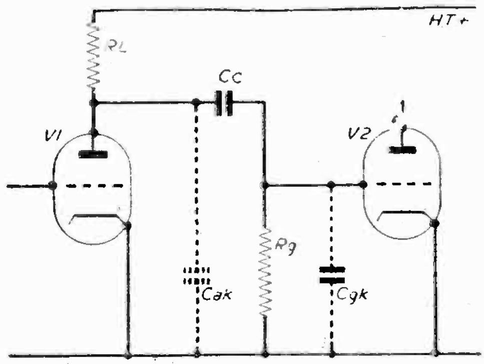


Fig. 15.—An amplifier coupled to a following valve.

circumstances. For instance, gm for the 6BR7 is quoted in the lists at 1.25 mA/V for Ea 250V, Esg 100V and Eg −3V. It was found above that gain was 176 times with an anode load of 220kΩ. But from the equation derived above the following is obtained :

$$\text{gm} = \frac{1000 \times \text{gain}}{\text{ra}}$$
$$= \frac{176000}{220000}$$
$$= .8 \text{ mA/V.}$$

It is necessary now to develop the theory of amplification beyond the present conception of an isolated valve with idealised resistive load so as to get an idea of what happens in practice, though the purely A.C. considerations will still be dealt with, leaving until later the introduction of the complications arising from the need for D.C. to be applied to the valve to produce the A.C. phenomena that are being discussed.

Fig. 15 develops the circuit to introduce the input to the following valve. Cc is the coupling capacitor and the sole purpose of introducing it is to isolate the grid of the following valve from the H.T. appearing at the anode of the first valve. The introduction of this capacitor requires the provision of an alternative path for electrons that may collect at the grid of V2. Without Cc they could find their way through RL, but now that the capacitor has been introduced, Rg has to be added as a path for those electrons.

The capacitance of Cc is so chosen that its reactance to the lowest frequency that is to be amplified is negligible compared with the resistance of Rg. The equivalent circuit from an A.C. point of view is as shown in Fig. 16a, and the reason for the need for a large coupling capacitor is seen. Cc and Rg form a potentiometer across the output signal and only that part of the signal appearing across Rg is passed on to succeeding circuits. If the reactance of Cc is small compared with the resistance of Rg, there will be negligible loss of signal amplitude in the coupling. If the capacitor is correctly chosen, therefore, it can be ignored, at least for a first estimation of results, and Fig. 16 shows that then RL and Rg are in parallel and the effective load on the valve is the resultant of these two resistors in parallel, which can be derived from the standard formula :

$$\text{Req} = \frac{\text{RL} . \text{Rg}}{\text{RL} + \text{Rg}}$$

(Req being the equivalent resistance of the two in parallel.) And Reg so derived must be used in the formulae for gain previously developed. It has already been seen that the size of RL is limited by the need to pass H.T. to the anode without undue voltage drop and Rg will be made as large as possible in order to prevent it from reducing the size of the equivalent load unnecessarily. There is an upper limit to the size of Rg, however, set by the tendency of the grid to collect a few electrons which, in passing through Rg, will produce a voltage which might be detrimental to the working of the valve. Generally, the limit to the size of Rg is lower for a power valve in the output stage of an audio amplifier (generally ¼ MΩ but sometimes 100 KΩ; the valve makers specify where the requirements are out of the ordinary) than for an ordinary voltage amplifier such as is the prime consideration at present, where 1 MΩ is the likely limit.

Stray Capacitance

Theoretically, perfect components and construction have been assumed up to now, but in actual fact the circuit is more complicated by virtue of stray reactive

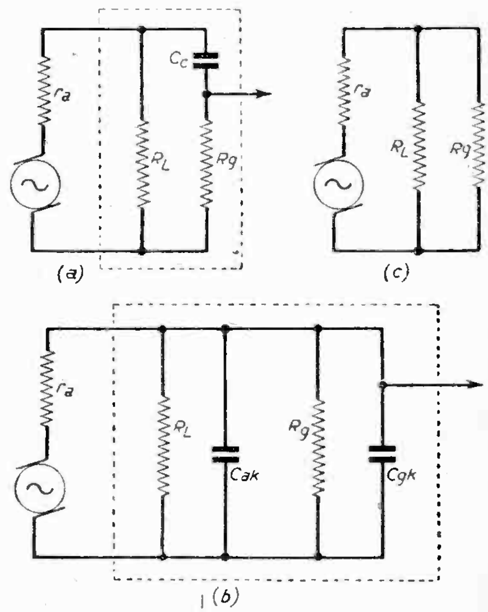


Fig. 16.—Equivalent circuits at different frequencies.

effects. The valve itself and the wiring and components associated with it introduce stray capacitances, for instance, from anode to cathode and from grid to cathode, and are shown as Cak and Cgk on the elaborated equivalent circuit given in Fig. 16 as well as in the theoretical circuit of Fig. 15 and in the final count the reactance of Cc cannot be completely dismissed because a zero reactance cannot be achieved and so there must always be some loss therefrom. The effect of these capacitances and, of course, any reactive effect, can be assessed only if the frequency of operation is introduced, and as the resistance-capacitance type of amplifier is normally only for audio and video work, such frequencies will be in mind in what follows.

The stray capacitances are seen to be in parallel with the resistances in the circuit and so they will have the least effect on the frequencies for which their reactances are highest. This will easily be appreciated if first a capacitance of infinite reactance (i.e., an open circuit or zero capacitance) is considered. This would obviously have no effect if in parallel with a resistor. Similarly, a capacitance with zero reactance, if such were possible, would act as a short-circuit to the resistance and so would have maximum effect. But, of course, the reactance of a capacitor increases as the frequency decreases, so the parallel strays will have most effect on the higher frequencies.

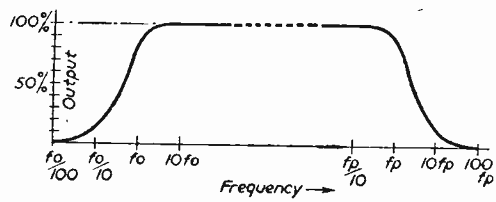


Fig. 17.—Typical response curve.

For a given size of stray capacitance, of course, the ill-effects can be reduced by reducing the size of the load resistance, though at the expense of gain. The first step in design and constructional work is to reduce the strays to the practicable minimum, but often this is not enough and the alternative course of reducing the load has to be resorted to. This is seen in television video amplifier design, for instance. On the other hand, the coupling capacitor Cc is a series element and consequently it has most effect at the frequencies at which its reactance is greatest, i.e., the lower frequencies, and in this case to minimise the effect Rg should be made as large as possible.

Bandwidth

Now to put aside pure theory and to look at the practical aspects of the case. The designer has two problems : first, he has to obtain sufficient gain for his purpose and, secondly, he has to maintain that gain more or less without variation over the required bandwidth. The important consideration in the second problem is not the actual bandwidth but rather the ratio of the bandwidth to the middle frequency to be handled. If he required a bandwidth of, say, 10 Kc/s with a middle frequency of 1 Mc/s (i.e., a medium-wave R.F. amplifier), the bandwidth is only 1 per cent. of the frequency of operation. He will have no difficulty in obtaining the necessary bandwidth with a resistance-capacitance amplifier because the reactance of neither Cc nor the strays is likely to vary much over a 1 per cent. deviation in frequency. He will run into much more trouble in his endeavours to obtain a useful degree of amplification at this frequency and by this method, but more will be said about that aspect later.

At audio frequencies the situation is different and the bandwidth is likely to be between 5 Kc/s and 20 Kc/s, beginning at practically zero frequency, so that a substantially aperiodic (i.e., non-frequency discriminating) characteristic is required, and for television video frequencies the range has to extend from zero up to the region of 3 Mc/s, which is even harder to cope with.

Response Curves

The general form of the response curve for a R.C. amplifier is given in Fig. 17. Over a mid-band of frequencies the amplification is seen to be constant. Here, the reactance of the stray capacitances is too large and that of Cc is too small to have any effect. The position at these frequencies is represented by the equivalent circuit in Fig. 16(c), the strays being to all intents and purposes non-existent and Cc being effectively a short-circuit. The valve anode load is thus RL and Rg in parallel, and the procedure in this case has already been given.

Lower Frequency Range

At lower frequencies the stray capacitances are even less significant, but Cc is now in evidence and the valve load becomes the equivalent of the network within the dotted lines on Fig. 16(a), the output signal being tapped off only part of the load. This produces a falling off of response towards the lower frequencies, as shown on the left-hand side of the curve in Fig. 17. At the other extreme Cc is negligible, but Cak and Cgk attain importance, and the effective load is given in Fig. 16(b). This load (and therefore the gain) decreases as frequency increases and gives the falling off of the right-hand part of the characteristic. The shape of the " skirts " (the ends of the characteristic falling off towards zero response) is always the same, but the steepness of the skirts and the length of the linear middle portion depend on the size of the strays and Cc.

The first problem, then, is to determine the size of C. A convenient point to start the consideration is the frequency at which the reactance of Cc equals the resistance of Rg. Take care not to jump to the conclusion that because the two arms of the potentiometer at this frequency are equal only half of the signal is passed on to V2. The error in this argument lies in the fact that one is a reactance and the other is a resistance so that they have to be added vectorially and the answer, in case the reader does not wish to work it out for himself, is that 0.7 of the available signal is actually passed to V2. Let fo be the frequency in question at which 0.7 of the signal at the anode of V1 appears at the grid of V2 ; then the following table can be compiled :—

Frequency	Amplification (× that at middle frequencies)
5fo	0.98
2fo	0.9
fo	0.7
½fo	0.45
0.2fo	0.2
0.1fo	0.1

(To be continued.)

On Your Wavelength

BY THERMION

A Bleat from the Guitarists

I HAVE received a marked copy of an obscure journal of which I was previously unaware, excusable as it is only 18 issues old, in which they criticise somewhat satirically an article in our companion journal, PRACTICAL MECHANICS, describing the construction of a guitarette. Strictly speaking, of course, it has no relation to the guitar, as it has only one string. The editorial comment is: "Of course, this will interest mechanics rather than musicians. It will still be able to make the 'plurping' sounds of the six-string electric 'guitar' (*sic*) but it will not be able to produce the yowling close harmony so characteristic of that instrument, which has been described by a leading British musicologist as 'the electric monstrosity of the dance bands.' Perhaps the so-called 'guitarette' would be improved if it had one string less!"

Well, I have never liked the guitar, which I see is derived from the Spanish "guitarra." The dictionary directs me to see also "Zither," "Citole" and "Guittern." Apparently no one has yet made up his mind what this weird and unwanted instrument is, and perhaps that is why intelligent people have produced the six-string electric guitar, and even the one-string guitarette. In point of fact, I do not like any plinka-plank instrument, whether plucked with the fingers like the harp, or plucked with a plectrum. But I definitely do not like the guitar. The very name reminds me of adenoids. I see that it is described as a musical instrument of the lute class with six strings and a handle or finger board provided with frets for stopping the notes. The latter, I should think, is a most important part of the instrument, and as far as I am concerned, it would sound far better if it had one more fret and muted strings. The particular journal to which I have referred is the official organ of the International Classic Guitar Association. This 16-page pamphlet, demy octavo in size, costs 9d. a copy. I see that *The Stage* says of it: "It is an interesting publication to lovers of the instrument"; that qualification "to lovers of the instrument," I hope, has not a *double entendre*! The editor who sent me the copy of *The Catarrh News* naïvely writes: "Please quote in your next issue." Well, I have done so, and commented in the same facetious strain. Its editor dares to be a Daniel!

The B.S.R.A. Exhibition

THAT enterprising body, the British Sound Recording Association, held its Annual Private Exhibition in May, and 24 firms exhibited. I have often wondered why such small associations go to the expense of staging a separate exhibition, when they could quite easily, more cheaply and with less trouble, stage it within Earls Court at the Radio Show. The exhibits would be brought to the attention of a far wider public and would probably convert many to the art. As it is, this exhibition in my opinion merely preaches to the converted. After all, sound recording is an offshot of radio, and I see no reason why each little industrial electron which comprises the radio industry atom should wish to fly off at a tangent and preserve its insular independence, by holding its own exhibition.

What is a Dabbler?

I NOTE that correspondents in an esteemed trade contemporary have been dealing with the question of dabblers in servicing, and endeavouring to define the term. There is no definition, except the obvious one that a dabbler is one who services receivers in his spare time. The term dabbler is intended to be a sneering reference to those who endeavour to earn a little extra money by repairing radio and TV. receivers in their leisure. A few who worry about the so-called dabblers are those who keep shops and are not even dabblers. In fact, the term mountebanks would accurately describe them. When in a particular locality such a trade dabbler is found out, and customers turn to a knowledgeable amateur, who is able at a modest cost to put their receivers right, he has no right to complain. The mere painting of a name over shop premises that the proprietor is a radio or television specialist, and a member of some association, the only qualification for membership of which is a few guineas a year, does not endow that proprietor with the qualifications and experience which his claims are intended to convey. There are many thousands of honest and skilled traders in this country who do not overcharge and know their business. A smaller number are sharp practice merchants who will charge ignorant customers several pounds for replacing valves, condensers, resistances and transformers when the only real defect is perhaps a broken soldered joint. They prey upon the ignorance of the public. Let us take a definition given in the journal to which I have referred: "The man who works at another job all day and spends his leisure time in trying to make pocket money is one example of the true dabbler." But then, by that same argument, many traders are dabblers in that they not only sell and service wireless receivers and television receivers, but also stock bicycles, perambulators, gramophones, cigarettes, newspapers, groceries, paints and varnishes and all the other heterogeny of a Portsmouth marine store.

There seems to be some criticism because skilled amateurs are able to obtain condensers, resistors and other components direct from the makers at retail prices. Even so their charges for repairing the set are much less than those of the trade dabbler, whose work quite often is unsatisfactory.

1912 The FIRST TWELVE YEARS 1925

IN THIS INSTALMENT THE WRITER DESCRIBES HOW SIGNALS WERE TRANSMITTED FOR THE FIRST TIME FROM A RACING CAR, AND A BROADCAST SECURED FOR THE FIRST TIME IN AN EXPRESS TRAIN

By C. H. Gardner

(*Concluded from page* 272, *May issue*)

THE record-breaking attempt being due to start at 8 o'clock the next morning, and the car not being available before the time of start, it meant that the equipment must be installed in the car during one of the breaks of one to two minutes during the period in which it came in for refuelling and tyre changes.

An evening in the workshop produced a small spark transmitter which, together with a 6-volt accumulator for supply, could be contained in a small wooden box which it was hoped would stand between the mechanic's feet on the floor of the car.

Early the next morning receiving equipment was installed at the top of the members' hill and arrangements were made to test out the transmitter in a fast touring car which it had been arranged would be allowed to circle the track whilst the record-breaking run was taking place.

In those days any wavelength below 200 metres was viewed with some awe, and the general idea was that the transmission should be made in the 440 metres "band."

Whilst a receiving aerial for this frequency presented no difficulty, an aerial which could be affixed in a matter of seconds to a racing car was certainly a major problem. A first idea was to raise a suitable length of wire by means of a small glider to be towed behind the car. An appeal was made to the Vickers Aircraft Factory situated by the track and in a very short space of time they had produced a beautiful little aluminium model with a wing span of about 18in. This had been tested in their wind tunnel and it was estimated it would operate satisfactorily at flying speeds of between 70 and 90 miles per hour. In order to keep this glider in flying trim, a large chunk of lead was fixed to its nose, making its appearance rather lethal, a feature which was found in practice to be a matter not entirely of appearance!

An experiment with this glider was made by launching it from the touring car whilst travelling at some 80 miles an hour, the attached length of aerial wire being coiled up in the back of the car. Unfortunately the turbulence behind the car had not been taken into consideration, and after rising 15ft. to 20ft. the glider made a realistic series of dive-bombing attacks on the unfortunate occupants of that vehicle. As the leading edge of the wings was sufficiently sharp to decapitate anybody with whom it came into contact, and the lead nose was sufficient to knock anyone into insensibility, the experiment was concluded in favour of a further trial with a less lethal idea embodying an inflated rubber balloon.

Oddly enough, this simple idea proved quite reasonably satisfactory and on the occasion of the next break in the run of the record-breaking car, the writer changed places with the mechanic who had been accompanying Mr. Edge, fixed the spark transmitter firmly between his feet, and as the car moved off threw overboard the aerial and hoped for the best.

On the top of the box that contained the transmitter was the Morse key and the necessary terminal for attachment to the aerial. A message was successfully transmitted, acknowledgment being received by means of a notice to that effect being chalked on a large blackboard on the side of the track. Alas, this was to be one of the few successful communications.

The wireless test period coincided with the time for Mr. Edge to take nourishment. Choice of suitable refreshment had resulted in the taking aboard of a fish bass full of pears, grapes, and other juicy fruits which were to be fed to Mr. Edge as the car bounced its way at speed round the track.

Racing cars are not designed with many conveniences for handling matters of this nature and the bass of fruit had to be held on my knee. No amount of "holding" could prevent this bag of fruit from beating itself to pulp as it leapt up and down. The racing car of the early twenties was not noticeable for smooth progress at speed on the track.

The juice from the resulting fruit pulp soon found its way through the bass and down my overalls until eventually it reached their extremities which were in fairly frequent contact with the aerial terminal of the transmitter.

Well-known to all habitués of the Brooklands Track, was a famous bump on the home banking. This generally resulted in any car hitting it becoming airborne for several feet, if not yards. Mr. Edge's navigation necessitated the traversing of this bump on each circuit, or approximately once every two minutes! Each time the bump was traversed the spark transmitter became airborne in the car, and the Morse key made circuit, and the resulting spark, instead of sending useful oscillations up the aerial, sent them through the fruit-dampened overalls via the writer's legs to the seat of the car and thus back to earth. A little electrical treatment of this nature goes a long way, and it must be confessed that after a few circuits the writer cheated miserably! The accumulator was hastily disconnected and any message which Mr. Edge requested to be passed was scribbled on a piece of paper and thrown overboard for the pit staff to collect.

We had, however, the satisfaction of having been the first to transmit wireless messages from a racing car engaged in breaking records—even if the messages were few and the whole plan fell far short of its aim.

(*Continued on page* 349)

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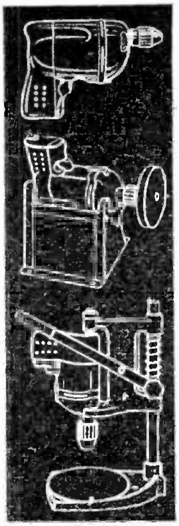

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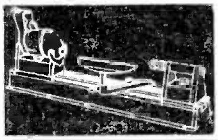

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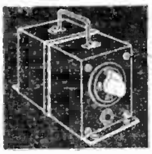

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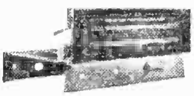

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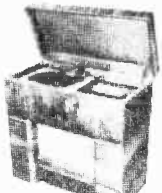
This month we offer a new booklet for Constructors. It shows how to make a sensitive and powerful superhet battery portable, which will be just the thing to take on a day out or on your holidays. The booklet also shows how to make the Picnic Player, a useful battery-driven record player. The price of the booklet is 2/6, which is returnable if component parts are purchased.

THREE OUTSTANDING BARGAINS



CONSOLE CABINET
Beautifully veneered and polished. Price £9.18.6, plus 15/- carr. and ins.

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5-valve Superhet Edgelit, station-named dial. Price £9.19.6, plus 7/6 carr. and ins.

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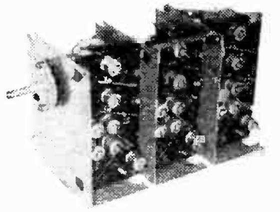
This is an excellent little radio in an attractive cabinet to which can be affixed transfers, thus making it extra suitable for nursery or child's bedroom. The circuit is a T.R.F. for A.C. mains operation. All the parts—bakelite cabinet, valves, knobs, back—in fact everything will cost you only **£3.15.0.** plus 2/6 postage. Construction data free with the parts or available separately at 1/6.

7-WAVE BAND ASSEMBLY



7-wave coil pack for up to 11 mtrs. with R.F. stage, three-gang tuning condenser, slow motion drive, I.F. transformers and numerous other parts, make a really fine receiver. Price **£6**, plus 10/- post and insurance.
Note: The above are new, but removed from chassis.

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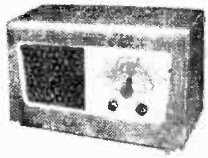

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10 x 8 x2½	... 7/6	17 x10 x2½	... 11/3
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". . . Mr. Keen's clarity of expression and care with terminology add to the value of this comprehensive volume."
—ELECTRICAL TIMES

Later Mr. Edge kindly put at the writer's disposal one of his well known AC cars, and with a more effective aerial we succeeded in transmitting wireless messages whilst circling the Brooklands Track, and at a later date used the same apparatus in connection with the timing of a motor speed hill climb.

Although the foregoing are some experiences of an early amateur, the final episodes have a slightly professional flavour, as they are connected with some experiments carried out with receivers, the design of which was the writer's responsibility at that time.

Railway Reception

It was on the way to Paddington Station that the germ of an idea came into existence that it would be good fun to see just how far it was possible to receive broadcasts while travelling in an express train. The more this was thought about, the more interesting appeared the project, and it was decided immediately to travel on a later train and in the meantime call at the Great Western Railway Company's General Offices to see if they were interested in the idea.

As soon as a discussion started it was apparent that the Railway Company were just as enthusiastic as the writer, and within the space of an hour or so a date had been fixed for the experiment which was to take place on the two hour express running between Birmingham and Paddington.

In order to enable suitable apparatus to be fixed up, the Railway Company agreed to shunt a suitable vehicle into a siding where it would be available for installation work to be carried out during the day or two preceding the attempt.

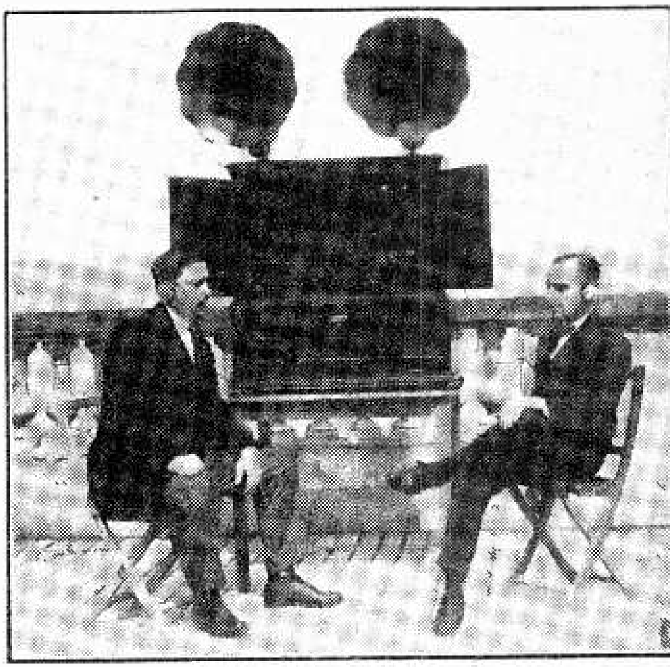
In due course, the suitable vehicle arrived, but as soon as the doors were opened its suitability became immediately open to question as apparently it had previously been used for some little period for the transport of fish!

However, drastic action was taken by the local representatives of the Company, and this resulted in it being possible to carry on with the work without any more inconvenience than might normally be experienced by the local fishmonger in the course of his business.

A six-valve receiver was securely anchored to a table which had thoughtfully been provided and the vehicle, fortunately being of wooden construction, it was found possible to erect an internal aerial.

The circuit of the receiver consisted of two H.F. stages, a detector, and an L.F. stage coupled to a two-valve "power amplifier."

At this time screen grid valves were not available, and the H.F. stages consisted of triodes with tuned-anode circuits. As may be judged, the total H.F. gain was not very considerable, hence the necessity for the somewhat cumbersome L.F. arrangements in order to get a signal which might reasonably be expected to operate one of the somewhat inefficient horn-type loud speakers which had just made their appearance.



The apparatus on the roof of the Grand Kursal at San Sebastian—referred to on the next page.

The day of the event duly arrived, and the wireless equipped van was tacked on to the end of a local train for a short journey to Birmingham where it had to be shunted on to the morning express from Wolverhampton to Paddington, which was already blowing off quantities of protesting steam at being delayed for a few minutes of the quite short time available for it to cover the next 112 miles. To allow of the minimum of delay, the wireless van was attached to the rear of the train, and this certainly proved a good test for the robustness of the equipment as the train was now ten minutes short of the rather limited time available for it to complete the journey. In fact, at one part of the journey the occupants of the wireless van, which now included the guard of the train, had to spend more time hanging on to anything available than in tuning in the equipment. At one point of the journey, even the experienced guard suggested that he could not recollect having previously traversed that somewhat twisty portion of the line with quite the same velocity. However, the train duly arrived on time at Paddington and some degree of success had been obtained in the preliminary trials.

The train was met at Paddington by certain officials who explained that somewhat higher officials would be occupying the van with us on the return journey, and the former officials giving a preliminary inspection of the vehicle, resulted in a still further de-fishing of the van and the provision of a few suitably upholstered chairs. This return journey presented somewhat of a problem as no scheduled broadcasts were due to take place during that period.

What followed must seem incredible to the present day listener. A telephone call was made to the BBC explaining the situation whereupon they agreed to make a special transmission to enable the experiment to continue.

Unfortunately, the log of the return journey had been lost. A full description of it appeared in the Great Western Railway House Journal, but in brief it was found that with the exception of a few places at which the train ran through tunnels, and one or two places where apparently local conditions were particularly difficult, the transmission was successfully received.

It may be observed that certain advantages were present for this reception. Firstly it was carried out in a wooden vehicle rather than a steel coach, and secondly no dynamo lighting was operating under the vehicle itself.

Later, a number of experiments were carried out by others under the more difficult conditions of reception in a railway compartment itself. However, once again, a first principle had been established in addition to the great interest of making the experiment itself.

Although the BBC so nobly co-operated on this occasion, there was another occasion on which quite unwittingly their unknowing lack of co-operation nearly caused a riot !

In Spain

A request had been received by a Spanish engineering firm to take some equipment to San Sebastian with a view to interesting the people of that country in the reception of broadcasting. This company had a flair for both timing and publicity, and suggested that the demonstration should take place during that fashionable month of the year when the nobility of Spain congregated in San Sebastian to participate in the many attractions of that place. Two of the major attractions were a series of bull fights by Spain's leading matadors, and the amenities of the Grand Kursal.

The Grand Kursal at San Sebastian was, and may still be (I do not know, not having visited Spain for very many years), what one might term the Monte Carlo of Spain. A magnificent building, it provided not only the gaming rooms, but also a magnificent hall in which at 8 o'clock each evening one of the leading orchestras of Spain provided music whilst the nobility and others paraded and talked prior to entering the gaming rooms. On the top of this hall was a large dome containing some fine stained glass, and around the dome was a flat roof.

It is necessary to explain this in some detail, because the scheme that had been evolved as a method of introducing broadcasting to the fashionable strata of Spain which attended the Kursal, was an arrangement with the Kursal authorities that equipment could be installed on the roof and that three or four of the stained glass windows could be removed to enable loud speakers to be directed down at the fashionable congregation assembled below. This indeed was a major stroke of enterprise on the part of the company concerned, and the necessary permission to carry out this somewhat extensive project was only obtained after much discussion.

It was, however, decided that the whole matter should be a surprise item, and that only the Directors of the Kursal and those immediately engaged in the project should know that it was to take place. The broadcast was to take place at 8 p.m. The director of the orchestra would tap his baton at a few seconds to eight, thus obtaining silence, and then instead of the orchestra starting, the chimes of Big Ben would be heard from the concealed loud speakers, this being followed by an announcement by the Directors of the wonderful achievement whereby the chimes of Big Ben had been heard at the Grand Kursal in Spain.

At a suitable time when the Kursal was closed, an experimental reception was made, this resulting in much back-patting and other suitable celebrations.

Behold then, the writer on the roof of the Kursal at five minutes to eight with headphones on head and a throw-over switch in hand. Down below strategically placed were the Directors of the Kursal waiting to give their momentous announcement. On the orchestra stand the immaculate leader of a famous Spanish orchestra waited, baton in hand, and coming through the headphones quite clearly, was a talk on the habits of the bee !

At five seconds to eight these habits did not seem to be fully explained, and at eight o'clock the bees were still busy returning to their hives—at two minutes past eight the BBC apologised for being unable to broadcast the chimes of Big Ben that evening owing to the bees having been too busy !

It was then that the riot nearly occurred. The Directors came to the conclusion that the whole scheme was a fraud, that broadcast reception in Spain was impossible, and that they had been put to considerable expense and inconvenience for an impossible stunt. The leader of the orchestra in some way also seemed to think that he had received some personal affront. The writer's knowledge of the Spanish language was very slight, which was perhaps just as well, but in no uncertain terms were we told to pack up and get out and never darken the doors of San Sebastian again. It is perhaps not easy to describe the atmosphere to those not knowing the Spanish temperament, but the writer for the next day or so had a feeling that at any moment some cloaked figure with a dagger might dart out of an alleyway and provide due retribution for an unforgivable incident !

Conclusion

It is hoped that the few incidents described will have shown some of the fun that was to be obtained and which, alas, can never return. Other awful incidents flash through the mind, such as the occasion when called upon in a series of broadcasts to devote one to the maintenance of crystal sets, it was suggested that the cat's-whisker point might become oxidised and cutting this off would provide a new surface with increased sensitivity. Unfortunately, unknown to the writer, just previously a large number of specially tipped cat's-whiskers had been sold to the public, who promptly proceeded to cut off the special tipping with rather disastrous results—but space in a journal like PRACTICAL WIRELESS is valuable and the Editor's ability to withhold the blue pencil must not be too greatly strained.

A Comprehensive Test Unit

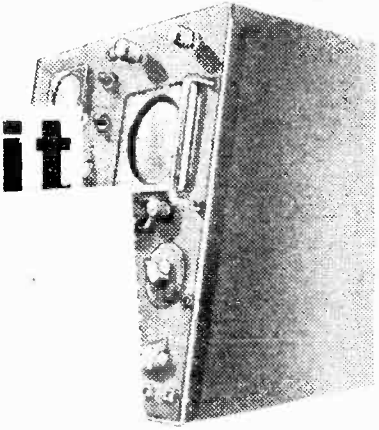


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Fig. 3.—The basic bridge circuit.

s included and output
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sion supplies. A pair of
amp. connectors were
ith a 250 mA fuse to
The grid-bias battery
was fitted in a wooden
top handle.

ex-government tube,
base and 4 v. heater
t equivalent), with an
nrys, Ltd., can supply
35/- each, or an SLC5
ontaining an ACR10,
ode).
3, V4 and V5—two
ral purpose triode—
diagram. V5 may be

as a constant current
ed capacitor (C10 to
f stray capacity) and
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oth waveform, the
ntrolled within wide
ntial of V5.
6F14 video pentode
l screen scan before
T rapidly above one
rtion is introduced

r V1 enable R10
switched attenuator
e waveforms to be

peak will drive the
ther axis. An SP61
but will not give as
Plessey miniature,
is enclosed in a
omponents associ-
win screen pick-up
he X1, Y1 and X2,

The timebase does not require to be screened if the above precautions are taken, although V3 should be mounted near to S2, the frequency selector switch.

V2 is an auto-sync valve, using an SP61 valve. The pulses from its anode trigger the timebase in step with any waveform present on the Y1 plate. A switch, S7, is fitted to render V2 inoperative as the timebase is often required in a free-running condition.

The E.H.T. supply is derived from a type of voltage doubler across the secondary of the mains transformer. The condenser C34 has a minimum value of 0.2 μF and must have a minimum working voltage rating of 2,000. Fortunately, this type of condenser with insulated terminals can still be obtained ex-government. The focus and brightness control spindles should be well insulated from the panel, either by ebonite bushes or by mounting them on a paxolin panel.

C21 and R51 have the optimum values for good flyback suppression, although at low frequencies it is not perfect, but the arrangement shown saves adding a special suppressor valve. C21 must have a working voltage rating of 2,000.

The width control R24 has an appreciable effect on the timebase frequency, but this is not usually troublesome and can be overcome by fixing V5 anode voltage and adding an X amplifier by duplicating the circuit of V1.

A slight ripple on the trace could not be eliminated with the compact construction decided upon but this is not noticeable except when examining small waveforms below 100 c.p.s. This ripple can be reduced to negligible proportions by mounting the mains transformer about 3in. behind the tube with a steel screen but this will increase the overall length by about 5in.

An A.C. connection to Y1 is provided by an additional socket coupled to the Y1 socket by C1—a 0.05 μF condenser. An X1 socket is also fitted and this, besides its normal use, also provides a variable output to test audio and radio I.F. amplifiers.

A graticule divided into 1 cm. squares was made from Perspex, and each division represents roughly a potential difference of 40 v.

Resistance and Capacity Bridge

A Mullard EM34 magic-eye tuning indicator was used for the bridge, and this gives a sharply-defined null point when connected to the basic bridge circuit shown in Fig. 3.

COMPONENT LIST

CONDENSERS

C1—.05 μF 1,000 v.
C2, C3, C4, C9, C22—8 μF, electrolytic, 350 v. working.
C5, C11—.25 μF 500 v.
C6—50 μF 50 v., electrolytic.
C7—100 pF silver mica.
C8—.1 μF 500 v.
C10—1 μF 500 v.
C12—.05 μF 500 v.
C13—.01 μF 500 v.
C14—.005 μF 500 v.
C15—.001 μF 500 v.
C16, C28—300 pF silver mica.
C17—100 pF silver mica.
C18—Stray capacity.
C19—.5 μF 500 v.
C20—.01 μF 500 v.
C21, C32, C33—.1 μF 2,000 v. working.
C23, C24 — 16+8 μF electrolytic, 450 v. working.
C25—.02 μF 350 v.
C26—1 μF 350 v.
C27—.01 μF 350 v.
C29, C30, C31—.1 μF 350 v.
C34—see text.

RESISTANCES

R1, R35—20 MΩ.
R2, R6, R21, R29, R42—2.7 MΩ.
R3, R20, R22—47,000 Ω 2 w.
R4—20,000 Ω 2 w.
R5, R16—10,000 Ω 1 w.
R7—2,200 Ω 2 w.
R8—6,800 Ω 2 w.
R9—150 ohms.
R10—2,500 Ω wire-wound pot.
R11—47,000 Ω 1 w.
R12—30 meg.—(three 10 MΩ. resistors.)
R13, R30, R33, R34—15,000 Ω.
R14—50,000 Ω 1 w.
R15 — 50,000 Ω wire-wound pot.
R17—1,000 Ω.
R18—2.2 MΩ.
R19—2,200 Ω.
R23, R41—10,000 Ω.
R24 — 100,000 Ω wire-wound pot.
R25—90,000 Ω.
R26, R27, R46, R47—1 MΩ.
R28—4,700 Ω.
R31—2,500 Ω wire-wound linear pot.
R32—220,000 Ω.
R36, R40, R43, R52—100,000 Ω.

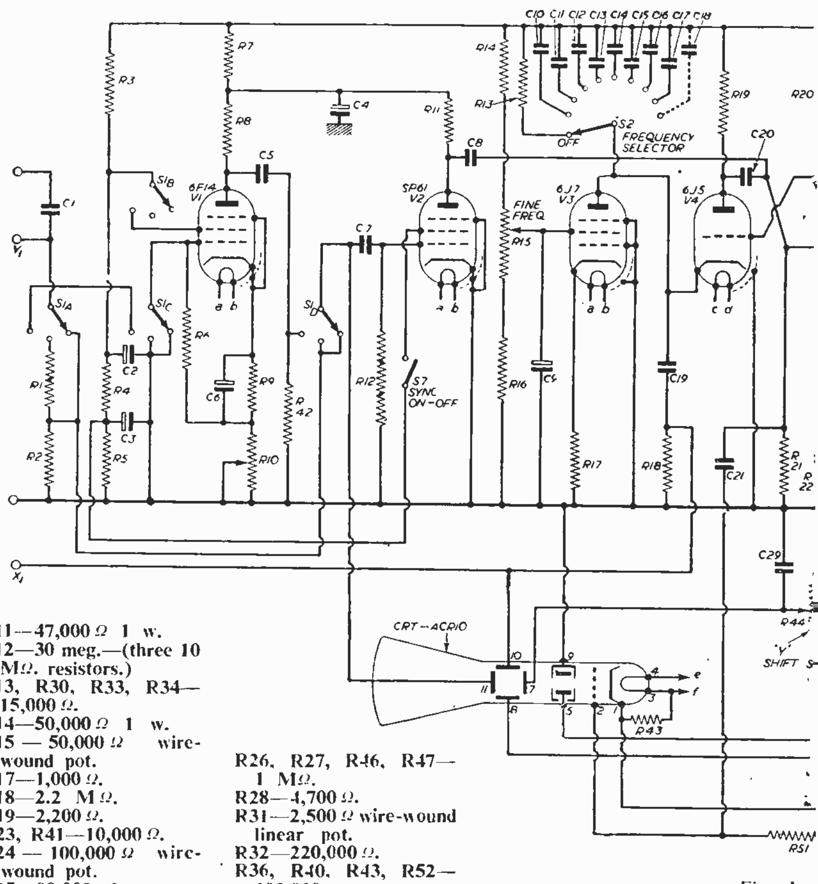


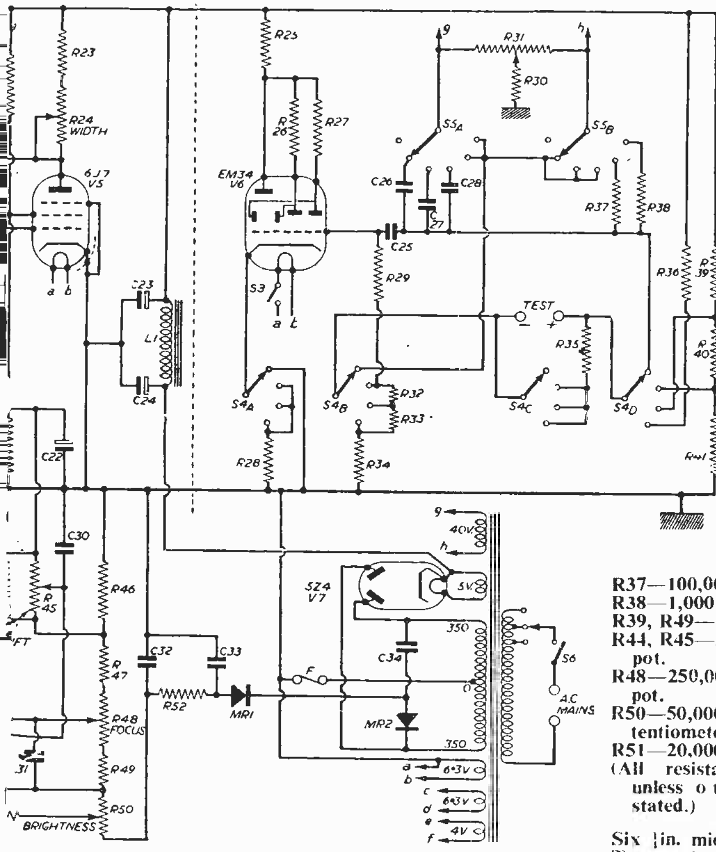
Fig. 1.—

The energising voltage for the bridge is approximately 40 v. A.C. obtained from an additional winding on the mains transformer. This is an Elstone component—SR/350 which has plenty of room for the additional windings required, i.e., an extra 6.3 v. for V4, 4 v. for C.R.T., 40 v. for the bridge. Winding cd is 28 turns of 24 s.w.g., ef is laid alongside this and has 19 turns of 22 s.w.g., gh is 190 turns of 38 s.w.g. wound over the top of these two with adequate insulation between each winding. The cardboard shields may need to be cut off flush with the laminations instead of passing inside the "windows" as formerly.

If accurate values for C26, C27, R37 and R38 are obtained the circuit shown will only require a single scale and no particular care need be taken concerning layout, etc. C28 is switched in to enable capacities down to 20 pF to be measured, and this is the lowest practical limit. A separate scale has to be provided for this range.

S4 provides for insulation tests at 15, 150 and 350 v. This is a very useful aid in determining the condition of electrolytic and paper condensers, as a leakage of 20 megohms can be detected on the eye connected as shown in Fig. 3. If an old but serviceable electrolytic is connected its "reforming" (taking possibly two minutes or more) can be observed directly as a gradual closing of the eye. The potential divider circuit used ensures that equal deflection for the same leakage occurs irrespective of the test voltage. The eye is biased by R28 when acting as an insulation tester. R35 is also switched across the test terminals to extend the indication to 20 megohms, as the eye alone will only indicate up to 10 megohms. R31 is a good quality 3 watt linear wire-wound potentiometer which gives a scale not too badly cramped at the extremes.

The recommended method of calibration for those who do not have access to an accurate bridge is to purchase C26, C27, R37 and R38 as accurate components and, after wiring and testing the circuit, proceed to mark the M/10 scale (i.e., 2,000 ohms to 5 megohms) in pencil, either by using further accurate values or by taking the mean readings of a large number of assorted sizes. With patience and a little ingenuity nearly the whole scale can be marked, and then the intermediate divisions added by inspection. The scale now holds for all other values of resistances and condensers with



-Circuit of the C.R.O. and bridge.

COMPONENT LIST

V1 6F14—Mazda video pentode.
V2 SP61—Mazda H.F. pentode.
V3, 5 6J7—H.F. pentode.
V4 6J5—General purpose triode.
V6 EM34—Mullard tuning indicator.
V7 5Z4—H.T. rectifier.
C.R.T. ACR10 — ex-Govt. 2¾in. tube.
MR1, MR2—S.T.C. K3/40 pencil rectifiers.
F—250 mA. fuse.
One B8A valveholder.
One Mazda octal valveholder.
Five International octal valveholders.
One Duodecal valveholder.
One Fuseholder.
One pair female and male 5 amp. 2-pin connectors.
L1—20 H. smoothing choke, Elstone SC/MA.
T1—350-0-350 v. 80 mA. mains transformer, 0-4 v.-6.3 v. Elstone S/R 350.
S1A-D—4-pole 3-way miniature Plessey switch.
S2—1-pole 9-way Yaxley switch.
S3, S6, S7—250 v. toggle switches.
S4A-D—2-bank 2-pole 4-way Yaxley switch.
S5A, B—2-pole 6-way Yaxley switch.
Seven ¾in. pointer knobs.

R37—100,000Ω—see text.
R38—1,000 Ω—see text.
R39, R49—150,000 Ω.
R44, R45—2 MΩ. carbon pot.
R48—250,000 Ω carbon pot.
R50—50,000 carbon potentiometer.
R51—20,000 Ω.
(All resistances ½ w. unless otherwise stated.)

Six ¾in. midget knobs.
Ten wander plug sockets.

the exception of the pF range, which is calibrated directly with a number of known values.

After checking all the ranges and altering any obvious inaccuracies (the scale is non-linear), the numbers may be painted in by using black synthetic enamel in a steel bow pen. The circular boundaries are deep scores in the panel made by dividers or a tank cutter. The enamel is smeared round them and then wiped off leaving a clear black line. The same method is used to mark the graticule, and the cursor, which is a piece of Perspex screwed to the back of an old tuning knob. A switch S3 is fitted to break V6 heater circuit when the bridge is not required.

Multimeter

This is built up from an ex-government 2¼in. 1 milliamp moving-coil meter giving D.C. voltage readings at 1,000 ohms per volt. A 1 mA meter rectifier is employed to enable A.C. voltage measurements to be made. The 0-10 v. A.C. range is not linear, but to avoid marking an extra scale the important voltages, i.e., 2, 4 and 6.3 v. were marked with dots. The scale on these meters is usually .2 and so on up to 1. The easiest way to convert the scale is to scratch out the decimal points and add a zero to the 1 with indian ink, then add the figures 1 to 5 below the scale. The resistance scale is calculated from Ohm's law and the appropriate divisions marked in on a separate scale below the main one: remember to subtract the internal dropper resistance from the calculated value!

The shunt R5 is adjusted so that the meter reads

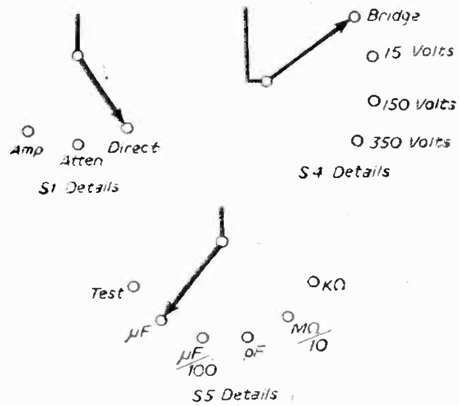


Fig. 4.—Details of switching.

17 mA full scale, and this will enable the R/100 range to coincide with the scale already marked. The 30 ohm zero adjuster is an old filament rheostat and is

(Concluded on page 357)

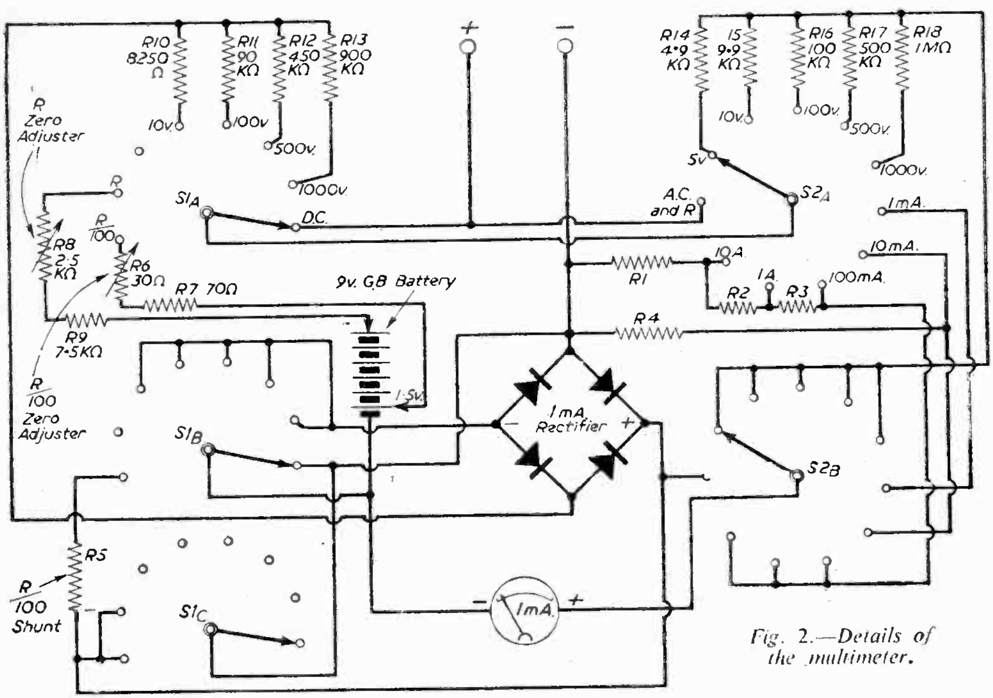


Fig. 2.—Details of the multimeter.

R1, R2, R3, R4, R5—Shunts—see text.
R6—30 Ω wire-wound pot.
R7—70 Ω.
R8—2,500 Ω carbon pot.
R9—7,500 Ω.
R10—8,250 Ω.
R11—90,000 Ω.
R12—450,000 Ω.
R13—900,000 Ω.
R14—4,900 Ω.
R15—9,900 Ω.
R16—100,000 Ω.
R17—500,000 Ω.
R18—1 MΩ.
S1A-C—3-bank 1-pole 8-way Yaxley switch.
S2A-B—2-bank 1-pole 11-way Yaxley switch.
Two instrument terminals.
One mA 2¼in. moving coil meter.
One mA. meter rectifier.
One 9 v. grid bias battery.

Volume Controls
Midget Ediswan type. Long spindles. Guaranteed 1 year.

No. Sw.	S.P. Sw.	D.P. Sw.
3/-	4/-	4/9

ALL VALUES.—10,000 ohms to 2 Megohms.

80 ohm **CABLE COAX**
STANDARD ¼in. diam. Polythene insulated. GRADE "A" ONLY
Not Ex-Govt.
8d. yd.
COAX PLUGS, 1 2 each. SOCKETS 1 2 each. LINE CONNECTOR, 1 2. OUTLET BOXES, 4 6.

W/W EXT. SPEAKER CONTROL 10Ω, 3/-.

BALANCED TWIN FEEDER per yd. 6d. } 80
TWIN SCREENED FEEDER per yd. 1/- } ohms
50 OHM COAX CABLE, 8d. per yd. ¼in. dia.

TRIMMERS, Ceramic, 30, 70 pf. **9d.** 100 pf. 150 pf. **1/3** ; 250 pf., **1/6** ; 600 pf., **1/9.**

RESISTORS.—All values : 10 ohms to 10 meg., ¼ w. **4d.** ; ½ w. **6d.** ; 1 w. **8d.** ; 2 w. **1/-** ; High Stability, ½ w. 1%, **2/-.**

WIRE-WOUND RESISTORS.—Best Makes Miniature Ceramic Type—5 w., 15 ohm to 4 K., **1/9** ; 10 w., 20 ohm to 6 K., **2/3** ; 15 w., 30 ohm to 10 K., **2/9** ; 5 w. Vitreous, 12 K. to 25 K., **3/-.**

WIRE-WOUND POTS. 3 WATT, FAMOUS MAKE
Pre-Set Min. TV. Type. Knurled Slotted Knob. All values 25 ohms to 30 K., **3/-** ea. 50 K., **4/-.** Ditto Carbon Track 50K. to 2 Meg., **3/-.** | Standard Size Pots, 2¼in Spindle. High Grade. All Values. 100 ohms to 50 K., **5/6** ; 100 K., **6/6.**

O/P TRANSFORMERS.—Small Tapped p.m. pentode **3/9.** Heavy duty 70 ma., **4/6.** Ditto, tapped, **4 9.**

L.F. CHOKES 10 h. 65 ma., **4/6.** 20/25 h. 100 150 ma., **12/6.** 5 h. 250 ma., **15/-.** 15 h. 100 ma., **10/6.**

LYNX, choke 3h. 250 ma., **13/6.** **SIMPLEX,** 10h. 150 ma., **10/6.**

MAINS TRANS.—Made in our own workshops to high grade specification. Fully inter-leaved and impregnated. Heater Trans., tapped prim. 0-200 v. 250 v., 6.3 v. 1½ amp., **7/6** ; ditto 6.3 v. 3 amp., **10/6** ; ditto, 12 v., .75 a. amp., **7 6.** 350-0-350, 80 ma., 6.3 v. 4 a., 5 v. 2 a., ditto 300-0-300, ditto 250-0-250, **21/-.** Viewmaster, **35/-.** Teleking, **30/-.** Lynx, **30/-.** Coronet, **30 -.** Super Visor, **30 -.** Simplex, **35/-.**

SOUNDMASTER SPECIALS.—Mains Trans., **35/-.** L.F. Choke, **10/6.** O/P Trans., **5/6.** Envelope **6 6** Specified Wafer Switches, **22/6** per set of 3.

GOODMANS WIDE ANGLE DUOMAG FOCUS UNIT. Centraliser and Vernier Focus Adjuster, **35/-.**

ELAC ION TRAPS.—IT6 for 35 mm. Tubes, **2 6** ea.

TAPE RECORDING BARGAINS
LIGHTWEIGHT XTAL HAND MIKES. Chrome finish—Quality and sensitivity for only 25/-.
PLASTIC RECORDING TAPE by G.E.C. 1,200 ft. complete with spool. Ideal Soundmaster, etc., 19/6, post free.

WOODEN WALNUT CABINET.—12in. x 7in. x 5in. complete with punched chassis, TRF or superhet, dial, back-plate, drum, drive, spring, pointer, etc., **28/6,** plus post 2/-.

TYANA.—Midget Soldering Iron. 200 220 v. or 230/250 v., **14/11.** **TYANA TRIPLE THREE.**—Complete with detachable bench stand. **19/6.**

NEW SOLON MIDGET IRON.—25 w., **19/6.** IDEAL FOR RADIO CONSTRUCTORS.

C.R.T. HEATER ISOLATION TRANSFORMER.—Low leakage winding with 25% sec. boost, 2 v., **10/6** ; 4 v., **10/6** ; 6.3 v., **10 6** ; 12 v., **10,6.**

MIKE TRANSF.—Ex-Govt. Ratio 50 : 1, **3/9** ea.

V'HOLDERS.—**Pax** : 10, **4d.** ; EF50, EA50, **6d.** ; **B12A CRT, 1/3. Moulded** : 10, **6d.** ; B7G **9d.** ; with screening can, **1/6** ; B8A, B8G, B9A, **1/-** ; **VCR97, 2/6. Ceramic** : EF50, B7G, **1/-.** **All English,** 5, 7, 9 pin and U.S.A. UX types, **1/-.**

TAG STRIPS.—2- or 3-way, **2d.** ; 4- or 5-way, **3d.** ; 6-way, **4d.** ; 9- or 10-way, **6d.,** etc.

TV AERIALS.—Full range popular types in stock, Aerialite, etc. All channels. Indoor loft type Inv. T., **13/6.** Outdoor single dipole, **37 6.** H-type with chimney lashings, etc., **92/6.** X-type Dublex, 7ft. mast chimney lashings, etc., **88 6.**

TOGGLE SWITCHES EX-GOVT. "On-Off," **9d.** Ersin M'core solder 60/40, 16 g. or 18 g., **5/6 ½ lb.** ; T.C. wire, 18 to 22 s.w.g., per yd., **2d.** PVC Connecting wire, 10 colours. Single or Stranded, **2d.** yd. 2 K. 5 w. H.D. w/w Pots, **4/6** 10 K., 25 K., Colvern w/w Pot. 1in. spindle, **3 6.** **SCREENED GRID CAPS** I.Oct., or Mazda, **6d.** ea. **BULGIN HIGH VOLTAGE VALVE CAPS,** I.Oct., **1/-.**

FUSES.—1¼in. all values 60 ma. to 10 a., **6d.**

ALADDIN FORMERS and cores, ¼in., **8d.** ; ⅜in., **10d.**

SLOW MOTION DRIVES.—Epicyclic ratio 4 : 1, **2 3.**

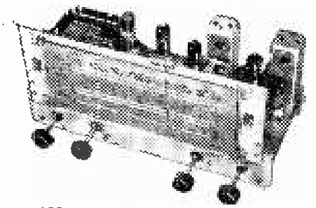
INT OCTAL CABLE PLUG (8-pin), with cover, **1/3.**

200/250 Volt SELECTOR SOCKET (2in. x 1in.), with Plug, **1/-.** **PILOT LAMPS.**—6.3 v. .3 a., **8d.**

SPEAKER FRET.—Expanded anodised metal, 14in. by 9in., **3/-.**

EXT. L.S.—Switched Socket, on-off and parallel switching, complete with plug, **2/-.**

COPPER PLATED AERIAL RODS. ¼in. x 12in., push fitting, **2,6 doz.**



ALL WAVE RADIOGRAM CHASSIS
THREE WAVEBANDS FIVE VALVES

S.W. 16 m.—50 m.	LATEST MULLARD
M.W. 200 m.—550 m.	ECH42, EF41,
L.W. 800 m.—2,000 m.	EBC41, EL41, EZ40.

Brand New and Guaranteed, with 10in. P.M. Speaker, A.C. 200 250 v. Four position Wave-change Switch. Short-Medium-Long-Gram. Slow Motion Tuning. Speaker and Pick-up connections. High Q iron-dust cored coils, 465 kc/s I.F. Latest circuit technique delayed. A.V.C. and Negative feedback. Output 4.2 watts, 3 ohm output transformer on chassis. Chassis size 13¼ x 5½ x 2¼in Glass Dial—10in. x 4½in., horizontal or vertical type available, lit by 2 Pilot Lamps. Colour Black Station names, L.W. Green, M.W. Red, S.W. White. Four Knobs supplied. Walnut or Ivory to choice, aligned and calibrated. Chassis Isolated from mains PRICE, **£10/15/0.** Carriage and Insurance, 4 6. (Without 10in. Speaker, **£9/15/0.** Carr. & Ins., 4 6.)

BARGAIN OFFERS
RECOMMENDED FOR ABOVE CHASSIS GREAT REDUCTIONS
Brand new Plessey 3-speed Autochanger Mixer Unit for 7, 10 and 12in. Records. Twin Hi-Fi Xtal Heads with Duopoint sapphire stylus. Plays 4,000 records. Sprung mounting. Superb Quality. Bargain Price, 9½ gns. post free.

Ediswan 78 r.p.m. Single-player Gram Unit. High Impedance Magnetic Pick-up. Press lever start for 10in. or 12in. records. auto stop. Listed 7 gns. Our Price £4/10/-.

NEW BOXED — **VALVES** — **ALL GUARANTEED**

1A5	5/6	6J5	7 6	12Q7	10/6	EF50 Equip	5/6
1R5	8/-	6J7	8 6	12SH7	5/6	British	7/6
1S5	8/-	6K6	7 6	35L6	10/6	Sylvania Red	10/6
1S4	8/-	6K7	6 6	35Z4	10/6	EF91	8 -
1R5	8 -	6K8	9/-	OZ4	8/6	EF92	9/6
3S4	9/-	VT127 } Pen46 }	9 -	50L6	9 6	EL32	9/6
3V4	8/-	EF80	10 6	807	10/6	7C6	9/6
3D6	2/6	6L6	10 6	GZ32	15/-	EY51	12 6
5U4	10 6	6F25	15 -	9001	7/6	EY91	8 6
5Z4	9/-	6Q7	9/6	9006	7/6	HVR2a	7/6
6X4	7/6	6SA7	8 6	CV6	3/6	MS/PEN	6/6
6AG5	7/6	6SH7	6/6	DET18	8/6	PY80	11/6
6AM6	9/-	6SL7	9 -	DK91	8/-	PY81	11/6
6AT6	10/6	6SN7	11/	DF91	8/-	PY82	10/6
6B8	7/6	6U5(Y63)	8 -	DAF91	8/-	PEN25	8/6
6BA6	8 6	6V6	8/-	DL92	9/-	SP61	8/6
6BE6	10 6	6X5	9/-	DL94	9/-	U22	9/6
6BW6	10/6	6AK5	10/6	E1148	4/6	VP23	7/6
6C4	7 6	7S7	9/6	EA50	2/-	VR116	6/6
6C6	7 6	8D3	9 -	6AL5	7/6	V1139	9/6
6D6	7 6	9D2	5 6	EB91	7,6	ECL80	12/6
6F6	9/6	12A6	7 6	EBC33	9 6	25L6	10 6
6F12	9/-	12AX7	10/6	EC91	7/6	25Z6	10/6
6G6	6 6	12K7	10/6	EF36	7/6	25Z4	10 6
6H6	3/6	12K8	10 6	EF39	9/-		

Huge Stock B.V.A. Valves at 1951 low tax prices.

SPECIAL PRICE PER SET
1R5, 1T4, 1S5 and 3S4 or 3V4 ... ... **30/-**
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5 ... **37/6**

VIEWMASTER. 12 valves, **£6/10/-.** With EY51, **£7.** **TELEKING.**—17 valves, **£9/10/-.** **LYNX.**—17 valves, **£9.** **CORONET.**—4 valves, **45/-.**

SUB MINIATURE VALVES
WIRE ENDS
★ R.F. Pent. .625 v. Fil
● L.F. Pent. 1.25 v. Fil.
Brand new. Ex Deaf Aid Apparatus, by Mullard and Hivac. Types :—

★ DF66	★ XFW20	all at
★ DF70	★ XFW30	**7/6** each
● DL66	● XFY11	
● DL72	● XFY31	post free

CRYSTAL DIODE.—Very sensitive. G.E.C., **3/6.**
H.R. PHONES.—(Hi-grade Amer.), **15/6** pr. **S. G. BROWN'S,** 4,000 ohms, **15 6** pr.

T.R.S. RADIO COMPONENT SPECIALISTS
THO 1665 Buses 133 or 68 pass door.
307, WHITEHORSE ROAD, WEST CROYDON.
Mail Order : **71, MEADVALE ROAD, EAST CROYDON.**
P. and P., 6d. £1 orders post free. Lists 3d.
ALL MAINS TRANS.—1/- extra postage.

ELECTRODYNAMIC MIKE INSERT.—U.S.A. make, precision engineered. Size only 1in. diam. by ⅜in. Bargain Price **3/9.** Matching Trans. **3/9.**

CONDENSERS.—New stock best makes, .001 mfd. 6 kV. T.C.C., **5/6.** Ditto, 12.5 kV., **9/6** ; 2 pf. to 500 pf., **6d.** ; .001, .005, .01, T.C.C. 500 v., .01 Sprague 500 v., .02 N.S.F. 500 v. .1 mfd. 350 v. Micamould Tub., **9d.** ; Hunts Moldseal 500 v. .05 mfd. and .1 mfd., **1/-** ; .25 mfd., **1 6** ; Tubular .5 mfd., 350 v. **1,9.**

SILVER MICA CONDENSERS.—10%.
5 pf. to 500 pf., **1/-.** 600 pf. to 3,000 pf., **1,3.**

DITTO 1% (ex. stock).
1.5 pf. to 500 pf., **1/9.** 515 pf. to 1 000 pf., **2/-.**

ELECTROLYTICS ALL TYPES NEW STOCK.

Tubular Wire ends	
1/275 v. B.E.C.	**2/-**
2/450 v. B.E.C.	**2/3**
4/350 v. Dub.	**1/6**
4/500 v. Hunts	**2/-**
8/450 v. B.E.C.	**2/3**
8/450 v. T.C.C.	**2/9**
8/500 v. Dubilier	**2/9**
10/500 v. Dubilier	**2/6**
16/500 v. Dubilier	**4/-**
8+8/500 v. Dubilier	**4/6**
16/350 v. B.E.C.	**3/-**
32/350 v. Dubilier	**4/-**
32/500 v. Dubilier	**5/-**
32+32/350 v. Dub.	**5/6**
25/25 v. Dubilier	**1/9**
50/25 v. Plessey	**1/9**
50/50 v. Plessey	**2/-**
Can Types, Clips, 3d. ea.	
16/450 v. T.C.C.	**3/6**
32/350 v. B.E.C.	**4/-**
60/350 v. T.C.C.	**6/6**
250/350 v. B.E.C.	**8/6**
8+16/450 v. B.E.C.	**5/-**
8+16/500 v. Dubilier	**5/6**
16+16/450 v. B.E.D.	**5/6**
16+16/500 v. Dub.	**6/-**
32+32/450v. B.E.C.	**6/6**
32+32/350 v. +25/25 v. in same can B.E.C.	**6/6**
60+100/350v. Hunts	**11/6**
100+200/275 v. B.E.C.	**12/6**

SPECIALS.—Can Types, 500 mfd. 12 v., **3/-** ; 1 000 mfd. 12 v., **5/-** ; 1,000 v. mfd. 6 v., **4/6** ; 16 mfd. 700 v. Hunts, **6/6** ; .1 mfd. 2 kv., **4/6** ; .5 mfd. 3.5 kv., **5 6.**

SENTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK VOLTAGES.—K3/25 2 kV., **4/3** ; K3/40 3.2 kV., **6/-** ; K3/45, 3.6 kV., **6 6** ; K3/50 4 kV., **7,3** ; K3/100 8 kV., **12 6** ; K3/160 14 kV., **18/-.**

MAINS TYPE.—RM1, 125 v., 60 ma., **4/-** ; RM2, 100 ma., **4/9** ; RM3, 120 ma., **5/9** ; RM4 250 v. 275 ma., **16 -.**

KNOBS, GOLD ENGRAVED.—Walnut or Ivory, 1½ in. diam., **1/6** each. "Focus" "Contrast," "Brilliant," "Brilliance—On-Off," "On-Off," "Volume" "Vol.—On-Off," "Tone," "Tuning," "Treble," "Bass," "Wavechange," "Radio-Gram," "S., M., L., Gram.," "Record-Play," "Brightness," Ditto not engraved, **1/-** each.

POINTER KNOBS.—Brown with white marking line, small, **9d.,** large, **1/-.**

COILS.—Wearite "P" type, **2 6** each. Osmor "Q" Type, adj. dust core, **3/6** each. All ranges.

REACTION COND.—.0001, .0003, .0005 mfd., **3/6** ea.

SURPLUS MAINS TRANS.—Prim. 0-200/250 v. ; Sec. 275-0-275 v., 60 ma., 6.3 v. 3 a., 6.3 v. 1 a., **10/6** ; ditto, 260-0-260 v. 80 ma., 6.3 v. 3 a., 4 v. 1 a., **12/6.**

E.H.T. TRANSF.—4 Kv. A.C., 2 v. 2 a., **45/-.**

VIBRATOR TRANS.—6 v. input, 230 v. 50 ma. output, **9/6.** P. & P., 1/-.

VCR97 £2
TESTED FULL PICTURE

CHARGER TRANS. PRIM.—0-200/250 v., sec. 0-9 v.-15 v. 1 a., **13/6** ; 2 a., **16/-** ; 3 a., **18/6** ; 4 a. **21/-** ; 6 a., **26/-.**

FULL WAVE BRIDGE SELENIUM RECTIFIERS.—6 or 12 v. 1½ amp., **8/9** ; 3 a., **12/6** ; 4 a., **15/-** ; 6 a., **23/6.** Ditto F.W. only 6 v., 1 a. (9 v.-0-9 v. A.C.), **5/6.**

ACID HYDROMETER.—New ex-Govt. Unbreakable. Packed in metal case, 7in. x 1¼in. dia., **4/6.**

H.F. MIDGET CHOKES.—14 M.H., **2/6** each.

BRIMISTORS.—CZ1 for .3 a. heater chains, **3/6.** CZ2 for .15 a., or .2 a., **2/6.**

COPPER ENAMEL WIRE.—¼ lb. 14 to 20 s.w.g., **2/-** ; 22 to 28 s.w.g., **2/6** ; 30 to 40 s.w.g., **3/6.**

SWITCH CLEANER Fluid, squirt spout, **3,9** tin.

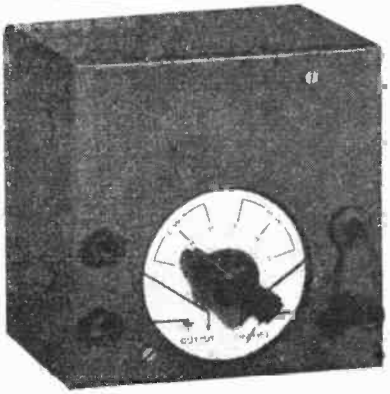
5in. **RADIO SCREWDRIVERS.**—Sheffield made blade, 2½in. x ⅛in. Ins. handle, 5,000 v., **4½d.** each.

TWIN GANG TUNING CONDENSERS.—.0005 mfd. midget with trimmers, **8/6** ; 375 pf. midget less trimmers, **6/6** ; .0005 Standard size with trimmers and feet, **9/-** ; less trimmers, **8/-** ; ditto, soiled, **2/6.**

BULGIN MAINS PLUGS.—Re-entrant safety type, complete with plug. 3 way, **3/6** ; 6 way, **5/6.**

LOUDSPEAKERS P.M., 3 OHM.
3in. Plessey, **12/6.** 5in. Goodmans, **13/6.** 6½in. Elac, **14/6.** 8in. R. & A., **17/6.** 10in. Plessey, **25/-.** 12in. Truvox, **55/-.**

I.F. TRANSFORMERS
465 Kc/s Slug tuning Miniature Circular. Can, 2¼in. by 1½in. diam. Fits octal V-holder cut out. High Q and good bandwidth. By Pye Radio. Two mounting feet.
BRAND NEW, 6/9 PAIR



SO SIMPLE TO USE
SO EASY TO BUILD

NO additional

- power supply
- tone source
- energising
- calibrating

or

- metal work

are required with any of these Kits

EACH KIT IS A COMPLETE WORKING INSTRUMENT ON ASSEMBLY

Only the simplest of tools are required for assembling and ample diagrams with step by step instructions are supplied in each case.

All Kits operate from a standard 1½ volt torch cell.

In addition to thousands of satisfied amateur and trade customers, we also supply Technical Colleges, Relay Companies, Government Departments, Secondary Schools and Aircraft Companies with these Test Gear Kits. They are now being used in United States, Canada, South America, Australia, New Zealand, Borneo, Malaya, Iraq, India, Egypt, Morocco, Greece, South Africa, Kenya, Rhodesia, Nigeria, Uganda, etc., etc., etc.

SPOT FREQUENCY SIGNAL GENERATOR

Fully screened in steel case 4in. x 4in. x 3in. Provides modulated signal on six switched spot frequencies, three on long waves and three on medium. As illustrated above. **35/-** P.& P. 1/6

465 Kc/s I.F. ALIGNER

Fully variable tuning from 445 to 485 Kc/s. All other details as in Sig. Gen. above. **17/6** P.&P. 1/6

R. M. TWIN MULTI-OHMER

Resistance substitution set with both fixed and variable outlets, covering all useful values up to 7 megohms. **25/-** P.&P. 1/6

RES/CAP. BRIDGE

Six ranges. 500 pF to 50 mfd. 10 ohms to 5 megohms. For use with any type 'phones. **31/6** P.&P. 1/6

INDUCTANCE BRIDGE

Five ranges. 50 micro/Hy. to 100 Hy. For use with any type 'phones. **42/6** P.&P. 1/6

AUDIO BRIDGE

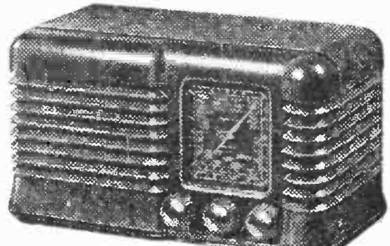
Three ranges. 40 to 16,000 cycles. **38/6** P.&P. 1/6

Stamp for illustrated leaflets. Cash with order or C.O.D. Overseas 3/6 extra.

RADIO MAIL DEPT. F, 4-6, RALEIGH STREET, NOTTINGHAM.

the "ATOMIC"

A.C. SET FOR 90/-



YOU can make this attractive 3-valve A.C. Mains Set (2 Wavebands). Send only 90/- plus 3/- Carr. & Ins., and complete parts, including Valves, Ready-to-Use Chassis, Moulded Cabinet in Ivory or Walnut and full, illustrated instructions will be sent by return. YOU CAN MAKE MONEY MAKING THESE SETS FOR FRIENDS—they're simple to construct and amazing value. Many already in use.

- **Send for Point-to-Point Wiring Diagram and list of Parts, 1/-, POST FREE.**
- **Screwdriver, Pliers and Soldering Iron, only tools required.**
- **All Parts sold separately.**
- **Money Back Guarantee.**
- **No Radio Knowledge required.**

Call and hear this quality Receiver working at Birmingham's largest Radio Home Constructors' Shop (opposite the Hippodrome).

Every courtesy will be extended to you.

Norman H. Field Tel.: MIDLAND 3619

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The solder for all

HOME TELEVISION
CONSTRUCTOR SETS

Designers of television constructor sets know that the efficiency of their equipment depends on the solder used by the constructor—that's why they recommend Ersin Multicore for trouble-free, waste-free soldering. Ersin Multicore, the only solder containing three cores of extra-active, non-corrosive Ersin Flux, is obtainable from all leading radio shops. Ask for Cat. Ref. C.16018, 18 S.W.G. 60/40 High Tin Television and Radio Alloy. The size 1 Carton contains 55 feet of solder, costs 5/-.

Ersin Multicore Solder

In case of difficulty in obtaining supplies, please write to

MULTICORE SOLDERS LTD. MULTICORE WORKS, MAYLANDS AVE., HEMEL HEMPSTEAD, HERTS. ● Boxmoor 3636 (3 lines).

mounted below the chassis together with the 2,500 ohm pot. for the higher range. These adjusters are accessible through the holes shown in the side of the case near the front.

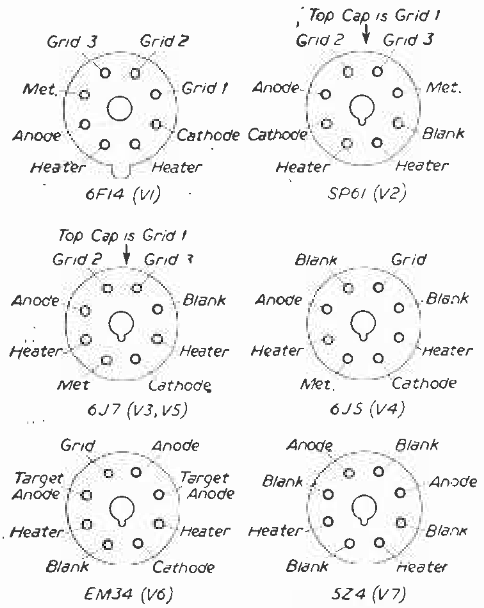


Fig. 5.—Valve base data.

The bridge can do its first job in selecting correct values for the meter voltage droppers. The best method to obtain a "spot on" value is to obtain a resistor higher in value than that required and then add a very high resistance in parallel to give the correct value. The current shunts will require some patience and the best procedure is to calculate the values roughly by Ohm's law, e.g., the 100 mA shunt R3 will be approximately 1/100 of the meter resistance. The length of resistance wire required can be found from wire tables and a loose length of wire connected across the meter terminals. The length of this wire is adjusted until the meter reading is correct. This method is also used to find R2 and R1, and the whole procedure repeated until the correct lengths are obtained. A meter known to be accurate must be used to obtain correct calibration, although a fair degree of accuracy can result from the use of a 6 v. accumulator and some octal valves with known filament ratings. It was found convenient to make R1 of 18 s.w.g. tinned copper wire, R2 of 22 s.w.g. Eureka wire, R3, R4 and R5 of 30 s.w.g. enamelled Eureka.

After the correct lengths of wire are found they can be wound on to paxolin strips approximately $\frac{3}{4}$in. wide. The blank switch contact on S1 can be used as a safety position or as an A.C. current range if required, although the latter is not recommended. If difficulty is experienced in obtaining an eight-way switch, merely obtain one with a greater number of positions and solder a small piece of plate bent to an "L" shape to the stop plate at the place required to form the limit of travel. The resistors and shunts can be mounted entirely on the switch banks and the meter rectifier tapped out to 5BA and mounted on an end of the switch rods. Both meter terminals should be insulated from the panel.

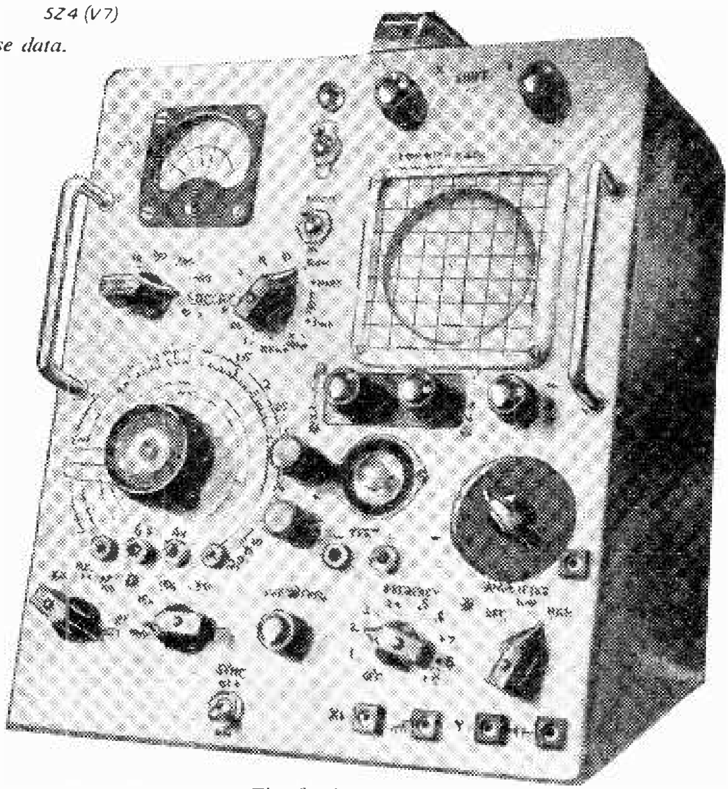
Constructional Notes

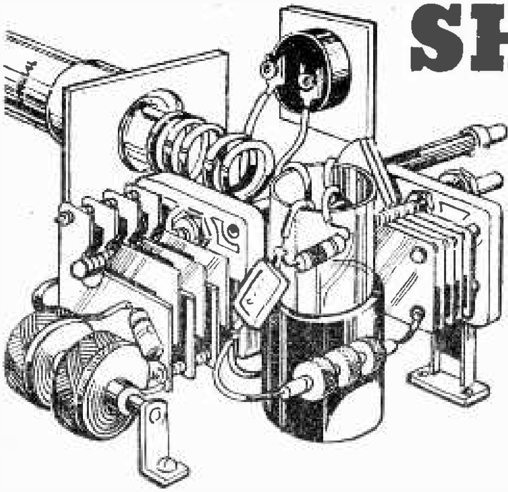
The chassis, front panel and case were all made from 18 s.w.g. aluminium.

The front panel is finished in the flat and then the $\frac{1}{2}$in. edges turned up by bending over against a piece of 1in. wood finished to the exact inside measurements of the panel.

The chassis is the usual inverted tray with a brace across the middle of the bottom and two struts bolted to the upper part of the panel by the handles.

The case slides between the chassis and the flaps on the front panel. It is secured by small P.K. screws and has a strut across the back at the top. Fibre board was used as a bottom and back cover.


The finished instrument.



SHORT-WAVE SECTION

COMMENCING SHORT-WAVE LISTENING.

AN ARTICLE OF SPECIAL INTEREST TO THE BEGINNER

By W. J. Delaney

MANY younger readers take the opportunity at this time of the year to start some new activity and those who are interested in radio often decide upon short-wave listening, which offers a diversion from ordinary broadcast or television listening. Unfortunately disappointment often results and active participation in short-wave activities is lost, perhaps for good, simply because one or two important factors are overlooked. The holidays obviously present a very favourable period during which construction may take place, any aerials be erected, and there is adequate time available for experiment. It should be borne in mind first, however, that the behaviour of the short waves, or high frequencies, is very different from those used for normal broadcasting. It is very desirable that one should think in terms of frequency rather than of wavelength so far as short waves are concerned, and then a number of points become more obvious. It will be remembered that the radiated wave travels from the transmitting aerial exactly in the same manner as the wave on a pond, and the number of waves in a second is the frequency. The shorter the wavelength, therefore, the higher the frequency, and if, instead of talking about short waves, one refers to them as ultra-high frequencies one automatically regards them as a little more tricky. So many younger listeners think of the "short waves" as being a simple modification of the ordinary medium-wave broadcasts and they rig up very rough one-valve receivers and tack on the normal outside aerial of 30 or 40 ft. and then find results disappointing. As a result they regard "short-wave listening" as not worth while and give it up. Thinking of ultra-high frequencies, however, should call for a little more respect in dealing with them and if the following points are borne in mind it will be found that there is a very interesting field available which will give adequate reward for the time and trouble spent in constructing and trying out the apparatus.

High-frequency Circuitry

First, the fact that the signals are at high or ultra-high frequency means that the receiver must be built rather carefully with properly chosen parts. In most cases it is a waste of time to try to adapt standard broadcast components. Use proper short-wave parts and, although it is always a good plan to buy new parts, there are many ex-Service parts which are designed specially for U.H.F. use and which are available at low cost. Variable condensers especially are important and should be not larger in capacity than .0002 or .0003 μF for tuning, and H.F. chokes and valveholders should also be of the special type. Remember that the very high frequencies must be kept in their proper place, and that is in the actual circuit, and therefore spacing of leads from a metal chassis, etc., should be attended to so that there is no risk of leakage or losses due to unwanted stray capacities. In the latter respect an important point concerns the use of headphones. These are perfectly permissible, and, in fact, much short-wave listening has to be carried out on phones. Accordingly, the phones should be provided with a by-pass condenser so that H.F. currents do not leak into the phone leads. Alternatively, low-impedance phones may be employed with a suitable matching transformer in the receiver.

If H.F. leaks into the phones, then every time the hand approaches the receiver the tuning may be affected and critical tuning will be impossible. A good plan is to use a vertical metal panel, and to make sure that a really good earth connection is employed, and this will serve to screen the body and avoid these erratic tuning effects. If a loudspeaker is employed the same main feature should again be adopted, namely, keep H.F. out of the leads. No exact details can be given here, as so much depends upon the circuit which is employed, but if a single reacting valve detector is being employed, for instance, then a really good H.F. choke, suitable for the frequencies being used, should be fitted in the anode circuit, with a by-pass condenser from anode to earth. The latter should always be fitted, and if it is found that it reduces the reaction effect, then the latter circuit should be modified. In some circuits the only H.F. by-pass is through the reaction circuit, and obviously if reaction is set very low then the by-pass may be insufficient and H.F. will leak elsewhere. In those receivers employing L.F. amplifying stages the H.F. should be prevented from reaching the L.F. stages by the same means, and, of course, from a quality point of view no H.F. should be present.

Aerials

As we have mentioned the elusive nature of the high frequencies, we must also bear this in mind when considering the aerial. Any old piece of wire slung up will not do, as insulation is quite important. There are two things to be considered here. First, the signal currents arriving may be very weak and

(*Continued on page* 378)

TRANSMITTING TOPICS

NEUTRALISING A SINGLE-ENDED STAGE

By O. J. Russell, B.Sc., A.Inst.P. (G3BHJ)

ONE problem often facing the amateur is that of instability at the higher frequencies. Thus while the transmitter may have been used with perfect stability on the lower frequency bands trouble with instability sets in on the H.F. bands. In a typical case, up to 7 Mc/s, no trouble is experienced, and 14 Mc/s may produce "conditional stability," while on 21 and 28 Mc/s stability is poor. The usual trouble is that P.A. self-oscillation occurs. This may be prevented in some cases by tight coupling of the aerial circuit, so that oscillation is damped. However, this is generally unsatisfactory, as stability then usually depends very critically upon the P.A. stage tuning. The indications of such regenerative effects are sudden and violent changes in P.A. current with very slight changes in the P.A. grid and anode tuning. Even if the amplifier is nominally stable at one setting it may burst into oscillation with small frequency changes, or, worse still, burst into spurious oscillations under modulation or generate spurious bursts under keying transients. In one case a transmitter generated no TVI when on 'phone, but on C.W. created violent TVI. This surprising result was traced to parasitic oscillation bursts occurring only when the P.A. came into operation. On 'phone only one transient burst occurred at the start of the transmission, but of course under keying a series of bursts occurred at the start of each morse symbol. Until this occurrence no suspicion of instability had existed.

While some amateurs take the attitude that the modern high-slope tetrode or pentode is likely to "take off" when running unloaded, and philosophically add aerial coupling to "stabilise" the stage, this is hardly a satisfactory solution for the reasons previously given. The only alternative appears to be neutralisation, by means of which a P.A. stage can be absolutely stabilised. This seems a hard decision to the amateur who has taken too seriously the advertising matter assuring him that the modern tetrode valve needs no neutralising. Furthermore, if he has already designed a single-ended stage transmitter for all-band operation—on the basis of his trouble-free operation at the lower frequencies—he is apparently faced with a major rebuild and the purchase of a split-stator condenser in order to build a balanced P.A. tank circuit for the orthodox anode neutralised stage. Worse still, if the now popular Pi-network tank circuit has been constructed, which is effective on TVI reduction, there seems no easy way of neutralising it at all! All this is most discouraging.

There are, of course, one or two methods such as "link coil" neutralising which are sometimes advocated, but these are somewhat fiddling and are awkward when band changing is needed. It is surprising, therefore, that the system to be described

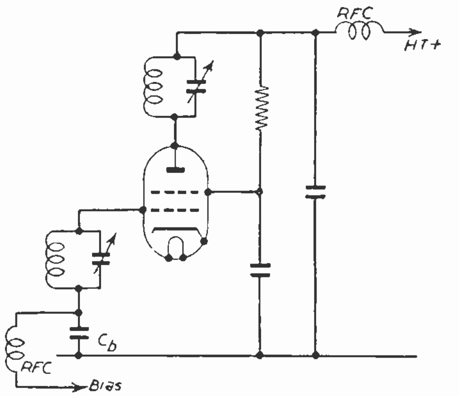


Fig. 1.—A conventional single-ended Tetrode P.A. stage.

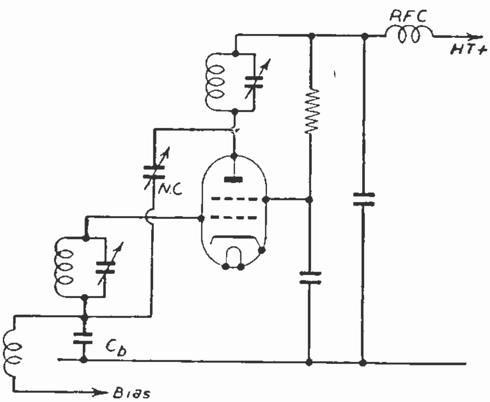


Fig. 2.—Addition of the neutralising condenser N.C. enables the single-ended stage to be neutralised very simply.

is not recommended more often, as it has the merit of simplicity, and can be added to most single-ended tank coil P.A. stages, including Pi-network tanks, without involving drastic structural modifications.

The Circuit

Taking the simple single-ended stage of Fig. 1 as an illustration, the circuit of Fig. 2 shows how the addition of a single neutralising condenser produces a neutralised stage.

As the principle may not be immediately clear from the circuit, which seems "too simple to work," it must be explained that in reality the circuit is a "capacity tap" form of grid-neutralised arrangement. To show this more clearly, the essential components of the bridge network forming the neutralising system are drawn in bridge form in Fig. 3. As might be expected, the important components are those invisible on the usual circuit diagram, that is, the grid-to-earth capacity of the P.A. valve and the apparently unimportant "earthing condenser" attached to the earthy end of the grid circuit. As Fig. 3 shows, the "ratio arms" of the bridge circuit are formed by the grid-to-earth capacity of the valve and the "earthing" or "by-pass" condenser from the earthy end of the grid tuned circuit to earth! This is important, as it means that the actual value of the neutralising condenser has to be many times greater than the "anode to grid" capacity of the valve which is to be "neutralised" out. In fact, with a valve such as the 807, where the small anode-to-grid capacity usually means the improvisation of a very awkward "twisted wire" or some similar very small neutralising capacity, the circuit of Fig. 2 enables a normal small variable condenser, which can be a readily adjustable panel control, to be used.

Thus, to take a concrete case, with a P.A. stage using a valve of 10 pF grid-to-earth capacity and with the grid circuit "earthing" condenser of the usual value of, say, 1,000 pF, the "bridge ratio" is 1,000/10 or 100 to 1. If, therefore, the grid-to-anode capacity is one-tenth of a pF, the neutralising condenser needs to be one hundred times this, or 10 pF, a very convenient size. However, as the grid circuit "earthing" condenser can be selected or even made partially variable, any valve within reason can be neutralised with a reasonable size of neutralising condenser.

Flexibility

It will be seen that the system is thus highly flexible and can, in fact, be so adjusted as to be used with almost any P.A. valve of the tetrode class, which normally would require an almost microscopic neutralising capacity! In fact, if the "bridge ratio" is made too large, then one may need to use an unnecessarily high neutralising capacity, say, 50 pF. However, with the realisation that the original grid-circuit bypass condenser controls the "bridge ratio" of the neutralising bridge, it can be easily arranged that a tetrode or pentode stage can be neutralised with a comfortable neutralising capacity such as 5 pF or 10 pF within the range of a compact low-capacity variable condenser. In practice, of course, the neutralising adjustment is carried out in precisely the same way as any conventional neutralising circuit, that is, until R.F. transfer through valve inter-electrode capacity to the anode tank circuit is balanced out. Perhaps the method of observing whether the grid current varies with P.A. tank tuning is the most useful method, as it is more sensitive generally than the rather crude method of testing for anode circuit R.F. by a neon lamp! To neutralise by the grid current method no H.T. is applied to the P.A. valve, and the "flickers" of the grid current to the stage underdrive are observed when the anode tank is swung through resonance. As the correct adjustment of the neutralising condenser is reached the grid current flicks become less, until finally little or no flick can be observed on swinging the anode tank tuning. P.A. H.T. can then be applied as neutralising has been achieved.

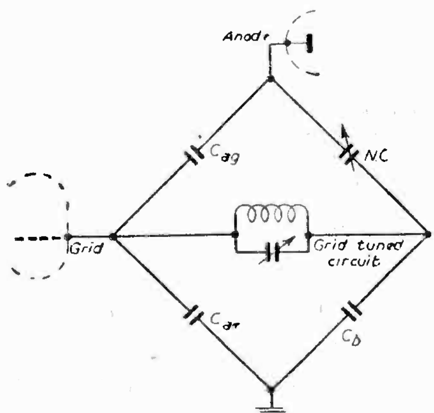


Fig. 3.—The essential "neutralising bridge" inherent in the circuit of Fig. 2.
C_b Bypass condenser as in Fig. 2.
C_{ag} Anode to grid capacity of P.A. valve.
C_{ae} Anode to earth capacity of P.A. valve. This capacity together with C_b determines the "ratio arm" of the neutralising bridge, so that with usual values the tiny capacity C_{ag} may be neutralised by an orthodox capacitor N.C. having a value of some 5-10 pFs.

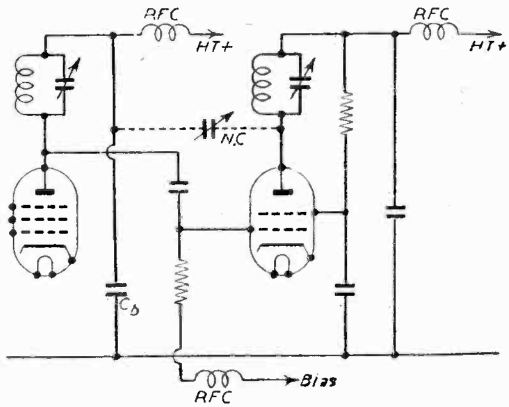
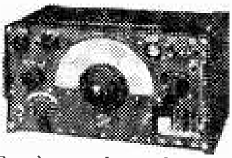


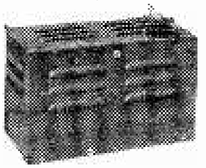
Fig. 4.—A P.A. with an untuned grid circuit driven by capacity coupling from the tank of the driver valve can have a neutralising capacitor added as shown by the dotted lines. Strictly the anode earth capacity of the driver valve should be included in calculating the "bridge ratio."

EX-A.M. RECEIVER TYPE R1155



Brand new and unused. 5 Frequency ranges: 18.5-7.5 Mc/s; 7.5-3.0 Mc/s; 1,500-600 Kc/s; 500-200 Kc/s; 200-75 Kc/s. Supplied in maker's original wood transit case. LASKY'S PRICE. **£11/19/6.** Complete. R.1155 Receivers. Secondhand, aerial tested. **£7/19/6.** Carriage and packing, 12/6 per unit extra, including 10/-, which will be refunded on return of packing case.

ASSEMBLED POWER PACK/OUTPUT STAGE FOR R.1155 RECEIVER



For use on 200-250 v. A.C. mains. Complete with 2 valves. In metal case size: 12 x 7 x 5½ins. LASKY'S PRICE **79/6.** Carr. 5/- extra.

Power Pack as above. Fitted with 6½in. p.m. speaker. LASKY'S PRICE. **£5/5/-.** Carriage 5/- extra.

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MBA/8. SPECIAL OFFER. Drop through type. 235-0-235 v. 60 mA. 6.3 v. 3 a., **12/6.**

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1T4	7/6	12Q7	8/6	KT2	3/6	6L6	10/6
1R5	7/6	6AL5	9/-	6K8	8/6	EA50	2/6
1S5	7/6	6K7	4/6	U50	7/6	EBC33	7/6
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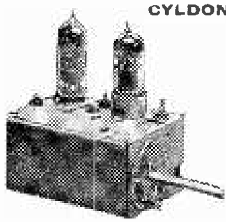

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6 volt		12 volt	
½ amp.	2/6	½ amp.	3/11
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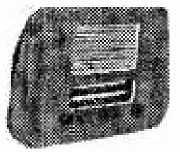
LASKYS RADIO

THE HARROW BAFFLE CABINET



Build a "second set" to be proud of. Pleasing design cabinet, with drilled chassis, dial drive and back. Finished in satin mahogany veneer. Outside dimensions: 17½in. wide, 11½in. high, 5in. deep. Receiver design uses 2-6K7, 6V6 and 5Z4. Total cost to build is less than **£5/10/-.**

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Chassis supplied with 5 octal valveholders, medium wave aerial and oscillator coils. Output transformer, volume control, sundry resistances and condensers, dial and knobs. Case finished in pleasing shade of brown crackle. Dial calibrated 150-550 metres.

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Now available. 12in. Goodmans heavy duty. 15 watts, 15 ohms.

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The Radio Trades Examination Board

THE 1953 EXAMINATION PAPER AND A REPORT ON THE RESULTS BY THE CITY AND GUILDS OF LONDON INSTITUTE, DEPARTMENT OF TECHNOLOGY

IN order to assist those readers who are interested in obtaining the Radio Servicing Certificate issued by the City and Guilds Institute, we give below the two papers set at the 1953 examination, and following this a detailed summary on the results.

First Paper

Not more than eight *questions are to be attempted. The maximum number of marks obtainable is the same for each question.*

Questions may be attempted in any order, but the answers must be clearly numbered.

1. Draw a circuit of an audio-frequency amplifier (omitting the power supply circuits) capable of delivering 10 watts to three loudspeakers, one of which is a "tweeter."

Give values against all components, and valve types against valve symbols.

Describe briefly the circuit arrangements and state how you would ensure that the speakers operate in phase.

2. Describe briefly, illustrating your answers, the following aids to the suppression of radio interference with sound broadcast reception :—

(*a*) an anti-static aerial,

(*b*) a D.C. mains filter (giving approximate values of components),

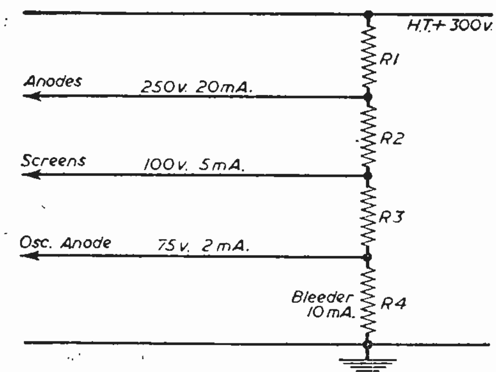
(*c*) a suppressor unit for fitting to small commutator motors such as are incorporated in vacuum cleaners, hair dryers, etc.

3. Having replaced some components in the tuning circuits of a service signal generator, describe fully how you would check the calibration of the instrument using :—

(*a*) Another signal generator.

(*b*) B.B.C. transmissions.

4. (*a*) State the values and nearest commercial wattage ratings of R1, R2, R3 and R4 in the diagram below :



(*b*) What type of resistors would you prefer to use in this arrangement ?

5. State the expressions for determining each of the following :—

(*a*) The joint capacitance of capacitors in series.

(*b*) The joint resistance of resistors in parallel.

(*c*) The connection bettween wavelength and frequency.

(*d*) The value of cathode biasing resistor.

(*e*) The current in a circuit having resistance, capacitance and inductance in series.

(*f*) The turns ratio of a loudspeaker output matching transformer.

6. (*a*) Describe fully, with the aid of sketches, two methods by which ferrous material may be magnetised permanently. Illustrate the molecular structure of the material before and after magnetisation.

(*b*) What precautions would you take when handling small permanent magnets ? State the reasons for your answers.

(*c*) Give three practical applications of a permanent magnet and three of an electro-magnet. Keep your answers brief, stating merely the names of the appliances.

7. (*a*) Give a diagrammatic sketch of the windings and general arrangements of a simple A.C./D.C. turntable motor.

(*b*) Explain why the motor functions on both A.C. and D.C.

8. (*a*) Describe fully the functions of each electrode of an indirectly-heated R.F. pentode valve. Illustrate your answer with a circuit symbol of the valve and a sketch of the electrode arrangement.

(*b*) What are the reasons underlying the development of the glass-based type of valve ?

(*c*) State one method used by receiver manufacturers of dissipating the heat from a valve enclosed in a metal screen.

Second Paper

All questions refer to a radio receiver, the circuit diagram of which is attached to this paper. **Not shown.**

Not more than six *questions are to be attempted. The maximum number of marks obtainable is the same for each question.*

Questions may be attempted in any order but the answers must be clearly numbered.

1. What are the functions of the following components ?

(*a*) R7,

(*b*) L1,

(*c*) R11,

(*d*) C29,

(*e*) R21,

(*f*) Mo.

2. (*a*) Describe fully the tone-correcting circuits and associated components which are in operation only on "gram."

(*b*) Explain briefly the advantages claimed for the inclusion of negative feed-back in A.F. stages.

3. Which components constitute the following ?

(*a*) Variable tone control.

(*b*) Output pentode safety load resistor.

(*c*) A.g.c. load resistor.

(*d*) V1 cathode biasing resistor.
(*e*) M.W. R.F. circuit trimmer.
(*f*) Aerial static-discharging resistor.

4. Describe fully the R.F. stage of the receiver, tracing the signal from aerial socket to V2 mixer grid on each waveband.

5. Describe in detail all the functions of V4 explaining how it operates in each case.

6. (*a*) Why is the motor connected as shown in the circuit diagram?
(*b*) What is represented by the dotted line above the laminations of T4? Why is it incorporated in the transformer and how does it function?
(*c*) Where would S4 be located in the instrument?

7. (*a*) Is the a.g.c. in this receiver delayed, simple or amplified?
(*b*) Explain these three systems of a.g.c., illustrating your answers, and state the advantages and/or disadvantages of each.

8. (*a*) Describe fully the alignment of the R.F. and I.F. circuits when the receiver is switched to M. W.
(*b*) State one precaution (obvious from examining the diagram) which has been taken to ensure that the various waveband circuits do not inter-act.

Examiner's Report

The following summary of the general report is given on the papers as a whole, and is not necessarily applicable to the work of individual schools.

General

The standard was fair but questions requesting full details were answered far too briefly. This is possibly due to the candidates being of a higher standard on their practical work than on their theoretical, together with their inability to express themselves.

First Paper

Question 1. Not many candidates attempted this question and of those who did several quite obviously did not appreciate that a "tweeter" loudspeaker can only handle the higher frequencies. In their circuit diagrams they merely connected the "tweeter" in parallel with the larger speaker but this did not satisfy the examiner, as many true "tweeters" would be damaged if called upon to handle low frequencies at a high output. Very few candidates gave a cross-over circuit which fed only the required frequencies to the loudspeakers.

Question 2. A popular question satisfactorily answered by the majority of the candidates who attempted it.

Question 3. Nearly all candidates who attempted this question dealt with the matter far too briefly. They failed to mention some of the finer points such as the need for operating the equipment for a short period before commencing adjustments, for reasons of stability, and they made no comment as to the need for checking that the right harmonics were being used.

Nevertheless, many good *practical* answers were submitted.

Question 4. Fairly well answered by most of the candidates tackling this question. Some gave only the wattage rating of the resistors and omitted to give the ohmic values. A few failed to take into account the bleeder current.

Question 5. Nearly all candidates attempted this question but many failed to answer (d) and (f) correctly. In (*d*) many gave "R" as being $\frac{V}{I}$ but gave I in milliamps. This, of course, should be in amperes and should be the *total* cathode current, and not just the anode current as some of the candidates described.

In (*f*), too many gave the answer as being the square root of "resistance" of anode load over the "resistance" of the speech coil, where of course, they should have stated "impedance."

A few of the candidates mentioned a small point, i.e., that the calculations are effective only on one frequency and that matching is not theoretically perfect on any other frequency.

Question 6. Many good answers were given to this question with satisfactory sketches. Quite a number of them, however, confused the molecular structure of the material arrangements with positive and negative charges of electricity, stating that a current is passed through a bar of ferrous material until all molecules are positive!

Question 7. Only a few candidates attempted this question, but many gave very good answers with praiseworthy sketches.

Question 8. Quite well answered by the many candidates who attempted this question. In (*c*) only a few mentioned that, in addition to perforating the metal valve screen, painting it with a matt black paint helps to dissipate heat.

Second Paper

Question 1. Satisfactorily dealt with by the majority of candidates answering it. Part (*a*) gave most trouble, R7 providing biasing on M. W. and L. W. to render V1 inoperative.

Question 2. Not many attempted this question, but there were some good answers explaining P. U. matching and tone correction.

Question 3. A popular question for which most candidates earned good marks, but many gave VR1 instead of VR2 in answer to (*a*).

Question 4. Far too briefly answered by the majority of candidates attempting this question. Many omitted to describe the shorting to chassis on S. W. of the plate aerial and L3, also R4 which provides positive bias via R8 and R7 on M. W. and L. W. to make V1 inoperative.

Half of the candidates traced the signal through the components of only *one* waveband.

Question 5. Again, answers were far too brief and in most cases only the functions were listed with a string of components relating to each function, but *how* the valve and its associated circuits operate within each function was ignored.

Question 6. Part (*a*): many referred to "resistance" of extra primary turns keeping the volts down on high mains voltages. Turns-ratio is the key: auto-transformer effect.

Parts (*b*) and (*c*) were answered satisfactorily in most cases.

Question 7. Most answers were quite satisfactory: many candidates chose to attempt this question.

Question 8. Many candidates lost marks for extreme brevity and omission of such points as checking scale calibration, adjustment of I. F. filter (L1), repeating adjustments after initial setting-up, etc.

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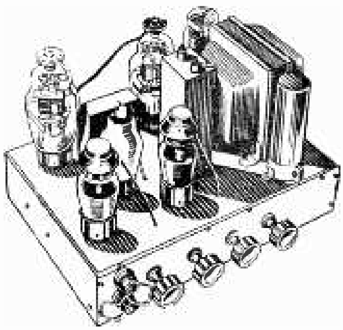

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3S4	9/9	6SN7GT	11/9	AC5PenDD	9/9
5Y3G	8/9	6V6G	8/9	CY41	8/11
5U4G	10/6	6V6GT	8/9	EF36	4/11
5Z4G	9/6	6X5GT	8/9	EB91	8/9
6AL5	9/9	8D2	2/11	EF91	9/9
6F6G	7/9	807	6/11	MU14	9/6
6AM6	9/9	9D2	2/11	MS/Pen	5/9
6J5G	5/11	12A6	7/9	SP4	5/9
6J7G	7/6	12K7GT	10/6	SP41	1/11
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32μF 350 v	3/6	64μF 450 v	4/9
25μF 25 v	1/3	8-8μF 350 v	3/9
50μF 12 v	1/3	8-8μF 450 v	3/9
50μF 50 v	2/3	8-15μF 450 v	3/9
		8-16μF 450 v	4/6
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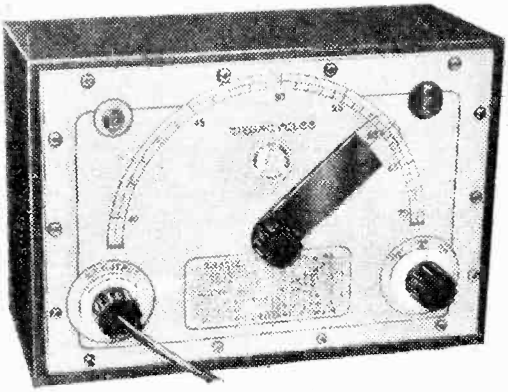

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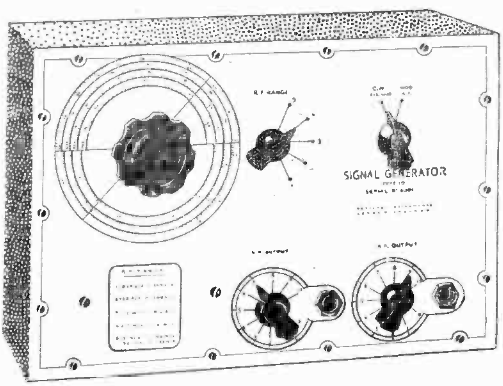

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Surplus Valves for Voltage Doubler Circuits

DETAILS OF EX-SERVICE VALVES, WITH BASE CONNECTIONS

By E. G. Bulley

THERE are many valves available upon the surplus market to-day which were originally designed for use as voltage doublers. Such valves are known under their commercial designation, so little difficulty will be encountered in finding them. These valves are really high-vacuum rectifiers, but having two separate cathodes, that is to say, they are or comprise two separate diode units in one envelope but having a common heater. Reference to Fig. 1 will clarify this point.

Valves belonging to this category are extremely useful for A.C./D.C. receivers because they can be converted to half-wave rectifiers simply by strapping both anodes and both cathodes together. Fig. 2 is a typical power supply which is suitable for an A.C./D.C. receiver, and shows the valve connected as a half-wave rectifier. Such circuits avoid the use of a mains transformer, thus reducing the cost.

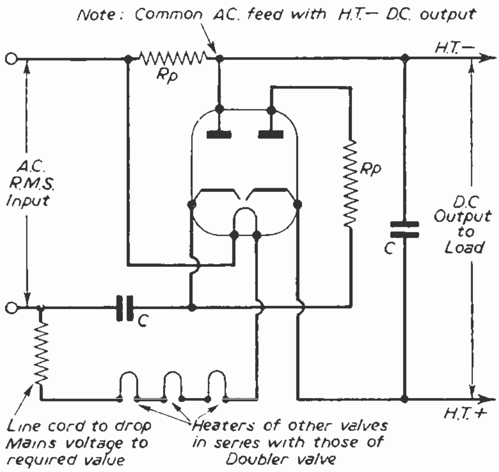
One must, however, bear in mind that the heater of the rectifier is in series with all others in the circuit.

Furthermore, whilst considering the use of these valves as half-wave rectifiers, the output from the power supply should be filtered with a condenser input type, as this enables, as far as it is possible, a high D.C. output to be obtained. The input condenser is usually the order of 16 μF and it is advisable not to go below this value.

Fig. 3 is a circuit wherein the valve is connected in a half-wave doubler system, whereas Fig. 4 shows the valve in a full-wave doubler circuit. However, for convenience the latter will be considered so that the reader will appreciate the actual operation of the circuit.

Voltage-doublers

A voltage-doubler circuit gets its name from the fact that the D.C. output from the circuit is more or less equal to twice the value of the peak A.C. input voltage, assuming, of course, a no load condition. That is to say, the D.C. output from one half of the



Rp = Resistors used for protection purposes

Fig. 3.—A half-wave doubler circuit.

valve is equal to $\sqrt{2} \times$ R.M.S. input value. Now the same output is also obtained from the other half of the valve and as both outputs are in series, the total or sum of these D.C. outputs is equal to twice the input (peak A.C. voltage).

By referring to Fig. 4, the reader will notice that

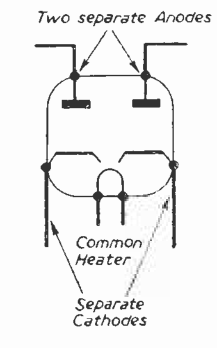


Fig. 1.—Theoretical symbol for a double-diode.

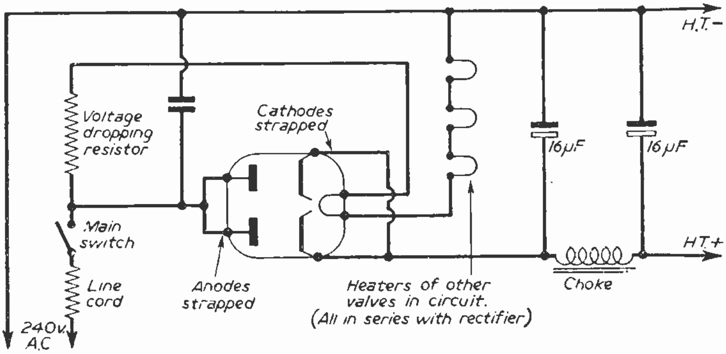
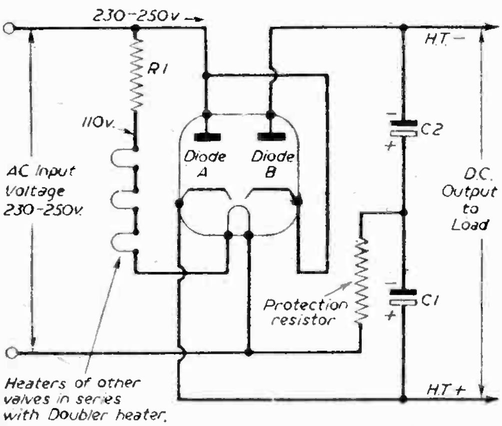


Fig. 2.—Typical A.C./D.C. mains unit.

the anode of one of the diode units (A) is connected to the cathode of the other diode unit. These, in turn, are taken to one of the input terminations. Now when the diode unit (A) passes current, it builds up a positive charge on the condenser C1, and likewise



Note: C1 and C2 should be approx. 32 µF but not less than 16 µF. R1 is a suitable line cord to drop Mains voltage to a suitable value eg 110 volts.

Fig. 4.—Circuit for a voltage doubler.

the other diode unit conducts and builds up a negative charge on the condenser marked C2. The accumulation of the positive charge produces a D.C. voltage on C1 equal to $\sqrt{2} \times$ E R.M.S. Similarly, the charge on the other condenser also produces a D.C. voltage of equal value, and as both these condensers are in series, both the D.C. voltages are added together to get the total D.C. output, which, as previously mentioned, is equal to the peak A.C. voltage multiplied by 2. For example, assume an input of 110 volts A.C. The peak A.C. voltage is approximately 1.4×110 volts = 154 volts. The D.C. output, therefore, will be equal to twice this value, namely 308 volts, assuming a no load condition.

Regulation

Furthermore, one must bear in mind that in circuits utilising these valves as doublers the heaters are in series with the other valves of the circuit, as already mentioned, for half-wave rectification. Another point worthy of note is that in the voltage doubler circuit shown there is not an earth connection. This, of course, can be considered a disadvantage, but, when one realises that it does away with the mains transformer, it is worthy of consideration by the experimenter.

The full-wave doubler circuit has a better voltage regulation than that of the half-wave type. Valves suitable for voltage doublers are shown in Table 1, and they can also be used in the power supplies of A.C./D.C. receivers. One must, however, bear in mind that such circuits, having no earth connections, can be considered dangerous, the reason being that the chassis can become "alive" dependent upon the input to the mains plug.

TABLE I

(Ratings for use in doubler circuits)

Type	Heater volts	Heater Current	(Per anode) Anode volts (A.C.)	D.C. output current (mA.)
HALF-WAVE VOLTAGE-DOUBLER				
25Z5	25	0.3 amps.	110 max.	75
25Z6	25	0.3 amps.	110 max.	75
50Y6	50	0.15 amps.	110 max.	75
50Z7	50	0.15 amps.	110 max.	65
FULL-WAVE VOLTAGE-DOUBLER				
25Z5	25	0.3 amps.	110 max.	75
25Z6	25	0.3 amps.	110 max.	75
50Y6	50	0.15 amps.	110 max.	75
50Z7	50	0.15 amps.	110 max.	65

Marconi Engineer-in-chief Retires

MR. G. M. WRIGHT, C.B.E., B.Eng., M.I.E.E., having reached the normal retiring age, as from 1st April relinquished his position as engineer-in-chief of Marconi's Wireless Telegraph Co. Ltd., but remains with the company as full-time general technical consultant.

Several changes among the senior technical appointments as a result come into effect on that date.

Mr. B. N. MacLarty, O.B.E., M.I.E.E., took over the position of engineer-in-chief. His deputy is Mr. R. J. Kemp, the present chief of research.

Dr. E. Eastwood, Ph.D., M.Sc., M.I.E.E., deputy chief of research, replaced Mr. Kemp as chief at the company's research establishment at Great Baddow.

The retiring engineer-in-chief, Mr. G. M. Wright, joined the company in 1912. During the First World War, while holding a temporary commission in the R.N.V.R., he was closely associated with the famous naval D.F. network and other special duties. In 1919 he returned to the research department, of which he was appointed deputy chief in 1928, and later, chief. His work as a research engineer gained for him an international reputation, particularly in the fields of D.F. and facsimile telegraphy. During the Second World War he was seconded to the Admiralty.

Mullard T.S.D. Changes

MR. H. P. WHITE, B.Sc., has recently been appointed head of the data and publications section of the Mullard Technical Service Department (T.S.D.). Under the direction of Mr. T. H. Jones, head of T.S.D., one of Mr. White's principal responsibilities will be compiling and publishing technical data and information on the applications of Mullard valves and tubes for use by equipment manufacturers, service engineers and home constructors. This work is typified by the Mullard technical handbook, a compendium of comprehensive data on Mullard valves and tubes, which is found on the desk of almost every circuit and equipment designer. Among other publications produced by the section is "Mullard Technical Communications," a technical house organ, published approximately every quarter.

One of the main functions of the data and publications section of T.S.D. is the enquiry service whereby dealers, service engineers and home constructors may obtain information on the application and substitution of valves and tubes. It also acts as a source of technical information that can be drawn upon by other departments within the Mullard organisation.

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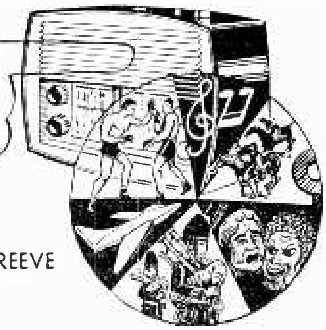


By MAURICE REEVE

News and Views

THE dissemination of opinions on current events, apart from the recording of the events themselves, is one of the most important of the BBC's functions, and it is one which, on the whole, they do extremely well, which cannot be said for the principles governing the publishing of the happenings in the news bulletins. They are altogether a sorry business.

There are two main classes of event. One kind, the kind that only arouses feeling but not comment, such as a railway or air disaster, earthquake, etc., does not concern us here. They are merely tabulated in order of importance and the public informed of them through the news bulletins—fifteen minutes of abysmal dreariness, boredom and endless repetition. The second category is of those events which arouse varieties of opinion and are subjects of controversy between the various strata of society. These include such things as domestic and international politics, economics, religion, etc. A general election, taxation proposals, new laws, re-armament and a host of other things big and small immediately arouse either our ire, rage and resentment or our gratification, pride and self satisfaction. The news bulletins tell us, usually *ad nauseam*, that such and such a thing has happened. This has to be, and is, followed by usually expert and always intelligent views as to the pros and cons likely to ensue.

The new Tuesday and Friday feature, " At Home and Abroad," may become the best of these programmes. It has most of the advantages and few of the disadvantages of programmes like " Any Questions." Both sides of an argument are expounded with equal force and a far greater degree of objectivity is obtained owing to the absence of that very controversial item of a show's concomitants—the live audience. Laughs cannot be raised, or sympathy aroused, audibly. The reactions aroused are on the single listener and are unknown elsewhere. To some this may mean that it lacks the purely entertainment appeal of, say, " Any Questions." Perhaps it does, but certainly not to me, much as I like " Any Questions " and highly as I rate it among BBC feature programmes.

The recent number devoted to the McCarthy question seemed to me a model for such programmes to be built upon. " Any Questions " recently dealt with the Senator from Wisconsin and, if I remember rightly, the team's opinion that night was unanimously against McCarthy's methods. " At Home and Abroad," by careful selection of both McCarthy's own voice and Governor Stevenson's, together with the President's and radio commentators', gave us an absorbing half-hour equally divided between both views (pro- and anti-McCarthy, not, be it noted, pro- and anti-Communist ; all were anti-Communist), with the listener left, as he should be, to come to his own conclusions on the vexed questions raised. All the programme did was to help him form more accurate ones than he might have otherwise done. It would be great fun to hear some of the more forceful personalities of " Any Questions " away from their audiences.

Repetition of Formula

" The Weekly Bind "—the recently resuscitated form of " Much Binding " has gone off the air for annual vacation variety shows enjoy, thus giving the variety programme directors a chance to let it meet the fate it has earned for itself, to wit, oblivion. It completely failed to live up to its first three or four issues, and such features as Costa's " Costarisms," " I never let the grass grow under my feet " and " Hello Sir dearie " from Miss Plum at the switchboard became very wearisome week after week. These regular repetitions of a set formula or pattern must contain a constantly varying flow of originality and variety within their rigid framework if they are to be both looked forward to with keenness and enjoyed with relish. " The Weekly Bind " offered none of this.

Saturday Soccer

I would suggest that at this stage of the football season the Saturday afternoon soccer commentaries, apart from the Cup competition and internationals, should be confined to teams concerned with championships and relegations.

Hibberd Again

In a programme telling the story of the British and Foreign Bible Society, our old friend Stuart Hibberd gave an almost perfect example of the art of radio narrative.

Drama

" Dulcinea," from the French of Gaston Baty, was a delightful after commentary or sequel to the immortal classic of Don Quixote. Margaret Rawlings and Edward Chapman carried it in fine style.

Mr. Chapman, with accomplished aid from Leslie Perrins and their colleagues, was also heard to good advantage in a revival of Galsworthy's powerful play on the class warfare after the First World War " The Skin Game."

Celia Johnson in " The Heiress," taken from Henry James's " Washington Square," was postponed owing to the death of Cecil Trouncer. It served to show what a great loss both radio and the stage suffered in Mr. Trouncer's passing. In the character of the heiress's father, Dr. Sloper, he is made to refer to his approaching demise and to give instructions in certain wishes he has in the story, an extraordinary if coincidental foreshadowing of what was tragically to happen so shortly to himself.

News from the Trade

Denco Coil Packs

FOUR new coil packs are announced by Denco (Clacton), Ltd. These are of the single-hole fixing type and consist of a pre-set model and three-waveband types, all consisting of aerial and oscillator coils. The pre-set unit covers four medium-wave stations or one long and three medium-wave. The three-waveband models are designed to be tuned with either .0005 or .00037 μF condensers, and recommended scales are supplied by Jackson Bros. The SL8 spin-wheel full-vision drive as used in our Coronet series will also line up with these coils. The illustration below shows one of each of the two types, the prices of which are 33s. 4d. for the pre-set and 42s. 8d. for the tuned types.—Denco (Clacton), Ltd., 357/9, Old Road, Clacton-on-Sea, Essex.

New Mullard Xenon Rectifiers

MULLARD, LTD., have recently introduced two inert gas-filled rectifiers, types RR3-250/3B28 and RR3-1250/4B32. These valves, which are used in the high-tension supplies of radio transmitters and similar equipment, have advantages over the mercury vapour type generally used. They will operate over a much wider ambient temperature range, of the order of −55 deg. C. to + 75 deg. C., and, moreover, they may be mounted in any position. The valve heating time is short—10 and 30 seconds respectively—as opposed to a period up to 15 minutes for mercury vapour rectifiers. These characteristics, coupled with comparatively small size and light weight, make these rectifiers particularly suitable for operation under the arduous conditions to which services equipment may be subjected. The RR3-250/3B28 and RR3-1250/4B32 are direct replacements of American types 3B28 and 4B32.

In a single-phase full-wave circuit a pair of RR3-250s are capable of an output of 0.5 amps at 3,200 volts. Two RR3-1250s, under the same conditions, have full load ratings of 3,200 volts at 2.5 amps.—Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

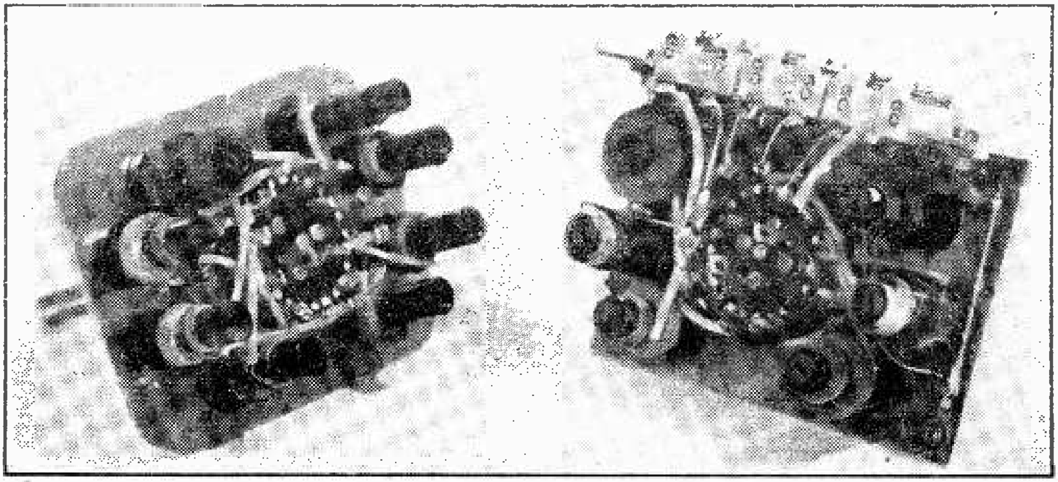
Primax Soldering Gun

THE new balanced grid soldering gun announced by S. Kempner has a number of novel features. The tip is of a special alloy and does not need re-tinning or replacement. The mains loading is 60 watts and the heating time is only six seconds. With a weight of 23 ozs. this forms a very convenient tool for receiver construction, but like all irons of this type requires care in its use. The tip is very small, and thus if applied to large metallic surfaces the heat will be conducted away. The side of the tip should be used in such cases and it should, of course, only be used for the smaller types of work. If the iron is kept on for a long period the tip may corrode, but is easily cleaned by wiping with rag or paper whilst it is cooling off. The price is 70s., and the iron is for A.C. supplies only.—S. Kempner, 19, Ebury Street, London, S.W.1.

The "Primax" Soldering Gun.

New Industrial Radio Receiver

THE General Electric Co., Ltd., has introduced a new industrial radio receiver suitable for medium-sized premises. Known as the BCS2353/4, it has been designed to serve as the nucleus of small high-quality sound installations in clubs, hotels, hospitals, schools, small factories and similar applications. It is highly versatile, its numerous applications ranging from normal radio reception of such special programmes as those broadcast for workers, invalids, and students to the presentation of disc recordings, topical discussions and announcements, as required. Further details may be obtained from General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.



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OPEN TO DISCUSSION

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

"Vulgar" Music

SIR,—I have just read "Programme Pointers" by Maurice Reeve, and do take objection to his reference that the "Swedish Rhapsodie," arranged by Faith is vulgar. Please will you ask him what is "vulgar" music. I learned that the word vulgar had a very different meaning and I cannot see where the comparison comes in with this particular tune. One must admit it is rather catchy and a tremendous lot of people think so. I wonder how many times this piece of music was played at the Radio Exhibition? I have also recordings of Listz rhapsodies; they are certainly different from the Swedish Rhapsodie, but surely both types can be appreciated by one and the same person with a respect for most types of music well played.

Merely because one type is not so "long haired" as the other does not displace it as pleasure giving, and to debase it with such an expression is quite wrong.—J. L. TIPLER (Huddersfield).

Electrical Interference

SIR,—*Re* A. E. Lofting's article on "Interference Suppression" in your May issue, whilst I do not wish to comment on the methods of suppression recommended, I feel it is most necessary to remark on his complete dismissal of the limits on capacitor sizes laid down by the British Standard Institution, with the result that, under certain very likely fault conditions the use of the units illustrated could result in fatal consequences. It is most important that the limits laid down in B.S.613 are adhered to, and this limits the maximum capacitances that can be used in the "centre tapped to earth" connection (i.e. figs. 1 and 3 in the article) to .005 microfarad, and these must be of the 2,250 v. test type. It is most essential to remember that on a 50 cycle mains supply, a .1 microfarad capacitor has a reactance of only some 30 kΩ and no one would connect their washing machine frame to the mains via a 30,000Ω resistor, even if it was properly earthed, and the danger is just as great if a .1 microfarad capacitor is used.—A. HALE (Enfield).

"Walkie-talkies"

SIR,—Having read with interest the recent controversy over the conditions for granting an amateur transmitting licence, I felt obliged to raise a matter which I consider is woefully neglected in the present arrangement, namely the operation of portable trans-receivers or "walkie-talkies." I would hasten to add that I personally am not a licensed amateur, nor have I any immediate ambition to become one, although I am ready to admit that as a class the British amateurs are a grand set of chaps. To exploit my interest in walkie-talkies, however, not only am I compelled to obtain a licence and spend 12 fruitless months pounding a morse key, but the G.P.O. will also require me to carry a class D wavemeter around whenever I operate my transceivers (or to use crystal control—a serious limitation to circuit design and simplicity, since a walkie-talkie usually employs a regenerative receiving circuit which becomes an oscillator on transmit). Furthermore, I may then only contact licensed amateurs, who are frequently not to be found in the area where one wishes to carry out tests.

By all means impose these restrictions where the transmitter is to be relatively high-powered and provided with an efficient aerial; the existing rules of amateur radio are (as any thinking person will admit) very necessary in such cases where neglect of these matters may well constitute a serious threat to essential services. But since walkie-talkies are by their very nature low-powered and very limited in their range of radiation, is there any real reason why they should not be governed by rules similar to those of radio control? Or might a provisional licence be granted, costing about 10s. and permitting bona fide experimenters to transmit with powers of one watt or less on a specific band (probably V.H.F.) without the need for accurate frequency control? This extremely interesting and absorbing aspect of radio would then be opened to many who at present cannot conduct their tests with the sanction of the law. The G.P.O. would be provided with a new source of revenue, and the fully licensed amateur would largely be freed from the present menace of pirates.—P. BRADLEY (Cheshire).

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 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.

Jazz and Dance Music

SIR,—I noticed with interest your further condemnation of "Jazz Bands" in your article in the May issue of PRACTICAL WIRELESS. Since I assume that you are mainly concerned with BBC broadcasts, I am wondering what sort of apparatus you use for reception; the amount of jazz broadcast by the BBC is so small that I suspect your receiver is receiving transmissions denied to the normal set.

If this is not so, then I can only conclude that you are confusing jazz with "Dance Music" as played by "Show Bands" and the like, which I agree occupy too much valuable broadcast time.

In case you should think that I am splitting hairs over nomenclature, I feel that your condemnation of "jazz" is no more justified than that of people who, on hearing *any* form of classical music they don't like, switch off with muttered protests against "dreadful *chamber music*." (This is not a true parallel but I hope you see what I mean.)

If it is the blood of the dance and swing bands and their attendant crooners that you are after, then I am with you—provided that a proportion of the vacant programme time is allotted to the real jazz!

It may be, of course, that you would not—or do not—like jazz either—but there can be no complaint about the time it occupies in BBC broadcasts.—D. MAYHO (Bromley).

The R1132A

SIR,—I am sure many readers own one of the ex-R.A.F. R1132A V.H.F. receivers, and may regard them as one of the best buys on the surplus market today. But there seems to be very little mentioned about these jobs. My rig works well on the BBC experimental station at Wrotham and also nearby R.A.F. stations, but I have been unable to get it operating on 144 Mc/s.

I would like any reader who owns one of these sets to pass the gen on, as I am sure many readers will benefit.—F. J. WALKER (Cambridge).

SIR,—Being the owner of the above type of wireless receiver, I would like to offer the following advice to R. Pinches of Plymouth, whose query appeared in your March issue of PRACTICAL WIRELESS.

I have obtained very satisfactory results by using a Mullard OM.4 amplifier triode for output. The phones transformer remains connected between H.T.+ and the anode of the 6J5 and a .001μF mica condenser is taken from the 6J5 anode to the OM.4 grid, which has a .25 megohm "grid leak" resistor. The diodes are connected to the cathode which is taken to earth through a .1MF condenser by-passed with a ½ watt 100 ohms resistor. If this circuit is used the hum may be greatly reduced by switching the db attenuation to −12. The output is 2 watts and drives a 6in. speaker comfortably. To improve tone a .1MF paper may be connected across the O/P transformer.—P. G. RAND (S.W.8).

SHORT-WAVE SECTION

(*Continued from page* 358)

thus every available part must be collected and fed to the receiver. Therefore, you need a collector which is well clear of any metallic bodies round the house such as rainwater gutters, fall pipes, etc. Secondly, to make the most of the weak signals the aerial should be somewhere near the actual resonant frequency of the signal. If you are just interested in general listening you should consider the waveband upon which you wish to carry out your experiments and then cut an aerial which will be roughly resonant to the centre of the band. Erect this as high as possible and make sure that really good insulators are fitted to avoid leakage down wet guy or supporting ropes. Also remember that many of the more important high-power short-wave stations to-day use a radiating mast, which means that the signal is vertically polarised, and therefore a vertical receiving aerial will provide the best results. If you can attach a length of wood or pole to the chimney stack in a horizontal position this will form a good anchoring point. Alternatively a length of wood attached to the board carrying the rain gutter round the roof may be used. A mast in the garden is, of course, much better, and the aerial should be held rigidly in a vertical position, both top and bottom. The lead should run off to the receiver, and this also should be held firmly so that it cannot sway in a wind. Finally, remember that a really good earth connection will not only improve signal strength but also remove all kinds of erratic behaviour of the signals. Attention to the above points will enable you to get off to a good start in short-wave listening and many hours of interest will be provided.

CONVERTING T.R.F. TO SUPERHET

(*Continued from page* 338)

at the other side of the gang condenser. If, however, the opportunity of completely rebuilding the early stages is to be taken, then the F.C. valve may be used in the original R.F. valveholder, and the I.F. valve may occupy the detector valveholder. If a metal-oxide detector is used, or the circuit in Fig. 6, no further valveholder will be required. If, however, the D.D.T. stage is to be provided, no undue difficulty should arise in finding space for it.

A.V.C. Circuits

The A.V.C. circuit may finally be added with little trouble, and the full superhet circuit is illustrated in Fig. 7. This is suitable for A.C operation, or A.C./D.C. operation with a 25A6 or similar .3 amp output valve. (The 25A6 requires a 440 ohm bias resistor.)

Here, a voltage is generated by rectification at the second diode, and applied as bias to F.C. and I.F. valves, thereby reducing their gain when the signal is strong. This is the automatic volume control circuit, and tends to maintain a more equal output with signals of widely differing strength. It is not found in small T.R.F. receivers since insufficient pre-detector gain exists for it to be worth while.

It will be noticed that the A.V.C. circuits are decoupled to avoid undesired coupling between F.C. and other stages. With coilpacks intended for bottom-end coupling, the maker's circuit must be followed since decoupling condensers may be omitted, or only be of small value (usually about .002μF) in the F.C. stage.

Finally, the power-supply section of the receiver will not normally require any modification.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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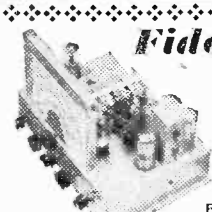

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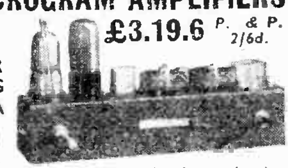

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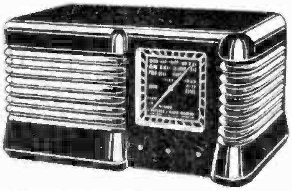

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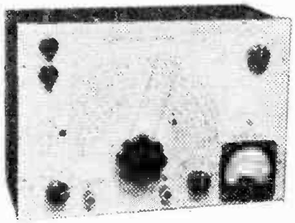

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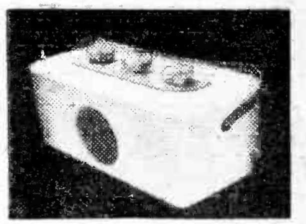
Trimmers, 5-40 pf., **5d.**; 10-100, 10-250, 10-450 pf., **10d.**

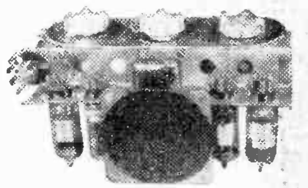
Germanium crystal diode, **1/6**, post paid.

BATTERY CHARGER KIT, comprising metal case 5 x 4½ x 4½ trans. 230/250 v. and metal rec. Will charge 6 or 12 v. battery at 1½ amp., **19/6**. P. & P. 2/6.



PERSONAL PORTABLE CABINET in cream-coloured plastic, size 7 x 4½ x 3in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7½ v. batteries, **10/-**. P. & P. 2/-.

3in. P.M. SPEAKER to fit above, **10/-**. Miniature output transformer, **5/-**. Miniature wave-change switch, **2/-**. Miniature 1-pole 4-way used as Volume and Off, **2/-**. 4 B7G valveholders, **2/4**. Midget twin gang ⅞in. dia., ⅞in. long and pair medium and long-wave T.R.F. coils ⅜in. long x ⅜in. wide; complete with 4-valve all-dry mains and battery circuit, **9/6**. Condenser Kit, comprising 11 miniature condensers, **3/6**. Resistor Kit, comprising 15 miniature resistors, **4/6**. 25 x 25 mfd., **1/6**. P. & P. 2/6. Valves to suit above **10/-** ea. Point to Point Wiring Diagram **1/-**.



View of chassis as it would look when assembled with valves inserted.

Extension speaker cabinet, in contrasting walnut veneers, size 15 x 10½in. Will take 6½ or 8in. speaker, **17/6**. P. & P. 2/-.

Volume Controls. Long spindle less switch, 50 K., 500 K., 1 meg. **2/6** each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., **4/-** each; 100 K. and 50 K., **3/6** each. ½ and 1 meg., long spindle, double pole switch, miniature, **5/-**. P. & P. 3d. each.

Standard Wave-change Switches, 4-pole 3-way, **1/9**; 5-pole 2-way, **1/9**. Miniature 3-pole 4-way, 4-pole 3-way, **2/6**.

Valveholders. Paxolin octal, **4d.** Moulded octal, **7d.** EF50, **7d.** Moulded B7G, **7d.** Loctal amphenol, **7d.** Loctal pax., **4d.** Mazda Amph., **7d.** Mazda pax., **4d.** B8A, B9A amphenol, **7d.** B7G with screening can, **1/6**. Duodecal paxolin, **9d.**

Twin-gang .0005 Tuning Condensers, **5/-**. With trimmers, **7/6**.

Midget .00037 dust cover and trimmers, **8/6**.

P.M. SPEAKERS	with trans.	less trans.
3½in.		13/6
5in.	16/6	12/6
6½in.	16/6	12/6
8in.	18/6	15/-
10in.		19/6

Post and packing on each of the above, 1/6 extra.

Truvox BX11 12 in. P.M. 3 ohm speech coil, **45/-**. P. & P. 3/6.

RADIOGRAM CHASSIS.—5 valve A.C./D.C. 3-way band superhet. 195/255 volts 19-49, 200/550 and 1,000-2,000 metres, flywheel tuning frequency, 470 Kc/s iron cored coils and IFs. Size of chassis 13 x 6½ x 2½. Complete with valves, p. & p., 5/-, **£8/17/6**.

Terms of business: Cash with order. Dispatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.

D. COHEN,

RADIO AND TELEVISION COMPONENTS

23, HIGH STREET, ACTON, W.3. (Opposite Granada Cinema)

Hours of Business:—Saturdays 9-5 p.m. Wednesdays 9-1 p.m. Other days 9-4.30 p.m.