TESTING TRANSISTORS

PRACTICAL WIRELESS

1/-

DECEMBER 1955

EDITOR: F.J.CAMM

An 8-Valve AM/FM Receiver

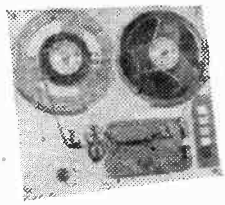
!! HOME CONSTRUCTORS !!

You can assemble the Stern's "Fidelity" Tape Recorder for only £40

!!! IT ONLY NEEDS CONNECTING UP !!!

This 2-speed Twin Track Recorder although supplied at a Genuinely Low Price, provides absolute Fidelity Recordings, and in addition to being completely dependable has a performance at least equal to Recorders marketed at a far higher price. The actual assembly of the Recorder is simple, and only involves a few connections. The Truvox Tape Deck and the Quality Amplifier are supplied tested and ready for use, and all that is required to complete the Recorder is to connect the two together (a connection chart is supplied for this purpose) and secure them by the screws provided into the Attache Case. The items illustrated and described below form the complete equipment.

SEND S.A.E. FOR DESCRIPTIVE LEAFLET INCLUDING PRICE DETAILS & H.P. TERMS

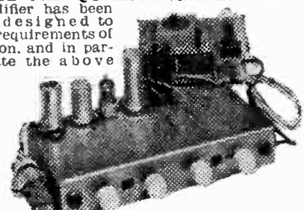


TRUVOX TAPE DECK MODEL Mk. III/TR7u

This is Truvox's new "small" design being only 14in. x 13in. The whole instrument is built to close engineering limits resulting in the minimum of "wow" and "flutter" values. It will play the NEW PRE-RECORDED TAPES and takes all standard tapes up to 1,200ft.

SCOTSBOY MAGNETIC RECORDING TAPE

Supplied complete with a 1,200ft. reel of Scotsboy Tape. In addition, the Recorder will take all standard makes of tapes.



MODEL TRF QUALITY AMPLIFIER

This amplifier has been expressly designed to meet the requirements of enthusiasts for fidelity reproduction, and in particular to CORRECTLY operate the above TRUVOX DECK. It is supplied complete with a matched Elliptical 3 ohm P.M. Speaker. It incorporates an efficient Tone Control arrangement and has a Magic Eye Level Indicator (Operative on Record). It can also be used as a general purpose Amplifier for high quality reproduction of gramophone records direct from a Gram Unit.

MODEL MIC33/1 ACOS CRYSTAL MICROPHONE

A highly sensitive Mike which accurately matches the input arrangement of the Amplifier.

It can be supplied complete and ready for use for £43. H.P. Terms available.

PORTABLE ATTACHE CASE

This, as may be judged from the illustration above, is a neat, compact and attractively finished case, being covered with maroon rexine and having an ivory coloured speaker escutcheon. It contains concealed pockets to accommodate the Microphone, Mains Lead and a spare 1,200ft. reel of tape.

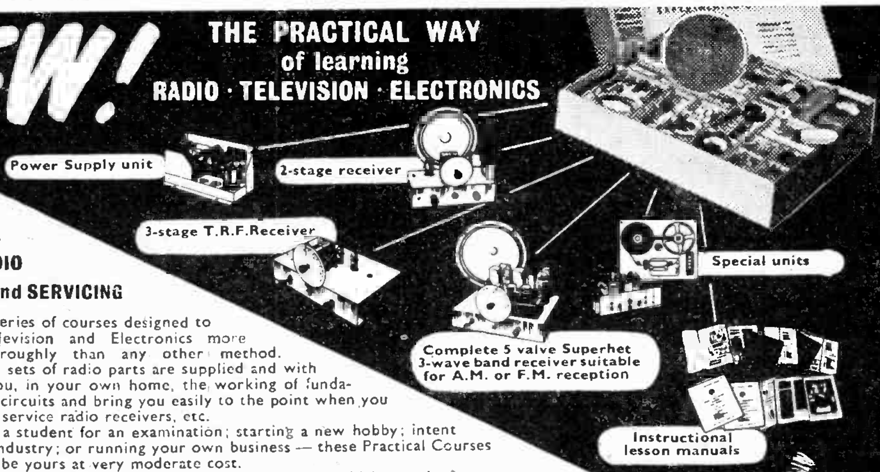
STERN RADIO LTD.

109 & 115, FLEET STEET, E.C.4

Tel.: CENTRAL 5812-3-4.

NEW!

THE PRACTICAL WAY of learning RADIO · TELEVISION · ELECTRONICS



COMPLETE EXPERIMENTAL COURSE in RADIO ENGINEERING and SERVICING

An entirely new series of courses designed to teach Radio, Television and Electronics more quickly and thoroughly than any other method.
Specially prepared sets of radio parts are supplied and with these we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio receivers, etc.
Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business — these Practical Courses are ideal and may be yours at very moderate cost.
With these outfits, which you receive upon enrolment and which remain your property, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to designing, testing and servicing of complete Radio and Television Receivers.

SEND COUPON FOR FREE PROSPECTUS

To E.M.I. Institutes,
Dept. 32X, Grove Park Road, London, W.4.
Please send me your FREE book on Practical Courses
Name ....
Address ....
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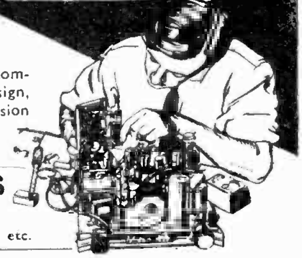
December IC.68

NEW TELEVISION COURSE including a complete set of equipment dealing with the design, construction and servicing of a high quality television receiver.

COURSES FROM 15/- PER MONTH



EMI INSTITUTES

An educational organisation serving the E.M.I. Group of Companies which include
"His Master's Voice," Marconiphone, Columbia, etc.

FOR SUITABLE CHRISTMAS PRESENTS

B.S.R. MONARCH AUTOMATIC RECORD CHANGER

These units will autochange on all three speeds, 33⅓, 45, and 78 r.p.m. They play MIXED 7in., 10in. and 12in. records.

They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch. Minimum baseboard size requires 14in. x 12½in., with height above 5¼in., and height below baseboard 2¼in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price. These units are beautifully finished in cream enamel with cream bakelite arm.

COMPLETE WITH FULL INSTRUCTIONS, **£8.19.6.** Carriage charge 3/-.

MAINS TRANSFORMERS 3-WAY MOUNTING TYPE

MT1
Primary: 200-220-240 v.
Secondaries: 250-0-250 v. 80 mA. 0-6.3 v. 4 amp. 0-5 v. 2 amp.
Both tapped at 4 v............**17/3** ea.

MT2
Primary: 200-220-240 v.
Secondaries: 350-0-350 v. 80 mA. 0-6.3 v. 4 amp. 0.5 v. 2 amp. Both tapped at 4 v..................**17/6** ea.

Model makers' transformer for train sets., etc.

MT3. 30 volt 2 amp. tappings at 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20 24 volts from 200-250 v. Mains input. Price **17/6** each.

HEATER TRANSFORMERS

230 v. Input	2 volt .5 amp.	4/3
230 v. Input	2 volt 3.0 amp.	7/9
230 v. Input	4 volt 1.5 amp.	5/-
230 v. Input	4 volt 3.0 amp.	10/-
230 v. Input	5 volt 2.0 amp.	10/-
230 v. Input 6.3 volt	.5 amp.	5/-
230 v. Input 6.3 volt	1.5 amp.	6/-
230 v. Input 6.3 volt	3.0 amp.	9/-
230 v. Input 12 volt	.75 amp.	5/-

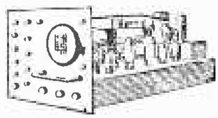
PERSPEX IMPLOSION GUARDS

Incorporating brown escutcheon and grey filter, drilled ready to fix to cabinet. 12in. type, **11/3** ea; 16in. type, **14/6** ea.

HEADPHONES

CLR Low resistance type 120 ohms. 7/3 pr.
CHR High resistance type 4,000 ohms. **13/6** pr.

COLLARO High Fidelity Pick-up for standard records. Listed 46/5. Our Price, **30/-** ea.

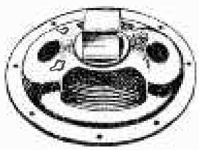


AMERICAN INDICATOR UNIT TYPE BC929A

Brand new incorporating 3in. tube 3BP1, with mu-metal shield, 2-6SN7GT, 2-6H6GT, 6X5G, 2X2, 6G6G, 9 potentiometers, 24 v. aerial switch motor, transformer, and a host of small components. The whole unit which measures only 8¾in. x 8½in. x 13¾in. is brand new, enclosed in black crackle box, and can be supplied at **65/-**, plus 5/- p. & p.

2 RANGE POCKET VOLTMETER

Ex Ministry, brand new, 0-15 volts, 0-250 volts moving coil 315 ohms per volt, complete with leads **16/3** each.



LOUDSPEAKER UNITS

All PM 2 to 3 OHMS UNLESS OTHERWISE STATED.

	each
ELAC 5in. Round Type... ..	17/3
LECTRONA 5in. Round Type	17/3
PLESSEY 6½in. Round Type ..	17/6
GOODMANS 4in. x 7in. ELIPTICAL UNIT.........	21/10
GOODMANS 8in. UNIT......	18/3
GOODMANS 10in. UNIT...	25/3
R & A 10in. UNIT...........	25/3
TRUVOX 6½in. WAFER UNIT	20/-
PLESSEY 12in. LIGHT-WEIGHT	35/-
R & A 8in. UNIT	17/3
LECTRONA 6½in. with output transformer	18/3
R & A 6½in. mains energised 600 ohms	17/3
PLESSEY 8in. mains energised 600 ohms	21/-

DEFIANT EXTENSION LOUDSPEAKERS

6½in. speaker unit in wooden cabinet with volume control...... **42/6** each.

EX GOVERNMENT HAND MICROPHONES

Complete with lead, switch incorporated in the metal case... **12/6** each.

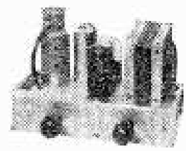
VOLUME CONTROLS

Single Pole Switch. 100KΩ, ¼ meg., ½ meg., 1 meg., 2 meg., **3/9** each. Double Pole Switch, 50K, ¼ meg., ½ meg., 1 meg., **4/9** each.

CONNOISSEUR PICKUP

At a fraction of original price. Complete with matching transformer, **29/6**.

AMPLIFIER



A complete amplifier for your Christmas entertainment. Fully tested and ready for use. A.C. mains.

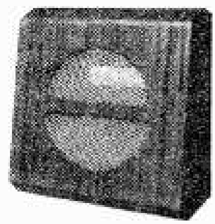
★ 3 valves, 6B8, 6V6, 6X5. 3-4 Watts Output.
★ Sockets for pickup input, Loudspeaker.
★ Controls, volume and tone.

Price **79/3**, plus 2/6 packing and post.

DRYDEX TORCHES AT BIG REDUCTIONS

2PT5. Penlight, chrome, clips into pocket like a pen...... **1/7** ea.
2N5 Handylite (coloured) suitable for ladies' handbags .... **1/7** ea.
N15 Candelite (coloured) ideal for child's bedroom. .. **3/6** ea.
Prices include bulb but exclude batteries.

LOUDSPEAKER CABINETS



This attractive walnut finished cabinet is available for 6½in. or 8in. speaker units. Metal speaker fret, complete with back and rubber feet.

6½in. type:
Measures 8¾in. x 8½in. x 4½in. at base. Price **16/3** each.

8in. type:
Measures 10½in. x 10½in. x 5in. at base. Price **20/3** each.

CONDENSERS

TUBULARS WITH WIRE ENDS. 8 mfd. 500 v., **1/9** each; 16 mfd. 500 v., **2/-** each; 25 mfd. 25 v., **1/3** each; 50 mfd. 50 v., **2/6** each; 100 mfd. 50 v., **1/9** each; 8 x 8 mfd. 450 v., **4/-** each; 50 mfd. 12 v., **1/6** each; 20 mfd. 500 v., **3/3** each.

CLEM TRAVELLING IRON

With asbestos stand. Attractive colours. Blue, Green, Red, 110-250 volts. **16/6** each.

PUBLICATIONS

Wireless Amplifier Manual No. 2, **3/-**.
Radio and Television Manual, **2/6**.
Listeners Guide to Radio and T.V. Stations of the World, **2/6**.
Wide Angle Conversion for Home Constructed Televisors, **3/6**.
Radio and Television Pocket Book, **2/6**.

SOLDERING IRONS

Solon soldering irons, pencil or oval bit. Please state type required. 65 watts 230-250 volts, complete with length of 3-core cable, **18/3** each

VARNISHED COTTON SLEEVING

1 mm. to 2 mm. **1/6** per doz. yards
3 mm. to 5 mm. **2/6** per doz. yards
6 mm. to 8 mm. **3/6** per doz. yards
10 mm. to 14 mm. **5/6** per doz. yards
VARIOUS BRIGHT COLOURS.

THE COMPACT TELEVISION AERIAL BY ANTIFERENCE, LTD.

Supplied complete with universal mounting and backplate in neutral brown finish. Overall length 5ft. 6in. Packed in carton 3ft. 4in. long. Complete with full instructions. Cat. No. CD4. List price 50/- ... ... **13/6** ea.

FLEX MAINS TYPE

Twin 14/0076. P.V.C. covered ... ... **3d.** per yd.

SCREENED CABLES

Single Type ... ... **6d.** per yd.
Twin Core ... ... **7d.** per yd.
Three Core ... ... **6d.** per yd.

MAINS DROPPING RESISTORS

725 Ω Erie tap at 600 Ω **1/3** ea.
650 Ω taps at 375 Ω, 500 Ω 5 Ω, 30 Ω ... ... **2/6** ea.
770 Ω Mains Dropper for Midget Radios with a tap at 125 Ω size 3in. long x ⅝in. dia. ... ... **1/3** ea.
Dagole Mains Dropper .3A, cement coated with 2 sliders **3/9** ea.
.2 amp as above 1,200 Ω ... **3/9** ea.
Green Vitreous Mains Dropper 1,328 Ω 2 taps ... ... **1/3** ea.
Zenith Mains Dropper 910 Ω ... **2/-** ea.

CHOKES

20H, 250 Ω, 60 M/A. Clamp Construction ... ... **6/-** ea.
10H, 209 Ω, 90 M/A. Clamp Construction ... ... **9/3** ea.
10H, 200 Ω, 150 M/A. Clamp Construction ... **13/-** ea.
5H, 250 M/A, 200 Ω. Fully Shrouded ... ... **13/3** ea.
10H, 300 Ω, 40 M/A. Midget Clamp Construction ... **5/3** ea.

TRANSFORMERS FOR BATTERY CHARGERS

230v. Input Tapped 6-12v. 1 amp ... ... **13/6** ea.
230v. Input Tapped 6-12v. 3 amp ... ... **18/-** ea.
(Both with tap on Primary for 2.5v. Pilot light)

IRON LEADS

Black and white flat iron leads, bonded ends ... **1/-** ea.

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

ALPHA RADIO SUPPLY CO.
5/6 VINCES CHAMBERS
VICTORIA SQUARE
LEEDS I.

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 9d.; 20/- add 1/-; 40/- add 1/6; £5 add 2/- unless otherwise stated. Minimum C.O.D. fee and postage 2/3.

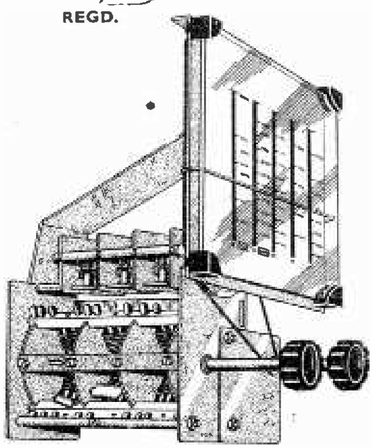
MAIL ORDER ONLY

MAXI-Q

REGD.

WORLD WIDE COVERAGE

with the FINEST POSSIBLE TUNING UNIT available — taking advantage of the latest technical achievements in raw materials



Steel Frame—Rotary Turret—Silver Plated Contacts—Polystyrene Insulation—Five Colour Glass Scale—Spin Wheel Drive—Fully Assembled and Factory Aligned—Five Wavebands (1) 150-400 Kc/s. (2) 530-1,600 Kc/s. (3) 1.5-4 Mc/s. (4) 4-12 Mc/s. (5) 10-30 Mc/s.

CT.6—Mixer and Oscillator—£5 plus £1.13.4 P.T.
CT.7—R.F., Mixer and Osc.—£6.15.0 plus £2.5.0. P.T.

Full Application data and technical information appears in TECHNICAL BULLETIN DTB.2—price 1/6.

Available from all reputable stockists or in cases of difficulty direct from these works. Send 1/- in stamps for General Catalogue.

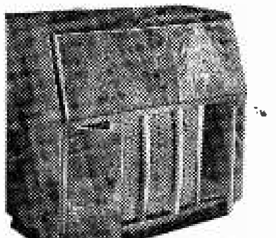
DENCO (CLACTON) LTD.

357-9 OLD ROAD, CLACTON-ON-SEA, ESSEX.

STOP PRESS—" MULLARD F.M. TUNER."—I.F. Rejectors, Ref. 510/IFF, 2/6. Aerial Coil L1/L2, Ref. 510/AE, 4/6. Choke L3, Ref. 510/RFC, 2/-. R.F. Coil L4, Ref. 510/RF, 2/6. Oscillator Coil L5/L6, Ref. 510/OSC, 4/6. 1st I.F.T. L7/L8, Ref. 510/IFT1, 7/6. 2nd I.F.T. L9/10, Ref. 510/IFT2, 7/6. Ratio Detector Transformer L11/12/13, Ref. 510/RDT, 12/6.
Aluminium Chassis, completely punched, 12/-.
" OSRAM F.M. TUNER."—Chassis, Front Panel, Printed Dial Plate and Drive Mechanism, 37/6. Aerial Coil O/T1, 2/9. R.F. Coil O/L1, 2/6. Oscillator Coil O/L2, 2/-. 1st, 2nd and 3rd IFT's, IFT.11/10.7, 6/- each. Ratio Discriminator Transformer O/T2 (T5), complete with crystals, 19/6.
F.M. TUNER UNIT assembled complete with valves, £7.2.6 plus £2.7.6. P.T.

SUPERIOR RADIO SUPPLIES

SUPERIOR BUREAU



An elegant cabinet in richly figured walnut veneer, internal panels in polished sycamore. A drop front lid covers a sloping, uncut control panel (14in. long x 10½in. high) alongside which is an uncut baseboard (17½in. long x 13½in. back to front). The inside of the drop front lid is panelled in beige leatherette. In the lower part of the cabinet are two large storage cupboards (13½in. high, 7½in. wide, 16½in. deep). The lid and cupboard handles are in chased Florentine bronze. Overall dimensions (33in. high, 34in. long, 16½in. deep). Price £17.0.0. plus 15/- carr. Send for Cabinet Leaflet.

TERMS: Cash with order or C.O.D. Extra charge for C.O.D. U.K. and N. Ireland only.

DULCI BAND 3 T.V. CONVERTER

★ ★ **Type I.K.O. Patents** ★ ★

A complete self-contained unit, suitable for converting all makes of T.V. Housed in a polished wood cabinet size 7in. x 10in. x 5½in. All channels are iron core tuned with pre-set adjustments. Input signal equalising is provided. Valves Z77, Z77, 12AX7, 6X4. Power supply, A.C. Mains 200/250 volts. Service Data available on request. Price £9.15.0. Plus 3/6 post and packing.

★

F.M. & A.M./F.M. CHASSIS

Send for details of the latest types of High Quality V.H.F. Tuners and Amplifiers suitable for Band 2. Also, complete 4 Wave-Band 9 Valve Push-Pull A.M./F.M. Quality Radiogram Chassis.

★

DISC PLAYERS

Specially designed for the HI-FI enthusiast and home constructor. These Disc Players consist of the latest Three-Speed Automatic Record Changer, complete with crystal turn-over pick-up head for long-playing and standard records. This unit is mounted on a Sycamore veneered base which is complete with fitted Mains lead, and screened Pick-up lead, ready for connecting up. Brand new and boxed. Price £10.16.0. Plus 5/- Post and Packing.

THE "SUPEREX 55" ATTACHE PORTABLE

Building Cost £7.15.0. plus 3/6 P.P.

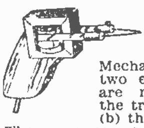
★ Really outstanding quality.
★ Four Valve Battery Superhet.
★ Long and Medium Wave-lengths.
★ Perfect Reception in All Areas.
★ Rexined Cabinet 10½in. x 8½in. x 5in.
★ Very Simple Construction.

Send 1/3 for " Superex 55 " Construction Booklet.

Shop open 9 a.m. to 6 p.m. Monday to Saturday. 1 p.m. Thursday. Personal Shoppers Welcome.

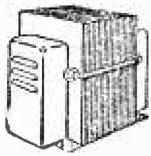
(PW/D) 37 HILLSIDE, STONEBRIDGE, LONDON, N.W.10. Tel.: ELGar 3644.

MAKE A SOLDER GUN

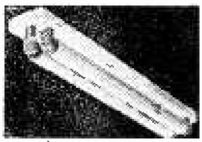


A 7-second solder gun was described in "Practical Mechanics." Only two essential parts are required: (a) the transformer and (b) the push switch. These we can supply at 13/6, plus 2/- post. The rest of the parts you will have in your own "junk" box. Copy of the article concerned given free with the kit.

TRANSFORMER SNIP 11/6

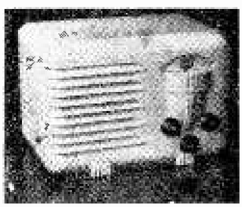


Post 2/- Fully shrouded — standard 200-250 v. primary 280-0-280 at 80 m/a. 6.3 v. at 3 amp., 5 v. at 2 amp.



THE TWIN 20

This is a complete fluorescent lighting fitting. It has built-in ballast and starters — stove enamelled white and ready to work. It is an ideal unit for the kitchen, over the work-bench, and in similar location. It uses two 20-watt lamps. Price, complete less tubes, 29/6, or with two tubes, 39/6. Post and insurance 5/-. Extra 20-watt tubes, 7/6 each.



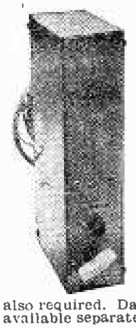
MAINS-MINI

Uses high-efficiency coils—covers long and medium wavebands and fits into the neat white or brown bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, £4/10/0, plus 3/6 post. Constructional data free with the parts, or available separately 1/6.

MULLARD AMPLIFIER "510"

A Quality Amplifier designed by Mullard. Power output exceeds 10 watts. Frequency response almost flat from 10 to 20,000 C.P.S. For use with the Acos "Hi G" and other good pick-ups. Made up and ready to work is £12/10/- or 85/- deposit, plus 10/- carr. and insurance. Available in kit form. Send for Mullard Shopping List.

ADDITA — BAND III CONVERTER



Midlands and London version now available.

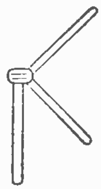
Our Addita is giving very satisfactory results, and we have had many pleasing reports regarding its performance.

It is a very neat-looking unit and fits to the side or the back of the televisor. It is designed to convert any T.V. superhet or T.R.F. and no internal modifications of any kind are required. Simply plug in the aerials, connect to the mains, and you have Band I or Band III at the flick of a switch. Price £7/10/- and 2/6 post and insurance.

BUILD IT YOURSELF

Price of all components, including stove enamelled case and even transfers for the front, is £4/5/-, plus 2/6 post, or £5/5/- if mains components also required. Data is included free with the parts or available separately price 2/6.

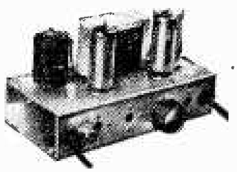
BAND 3 AERIAL KIT



An interesting aerial, "The Folded V," was described in the July number of this magazine. We tried this and found it to be most efficient. The kit comprises alloy elements and connectors, neat plastic centre piece and saddle for mounting. 8/6 post 1/6.

W.W. Band III Kit

One of the most successful circuits for Band III conversion at aerial frequency. We offer a complete kit of parts including the specified EF80 valves, wound coils, drilled chassis, in fact, everything including a copy of the circuit diagram. Price only 42/6, post 2/6 extra. Mains components if required 25/- extra. Data available separately, price 1/-. **Ready to work models 69/6, plus 2/6 post.**



ENTIRELY NEW CIRCUIT

Redesigned and now built by the Cleveland Company—very good reports received.

THE "WINDSOR 5"

This is a 5-valve A.C. superhet covering the usual long, medium and short wavebands. It has a particularly fine clear dial with an extra long pointer travel. The latest type loctal valves are used and the chassis is complete and ready to operate. Chassis size 15 x 6 x 6in. Price £9/19/6, complete with 8in. speaker. Carriage and insurance 10/-. H.P. terms if required.

TABLE RADIO CABINET

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 15½ x 14 x 6½in. Walnut veneered and satin finished 37/6, carriage and packing 3/6. Note—This cabinet is the correct one for the Windsor chassis above with 6½in. speaker.

RECORD PLAYER £4-10-0

3-speed Gramophone Motor

Latest rim drive 3-speed motor with metal turn-table and rubber mat. Small mod. makes speed easily variable for special effects and dance work.

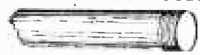
Hi-Fi Pick-Up

Using famous Cosmocord Hi-G turn over crystal. Separate sapphire for each speed. Neat bakelite case with pressure adjustment.

Special Snip Offer This Month

The two units as illustrated £4/10/- or made up on board as illustrated £5/10/- plus 5/- post and insurance.

½-INCH ALUMINIUM TUBING



Ideal for making T.V. aerials, etc., 1/6 per foot, 6 feet lengths 8/4.

CAR STARTER/CHARGER KIT

All parts to build 6- and 12-volt charger which can be connected to a "flat" battery and will enable the car to be started instantly. Kit comprising the following:—

Mains transformer	19/6
6-amp. rectifier	32/6
Regulator Stud Switch ...	3/6
Resistance Wire	2/-
Resistance Former	2/6
Mains on/off Switch ...	1/-
0-5 amp. Moving Coil Meter	9/6
Constructional Data ...	1/6

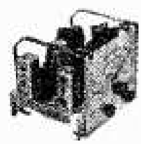
or if bought all together price is 69/6, plus 2/- post and packing.

PRACTICAL TV. *BLUEPRINT*

BAND III CONVERTER

All parts to build this most successful converter are available. Price inc. valves, metal chassis, wound coils etc, 59/6, post and packing, 2/6.

5-VALVE SUPERHET YOURS FOR ONLY 40/- DOWN



Chassis size approx. 9½ x 7½ x 8½. First-class components. A.C. mains operation. Three wave (medium and two shorts). Complete with five valves, ready to work. New and unused. Cash price £5/19/6, or 40/- deposit and 9 monthly payments of 10/- (carr. and ins. 7/6).

THE CLEVELAND F.M. TUNER

This tuner is based upon the very successful circuit published by Data Publications. We have made up models at all branches and will gladly demonstrate. Stability is extremely good and making and aligning most simple. Cost of all parts including valves, prepared metal chassis, wound coils and stove enamelled scale, slow-motion drive, pointer, tuning knob, in fact everything needed is £6/12/6. Data is included free with the parts or is available separately, price 2/-. Extra for fringe area model, 20/-.

ELECTRONIC PRECISION EQUIPMENT, LTD.

Post orders should be addressed to E.P.E. LTD., Dept. 5, 123 Terminus Road, Eastbourne.

Post enquiries to Eastbourne with stamped envelope, please.

42-46, Windmill Hill, Ruislip, Middx. Phone: RUISLIP 5780 Half day, Wednesday.	152-3, Fleet Street, E.C.4. Phone: FLEet 2833 Half day, Saturday.	29, Stroud Green Rd., Finsbury Park, N.4. Phone: ARChway 1049 Half day, Thursday.	249, Kilburn High Road, Kilburn. MAIda Vale 4921.

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXI No. 590, DECEMBER, 1955
EDITOR : F. J. CAMM
23rd YEAR OF ISSUE

COMMENTS OF THE MONTH
BY THE EDITOR

Radio v. Television

A RECENT survey has shown that ITA programmes have not seriously interfered with the BBC, and that only one in five of those within the service area of ITA are at present looking in to the programmes. There has been some falling off in the number of listeners to sound radio, but it is not of a serious nature. We have always felt that the high cost of programme time on ITA would render it unattractive to advertisers, who can achieve better and more permanent results by the printed word. The rival TV programmes have had the effect of gingering up the BBC both on sound and TV, and they are anxious to retain the services of the best entertainers. If they will accept our advice, they will gradually veer off parlour games, especially those of the American inspired variety. There is something unreal about them, and something sickly about the oracular pomposity of those elevated to fame from an obscurity from which they should never have emerged. There needs to be greater variety, not only in the programmes themselves, but in the personnel which provides them. Otherwise the best material will go from sound broadcasting to ITA. This is having its teething troubles and is not finding it too easy to sell programme time. There has not been the anticipated rush by leading advertisers, though this reluctance may only be temporary.

As for the entertainers, they are between Scylla and Charybdis. They fear, perhaps with some justification, that if they yield to the attractive offers of ITA they will be finished with the BBC. There is, however, no real shortage of talent. Whilst the BBC ties itself to a more or less closed corporation of entertainers and producers, skilled musicians and entertainers endeavouring to reach the top have little chance. It is certain, however, that if ITA does succeed there will be a clamour for commercial sound programmes within a few years. If advertising is right for one media it must be for the other. Such programmes might keep money in this country which is now being sent abroad.

The Editor and Staff Join in Wishing Every Reader a Very Happy Xmas

RADIO-CONTROLLED TRACTOR

A RADIO-CONTROLLED tractor was recently demonstrated at the Ford Mechanised Farming Centre at Boreham. The system is powered by 12-volt batteries and the tractor can be made to perform right and left hand turns, the clutch can be engaged and disengaged and the hydraulic system operated by means of remote radio control.

Beyond demonstrating that it is possible to control full-sized vehicles by radio, it is difficult to see what other purpose the demonstration achieved. If a man is required to operate the transmitter he might just as well be perched in the seat of the tractor and eliminate the expense and to some extent the uncertainty of radio control.

"A BEGINNER'S GUIDE TO RADIO"

A FURTHER reminder that the series of articles entitled "A Beginner's Guide to Radio," which ran for over two years in this journal, has been reprinted with additional matter in book form and copies cost 7s. 6d. or 7s. 10d. by post. The series has been reprinted in this form at the special request of large numbers of new readers who were unable to purchase the article in serial form. The edition is limited and it is therefore necessary to order copies at once.

"THE PRACTICAL HOUSEHOLDER"

OUR new companion journal, *The Practical Householder*, has in the short space of three months achieved a national circulation of hundreds of thousands per month.

It is however, important, to place an order for its regular delivery with your newsagent, as it is not possible to print copies in expectation of chance sales.

END OF VOLUME

THIS issue completes Volume 31. The index for it is in course of preparation and copies will be available in a few weeks at 1s. 1d. each by post.—F. J. C.

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of August, 1955, in respect of wireless receiving stations situated within the various postal regions of England, Wales, Scotland and Northern Ireland. The numbers include licences issued to blind persons without payment. The grand total of sound and television licences was 14,124,587.

Region	*Number*
London Postal	1,455,636
Home Counties	1,392,566
Midland	1,129,230
North Eastern	1,485,335
North Western	1,139,810
South Western	925,116
Wales and Border Counties ...	582,811
Total England and Wales ...	8,110,504
Scotland	1,008,626
Northern Ireland	219,042
Grand Total	9,338,172

BBC V.H.F. Transmitter in North Wales

THE steps taken by the BBC to deal with the serious interference from foreign stations with reception of the Welsh Home Service include first the necessarily limited improvements made last winter in the medium-wave transmissions and secondly the acceleration of plans for the introduction of V.H.F. (very high frequency) transmitters in Wales. In order to provide the greatest possible coverage in Wales in the shortest time, V.H.F. transmitters are already being installed at Wenvoe to serve South Wales, and a station is being built at Blaen Plwy, near Aberystwyth, to serve the coast of Cardigan Bay. It is hoped that the transmitter at Wenvoe for the Welsh Home Service will be completed by the end of this year and that the station at Blaen Plwy will be completed by the end of 1956. It is also planned to construct V.H.F. stations in the neighbourhood of Corwen and in Anglesey.

B.I.R.E.

THE following meetings will be held during November:

London Section, *Wednesday, November 30th*, 6.30 *p.m.*, at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. "High Fidelity Loudspeakers: The Performance of Moving-Coil and Electrostatic Transducers," by H. J. Leak, M.Brit.I.R.E.

North-Eastern Section, *Wednesday, November 9th*, 6 *p.m.*, at Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Turret Tuners for Multi-Channel Television Reception," by R. Holland.

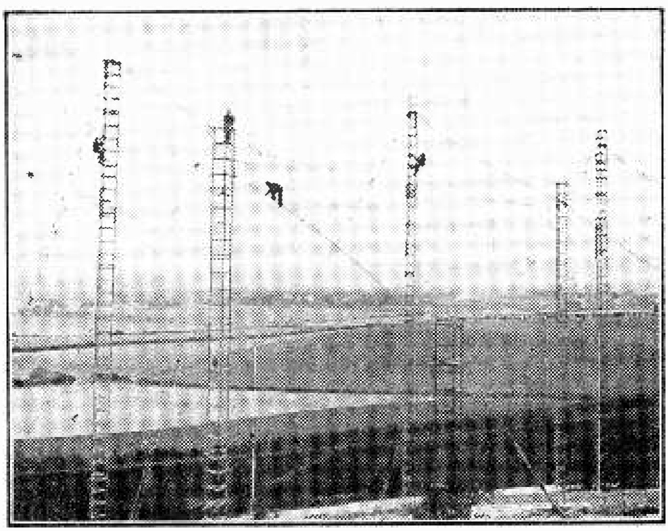
Merseyside Section, *Wednesday, November 9th*, 7 *p.m.*, in the Council Room, Chamber of Commerce, 1, Old Hall Street, Liverpool, 3. "The Dekatron Tube in a Digital Transmission System," by G. Shand, B.Sc., B.Sc.(Eng.).

West Midlands Section, *Wednesday, November 9th*, 7.15 *p.m.*, in Room 133, Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. "Closed Circuit Industrial Television," by H. A. McGhee.

Scottish Section, *Thursday, November 10th*, 7 *p.m.*, at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow. "Some Applications of Electronics to Marine Echo-Sounding," by F. Baillie, Assoc.Brit.I.R.E.

Brema Monthly Retail Survey—August, 1955

RETAIL sales during August can usually be expected to exceed those for June, the increase in the hire purchase deposit introduced at the end of July is, however, reflected in the level of sales during August, showing for radio receivers a fall of 11,000 from July and 1,000 from June and for radiograms a fall of 2,000 from the levels of both July and June. For television, August sales exceeded those for July by 3,000 and those for June by 6,000. It is believed, however, particularly with the impetus to television sales which



Steeplejacks at work on the 110ft. masts of a new U.S. Forces radio station at Kingston Blount, near High Wycombe.

could be expected from the approach of the additional service by the I.T.A., that sales of television receivers would have been considerably higher if the hire purchase deposit had not been raised.

1956 Conference for Llandudno

THE fourth National Radio and Television Retailers' Conference, organised by R.T.R.A., will be held next year at Llandudno. As usual, it will be open to retailers, wholesalers and manufacturers.

Detailed arrangements have yet to be completed, and further announcements will be made as soon as information becomes available.

Telegraph Link with Laos Now Open

A DIRECT wireless telegraph circuit has now been opened between the Hongkong station of Cable & Wireless, Ltd., and the Laos Administration's station at Vientiane.

It is proposed to extend the circuit in the near future.

Electronic Fishing

IT is reported that a novel form of fishing using a radio set has been developed in Japan. It is based on the theory that an underwater radio beam will be followed to its source by fish, and for this a transmitter is placed in the centre of a large Y-shaped net. It was developed by Prof. Ando, of Ehime University, and it is stated that on the first test the fish swam into it in droves.

Solderless Connections

A NEW form of connecting link is announced by the R.C.A., in which the connecting wire is wrapped round a square-edged lug. The wrapping, consisting of three or four turns, is carried out by a power-tool type of instrument and is so tight that the square edges of the lug bite into the copper connecting wire. It is claimed that the joint is as sound mechanically and electrically as the orthodox soldered connection, but if it is unwrapped during servicing work they recommend that the connection should only be re-made by soldering, not by re-wrapping the lead.

BBC Engineering Division Appointment

THE BBC announces the appointment of Mr. W. A. Roberts, A.M.I.E.E., as Regional Engineer, Midland Region, in succession to Mr. J. A. Cooper, B.Sc.(Eng.), A.M.I.E.E., who will shortly be retiring from full-time duties after 32 years' service.

Mr. Roberts joined the Engineering Division of the BBC in 1937. In 1941, after serving in the London control room and at the Droitwich transmitting station, he joined the headquarters staff of the Superintendent Engineer (Transmitters).

Early in 1954, Mr. Roberts was seconded to Her Majesty's Colonial Office as technical adviser on broadcasting development in the Colonies, in which capacity he has travelled extensively.

Additional space in next year's Foire de Paris will also be given to the foreign national stands, whose number—24 in 1955—it is expected, will be considerably increased.

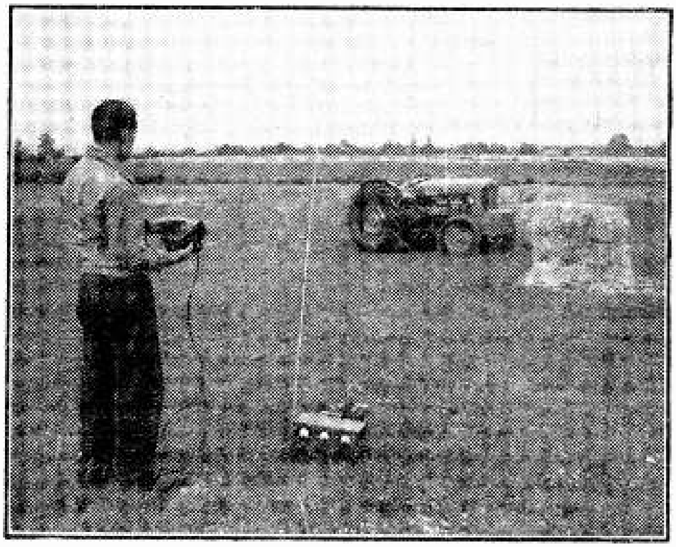
Quarters set aside for foreign visitors, with offices for interviews, secretarial service, etc., are also to be enlarged.

Radio-controlled Tractor

FORD MOTOR CO., LTD., recently demonstrated at its mechanised farming centre at Boreham, Essex, a radio-controlled Fordson "Major" diesel. It is believed to be the first radio-controlled tractor to be shown in this country.

The small control box transmits six different commands to the tractor, governing its turning left and right, clutch operation, the raising and lowering of the implement, and the fuel cut-off mechanism.

This tractor modification is not going into production, but perhaps something along these lines will in the future be used in the transport of dangerous fissionable material at atomic plants. In addition, this departure may well foreshadow "the shape of things to come."



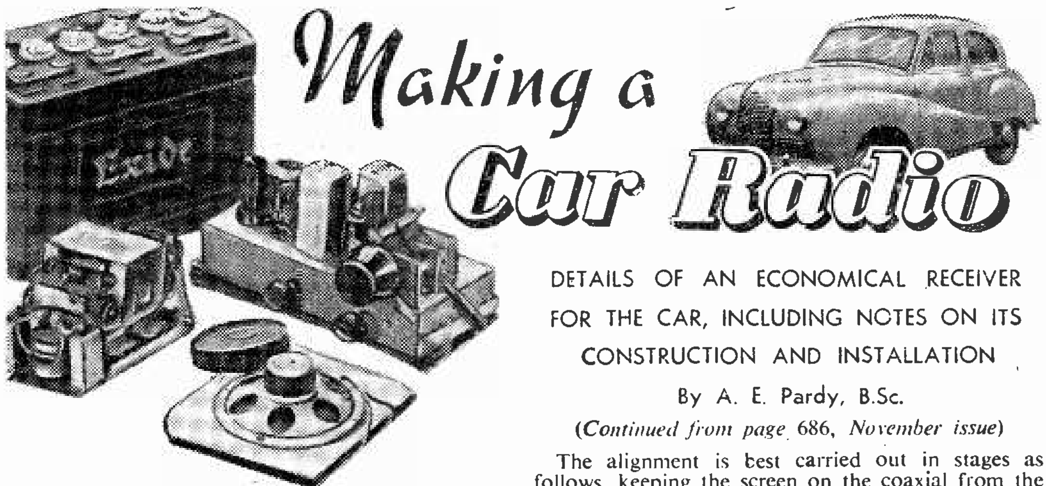
A radio-controlled tractor at work.

Biggest Paris Exhibition Hall Under Construction

PRINCIPAL of many changes that will be seen at next year's Foire de Paris, the Paris annual international trade fair, to be held May 5th to 21st, will be a new exhibition hall that will be the largest in Paris. As soon as this year's fair was closed, work on the new hall was begun.

A central facade of 246ft. in length and 72ft. in height will be flanked by two wings each of 328ft., 36ft. high. The greatest depth of the building will be 608ft.

Our next issue, dated Jan.'56, will be on sale on Wednesday Dec. 7th.



Making a Car Radio

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

By A. E. Pardy, B.Sc.

(*Continued from page 686, November issue*)

TO arrange for alignment the domestic receiver should be accurately tuned in to a reliable medium-wave station, preferably at about 300 metres (1,000 kc/s). A short length of coaxial cable has the centre core connected through a small capacity condenser (25-50 pF 350 volt) to the grid cap of the I.F. amplifier valve and the screen of the coaxial to the chassis—via a .1 μF 350-volt condenser if the receiver is not isolated from the mains. If a sudden drop in volume occurs use a smaller condenser for the grid connection or wrap an insulated wire around the grid lead to form its own condenser. Turn the volume control to "low."

The car radio receiver is now assembled alongside the domestic receiver and connected up to the speaker and rotary generator, using a spare 12-volt or 6-volt car battery. (If a spare A.C. powerpack has a suitable output of 220 volts D.C. and 12 volts or 6 volts A.C. it should be used to avoid the "whine" from the generator.)

The power is now applied to the receiver and if a voltmeter is available a rough check can be made against the following table:

Check point	Voltage
V1—Anode (pin 8)	100
V1—Screen (pin 6)	100
V2—Anode (pin 3)	180
V2—Screen (pin 4)	115
V3—Anode (pin 8)	180
V3—Screen (pin 6)	115
V4—Anode (pin 6)	60
V5—Anode (pin 3)	200
V5—Screen (pin 4)	180
V2—Oscillator anode (pin 6)	90
H.T. line—Tag strip	180
H.T. line—Pye socket	220

If all is in order alignment can now be commenced, but if the dial is not calibrated two suitable stations near the ends of the dial should be marked for reference at about 200-220 metres and 500 metres. (West or Luxembourg and North or Third Services are suitable.)

Condenser C17 is temporarily short-circuited and one winding of the oscillator coil is short-circuited by connecting the red tag to earth. Volume is turned full on.

The alignment is best carried out in stages as follows, keeping the screen on the coaxial from the domestic receiver connected to the car radio chassis and using the core as the signal input.

1. Connect the signal input to the grid cap of V2 and if a signal is heard adjust T1, T2, T3 and T4 in that order for maximum signal.

2. If no signal is heard, transfer the signal input to the grid of V3 and repeat the procedure, adjusting T3 and T4 only for maximum signal.

If a signal is still not heard, connect a "damper" (.1 μF and 50 kΩ in series) across the primary and adjust T4 for maximum signal. Transfer the "damper" to the secondary and adjust T3 for maximum signal.

Transfer the signal input back to the grid cap of V2 and adjust T1 and T2 for maximum signal, using the "damper" in the same manner if necessary.

3. Transfer the signal input to the aerial socket and adjust C5 for minimum signal followed by adjusting T1, T2, T3 and T4 for maximum signal.

4. Remove the coaxial lead from the domestic receiver, switch it off, and remove the short-circuit from the oscillator coil. Connect a good aerial to the aerial terminal.

5. Set the dial to the chosen station at about 200 metres, set the wave change switch to M.W. and adjust C7 until the required station is received at maximum volume.

6. Set the dial to the station near 500 metres and adjust the padder C11 to give maximum volume.

7. Change the wave change switch to L.W., set the tuning condenser about half-way and adjust C10 to give maximum volume on the Light Programme (1,500 metres). Slowly swing the tuning condenser while simultaneously adjusting C10 to find the position of maximum volume. Mark the dial for 1,500 metres. Slightly swing the tuning condenser while adjusting C7 to find the position of maximum volume.

One of the difficulties with a car radio is the tendency for the vibration to upset these alignments, but this effect is negligible if the I.F. transformers have their trimmers carefully sealed. If the padders C10, C11 and the trimmer C7 will only comply with the adjustments by being opened a considerable distance, they should have a few plates removed and the alignment repeated until adjustment is obtained with the screws in fairly tight. The trimmer C7 is very critical and it is advisable to replace it at this stage by a fixed condenser, the correct value being found by experiment, paralleling if necessary.

The car aerial should now be connected through the correct length of coaxial cable and the power-pack, if used, replaced by the rotary converter.

Stages 5, 6 and 7 of the adjustments should now be checked, and then the short-circuit across C17 removed.

Installation

The receiver is now ready for installing, but before doing so it is advisable to check the smoothing on the rotary converter. If a background mush is heard behind a local station programme it is possible that the generator may be inadequately filtered against R.F. signals, and this effect is usually most pronounced on the long-wave band. Although this interference may be negligible when compared with the wind and engine noises in a car, it does appear to be additive to the aerial signal and thus gives a greater A.V.C. control voltage, which in turn lowers the overall gain.

If this trouble is experienced, it can usually be cured by connecting the grid winding of a long-wave coil (Wearite P.A.1) in series with the H.T. line and decoupling the generator side to earth through a 100 pF condenser.

It has been assumed that the converter itself has been purchased "fully suppressed," but if not the suppression equipment can be wired up as shown in the theoretical circuit, using heavy duty R.F. chokes and .001 μF condensers on the H.T. side and heavy current chokes and .1 μF condensers on the L.T. side.

The arrangement of the receiver in the car will, of course, depend upon the various facilities available, but if a few basic rules are observed no difficulty should be experienced in obtaining good results. These rules are :

1. The receiver should be mounted in a place reasonably free from engine heat and, if possible, screened by one thickness of metal from the ignition system.
2. The generator should be mounted outside the saloon part of the car, otherwise the "whine" becomes excessive.
3. All control spindles, cables, etc., which pass through the walls of the saloon must be grommeted or bushed to avoid noise and draught.
4. All cables and leads must be fully screened until they are well clear of any interference zone in the car.
5. Reasonable ventilation should be provided for the receiver and every precaution taken against vibration or jolts.
6. The connection to the electrical system should be made so that the receiver is protected by the auxiliary fuse, and the "chassis" connection should be made at the end of the power cable only.

A baseplate for mounting the receiver should now be prepared from a sheet of 16 s.w.g. aluminium or steel and drilled as shown in Fig. 6. Rubber mounting blocks are now fitted to this baseplate, the most useful type being the ex-Government type similar to those used for supporting the dynamotors on American aircraft equipment (such as B.C.459). The clips for these blocks are bolted to the receiver and the base-

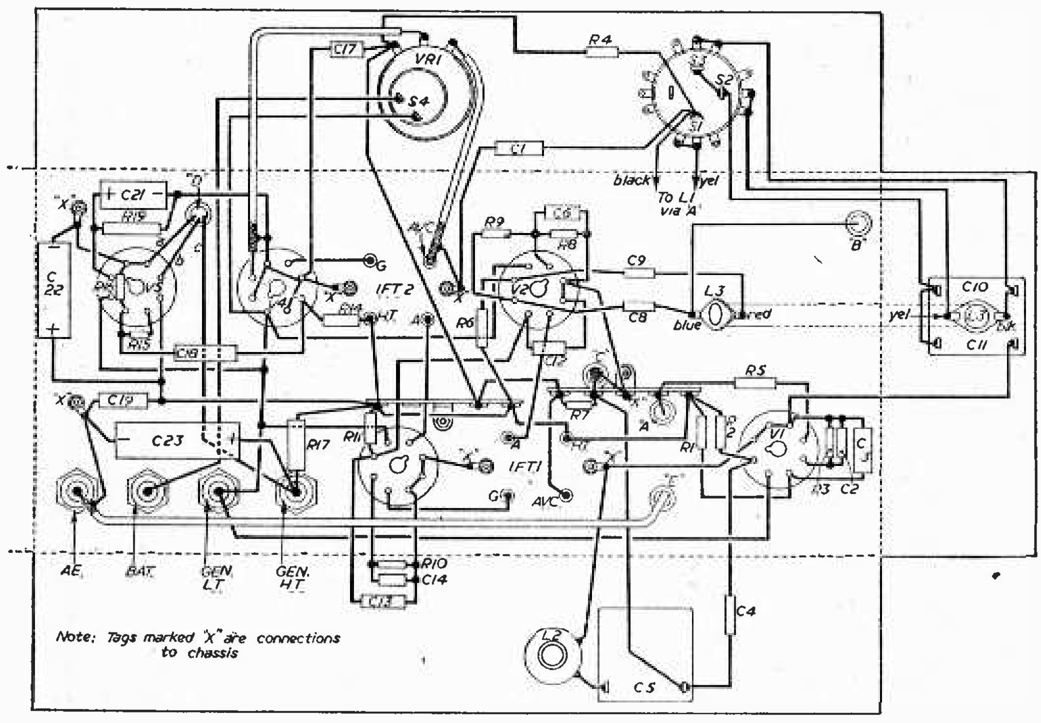


Fig. 4.—Wiring diagram of the receiver section.

plate checked for fit. It may be necessary to countersink on the underside of the chassis to allow the head of the mounting block to protrude far enough for the clip to operate. A similar arrangement can be adopted for the rotary converter, although a simple alternative is to strap the converter to a soft rubber block by means of tapes or rubber bands and use the block as a baseplate. The generator must not be bolted direct to the car chassis, as the noise from it may be transmitted to the inside of the saloon.

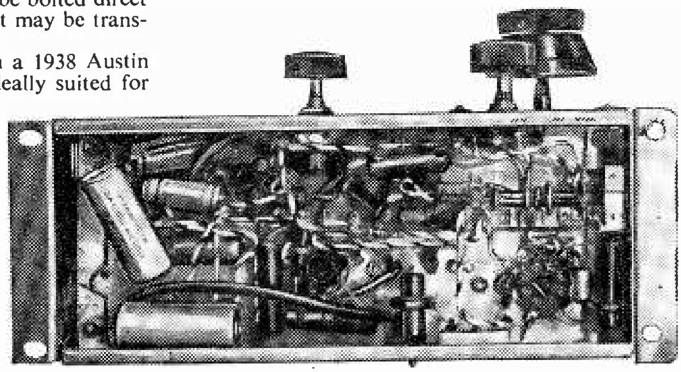
The original receiver is installed in a 1938 Austin Ten (Cambridge) saloon, which is ideally suited for this receiver by having a tool compartment running the full width of the bonnet immediately behind the glove compartment and dashboard. As a guide to the installation of the receiver, the procedure adopted in the original arrangement will be dealt with in detail.

The partition from the centre of the tool compartment is removed and both baseplates bolted to the base of the compartment, using self-tapping bolts with a 1/16in.-thick steel washer on each bolt under the baseplate. The receiver baseplate is arranged immediately behind the glove compartment and the generator base as near to it as possible (Fig. 7).

The felt lining is removed from the glove compartment and three holes for the control spindles are cut out of the back of the compartment by using an octal size chassis cutter—the centres of these holes corresponding to the centres of the spindles. Squares of insertion rubber or inner tube rubber (2in. × 2in.) are cut, a nail hole punched centrally in each, and these are threaded back over the central spindles. One additional hole (¼in.) is drilled to the extreme left of the glove compartment and fitted with a ¼in. grommet.

The receiver and generator units are now mounted in position and the rubber squares glued to the back of the panel by Bostik adhesive.

Holes are now cut in the felt lining to correspond with the control spindle and the grommet, the lining replaced and the knobs fitted. The speaker is mounted on ½in. thick compressed cardboard, which is cut to fit tightly in the left-hand corner of the glove compartment. A layer of fabric is arranged over the front of it and a length of flex connected to the speech-coil terminals. The flex is threaded through the grommet hole and the speaker pressed into position. The speaker leads are soldered or clipped to the output transformer.



An underside view of the receiver showing the wiring.

The coaxial plugs from the generator are now connected and the lead to the battery is connected up, the latter by passing through the grommet for the speedometer cable and connecting to the distribution box. The fuse should be removed from the distribution box, the braid connected to E and the core to A2, and the fuse replaced.

The aerial employed consists of a length of insulated rod stapled to 2in. wooden blocks, which, in turn, are screwed up under the ends of the offside running board. The core of the aerial coaxial cable is soldered firmly to this rod and the braid and outer protection cut well back. The joint is then encased in

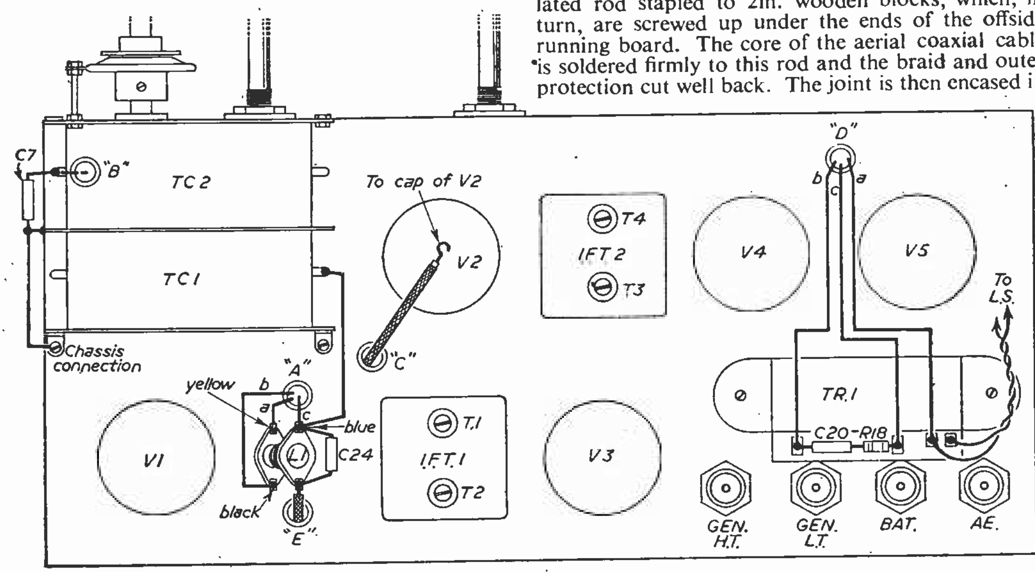


Fig. 5.—Top chassis view of the receiver.

pitch or compound for waterproofing. The cable is fed up through a hole in the tool compartment to the aerial terminal. This aerial arrangement gives quite good results, but if it is felt worth while to purchase a commercial rod aerial improved performance will be obtained as the arrangement used is liable to be a little "directional," and unless well protected against moisture can fall in efficiency in wet weather. Moreover, it would appear that it cannot be employed with

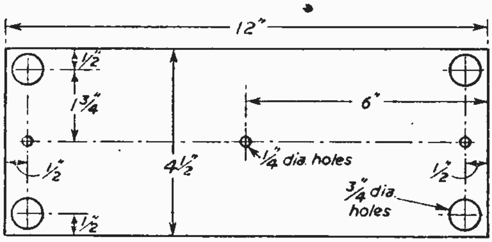


Fig. 6.—Details of the anti-vibration plate.

metal running boards. (A wooden running board is fitted to the author's car.) A side-mounted vertical aerial was found to give an improvement and the roof mounted aerial the best results of all.

Interference Suppression

It is assumed that the wiring of the car is in good condition so that any interference can be assumed to be normal and suppressible. Interference can occur from a number of sources, and the suppression of each will be dealt with in turn.

1. *Ignition.*—This is indicated on the receiver as a series of "clicks" which increase with engine revs and which also exist when the engine is "ticking over" slowly. It can generally be cured by connecting suppressor resistances (K.L.G. shrouded type) in each plug lead and by connecting a .1 μF condenser between the ignition coil S.W. terminal and chassis. It is recommended to leave the plug suppressors until the last stage in suppression as they may not be necessary at all, especially if a TV suppressor is fitted.

2. *Dynamo.*—This gives a rough "burring" interference which can be suppressed by a .1 μF condenser between the generator armature terminal and chassis (do not use any condenser between the field and chassis in a car using a vibratory voltage regulator).

3. *Voltage Regulator.*—The symptoms are very similar to ignition interference, but they occur only when the engine is running sufficiently fast to give full charge. Apart from replacing the regulator unit with a special suppressed type, a very high degree of suppression can be obtained by connecting a "damper" (.1 μF condenser 350 volts and 1,000 ohms 1 watt resistor in series) between E and F on the distributor box. *Under no circumstances* should a condenser alone be used in this position as the characteristics of the voltage regulator will be adversely affected and may result in considerable damage to the charging components.

4. *Accessories.*—The only accessory likely to give consistent interference is the windscreen wiper motor, and this gives a background mush especially on the long-wave band. A .1 to 1.0 μF condenser across the motor terminals usually gives sufficient suppression.

Other accessories are used only intermittently and should not require suppression.

Alternative Valves and Voltage Supplies

The receiver so far has been designed by using 12-volt valves, parallel connected and a 12-volt generator, but if the car system is 6 volt, then each valve can be replaced by its 6 volt equivalent and the generator replaced by one giving the same output with 6 volts input. Attempts have been made to modify the L.T. side of a 12-volt generator to use it on a 6 volt system, but it was found impossible to obtain full output.

The 6-volt valves can, of course, be used with the 12 volt supply by a suitable series parallel arrangement and by using a dropper series resistance with V5, care being taken to give correct current flow for each valve. Some generators give a 6.3 output as well as the 220-volt D.C. and these are ideally suited for this work.

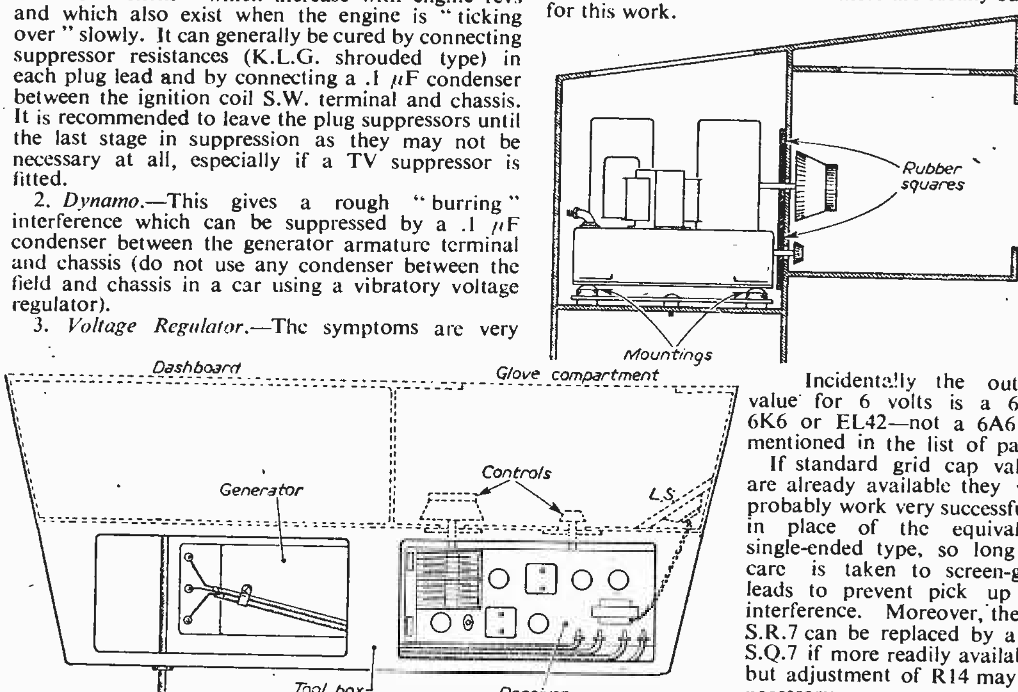


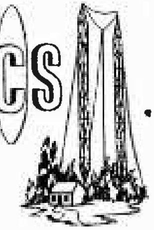
Fig. 7.—Plan and side view (above) of the method of housing the receiver.

Incidentally the output value for 6 volts is a 6F6, 6K6 or EL42—not a 6A6 as mentioned in the list of parts.

If standard grid cap valves are already available they will probably work very successfully in place of the equivalent single-ended type, so long as care is taken to screen-grid leads to prevent pick up of interference. Moreover, the 12 S.R.7 can be replaced by a 12 S.Q.7 if more readily available, but adjustment of R14 may be necessary.

(*To be continued*)

TRANSMITTING TOPICS



DESIGNING THE POWER PACK

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

WHILE the power supply is an essential item in the amateur transmitter's equipment it is also very often the one item taken for granted. This is unfortunate, as transmitter performance may be adversely affected by the power pack performance. This is particularly true of C.W. transmitters when keyed, and of phone transmitters employing Class B modulators, not to mention Class B linear amplifiers in a single-sideband suppressed carrier assembly. Briefly, the provision of a power pack able to supply the rated volts at the rated maximum current drain is "a necessary but not sufficient condition" for satisfactory power pack performance. While such matters as freedom from ripple immediately spring to mind, there are other factors of equal or greater importance that may need attention. Therefore it is advisable to consider the elements of design in connection with the main power supply. This need not include details of deriving a neon stabilised source for a V.F.O., or of dropping volts for low power stages, as this is well known. Less publicised, however, are the performance factors of a straightforward power unit.

Only the full-wave circuit need be considered, as this is general practice. Proponents of bridge and other circuits need not read on; this treatment is not for the advanced, but for the practical amateur. The basic full-wave circuit is shown in Fig. 1. While two independent rectifiers are shown in medium power units it is often possible to employ a single full-wave rectifier incorporating two diode units in the same envelope (Fig. 2).

Generally speaking, the "condenser input" circuit is unduly popular among amateurs. While the condenser input circuit is universal in small broadcast receiver packs it is not necessarily a good choice for a transmitter pack. The condenser input circuit is shown in Fig. 3, and as the name suggests the rectifier output is fed directly into a condenser. This condenser is variously known as the "input" or "reservoir" condenser. However, there is another important circuit known as the *choke input* circuit, in which the rectifier output is fed directly into a smoothing choke as shown in Fig. 4. For transmitter use the choke input circuit has valuable properties, which often make it preferable to the condenser input arrangement.

Condenser Input

To understand the difference in properties of the two arrangements we must consider the question of power pack regulation. Briefly, the condenser input circuit has poor regulation, while the choke input circuit has good regulation—if correctly designed. That the condenser input circuit has poor regulation is another way of saying that the output voltage varies according to the current drawn from the power pack. The choke input circuit if correctly designed, however, has very little voltage variation with loading, so that it is particularly useful in conditions where the transmitter takes a fluctuating load current. This is the case in C.W. rigs under keying. Thus, with the key up and the P.A. cut off, with poor regulation the voltage may soar. This may subject by-pass condensers and other components to a needless voltage stress. Moreover, when the TX is being tuned up, a soaring H.T. line at "minimum dip" may cause R.F. flashover. Again, under keying, a violent transient dip in voltage occurs as the P.A. "picks up," leading to undesirable radiation of transients. This is more often the cause of so-called "key clicks" than lack of keying filters in the buffer stage. In fact, attempts to correct key clicks of this type by excessive "keying lag" filters in the keying circuit merely lead to an excessively "soft" characteristic if any relief from keying splatter is to be obtained. A further effect of poor regulation is the irritating "pinging" effect noticed on some C.W. transmissions. Here, due to poor regulation, the voltage is high at "key up," so the PA initially has a high H.T. voltage. The start of the radiated character is thus stronger than the end of the character, as the

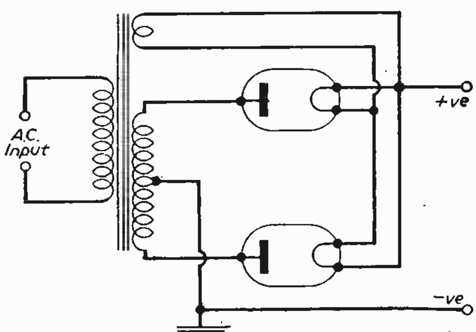


Fig 1.—The full-wave rectifying circuit.

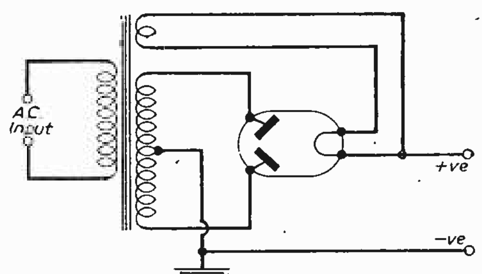


Fig. 2.—In low-power packs a single double-diode rectifier is commonly used.

voltage of the pack falls rapidly under load. This gives the irritating " pinging " effect.

However, poor regulation is even more disastrous in telephony transmitters where high-efficiency Class AB2 and Class B modulators are used. Distortion is greatly increased, while peak power output is reduced if the power source has poor regulation. In extreme cases it may not be possible to achieve full modulation. Class B modulators require very high peak current outputs, while the idling current drain is small. Incidentally, an idling Class B stage may be subjected to undesirably high dissipation if the output of the pack soars under zero signal conditions.

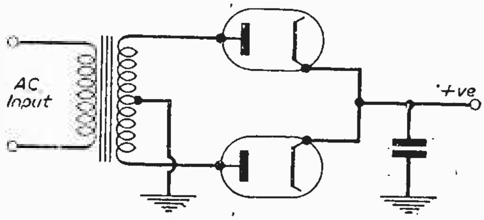


Fig. 3.—The condenser input circuit.

Artificial Load

One palliative measure with condenser input units is to use a bleeder resistance shunting the pack. This has to carry a fairly heavy current, and while not preventing voltage changes does reduce the amount of change. However, this involves a considerable power waste in the resistor, a heavier load on the rectifier and transformer, and is generally usable only when there is an adequate power reserve. In some cases the necessary " ballast " load on the pack may be the drain of other stages of the transmitter, thus usefully employing the power instead of wasting it in a resistor. One such method is to run both the modulator and PA stage from the same supply. If the modulator is switched off for C.W. operation the rise in power pack voltage enables a higher input to be run on C.W. As most PA valves are rated for considerably higher inputs on C.W. than on anode modulated phone this is quite a convenient arrangement. However, it may need more efficient by-passing and filtering arrangements to enable this to be done safely. Moreover, the high combined currents of the two stages may require a larger transformer and a more expensive rectifier and smoothing choke. It may be more economical to run each stage from a separate power pack rated lower than a single pack.

In order to judge the regulation effects of a typical condenser input type of power pack the curve of Fig. 5 shows the approximate output voltage of a condenser input circuit having a 6μF input condenser, and a 600-0-600 transformer, a nominal " 600 volt " power pack. It will be seen that except for very heavy loads, the output is always *above* 600 volts. This leads to the second important difference between the condenser input and the choke input circuits. The condenser input circuit, while having an output voltage greatly dependent upon the load current, and also dependent to some extent upon the size of the input capacitor, may be taken as giving an output of, say, 10 per cent. above the nominal transformer voltage. Thus a pack using condenser input full-wave rectification from a 600-0-600 power transformer would give, say, a nominal 650 volts output.

Use of excessively high values of input condenser do not give appreciably more output voltage and place a heavy strain upon the rectifier. For transmitter use therefore, a 4 or 6 μF input condenser is ample and higher values should be used only if they are sanctioned by the valve maker.

By contrast, the correctly designed choke input circuit gives a nominal voltage output of 10 per cent. less than the transformer voltage. Thus to get 600 volts output we should need a 660-0-660 transformer. However, in both the choke and condenser input circuits it is wise to allow for voltage drop in the rectifier. Vacuum rectifiers may have a drop of some 50 volts internally, while mercury rectifiers have an internal drop of some 15 volts. The resistance

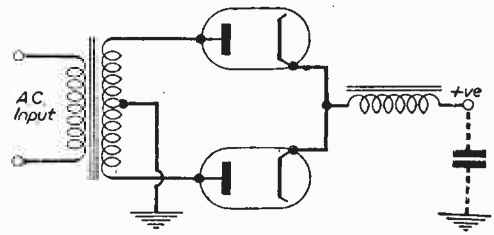


Fig. 4.—The choke input circuit.

of smoothing chokes must also be allowed for, as at the rated or required current this may produce an appreciable drop in output volts. Accordingly, the usual assumption that a condenser input circuit gives approximately the transformer voltage output is usually justified under full load conditions. For the choke input circuit all factors can be allowed for by assuming the input is some 15 per cent. to 20 per cent. lower than the transformer voltage.

Mercury Vapour Rectifiers

It should be noted that vacuum rectifiers may be used in both the condenser and the choke input

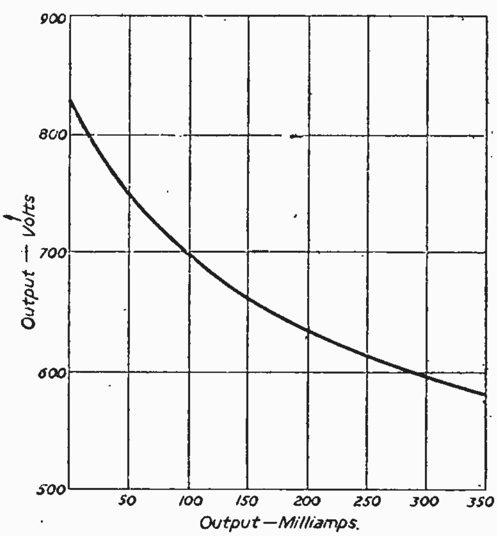


Fig. 5.—Regulation curve of a 600-volt condenser input circuit power pack.

types of circuit. With one or two exceptions mercury vapour rectifiers may *only* be used with the choke input circuit. On the condenser input circuit mercury rectifiers tend to pass very high peak currents, and are quickly ruined, even if the mean load current is not excessive. One or two mercury rectifiers may be used with a condenser input filter, but this is very exceptional and generally mercury vapour rectifiers must be used with the choke input filters.

Generally the use of mercury vapour rectifiers gives very good performance in the choke input circuit, as they have a very low voltage drop of 14 volts and they are capable of high current outputs. Generally, of course, the selection of a rectifier valve for a particular circuit must be made by a careful inspection of the valve manufacturers' recommendations for the particular type of circuit used.

In connection with the choke input circuit, it must be emphasised that the value of the choke used must not be smaller than a critical figure if correct operation is to be obtained, in particular good regulation over a wide range of load currents. In fact, a bleeder resistor should be used to prevent the load current from ever becoming zero. If we use a bleeder resistance of R ohms, then the minimum inductance value for the input choke in henries should be at least that given by the equation

$$L = \frac{\text{Load Resistance Ohms}}{830}$$

If the input choke has this value good regulation is obtained, and the output voltage will not rise at low currents. However, in the interests of good rectifier life, it is usual to use an inductance of twice this value, so that we should use

$$L = \frac{\text{Load Resistance in Ohms}}{400}$$

as a safe design value. With this value of input choke the *peak* rectifier current is about only 10 per cent. higher than the actual load current drawn from the power pack. The condenser input circuit, on the other hand, imposes peak currents of from two to five times the load current drawn from the pack, depending on the value of capacitance used for the input capacitor. Reference to maker's values of permissible peak current ratings will reveal the advantage of choke input circuits when a high output current is needed from the power supply.

Swinging Choke

However, it is clear that as the load current increases so the value of input choke needed decreases, as a heavy load is equivalent to a larger bleeder loading. Thus the "swinging" choke is often employed. At *low* currents it has a high inductance, which falls as the current through it increases. A choke designed as a swinging choke is much cheaper than a choke rated for constant inductance with high load currents. Moreover, at *low* currents we are interested only in preventing the output voltage from soaring, so we can calculate the maximum inductance at low current (i.e., when the bleeder resistance is only drawing current) as $L\ Max = \frac{\text{Load R Ohms}}{830}$. Thus, for a 20,000-ohm bleed resistor a value of 25 henries might be selected. At the full output of the pack we can calculate the effective resistance of the load by Ohm's law. At *maximum* current we are concerned with keeping the peak current down, so that the minimum choke inductance is given by

$$L\ Min = \frac{\text{Effective Full Load Resistance}}{400}$$

Thus, for a total drain on the power supply of 300 mA at 600 volts, the effective load resistance is given by Ohm's law as $\frac{600 \times 1{,}000}{300} = 2{,}000$ ohms, requiring a minimum choke inductance of $\frac{2{,}000}{400} = 5$ henries. In fact, the swinging choke designed to have 25 henries at low currents and 5 henries at high currents is a standard design, and is usually specified as 25/5 henries together with the current at which the inductance falls to 5 henries.

We must now consider the important question of ripple. In a transmitter for C.W. purposes a ripple percentage of 5 per cent. is permissible for the PA stage. In telephony the PA may have a ripple of 0.5 per cent. Driver stages should not have more than 1 per cent. ripple, while speech amplifier stages should not have more than 0.1 per cent. ripple in high-gain modulators. It is, of course, relatively easy adequately to filter the H.T. for lower-power buffer and speech amplifier stages. For high-power stages the cost of components becomes important. It is therefore necessary for the most economical design to consider the filter design on more than the "brute force" methods used for low power packs, where high-capacity electrolytics solve most hum and ripple problems.

The ripple problem, then, consists of knowing *what* the ripple output of the rectifier circuit is, and then selecting suitable filter values to reduce the ripple to the desired level.

(*To be continued*)

Selectivity and the R.1155

A USEFUL HINT FOR IMPROVING THE UTILITY OF THIS POPULAR Ex-R.A.F. RECEIVER

By C. B. Cruickshank

THE 20-metre amateur band on the 1155 occupies a space of about a quarter of an inch on the tuning dial length of approximately 11in.—one forty-fourth! There are no band-spreading devices on the set, and it is very annoying to hear good DX coming through, only to be lost in the relatively local QRM. With this problem in mind, it was decided to fit an additional I.F. stage to the receiver.

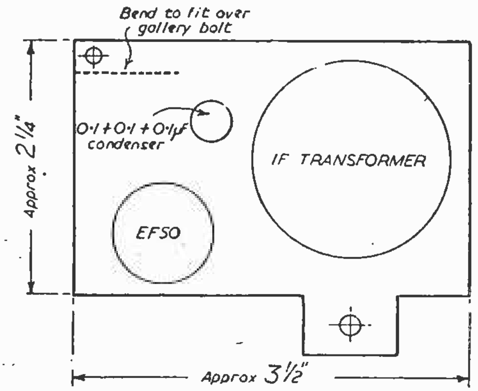


Fig. 1.—General aspect of the new stage.

To be conventional, the I.F. stage should have been situated between the existing stages, but even after the removal of all redundant D.F. components, space could not be found. Beneath the chassis of a 1155 and behind the coil pack there is a large space occupied only by a trap in the anode circuit of the R.F. stage ; sufficient space—yes, but it means that the stage has to be mounted on its side. This arrangement has proved not to be a disadvantage in practice.

The stage was designed on a small sub-chassis, and after mounting on the receiver only five soldered connections to easily accessible points are required. The advantage of this method is in the fact that the RX may be kept in use while the additional stage is being constructed.

Components Required

The list of components is not impressive and is as follows :

One 1155 I.F. transformer assembly with screening can.

One 0.1+0.1+0.1 μF single-hole fixing condenser.

One EF50 (VR91) or KTW63.

One B9G or octal valve base.

Screened wire and a piece of aluminium measuring roughly 3in. × 4in.

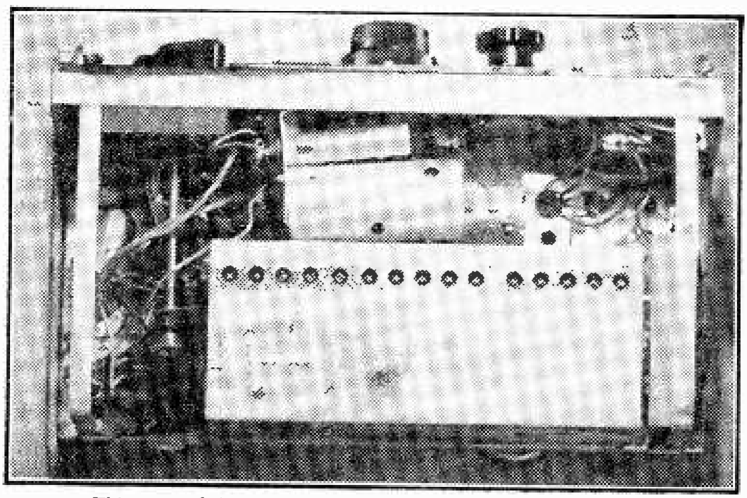
In almost all radio "junk" shops will be found 1155s in a state which would preclude their ever being reconditioned as receivers again ; they are only of component value and at that they are not much good. As a result they usually go for around 10s. minus the slow-motion tuning drive. An alternative source for an I.F. transformer would be in the kits of spares often advertised for 1155s in this journal.

The condenser can be taken from the receiver from between the two X65s used in the D.F. circuit.

An EF50 has been specified because it is fairly small and has all the connections brought out to the base, but there is no reason why a KTW63 should not be used. If the latter is used it may be necessary to shift the trap further over towards the power plug. This may be necessary on some receivers even when an EF50 is used.

Mounting

As the sub-chassis is secured to the main chassis



This view of the receiver shows the layout of the new section.

by one of the bolts which holds the plate on which the tuning condensers are mounted and at a second point by a nut already in position holding down a wire gallery, there is no need to drill fixing holes in the main chassis. The use of these fixtures makes it difficult to give precise measurements for the sub-chassis, but in Fig. 1 the general aspect may be seen. A good method of obtaining the correct size of chassis without much effort is to cut an old postcard to the required size and use it as a template for cutting the chassis.

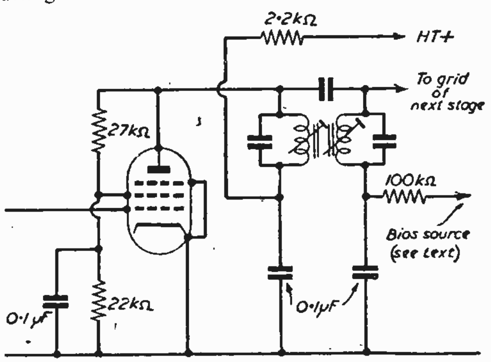


Fig. 2.—Circuit of the new stage.

To prevent instability it will be obvious that the screening must be good and it is, therefore, advisable to use the screening *can* from the last I.F. stage of the old 1155 as it has a bottom to it and is not dependent on the chassis to screen the open end. The I.F. transformer assembly from the last stage should not be used in the conversion as it has a tapped primary. When marking out the sub-chassis particular attention must be paid to the holes in the screening can which give access to the dust cores. Their position is obvious from the illustration. Another point to watch is that the slots in the end of the dust cores are facing the end of the coil next to the holes in the can which will be accessible when the unit is in position.

Connections

When the assembly is complete there will be five leads to solder into the set ; H.T. line, heater supply, input to and output from the new I.F. amplifier, and the bias lead. Bias can be obtained from the centre of the two resistors situated on a tag board at right angles to the chassis immediately below the second I.F. transformer. There should be a 100 K resistor in series between the I.F. former and the bias source. In most cases this resistor will form part of the I.F. transformer assembly ; if not, it can easily be introduced.

There are a number of points from which H.T. and heater supplies can be drawn but to avoid making soldering joints in awkward places it is suggested that the heater supply is drawn from the third tag from the inside on the tagboard immediately below the output transformer, that is, below it when the set is in its normal position. A check should be made that the third tag on your particular set is, in fact, coupled to the heater supply. The H.T. connection could be made to the third last tag—again a check should be made.

The grid of the new stage is fed by screened cable from the output of the second I.F. transformer and the output from the stage goes to the grid of the last I.F. valve.

Testing

With the unit installed, switch on and tune the set to the BBC Home Service and adjust the new I.F. transformer cores for maximum volume. Of course, if an output meter and/or signal generator is available they should be used, but their absence should not deter the 1155 owner from making this modification.

There is a wide variety of power supplies now in use for 1155 and the H.T. voltages tend to vary to an extent which would make war-time R.A.F. radio mechanics squirm. One of the evils of this variance is that the bias voltage is in all probability wrong. A way of adjusting this and perhaps getting a little more amplification is to disconnect all the wires from the wirewound potentiometer marked " Meter Balance " and take a lead from one side of it to H.T. negative. That is all that is necessary, as the centre tap is already connected to the chassis. On the author's set this potentiometer has been shifted down close to the power plug as can be seen from page 741.

Aerial Matching

Another dodge worth trying concerns matching the aerial to the set. Connect the lead-in wire direct to the grid of the R.F. stage and if it improves matters on the 7.5 to 18 megacycle band it can be made a permanent fitting by soldering a screened lead to the wire which goes from the filter immediately before the R.F. stage to the R.F. stage and taking it out to a socket on the front panel of the set. This tip will only be of use if the present aerial is not matched to the set.

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C 9	0·02μF	750	B 404	2 1½
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C 11	220pF	350	L 433	1 6
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C 16	0·01μF	350	B 810	1 6
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C 18	0·05μF	500	B 405	2 3
C 19	50μF	25	JD 53T	2 9
C 20	50μF	25	JD 53T	2 9
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On Your Wavelength

BY THERMION

Time Gentlemen, Please

I AM not referring to the barmaid's song, but to the habit which some announcers have of announcing the wrong time in the morning. Have they forgotten to put their watches back? There is another irritating habit of interjecting the time announcement just as another is being made, concerning, say, the next piece of music.

As a matter of fact, these early-morning programmes are very small beer. They are poor in quality, rather drowsily put over and they are wrong in character. The fact is, I suppose, that we have become sated with radio programmes. It is on tap whenever we want it, and I am certain we should appreciate it more if programmes were only available, say, three times a week and for shorter periods. Perhaps some of our old zest would return. I recall the days of Writtle, long before Savoy Hill days. One programme for half an hour every week; often by the time you had scratched about on the crystal to find the sensitive spot the programmes had finished. The programmes were, of course, of very poor quality. P. P. Eckersley was chief engineer, announcer and general factotum, but we *enjoyed* them. The quality did not matter. We have become more choosy since then. My own pet hate is hearing the same old announcers year in and year out. I should hate to see the same actors in every theatre I visited. A change of cast infuses new blood and new life into any programme. I have, for example, had too much of Richard Dimbleby, Philip Harben, Kenneth Horne, not so much for their appearances as for their programmes. One does not wish to see a Punch and Judy show every week! There is a way out of this. Instead of the BBC smugly relying upon its Listener Research Department, let it deliberately invite once a week, criticisms from listeners, instead of relying upon the criticisms coming in haphazardly, also invite suggestions as a programme feature. Then a programme could be put out once a week under the title "Listeners' Choice," decided by popular vote. I am certain that the BBC would have some shocks.

Radio in Schools

IT is a sign of the times in this atomic age that schools now teach radio construction instead of how to make silly ash trays and photo frames out of cigar boxes. The handicraft classes of most schools were humorous affairs a few years ago. The instructors were usually uncertificated teachers, with no pretensions to education. Most of them had never served an apprenticeship, yet were appointed to teach youths in the use of tools. In some areas this still holds true, but education committees are now a little more selective in these appointments and insist upon qualified craftsmen. I mention this because I receive during the course of the year many letters from headmasters asking for guidance in starting radio classes, for which there is no shortage of pupils. Local enthusiasts who feel that they would like to encourage the young generation should get into touch with the headmasters of local schools and offer assistance, and where possible any spare parts for which they have no further use. The schools would also welcome any technical books on the subject. One school I know has built (and very successfully) our Supervisor and adapted it for ITA. I think this form of technical instruction is far better than teaching boys fretwork and how to make dust-collecting articles in wood, which are promptly put in the cupboard under the stairs. I also think that all headmasters should now investigate the qualifications of these "professional" amateurs who pose as instructors and "teachers."

Car Radio

A READER residing in Crewkerne, Somerset, tells me that he has been refused a road fund licence for his car because he declined to answer the question printed on the form asking whether his car is fitted with radio. This question was introduced a few years ago and motorists have always resented it. This journal in its criticism of these snooping tactics said that the Minister of Transport was not empowered to ask such a question. The Ministry, however, said that they were. After further pressure on the point they announced that they had not, and that motorists could ignore the question. I wonder how many local post offices have refused a licence under these conditions? I should like to hear from any readers so that I can write to the head postmaster concerned, to ensure that he is properly instructed in the law, passes this information along to his staff, and complies with the instructions of the Postmaster-General. In this particular case, I wrote to the head postmaster concerned, because my reader was still without a road fund licence, having declined to answer the question on a matter of principle. In point of fact, his car is not fitted with radio. Everyone who has a radio fitted to his car should pay tax, and no one has any sympathy for the motorist who endeavours to evade payment of tax. What I object to is one Ministry trying to do the work of another and acting as snoopers for the Post Office. Let the Post Office devise its own means of tracking down offenders. It should be easy enough. Incidentally, judging from the queries received, car radios are by no means so reliable as the domestic receiver. Few of them give consistent trouble-free service for more than a few months. The rectifying unit, usually of the vibrating reed type, is the main cause of trouble. I have had two car radio receivers and each gave trouble within six months. As it is nearly impossible to get these serviced locally the car must be taken to some remote service depot and left for a day or so. The operation of a wireless set from a 6- or 12-volt direct current supply must, I fear, always be unsatisfactory, since it is not possible to step up direct current except by means of a converter which converts this into A.C.

TRANSISTOR and DIODE Testing

AN ARTICLE FOR THE BEGINNER AND EXPERIMENTER

By R. F. Graham

A DIODE or a transistor should be preliminarily tested before it is put into use. It is desirable to know whether it is suitable for the purpose intended, and if subsequent defects develop it can be tested again to compare with the original notes and ascertain the extent of damage—also the cause.

Do not use an ohm-meter; most of these will cause a damaging current to pass, and in any case the reading will be useless because the resistance of a semi-conductor varies with current and the ohm-meter also supplies different currents at different readings which are unknown quantities, except that more current passes at lower resistance readings, and so a defective diode may appear to be good.

For preliminary tests a volt-meter in series with a battery may be used, the current is limited to less than the full-scale deflection, and the resistance can be calculated.

For example. You want to find the best diode and you have a 3-volt battery and a 5-volt meter with a resistance of 1,000 ohms per volt and 1 milliamp full-scale deflection. This meter shows the battery to be exactly 3.05 volts. Now a GD3 diode is connected in series with the anode white end to the volt-meter negative lead and the cathode red end to the battery negative. The meter positive lead is connected to the battery positive and a reading of, say, 2.65 volts is noted. Since a 5-volt reading equals a current of 1 mA, a 1-volt reading is equal to 0.2 mA and the 2.65 reading shows a current of 0.53 mA (2.65×0.2). Applying Ohm's law we divide 3.05 battery voltage by 0.53 mA and this shows a total resistance of 5,760 ohms in circuit. But 5,000 of this is the meter resistance so the remaining 760 ohms is the diode resistance when 530 micro-amps pass through it. At a greater current the resistance will be less as we shall see later. Now reverse the diode connections, white to battery minus, red end to meter negative, and the pointer does not move from zero. The diode is a good one. If the meter shows more than a quarter of a volt, the diode is not suitable for a diode-transistor receiver. There are many bad ones on the "surplus" market. Also, remember that the nearer the meter reads to actual battery voltage the better the diode. A reading of less than 2½ volts with a 3-volt battery means the diode is not good enough. The GD3 at 2.65 volts only just passed the test.

Diode D.C. Tests

Having selected a diode as advised a better test is called for with more current passing through.

Most diodes are point contact devices and will not carry much current, but should be able to carry 2 to 3 mA and to work continuously at 1 milliamp.

The circuit is shown in Fig. 1.

A test lead is connected to the negative terminal of a 4-volt accumulator. One end of an 800 ohms resistor is connected to the accumulator positive and the other end to the positive end of a 5-mA meter. The negative terminal of the meter is connected to one end of a 200-ohms variable resistor. The other end of this resistor is connected to the slider and to another test lead.

Before use the meter is checked to give exactly the same reading as the actual voltage reading of the accumulator. For this purpose a volt-meter is connected across the accumulator and the pot. slider is adjusted to give the same reading on the mA meter when the test leads are connected together. Now the mA meter also shows voltage readings just like a volt-meter with 5 mA full-scale deflection and a total of exactly 1,000 ohms at any reading, viz., 200 ohms per volt or mA. Any suitable resistance connected to the test leads can be calculated as before.

For example, the same GD3 gives a reading of 3 mA and zero when reversed. The accumulator measures exactly 4.01 volts. The diode resistance is $(4.01 \div 3) - 1{,}000$ viz., 335 ohms, and not 760 ohms when only 0.53 mA were passing. Or with the same 3-volt battery the reading is 2.20 mA and diode resistance works out to be 386 ohms at this current.

Transistor D.C. Tests

The same circuit (Fig. 1) is used. A transistor may be looked upon as two diodes with a common base, emitter to base, and collector to base, and a third composite assembly having the transistor effect, namely, between emitter and collector with the base plate between them. The base consists of a very thin rectangular slab. The emitter is a disc-shaped blob on one side of the base and collector is a similar smaller blob on the opposite side. In a p-n-p type both the emitter and collector are "p" type and the base is "n" type germanium. The only difference between a collector and emitter is size. Connections in a circuit may, therefore, be reversed, with the only result that slightly more amplification takes place with grounded emitter than with grounded collector. But since the base controls the amount of current passing between emitter and collector it is very important to connect the base correctly so that it does not receive excessive bias voltage and current, which may easily destroy a transistor by excessive

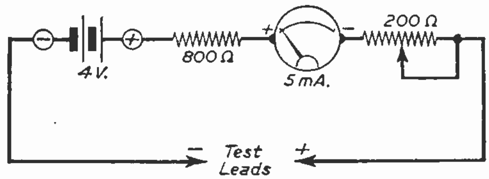


Fig. 1.—Circuit of simple test arrangement.

output. However, with the test circuit shown, and 1,000 ohms in series, less than 4 mA will pass no matter how the connections are made and so there can be no damage done. The leads of an unknown type of transistor can be labelled 1, 2, 3 and tested. When it is found to be p-n-p or n-p-n the leads can be marked accordingly. The odd one of the three will be the base.

Each transistor may be tested 12 different ways for a complete set of readings. One test lead may be connected to any one of the transistor wires and the other test lead may be connected to any other one or both of the free wires. A complete set of such readings is shown below for an OC71 p-n-p type transistor. Where b is base, e is emitter, c is collector, and the plus sign means it is connected to the positive test lead while the minus sign means it is connected to the negative test lead. If there is no plus or minus sign but an " o " it is left open in the air and is not connected at all, so that an infinite resistance may be assumed between it and the other connected leads.

The goodness of a transistor may be judged roughly from the high readings, which should be close to the battery voltage, while the reverse, minimum readings, should be as near zero as possible; especially in the case where the base is not connected. Good transistors show zero readings, and the highest reading not less than 3.8 with a 4-volt accumulator.

A damaged transistor will not show zero readings but the leakage may be considerable. A leakage of as much as 1½ mA will work somehow in a receiver, but the transistor will not be any good for many other purposes. If a damaged transistor is connected with b to plus test lead and both e and c to the negative test lead, the leakage reading will gradually drop and in a few days it will reform to a reasonable low reading. It may be near zero, but this is not a permanent cure. On the other hand if connected with base in the air it will degenerate and the leakage current will gradually increase. With base not connected, or even with a high resistance to plus, readings slowly increase in time if a transistor has been damaged; a good one stays at zero.

Plotting D.C. Curves

As in valve theory, germanium and other semi-conductors will produce equally useful curves, with equally useful information. The understanding of how a transistor works can thus be more clearly understood by anyone who has studied valve curves but is not conversant with the modern transistor theory.

The Tester (Fig. 2)

This consists of an insulated panel about 5in. square with terminals all round and a few components for convenience. The soldered wiring under the panel is clearly marked out on the top, so that any desired circuit may be connected up and checked before use. The 800 ohms resistor is included for preliminary

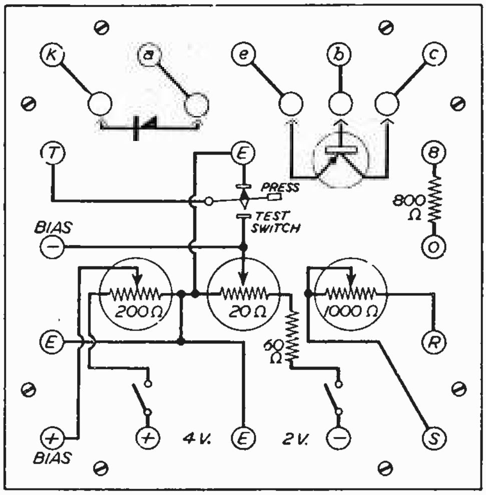


Fig. 2.—Wiring of a diode/transistor test panel.

tests as in Fig. 1. The press button switch is a convenient refinement. It connects input to earth while bias is being adjusted, since readings above 4 mA should not be left on to avoid warming up a transistor. The three wire-wound variable resistors are good enough to carry 0.1 amp, likewise the 800 ohms resistor. Low value bias pot. 20 ohms avoids adding series resistance to input. Two battery switches to save battery drainage are added for convenience.

DIODE TUBE

OC71 p-n-p b=base c=Collector e=emitter	Meter Readings mA.	+ Means connected to positive test lead. — „ connected to negative test lead. o „ NOT connected, left open.
b+ c− eo	0.0000	Diode reverse current, good.
b+ c− e+	0.0006	Small leakage, passable.
b+ c− e−	0.0005	Reforms, readings fall in time.
b+ e− co	0.0002	Diode, should be zero, for R.F.
b+ e− c+	0.0005	Small leakage, passable.
b− e+ co	3.39	Diode (poor at R.F.)
b− e+ c+	3.40	Power Diode (poor at R.F.)
b− e+ c−	3.81	*Efficiency*. Reading should be nearly the same as battery volts.
b− c+ eo	3.39	Diode (poor at R.F.)
b− c+ e−	3.72	Efficiency. Reading always less than above. See b−e+c−.
bo c+ e−	0.002	Degenerates, readings rise slowly and stop.
bo e+ c−	0.013	Degenerates, should be zero. Base not pure enough.

The completed panel is screwed down to four stand-off strips of wood making a frame all round or it may be fitted on to a shallow box.

Six different circuits can be connected up for a p-n-p transistor alone, namely, input to base and output from emitter or collector; input to emitter and output from base or collector; input to collector, and output from base or emitter. In all cases the third is grounded. Another six for a n-p-n type, with battery and meter connections reversed. Input may be positive or negative so total is 24 each producing two curves, from which other curves can be plotted. Double this if a diode is used in series, multiply the total by the number of different voltage batteries, by the number of different input and output resistors and combinations and the number of circuits becomes fantastic. Furthermore, this tester is useful for A.C., A.F. and R.F. tests. A whole book could be written about this. If we take one example, which is interesting from the wireless point of view, then any other useful set of curves will be easy.

Diode-Transistor

Tester connections for combined GD3 and OC71 with input through the diode to base, grounded emitter, and output to collector, at various negative bias voltages, for two curves; one Ib input current and the other Ic output. It is not necessary to measure emitter current because it is equal to input plus output currents

Output Circuit. A wireless receiver will have an output transformer and in most cases it may be assumed to be 100 ohms as an average. If the meter to be used to measure output has a resistance of 10 ohms, then the 1,000 ohms variable must be adjusted to 90 ohms by means of an accurate ohm-meter, for the desired total of 100 ohms. A short flex is then connected from (c) collector terminal to (R) terminal and the 5 or 10 mA meter is connected from (S) terminal to 2V (—) terminal. A short wire is connected from (e) emitter terminal to (E) earth terminal just below it. A 2-volt accumulator is connected between the 2-volt (E) and (—) terminals and this completes the output circuit for one of the curves.

Input Circuit. This consists of a 0.5 volt meter between terminals (—) bias and (E) just below it. It should be an accurate moving-coil type because very small fractions of a volt produce big changes in output current at higher readings. A 250 micro-amp meter is connected from (T) test terminal to (k) cathode terminal. This should also be a good moving-coil, to indicate the small readings at very small bias. A short flex from (a) anode terminal to (b) base terminal completes the input circuit for the second curve.

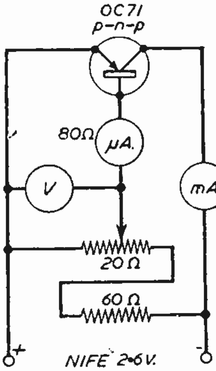
When the accumulator is switched on, the voltmeter will show the bias voltage as adjusted by the 20-ohms potentiometer. When the test switch is pressed the μA meter will indicate the bias current passing through the diode and transistor. At the same time the mA meter will indicate the amplified output current. Remove finger and the press switch is off.

For readings up to 3 mA, the press switch may be omitted by connecting the μA meter to (—) bias instead of (T).

It is desirable to take down input and output current readings at intervals of 0.02 volts from zero to the maximum permissible D.C. output current, usually 5 mA. If any higher readings are attempted they should be of very brief duration and the press switch is compulsory. Fig. 4 curves seven and eight were plotted from such readings.

Reversed Voltage Circuit

Disconnect the 250 μA meter and reconnect it reversed from (+) bias to (k). Connect a 6-volt meter between (—) bias and the (E) terminal. Turn the 200-ohms slider to earthed end; connect a 4-volt accumulator between (+) 4V and (E) terminals, and switch on both accumulators. Take meter readings at ½ volt intervals by adjusting the 200-ohms slider. The readings should be very small, or none with a perfect diode and transistor.



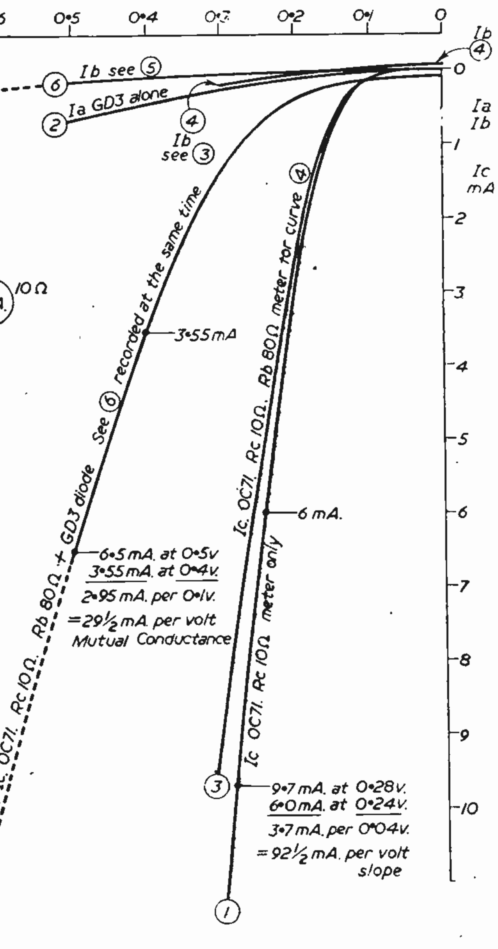


Fig. 3.—Test circuit and curves for low resistance tests.

Low Resistance Curves (Fig. 3)

All curves were accurately plotted from readings on best make of meters. The following information should be compared with the actual curves referred to for a clear understanding.

All inputs are to base, outputs to collector with grounded emitter. The same GD3 diode and OC71 transistor were used in all cases with a NiFe accumulator which measured 2.6 volts at all times. The test panel was used as described.

(1) Ic output curve with only 10 ohms Rc, viz., meter resistance. Input direct to (b) base terminal from (T) bias terminal. This is the best curve, it is steep and straight over a long portion with a mutual conductance 99½ mA per volt.

This is an average transistor. Better ones show a slope of over 100 mA/v.

(2) Id curve, or current passing through a diode alone.

Plotted to see whether a GD3 will pass sufficient current at various voltages to suit the transistor requirements.

(3) Ic with same conditions as for curve one, except that a 250 μA meter having 80 ohms resistance was connected to measure input current for the next curve four.

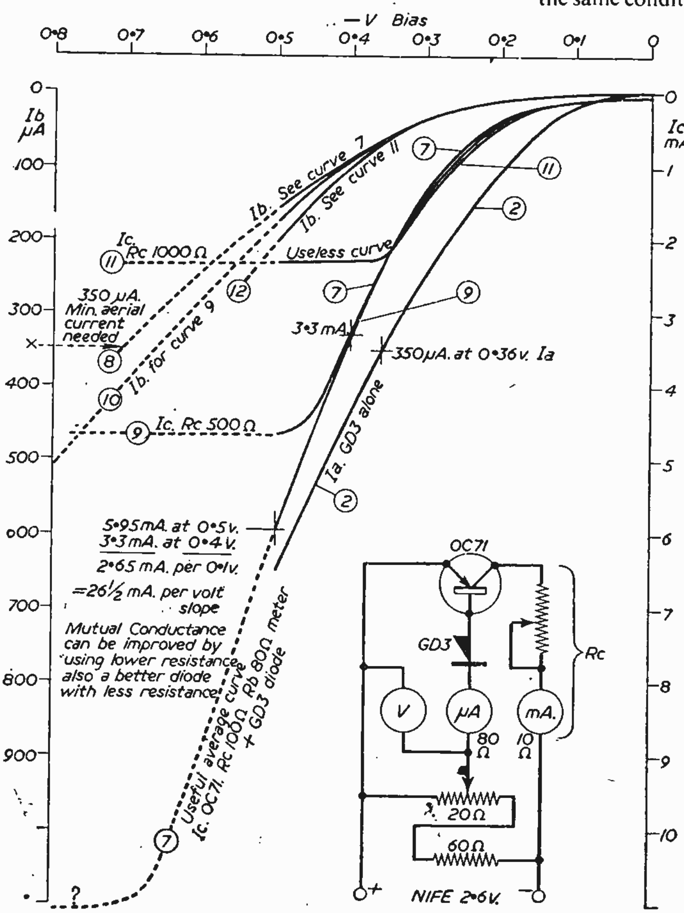


Fig. 4.—Diode and transistor curves.

(4) Ib input curve. At -0.3 volts it shows that the transistor requires 225 μA for an output of 9.45 mA and curve two shows that the diode passes 250 μA, enough by a small margin.

(5) Ic output curve when the input is through a diode to base including a meter to measure input current for curve six. This curve does not look nearly so good as one or three, due to the extra resistance of the diode and meter in the input. It is, however, the best practical curve that can be obtained, with only 10 ohms in the output circuit. The slope works out to be 29½ mA/v. That is much better than any output valve in a home receiver.

(6) Ib input curve. At -0.5 volts it shows 155 μA are required and the diode at this voltage can pass 650 μA, see curve two. The diode can, therefore, pass more than the transistor can take, to beyond overload output current, in a diode-transistor combination. The remark in (4), therefore, does not apply to such a combination. Also it is quite obvious that the sensitivity of a wireless receiver is much better when it requires less aerial current input.

Diode-Transistor Curves (Fig. 4)

Again the same GD3 and OC71 were used under the same conditions as for curves in Fig. 3 for purposes of comparison.

(7) Ic output curve has the same input meter and diode as in curve 5 but the resistance in the output, including the same meter, has been increased to a total of 100 ohms.

This curve represents the average type of results which may be expected in home-made receivers, with an output transformer having a fair amount of D.C. resistance. The slope is not quite so good as curve 5, but the mutual conductance of 26½ mA/v compares favourably.

(8) Ib input curve, for curve 7 was recorded at the same time. It shows slightly greater inputs than curve 6, but the difference is negligible.

(9) Ic, the same conditions as 7 except that the output Rc resistance has been increased to a total of 500 ohms. This curve shows that the output current is being gradually cut off by Rc from about 4.1 mA to complete cut off at 4.7 A, when audio frequency distortion is bound to occur with no signal amplification above 4.7 mA. It is also to be noted that this curve crosses over curve 7 at about -0.41 volts and rejoins at about -0.2 volts close together.

(10) Ib input curve for (9) Ic shows distinctly more current than curve 8.

(11) Ic, the same conditions as 7 and 9, except that Rc has been increased to a total of 1,000 ohms. Now the output is shown to be cut off quite briskly and is useless above 2.3 mA. There is no straight portion worth considering and since the receiver is usually adjusted for about 1½ mA steady reading, it leaves about 0.7 mA slope to work on. The out-

put from a loudspeaker would be nothing short of horrible. Try a pair of 1,000 ohms phones instead of transformer.

(12) Ib input curve shows a still greater requirement of current from an aerial, reducing sensitivity.

All the curves are sufficiently accurate for extracting other information, and for plotting other curves, such as input current against output current. However, it is hoped serious experimenters will plot their own curves to know their transistors and how they work in different kinds of circuits. The curves examined definitely show the advisability of using as little resistance in a circuit as possible, Rb, Rc, and this applies equally to Re and a good earth.

with less D.C. resistance at small currents. This is so important that a transistor was tried as a diode b to e, then b to c, then b to e and c joined together, etc., but it proved to be a very poor rectifier, in spite of lower resistance. Signal strength was not to be compared with a GD3, but there may be others better than GD3 for our purposes ; they need finding. Perhaps a small independent current passed through a diode to reduce its resistance but not spoil its rectifying properties will work, but this has not been tried yet, or another kind of circuit using a point contact transistor as a diode with collector for amplified R.F. feed-back or reaction coil. Here is food for thought for experimenters.

METER READINGS, ALL IN MICROAMPS, FOR PLOTTING CURVES FIGS. 3 AND 4.

Best quality moving coil meters were used. 250 μA 80 *ohms*, 1 *mA* 10 *ohms*, 10 *mA* 10 *ohms, and* 0.5 *volts. Resistances Rc and Rb are shown as total including meter resistance. Nickel iron accumulator used showed* 2.6 *volts at all times.*

Bias −V	1 Ic	2 Id	3 Ic	4 Ib	5 Ic	6 Ib	7 Ic	8 Ib	9 Ic	10 Ib	11 Ic	12 Ib	Bias −V
0.00	7	0000	7	−20	98	0	60	0	65	0	65	0	0.00
0.02	14	1	11	−18	100	0	70	0	75	0	78	0	0.02
0.04	17	2	18	−15	108	0	75	0	77	0	85	0	0.04
0.06	30	5	34	−10	114	0	80	0	85	0	90	0	0.06
0.08	64	10	73	−2	123	1	88	0	94	0	98	0	0.08
0.10	128	17	144	0	137	2	100	0	110	0	116	0	0.10
0.12	268	24	290	+6	157	3	122	1	130	1	141	1	0.12
0.14	616	40	640	14	193	4	150	2	170	2	180	2	0.14
0.16	1080	60	1050	22	232	5	212	4	215	4	240	4	0.16
0.18	1800	81	1680	38	305	6	277	6	280	7	320	7	0.18
0.20	3140	102	2850	62	395	8	377	9+	385	10	428	10	0.20
0.22	4320	132	3950	90	533	12	510	12	500	12	570	12	0.22
0.24	6000	158	4920	110	674	14	656	16	640	18	720	18	0.24
0.26	7650	192	6350	145	854	19	804	20	837	21	928	22	0.26
0.28	9700	215	7600	180	1110	25	1180	28	1080	29	1150	30	0.28
0.30	—	250	9450	225	1400	32	1300	33	1400	38	1420	39	0.30
0.32	—	270	—	—	1700	39	1610	41	1680	42	1680	44	0.32
0.34	—	311	—	—	2100	49	2050	52	2030	54	2010	56	0 34
0 36	—	353	—	—	2600	60	2470	62	2380	64	2250	69	0.36
0.38	—	390	—	—	3010	70	2770	72	2850	78	2300	82	0.38
0.40	—	430	—	—	3550	81	3300	86	3350	90	2320	99	0.40
0.42	—	478	—	—	4030	92	3730	98	3650	102	2340	115	0.42
0.44	—	520	—	—	4620	107	4250	110	4120	119	2340	138	0.44
0.46	—	570	—	—	5280	123	4850	128	4460	136	2350	159	0.46
0.48	—	610	—	—	5780	140	5400	145	4600	155	2350	178	0.48
0.50	—	650	—	—	6500	155	5950	158	4640	174	2360	200	0.50
−V Bias	Rc 10 ohms	Rd 80 ohms	Rc 10	Rb 80	Rc 10	Rb 80 plus GD3	Rc 100	Rb 80 plus GD3	Rc 500	Rb 80 plus GD3	Rc 1000	Rb 80 plus GD3	−V Bias
	1	2	3	4	5	6	7	8	9	10	11	12	

Some may say resistance can be compensated for by using higher voltage batteries. That is as it may be, but then a higher degeneration, or leakage referred to, will take place due to diode resistance. This will also need compensating, and what is the sense of larger batteries when better results can be obtained with lower voltages? It has been tried.

The less resistance there is in the circuit of a receiver the better will be its sensitivity for getting distant stations, and the fidelity will be improved very much more, permitting greater volume without distortion. Likewise, there is a great possibility of improving a receiver by a search for better diodes

Books Received

"**Second Thoughts on Radio Theory,**" by "Cathode Ray," of *Wireless World.* Size 8¾in. x 5½in., 409 pages. 266 illustrations. Cloth bound with jacket. Price, 25s. net.

"**Guide to Broadcasting Stations 1955-56.**" Compiled by the Staff of *Wireless World.* Eighth Edition. Size 7¼in. x 4¾in., 80 pages. Price 2s. 6d. net (postage 2d.).

Both the above published by Iliffe & Sons.

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	33,000	1/9
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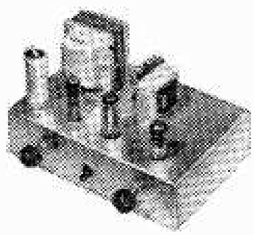

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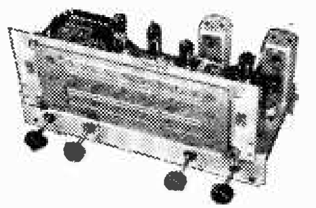

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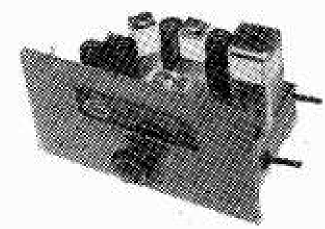

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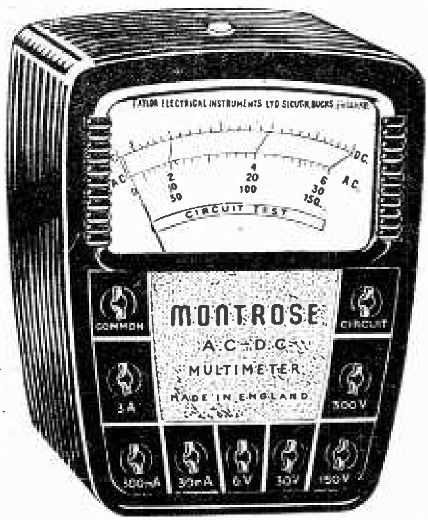

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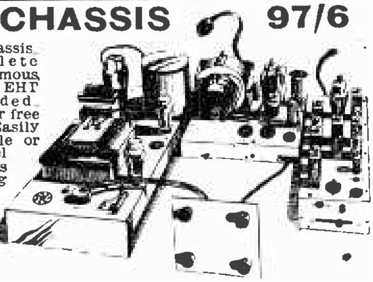

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EAL 5737

A Three-valve Single Span

A SELECTIVE CIRCUIT FOR THE EXPERIMENTER

By F. J. Shipgood, A.M.I.P.R.E.

WITH the present overcrowding of stations on the broadcast bands, the design of a receiver of adequate selectivity becomes a problem. Whether a T.R.F. or superhet be used, it is usually necessary to employ two tuned circuits with the attendant twin-gang condenser, trimmers and, in the case of the superhet, padders.

A simple yet selective receiver is provided by a variation on an old idea, the single-span.

The principle of the single-span is to use an aperiodic R.F. stage so that all signals available in the aerial circuit are presented at the grid of a first detector or frequency-changer. The anode circuit is tuned to some intermediate frequency, and a local oscillator is arranged to beat with the wanted signal so as to produce the I.F.

The early single span used a high value of I.F. in order to discourage second channel interference and to reduce the ratio of the two extreme oscillator frequencies. For example, if the receiver was required to tune from 150 kc/s to 1,500 kc/s, a ratio of 10 : 1, with an I.F. of, say, 1,500 kc/s, the extreme oscillator frequencies were 1,650 kc/s and 3,000 kc/s, a ratio of less than 2 : 1. Thus the tuning was well within the span of a 200 pF tuning condenser. The disadvantage of using the high I.F. was the loss of adjacent channel selectivity, and a large number of I.F. stages were necessary.

In order to utilise standard components a compromise was made, and using an I.F. of 465 kc/s and a 300 pF midget air dielectric variable condenser, the tuning range was found to be 600 kc/s to 3 Mc/s.

The Circuit

The circuit shows the aerial connected directly to the grid of a 6K8, and an untuned coil placed between grid and chassis. The remainder of the valve circuit is conventional. A grid-tuned series-fed Meissner forms the local oscillator circuit, and the usual value of decoupling, self-bias and automatic bias components are used. The I.F. transformer (the only one) in the anode circuit is coupled to the grid of a leaky-grid detector, and this is resistance-capacity coupled to a 6V6 output stage.

The circuit was required originally for a bedside receiver and the sensitivity was adequate for this purpose. The main thing was that its tuning was razor-sharp and the Light Programme on 247 m. and the Home Service on 261 m. were easily separated.

Increased Sensitivity

To increase the sensitivity there is a choice of methods. The obvious one involves an additional I.F. amplifier—a 6B8 could be employed as such, one of the diodes being used as the detector. A reaction coil may be wound on the I.F. transformer,

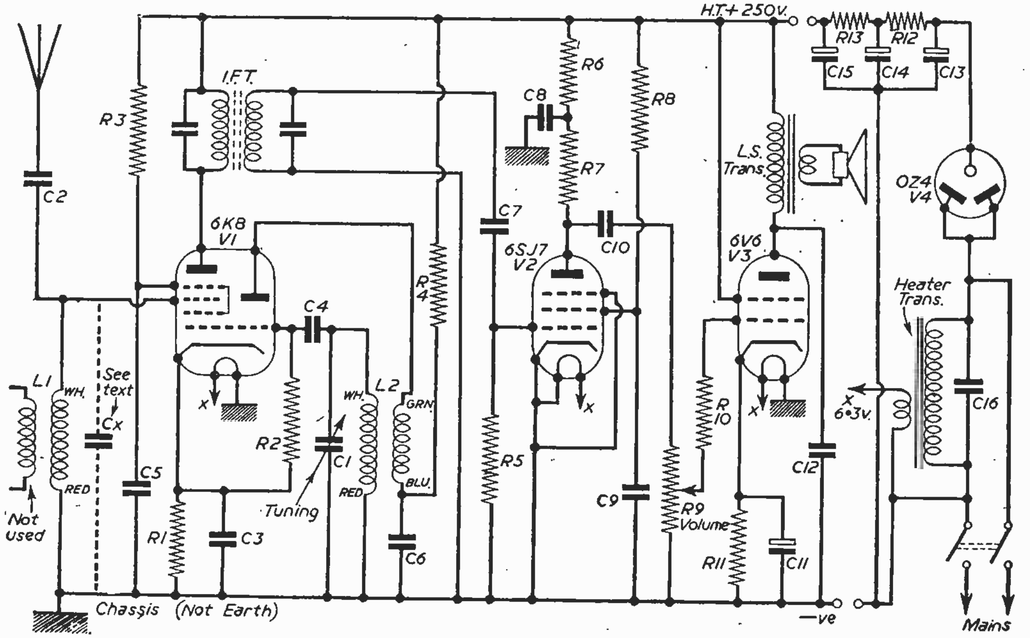


Fig. 1.—Theoretical circuit of the receiver.

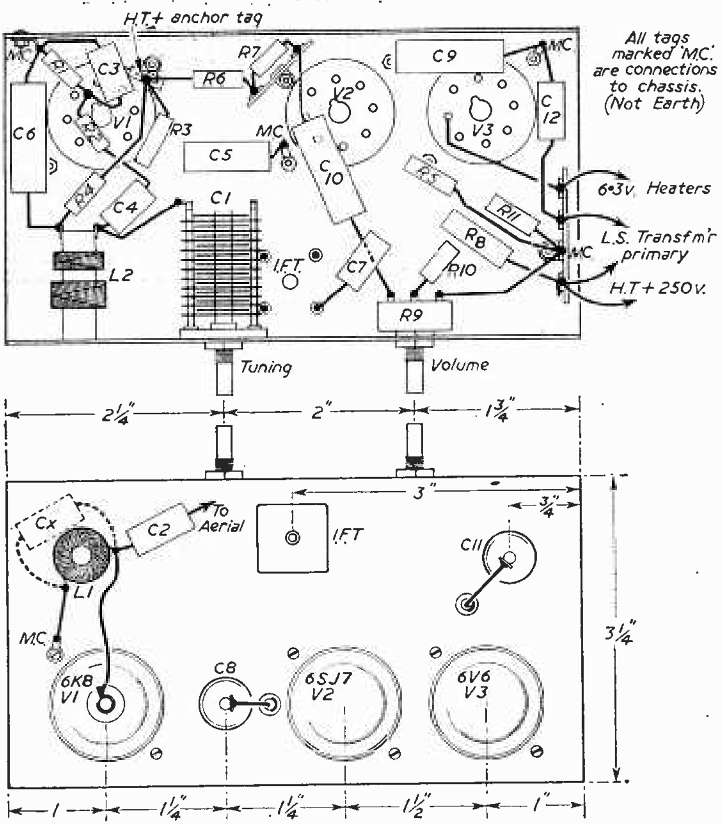
although this will prove difficult if a midget type transformer is used. Both of these methods further increase the selectivity.

However, the simplest method is another compromise. The R.F. coil is tuned to some optimum point by a small preset trimming condenser. For instance, a 50 pF trimmer tuned in 208 metres and gave greatly increased gain on 194 m., 247 m. and 261 m., that is, Third, Light and Home programmes, in the area in which the receiver was tested—North Shields.

Power Supply

The power pack consisted of a 6-volt filament transformer and 0Z4 cold cathode rectifier, both anodes strapped for half-wave rectification, two 500 ohm 2 W resistors and three high capacity electrolytic condensers. The inclusion of more than the usual capacity made the 50 c/s mains hum practically inaudible.

If, as in this case, the mains is connected to chassis, remember that the earth, if used, and aerial must be connected via suitable isolating condensers, say 0.005 μF.



Figs. 2 and 3.—Top and botton chassis details.

COMPONENT LIST

CONDENSERS

- C1—300 pF variable.
- C2—0.005 μF
- C3—0.01 μF
- C4—50 pF
- C5—0.1 μF
- C6—0.1 μF
- C7—300 pF
- C8—0.5 μF
- C9—0.5 μF
- C10—0.1 μF
- C11—25 μF 25 v.
- C12—500 pF
- C13 } 16+32 μF
- C14 } Electrolytic
- C15 { 16+32 μF (in parallel)
- C16—0.01 μF

RESISTANCES

- R1—330 Ω, ¼ W.
- R2—47 K, ¼ W.
- R3—22 K, ¾ W.
- R4—33K, ¾ W.
- R5—1 Meg, ¼ W.
- R6—47 K, ½ W.
- R7—250 K, ½ W.
- R8—100 K, ¾ W.
- R9—½ meg. potentiometer
- R10—33 Ω, ¼ W.
- R11—240 Ω, ½ W.
- R12—500 Ω, 2 W.
- R13—500 Ω, 2 W.

VALVES

- V1—6K8GT V2—6SJ7G
- V3—6V6GT V4—074

COILS

- I.F.T.—465 kc/s midget
- L1—Weymouth HA3
- L2—Weymouth HO3

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Stylus Testing Service

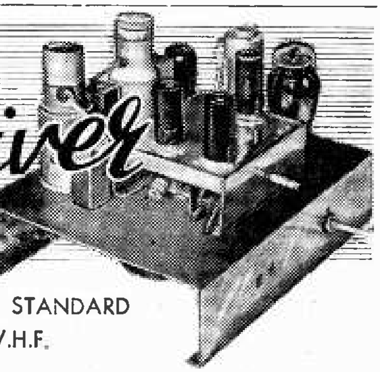
PLANS to set up dealer "needle clinics" where sapphire styli may be regularly inspected and, where necessary, replaced are announced by Philips Elec:r cal Limited.

Many record collectors go to great lengths to preserve their records by correct storage, cleaning, etc. It is often found, however, that insufficient attention is paid to the stylus which, in spite of the extreme lightness of the modern pick-up, is subjected to considerable pressure at the very small surface of the tip actually in contact with the record. Apart from this fair wear and tear, a sapphire needle can easily be damaged by mishandling; this, as well as doing harm to the records, may well cause distortion in reproduction.

To enable dealers to offer an efficient needle inspection service, Philips are now able to supply them with a special needle-testing microscope. This has a rotatable platform with two pick-up holders which permit of an immediate comparison between the stylus under inspection and an unused one.

The needle microscope (Type AG7004) is offered to dealers on a non-profit basis at a price of £6 net.

An 8 Valve A.M./F.M Receiver



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

THE instrument here described has been designed with a close watch on expense, and wherever possible the main components specified are "Government surplus." Sound circuitry has, however, not been sacrificed, and if reasonable care and skill are exercised the finished article will be found capable of high-quality reception of broadcast programmes.

Fig. 1 shows the complete circuit diagram; it will be seen that the receiver comprises four recognisable units apart from the power supplies.

The V.H.F. unit, which is mounted on a separate chassis, consists of an R.F. stage, oscillator and frequency changer. Miniature valves are used; pentodes in the R.F. and F.C. stages and a triode in the oscillator section. The valves are as follows:

Pentodes: CV138 (roughly equivalent to EF91).
Triode: CV858 (roughly equivalent to 6J6).

These are probably still available from at least one dealer in surplus components; early in the year the cost to the writer was 6s. 6d. for the pentodes and 7s. 6d. for the triode.

The I.F. stages use the famous and very cheap CV1065, which is widely advertised at prices as low as 2s. 6d. VR91 (EF50) valves could be used in this section of the receiver, but little is gained thereby, since the CV1065 works very efficiently at the chosen I.F. of about 10.7 Mc/s. The CV1065 also has the advantage of a top-grid cap.

It is not satisfactory to attempt to use CV1065 in the V.H.F. section. The cathode lead inductance and transit time together reduce the input resistance to less than 1,000 ohms and gain suffers severely from the heavy damping imposed on circuits connected to the grid. Close to a transmitter the VR91 (EF50) would probably barely suffice, but cannot be recommended for distances greater than about 20 miles from a station.

The detector is the "ratio-detector" type discriminator. This has several advantages over the Foster-Seeley discriminator, especially in that it requires only a minimum of "limiting," and so saves an I.F. stage. At high signal levels, however, it is not quite so satisfactory, and here the last I.F. valve has been arranged to work as a leaky grid detector—which has its own A.V.C. action—with a reduced screen voltage.

A double-diode valve is used as the rectifier in the discriminator circuit; the writer employs a CV1054 which he had on hand. These valves do not appear to be advertised very much now, and either an EB34 could be used (the direct equivalent) or two EA50 miniature diodes, which can be bought very cheaply in the "surplus" market.

The A.F. section is quite conventional and uses another CV1065, triode connected, as first A.F. amplifier resistance coupled to a 6V6 output stage. A measure of negative feedback is employed to reduce the harmonic distortion to under 1 per cent. If desired the constructor could easily add a phase-splitter and a push-pull output.

Circuit Descriptions

V.H.F. Section.—In the V.H.F. stages the conventional technique for superheterodyne receiver design was found quite satisfactory. The R.F. stage gives only a little gain—7 or 8 approximately—and it is not worth while to tune it, since it is so heavily damped by the aerial that the entire trouble and expense of a three-gang tuning capacitor is unnecessary. The R.F. stage does, however, minimise radiation from the aerial. Such radiation would interfere with other users of the V.H.F. band, and some of these users are

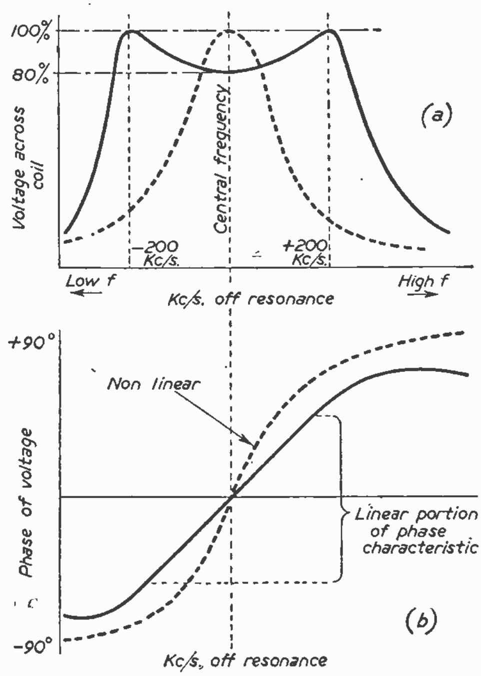
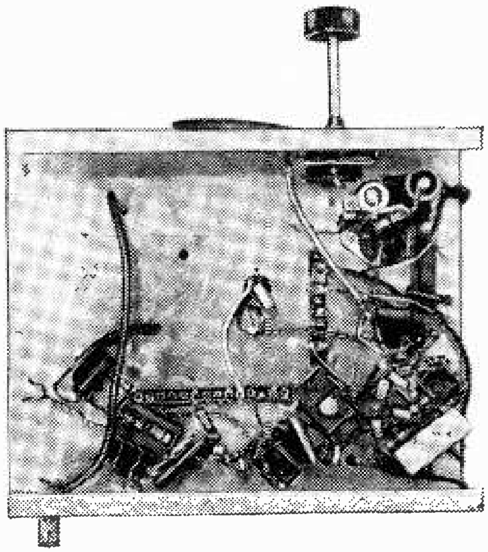


Fig. 2.—I.F. response curve required (a) and resulting phase characteristic (b).

the police, therefore don't try to economise by omitting the R.F. stage! The R.F. grid circuit is tuned flatly to the middle of the band to be covered, and this proves quite satisfactory in practice.

The frequency changer is tuned in the conventional manner with a capacitor of maximum value about 10 pF. The F.C. grid circuit tunes much more sharply, and even though the stage gain is not high by medium-frequency standards the tuning enables the grid circuit to present a much more constant impedance to the oscillator output. "Mixing" is effected in the grid-circuit of the F.C.—an efficient arrangement—and the oscillator frequency passed into the grid circuit is varied by a tuning capacitor ganged with the F.C. grid tuning capacitor. Padding is by a fixed capacitor of 100 pF and trimming by variable trimmer of 5 pF maximum.

The frequency range covered by the receiver is from 85 to 105 Mc/s, and the oscillator works at a frequency higher than the signal. The band includes all the projected FM transmissions of the BBC, and at present police broadcasts also.



Underside view of the receiver.

I.F. Section—The I.F. section utilises conventional tuned transformer coupling between stages. This method is employed to enable the correct shape of I.F. response curve to be obtained, as shown in Fig. 2(a).

It is important to go to a little trouble to obtain the right shape of curve. A single peaked curve, such as is produced by single-tuned circuits without "staggered tuning" gives a non-linear phase characteristic. The dotted curves in Fig. 2(a) and (b) show this. Considerable A.F. distortion can result from an I.F. amplifier with this property. The "ears" of the recommended response curve are arranged to straighten out the middle part of the phase characteristic, and provided the frequency deviation of the carrier is well within this portion the A.F. response is satisfactory. The whole process reminds one of choosing

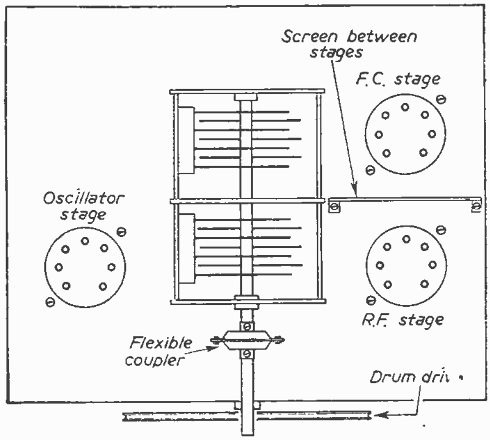


Fig. 3.—Plan of the V.H.F. section.

the linear part of a valve characteristic for the operating range of an amplifier, and the reasons for doing so are related.

The method of alignment will be given later. Although lining up the amplifier is worth quite a little trouble, small errors in the response curve are not very important; what must be avoided is the sharply peaked voltage curve represented dotted in Fig. 2(a). Positive feedback in the I.F. amplifier, even if it does not cause actual instability, will give a peaky curve, and so this trouble must be avoided at all costs.

INDUCTANCE AND TRANSFORMER WI

L1—5 turns 18-gauge enamelled copper wire, tapped 1½ turns from earth end, spaced 0.5in. Former: Aladdin ¼in. diameter with iron-dust core.

L2—3 turns 18-gauge enamelled copper wire, same type former, spaced ¼in.

L3-L4—Anode winding: 2½ turns 18-gauge spaced to ¼in. Same type former. Grid winding: 1½ turns any smaller gauge (say, 28-gauge); wire in this insulated sleeving wound between the turns of the anode winding nearest the H.T. end. Same type former.

I.F. Transformers (2 required).—Primary and secondary: 25 turns 28-gauge enamelled copper wire close-wound. Adjacent ends 7/20in. (0.35in.) apart accurately. Outer ends grid and anode respectively.

Discriminator Transformer.—Primary: 40 turns 34-gauge enamelled wire close-wound.

The Detector

The constructor is probably familiar with the operation of this circuit, but a brief description is given for reference. Referring to Fig. 4, it will be seen that a tertiary winding injects into the secondary a reference current. As primary and secondary are tuned to the carrier mean frequency, in the secondary winding the phase of the current will vary relative to the voltage, depending on whether the tuned circuit is inductive (current leading) or capacitive (current lagging). This current either adds up with or has subtracted from it—depending on the phase—the "reference" current, and hence varies as the instantaneous frequency varies. The rectifiers, with their associated R.C. network, thus enable an "audio" voltage to appear whose frequency depends on the *rate* of frequency deviation and whose magnitude depends on the *amount* of frequency deviation, i.e., the signal is "demodulated."

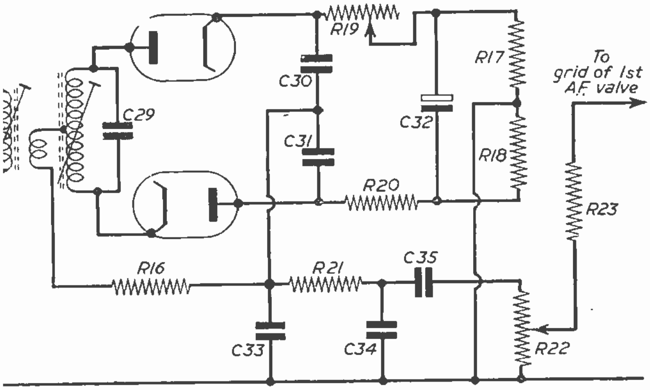


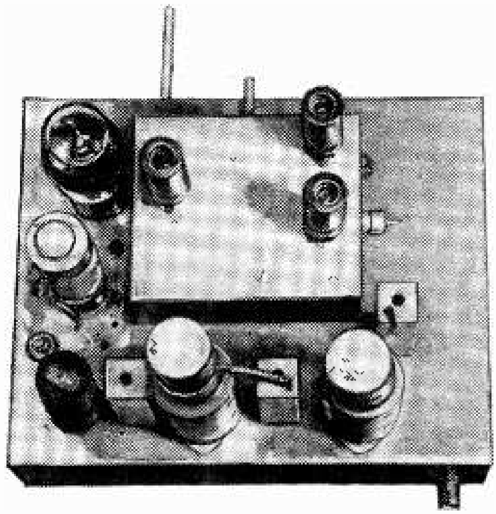
Fig. 4.—Circuit of the F.M. detector stage.

The ratio detector and the previous I.F. stage give rise to I.F. harmonics, which by feeding back into early stages of the receiver can cause much trouble. This difficulty has been completely overcome by decoupling the diode heater supply and by mounting the V.H.F. section of the receiver on a separate chassis. No particular screening has been found necessary.

Constructional Details

The V.H.F. Section—The entire receiver, apart from the power pack, is housed on a chassis of 16 gauge aluminium, measuring 10in. x 8in. x 2½in. The V.H.F. chassis sits on the top. The accompanying illustrations, taken with the dial and drive removed, show the layout.

The V.H.F. chassis is 4½in. x 4in. x 1¾in. deep, and houses the midget tuning capacitors and associated circuitry, together with the oscillator, R.F. and F.C. stages. Fig. 3 shows the layout used in the writer's receiver. The coils, of which details are given later, are wound on miniature Aladdin formers (about ¼in. diameter) with iron-dust cores. They are connected directly, beneath the chassis, to the valve-holder pins, and the resistors and capacitors are also wired by the shortest possible connections between the appropriate points.



Plan view of the receiver.

In wiring up a number of points require attention. The miniature disc-seal valves used are prone to crack if any stress exists in the holders after wiring. For this reason all distortion and tension must be avoided. Indeed, if a really hot and clean iron is used it

(*Continued on page* 761)

FOR THE 8-VALVE AM/FM RECEIVER

Secondary: take enough 34-gauge wire to wind about 50 turns and fold in two. Wind 15 turns of the doubled wire, close-wound (30 turns in all). Cut the end of the wire to leave two identical interleaved windings. For the centre tap connect the *end* of one winding to the *beginning* of the other. See diagram Fig. 5. Ends of primary and secondary 0.2in. apart accurately.

Tertiary.—11 turns 34-gauge enamelled wire, close-wound over "Sellotape" overlay at end of primary remote from the secondary.

Formers for I.F. and Discriminator Transformers.—0.3in. diameter, 2¼in. long, cans 2½in.×0.8in.×0.8in. These, in the writer's receiver, were obtained from a local retailer (new) for 2s. 2d. complete with two cores, but the make is unknown. Any similar component would be satisfactory, provided the former diameter is the same and the can of not smaller dimensions.

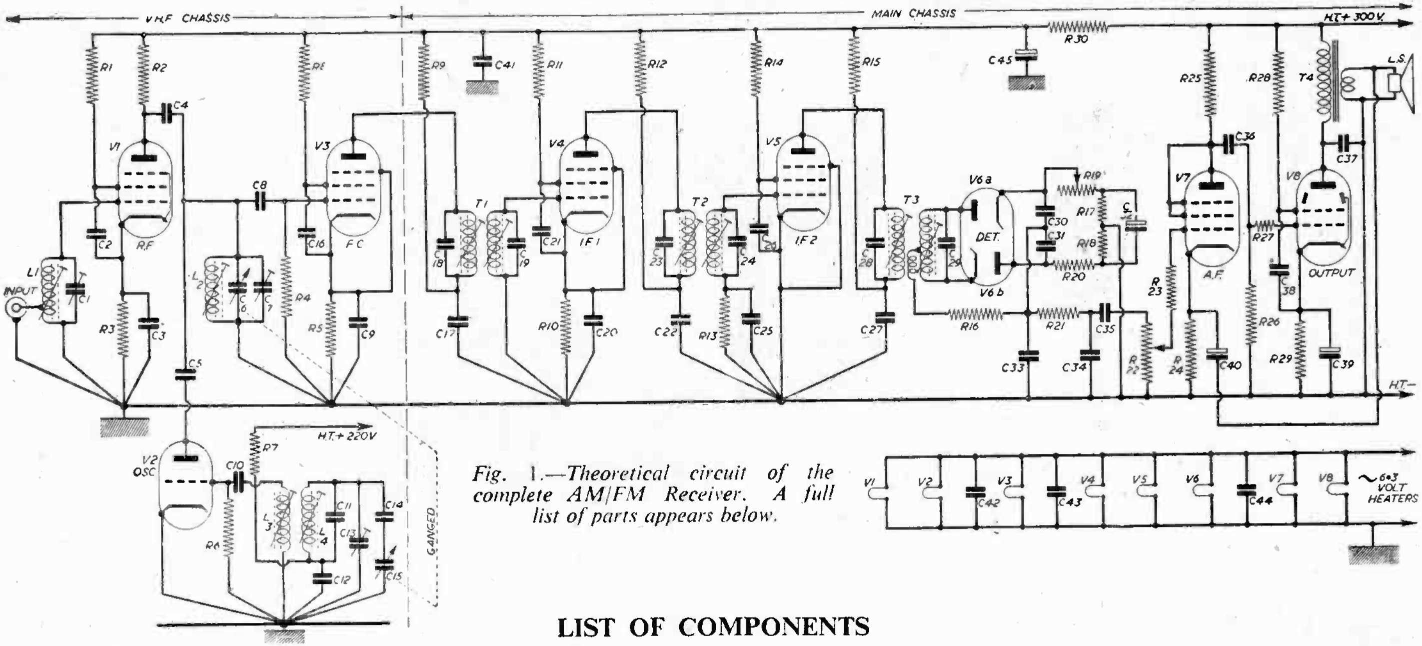


Fig. 1.—Theoretical circuit of the complete AM/FM Receiver. A full list of parts appears below.

LIST OF COMPONENTS

RESISTORS (all ½ watt except where stated).
R1—22 K.
R2—10 K.
R3—220 Ω.
R4—1M Ω.
R5—220 Ω.
R6—33 K.
R7—68 K.
R8—1 K.
R9—1 K.
R10—220 Ω.
R11—1 K.
R12—1 K.
R13—100 K.
R14—100 K.
R15—1 K.
R16—56 Ω.
*R17—6.8 K.
*R18—6.8 K.
R19—2 K var.
R20—1.2 K.
R21—100 K.
R22—1 M Ω var.
R23—47 K.
R24—220 Ω.
R25—68 K.
R26—500 K.
R27—47 K.
R28—22 K, 1 watt.
R29—330 Ω.
R30—Adjust for correct voltages 3 or 4 watt.

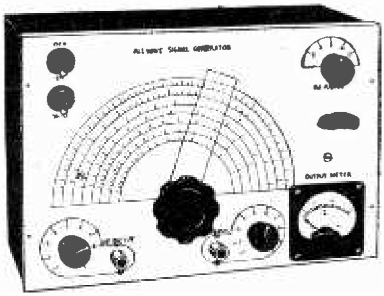
* Actual value less important than close match.

CAPACITORS
C1—4 pF.
C2—220 pF.
C3—220 pF.
C4—100 pF.
C5—1.5 pF.
C6—10 pF var.
C7—5 pF max.
C8—50 pF.
C9—1,500 pF.
C10—25 pF.
†C11—8.2 pF.
C12—220 pF.
C13—5 pF max.
†C14—100 pF.
C15—10 pF var.
C16—1,500 pF.
C17—1,500 pF.
C18—50 pF.
C19—50 pF.
C20—.002 μF.
C21—.002 μF.
C22—.002 μF.
C23—27 pF.
C24—27 pF.
C25—25 pF.
C26—.002 μF.
C27—.002 μF.
C28—12 pF.
C29—27 pF.
C30—220 pF.
C31—220 pF.
C32—8 pF elec. 50 v.
C33—220 pF.
C34—50 pF.
C35—0.1 μF*.
C36—0.1 μF*.
C37—.002 μF*.
C38—4 μF elec.
C39—50 μF elec. 50 v.
C40—8 μF elec.
C41—1,500 pF.
C42—250 pF.
C43—250 pF.
C44—1,500 pF.
C45—8 μF elec.

COILS AND TRANSFORMERS
L1, L2, L3, L4 } See text and table.
T1, T2, T3 }
T4—Good quality output transformer matching 6V6 to loudspeaker used.

VALVES
V1—CV138 (EF91).
V2—CV858 (6J6).
V3—CV138 (EF91).
V4—CV1065 (SP61).
V5—CV1065 (SP61).
V6—CV1054 (EB34).
V7—CV1065 triode connected (SP61).
V8—6V6.

All capacitors ceramic or silver mica C1 to C16, except as stated.
† Erie NPOK.
Capacitors ceramic or mica, C17-C44, except where stated; * C35, C36, C37 can be tubular.



COMPLETELY BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-320 Kc/s, 300 Kc/s-900 Kc/s, 900 Kc/s-2.75 Mc/s, 2.75 Mc/s-8.5 Mc/s, 8 Mc/s-28 Mc/s, 16 Mc/s-56 Mc/s, 24 Mc/s-84 Mc/s. Metal case 10in. x 6½in. x 4½in. Size of scale, 6½in. x 3½in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. output continuously variable 100 milli-volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel. Accuracy plus or minus 2%. **£4/19/6** or **34/-** deposit and 3 monthly payments **25/-**. P. & P. 4/- extra.

Heater Transformer. Pri. 230-250 v. 6 v. 1½ amp., **6/-**.

Three-speed automatic changer, B.S.R. Monarch, current model. Will take 7in., 10in. or 12in. records mixed. Turn-over crystal head, cream finish. VERY LIMITED QUANTITY. A.C. mains 200/250. **£7/15/0.** P. & P. 3/-.

T.V. CONVERTER for the new commercial stations, complete with 2 valves. Frequency can be set to any channel within the 186-196 Mc/s band. I.F. will work into any existing TV. receiver between 42-68 Mc/s. Input arranged for 80 ohm feeder. EF80 as R.F. amplifier, ECC81 as local oscillator and mixer. The gain of the first stage, R.F. amplifier 10DB. Required power supply of 200 D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring freedom from unwanted signals. Simple adjustments only, no instruments required for trimming. Will work into any T.R.F. or Superhet. Incorporating Band switch, and wire-wound gain control. Fully screened in black crackle finished case, size 5½in. long, 3½in. wide, max. overall height 4½in. **£2.19.6.** P. & P. 2/6.
As above with built-in power supply, **£3.19.6.** P. & P. 2/6. A.C. mains 200/250.

Extension Speaker cabinet in polished walnut, complete with 8in. P.M. P. & P. 3/-. **24/6.**

8in. P.M. Speakers, removed from chassis, fully guaranteed. All by famous manufacturers. P. & P. 1/6. **12/6.**

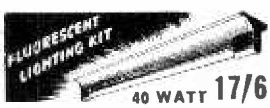
Volume Controls. Long spindle less switch, 50 K., 500 K., 1 meg., 2/6 each. P. & P. 3d. each.

Used A.C. Mains 200/250 volts, 4-valve plus Metal Rectifier, medium wave superhet in polished walnut cabinet, size 14 x 9½ x 7½in., complete with valves 6K8, 6K7, 6Q7 and 6F6. 6½ PM speaker. Fully guaranteed. P. & P. 7/6. **£3/15/-.**

Constructor's Parcel: Medium & Long-Wave A.C. Mains 230/250 2-valve plus Metal Rectifier, 22/6. Comprising chassis 10½ x 4½ x 1½in., 2 waveband scale, tuning condenser, wavechange switch, volume-control, heater trans., metal rectifier, 2 valves and v/holders, smoothing and bias condensers, resistors and small condensers, and medium- and long-wave coil, litz wound. Circuit and point-to-point, **1/3.** Post and packing, 2/6 extra.

Volume Controls. Long spindle and switch, ¼, ½, 1, and 2 meg., 4/- each, 10 K. and 50 K., **3/6** each. ½ & 1 meg., long spindle, double pole switch, miniature, **5/-.**

Standard Wave-change Switches. 4-pole 3-way, **1/9**; 5-pole 3-way, **1/9.** Miniature 3-pole 4-way, 4-pole 3-way, **2/6.** 2-pole 11-way twin wafer, **5/-.** 1-pole 12-way single wafer, **4/-.**



A.C. Mains 230-240. Comprising choke, power-factor condenser, 2 tube holders, starter and starter-holder. P. & P. 3/-. 17/6.

20 watt A.C. or D.C. 200/250 v. fluorescent kit, comprising trough in white-stoved enamel, two tubeholders, starter, holder and barreter. P. & P., 1/6. **12/6.**

1,200ft. High impedance recording tape on aluminium spool **12/6** post paid.

Polishing attachment for electric drills. Quarter-inch spindle, chromium-plated, 5in. brush, 3 polishing cloths and one sheep-skin mop, mounted on a 3in. rubber cup. P. & P., 1/6. **12/6.** Spare sheep-skin mops, **2/6** each.

R. & T.V. COMPONENTS (ACTON) LTD.

23, HIGH STREET, ACTON, LONDON, W.3

SPECIAL OFFER — VERY LIMITED QUANTITY
7 valve push-pull A.C. Mains 200/250 v.

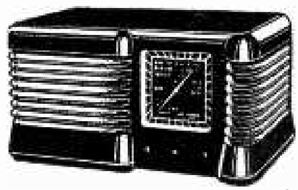
RADIOGRAM CHASSIS

3 wave band, coverage short wave 16-50 m., medium wave 187-550 m., long wave 900-2,000 m., 4 controls, volume control on-off, tone control, tuning and wave change with gram position. Valve line up X79, W727, two DH77's, two EL41's and EZ30. Output 7 watts. Size of chassis 16in. x 7in. x 2½in. Size of scale 12in. x 4in. Overall height including back plate 7½in. BRAND NEW. Fully guaranteed. P. & P. 7/6. **£9.19.6**

PERMEABILITY TUNED T.V. CONVERTER

for new commercial stations

Input 300 ohm balanced line or 80 ohm coax. Coverage 180-200 Mc/s. Vision I.F.:—10.7 Mc/s. Valve line-up 6AK5 R.F. amplifier, 6AK5 mixer, 6C4 separate oscillator. This is a high gain unit, ideal for fringe areas. Can also be used as **FM. TUNER.** Frequency coverage 80-100 Mc/s. I.F. 10.7 Mc/s. Size 9in. wide, 6½in. deep, 4in. high, 9in. scale, width including overlap 14in. Complete with 3 valves. P. & P. 3/-. **£4/9/6.**
10.7 Mc/s I.F.'s to suit above, **4/6** each.



Complete A.C. Mains 3 Valve plus metal rectifier T.R.F. kit. In the above cabinet, **£3 15/0,** plus 3/6 P. & P.

PLASTIC CABINET as illustrated, 11½ x 6½ x 5½in., in walnut or cream. ALSO IN POLISHED WALNUT, complete, with T.R.F. chassis, 2 waveband scale, station names, new waveband, back-plate, drum, pointer, spring, drive spindle, 3 knobs and back, **22/6.** P. & P. 3/6.

As above with Superhet Chassis, **23/6.** P. & P., 3/6.

As above complete with new 5in. speaker to fit and O.P. trans., **40/-.** P. & P. 3/6. With Superhet Chassis. P. & P. 3/6. **41/-.**

Used Metal Rectifier. 230 v. 50 mA., **3/6**; gang with trimmers, **6/6**; M. & L. T.R.F. coils, **5/-**; 3 Govt. valves, 3 v/h and circuit, **4/6**; heater trans., **6/-**; volume control with switch, **3/6**; wave-change switch, **2/-**; 32 x 32 mfd., **4/-**; bias condenser, **1/-**; resistor kit, **2/-**; condenser kit, **4/-.**

P.M. SPEAKERS. 6½in., closed field, **18/6.** 8in. closed field, **20/6.** 10in. closed field, **25/-.** 3½in., **16/6.** P. & P. on each, 2/-.

Valveholders. Paxolin octal, **4d.** Moulded octal, **7d.** EF50, **7d.** Moulded B7G, **7d.** Loctal amphenol, **7d.** Loctal pax., **7d.** 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, **6/6.**

32 mfd., 350 wkg.	2/-	16 + 16 mfd., 350 wkg. ...	3/3
16 x 24 350 wkg.	4/-	60 + 100 mfd., 280 v. wkg.	7/-
4 mfd., 200 wkg. ...	1/3	50 mfd., 180 wkg.	1/9
40 mfd., 450 wkg.	3/6	65 mfd., 220 wkg.	1/6
16 x 8 mfd., 500 wkg. ...	4/6	8 mfd., 150 wkg.	1/6
16 x 16 mfd., 500 wkg. ...	5/9	50 mfd., 12 wkg.	11d.
16 x 16 mfd., 450 wkg. ...	3/9	50 mfd., 50 wkg.	1/9
32 x 32 mfd., 350 wkg. ...	4/-	Miniature wire ends moulded 100 pf., 500 pf., and .001 ea.	7d.
25 mfd., 25 wkg.	11d.	280-0-280 80 mA., 4 v. 4 a., 4 v. 2 a.	14/6
250 mfd., 12 v. wkg. ...	1/-	250 v. 350 mA., 6.3 v. 4 a. twice, 2 v. 2 a.	19/6
16 mfd., 500 wkg., wire ends...	3/3	Auto-trans., input 200 250 HT 500 v. 250 mA. 6 v. 4 a. twice 2 v. 2 a. ...	19/6
8 mfd., 500 v. wkg., wire ends...	2/6		
8 mfd., 350 v. wkg., tag ends...	1/6		
100 mfd., 350 wkg. ...	4/-		

Potato & Vegetable Peeler, by famous manufacturer, capacity 4½lbs., complete with water pump. All aluminium construction, white stove-enamel finish. Originally intended for adaption on an electric food-mixer, can easily be converted for hand operation. **39/6.** P. & P., 3/-.

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.

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		5Z4g	8/9	6F15	12/6	6V6G/GT	7/6	10P14	11/6	25Z5	9/-	EZ40	10/-	PCF82	12/6	VR65	3/6
		6A7	10/6	6G6G	6/-	6X4	8/-	12A6	6/9	25Z6GT	8/6	EZ41	11/-	PL81	13/6	VR65A	3/3
		6A8G/GT	10/6	6H6	3/6	6X5G/GT	7/9	12AH7	6/9	35L6GT	9/-	EZ80	10/-	PL82	11/6	VR66	3/9
		6AC7	6/6	6J5G/GT	5/-	7B6	10/-	12AT7	9/-	35W4	10/-	E1148	2/-	PL83	13/-	VR91	5/6
0Z4	6/-	6AG5	6/6	6J5M	6/6	7B7	9/-	12AU7	9/6	35Z4GT	9/-	FW4/500		PP225	5/-	VR91SYL	8/-
1A3	9/-	6AK5	6/6	6J6	7/6	7C5	8/6	12AX7	10/-	5016GT	9/-		10/-	PY80	10/-	VR92	2/-
1A5GT	6/6	6AL5	7/-	6J7G	6/6	7C6	8/6	12BE6	10/-	AC/P	6/9	GZ32	12/6	PY81	11/6	VR105/30	7/-
		6AM5	5/-	6K6GT	6/6	7H7	8/-	12C8	8/-	AC6/PEN	5/6	H30	5/-	PY82	10/6	VR105/20	9/-
1A7	11/6	6AM6	7/6	6K7G/GT	5/9	7Q7	8/-	12H6	5/-	ATP4	6/6	HL2	5/6	QP21	7/6	VR116	4/-
1C5GT	8/-	6AQ5	8/6	6K7	6/9	7R7	8/6	12J5	6/-	DH73M	10/-	HL23DD	7/6	SP22	6/-	VR119	4/-
1L4	6/6	6AT6	8/-	6K8G	8/6	7S7	9/-	12J7	9/6	EAF42	12/6	HP211C	6/9	SP220	6/9	VR123	6/6
1LD5	6/9	6B4	5/-	6K8GT	9/6	7Y4	8/6	12K7	9/6	EB41	8/-	KL35	8/6	U10	9/-	VR136	7/-
1N5	10/-	6B8G	4/-	6L1	12/6	75	10/6	12K8	11/-	EBC41	11/-	KT2	5/-	U22	8/-	VR137	5/6
1R5	7/6	6BA6	8/6	6L6G	9/-	77	8/-	12Q7	9/-	EBF80	11/6	KT33C	10/6	U25	13/6	VR150/30	9/-
1S5	7/6	6BE6	8/-	6L7M	7/6	80	8/6	12SC7	7/6	ECC31	10/-	KT66	10/6	U229	13/6	VP23	8/-
		6BR7	9/6	6N7	7/-	807	7/6	12SG7	7/6	ECH35	13/6	KT74	8/-	U403	10/-	VS70	3/-
1T4	7/6	6BW6	8/6	6Q7G/GT	9/-	8D2	2/9	12SH7	5/6	ECH42	10/6	KTW61	7/9	U404	9/-	VT52	8/-
1U5	8/-	6C4	7/-	6SA7GT	8/-	9D2	3/9	12SJ7	8/6	ECL80	11/6	KTW63	8/6	UU6	10/-	VT501	6/-
2X2	4/-	6C5GT	7/8	6SG7	7/6	9001	5/6	12SK7	6/6	EF22	8/6	KTZ41	6/-	UB41	8/-	VU39	8/9
3A4	7/-	6C6	6/6	6SH7	6/-	9003	5/6	12SQ7	8/6	EF41	10/-	LP220	6/9	UBC41	11/-	VU64	8/6
3Q4	9/6	6C9	8/-	6SJ7GT	8/-	9004	5/6	12SR7	7/6	EF42	12/6	MH4	5/6	UCH42	11/-	VU111	3/6
3Q5	10/-	6CD6G	13/6	6SK7	6/3	9006	6/-	12SX7	12/6	EF80	11/6	MS/PEN	5/-	UF41	11/-	VU120A	3/-
3S4	8/6	6D3	7/3	6SL7	8/-	954	2/-	20D1	10/6	EL2	12/6	N709	12/-	UL41	11/6	W61	8/-
3V4	8/6	6D6	7/3	6SN7	8/-	955	4/9	20F2	12/6	EL35	7/6	P215	5/-	UY41	10/6	W77	8/6
		6F1	12/6	6SQ7	9/-	956	3/6	20P1	15/-	EL41	11/6	PEN25	8/-	VR21	3/-	X65	10/-
4D1	3/-	6F6G	7/6	6SS7	8/-	10C1	12/6	20L1	12/6	EL84	12/-	PEN46	8/6	VR53	6/6		
42	8/-	6F6M	8/6	6U4GT	15/-	10C2	12/3	25L6GT	8/6	EM34	11/6	PEN220A		VR54	2/-	X66	11/6
5U4G	8/6	6F11	13/-	6U5G	8/6	10F1	10/-	25U4GT	9/6	EM80	11/-		4/-	VR55	7/6	Y63	9/-
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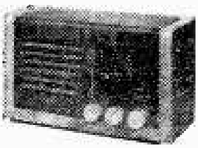

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Unit contains VCR517 Cathode Ray 6in. tube, complete with Mu-Metal screen, 3 EF50, 4 SP61, and 1 5U4G valves, 9 wire-wound volume controls and quantity of resistors and condensers. Suitable either for basis of television (full picture guaranteed) or Oscilloscope. Offered BRAND NEW (less relay) at 67/6. Plus 7/6 carr. "Radio - Constructor" 'scope circuit included.

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may well be a good idea to wire up with valves already in position. For those who doubt the wisdom of this it is possible to obtain a jig to plug in while soldering goes on, but in the absence of this the greatest care must be taken. If, when wiring is complete, there is any need to use undue force to seat a valve, careful inspection and adjustment of the components will need to be undertaken until a nice smooth push-fit is obtained. If the valveholder sockets are too tight use a piece of 18-gauge bare wire to wriggle them apart a little. Carelessness in seating the miniature valves is certain to result in one or more breakages in use, and as these are the most expensive valves used in the receiver the moral is obvious.

The writer was at first puzzled about instability occurring in the R.F. amplifier; the R.F.-F.C. circuit oscillated at about 17 Mc/s. This was traced to the

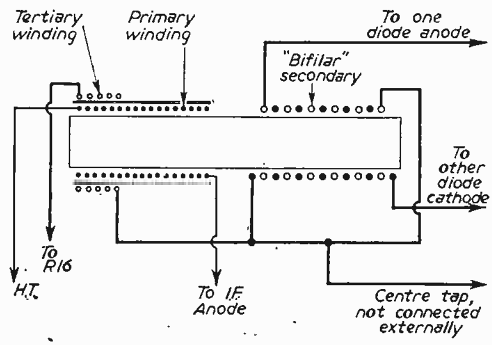


Fig. 5.—Details of the discriminator transformer. Wiring details are on page 756.

fact that decoupling capacitors had been returned to the earth tag for the stage, and when they were reconnected to the cathode pin of the valve the instability disappeared.

It is very important that mica or ceramic capacitors of the correct value are used in the V.H.F. circuits, as well as in the I.F. amplifier. Tubular capacitors, even of about the right value, are quite useless because of their high self inductance; it makes no difference if they are labelled "non inductive"—they always are at these frequencies. Wire-wound resistors are also anathema in all but the A.F. section for precisely the same reason—and so are the carbon resistors with a spiral element.

The iron-dust cores are not intended to contribute much to the inductance of the associated coil. They are for trimming purposes only, and best results are obtained with only just enough "iron" in the circuit to correct for inaccuracies in spacing turns.

The connection to the first I.F. transformer—which is mounted on the main chassis—from the F.C. anode is by means of a piece of coaxial cable. Ordinary screened lead would do well in this position, with twin flex inside it for the H.T. return, but the writer found it elegant to use the braiding to conduct the H.T. and the coaxial cable has an outer plastic sleeve which facilitates this.

The coils for the V.H.F. section are so arranged that the cores are accessible from the sides of the chassis. Trimming capacitors are similarly situated. All trimming can then be done with the V.H.F. chassis bolted to the main chassis, provided care is exercised in placing the main-chassis valves to enable a trimming tool to pass comfortably between. The best trimming tool for V.H.F. and H.F. work is undoubtedly a strip of ¼in. Perspex filed to a screwdriver point, and of adequate length (say, 10in.), for hand-capacity effects can be a bother with too short a trimmer screwdriver.

Erie ceramic capacitors are used preferably throughout the V.H.F. section, because they combine excellent electrical characteristics with small size; both are very important. Resistors can all be of ¼ watt rating in this section of the set. It is important to use the specified capacitor in positions C11 and C14, otherwise oscillator frequency drift will occur over a lengthy period even after 10 minutes' warm up.

The I.F. Amplifier—This amplifier is quite straightforward to construct; provided that mica or ceramic capacitors are used, together with non-inductive resistors and a common earthing point for each stage, no instability troubles are likely to arise. Inter-stage screening below the chassis was not found to be necessary with CV1065 valves, as these have a top grid cap which effectively isolates the grid circuit from the anode circuit. Shortest route wiring is very necessary. It was found advisable to enclose the valves in screening cans, in spite of their metallised envelope, to cover up the grid connections, but a simple top-cap screen might well be found all that could be desired.

The I.F. chosen, 10.7 Mc/s, is one which offers good amplification with stability, but the constructor may find it advisable to vary the actual I.F. by a few kc/s either way to dodge a powerful short-wave transmitter. Break-through has been found negligible in the writer's set, though the amount of morse that is heard when a finger is brought to the first I.F. grid cap shows that with less careful screening trouble might have been experienced.

The Detector Circuit (*Fig.* 4)—Though the construction of this circuit is conventional, and has to be carefully carried out, no especial difficulties are likely to be experienced. Certain of the components are somewhat critical in value; for example, C29 should not be replaced by a "near value" and the resistors R17 and R18 should be matched from the constructor's stock to close equality.

(*To be continued*)

Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

MOST of us turn to "Sports Report" on Saturday afternoons in the fond hope that the kindly reader of the football results will give us news rendering it unnecessary for us to "put any water with it" again for the rest of our natural lives. Hitherto this has been a terse and compact little programme of half-an-hour's duration based on the results followed by four or five lively and succinct match reports, concluding with an interview or two with well-known figures in the sporting world. The whole most ably conducted by Eammon Andrews.

Now its length has been doubled. Lasting from five until six it has, inevitably, lost its cohesion and has become rambling and repetitive. The match results are given us as they come through. Thus, already having had them all by five-thirty, they are then read out again complete, as hitherto. As they are gone through for yet a third time in the Home Service at 6.15, the BBC's genius for repetitiveness is given full rein. The train announcers at Waterloo are nothing by comparison.

I wonder if Lord Reith, when at Broadcasting House, ever got known as "repetitive Reith"—not that he would have had much to do with it!

"The Investigator"

Although "McCarthyism" is something of a back number these days, the Canadian Broadcasting Co.'s "satirical extravaganza" on the subject, "The Investigator," made good entertainment and served a useful purpose. Written by Reuben Ship, the title role was brilliantly played by the Canadian radio star, John Brainie. It was first produced in Canada in May, 1954.

"Topic for To-night"

Now returned from its vacation this is a good feature when original. But sometimes, especially when dealing with industrial, parliamentary and diplomatic matter, it is a mere repetition of what we have already heard earlier in the evening in "Radio News Reel."

Plays

"The Woodlanders," Thomas Hardy's beautiful novel of the Wessex countryside, is being serialised excellently on Sunday evenings. All the famous characters are there to the life. Renee Asherson as Grace, Andrew Foulds as Fitzpiers, Beatrice Bevan as Marty, June Barry as Suke, Tony Britton as Giles Winterbourne, Pauline Letts as Mrs. Charmond, as well as many others. Done from the West of England studio, the adapter, Desmond Hawkins, and the producer, Owen Reed, have put much sympathy and understanding into their work. Few novels stand up to serialisation better than Hardy's, as "The Mayor of Casterbridge" showed.

"Mycenae's Second Glory," written and produced by Leonard Cottrell, told of excavations there, up to 70 years ago, which led to the confirmation and settlement of hitherto disputed points in classical literature. Even a layman in the subject like myself had his interest aroused.

"Fair Passenger," by Aimée Stuart, and adapted by Joan Brampton, made a welcome and entertaining contribution to that heterogeneous collection of plays, novels, stories, scenarios, scripts and what have you, embraced in the wide-encircling arms known as "Saturday Night Theatre." Meggie and Erica are talked to by film producer Frank Clayton as few women would put up with in real life. Pauline Jameson, Edward Chapman, Jane Barrett, Lydia Sherwood and Alan McClelland provided the comedy.

An excellent series of plays and adaptations is in progress on Mondays and Saturdays. Great drama returned to the air for the inauguration, in the form of "Heartbreak House." If there were one or two stumbles here and there, the company gave an excellent performance. Monica Grey as Ellie Dunn, Marjorie Mars as Lady Utterword, Barbara Couper as Hesione Hushabye all twisted and wheedled the men round their little fingers just as Shaw intended them to.

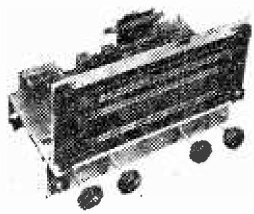
"The Course of Law"

This is a series of programmes specially designed to help the many followers of murder trials in the processes of the law therewith concerned, from the accused's first appearance on a charge of murder to, we presume, the donning of the black cap in the Central Criminal Court, followed by every known kind of appeal. It is an excellent idea and, at the time of writing, has been absorbingly interesting. Compiled by Henry Cecil, narrated by Norman Shelley and acted by Janet Bruce, Mary O'Farrell, Wilfred Babbage, Hamilton Byce, Wm. Fox, Chas. Lamb, Chas. Stidwell and Geoffrey Wincott. Producer, Eileen Molony.

Wilfred Pickles

If the BBC were to close down to-morrow and, like Macaulay's New Zealander surveying the ruins of London from London Bridge, quit the contemporary scene and become part of history, Wilfred Pickles would be one of the few remembered names of the hundreds who have entertained us through the microphone.

He was suitably and properly honoured in the form of a very pleasant programme celebrating his and Mabel's silver wedding. Many of Broadcasting House's and the entertainment world's VIPs combined for an hour to pay tribute to a very lovable character and a very wise and witty guy.



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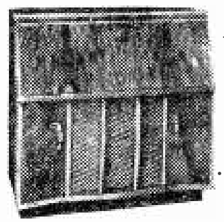

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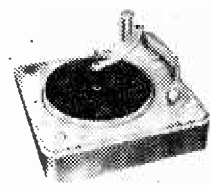

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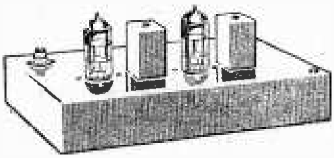

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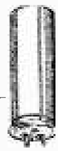

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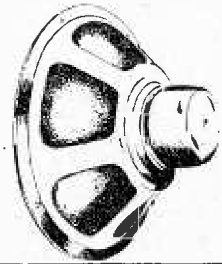

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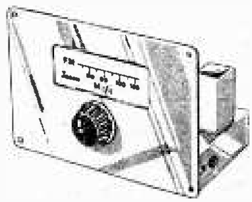

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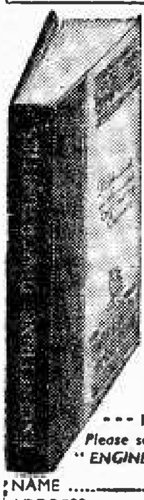

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The main controls are "wavechange," "tuning," "tone" and "on/off-auto"; the "volume" and "auto timeset" are in the form of thumb controls situated in the centre of the control panel.

The Clock Circuit

From the complete circuit at Fig. 1 it may be seen that the A.C. input passes to the primary of the mains transformer T2 via the "on/off-auto" switch S2. In the "off" position the switch is open, in the "on" position the switch is closed and the input goes direct to the transformer, and in the "auto" position the mains input circuit is either closed or open, depending on the setting of the clock switch S3.

This switch is controlled by the timing mechanism in the clock; it closes, and thus switches on the receiver, at the time selected by the "auto timeset" control, and without further attention will also automatically switch off the receiver after approximately two hours.

As the clock movement is connected directly to the mains supply, it continues working even when S2 is set at the "off" position.

Circuit Description

The aerial signal is fed across an I.F. filter circuit comprising T1 and L1. From here it is taken to the primary winding of the long, medium or short-wave aerial coil as selected by switch S1A, and then on to the signal grid of the hexode section of the frequency changer valve V1, via the secondary winding of the aerial coil as selected by S1B.

The triode section of V1 operates as an oscillator, the associated inductively coupled oscillator coils being selected by switches S1C and S1D—switch S1 is, of course, a ganged Yaxley wafer type.

An intermediate frequency of 465 kc/s is developed in the first I.F. transformer (I.F.T.1) and is passed on for amplification to the signal grid (grid 1) of V2, which is a variable-mu R.F. pentode.

The amplified signal is developed in the second I.F. transformer (I.F.T.2) and is taken to the signal diode in the double-diode-triode valve V3 for demodulation. The demodulated A.F. signal develops across the volume-control R1, and is fed via the coupling capacitor C7 to the grid of V3 for amplification at A.F. R2, C5 and C6 are the components used for I.F. filtering. Pick-up terminals brought out to the rear of the chassis permit the application of a pick-up signal across R1. The volume-control thus permits adjustment of the pick-up signal, but when using this facility it is necessary either to remove the aerial or tune the receiver to a quiet part of the broadcast band.

The A.F. signal amplified by the triode section of V3 develops across R4, and is passed via the A.F. coupling capacitor C7 to the control grid of the output valve V4. The output stage is quite conventional as will be seen: capacitor C8 and the variable resistor R3 constitutes a "top-cut" type tone-control circuit. A facility is provided for using an extension loudspeaker, the internal loudspeaker being disconnected by removing a plug from a socket at the rear of the cabinet.

Automatic Volume-control

It will be noticed that the signal diode is strapped direct to the A.V.C. diode in V3. A separate diode is thus not used for A.V.C. on this receiver, but the negative voltage appearing at the junction of R2 and C5 in the I.F. filter circuit rises and falls with signal level. This voltage is, therefore, quite suitable for varying automatically the gain of the first two valves. It is fed back through R5 and decoupled by C9; it will be observed that only the fixed bias, developed across R6 in the cathode circuit of V1, is applied to the frequency changer on short-waves.

The Power Supply

H.T. power is supplied by the full-wave rectifier valve V5, and the lower secondary winding on T2

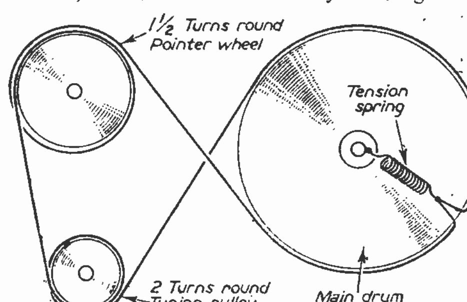


Fig. 3.—Drive cord details.

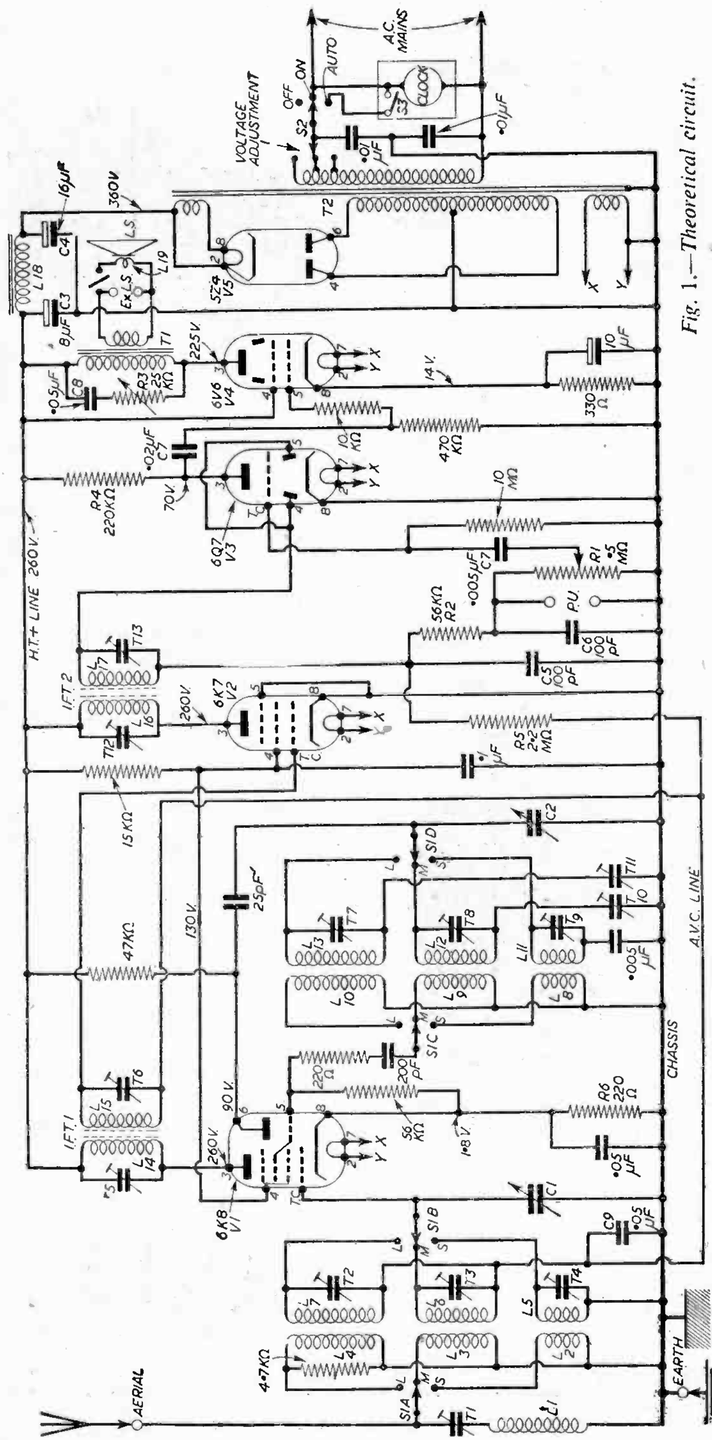


Fig. 1.—Theoretical circuit.

supplies the valves V1 to V4 with L.T.—V5, of course, has its own L.T. winding. Power for the pilot bulbs is also taken from across the lower L.T. winding on T2.

H.T. smoothing is performed in part by the loudspeaker field winding L18 and part by the two electrolytic capacitors C3 and C4, these being in single unit form.

Mechanical Arrangements

Removal of the chassis from the cabinet of this receiver is quite a simple matter. It involves simply removal of the back of the cabinet, removal of the loudspeaker chassis and baffle which is effected by extracting the small screw positioned at the centre edge of the baffle board and extracting the chassis fixing screws located beneath the cabinet.

In order to remove the clock it is necessary first to disconnect the associated leads from beneath the receiver chassis, unscrew the handset knob and shaft from the rear of the clock by depressing and turning against the arrow marked on the knob, unclip the pilot bulb holder, and finally removing the clock unit complete by removing the nuts and bolts which secure the mounting plate to the chassis and releasing the back support bracket by extracting the screw situated at the back of the clock.

The Dial Drive

A diagram illustrating the cord-drive arrangement is depicted at Fig. 3. If it becomes necessary to replace this flax-braided cord, No. 40 or equivalent nylon drive cord only should be used. Before the cord can be replaced, however, it is necessary to remove the tuning pointer and scale mounting plate.

On re-assembling, the tuning gang C1, C2 should be adjusted to maximum capacitance and the pointer replaced to coincide with the scale limiting marks at the low-frequency end of the scales. It is quite normal for the pointer to overrun the scale by approximately ⅛in. when the gang is turned to minimum capacitance.

Alignment Procedure

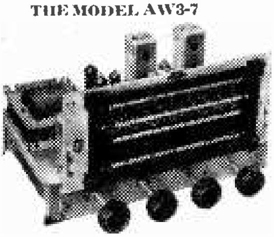
For accurate alignment a closely calibrated modulated

(Continued on page 769)

TWO REALLY EXCELLENT BARGAINS

A LARGE BULK PURCHASE ENABLES US TO OFFER THESE TWO MODELS AT THE GENUINELY REDUCED PRICE OF

THE MODEL AW3-7



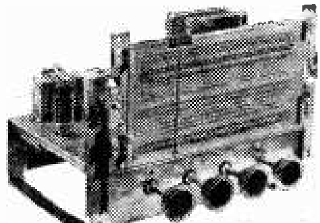
£12/19/6 EACH

(plus 7/6 carr. & ins.)

H.P. TERMS: DEPOSIT £4/6/6 PLUS 10 MONTHLY PAYMENTS OF 19/4

BOTH CHASSIS ARE BY A WELL RESPECTED SET MANUFACTURER AND NEITHER WERE MADE TO SELL AT THE LOW PRICE AT WHICH WE NOW OFFER THEM

THE MODEL B3PP



THE AW3-7. A 7 Valve 3 Waveband design having a "Push Pull" Stage to provide approx. 7 Watts Output.

GENERAL DETAILS

- Incorporates the latest Osram Valve Line up of X79-W77-DH77-H77-U78 and two type N78's in Push Pull.
- Provides coverage of 3 Wavebands: Short waves 18-50 metres. Medium 190-550 and Long Waveband 800-2,000 Metres.
- Has four Controls: (1) Volume with On/Off switch. (2) Tone Control, operative on Gram and Radio. (3) Wavechange Switch with Gram positions. (4) Tuning Control.
- Extension Speaker and Pick-up connections are provided on rear of Chassis.
- Overall size of Chassis is 12" x 7" x 8" high.
- Has an attractive three-colour illuminated Dial, size 11½" x 4½".
- A Bronze Dial Escutcheon is available for 4/6.
- Operates on A.C. Mains 200 to 250 Volts. 50 Cycles.

THE B3PP. A 6 Valve 3 Waveband design with a "Push Pull" Stage for approx. 6 Watts Output.

GENERAL DETAILS

- Employs the latest Valves 6BE6, 6BA6, 6AT6, two B3W6s in push-pull and 6X4 (or similar) Rectifier.
- It has a Mains socket on the Chassis for connection to Gram Unit.
- Incorporates extension speaker and Pick-up sockets.
- Overall size of Chassis is 11in. x 7¼in., 8½in. high. Dial size. 8¼in. x 4½in. (A bronze-coloured Dial Escutcheon is available for 4/6.)
- Waveband coverage is Short wave 16 to 50 metres. Medium 187 to 550 and Long wave 900 to 2,000 metres.
- Has four controls: (1) Volume Control with on-off switch. (2) Tone Control (operative on Gram and Radio). (3) Wavechange Switch with Gram position. (4) Tuning Control (Flywheel type drive).
- Negative Feedback is employed over the entire audio stages.

These two Models have undoubtedly proved to be about the most popular and successful "replacement" Chassis yet offered. They were originally priced at £15/15/- each and are designed to the most modern specification with great attention having been given to the quality of reproduction, resulting in excellent clarity of speech and music on both Radio and Gram.

THEY MAKE AN IDEAL REPLACEMENT CHASSIS FOR THAT "OLD RADIOGRAM," ETC. ALL ARE BRAND NEW and FULLY GUARANTEED (BVA Valves, 90 days).

THE "W.B." PRE-FABRICATED CONSOLE CABINET

!! HOME CONSTRUCTORS !!

YOU CAN BUILD A GENUINE HIGH QUALITY RADIOGRAM for only

£33/10/-

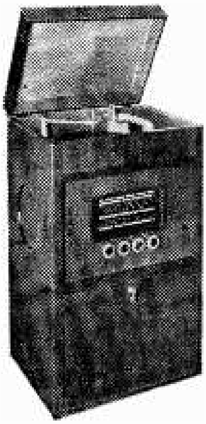
For this amount we will supply:

- THE MODEL B3PP or the Model AW3-7 RADIOGRAM CHASSIS (Illustrated and described above).
- THE B.S.R. "MONARCH" 3 SPEED AUTO CHANGER (illustrated and described here).
- A MATCHED 10in. P.M. SPEAKER.
- THE "W.B." PRE-FABRICATED CABINET.

Carriage and Insurance on all above equipment is 15/- extra and H.P. TERMS ARE DEPOSIT £11/3/4 (plus 15/- carr. & ins.) and 12 monthly payments of £2/0/11.

The illustration shows the Cabinet containing the B3PP Chassis and B.S.R. Changer and for Radiogram Constructors we supply it in its PRE-FABRICATED form but we cut the side panels for the Speakers and we CUT THE FRONT PANEL to accept either Models B3PP or AW3-7 Receiver Chassis—we also supply a template to enable the Constructor to easily fit the B.S.R. Changer on to the Gram Baseboard.

THIS IS AN OUTSTANDING OFFER AND A COMMERCIALLY MADE RADIOGRAM OF SIMILAR HIGH QUALITY WOULD COST ABOUT £65/-/-.



THE CABINET ONLY is ideally suitable for "Hi Fi" equipment where a separate Speaker is used, but also equally suitable for a RADIOGRAM or as a TAPE RECORDER CABINET.

PRICE £12/12/- (plus 7/6 carr. & ins.)

H.P. TERMS. DEPOSIT £3/3/- and 12 monthly payments of 17/6.

These Cabinets are all finished in highly polished Walnut veneer, and are supplied packed flat, complete with screws. Easily assembled in a few minutes, the only tool required being a screwdriver. "Hi Fi" enthusiasts will find it ideal for the accommodation of a high quality Amplifier, together with a Tuning Unit and any type or make of Record Player (excluding Connoisseur).

The attractive high polished finish gives the Cabinet a very pleasing appearance and it has:

(a) Hinged Lid under which is uncut polished board for mounting the Record Player.

(b) Uncut Front Panel—Into which the Tuning Unit Dial and Amplifier Control Panel can be mounted or similarly any Radio Receiver.

(c) Sectionalised Record Storage space is provided at the base of the Cabinet.

(d) Overall size of Cabinet, 19½in. wide x 15in. deep x 35in. high.

WE ARE NOW PRINTING NEW ILLUSTRATED and DESCRIPTIVE LEAFLETS CONTAINING DETAILS OF: AMPLIFIERS · REPLACEMENT RADIO · RADIOGRAM CHASSIS · RECORD PLAYERS · RADIO TUNING UNITS · LOUDSPEAKERS · BAND I BAND III T/V CONVERTERS · ETC.

SEND S.A.E. FOR A COPY

!! MANY PRICE REDUCTIONS !!

DON'T BUY UNTIL YOU'VE SEEN THESE LEAFLETS

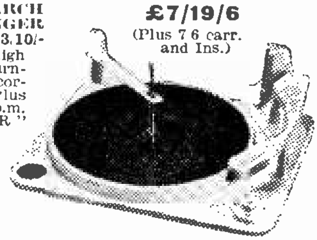
AN EXCEPTIONAL OFFER FOR CASH ONLY

The B.S.R. MONARCH 3 SPEED AUTOCHANGER NORMAL PRICE £13/10/-

- Complete with High Fidelity Crystal "Turnover" Head which incorporates separate stylus for L.P. and 78 r.p.m. records.
- A "MIXER" Unit that will autochange on 7in., 10in. and 12in. records.
- Brand New in Maker's Cartons, complete with mounting instructions.

£7/19/6

(Plus 7/6 carr. and Ins.)



STERN RADIO LTD. 109 & 115 FLEET ST., E.C.4. *Telephone* FLEet 5812/3/4

service oscillator and an output meter are essential. The output meter should be loaded to 3 ohms and connected across the extension loudspeaker sockets, and the internal speaker disconnected. Alternatively, an A.C. voltmeter could be connected through an 0.1 μF 500 v.w. isolating capacitor between pin 3 of V4 and chassis.

In either case it is essential to maintain the minimum of input signal from the oscillator consistent with a readable deflection on the output meter. A high input will give rise to false readings as the result of the A.V.C. action. For the same reason the oscillator signal should progressively be reduced as the various circuits approach correct alignment.

As is general practice, the I.F. stages should first be aligned. This is carried out by shorting the oscillator section of the tuning gang C2, and applying the oscillator signal (465 kc/s (645 metres) modulated) between the top-cap of V1 and chassis. The volume control should be turned to maximum and the tone control turned to the minimum top-cut position. Trimmers T13, T12, T6 and T5 should then be adjusted, in that order, for maximum indication on the output meter. The positions of the trimmers on the chassis are shown in Fig. 2. As this concludes I.F. alignment, the short across C2 should be removed, the signal generator leads taken from V1 and the top-cap reconnected.

Before commencing alignment of the R.F. and oscillator sections care should be taken to ensure that the tuning pointer coincides with the radial marks at the low-frequency end of the scale when the tuning gang is at maximum capacitance—fully meshed. The signal generator output should be connected across the receiver aerial and earth terminals, via a suitable dummy aerial and an output meter, as for I.F. alignment, should be employed.

For medium-wave alignment inject a modulated 1,450 kc/s signal, tune the receiver to 207 metres and adjust the medium-wave oscillator trimmer T8 then the aerial trimmer T3 (Fig. 2) for maximum indication on the output meter.

Inject a modulated 600 kc/s signal, tune the receiver to 500 metres and adjust the medium-wave padder T10 (Fig. 3) for maximum output while rocking the tuning slightly either way for optimum tracking. Finally, repeat alignment at 207 metres.

For long-wave alignment inject a modulated 300 kc/s signal, tune the receiver to 1,000 metres and adjust the long-wave oscillator trimmer T7, then the aerial trimmer T2 (Fig. 3) for maximum output.

Inject a modulated 175 kc/s signal, tune the receiver to 1,714 metres and adjust the long-wave padder T11 (Fig. 2) for maximum output while rocking the tuning for optimum results. It may be necessary to repeat this procedure several times to secure good long-wave tracking.

For short-wave alignment inject modulated 20 Mc/s signal, tune the receiver to 15 metres and adjust the short-wave oscillator trimmer T9 (Fig. 2) for maximum output (if it is found that the signal can be tuned at two settings of this trimmer, the one of lesser capacitance is correct). Finally, adjust the short-wave aerial trimmer T4 (Fig. 2) for maximum output after having established the correct setting for T9.

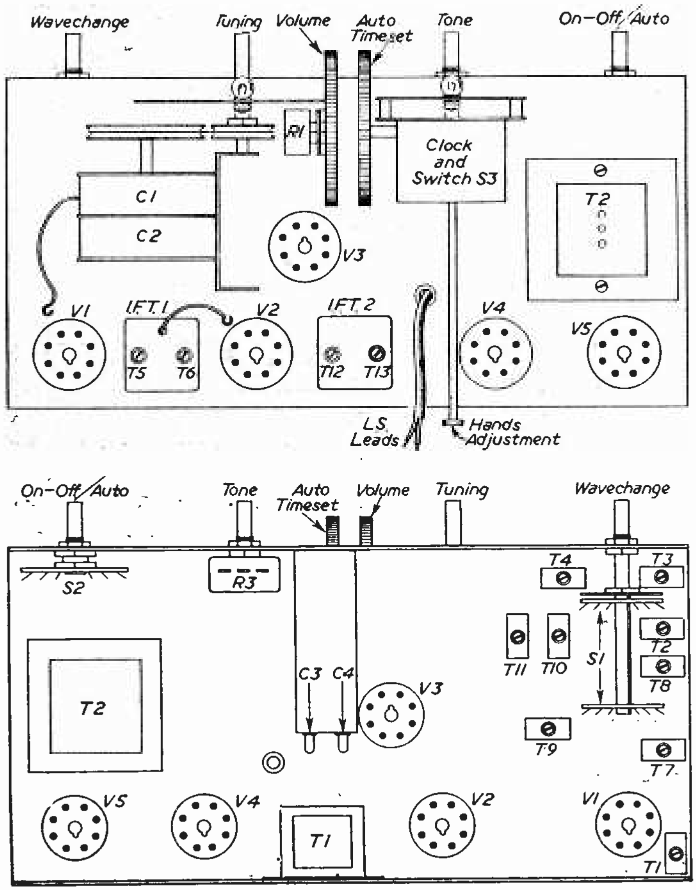


Fig. 3.—Top and bottom chassis details.

The I.F. Filter

If the I.F. filter is incorrectly adjusted heterodyning (whistling) and breakthrough of morse may be experienced on all stations. This is adjusted by applying a very powerful modulated signal at 465 kc/s across the aerial and earth terminals, via a dummy aerial, and adjusting T1 (Fig. 2) for *minimum* output. In order to be certain that the filter is adjusted precisely at the intermediate frequency, the service oscillator should be tuned in the region of 465 kc/s for maximum output before actually adjusting T1.

General Servicing Notes

If the receiver fails completely the stage at fault can often be located quickly, first by touching the top-connection of V3. If the triode section of V3, V4, the associated coupling circuits, the loudspeaker and H.T. section are operating a fairly loud 50 c.p.s. hum will emit from the loudspeaker.

If this does not happen, then, after the receiver has been on for about 10 minutes, the temperature of V4 should be tested with the hand. If working properly, this valve should be more than uncomfortably hot; if it is open-circuit or low in emission, or if H.T. is lacking, then it will be relatively cool.

If it is cool the rectifier valve V5 should be observed carefully to ascertain that its filament is alight. Assuming that the filament is alight, the temperature of this valve should be checked with the hand. Should it be very hot indeed and exhibiting a blue glow in the vicinity of the anodes, a high-tension short is probably responsible, and C3/4 should be checked for insulation.

If a test meter is available, at this stage it would be desirable to check the voltages on V4. If the anode voltage is lacking the primary winding of T1 is most likely open-circuit, though this generally shows in V4 by the screen grid glowing bright red.

If no voltage is present on the H.T. rail a check for voltage should be made on the filament of V5. 360 volts or more here and no H.T. line voltage almost certainly indicates that the loudspeaker field winding L18 is open-circuit. If the voltage is less than 360 at V5 cathode, a short in C3 is possibly responsible, though this would be revealed by L18 overheating.

Assuming now that a hum can be obtained by touching the top connection of V3 the trouble most likely lies somewhere in the stages V1 and V2. The valves should first be suspected, of course, and initially an attempt should be made to ascertain whether or not they are glowing.

If a heavy click results from the loudspeaker on touching the top connection of V2 with a screwdriver blade, this valve may tentatively be assumed in order and V1 and associated circuit should come under immediate attention. If the same effect occurs on touching the top connection of V1, the faulty component is almost certainly associated with the triode section. A check of anode voltage would help and the anode and grid coupling capacitors should be checked by substitution.

Excessive distortion accompanied by V4 becoming very hot generally means that C7 has turned into a resistor. This can be proved fairly conclusively by checking the cathode voltage of V4, which will be considerably higher than 14 volts if C7 is leaky. Should no voltage at all be measured at V4 cathode, the 10μF cathode decoupling capacitor should be replaced.

News from the Clubs

THE BRADFORD AMATEUR RADIO SOCIETY
Sec.: F. J. Davies, 39, Pullan Avenue, Eccleshill, Bradford, 2.

THE next meetings of the Bradford Amateur Radio Society are as follows:

November 22nd. Display of Members' Gear.
December 6th. Dinner.

All meetings are held at Cambridge House, Little Horton Lane, Bradford, and commence at 7.30 p.m.

Full details of the Society's activities may be obtained from the Secretary.

TORBAY AMATEUR RADIO SOCIETY
Hon. Sec.: L. H. Webber, G3GDW, 43, Lime Tree Walk, Newton Abbot.

HELD under the chairmanship of G2GK, the September meeting was not well attended—several members being sick and several on holiday.

The first of the recorded lectures booked for the winter season was well appreciated.

The question of the annual dinner and social will be discussed at the next meeting.

BRIGHTON AND DISTRICT RADIO CLUB
Hon. Sec.: F. W. How, Top Flat, 67, Marine Avenue, Hove.

AT the annual general meeting of the above club, held at the club headquarters, the following committee was elected. Chairman, T. J. Huggett; Hon. Treasurer, R. Sowerby; Vice-Chairman, C. Fairchild; Fifth member, Mr. Hemsley.

COVENTRY AMATEUR RADIO SOCIETY

AT the A.G.M. held on September 26th, the following Officers and Committee were elected: Mr. D. W. Harries, G3RF, Chairman; Mr. J. H. Whitby, G3HDB, Secretary; Mr. K. Barber, G3HDP, Treasurer; Mr. H. Chater, G2LU; Mr. K. Lines, G3FOH; Mr. A. Noakes, G2FTK; Mr. N. Bond, G3IHX; Mr. J. Faldon; Mr. R. Bastin.

The following is the forthcoming programme at 9, Queens Road, 7.30 p.m.:

November 7th—Sausage and mash supper, Hertford Arms.
November 21st—Low cost 2-metre transmitter—Ray Bastin.
December 5th—Lecture G2FTK.
December 19th—Members Xmas party.
January 2nd—Lecture.
January 7th—Children's Xmas party.
January 16th—Lecture.
January 30th—Lecture.
February 13th—Aerials and Relays—G5GR.

EAST BERKSHIRE COLLEGE RADIO SOCIETY (G3/KAL
Hon. Sec.: Mr. F. Rickards, A.M.I.P.R.E.

THE winter programme includes various lectures, film shows, technical visits, junk sales, etc., further details of these arrangements will be made in the monthly news letters.

A course of lectures and morse instruction will also be given for those members wishing to sit for the R.A.E. of the C. & G.

New members, especially beginners, are always welcome and are invited to contact the secretary.

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

THE third and last D.F. contest in 1955 was held on Sunday, September 4th, and was won by P. Rogers assisted by D. Anderson, G3JIT. The D.F. shield for the best performance in the three contests is retained by C. Hatfull, G3HZI.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Road, London, S.E.14. New members are welcome and details of membership can be had upon application to the Hon. Secretary.

THE SLADE RADIO SOCIETY
Hon. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

THE club station at the Church House is open every day of the week for the use of members. The following programme of instructional classes has been arranged:

Every Monday evening at 8 p.m.—"Station Operation and Procedure."

Every Tuesday evening at 8 p.m.—"D.F. Receiver Design and Operation."

Every Wednesday evening at 8 p.m.—"Morse Practice and Equipment Design."

Every fourth Friday evening at 8 p.m.—"A Course of Instruction for members intending to sit for the Radio Amateurs' Examination."

Visitors to the society's meetings, which commence at 7.45 p.m. prompt, and to the club station, are cordially welcome.

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

THE majority of the members who took the R.A.E. course, held during the past winter, were successful in passing the examination and already there are several new call signs amongst the group members. Any person wishing to take part in a similar course at the above head quarters should apply immediately either in person on meeting nights or by post to the Hon. Sec.

RADIO CONTROL

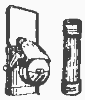
All parts including valve, paxolin panel, coil formers, etc., etc., to build regenerative receiver, given in September *Practical Mechanics*, price **14/6**, plus 2/- post.

A WONDERFUL CHRISTMAS PRESENT

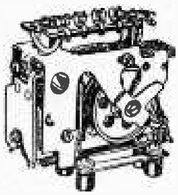
Non-Mains absolutely safe

Children of all ages enjoy playing records and will be overjoyed to own the fine portable illustrated alongside. This uses the Garrard spring motor and a 2-valve battery amplifier. The case is in two-tone imitation crocodile lizard skin. Special price **£7.19.6**. Carriage 7/6 extra.

SIX TORCHES 5/-



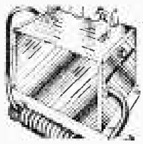
Parcel containing 2 hand lamps and four assorted tubular torches. Only 5/-. Post 1/6.



REMOTE CONTROL

With only one pair of wires and a simple push button you can select any one of four stations without leaving your armchair. This is just one of the many applications of our impulse relay. There are many other purposes to which it can be put. Note they are somewhat soiled due to storage, but mechanically O.K. Price **2/6**, plus **9d.** post, booklet free with relay or sep., **1/6**.

CLEVELAND CAR BATTERY CHARGER

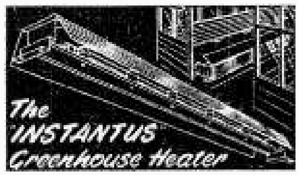


gives 1½ amps. charge — uses everlasting metal rectifier and robust double-wound mains transformer—in metal carrying case with leads and croc. clips.

Price 6 volts **29/6** : 6 to 12 volts **39/6**. Post 2/6.

ELECTRONIC PRECISION EQUIPMENT, LTD.

See page 729 for addresses



4ft. long made from heavy gauge sheet steel (galvanised), 1 kW. suitable A.C. or D.C. Price **£2.10.0** and 5/- carr., or with thermostat **£4.5.0.** Note : The thermostat mounts separately and will control up to three heaters.

1in. MICROMETER

Exceptional purchase enables us to offer a 1in. precision micrometer at the very low price of **10/-**. A micrometer is an essential part of an engineer's equipment. If you act quickly you can acquire one now at the remarkably low price of **10/-**, post free.

FINSBURY TAPE RECORDER

This is a fine instrument using the now-famous Truvox Model TR7U tape deck, in conjunction with a 4-valve amplifier specially designed for tape work. It will provide recording and playback of the highest fidelity. Its performance is superior to most proprietary recorders of similar price level and as good as many marketed at much higher prices.

It will take all standard tapes up to 1,200ft. providing up to two hours playing. It will also play new pre-recorded tapes.

The instruments are carefully checked before dispatch and can be heard working at any branch.

Price, complete and ready to work, **£43**, plus £1/10/- carriage and insurance, partly returnable.

FOR HOME CONSTRUCTORS wishing to build equipment into their own cabinets the amplifier and tape deck are available separately, prices as follows :—

Truvox TR7U Tape Deck ...	£23 2 0	plus 10/- carr.
Finsbury Hi-Fi Amplifier, complete with 8in. Speaker ...	£14 14 0	,, ,,
Acos Crystal Microphone ...	£2 10 0	
Reel of Tape ...	£1 15 0	

Special Offer This Month. Tape Deck, Amplifier, Speaker and Reel of Tape, **£33/10/-**, plus £1 carriage and insurance.

CONDENSERS

100 Mixed Condensers **15/-** 5pf to 1 mfd

RF UNITS.—24 or 25, 12/6 each.

ELECTROLYTIC 450 wkg. 8 mfd., 2/6 ; 8 + 8 mfd., 3/- 8 + 16, 4/- ; 16 + 16, 4/6 ; 20 mfd. 500 volt, 3/- ; 32 mfd., 5/- ; 25 mfd., 25 volt, 50 mfd. 25 volt, 50 mfd. 50 volt, 2/- each ; 1,000 mfd. 25 volt, 4/6 ; 100 mfd. 450 volt, 4/6.

RESISTORS

Mixed Resistors Our Selection **12/6** Per 100 Brand New. ¼, ½, 1, 2 watt.

Cracked Carbon High Stability Resistors, 1/- each.

POTENTIOMETERS. — All values to 2 meg., 2/6 each ; 6 for 12/-.

METERS. — M.C., M.I., T.C., 8 for £1.

TRANSFORMERS. — £1 each. New PRI, 230 v. A.C. 275-275 80 ma, 6.4 volt, 4 a, 6.3 volt 0.9 a.

OIL FILLED TRANSFORMER

VALVES

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Using TEST INSTRUMENTS

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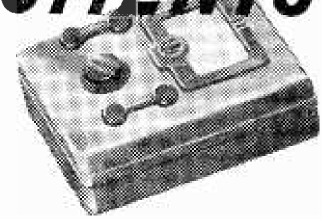

(*Continued from page 668 November issue*)

ON an audio amplifier, for example, it becomes a simple matter to follow a test signal through the various stages and observe whether it changes appreciably in form as it enlarges in amplitude. In order to do this, of course, a distortionless test signal is first required. This can be obtained at any frequency from an audio oscillator (generator) or at one particular frequency (generally 400 c.p.s.) from the A.F. output terminals on a signal generator. It will be remembered that we have already discussed this facility of the signal generator in Part 8 of this series.

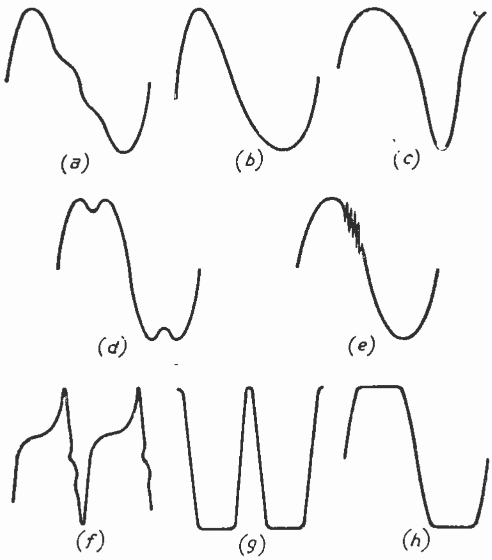

Fig. 47.—Distortion waveforms often encountered in A.F. amplifiers.

The output of the generator or oscillator should have a waveform which closely follows that of a pure sine wave—Fig. 46—and it may be injected into the input of the A.F. amplifier. The gain controls of the generator and amplifier should be adjusted so that overloading does not occur, and the resulting amplified waveform may be inspected at various points along the amplifier chain by feeding the signal to the "Y" plates of the oscilloscope and adjusting the t.b. frequency until one complete waveform is displayed. The deflection amplifier may or may not be required, depending on, of course, to what extent the generator signal is amplified in the actual A.F. amplifier itself. For instance, the deflection amplifier will almost certainly be necessary to view the signal waveform direct from the generator; it may even be necessary after the signal has passed through one stage of the amplifier under test.

It is best to pick up the amplified signal from a grid circuit as opposed to an anode circuit, for in the latter case a D.C. potential of fairly high magnitude is present, and this may cause the trace to be deflected completely off the screen. Some 'scopes have a blocking capacitor connected to the "Y" plate terminal, and this then would not apply. The problem may be solved easily enough, of course, simply by using an external capacitor, and it is desirable to take this action when the 'scope is to be connected to a D.C. carrying circuit.

The waveforms of Fig. 47 show some of the forms a pure sine wave may take after passing through an amplifier. At (a) is shown third harmonic distortion; (b) and (c) indicate a degree of second harmonic distortion, the inverted appearance of (b) with respect to (c) is brought about by the difference in phase of the harmonic content with relation to the fundamental content. In all cases the deformation of waveform produced depends upon the phase of the harmonic relative to the fundamental; the combined wave being obtained by adding the instantaneous values of the fundamental and the harmonic contents together.

Second harmonic distortion often results by bottom bend cut-off or a flow of grid current in a class A amplifier.

Third harmonic distortion of a different phase relationship is depicted at (d). Distortion due to severe overloading of an A.F. output stage (mainly the result of distortion in the output transformer) is shown at (f). Waveform (g) indicates a cutting of the lower peaks due to anode bend distortion or excessive bias; cutting of the upper peaks may mean that the bias is insufficient or that grid current is flowing in a class A amplifier.

When both peaks of the waveform are cut as at (h) insufficient H.T. or expecting too much output voltage from a certain stage may be responsible and should be investigated. Reducing the signal input by turning down the volume control would undoubtedly turn this waveform into a pure sine wave.

Parasitic oscillation is readily revealed by a display such as (e), with the 'scope connected to the amplifier output terminals. As the frequency of this kind of oscillation is generally outside the range of the audio spectrum a 'scope often represents the only instrument conclusively capable of detecting it, it being not generally audible from the loudspeaker, though it does much to aggravate general poor quality.

So far we have considered the use of an oscilloscope for signal tracing in A.F. equipment. We have seen that by injecting a signal from an A.F. oscillator or generator we could connect the 'scope at various points along the amplifier chain and observe the degree and type of distortion by comparing the waveform of the input signal with that of the amplified signal.

In order to perform this test successfully it is essential that the signal applied to the amplifier is of an amplitude slightly less than that required to drive it fully, for if this precaution is ignored the waveform of the amplified signal will undoubtedly show flattening of its peaks. The same effect will result if the deflection amplifier in the oscilloscope is overloaded. It is as well, therefore, to ensure that the minimum signal is applied to the deflection amplifier, if it is necessary to use this, consistent with readable vertical " Y " deflection of the trace.

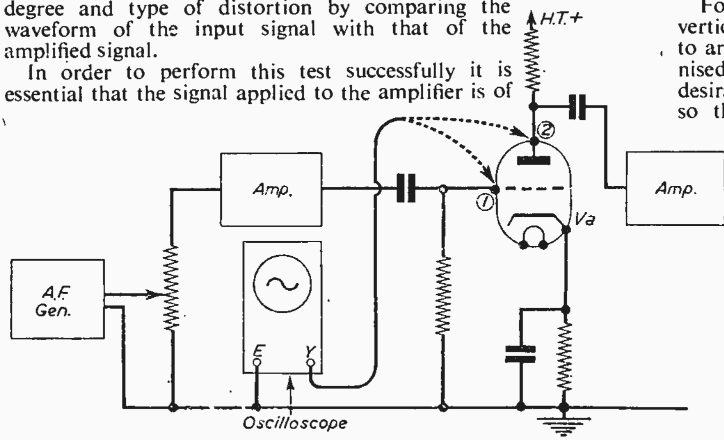

Fig. 48.—Showing a method of checking stage gain.

There is an alternative method of waveform checking through an amplifier by connecting the 'scope to the output and moving the oscillator or generator along the circuit in steps. Such a method may be found more suitable in certain cases, though, generally speaking, the previously described method is the most versatile and satisfies the majority of test conditions, particularly for quickly locating the stage in an amplifier which is responsible for distortion.

Moreover, an indication of normal stage gain accompanies the check when the 'scope, instead of the generator, is moved along the circuit, for if the various A.F. stages are doing their job and amplifying the signal properly a reduction of deflection amplifier gain should be required as the 'scope is taken along the amplifier, from the input to the output.

Checking Stage Gain (41)

For this purpose the 'scope is used simply as a device for measuring the A.F. voltage going into a certain stage and for measuring the voltage coming out of it, the stage gain, of course, being the ratio of these two voltages; and if the logarithm (to the base of 10) of this voltage ratio is multiplied by 20, then we get the stage gain expressed in decibels (db).

The circuit arrangement for this check is illustrated at Fig. 48, where Va represents an individual stage of an A.F. amplifier whose gain it is desired to check.

The A.F. generator is connected to the front of the amplifier in the usual way, and the " Y " plate of the 'scope is connected to the anode of Va (if necessary, via an isolating capacitor)—point 2. The A.F. generator is then adjusted to provide a signal of voltage which is known not to overload the amplifier as a whole. The amplitude of vertical deflection of the trace is noted and compared with the amplitude of the trace when the 'scope is connected to the grid—point 1.

For the purpose of comparison of vertical amplitudes it is not essential to arrange for the display of synchronised waveforms; it is, in fact, desirable to slow-down the timebase so that a rectangle of illumination forms on the screen. Some 'scopes provide a calibrated graticule as an aid in taking off such measurements from the screen, but if one is not provided it can easily be made by scribing off a square of Perspex and arranging a simple method of fixing it in front of the screen. It will need to be calibrated, of course, but this is a relatively simple matter which was described in a previous section in this series.

If insufficient vertical deflection is obtained the deflection amplifier will have to be used, and if the gain of the amplifier has to be altered between the two voltage measurements then this will need to be taken into consideration in assessing the final voltage ratio. On certain 'scopes the attenuators are marked to ease this calculation.

Checking Frequency Response (42)

One of the most reliable ways of doing this is by measuring, with the assistance of a 'scope, the voltage developed across a load resistor at the output of the amplifier at various frequencies within the pass-band of the equipment. An audio oscillator having a constant, or monitored, output is essential for this test. The oscillator is adjusted to various spot frequencies within the pass-band spectrum and the relative output at each frequency plotted to provide a graph as shown in Fig. 49. *(To be continued)*

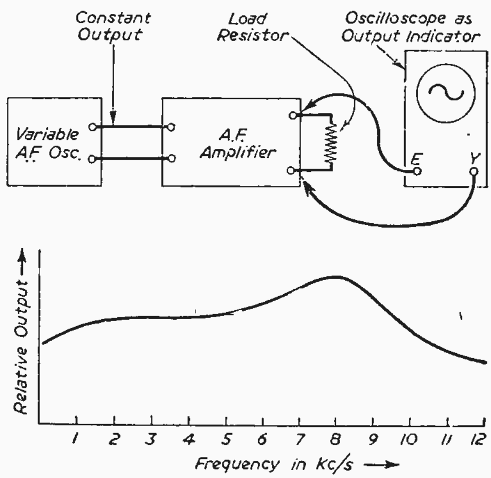

Fig. 49.—A method of checking the frequency response of an A.F. amplifier.

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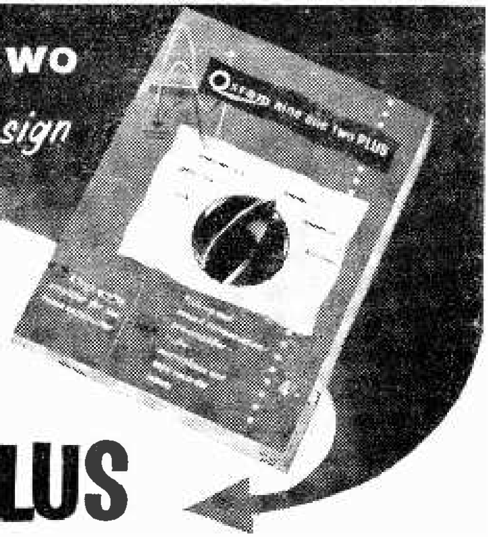

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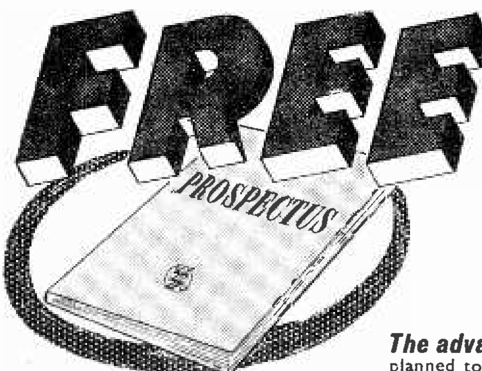

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A MULTIVIBRATOR TIMEBASE

AN UNUSUAL OSCILLOSCOPE SCAN GENERATOR

By Hugh Guy

CIRCUITS used for the generation of scan waveforms for oscilloscope timebases generally employ a pentode connected as a Miller stage. Such a circuit gives a very linear scan and is bettered only by the Puckle timebase which is used in special circumstances. Whatever the circuit, however, the phenomenon of charging and discharging a condenser is fundamental to them all, and differences occur only in the manner in which refinements are added to make the charging as linear as possible.

A little elaboration at this point may help to clear up a lot of misunderstanding. The word "linearity" is often encountered in television terminology. The exact definition of this word is hard to find, but the quality implied by it is easily explained. When a spot is made to traverse the screen of a cathode ray tube, and it moves steadily from one side to the other, then

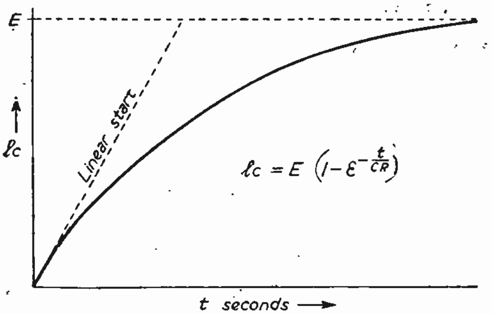

Fig. 1.—Build-up of voltage across a condenser.

the trace produced by this spot is said to be linear. If, on the other hand, it gathers or loses speed in its journey, then it is non-linear, an effect which it is all too easy to produce as a rule.

What are the results of non-linearity? These are already familiar to the owner of a television set with a non-linear frame scan, but considering our original example, with a non-linear scan waveform applied to the X plates, a sine-wave applied to the Y plates will not appear as a regular waveform on the tube face. It will appear to be cramped at one end, corresponding to the slower part of the scan waveform.

Obviously, then, one essential of a scan generating circuit is to produce a linear or sawtooth waveform. Now when a condenser is charging the voltage building up across the terminals does not increase linearly with respect to time; it is in fact an exponential increase as the familiar curve of Fig. 1 clearly shows. However, the beginning of this curve is quite straight and the departure from the linear case is imperceptible for the first few volts. If, therefore, we utilise only the beginning of the charge characteristic in a scan-generating circuit, the resultant trace will be quite linear.

This is the method of producing a linear scan used in the multivibrator circuit shown in Fig. 2, and though lacking the refinement of the Miller scan generator has some advantage over the latter.

The Multivibrator

The circuit about to be described is not widely used, partly due to the complexity of its design, but it produces two useful waveforms and has certain advantages over the normal "cross-coupled" free-running multivibrator.

In the circuit of the multivibrator we see that the cathodes are strapped together being earthed through a common resistor Rk. The output from the anode of the second valve is D.C. coupled by the resistance chain Rb, R1 and R2 to the grid of the first stage. To the grid of the second valve is connected the condenser C which will produce the scan waveform, being charged through the resistance R, which is returned to H.T.

The first anode provides another output, which it will be shown coincides with the flyback period of the sawtooth waveform produced across the condenser C.

Before the H.T. is switched on, condenser C is uncharged and the grid of V2 is therefore at earth potential. When the H.T. is applied, V1 grid is immediately set at the positive potential determined by the voltage dividing chain Rb, R1 and R2, and is therefore more positive than V2 grid, whose rise of potential is determined by the combination of C and R. A large anode current therefore flows in V1, which has a low value of anode resistor Ra, whilst none flows immediately in V2 and the cathode potential rises to some positive value, due to the anode current of V1.

Meanwhile the potential across C increases according to the curve shown in Fig. 1, until the difference in potential between V2 grid and the common cathode is reduced sufficiently to allow current to flow in V2 also. V2 has a large value of anode resistor Rb, and consequently the anode potential of V2 falls considerably due to the commencement of flow of anode current. This drop is conveyed, attenuated slightly, to the grid of V1. Now it is the large anode current of V1 which, up to this moment, has sustained the cathode at its present potential. The fall of V1 grid voltage, therefore, considerably reduces, and in fact cuts off, the anode current of V1,

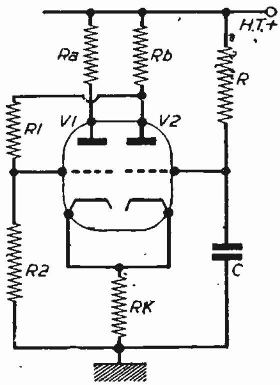

Fig. 2.—Basic multivibrator circuit.

and the cathode potential drops instantaneously to a new value determined by the anode current of V2.

In turn this fall in cathode potential now makes the grid voltage of V2 many volts positive with respect to the cathode and the condenser C discharges rapidly through the resistance formed by the diode of V2 grid and cathode, and the cathode resistor Rk.

This discharge continues until the falling discharge current has reduced the cathode potential to the value where the grid-to-cathode potential of V1 is now small enough for V1 to conduct again. When

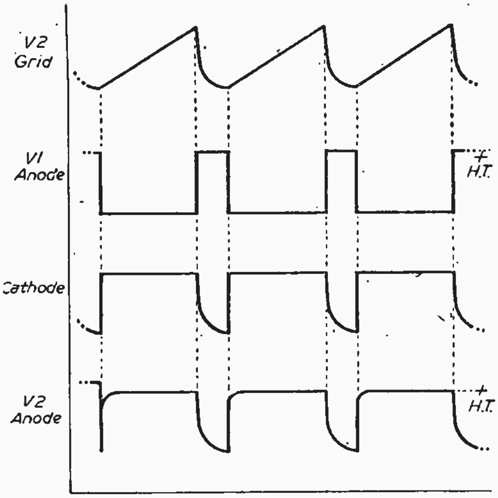

Fig. 3.—Multivibrator waveforms (not to scale).

this occurs, of course, the cathode is again carried to its original high value, V2 is cut off, and the cycle recommences.

The Waveforms

At the grid of V2 by careful design it is arranged that a sawtooth is created, the rising slope corresponding to the time that condenser C is charging from the limit set by the lower cathode voltage to that set by the upper cathode voltage. The flyback is created when V2 conducts, and condenser C discharges through the grid circuit of V2 and the cathode resistor Rk.

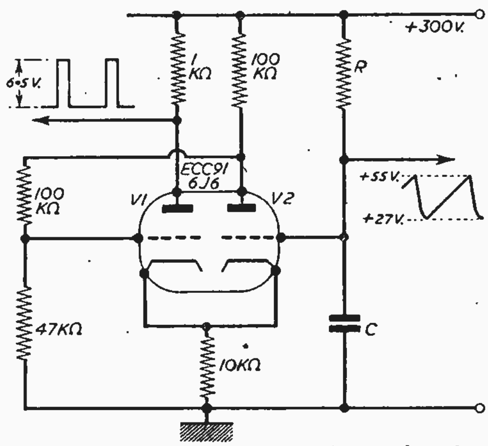

Fig. 4.—Simple scan generator showing waveform amplitude.

While the sawtooth on V2 grid is rising V1 is conducting hard, and a large anode current maintains the anode of V1 several volts below the H.T. level. During the flyback period, however, since V1 is cut off, the anode potential here rises to H.T. and a positive pulse coincident with the flyback is created. Due to a much higher value of anode load in the other anode circuit, V2 anode current is much less than that of V1 ; in fact the operation of the circuit relies on this discrepancy in anode currents. The waveform at the other anode is an inverted replica of that at V1 anode, whilst that at V1 grid is merely the signal at V2 anode attenuated.

These waveforms are all clearly shown in Fig. 3.

Circuit as Scan Generator

The problem of linearity rears its head when we decide to use the circuit as a scan generator, since extra care must be exercised in the design if we are to avoid the pitfalls outlined in the opening paragraphs. We can use the principle of charging a condenser through a resistor, a procedure used at V2 grid, only if we limit the charging to a few volts of the total H.T. voltage. This automatically rules out the possibility of using the generator to drive the plates of an electrostatic tube directly because the useful amount of voltage we can develop would not be of sufficient amplitude.

Trapezium Distortion

However, the limited amount of linear scan can easily be amplified in a following stage and if such a stage is made a long-tailed pair, then a second effect known as trapezium distortion can be overcome by feeding both X plates with the push-pull output that this stage provides.

Trapezium distortion results from feeding only one X plate and earthing the other, and appears as an effect very similar to that due to a non-linear timebase scan.

Simple Convertor

Thus the maximum advantage is gained by using two stages for the timebase circuit in a simple oscilloscope. Both stages can consist of double triodes and if these take the form of the ECC91 or CV858, a valve readily obtainable on the surplus market, the amount of space in the oscilloscope devoted to the timebase can be negligable.

The basic circuit of a suitable scan generator is given in Fig. 4, where some of the points indicated above become obvious. The big difference in the values of the anode loads, for example, is due to the difference in the anode currents required to fix the amplitude of the cathode excursion. The latter in turn is approximately equal to the scan amplitude at the grid of

(Continued on page 781)

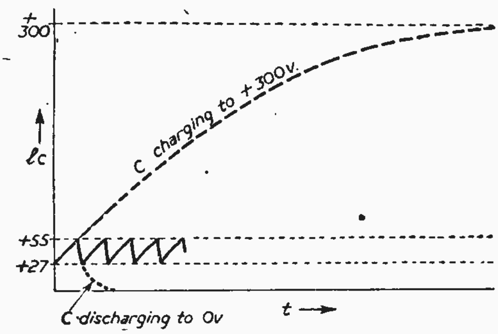

Fig. 5.—Scan and flyback as part of charge and discharge characteristic.

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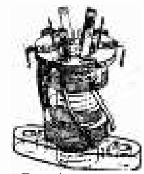

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V2. Therefore, from a knowledge of the required scan amplitude, values may be assigned to both the anode loads and the cathode load. Approximately, the scan equals the product of the anode current change and the value of the cathode resistor.

To assist in the production of a linear scan, we know from earlier paragraphs that the excursion of V2 grid must only be a small fraction of the permissible charging voltage. This requirement can be fulfilled, not only by limiting the scan amplitude but also by making the charging voltage as high as possible. This in turn is achieved by using a relatively low value of

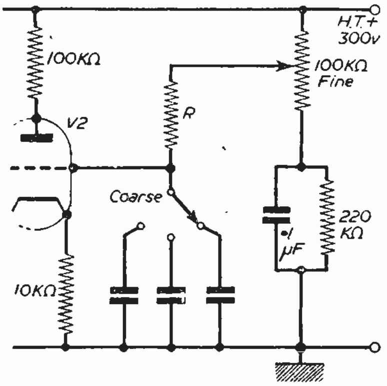


Fig. 6.—Fine and course scan-time controls.

cathode load, thereby ensuring that the build-up of voltage at V2 grid starts from a low value. This level, remember, corresponds to the point where V1 just commences to conduct after the flyback has occurred, and it will not, therefore, be at earth potential. This fact is clearly shown in the waveforms for the circuit.

The actual levels corresponding to the start and finish of the scan waveform must be known before we can work out the values of the charging condenser and resistor, C and R respectively, in the circuit of Fig. 4. Doubtless the experimenter will wish to decide for himself the ranges that the timebase will generate and so the method is outlined below and an example given.

Timing Calculations

Referring to Fig. 5 the grid waveform is again shown to consist of two exponentials. Neither starts from zero voltage and neither completes the charge or discharge that it is performing. However, from a knowledge of the condenser charge and discharge formulæ and the limits of the grid waveform voltages we can very accurately predict the time that each operation will take.

At the end of the flyback in the circuit of Fig. 4 the voltage at V2 grid is 27 volts, whilst at the "top" of the scan the grid is at 55 volts and, therefore, the scan generated is of 28 volts amplitude.

Thus when the condenser is charging its potential rises from 27 volts and were nothing to stop it it would eventually rise to the H.T. voltage of +300 volts. Its maximum excursion would then be 273 volts. Actually it is only permitted to rise 28 volts.

The formula which gives us the time taken for this small excursion enables us to determine the ratio t/CR where t is the time in seconds, C is in farads, and R is in ohms. In general symbols this formula is:

$$e = E\ (1 - \varepsilon^{-t/CR}).$$

Putting in the figures we have chosen makes this:

$$28 = 273\ (1 - \varepsilon^{-t/CR}).$$

This formula must now be simplified using natural logarithms, a task the mathematicians may enjoy. The final answer, for those who prefer to have it worked out for them, becomes:

$$t/CR = \cdot 09.$$

If, for example, we wanted a scan to take 100μ secs., we would choose two components whose values, when multiplied together, gave 100/1.09, remembering that we are working in μsecs. Two such components might be a 510 pF condenser and a 1.8 M resistor.

Unfortunately we do not have so much choice over the flyback time since the value of the discharge resistance, being the grid-cathode diode resistance and the cathode load in series is already fixed. However, the arrangement does permit some latitude and the flyback time and hence the width of the pulse at V1 anode may be predetermined if we choose the value of condenser to suit the required discharge time first and then fix the value of R to produce the specified scan time.

In the discharge circuit the condenser discharges into the cathode load of 10 K. through the diode resistance which is probably about 1 K. The total discharge resistance is, therefore, 11 K.

We also know that the condenser discharges from a potential of 55 volts and would finally arrive at earth potential if permitted. However it can only discharge to 27 volts, and these two values enable us to solve the general discharge formulæ, which is:

$e = E.\varepsilon - t/CRd$ where Rd is the discharge resistance, being 11 K. in our case.

Putting in the figures, we get:

$$27 = 55.\varepsilon - t/CRd$$

and from this we learn that t/CRd is 0.70. For a given flyback time we can find a suitable value for C to combine with the 11 K. discharge resistor, giving a ratio of 0.70. We can then revert to the charge ratio

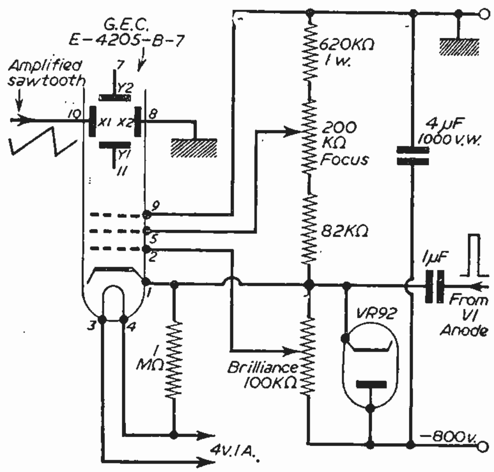


Fig. 7(a).—Power supply for 2½in. tube, showing flyback suppression.

of 1.09 and knowing the value of C work out the value of R to produce the required scan time.

Imagine, for example, that we want a scan time of 2,000 μsecs., say, and a flyback time of 25 μsecs. Solving the latter first to determine C we find that a 3,300 pF condenser will give the required flyback. Using this value to solve for R for the scan time of 2,000 μsecs., we find that a 560 K. resistor would produce the desired result.

Having learned the method of solving the component values we can now proceed to design our timebase.

Range Switching

Ideally any timebase should provide us with a means of expanding the trace we are examining by means of a fine control which is continuously variable, whilst coarse variations may be effected using a stepped switch.

These properties are easily imparted to the free-running multivibrator, as Fig. 6 shows. To give a smooth variation in scan time without affecting the flyback time, the H.T. end of R is returned to a decoupled potentiometer chain. The swing of voltage available on this control is sufficient to vary the scan time by 1.5 : 1. The charge $t/^{CR}$ ratio of 1.09 will still hold when the slider is at the upper end of the potentiometer; when calculating the times of the scans it is merely necessary to remember that this time may be increased by a factor of 1.5. This fact arises because when the potentiometer is at the lower potential end of the slider, resistor R is returned to +206 volts and $t/^{CR}$ then becomes 1.65, a fact the reader may easily verify for himself, using the method shown above.

We now have to devise a means of giving a coarse control of the scan time, and this is done by connecting a multi-positioned switch to V2 grid, and to each contact wiring a different value of condenser. These values again are determined from the product $t/^{CR} = 1.09$, R being constant while it varies from one position to the next giving the range of scan times required. When the range is changed, the flyback time will also change, but being short compared with the scan time, should not cause any difficulties. The mode of connection for the switch is also shown in Fig. 6.

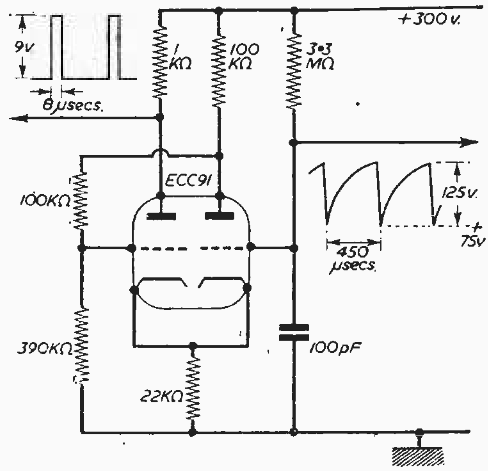


Fig. 8.—Multivibrator as generator.

Flyback Suppression

The waveform at V1 anode, being coincident with the flyback, may be used to suppress the flyback trace, which would otherwise appear as an annoying streak, marring the waveform being examined on the tube face.

There are at least two ways that this may be accomplished, both of which will be described, the choice of one depending on whether the reader intends to use push-pull drive to the X plates. Taking the simplest case first, and assuming that no push-pull drive is being used, then suppression may be achieved by coupling the pulse from V1 anode through a condenser to the cathode of the scope tube. Here a diode is used to D.C. restore the pulse so that it is positive-going on the level to which the cathode is set by its bias chain. The nett effect is to reduce or cut off the beam current in the tube for the duration of the pulse and thereby suppress the flyback.

The connections for a typical tube are shown in Fig. 7(a). The amplitude of the pulse required for suppression will naturally depend on the tube being used, and it may be necessary to increase the value of the anode load resistor in the multivibrator in order to develop sufficient voltage swing. Alteration of this resistor will in no way upset the working of the multivibrator within limits. With the present value of 1 K. in the anode circuit, a pulse of 6.5 volts is developed; this should provide a guide to the choice of any alternative resistor that is necessary.

The second method of suppression is given in Fig. 7(b), where the long-tailed pair stage is used to provide push-pull deflection of the beam. The scan waveform is fed to one grid of the long-tailed pair while the pulse is fed to the other grid, being D.C. restored. The output at each anode then consists of a combination of the two waveforms, and is drawn in the figure.

(*Concluded on page 786*)

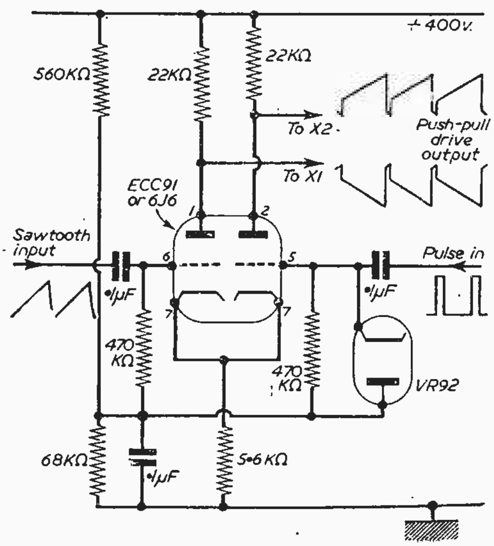


Fig 7(b). — Push-pull deflection with flyback suppression.

Modulated I.F. Generator

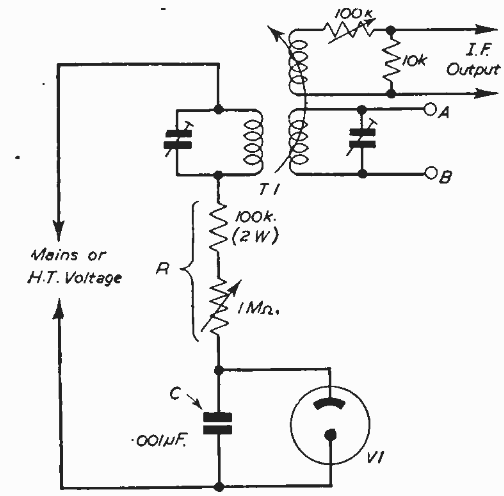
SIR,—Experimenters or amateur radio constructors may be interested in this circuit of a very simple Modulated Intermediate Frequency Generator.

T1 is a pre-aligned I.F. transformer. V1 performs a switching action at (approximately) 1 to 5 kc/s—depending upon the value of the preset 1MΩ pot and other circuit constants. T1 secondary tends to purify the resulting modulated wave. The coupling coil L3 has about one-third of the number of turns on L2 and is wound close to the latter. The neon V1 may have a striking voltage of 150-200 volts.

An approximate analysis shows that

$$\text{Modulation Frequency} = \frac{10^6}{2.3026 \times C \times R \times \log \dfrac{V_B - V_Q}{V_B - V_S}} \text{ c/sec.}$$

where V_B = H.T. voltage, V_S and V_Q are the neon striking and de-striking voltages respectively and C × R is the product of capacity in μF and R in ohms. The output is a harmonic of this frequency.



Mr. Kirwan's I.F. Circuit.

As the circuit takes very little current it may obtain its H.T. supply from the set being aligned, provided, of course, that this H.T. voltage exceeds the neon striking voltage.

The circuit may be adapted to individual requirements, e.g., the output from AB may be taken to a tuned amplifier and from thence to a cathode follower to give the low output impedance which is desirable.

Initially, when T1 is turned R is varied to give suitable modulation—P. N. KIRWAN (Co. Derry).

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.

Ex-R.A.F. Valves

SIR,—There are still countless numbers of ex-R.A.F. surplus valves available at very reasonable prices. I have had several in use in various sets for six or seven years still giving first-rate service. They are certainly an excellent proposition.

Have lost count of the various battery and mains sets I have made up since 1924, but easily the best superhet for tone and quality—crisp reproduction I have ever heard was built up to a specimen four-valve circuit in PRACTICAL WIRELESS for June 1954. The caption was simply "A Typical Full Superhet Circuit With A.V.C." It was not a constructional article. All component valves exactly as specified. Wearite Coils. Metal rectifier with two 32 mfd smoothing condensers on the choke. Mains hum is negligible. Results incredibly good.

For the frequency changer—I used VR57—equivalent of the EK32 or 6K8.

First detector VR53—equivalent of EF39 or 6K7. Second detector VR55—equivalent of EBC33 or 6Q7. Output VT52—equivalent of EL32. This makes a wonderful output valve that should be more generally used. Over the course of years, I occasionally find a VR53 not quite up to standard, and the frequency changers are usually the first to show signs of wear—but otherwise these surplus valves can be confidently recommended.

Congratulations on a very excellent monthly—every issue, to which I look forward keenly, scintillates with new interests. PRACTICAL WIRELESS is now better than ever.—A. J. SWEENEY (Gloucester).

Ex-Government Equipment Abroad

SIR,—With reference to Mr. G. H. Hobson's letter in your August issue on the subject of ex-Government equipment, it would be doing your overseas readers a real service if you could follow up his suggestion.

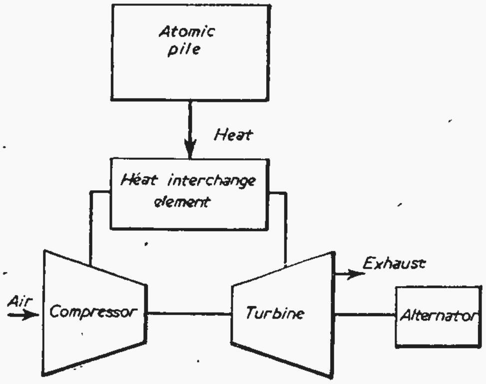
In the U.K. one can at least visit the shops and see the equipment, but in our case we have to order unseen, and too often pay the extra postage, duty, etc., for stuff that is unsuitable.

It is very difficult here to get anything but receiver part replacements, and most of our requirements have to be imported from the U.K. With surplus transformers especially, we are only interested in those which have a

110 volt primary, and we never see these advertised. I don't know if this is because they are not available, or if the advertisers don't bother to specify it, but I can assure them that a lot of us are in the market for surplus transformers with a centre tapped 600 to 750 volt secondary if the primary is 110 volt.—T. H. ALLEYMAN (Trinidad, B.W.I.).

Atomic Power

SIR,—Reading the latest reports of electric power from atomic energy projects in this country, the general plan seems to be to use heat energy from a reactor to produce steam in a more or less conventional plant for use in steam turbo alternators. As it is extremely unlikely that a method of deriving electrical energy direct from atomic reaction is possible or practical in the near future, I agree that the turbo alternator is the most feasible appliance at the present time, but as for using steam as the medium for motive power I consider this a little obsolete. Any boiler and turbine plant operator will tell you that the actual turbo-alternators give little or no trouble and that all the headaches are with the boilers and water recovery and feed conditioning systems necessary to render the water and resulting steam pure, or in effect to produce a pure gas for operation in the turbine.



Outline of Mr. Benson's idea.

Surely a simpler method for use of reactor heat would be in the gas turbine? Having a little knowledge of gas turbine operation I know that in theoretical considerations the gas is always considered to be air even after burning of the fuel in the combustion chamber. This means that the fuel is only burnt in order to raise the temperature of the gas at constant pressure, consequently if the fuel burner were to be replaced by a heating element deriving heat from an atomic reactor the cycle should operate as shown.

I appreciate that this would present a vast problem in heat interchange on which a large amount of research would have to take place before a workable element could be found. An advantage of the system affecting the life of the turbine is the purer gases flowing through it not causing as much erosion or corrosion.

The more I think of this idea the more I become convinced that there must be something basically wrong or someone must have thought of it before. However, I am sending it to you to see what your readers think or to point out where the reasoning falls down.—G. S. BENSON (Huddersfield).

A Multivibrator Timebase

(Continued from page 782)

The flyback period is now a sharp step which will result in a rapid retracing of the spot on the screen and consequent reduction in brilliance during this period.

Of course there is no reason why a combination of both effects should not be used, when a push-pull output will be used to drive the tube, while the pulse is fed, as in the first method, to the cathode of the tube. This latter method is probably the best of the three cases outlined since it can result in a guaranteed removal of the flyback trace.

Other Uses

There is naturally nothing to prevent the circuit from being used for purposes other than that of generating scan waveforms. It might merely be required as a pulse-generating medium, in which case the problem of non-linearity does not crop up. In such cases it is possible to save on the size of the condenser for a given scan time by arranging that the time of charge of the condenser is far greater than in the cases we have considered up to the present.

The circuit of Fig. 8, for example, gives a very large and very non-linear sawtooth and a very short pulse, which could be used as a master timer for a more elaborate scan generating circuit, providing as it does a very stable source of pulses.

Triggering

A final note on the circuit as a scan generator concerns triggering. It is very desirable to have provision in an oscilloscope timebase for means of triggering the scan externally. Happily, this may be easily achieved by connecting a terminal for positive triggering sources at V2 grid, and negative sources at either V1 grid or at the cathode.

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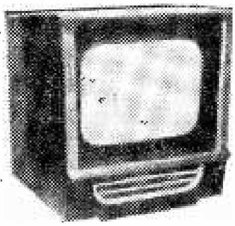

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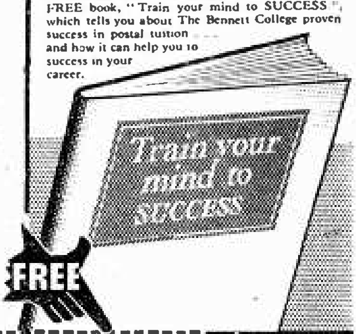

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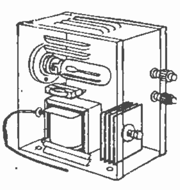

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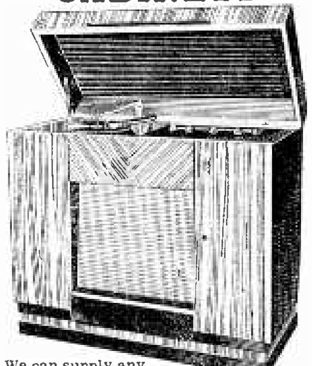

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