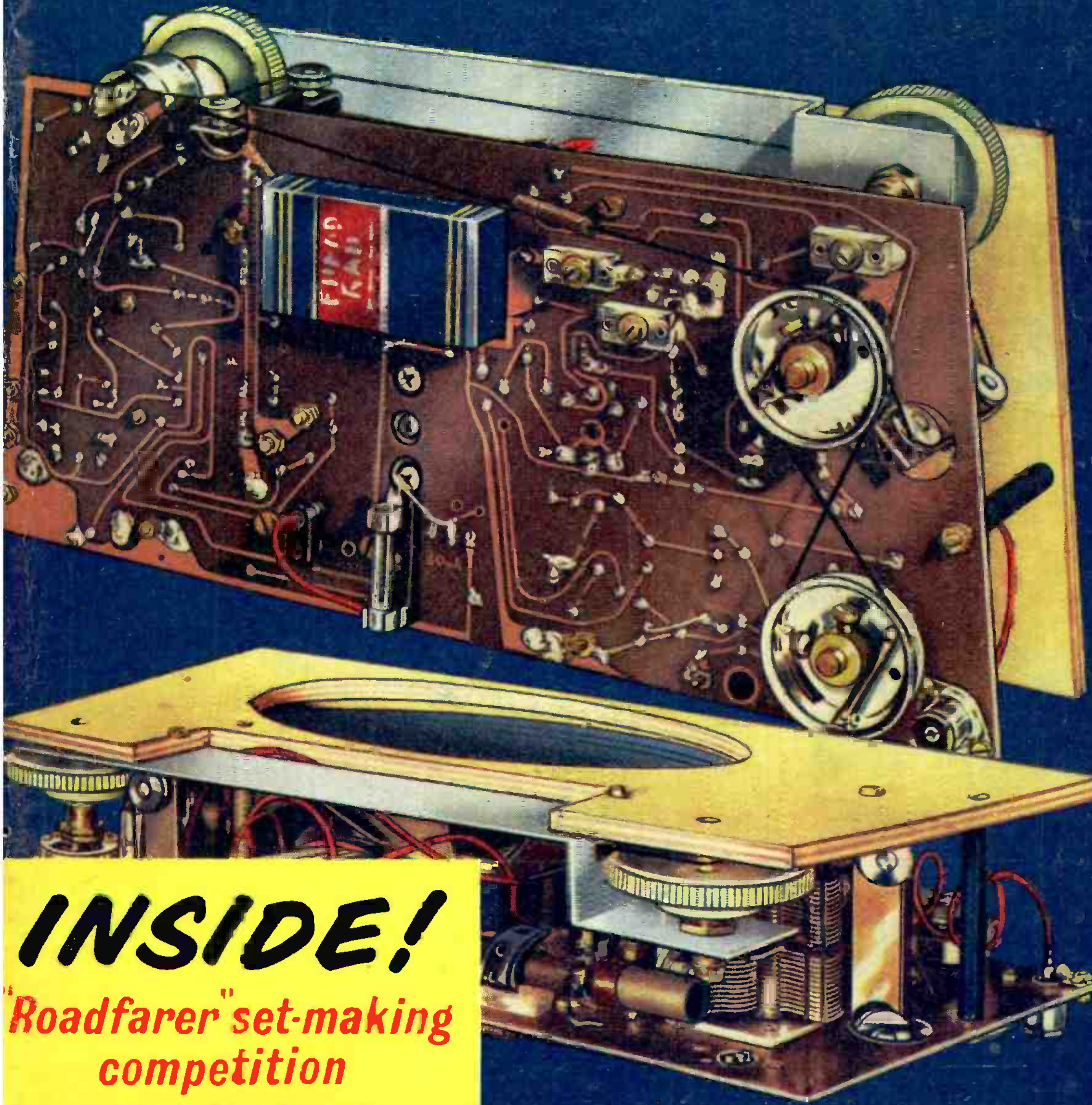
PRACTICAL WIRELESS

1/6

MAY 1961



INSIDE!

"Roadfarer" set-making competition —£100 first prize

HARVERSON SURPLUS CO. LTD.

HERE IT IS !

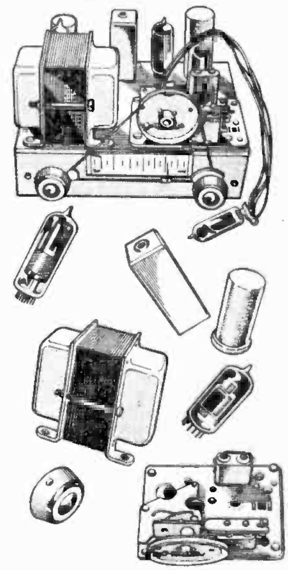
HARVERSON'S F.M. TUNER KIT

At last a quality F.M. Tuner Kit at a price you can afford. Just look at these fine features, which are usually associated with equipment at twice the price!

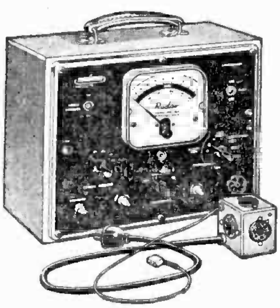
★ Philips F.M. Tuning Head.
★ Guaranteed Non-drift.
★ Permeability Tuning.
★ Frequency coverage 88-100 Mc/s.
★ OA81 Balanced Diode Output.
★ Two I.F. Stages and Discriminator.
★ E.M.84 Magic Eye.
★ Self powered, using a good quality, mains transformer and valve rectifier.
★ Valves used ECC85, two EF80's, EM84 (Magic Eye) and EZ80 (rectifier).
★ Fully drilled chassis.
★ Everything supplied, down to the last nut and bolt.
★ Size of completed tuner 8 x 6 x 5½in.
★ All parts sold separately.

£4.19.6
PLUS 8/6 P.P. & Ins.

Note:—To show the chassis more clearly the attractive 8 x 3in. black and gold dial supplied with this kit, is not shown in the illustration.



C.R.T. TESTER/REACTIVATOR



★ **TESTS** any tube without removal from set or carton.

★ **REPAIRS** tubes discarded for low emission.

★ **MEASURES** A.C. Volts, ★D.C. Volts, E.H.T.

The Radar Model 202 Tester-Reactivator is the most comprehensive instrument of its type on the British Market.

(Complete with E.H.T. probe)

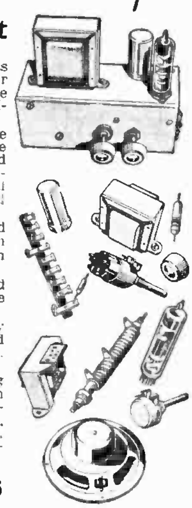
● Measures TRUE Beam Current ● Visual Indication when reactivating is complete (a Radar exclusive) ● Tests and Measures ALL tube Voltages including E.H.T. (another exclusive) ● Measures Resistance up to 100 Megohms ● Clears leaks by pressing a button ● Heater Current measurement 0-0.5A and 0-2.5A Linear Scale ● Adjusts heater current to ensure accurate Emission Test ● Portable for field or bench service.

BRIEF SPECIFICATION

Tests: Filament Continuity, Heater Current, Inter-Electrode Insulation, Final Anode Beam Current, Heater-Cathode Leakage, 4-stage Reactivation by New Pulsing Method. Universal socket fits all tubes. E.H.T. Probe. Measures: 0-25k Volts A.C., 0-500 Volts D.C., 0-25 kV., 0-100 Megohms. 0-250 micro-amps.
200-250 Volts A.C. Mains. Size 13in. by 10in. by 6in. Weight 14lb.

List Price ~~39~~ OUR PRICE £17.17.0
Plus 9/- P. & P.

Introducing . . HARVERSON'S Monaural Amplifier Kit **39/6**



In response to numerous requests from delighted purchasers of our "SUPER STEREO KIT" we have produced a "MONAURAL AMPLIFIER" on similar lines.

★ A UCL 82 valve provides a triode amplifying stage, and a pentode output stage (3 watts), enabling good amplification and sparkling reproduction to be combined with physical compactness (amplifier size, 7 x 3½ x 6½in. high).

★ Modern circuitry design, good quality O.P. transformer (to match ★3Ω) keep hum and distortion to a low level.

★ The controls, volume on/off, and tone, are complete with attractive cream and gold knobs.

★ The amplifier has a built-in fully smoothed power supply, using a good quality mains transformer (A.C. mains only) and metal rectifier.

★ All you need is supplied including easy to follow instructions which guarantee good results for the beginner and expert. All components, leads, chassis, valve, knobs, etc., are first grade items by prominent manufacturers.

OUR PRICE **39/6**
Plus 4/6 Post and Packing.

5in. LOUDSPEAKER TO SUIT 14/6 **EXTRA**

ALL PARTS SOLD SEPARATELY

For ADDRESS and 3 more pages of STUPENDOUS BARGAINS PLEASE TURN OVER

DEPT. P.W.3.

HARVERSON SURPLUS CO. LTD.

MONAURAL AMPLIFIER

This amplifier as illustrated, made by a leading manufacturer. Mullard valves—ECC83, EL84 x EL84, EZ80. Bass, Treble and Volume on remote panel. Elegant Knobs. OUR PRICE one month only £4.16.6 plus P. & P. 3/6.

STEREOPHONIC AMPLIFIER £5.10.0

Complete with 2 Loudspeakers Plus 4/6 P. & P.

This is a compact amplifier embodying the latest features and giving a high standard of reproduction, with ample volume. Supplied complete with valves (ECL82, ECL82, EZ80), panel, knobs, etc., and two specially selected 3Ω matched loudspeakers. Few only at such a low price. Don't risk disappointment. Order now.

BATTERY CHARGER RECTIFIERS

12 v. 1 amp. ...	5/-
12 v. 2 amp. ...	8/-
12 v. 3 amp. ...	10/-
12 v. 4 amp. ...	14/-
12 v. 5 amp. ...	16/-

P. & P. 6d.

TRANSISTOR BARGAINS

—— ALL FIRST GRADE ——

OC71	8/-
OC72	12/-
OC72 Matched Pair ...	25/-
OC45 Green Spot	15/-
OC45 Blue Spot	15/-
OC44	15/6
OA41 Diode	3/6

Postage on all above 6d.

SPECIAL OFFER

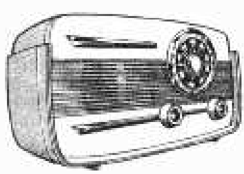
DON'T MISS THIS

MULLARD O.C.76 ... ... 10/6

MATCHED PAIR £1.0.0

Post and packing 6d.

HARVERSON SUPERHET 4 KIT



A medium and long wave superhet, incorporating two I.F. stages modern B9 valves (UCH81, UBF89, UCL83, U785), built-in ferrite rod aerial. All you need supplied from theoretical wiring diagram to last nut and bolt (main components ready mounted), including an attractive contemporary styled cream plastic cabinet with gold trimmings. Size 11½ x 4½ x 6½in.

PRICE £6.12.6 Post 3/6

All parts sold separately.

TRANSISTOR RECORD PLAYER CASE

A few only—Transistor record player cases in light grey cloth—complete with motor board. Size: 12 x 8 x 6in.

P. & P. 1/9 **18/6** each.

1/6 H.P. MOTOR

140 Watt (Approx. 1/6 H.P.). Series wound, 220/250 volt 50 cycle motor. Off load 14,000 rev/min. on load 8,500 rev/min. Ideal small saw, sewing machine, etc. post free. 30/-

SLOW MOTION TUNERS

500-500 Twin gang condensers with geared slow motion drive. 3/6 ea. 36/- per doz. P. & P. 6d.

WIRE WOUND POTS

12 Wire Wound Colvern Pots—all different values P. & P. 9d. 10/6

COSSOR C.R.T. SNIP

108K 10-inch. New and boxed 15/-, plus 6/- P. & P.

75K 10-in. New and boxed 15/-, plus 6/- P. & P.

ION TRAP MAGNETS

To suit the above, 2/9 each. P. & P. 3d.

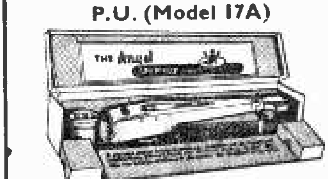
Mazda CRM 172—Not a Regun. Picture tested—12 months' Guarantee. £3.17.6. 12/6 P. & P.

CYLDON 12 CHANNEL TURRET TUNERS

New purchase offered at still lower price I.F. 33-38 Mc/s. Complete with PCC84 and PCF80 valves and 8 sets of Coils for 5 Band I Channels and 8, 9, 10 Band III. New and unused. Value over £7. OUR PRICE, post paid 32/6

GRAM & TAPE EQUIPMENT BARGAINS

THE WORLD FAMOUS E.M.I. ANGEL TRANSCRIPTION P.U. (Model 17A)



A Pick-up for the connoisseur originally priced at £17.10.0. The last remaining few offered at £4.10.0 Plus P. & P. 5/-.

RECORD CHANGERS

GARRARD

RC 98 Mk. 4H.	4-speed autochanger	£16.10.0
RC 120/D Mk.2	,, ,,	£9. 0. 0
RC 120 Mk.4D	,, ,,	£9. 0. 0
RC 120 Mk.4H	,, ,,	£9. 0. 0
RC 121 Mk.1	,, ,,	£11.0. 6
RC 121 Mk.4H	,, ,,	£11.0. 6
RC 121/40 Mk.2	,, ,,	£11.0. 6

Write for our new super list of Tape Decks and Changers.

B.S.R.

Monarch UA8 4-speed autochanger.	£6.19. 6
TU8 4-speed single player less pick up	£2.10. 0
UA14 Stereo Changer	£9.5.0

NOTE: Any of the above with Stereo Cartridge and Fittings, 16/- extra. Carriage and ins. on each of above 5/- extra.

TAPE DECKS

LATEST B.S.R. MONARDECK (single speed) 3¾in. per sec., simple control, uses 5¾in. spools .... £7.5.0 plus 5/6 carriage and insurance (tapes extra).

TRUVOX MARK III TAPE DECK. New and Boxed .... £10.6.6 Plus 6/- carr. and ins. (tapes extra).

E.M.I. 4-SPEED RECORD TURNTABLE & PICK-UP

Heavy 8¾in. metal turntable. Low flutter performance 200/250 v. shaded motor with tap at 80 v. for amplifier valve filament if required. Turnover LP/78 head.

89/6 COMPLETE Plus 4/6 P. & P.

SWITCHED ATTENUATOR

Audio to V.H.F. in four steps of 20 dB ± 0·02 dB up to 300 Mc/s. Cost £5.10.0 OUR PRICE £2.19.6 Plus 1/-. P. & P.

CONDENSER/RESISTOR PARCEL

50 mixed P.F. Condensers and 50 mixed Resistors. An assortment of useful values. All popular sizes—all new—a must for the serviceman and constructor. P. & P. 1/-. ONLY 10/-

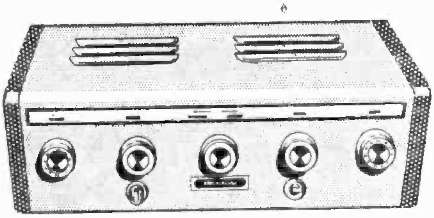
MIDGET I.F. TRANS & COILS

A Pair of midget 465 kc/s I.F. transformers, plus LW and MW coils. PRICE 10/- per set. P. & P. 1/9. Set of I.F. transformers for transistor superhet. 12/6. P. & P. 1/9.

HARVERSON SURPLUS CO. LTD. Dept. P.W.3

83 HIGH STREET, MERTON, S.W.19. CHErrywood 3985/6/7

HI-FI STEREO/MONAURAL AMPLIFIER



It is with great pleasure that we are able to offer an amplifier of this quality, (it will satisfy the most discerning enthusiast) at a price which places it within the reach of most people. This being the product of a company famed as a specialist in the audio Hi-Fi field it is made to very exacting standards.

It is designed for stereophonic reproduction from records, or tape, and monaural reproduction from records, tape, microphone, radio tuner, etc. Setting the STEREOPHONIC/MONAURAL control to stereo operation divides the amplifier section into two 2 valve Hi-Fi amplifiers, whilst switching to the monaural position reunites these into a quality push pull amplifier.

The unit is self powered by an internal power-pack, employing valve rectifier and mains transformer. The latter has a tapped input (200-210, 220-230, and 240-250 volts A.C.50 cycles only) and is double wound, providing complete isolation from the mains. This enables the amplifier to be used in conjunction with any equipment in perfect safety.

Five controls are provided in addition to an on/off switch, VOLUME I, TONE I, STEREOPHONIC/MONAURAL switch, TONE II, and VOLUME II. Both volume controls are calibrated to assist in securing perfect balance, and the tone controls are so designed that clockwise movement increases the treble response, whilst turning anti-clockwise causes the bass to predominate.

The complete unit is mounted in a stylish hammer finished metal case, stove enamelled in glossy two tone grey and slate blue. The cabinet front panel is equipped with a white on/off switch, red indicator neon with gold escutcheon, cream and gold name plate, five gold and white knobs and a cream and gold strip running full length above the knobs bearing the control names. On the back are the stereo and monaural inputs, mains voltage selector, and loudspeaker terminals. Matching is provided for a 3 ohm and 15 ohm speaker, for each channel. This enables the use of a bass speaker and tweeter on each channel, provided that one speaker has 15 ohm and the other speaker has 3 ohm impedance.

Unrepeatable at this price.

OUR PRICE £9.19.6 plus 4/6 post & packing.

YET ANOTHER HARVERSON AMPLIFIER SCOOP FOR ONLY 21/-

PLUS 6/6 P.P. & INS.

Owing to a fortunate purchase, we are able to supply these amplifiers at a fraction of the price normal for comparable equipment. Although not new, these units are in good condition, and represent a first class buy. Originally made for a relay wireless company, they are built to strict specifications by a prominent maker.

BASICALLY EACH UNIT COMPRISES . . .

R.F. AMPLIFIER, using a 10F3 valve, all contained in a screening box.

AUDIO AMPLIFIER, employing a 10P14 valve, and giving a good reproduction at 3 watts.

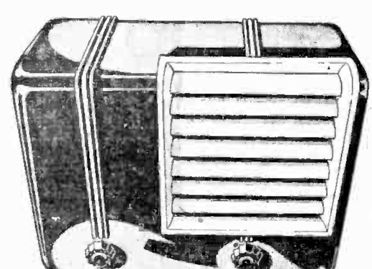
POWER PACK both the R.F. and the Audio amplifier are fed by a common internal fully smoothed power supply. This is provided by a tapped mains dropper (input 200/250 volts AC/DC), and a U404 rectifier valve.

INPUTS. Inputs are supplied for AC/DC mains, crystal pick-up, and six pre-set channels.

SPEAKER. A good qaulity 15 Ω permanent magnet 8-inch round speaker is fitted.

CABINET. All the above are housed in an attractive brown bakelite case, with cream speaker slats. (Case size 14" x 11½" x 6").

The applications to which these amplifiers can be put are limitless, for apart from the obvious use as a gram amplifier (2 can be used for stereo) they can be adapted for countless other uses, e.g. baby alarms, inter-coms, guitar amplifiers, etc.



OUR PRICE, including valves. ONLY **21/-** plus 6/6 post & insurance.

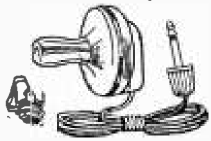
◀ Please turn back for another 3 pages of Bargains

Solderless Transistor 3

Any boy from eight years onwards will easily make this pocket size transistor set. No soldering is involved and in fact the set can be made up virtually without tools. It is nevertheless a workmanlike job which, when completed, will receive Luxemburg and local stations entirely without aerial or earth. Uses two transistors and diode in reflex circuit. Other features include optional medium and long waves and loud speaker.

The parcel contains everything necessary to complete as follows:—
Packet of Solderless terminals.
Packet of Condensers.
Packet of Resistors.
Packet of Transistors.
Connecting wire.
Proper plastic transistor set case with printed scale and tuner.
Hearing aid type headphone.
Plug and socket with on/off switch, and full comprehensive easy to follow instructions. Price 37/6 plus 2/6 post and insurance.

Miniature Earphones



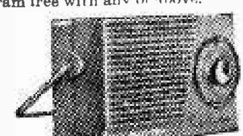
For Transistor Circuits or Deaf Aid. Very light weight and easy to wear, cord almost invisible, good quality production of music and voice, complete with miniature plug and socket, ready to use—correct impedance OK for red spot and similar transistors. Crystal and Magnetic. 9/-. Post and Insurance 1/-.

Miniature Plug and Socket

as used with the above can be supplied separately. Price 3/6.

Smallest Possible 2-gang

With built in trimmers, polystyrene cased, size only 1 x 1 x 7/16in., price 17/6. Smallest IF and oscillator to match, 21/-. P.P. input and P.P. output transformers, 12/6. Circuit diagram free with any of above.



Transistor Set Cabinet

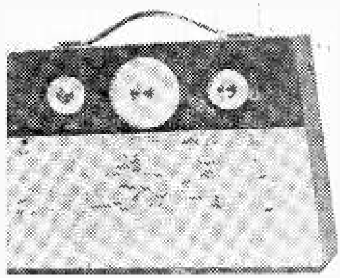
Very modern cream cabinet, size 5¼ x 3 x 1¾ in. with chrome handle...tuning knob and scale. Price 7/6, plus 1/6 postage and packing.

High Voltage Rectifiers

CV19 63 kV.. Peak 800 mA	£4 17 6
CV15 04 60 kV.. Peak 1,200 mA	£5 17 6
CV74 40 kV.. Peak 600 mA	£2 17 6
CV1508 8 kV.. Peak 1,000 mA	£1 17 6
CV1111 14 kV.. Peak 350 mA	7 6

THE REAL COMPANION

CAR RADIO PORTABLE



There's nothing to compare with this so don't buy your portable until you have heard this one—call at any branch for demonstration—you will be well satisfied—why not earn spare time cash making them up for your friends?

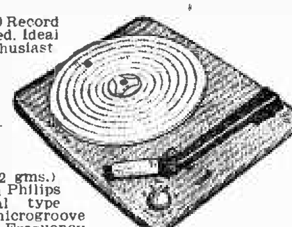
NOTE THESE FEATURES

★ 400/500 mw. Output Push-Pull. ★ 6 First Grade Transistors. ★ Latest Type Superhet Circuit. ★ Medium and Long Wave. ★ Internal Ferrite aerial litz wound. ★ High "Q" coils. ★ Latest type printed circuit with components plan. ★ Slow motion tuning. ★ Car aerial attachment. ★ Two-tone cabinet. ★ High flux elliptical speaker. ★ Size 11 x 8 x 3in. approximately. ★ Easy to follow instructions. ★ 12 months' guarantee all components. ★ No technical knowledge required. ★ Service available at moderate charges.

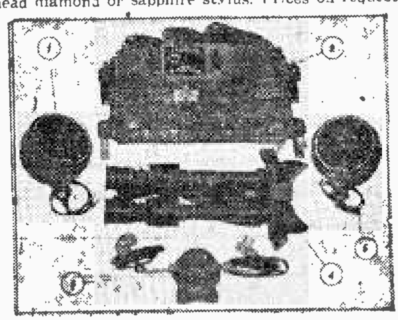
ORDER IN CONFIDENCE

Money returned in full if parcel not up to expectation and returned unassembled. Price complete, less battery £9/19/6. Battery 3/6 plus carr. and insurance 7/6.

PHILIPS TRANSCRIPTION UNIT

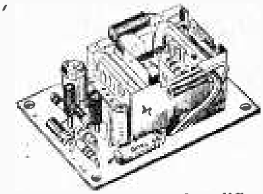


Philips AG 200 Record Player, 4 speed. Ideal for the enthusiast Pick-up arm wired for stereo, fine adjustment on all four speeds. Continuously variable pick-up weight (2.12 gms.) Supplied with Philips Hi-Fi crystal type AG3019 for microgroove and 78 r.p.m. Frequency response 30-15,000 c/s. Pick-up lifting and lowering device. Individually balanced heavy turntable. Muting switch. Can be used with any amplifier or radio set. Complete with monaural pick-up £10.10.0, or 2gns. deposit and 20 fortnightly payments of 10/-. Available also with stereo head diamond or sapphire stylus. Prices on request.



TABBY EQUIPMENT COMPLETE

Complete equipment for seeing in the dark, as fitted to Army vehicles for night driving, etc. Complete working equipment comprises: 2 Infra Red Radiators, adjustable binoculars, power pack for 6 or 12 volts, control units and inter-connection cables. Original cost probably around £100. Unused and in perfect order —£6.19.6 or 10/- deposit and 15 fortnightly payments of 10/-.



1 Watt Transistor Amplifier

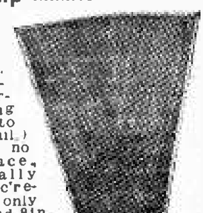
2 x CX71's direct coupled cascade drive to 2 precision matched OC74's in Class B push-pull provide up to 1 W. undistorted output from 5 mV: in at 1.5 K-ohm Frequency response. 60-16,000 c/s ± 3 dB. Overall size 3 x 2.2 x 1.2in 92/6. Post and ins. 2/6.

Yaxley Switches

Price 69/6 plus 2/6 post and insurance.

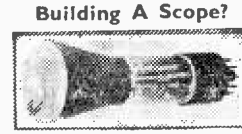
1 Pole 3 Way	1/6
1 Pole 5 Way	2/-
1 Pole 12 Way	3/-
2 Pole 2 Way	2/6
2 Pole 4 Way	2/-
2 Pole 6 Way	2/6
2 Pole 8 Way	3/6
2 Pole 12 Way	4/6
3 Pole 3 Way	1/6
3 Pole 6 Way	3/6
4 Pole 4 Way	3/-
6 Position Shorting	2/-
6 Pole 3 Way	2/6
6 Pole 3 Way	3/6
8 Pole 2 Way	2/-
9 Pole 3 Way	2/6
12 Pole 2 Way	2/-

Hi-Fi Snip Infinite Wall Baffle



Nicely veneered and polished. Corner fitting (attaches to picture rail.) Takes up no floor space. Gives really fantastic results with only low-priced 8in speaker. Fitting for tweeter. Only 45/- each, carriage and insurance 3/6.

Building A Scope?



3in. oscilloscope tube. American made type No. 3FP7, octal base 6.3 v. 0.6 amp. heater, electrostatic deflection, brand new and guaranteed, with circuit diagram of scope, 15/- each, plus 1/6 post and insurance.

Connecting Wire

P.V.C. covered in 100ft. coils—2/9 a coil or four coils different colours, 10/- post free.

Miniature Microphone

American made. Dynamic type, real bargain at 2/6, plus 6d. postage.

POCKET LOUDSPEAKER TRANSISTOR RADIO

Available Again at 42/6

Read these Testimonials

D. A. Hilton, Leigh, Lancs.
"I received 'Pocket 4' on Christmas Day. I made it up on Boxing Day and I am very pleased with the results. It brings in local stations and many foreign stations including Luxemburg at good strength. I am 13 years old".

Mr. J. Bell, Wolverhampton.
"I am writing to express my satisfaction at the standard of your kit for your Pocket 4 Transistor set and also to state that it has come up to my expectations in regard to performance".

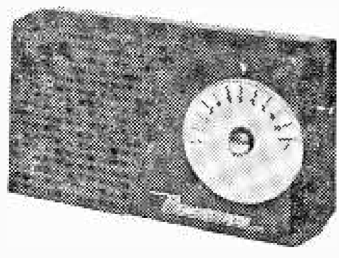
Mr. R. Belt, Newcastle-on-Tyne.
"I have built your Pocket 5 Transistor set, I am very pleased with it".

Mr. F. Jackson, Ickenham, Middx.
"I have built the Pocket 4 and am more than pleased with the results".

Mr. G. Bamford, Ramsgate.
"I find this set even better then you claim it to be and most certainly up to your usual standard of quality. I feel that nobody could fail to build it and get results. Even the first-time-ever novice, as your circuit diagrams and instructions are so clear and precise".

Mr. A. J. Simmonds, Welling, Kent.
"I purchased from you a week ago the Pocket 4 Transistor Kit, I put it together last night in 1½ hours, on switching on the set I was right on Radio Luxemburg. I must say thank you because not only has the set a very attractive appearance, it also behaves fantastically".

Over 1,000 letters received.



AVAILABLE WITH FIRST GRADE TRANSISTORS AND FOR LONG AND MEDIUM WAVES

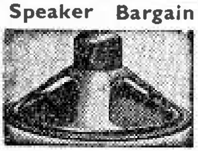
Circuit comprises 2 HF transistors reflexed to equal 4 stages. Permanent germanium diode and high gain AF output stage, fitted with miniature speaker, proper tuning condenser, volume control and in case with handle as illustrated (less monogram), completely portable. No **aerial or earth required.** Pocket 4 uses 3 transistors and 1 diode, price 52/6, plus 2/6 post and insurance. Pocket 5 uses 4 transistors and 1 diode and has feedback control, price **67/6**, plus 2/6 post and insurance.

GOOD RESULTS EVERYWHERE

Nothing can be more disappointing than to find that despite care in making up, your radio just will not work or needs a long high aerial and water pipe earth. We can prove good results in all areas and we guarantee all components for 12 months. Read just a few of the hundreds of testimonials we have received from constructors who have made these sets. Send in confidence. Money refunded if not up to your expectations. Plans free with parts, or separately **1/6**. More details S.A.E.

Also again available with S.B. transistors as last year 42/3 and 52/6, plus 2/6 post and packing M.W.

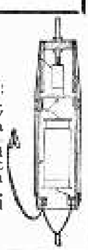
Speaker Bargain



12in. Hi-fidelity loudspeaker. High flux, permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new by famous maker. Price 32/6, plus 3/6 post and insurance.

Last Month's Blueprint
Come to us for all the parts—or send for list.

TRANSISTORISED STETHOSCOPE



Trace signal right through: Radio, T.V., Tape amplifier, Hi-Fi, etc.—simplest way to fault find—carry it like a fountain pen—all parts including transistor barrel crystal, everything except battery, 12/6 plus 1/6, data included or separately **1/6.** Or complete with deaf aid type earphone, 20/-.

Transistors for R.F., F.M., T.V. and U.H.F.

Frequencies quoted are approx. cut-off.

SB 078 15-20 Mc/s	8/6
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Re-gunned Tubes

We offer television tubes which have had new gun assemblies, new getters, new screens and have virtually been rebuilt as new

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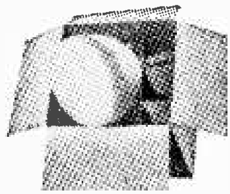

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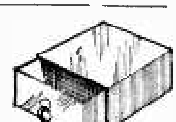

SUB MINIATURE COMPONENTS FOR TRANSISTOR SETS

- ★ Push-pull o.p.t. and driver **17/9** pair (500 milliwatt). **12/6** pair (300 milliwatt).
- ★ Push-pull driver with Sep. Secondaries for transformerless output **6/6.**
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- ★ Ferrite aerial with coils for medium and long wave and circuit **7/6.** Ditto for standard size set **10/6.**
- ★ Two gang tuning condenser to suit above I.F.S. and rod aerial—**11/6,** fast and slow; **9/6,** ordinary.
- ★ Printed circuit for above with construction data superhet pocket size **8/6.** Standard size **7/6.**
- ★ Smallest possible electrolytics **1/9** each. 1 mfd., 2 mfd., 8 mfd., 10 mfd., 20 mfd., 30 mfd., 50 mfd., 100 mfd., 200 mfd.
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- ★ Set of 6 transistors for superhet in original packets guaranteed. Mullard OC44., OC45., OC71 matched pair OC72 **£3.10.0** the set.
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- ★ Elliptical Speaker, 7" x 4", 3 ohm or 35 ohm **19/6.**

"Dim and Full" Switch

Particularly useful for controlling photoflood lamps which have only a short life at full brilliance. This switch has three positions; the first position puts two lamps in series at half brilliance for setting up, the second position is off and the third position full brilliance for the operation shots. Also useful for controlling night lights, heaters, etc., etc. Price 3/9 each, post 9d. Circuit diagram included.
Ditto but without the off position i.e. d.p.d.t., 10 amp 2/9.

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6AB8	9/-
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6AK5	8/-
6AL5	4/-
6AM6	4/6
6AQ5	7/6
6AT6	7/-
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6AV6	12/8
6B8	5/-
6BA6	7/6
6BE6	6/-
6BG6G	23/3
6BH6	8/-
6BJ6	6/-
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6BS7	25/-
6BW6	8/6
6BW7	6/-
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6C5	6/6
6C6	6/6
6C9	13/6
6C10	9/-
6CD6G	36/6
6CH6	9/-
6D3	19/11
6D6	6/6
6E5	12/6
6FI	26/6

6F6G	7/-
6F11	17/3
6F12	4/6
6F13	11/6
6F14	26/6
6F15	15/3
6F16	9/6
6F17	12/6
6F23	10/6
6F32	10/6
6F33	7/6
6G6	6/6
6H6GT	3/-
6J5	5/-
6J6	5/6
6J7G	6/-
6J7GT	10/6
6K7G	5/-
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6K8G	6/6
6K25	19/11
6L1	23/3
6L6G	8/-
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6L18	13/-
6L19	23/3
6LD3	8/6
6LD20	15/11
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6P28	26/6
6Q7G	6/6
6Q7GT	11/-
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65A7GT	8/6
6SC7	7/6
6SG7GT	8/-
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6SJ7GT	8/-
6SK7GT	6/-
6SL7GT	6/6
6SN7GT	5/6
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6U4GT	12/6
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6V6G	7/-
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6X4	5/-
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6/30L2	10/-
7A7	12/6
7B6	21/3
7B7	8/6
7C5	8/-
7C6	8/-
7H7	8/-
7R7	12/6
7S7	9/6
7V7	8/6
7Y4	7/6
8D2	3/6
8D3	4/6
9BW6	15/3
9D2	4/-

10C1	13/-
10C2	26/6
10D2	12/-
10F1	26/6
10F9	11/6
10LD3	8/6
10LD11	15/11
10P13	15/-
10P14	19/3
12A6	5/-
12AC6	15/3
12AD6	17/3
12AE6	13/11
12AH7	8/-
12AH8	12/6
12AT6	7/6
12AT7	6/-
12AU6	23/3
12AU7	6/6
12AV6	12/8
12AX7	7/6
12BA6	8/-
12BE6	9/-
12BH7	21/3
12E1	30/-
12J5GT	4/6
12J7GT	9/6
12K5	17/11
12K7GT	5/6
12K8GT	14/-
12Q7GT	5/-
12SA7	8/6
12SC7	8/6
12SG7	7/-
12SH7	8/6
12SJ7	8/6
12SK7	6/-
12SQ7	11/6
12SR7	8/6
12Y4	10/6
14S7	27/10
19AQ5	10/6
19H1	10/-
20D1	15/3
20F2	26/6
20L1	26/6
20P1	26/6
20P3	23/3
20P4	26/6
20P5	23/3
25A6G	10/6
25L6GT	10/-
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25Z6G	10/-
27SU	19/11
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30F5	6/-
30FL1	10/-
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30L15	11/6
30P4	12/-
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35A5	21/3
35L6GT	9/6
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35Z3	10/6
35Z4GT	6/-
35Z5GT	9/-
43	10/-
50C5	10/-
50CD6G	36/6
50L6GT	9/6
53KU	19/11
72	4/6
77	8/-
78	6/6
80	9/-
83	15/-
150B2	15/-
161	10/6
185BT	33/2
185BTA	33/2
304	10/6
305	10/6
807	7/6
956	3/-
1821	16/7
5763	12/6
7193	5/-
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9002	5/6
AC/PEN 5-pin	23/3
7-pin	15/-
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AC6PEN	7/6
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ATP4	5/-
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B36	15/-
BL63	7/6
C1	12/6
C1C	12/6
CBL1	26/6
CBL31	23/3
CCH35	23/3
CK506	6/6
CL33	19/3
CV63	10/6
CY1	18/7
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D1	3/-
D15	10/6
D63	5/-
D77	4/-
DAC32	10/6
DAF91	6/-
DAF96	8/6
DD41	13/11
DET25	7/6
DF33	10/6
DF66	15/-
DF91	3/6
DF96	8/6
DF97	9/-
DH63	6/6

DH76	5/-
DH77	7/-
DK32	12/-
DK40	21/3
DK91	6/6
DK92	9/-
DK96	8/6
DL33	9/6
DL66	17/6
DL68	15/-
DL72	15/-
DL92	7/-
DL94	7/6
DL96	8/6
DM70	7/6
E80F	20/-
EA50	2/-
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EABC80	9/-
EAC91	4/6
EAF42	9/-
EB34	2/6
EB41	8/6
EB91	4/-
EBC3	23/3
EBC33	5/-
EBC41	8/6
EBC81	8/-
EBF80	9/-
EBF83	13/11
EBF89	9/6
EBL21	23/3
EBL31	23/3
EC52	5/6
EC54	6/-
EC70	12/6
EC92	13/3
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ECC33	8/6
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ECC40	23/3
ECC81	6/-
ECC82	6/6
ECC83	7/6
ECC84	9/-
ECC85	8/6
ECC88	18/-
ECC91	5/6
ECF80	10/6
ECF82	10/6
ECH3	26/6
ECH21	23/3
ECH35	6/6
ECH42	9/-
ECH81	9/-
ECH83	13/11
ECL80	9/-
ECL82	10/6
ECL83	19/3
EF9	23/3
EF22	14/-
EF36	4/-
EF37A	8/-
EF39	5/6
EF40	15/-
EF41	9/-
EF42	10/6

EF50(A)	7/-
EF50(E)	5/-
EF54	5/-
EF73	10/6
EF80	6/-
EF85	6/-
EF86	10/6
EF89	9/-
EF91	4/6
EF92	4/6
EF97	13/3
EF98	13/3
EF183	18/7
EF184	18/7
EK32	8/6
EL32	5/-
EL33	12/6
EL34	15/-
EL38	26/6
EL41	9/-
EL42	10/6
EL81	12/6
EL83	19/11
EL84	7/6
EL85	13/11
EL86	17/3
EL91	5/-
EL95	10/6
EL820	18/7
EL822	25/-
EM34	9/6
EM71	23/3
EM80	9/-
EM81	9/-
EM84	10/6
EN31	37/-
EY51	9/-
EY83	16/7
EY84	14/-
EY86	9/-
EZ35	6/-
EZ40	7/-
EZ41	7/-
EZ80	7/-
EZ81	7/-
FC4	15/-
FC13	26/6
FC13C	26/6
FW4/500	8/6
FW4/800	8/6
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GZ33	19/11
GZ34	14/-
GZ37	19/11
H63	12/6
HABC80	13/6
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HL23DD	7/6
HL41DD	19/3
HL42DD	19/3
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KL35	8/6
KLL32	24/7
KT2	5/-
KT33C	10/-
KT36	29/10
KT41	12/6
KT44	12/6
KT61	12/6
KT63	7/-
KT66	15/-
KT88	24/-
KTW61	6/6
KTW62	7/6
KTW63	6/6
KTZ41	8/-
KTZ63	7/6
L63	6/-
LN152	9/-
MHL4	7/6
MHLD6	12/6
ML4	8/6
MS4B	23/3
MU12/14	8/-
N37	23/3
N78	19/11
N108	23/3
N308	20/7
N339	15/-
P61	3/6
PABC80	13/11
PCC84	8/-
PCC85	9/6
PCC88	18/-
PCC89	11/6
PCF80	8/-
PCF82	10/6
PCF84	16/7
PCF86	15/-
PCL82	10/-
PCL83	10/6
PCL84	12/6
PCL85	16/7
PENA4	12/6
PENB4	26/6
PEN4DD	26/6
PEN25	4/6
PEN40DD	25/-
PEN44	26/6
PEN45	19/6
PEN45DD	26/6
PEN46	7/6
PEN383	23/3
PEN453DD	33/2
PEN/DD 4020	33/2
PL33	19/3
PL36	12/-
PL38	26/6
PL81	10/6
PL82	7/6
PL83	9/-
PL84	12/8

PL820	18/7
PM2B	12/6
PM12	6/6
PM12M	6/6
PM24M	21/3
PX4	10/6
PY31	16/7
PY32	17/11
PY80	7/6
PY81	8/6
PY82	7/-
PY83	8/6
PZ30	19/11
QP21	7/-
QP25	14/6
QS150/15	10/6
R12	9/-
R18	14/-
R19	19/11
RG1/240A	45/-
RK34	7/6
S130	22/6
SP4(7)	14/6
SP41	3/6
SP42	12/6
SP61	3/6
SU25	26/6
SU61	9/-
T41	9/-
TDD4	12/6
TH41	26/6
TH233	33/2
TH2321	20/-
TP22	15/-
TP25	15/-
TP2620	33/2
TY86F	13/3
U12/14	8/6
U16	10/-
U18/20	8/6
U22	8/-
U24	29/10
U25	17/11
U26	10/-
U31	9/6
U33	26/6
U35	26/6
U37	26/6
U43	9/-
U45	9/-
U50	6/6
U52	6/6
U54	19/11
U76	6/-
U78	5/-
U107	16/7
U191	16/7
U201	16/7
U251	14/-
U281	19/11
U282	22/7
U301	23/3
U329	14/-
U339	16/7
U403	16/7
U404	8/6

U801	29/10
U4020	16/7
UABC80	9/-
UAF42	9/6
UB41	12/-
UBC41	8/6
UBC81	11/4
UBF80	9/-
UBF89	9/6
UBL21	23/3
UCC84	14/7
UCC85	9/-
UCF80	16/7
UCH21	23/3
UCH42	9/6
UCH81	9/6
UCL82	11/6
UCL83	19/3
UF41	9/-
UF42	12/6
UF80	10/6
UF85	9/-
UF86	17/11
UF89	9/-
UL41	9/-
UL44	26/6
UL46	14/6
UL84	8/6
UM4	17/3
UM80	15/3
URIC	18/7
UU6	19/11
UU7	16/7
UU8	26/6
UU9	7/6
UYIN	18/7
UY21	13/11
UY41	7/6
UY85	7/-
VMS4B	15/-
VP2	12/6
VP4	15/-
VP2B	14/6
VP4B	23/3
VP13C	7/-
VP23	6/6
VP41	6/-
VR105	8/-
VR150	7/6
VT61A	5/-
VTS01	5/-
W76	5/6
W81M	6/-
W107	18/7
W729	19/11
X24M	24/7
X41	15/-
X61(C)	12/6
X61M	26/6
X63	9/-
X65	12/6
X66	12/6
X76M	14/-
X78	23/3
X79	23/3
X109	17/3
XD(1.5)	6/6
XFG1	18/-

XFY12	9/6
XYF34	17/6
XH(1.5)	6/6
XSG(1.5)	6/6
Y63	7/6
Z63	7/6
Z66	17/6
Z77	4/6
Z719	16/-
Transistors and diodes	
CG1C	7/6
CG4E	7/6
CG6E	7/6
CG7E	7/6
CG10E	7/6
CG12E	7/6
GD3, 4, 5, 6, 8	4/-
OA70	4/-
OA73	4/-
OA79	4/-
OA81	4/-
OA86	6/-
OA91	5/-
OA95	5/-
OA210	25/-
OA211	40/-
OC16	54/-
OC19	54/-
OC23	87/-
OC26	44/-
OC28	25/-
OC35	48/-
OC44	26/-
OC45	23/-
OC65	22/6
OC66	25/-
OC70	14/-
OC71	14/-
OC72	17/-
OC73	20/-
OC75	15/-
OC76	15/-
OC77	21/-
OC78	17/-
OC81	18/-
OC170	35/-
OC200	54/-
OC203	58/-
TJ1	40/-
TJ2	45/-
TJ3	50/-
TP1	40/-
TP2	40/-
TS1	10/-
TS2	12/6
TS3	15/-
TS4	24/-
XA101	23/-
XA102	26/-
XA103	15/-
XA104	18/-
XB102	10/-
XB103	14/-
XB104	10/-
XC101	16/-

RADIO BOOKS. MULLARD AMPLIFIER MANUAL. 9/6d. MULLARD TRANSISTOR MANUAL 13/6d. BRIMAR VALVE MANUAL 7/-. ALL POST FREE.

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All with Long Spindle and Double-pole Switch. 4/6 each.

10 K 25 K 50 K 100 K
½ mg. ¼ mg 1 meg. 2 meg.

METAL RECTIFIERS *Full List with ratings free for S.A.E.*

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RM-3	7/9
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JUST OUT. MIDGET SILICON RECTIFIERS. OUTPUT 120 VOLTS AT ½ AMP. TWO IN SERIES GIVE 240 VOLTS AT ½ AMP. NO LARGER THAN A RESISTOR. 10/6 EACH.

ELECTROLYTIC CONDENSERS

Standard Can

16 x 8 x 8 mfd., 500 v.	4/-
32 x 32 mfd., 450 v.	5/9
64 x 120 mfd., 350 v.	8/3
60 x 250 mfd., 275 v.	9/6
100x400 mfd., 275 v.	12/6
100 mfd., 275 v.	3/-
200 mfd., 275 v.	4/-
100x200 mfd., 275 v.	9/6

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8 mfd., 450 v.	1/9
16 mfd., 450 v.	2/9
32 mfd., 450 v.	3/9
32 mfd., 350 v.	2/6
8 x 8 mfd., 450 v.	3/-
16 x 16 mfd., 450 v.	4/-
32 x 32 mfd., 350 v.	4/-
8 x 16 mfd., 450 v.	3/9

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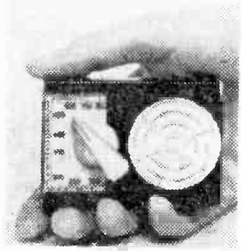
SENSATIONAL NEW 1961 DESIGNS—*BY CONCORD*

LOW PRICES ★ PICTORIAL STEP-BY-STEP PLANS ★ EASY AS A.B.C.

THE NEW "LISBON" TRANSISTOR SET

19/6

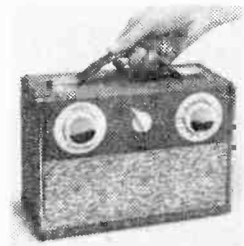
Build the miniature, highly sensitive **"LISBON"** design. This is a pocket 2-stage transistor set not much larger than a matchbox. Excellent clear reception covering all medium waves and working for months and months off a tiny 1½ or 3 volt battery costing only 3½d. A very simple set to build and an excellent introduction to transistor circuitry. Everything can be supplied down to the last nut and bolt including **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS FOR ONLY 19/6**, plus post and packing 1/6. (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



"MAJORCA" 7 TRANSISTOR RADIO

£10.19.6

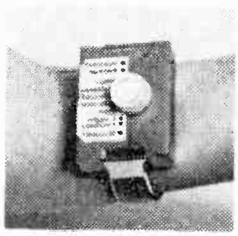
Build this 7-TRANSISTOR "MAJORCA" superhet portable with Car Radio aerial attachment. An exceptional high quality design giving remarkable tone with push-pull output. Can be built for **ONLY £10.19.6**, including everything down to the last nut and bolt and **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS**. Post and packing 3/6 (C.O.D. 3/- extra). Parts sold separately.



OUR NOVEL WRIST RADIO

22/6

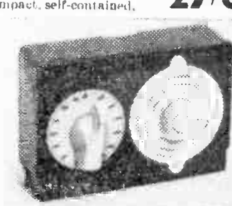
Our engineers have designed this novel Wrist Radio using latest transistor techniques. Size only 1½ x 1 x ½in. "Featherweight" yet gives clear, crisp reception over all medium waves. Tiny battery lasts months and months costing only 4d. No snags—anyone can build it in an hour or two using our **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS.** All parts can be supplied including case and strap **FOR ONLY 22/6**, plus post and packing 1/6 (C.O.D. 2/- extra.) Parts sold separately, priced parts list 1/-.



THE NEW "FLORIDA" VALVE RADIO

27/6

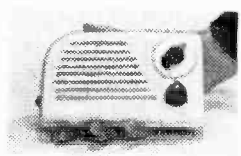
This sensational **"FLORIDA"** model is one of our most sensitive valve radios. It is a highly compact, self-contained, miniature push button base, valve pocket radio at absolutely rock bottom building cost. Covers all medium waves with very latest circuitry bringing in stations from all over Europe without fuss. Size only 4½ x 2¾ x 1½in. A fascinating pocket radio. We can supply all the parts including beautiful 2-tone case and **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS**, screws, wire, etc. Can be built for the exceptionally **LOW PRICE OF 27/6**, plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



OUR NEW 4 STAGE "MINUETTE"

39/6

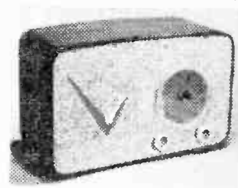
Build this newly-designed **"MINUETTE" 4-STAGE** transistor set in very strong ready drilled **ULTRA-MODERN CASE**, size only 6 x 3½ x 1in. Uses three transistors and diode and **SELF-CONTAINED LOUD SPEAKER**. Very sensitive, ideal for office, bedroom, holidays, etc. Months and months of listening off an 8d. battery. Can be built **FOR ONLY 39/6**, including **PROPER CASE**, miniature speaker, etc. **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS**, etc., plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



THE NEW "MONTE-CARLO" RADIO

£5.15.0

One of our new, exciting designs, the **"MONTE CARLO"** is a powerful, all mains, miniature table radio with the latest trimmings, gold insert knobs, special unmarkable plastic veneer, etc. The amazing circuit covers all medium and long waves with good selectivity, fantastic tone and output. Includes ready drilled and punched chassis, standard octal base valves, etc. All the parts can be supplied including **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS.** Everything down to the last nut and bolt **FOR ONLY £5.15.0**, plus post and packing 3/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.



THE NEW 3-STAGE "RIO"

29/6

Our fabulous new **3-STAGE MINIATURE LOUDSPEAKER DESIGN THE "RIO"** covers all medium waves including Home, Light, etc. Very reliable and lightweight. Works for months and months off an 8d. battery. Can be assembled in an hour or two. All parts can be supplied including miniature speaker and everything down to the last nut and bolt with **SIMPLE AS A.B.C. PICTORIAL STEP-BY-STEP PLANS** for **ONLY 29/6**, plus post and packing 1/6 (C.O.D. 2/- extra). Parts sold separately, priced parts list 1/-.

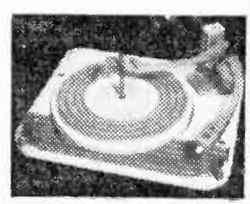
BRAND NEW RECORD CHANGERS

ONLY £8.15.0 BRAND NEW! the latest 4-speed Autochanger, B.S.R. UA14, as illustrated, few only **OUR PRICE £8.15.0.** P.P. 3/6.

BRAND NEW! the B.S.R. 4-speed Autochanger, UA8, few only left. **OUR PRICE £6.15.0.** P. & P. 3/6.

BRAND NEW! the **COLLARO** Junior 4-speed record player. **OUR PRICE 75/-.** P. & P. 3/6.

BRAND NEW! COLLARO "Conquest", 4-speed Autochanger. **OUR PRICE £7.15.0.** P. & P. 3/6.



CONCORD ELECTRONICS

210, Church Road, Hove, Sussex

Dept. PW30

Cheques accepted. Cash on delivery 2/- extra. Please print name and address in block letters. Suppliers to Schools, Universities, Government and Research Establishments. Complete range of components and valves stocked. *Regret no C.O.D. abroad. DEMONSTRATIONS DAILY AT WORKS*

R.S.C. HI-FI TAPE RECORDER KIT

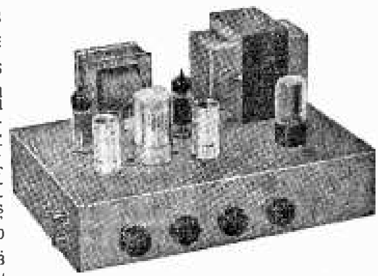
REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN HALF AN HOUR
The Recorder incorporates the Latest Collaro Studio Tape Transcriptor. The Linear LT45X High Quality Tape Amplifier listed £12.12.0 High Flux P.M. Speaker listed 30/-, empty Tape Spool, a Reel of Best Quality Tape listed 22/6 and a Handsome Portable carrying Cabinet with latest attractive two-tone polychrome finish, size 18 x 15 x 9in. high, listed £4.10.0, and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflet.

25½ GNS. Carr. 17/6

H.P. TERMS. Deposit £5.7.6 and 12 monthly payments of 2 gns. Cash price if settled in 3 months.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram. as in A10. High sensitivity. Includes 5 valves. ECC83, ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 D.B. 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc., OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12-9-7in. For A.C. mains 200-250 v. 50 c.p.s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/- (Or factory built 45/- extra).

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/3, and 9 monthly payments of 24/3. Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones, etc., with cash and credit terms.

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER

A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts, suitable for all crystal stereo heads. Ganged Bass and Treble Controls give equal variation of "lift" and "cut". Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. Full constructional details and price list 2/6. **8 Gns.** Carr. 10/-

DEAF AID EARPIECES. Low Impedance with lead, 8/9. High Impedance Crystal 8/9.
MICROPHONE INSERTS. Crystal type, 6/9.

TELEVISION RECTIFIERS 250 v. 200 mA, small size. Only 6/9 each.
RE-ENTRANT SPEAKERS. Tannoy. 8 watt, 7.5 ohms. Only 22/6 each. Parmeko Horn Type, 10 watt, 15 and 200 ohm matching, 59/6. R.C.A. 20 watt, 15 ohms or 200 ohms. 6 gns.
COLLARO RC 457 4 SPEED MIXER AUTO-CHANGERS. Turnover Studio Pick-up head, for 200-250 v. A.C. £7.19.6. Carr 4/6.
THE SKYFOUR T.R.F. RECEIVER. A design of a 3-valve Long and Medium wave 200-250 v. A.C. Mains receiver with selenium rectifier. High gain H.F. stage and low distortion detector. Power pentode output. Valve line-up 6K7, SP61, 6V6G. Selectivity and quality excellent. Simple to construct. Point-to-Point wiring diagrams, instructions and parts list, 1/9, maximum building costs £4.19.6, inc. attractive Walnut veneered wood cabinet 12 x 6½ x 5½in.
D.C. SUPPLY KIT. 12 v. 1 a. consisting of a partially drilled metal case, mains trans., F.W. Bridge Rectifier, 2 fuseholders and fuses. Change Direction switch, variable Speed regulator and circuit. For 200-250 v. A.C. mains. Suitable for Electric Trains, Limited number available at 33/9.

R.S.C. BATTERY CHARGING EQUIPMENT

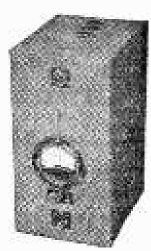
All for A.C. Mains 200-250 v., 50 ccs. Guaranteed 12 months.

ASSEMBLED CHARGERS

6 v. 1 amp.	19/9
6 v. or 12 v. 1 amp.	29/9
6 v. 2 amps.	29/9
6 v. or 12 v. 2 amps.	38/9
6 v. or 12 v. 3 amps. with ammeter	59/9

Above ready for use. With mains and output leads. Carr. 3/6.

HEAVY DUTY CHARGER KIT 6/12 v. 6 amps. variable output. Consisting of Mains Transformer 0-200-230-250 v.; F.W. (Bridge) Selenium Rectifier; Ammeter, Variable Resistor, Panels, Plugs, Fuses, Fuseholder and circuit, 59/9. Carr. 4/6.



Assembled 6 v. or 12 v. 4 amps. Fitted Ammeter and variable charge rate selector. Also selector plug for 6 v. or 12 v. charging. Louvred steel case with stoved blue hammer finished. Fused and ready for use with mains and output leads. **69/9** Carr. 5/- Terms: Deposit 13/3 and 5 monthly payments 13/3.

ASSEMBLED CHARGER 6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case finished attractive hammer blue. Ready for use With mains and output leads. Double Fused. Only **49/9** Carr. 3/9.

BATTERY CHARGER KITS Consisting of Mains Transformer. F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 3/6 extra.

6 v. or 12 v. 1 amp.	24/9
As above, with Ammeter.	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 2 amps. inclusive of Ammeter	42/9
6 v. or 12 v. 4 amps.	53/9
6 v. or 12 v. 4 amps. with Ammeter and variable charge rate selector.	59/9

CHARGER AMMETERS. 0-1.5 a., 0-3 a., 0-4 a., 0-7 a., 0-25 a., 0-60 a. 8/9.

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

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

TOP SHROUDED DROP THROUGH

250-0-250 v. 70 mA, 6.3 v. 2 a, 5 v. 2 a.	17/9
350-0-350 v. 80 mA, 6.3 v. 2 a, 5 v. 2 a.	18/9
250-0-250 v. 100 mA, 6.3 v. 2 a, 6.3 v. 1 a	19/9
250-0-250 v. 100 mA, 6.3 v. 3.5 a, C.T.	19/9
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.	25/9
300-0-300 v. 130 mA, 6.3 v. 4 a, 6.3 v. 1 a, for Mullard 510 Amplifier	29/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.	25/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.	25/9
350-0-350 v. 100 mA, 6.3 v. 4 v, 4 a, C.T. 0-4-5 v. 3 a.	25/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a.	29/9

FULLY SHROUDED UPRIGHT

250-250 v. 60 mA, 6.3 v. 2 a, 5 v. 2 a, Midget type 2½-3-3in.	17/11
250-0-250 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.	26/9
300-0-300 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.	26/9
350-0-350 v. 100 mA, 6.3 v. 4 a, 5 v. 3 a.	26/9
350-0-350 v. 150 mA, 6.3 v. 4 a, 5 v. 3 a.	35/9
425-0-425 v. 200 mA, 6.3 v. 4 a, C.T. 6.3 v. 4 a, C.T., 5 v. 3 a	49/9

FILAMENT TRANSFORMERS
All with 200-250 v. 50 c/s. primaries 6.3 v. 1.5 a, 5/9; 6.3 v. 2 a, 7/6; 0-4-6.3 v. 2 a, 7/9; 12 v. 1 a, 7/11; 6.3 v. 3 a, 8/11; 6.3 v. 6 a, 17/6; 12 v. 1.5 a twice, 17/6.

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.	3/9
Small Pentode, 5000 Ω to 3 Ω	3/9
Small Pentode 7/8,000 Ω to 3 Ω	3/9
Standard Pentode 5,000 Ω to 3 Ω	5/6
Standard Pentode 7/8,000 Ω to 3 Ω	5/6
10,000 Ω to 3 Ω	5/6
Push-Pull 10-12 watts 6V6 to 3 Ω or 15 Ω	18/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω	19/9
Push-Pull EL84 to 3 or 15 Ω	18/9
Push-Pull 15-18 watts, 6L6, KT66	22/9
Push-Pull for Mullard 510 Ultra Linear	29/9
Push-Pull 20 watts, sectionally wound 6L6, KT66 etc., to 3 to 15 Ω	47/9

ELIMINATOR TRANSFORMERS
Primaries 200-250 v. 50 c/s.

120 v. 40 mA, 5-0-5 v. 1 a.	15/9
90 v. 15 mA, 4-0-4 v. 500 mA	9/9

SMOOTHING CHOKES

150 mA. 7-10 H 250 ohms.	11/9
100 mA, 10 H 200 ohms	8/9
80 mA, 10 H 350 ohms	5/9
60 mA, 10 H 400 ohms	4/11

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s Primaries; 0-9-15 v. 1½ a. 11/9; 0-9-15 v. 2 a., 14/9; 0-9-15 v. 3 a, 16/9; 0-9-15 v. 5 a, 19/9; 0-9-15 v. 6 a, 23/9; 0-9-15 v. 8 a, 28/9.

AUTO (Step up/Step down) TRANS.
0-110/120-230/250 v. 50-80 watts, 13/9; 0-110/120-200/230/250 v. 150 watts 27/9.

MICROPHONE TRANSFORMERS
120:1 high grade, clamped, 6/9; 120:1 Potted. Mu-metal screened, 9/9.

FOR VALVES - TUBES AND COMPONENTS - BY RETURN POST SERVICE

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AZ1 10/-
AZ31 10/-
DAF96 8/-
DF96 8/-
DK96 8/-
DL96 8/-
DM70 7/6
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EAF42 9/6
EB91 4/6
EBC3 5/-
EBC33 6/9
EBC41 8/9
EBF80 9/9
EBF89 9/6
ECC81 8/-
ECC82 7/6
ECC83 9/-

ECC84 10/-
ECC85 9/6
ECF80 12/-
ECF82 10/6
ECH42 9/6
ECH81 9/-
ECL80 9/6
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EF6 5/-
EF41 9/6
EF50 5/-
EF50SYL 7/-
EF80 7/-
EF85 7/-
EF86 12/6
EF89 8/9
EF91 5/9

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EK32 7/-
EL32 4/6
EL33 14/-
EL41 9/-
EL84 9/-
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EM81 10/6
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KT61 13/6
KTW61 6/6
MX40 12/6
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N78 19/11
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P61 3/6
PCC84 8/6
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UCC85 9/6
UCH42 9/6
UCH81 9/6
UCL82 11/6
UCL83 13/6
UF85 9/-
UF89 9/-
UL41 9/-
UL84 9/-
UU6 10/-
UYIN 12/6
UY41 7/6
UY85 7/-

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VR105/30 8/-
VR150/30 7/6
VU39(MU 12/14) 8/9
Y63 7/6
1A7GT 13/6
1C2 11/6
1C5GT 12/6
1H5GT 9/-
1N5 10/6
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1S4 10/6
1S5 6/6
1T4 5/6
3D6 5/-
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3V4 8/-
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6AL5 4/-
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6AT6 8/6
6BA6 7/6
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6BH6 9/-
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6F6G 7/-
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6J7G 6/6
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6Q7G 7/6
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6SK7 6/-
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6SN7GT 7/6
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6X5G 7/-

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7B6 10/6
7B7 8/6
7C5 8/-
7C6 8/-
7H7 8/-
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10F1 12/6
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12AH8 12/-
12AT7 7/6
12AU7 8/-
12AX7 8/-
12BA6 9/-
12BE6 9/-
12C8 7/-
12J7GT 10/6
12K7GT 6/6
12K8GT 13/6
12K8M 13/-
12Q7GT 6/6
12SK7 6/-

12SL7 8/-
12SN7GT 10/-
15D2 7/9
25A6 9/-
25L6GT 10/-
25Z4 9/6
25Z5 8/-
25Z6 10/-
30FL1 10/6
30L15 23/3
30P4 15/-
30P12 12/6
30PL1 12/6
35L6GT 10/-
25Y5 9/9
35Z4GT 8/-
42 8/-
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50L6GT 8/6
75 10/6
80 8/6
142BT 3/6
210DDT 4/6
210VPT 3/6

LOUDSPEAKER UNITS

All Brand New

2½in. square Rola C25.........**26/10**
2½in. square EMI...............**18/6**
4in. square Elac Tweeter......**12/6**
5in. round Plessey with O.P.T. **16/6**
6½in. round Celestion.........**17/6**
8in. round Richard Allen......**18/6**
10in. round Elac...............**25/-**
12in. round Plessey............**29/6**
6in. x 4in. Plessey...............**19/6**
7in. x 4in. Plessey...............**19/6**
8in. x 5in. Celestion and Richard Allen **19/11**
10in. x 6in. Celestion and Plessey **22/6**

RECTIFIERS

RM1 **5/3**; RM2 **6/9**; RM3 **7/6**; RM4 **13/6**; RM5 **19/6**; 14A 86 **19/6**; 14A 97 **19/6**; 14A 100 **19/6**; LW7 **17/6**; 18RA 1-1-16-1 **6/-**; FC31 (14Ra 1-2-8-3) **22/6**; FC101 (14RA 1-2-8-2) **16/6**.

Rectifiers suitable for Battery Chargers 6 and 12 volt output:
2 amp .... **7/-** 3 amp...... **10/-**
4 amp .... **12/6** 5 amp **14/6**

HEATER TRANSFORMERS

All 240 v. input 4 v. 3 amp. **10/-**. 6.3 v. 1½ amp. **6/9**. 6.3 v. 3 amp. **10/-**. 12.6 v. ¾ amp. **5/9**. 5 v. 2 amp. **10/-**. 2 v. 3 amp. **8/3**.

"CABY" SUPREME MULTI-RANGE TESTER METER

Solves your problems with speed and accuracy.
Model A10. Measurement ranges: D.C. volts 10 v. to 1,000 v.
A.C. volts 10 v., 50 v., 250 v., 500 v., 1,000 v.
Resistance ohm; 10K ohms, 1 megohm. Size of meter 5¼in. x 3⅝in. x 1⅞in. Price **£4/17/6** inclusive of test prods., instruction and batteries.

P.W. TRANSISTOR SUPERHET PRINTED CIRCUIT VERSION

All components available from stock. Complete kit **£9/15/0.**

Full detailed shopping list, point to point wiring diagram, fully illustrated	1/6
Coil Set (Osc. and 3 I.F.T.s)	22/6
Driver Transformer	11/6
Output Transformer	10/6
Ferrite Rod Aerial	10/-
Printed Circuits	9/-
OO Gang Condensers	11/-
Volume Control V.C. 1545	10/6
Switch	3/6
Hardware Kit	4/6
Transistors (set of 6 plus crystal diode GD9)	70/-
Speaker	19/10
Case	7/6
Complete Kit of Condensers	15/-
Complete Set of Resistances	6/6
Trimmers (2)	2/8

All above components are brand new and are fully guaranteed.

MICROPHONES

★ Acos mic. **39/1**, crystal stick microphones for use as a hand, desk or floor stand unit, listed at 3 gns. **Our price 39/6.** Table stand 7/6 extra, floor stand adaptor 12/6 extra.

★ Acos Mic. 40, as supplied with modern tape recorders with a folding rest and 8ft. lead, listed at £1/15/0. **Our price 19/6.**

★ GBS Microphone Pencil Stick type, fitted with muting switch **42/-**.

★ T.S.L. Crystal "Stick" microphone, model MX3, for general purpose use, complete with table stand **45/-**.

★ T.S.L. Moving Coil Microphone, for high or low impedance. Brown and cream plastic case with a fold-in table rest. 6ft. cable and a standard 3-way connecting continental plug, **£4/4/0.**

COLLARO Mk. IV TAPE TRANSCRIPTOR

Four heads. Twin track operation. Pause control. Tape measuring and calibration device. Two motors. Fast re-wind. 7in. tape spool. 3 speeds. 3¾in., 7½in. and 15in. per second. Finish cream polystyrene cover plate with maroon control. Delivery from stock **£16/19/6.**

LATEST B.S.R. "MONARDECK" SINGLE SPEED

3¾in. i.p.s., takes 5¾in. spools. Simple controls. **£8/8/0.** Tapes extra. Carr. and insurance 5/6.

AUTOMATIC RECORD CHANGER UNITS

BSR "MONARCH" UA8. 4-speed unit with BSR FULFI cartridge. **£6/15/0.**

BSR "MONARCH" UA8. As above, but fitted with BSR FULFI STEREO cartridge. **£6/19/6.**

GARRARD 210 Automatic Record Changer. 4-speed will take eight records 10in. and 12in. arm wired for stereo fitted MPM head moulding with GC8 monaural cartridge. **£10/19/6.**

BSR "MONARCH" UA14 4-speed unit in two-tone grey, **£7/19/6.**

GARRARD RC120 Mk. 2 4-speed unit with manual control to enable records to be played singly. Fitted GC2 cartridge. **£6/19/6.**

E.M.I. Single player. 4-speed with automatic stop. Fitted with Acos stereo turnover cartridge. **£6/19/6.**

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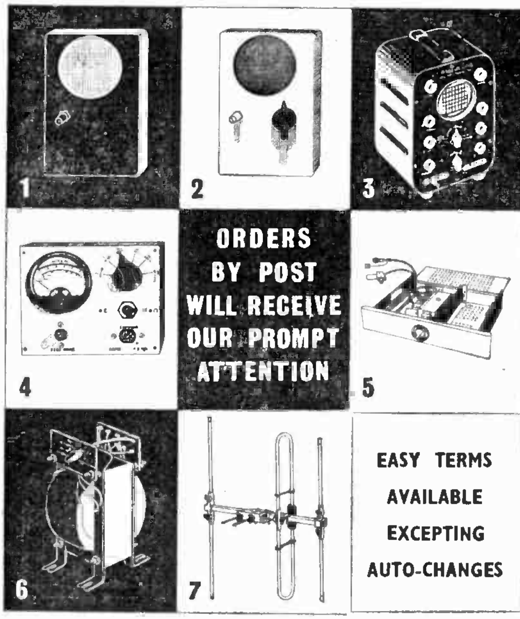

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4. **A.C./D.C. POCKET MULTI-METER KIT.** 2in. moving coil meter, scale calibrated in A.C./D.C. volts, ohms and milliamps. Voltage range A.C./D.C. 0–50, 0–100, 0–250, 0–500. Milliamps 0–10, 0–100. Ohms range 0–10,000. Front panel, range switch, wirewound pot (for ohms zero setting), toggle switch, resistor and rectifier. 19/6, P. & P. 1/6. Wiring diagram 1/-, free with kit.
5. **CHANNEL TUNER.** Will tune to all Band I and Band III stations. Complete with P.C.C.84 and P.C.F.80 valves (in series) I.F. 16–19 or 33–38. Can be modified as an aerial converter (instructions supplied). 32/6, plus 3/6 P. & P. **HEATER TRANSFORMER** to suit above, 200–250 v., 6/-, plus 1/6 P. & P.
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7. **WOLSEY 3-ELEMENT FOLDED DIPOLE.** I.T.V. Aerial less mounting bracket for external use, complete with 12 yds. of coaxial cable, 15/-, P. & P. 3/6.
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10. **SIGNAL GENERATORS.** Cash £4.19.6 or 25/- deposit and 4 monthly payments of 21/6. P. & P. 5/-. Coverage 120 kc/s to 84 Mc/s. Case 10 x 6½ x 4½in. Size of scale 6½ 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 millivolts. C.W. and mod. switch variable A.F. output and moving coil output meter Accuracy ± 2 per cent.
11. **BATTERY RECORD PLAYER AND AMPLIFIER.** 45 r.p.m. "Star" motor "Acos" crystal pick-up, 3 transistor push-pull amplifier complete with transistors. Output 500 milliwatts, 49/6, P. & P. 3/6.
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13. **B.S.R. MONARCH UAS WITH FUL-FI HEAD.** 4- speed, plays 10 records, 12in., 10in., or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour, brown. Dimensions: 12½ x 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with Ful-Fi turnover crystal head. £6.19.6, P. & P. 5/- With Stereo Head £7.19.6. P. & P.5/-.
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16. **PORTABLE AMPLIFIER.** On printed circuit for A.C. Mains 200/250 v. Size 4 x 3in. with tone and volume control. Valves: ECL82 and EZ80. 39/6, P. & P. 2/6.

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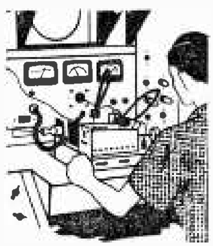

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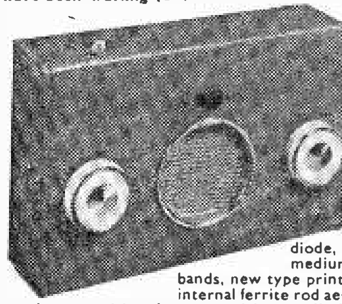
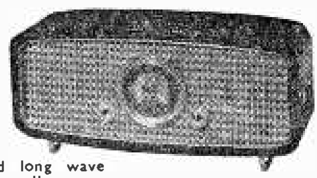
The Transistor Set you have been waiting for! **THE "FLEET SIX"**



The Transistor Set you have been waiting for, the "Fleet 6," a wow of a transistor set that really gets the stations. New design 6 transistor superhet pocket receiver, using 6 guaranteed first grade transistors plus sensitive diode, push pull output medium and long wave bands, new type printed circuit, high Q internal ferrite rod aerial, 2¼in. high flux speaker, provision for car aerial, overall size 6½ x 4½ x 1¾. Simple to follow instructions. All components guaranteed, service after sales. This is equal to many manufactured sets at double the price. All components including cabinet, transistors, speaker, circuit etc., **only £8/19/6** complete, post and pkg. 3/6. PP4 Battery 2/- extra. Due to overwhelming demand from last month's advert, we have been able to reduce this receiver from **£9/19/6.** All components sold separately. Send S.A.E. for details. Circuit and Instructions 2/6 post free.

SUPER SIX Table Model



The "Super 6" Table Model Transistor Receiver using six Mullard latest top grade transistors, printed circuit, medium and long wave bands, 500 M/W push pull output, 7 x 4 High Flux Speaker, high Q ferrite rod aerial, calibrated direct drive, beautifully polished cabinet, gilt trimmed, size 18in. x 7¾in. x 5¾in. Using Long-life power pack battery. All necessary components including easy to follow instructions and theoretical circuit, **£9/15/-** complete, post and pkg. 4/6. Battery extra. All components sold separately. Send S.A.E. for details. Circuit and instructions 2/6.

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The Cossor 4 valve s/het portable. L. and med. wave bands. 5in. speaker, using Ever Ready B126 90VHT, & AD35 1½ VLT batt. Attractive 2-tone finish in red and grey. Dimensions 9 x 8½ x 4½in. Original price 15 gns. Our price **£8/19/6** plus P. & P. 3/-. Batts. 10/- extra.
Also suitable mains unit. Original price 63/-. **OUR PRICE 45/-** plus 2/- P. & P.

PORTABLE BATTERY ELIMINATOR
MADE BY COSSOR

Housed in two containers which are to replace AD35 and B126 Batteries. 45/-, plus 2/- P. & P. Only suitable for use with Dk96 Series valves.

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Build the Labgear Audio Output meter. Two ranges—25 milliwatts to 1 watt. 1 watt to 100 watts. Accuracy 5%. Input impedance 3, 15 and 600 ohms. Printed circuit. All components including O-1MA moving coil meter and silver hammertone enamel case. Kit complete with instructions **59/6**, post and pkg. 1/6.

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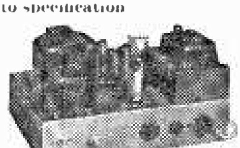
Designed by MULLARD—presented by STERN'S strictly to specification

COMPLETE KIT OF PARTS— MULLARD "5-10" MAIN AMPLIFIER



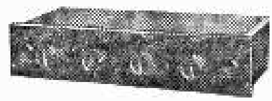
For use with the MULLARD 2-valve pre-amplifier with which undistorted power output of up to 10 watts is obtained. We supply **SPECIFIED COMPONENTS AND NEW MULLARD VALVES**, including **PARMEKO MAINS TRANSFORMER** and choice of the latest Ultra-Linear **PARMEKO** or the **PARTRIDGE** Output Transformer.

PRICE COMPLETE KIT (**PARMEKO** Output Trans.). **£10.0.0**

Alternatively we supply **ASSEMBLED** and **TESTED**. **£11.10.0**

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER, £1.6.0 EXTRA

MULLARD'S PRE-AMPLIFIER TONE CONTROL UNIT



Employing two EF86 valves, and designed to operate with the **MULLARD MAIN AMPLIFIERS**, but also perfectly suitable for other makes.

PRICE COMPLETE KITS OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

Supplied strictly to **MULLARD'S SPECIFICATION** and incorporating:

- Equalisation for the latest R.I.A.A. characteristics.
- Input for Crystal Pick-ups, and variable reluctance magnetic types.
- Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-amplifier
- Sensitive Microphone Channel.
- Wide range **BASS** and **TREBLE** Controls.

COMPLETE MULLARD "5-10" AMPLIFIER

The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction. Only Specified Components and new **MULLARD VALVES** are supplied including **PARMEKO MAINS TRANSFORMERS** and choice of the latest **PARMEKO** or **PARTRIDGE** ULTRA-Linear Output Transformers.

KIT OF PARTS **£11.10.0** OR ASSEMBLED and TESTED **£13.10.0**

HIRE PURCHASE (Assembled Amp. only). DEPOSIT £2.14.0 12 months at 19/10.

ABOVE incorporating PARTRIDGE OUTPUT TRANS. £1.6.0 extra.

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(b) The "5-10" and the 2-stage PRE-AMP both ASSEMBLED and TESTED H.P. Dep. £3.16.0 and 12 months of £1.7.8......... **£18.18.0**

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H.P. Terms: Deposit £5 and 12 months of £1.16.8.

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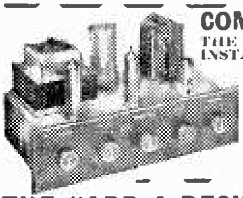
Carriage and Insurance 7/6 extra. Prices quoted are subject to £1.6.0 extra for Partridge Transformer.

COMPLETE MULLARD "3-3"



THE IDEAL AMPLIFIER FOR A SMALL HIGH QUALITY INSTALLATION PROVIDING EXCELLENT REPRODUCTION OF UP TO 3 WATTS OUTPUT

COMPLETE KIT OF PARTS **£7.10.0** OR ASSEMBLED and TESTED **£8.19.6**

(plus 6/6 carriage and insurance) H.P. Terms: Deposit £2.0.0 and 8 Months at £1.0.0. Complete to MULLARD'S SPECIFICATION including Mullard valves and a **PARMEKO OUTPUT TRANSFORMER.**

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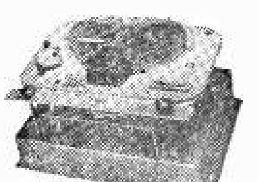
This model incorporates two Mullard 2-valve Pre-Amplifiers combined into a Single unit enabling it to be used for both **STEREOPHONIC** or **MONAURAL** operation. It is designed primarily to operate with our range of **MULLARD MAIN AMPLIFIERS** but will also operate equally well with any make of Amplifiers requiring an input of 250 m/volts.

COMPLETE KIT OF PARTS **£12.10.0** ASSEMBLED AND TESTED **£15.0.0**

H.P. £3 Dep. and 12 mths. at £1.2.0

THE "ADD-A-DECK"



Incorporating **GARRARD "MAGAZINE" TAPE** and the **MATCHED MODEL HF/G2P PRE-AMPLIFIER**

Supplied on ONE CHASSIS (as illustrated) READY FOR USE **18 Gns.**

(Carr. & Ins. 10/- extra).

Price includes Garrard Magazine and a 4in. Spool Double Play Tape

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Provides complete tape recording facilities and designed to operate through the pick-up sockets of the standard type of RADIO RECEIVER, or an AMPLIFIER, from which really first class reproduction is obtained. It consists of a Twin Track Deck connected to the Pre-amplifier and operates at 3¾in/sec. speed providing up to 1 hr. 16 mins. playing time.

MULLARD FOUR CHANNEL MIXER UNIT

Self powered with Cathode follower output. Incorporates Two inputs for MICROPHONES One for CRYSTAL PICK UP and a fourth for RADIO or TAPE

Complete Kit of Parts **£8.8.0**

Assembled and Tested **£10.0.0**

TERMS: Deposit £2 and 12 months at 15/-.

MODEL I.L. one microphone input matched for moving coil or Ribbon Mike. £1.17.0 extra.

RECORD PLAYERS

THE LATEST MODELS ARE IN STOCK, MANY AT REDUCED PRICES

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B.S.R. MONARCH UA8 4-speed mixer Autochanger with Crystal Pick-up.	**£6.19.6**
The **NEW COLLARO MODEL RP594** 4-speed Single Record Player. Studio Cartridge.	**£9.18.9**
The **NEW COLLARO C60** 4-speed Autochanger unit with Studio "O" Pick-up	**£7.19.6**
The **E.M.I.** 4-speed Single Record Player with crystal Pick-up.	**£6.9.6**
THE NEW B.S.R. Model UA12 in Stock. A4 "SPEED" MIXER AUTOCHANGER.	**£8.7.6**
UA12 also available incorporating the **B.S.R. STEREO** Pick-up, plays L.P. and 78 Records.	**£10.10.0**
GARRARD MODEL TA/MkII 4-speed Player fitted high output Crystal Pick-up.	**£8.10.0**
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Carriage and Insurance on each above. 5/- extra.

Mk.11 "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line up. FOR THE CONSTRUCTOR **£10.10.0** ASSEMBLED **£14.5.0**

A SPECIAL CASH OFFER!!

This very attractive **PORTABLE AMPLIFIER CASE** together with a good quality **GRAM AMPLIFIER** and a matched **P.M. SPEAKER.**

For ONLY **£8.7.6** (Plus 7/6 Carr. & Ins.)

The amplifier consists of a 2-stage design incorporating 3 modern B.V.A. valves and has separate BASS and TREBLE CONTROLS.

The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Mushroom Grey Rexine.

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(a) The 2-stage (plus Rectifier) **AMPLIFIER** **£4.2.6**

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(c) **6½in. P.M. SPEAKER 18/9** Carriage and Insurance 4/- extra.

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From 80-10 m. Power input 75 w. C.W., 60 w. peak C.C. phone. Output 40 w. to aerial. Compact and self-contained. Prov. for V.F.O. £29.10.0

VAR. FREQ. OSCILLATOR VF-1U
From 160-10 m. Ideal for our DX-40U and similar transmitters. Price less valves £8.19.6. £10.12.0

R.F. SIGNAL GENERATOR Model RF-1U
Up to 100 Mc/s fundamental and 200 Mc/s on harmonics and up to 100mV. output on all bands. £11.11.0

AUDIO SIGNAL GENERATOR Model AG-9U
10 c/s to 100 kc/s. switch selected. Distortion less than 0.1% 10 v. sine wave output metered in volts and dB's. £19.3.0

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Measures volts to 1,500 (D.C. and R.M.S.) and 4,000 pk. to pk. Res. 0.1 Ω to 1,000 MΩ D.C. input imped. 11M Ω. Complete with test prods leads and standardising battery. £13.0.0

Portable 2¾ in. SERVICE 'Scope Model OS-1
Compact portable scope ideal for servicing and general work. Y amplifier sensitivity 10 mV/cm; response ±3 dB 10 c/s-2.5 Mc/s. Time base 15 c/s-150 kc/s. Printed circuit. Case 7⅜ × 4⅞ × 12½in. long. Wt. only 10½lb. £18.19.6

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Has wide-band amplifiers, essential for TV servicing. F.M. alignment, etc. Vertical freq. response 3 c/s. to over 5 Mc/s. without extra switching. T/B covers 10 c/s to 500 kc/s. in 5 ranges. £34.15.0

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Measures capacity 10pF to 1,000μF resistance 100 Ω to 5 M Ω and power factor 5-450 v. test voltages. With safety switch £7.19.6

SINGLE CHANNEL AMPLIFIER, MA-12
10-12 watt Hi-Fi amplifier. Extremely low distortion and wide frequency range. £9.19.6

HI-FI EQUIPMENT CABINETS
Range of cabinets available with at least one to suit your particular needs. From small to large, housing Tape Deck, Record Player and full equipment. In the white for finishing to personal taste.
From £10.10.0 to £17.18.6

THE "MOHICAN" GENERAL COVERAGE RECEIVER, Model GC-1U
Fully transistorised, including 4 piezo-electric transfilters. The very latest and an excellent portable or Fixed Station receiver for the Ham and short-wave listener. £38.15.0

'PACKAGED DEALS' of Hi-Fi Equipment including TAPE DECKS (Collaro or Truvox). RECORD PLAYERS (Collaro or Connoisseur) and DECCA ffss PICK-UPS
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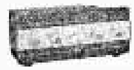
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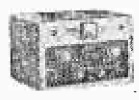
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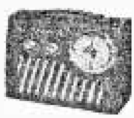
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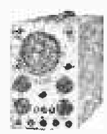
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Practical Wireless

VOL. XXXVII No. 651 MAY, 1961

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Contents

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

THE "ROADFARER" COMPETITION

As announced in the Editorial of the previous issue, prizes are to be offered for the best constructed "Roadfarer" receivers. This competition has been organised in conjunction with several manufacturers and a panel of judges has been formed from representatives of those firms whose products are used in the receiver, and, in judging the competition, the neatness and soundness of the constructional work will be taken into account.

Further details of the competition are given on page 85 and the rules and conditions of entry are clearly set out below.

RULES AND CONDITIONS OF ENTRY

1. There is no entrance fee.

2. The set must be the unaided work of the entrant and be built to the design given in *Practical Wireless* with the specified components.

3. No sets are to be submitted for examination until an announcement to this effect is made in *Practical Wireless;* intending entrants should complete the coupon published in the April or May issues of *Practical Wireless.*

4. Each set will remain the property of its constructor and although all reasonable care will be taken of entries while they are in the hands of the Committee, no responsibility can be accepted for any loss or damage.

5. The decision of the Committee in all matters related to the Competition shall be final.

6. Employees of George Newnes Limited and associated companies are not eligible to enter the Competition.

CONTRIBUTIONS

Those of our readers who wish to submit articles should send them direct to the Editor at the address given on this page. Manuscripts should be typewritten with double spacing although legible hand-written articles are also acceptable. Articles should be between 1,000 and 2,000 words in length, be written on one side of the paper only, and deal with the home construction of items of radio and electronic equipment. We do not require articles of a theoretical nature unless these are written expressly for the amateur constructor. Clear drawings of the apparatus should be included with the article and need only be sufficient for our draughtsmen to prepare suitable illustrations. We also like to include with articles photographic illustrations. Large clear prints, or preferably negatives, should be sent if possible but we are prepared to take the necessary photographs ourselves if the apparatus can be sent to us for inspection. An illustrated article is always of more appeal as the methods of construction are shown more clearly.

Our next issue, dated June, will be published on May 5th.

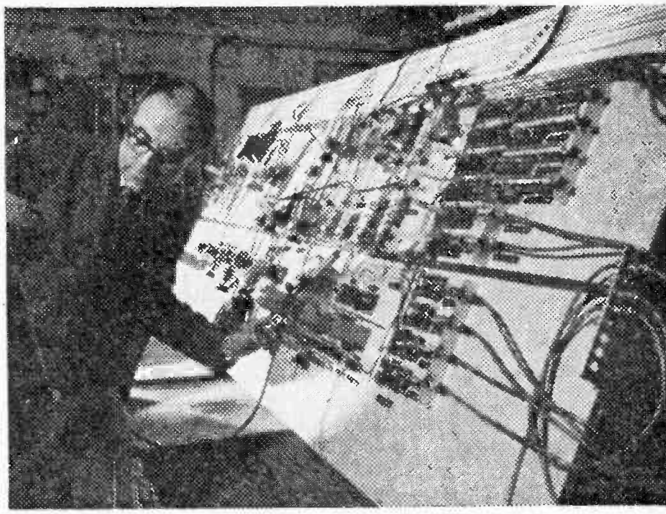
Round the World of Wireless

POTENTIAL AND CURRENT NEWS

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of January, 1961, 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.

Region	*Total*
London Postal	707,932
Home Counties	664,350
Midland	485,231
North Eastern	532,269
North Western	460,170
South Western	398,307
Wales and Border Counties	236,717
Total England and Wales	3,484,976
Scotland	392,287
Northern Ireland	119,885
Grand Total	3,997,148



Here adjustments are being made to the typical experimental apparatus used by the Electronic Switching Group in the development of electronic telephone switching networks at the G.E.C. laboratories at Wembley.

Electronic Telephone Switching

RESEARCH work on electronic telephone switching has been carried out in the G.E.C.'s Hirst research centre laboratories at Wembley, since the late 1940's. By 1955 the stage had been reached where the model electronic exchange, "Andrew", had established the basic feasibility of the time division multiplex technique as a basis for telephone switching.

More recently particular emphasis is being placed on system security, that is to say the ability of the exchange to continue to give service in the presence of component faults. Every effort is also being made to make the system simple in order to keep down cost and to facilitate maintenance and understanding of the operation of the exchange. On the component and circuit side the laboratories have established techniques in which full use of transistors is achieved.

The work of the electronic switching laboratories includes the design of models of a transistorised speech switching network and magnetostriction delay lines which are used for pulse generation and storage. Final engineering of the circuits for production is undertaken in the development laboratories at Coventry.

Oxford University Study of Recruitment to Higher Technological Education

THE University of Oxford Department of Education led by its director, Mr. A. D. C. Peterson, is to investigate the reasons for comparatively fewer students electing to read for technological qualifications in this country than in the U.S.A. and Russia. This research, which will occupy a period of two years, has been made possible by a grant of £2,500 to the University from the Capitol Radio Engineering Institute of Washington, D.C., through their International Division, C.R.E.I. (London).

Commenting on the grant, Mr A. F. R. Cotton, Managing Director for International Operations for C.R.E.I, said: "There is a feeling that some of the best brains in the country are being kept out of technology by the academic nature of grammar school curricula.

"This, and the tendency to regard technological studies as being more suitable for less able pupils, could cripple Britain in the world race for highly qualified technologists by closing the doors in this field to the most talented young men in the country. The Oxford University Department of Education is setting out to test both these theories and to compare secondary school curricula in England and Wales with those in the U.S.A., Russia, Sweden, Holland, Germany, Switzerland and France."

The Capitol Radio Engineering Institute, as well as running a residential school in electronic engineering technology in Washington, are pioneers of home study courses in advanced technological subjects, including nuclear engineering. These courses are now available in the U.K. and Europe. Students in Britain include serving officers and men of the Royal Air Force.

Intercommunications Contract

ULTRA ELECTRONICS LTD. have received a contract to supply their UA60 intercom equipment for the Westland P.531 aircraft being supplied to the Army Air Corps.

The value of the contract, which covers forty sets of equipment, is approximately £21,000.

Delivery of the equipment will commence this summer.

Plastics at Radio Components Exhibition

THE Ekco Plastics stand at the 1961 Radio and Electronic Components Exhibition, Olympia (30th May—2nd June), will feature the Company's extensive moulding service to the industry, which started nearly 30 years ago with the production of the first Ekco radio cabinets.

The use of plastics to enhance the styling of radio receivers is exemplified by a selection of the latest radio cabinets in a variety of colours, tuning scales, control knobs, etc. The back cover and front of the latest Ekcovision portable receiver represents the increasing application of plastics in television receiver design, while escutcheons, television tube masks and implosion screens will also be featured.

Plastic components also fill vital roles in the chassis of modern receivers, and the representative selection of such mouldings in the Ekco display includes coil formers, terminal blocks, transformer housings, etc.

Radar Fault Locator on Show

THE A.C. radar fault locator made by Ferranti Ltd., was on show to Britain's electrical engineers for the first time at the Electrical Engineers' Exhibition at Earls Court in March.

The prototypes have been tried by the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board, both of whom assisted in their development.

The locator has been designed to detect the position of arcing faults, ice build-up and conductor oscillation on 132 and 275kV transmission lines, although it can also be used for higher or lower voltages.

The prototypes were installed at Fort Augustus and Clydesmill Power Station, near Glasgow, and were successful in locating a number of faults. Two of the arcing faults which took place at Clydesmill were identified to within a span. An arcing fault caused by lightning was recorded at Fort Augustus.

The Ferranti fault locator operates on the radar principle of pulse reflection, the reflection being caused by any fault which may be caused by a flashover or to ice build-up on the line. The reflected pulses are received by the locator and displayed on a cathode ray tube for visual or automatic photographic record. The distance to the fault is found by measuring the time interval between the sending of the pulse and reception of its reflection.

Radar Defence Order from Sweden

THE Royal Swedish Air Board has placed a further contract to the value of over £1,700,000 with Marconi's Wireless Telegraph Co. Ltd., for the supply of secret electronic equipment for their air defence system. This follows substantial orders placed in 1959.

The twin problems which face any defence organisation are those of range of operation and warning time. The Swedish Air Force is powerfully equipped with fast fighters and surface-to-air missiles, but to use these effectively means must be found of collating relevant information and arriving at swift decisions.

At the centre of the Marconi system is a very high speed computer which solves a large number of interception problems simultaneously and enables the defence weapons — fighters, guided missiles and other defensive devices—to be brought into action at precisely the right instant. Black and white television and colour projection together with automatic information-dissemination techniques also play a vital part in the overall system. Approximately 500,000 transistors and diodes and 15,000 valves are incorporated in the equipment.

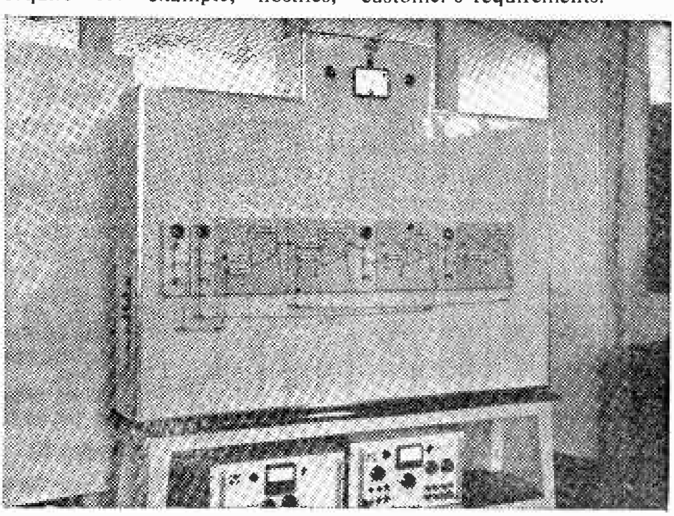
From the information bank the data are fed to the synthetic displays at positions manned by controllers and executive officers, who, by pressing buttons, can see the category of information they require—for example, hostiles, unengaged hostiles, all aircraft above a certain height, and so on. The constitution or number of aircraft is obtained from a special display nicknamed the "Magic Carpet" where the radar picture shows the numerical composition of a formation. The targets displayed for analysis are presented automatically in a "queue".

Analogue Computer

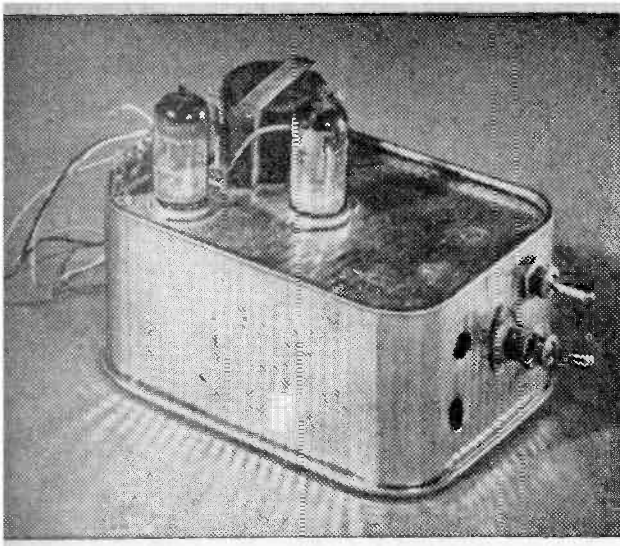
THIS 112-amplifier computor, made by Short Brothers and Harland Ltd. is designed to cope with the steady increase in the size and complexity of problems being encountered in engineering research and development. It incorporates all the automatic aids necessary to ease the handling of complicated problems, including those of nuclear kinetics.

Important features of Simlac are its new wiring techniques and a revolutionary patching system which completely eliminates cord clutter. The flexible selector system and associated problem check are unrivalled in the analogue computer field.

The computer consists of seven standard racks containing the electronic equipment. The three central racks being fronted by a double pedestal desk. The twin racks on either side of the central block are identical in construction and contain the computing elements. By plugging specified components into these racks the design of the basic Simlac can be varied to meet an individual customer's requirements.



The Simlac analogue computer made by Short Brothers and Harland Ltd.



THE P.W.

ADDING THE R.F. GENERATOR TO THE AUDIO MODULATOR UNIT

THIS chassis (No. 2) should have been completed to the stage shown in Figs. 5 and 6 (last month). Before proceeding this stage should be coupled up to the power unit (chassis No. 1) and 'phones connected to the output plug to check that the unit is in working order. Note that the heater circuit of V5 should have been wired and tested —pins 4/5, and 9 (see "Wiring and progressive testing" on page 1106 of the April issue).

Mounting the Components

The variable condenser is mounted to one side of the chassis, on top, as in Fig. 9. The condenser must open in such a way that it will not foul the coils to be mounted later. Any type of condenser with air spacing is suitable provided it is not too large for the available space. When mounted, check with a meter or torch bulb and battery that the fixed (stator) vanes are not shorted to the moving vanes at any part of their travel.

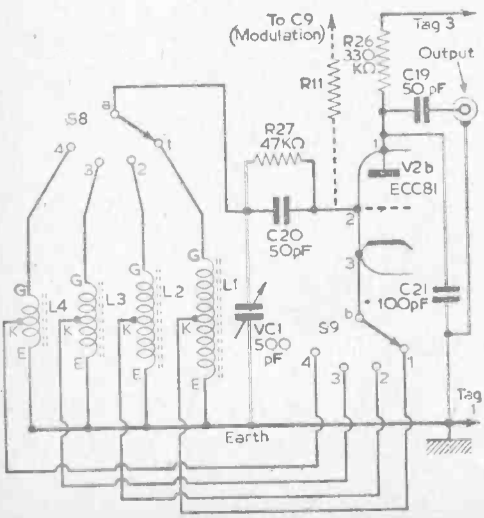


Fig. 7.—The circuit of the R.F. generator.

Making the Coils

The type of former required is shown in Fig. 8. All windings are carried out with 32s.w.g. copper wire, enamelled and new. Salvaged wire is unsuitable and must not be used. As each coil is completed, the turns are fixed with polystyrene cement.

Winding L4 (Fig. 8)

Leave about a foot of wire to spare and fasten it *temporarily* by one of the holes at the base (these are not used for connections) and wind on eight turns exactly, side by side starting almost at the bottom of the former. Now stretch the wire out for about 4in. and double it back again, and twist it together tightly near the coil. Now continue to wind another eight turns in the same direction. Then, wind the wire round a few more times about ¼in. further up the former. Now fix the winding with cement and allow it to dry overnight; then remove the extra turns.

Winding L3

This is carried out in the same way as L4 but 40 turns are wound on, side by side, each side of the centre tap (see Fig. 8).

Winding L2

This coil has more turns than L4 and L3 and the winding technique is therefore different. The turns of this coil (and those of L1) are not wound side by side but in a manner known as "pile winding". Coil L2 consists of 200 turns with a centre tap. Each half of the winding is wound over a length of ⅛in. When winding the two parts of this coil, wind more turns in the centre of each ⅛in. length than at the ends—as shown clearly in Fig. 8. As in the case of L3 and L4, the two halves of the winding must be wound in the same direction; the second half forms a continuation of the first.

When winding is completed, cement the turns together as for L3 and L4.

Winding L1

Mark the former about 1in. up from the bottom and proceed as for L2 but wind on 460 turns either side of the tap. Cement as before.

SIGNAL GENERATOR

By E. V. King

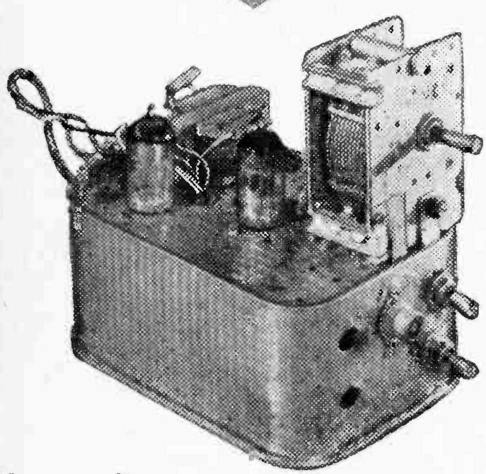
(Continued from page 1109 of the April issue)

COMPONENTS LIST
(to be added to Chassis No. 2)

Additional parts
C9 47pF (formerly 500pF)
R11 1M $\frac{1}{4}$W (formerly 100k)
Valve (V2) is already fitted (ECC81)

Switch
S8/R R.F. range switch: two-pole, four-way rotary type

Coils
L1, 2, 3, 4, are made up on formers as shown in Fig. 8. $\frac{1}{4}$lb of 32s.w.g. enamelled copper wire will be required. The four formers required are $2\frac{1}{4}$ to $2\frac{1}{2}$in. long and $\frac{1}{4}$in. in diameter. No cores are required
Variable condenser (VC1), 500pF max., air spaced. Single gang—any type which is small and the blades of which do not foul the coil formers when mounted as indicated (Fig. 9)
R26 330k $\frac{1}{4}$W
R27 47k $\frac{1}{4}$W
C19 mica or ceramic 50pF
C20 mica or ceramic 50pF
C21 mica or ceramic 100pF



Continuity Check

Scrape the enamel from the ends E and G of each coil and test them for continuity using a meter or battery and lamp. The battery voltage will have to be greater in the case of L1 as the resistance of the wire is fairly high.

The R.F. range switch is fitted as indicated in Fig. 10 with VR4 underneath it. These, however, are not used until later. The coils are now made up (Fig. 8) and L1 is mounted in position as shown in Fig. 9. To do this, two small screws are used from underneath. The coil positions are not unduly critical.

Wiring the Oscillator Stage

The completed circuit is shown in Fig. 7. Feedback is via the cathode and grid, and the tuned circuit is L1, 2, 3 or 4. The values of C20 and R27 will give good results from 150kc/s to 20Mc/s and should not be altered. If low emission valves are used the value of R26 may have to be reduced. It should always be as high as possible or the oscillations tend to be distorted (not pure sine waves).

Unsolder R11 from the output socket (see Fig. 6 last month) and leave it "in the air" for now. Refer to Fig. 10 and note that only additional wiring is shown for clarity. Wire C21 from pin 1 (valve V2b) to chassis, and from the same tag, R26 to the unused tag on the tag strip tag 3—eventually it will be connected to tag 3 of the

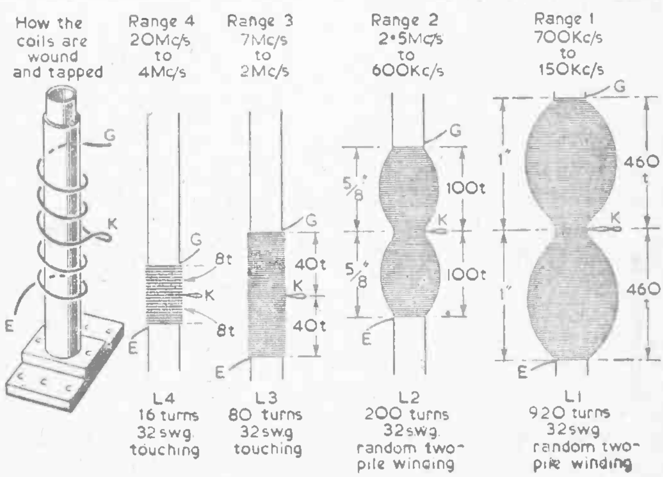
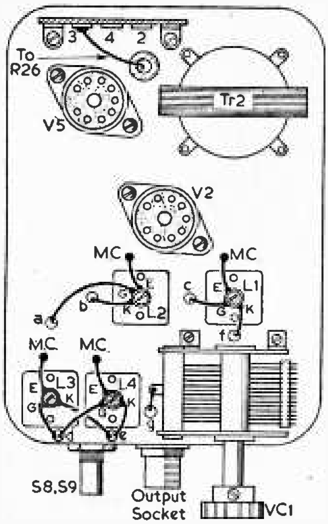


Fig. 8.—The coil winding details.

power unit. Solder R27 and C20 to pin 2 and join them together at the other ends.

The coil L1 is now wired as follows and not as in Fig. 10—note that the switch is not wired at all yet. Slip sleeving over the top lead (G) and wire it to the junction of the grid condenser and leak (R27, C20); then verify that three wires are soldered together at this point. Take the bottom lead of the coil (E) and solder it directly to the top of the chassis. Sleeving is not essential here. Clean the tap on the coil, tin the wires and solder an insulated wire to them which is then connected to pin 3 of the valve being wired. Make sure that both leads at the tap were tinned and soldered together. Now solder a temporary condenser of 50 to 500pF from the junction of R27, C20, L1 to chassis.



Tags marked MC are earthing connections to chassis

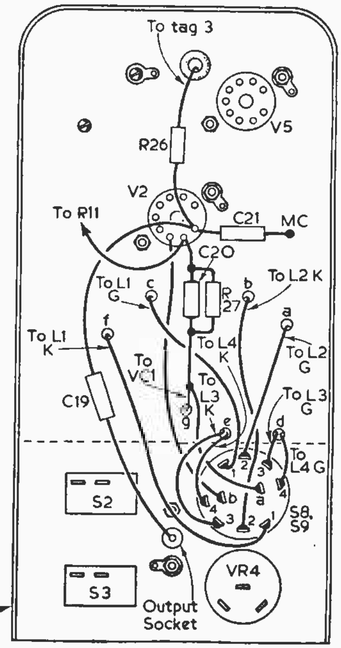


Fig. 9 (left).—Above-chassis layout of the R.F. generator—the audio modulator section is not shown wired.

Fig. 10 (right).—The underchassis wiring.

Testing for Oscillation

Connect the unit to the power pack and wire a milliammeter in the lead from tag 3 of the power pack to tag 3 of this unit. Switch on, and the current reading should be about 0·7mA. Now using an insulated screwdriver, short the junction of R27, C20 and G of the coil to earth. The anode current will now rise by a value of 0·01 or 0·02mA to give a reading greater than before, if the valve is oscillating. If the current does not alter, the unit is not working and the fault must be investigated. If no meter is available then you must assume for the time being that the unit is oscillating.

Varying the Frequency of Oscillation

The unit will be oscillating at a frequency of about 700kc/s if the temporary condenser fitted is only 50pF or at about 150kc/s if it is 500pF. Remove the temporary condenser and then connect the stator vanes of VC1 (already tested) through a hole in the chassis (using insulated wire) to the junction of R27, C20 and G of L1. Four wires are now joined at this position. VC1 is now tuning the inductance L1 and the frequency of oscillation will be variable from about 150kc/s to 600kc/s.

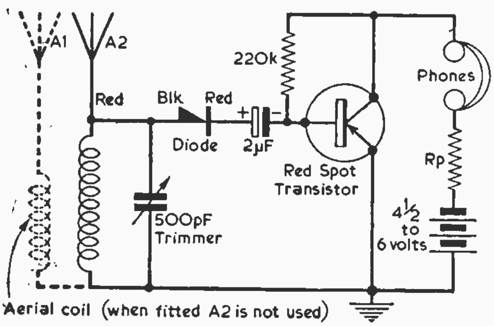


Fig. 11.—The circuit of a crystal diode receiver suitable for testing the R.F. section.

Second Check

A meter is wired as previously described in the H.T. lead to tag 3 of the power unit. Verify that in all positions of VC1 there is the required rise in anode current when G of coil is shorted to earth as before. Verify that the actual increase in current is more when the condenser is fully closed (about 0·06mA rise on shorting G) than when it is fully out (about 0·01 or 0·02mA rise on shorting G). Also, as the vanes are moved from the open position to the closed position the current drawn by the valve falls from about 0·77mA to 0·72mA. The actual current drawn does not matter, but the fact that it falls as the vanes are moved in does show that the valve is oscillating.

Modulating the R.F. Wave

The resistor R11 which was disconnected earlier may now be wired to pin 2 of V2 as indicated in Fig. 10. Note carefully that the values of R11 and and C9 have to be changed to those given in the list of components on page 25.

Condenser C19 must now be wired from pin 1 of V2 to the output socket (see Fig. 10).

Testing the Modulation

Preliminary tests may be made by connecting 'phones to the output socket. With S3 switched on (Fig. 4 last month), the modulation note should be heard faintly independent of the position of the variable condenser. However, if the R.F. section is not oscillating, no mixing will occur, but the note will still be audible, the valve acting as an amplifier. Further tests follow.

Testing on a Receiver

Use any TRF receiver which will receive long waves. A superhet is not really suitable as spurious oscillations will make tests very difficult. If a TRF receiver is not available then a small and cheap transistor/diode receiver can be made up quickly. Selectivity is not important at this stage and long waves only are required. A dual coil could be fitted for testing other ranges of the oscillator.

The circuit of a suitable receiver is shown in Fig. 11. A suitable layout is shown in Fig. 12.

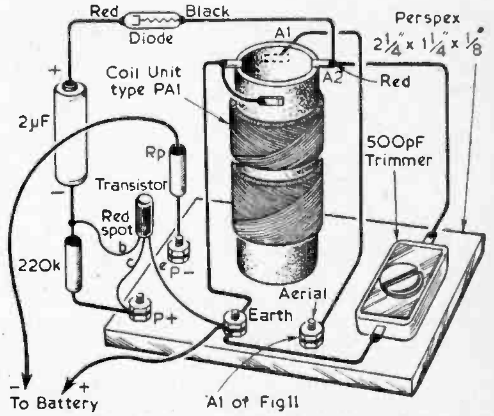
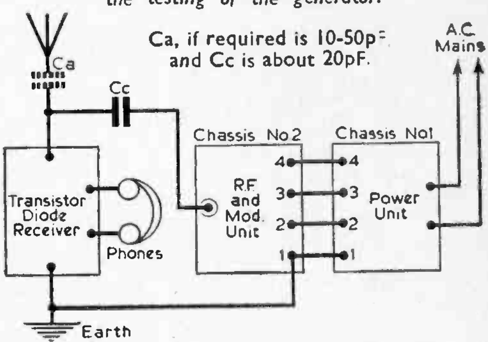


Fig. 12 (above).—Layout of the crystal diode receiver. (The collector of the transistor is indicated either by a spot of paint near to it or by wider spacing from the middle wire, which is the base. The remaining wire is the emitter.

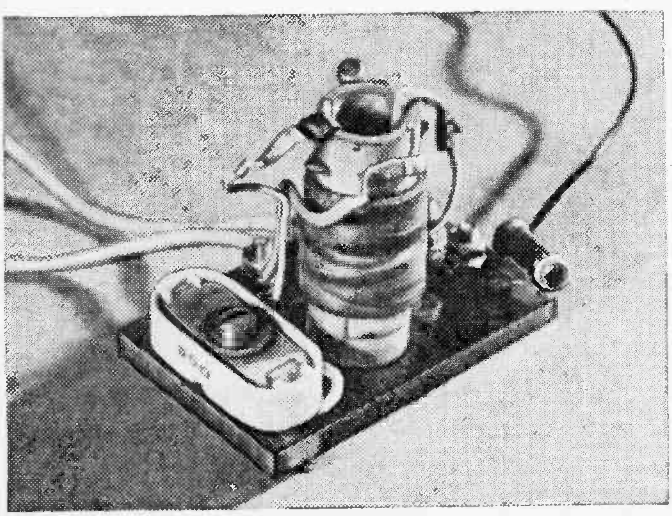
Fig. 13 (below).—The interconnections required for the testing of the generator.



Parts for the diode receiver

This is so simple that no constructional details are given. Parts for the receiver of Figs. 11 and 12 are as follows:

- ***Coil in prototype—Wearite PA1 (any long wave aerial coil will suit)***
- ***Trimmer—750 or 500pF***
- ***Transistor—Red spot or yellow/green***
- ***Diode—"surplus" type***
- ***Coupling condenser—About 2μF, above 6VW***
- ***One 220k ¼W resistor and one of 1000 Ω if low resistance phones are used. Leave out Rp with high resistance phones***
- ***Aerial—Preferably outside, and over 50ft.***
- ***Battery—Torch or cycle lamp type***



The crystal diode receiver—constructed on a paxolin chassis.

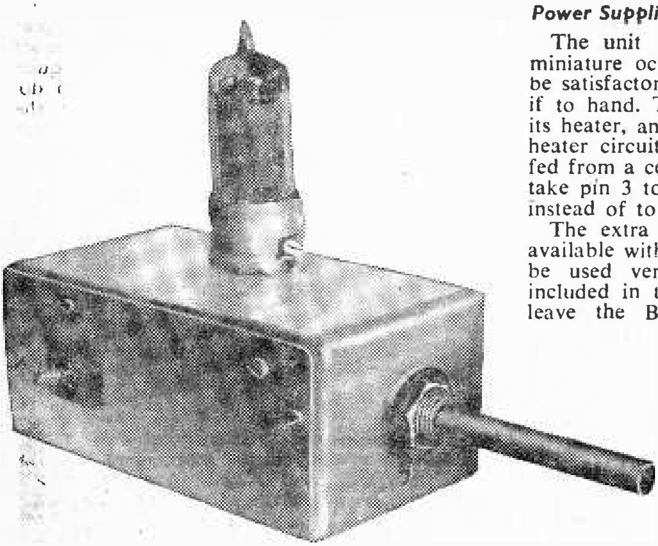
The units are wired as shown in Fig. 13 for the test. If an ordinary receiver is used the wiring is the same. If the receiver is sensitive then the aerial need only be short, if insensitive it must be long. Ca may be necessary for reasonable selectivity if a long aerial is used on very simple receivers.

Only sufficient power is required from the aerial for the long wave Light Programme to be heard very faintly. Any other Long Wave Station may be used if Droitwich reception is poor, e.g. Paris on 128kc/s.

Testing Procedure

Tune the receiver to L.W. Light Programme (200kc/s). Connect as shown in Fig. 13. If an A.C./D.C. receiver is used *the receiver itself must not be earthed.*

(Continued on page 47)



A Compact Add-in B.F.O. Unit

A SIMPLE ONE-VALVE STAGE

By J. Barrat

IN the usual type of superhet C.W. Morse is not audible, as a beat frequency oscillator is necessary for C.W. reception. Such an oscillator is always provided in a communications receiver, but is not normally fitted in ordinary all-wave or similar receivers. A beat frequency oscillator can, however, be added, and the B.F.O. described here is for this purpose.

A C.W. signal is an unmodulated radio-frequency wave. After detection, it does not in itself produce any audible tone, though it may be manifest as a rapid, intermittent clicking. The C.W. signal, as obtained from the receiver intermediate frequency stage, will be at intermediate frequency. The B.F.O. is tuned a little to one side of this frequency, and its output is mixed with the C.W. signal. As a result, an audio tone is produced when the C.W. is present.

As example, assume the receiver I.F. is 465kc/s. If the B.F.O. is tuned to 466kc/s, the frequency difference will be 1kc/s, or 1,000 cycles per second, so an audio note of this frequency will be heard. The B.F.O. might equally well be tuned to 464kc/s. In practice, the B.F.O. stage is usually tunable over a narrow band. This allows the audio note to be adjusted at will, and sometimes allows better reading through interference.

Power Supplies

The unit described uses a 6BA6, but any miniature octal-based or other H.F. pentode will be satisfactory. A triode can also be used instead, if to hand. This valve requires 6·3V at 0·3A for its heater, and this is drawn from the receiver heater circuit. In some receivers, heaters may be fed from a centre-tapped transformer. If this is so, take pin 3 to the other side of the heater circuit, instead of to chassis.

The extra heater current should normally be available without difficulty. If the B.F.O. will only be used very occasionally, a switch may be included in the heater circuit. But it is usual to leave the B.F.O. stage heater permanently in circuit, so that the B.F.O. can be switched on at once by means of the H.T. switch shown.

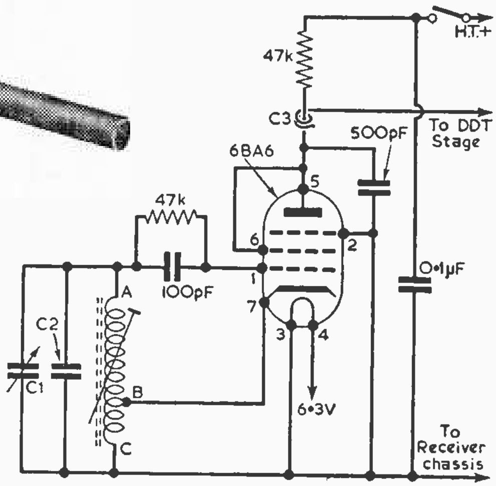


Fig. 1.—The B.F.O. stage circuit diagram.

With A.C./D.C. sets having heaters in series, the B.F.O. valve heater must be of the same current rating as other heaters.

The small H.T. current required also comes from the receiver. If the H.T. line voltage, or supply point, is over 200 or so, the 47k anode resistor can be increased to 100k.

C1 is a panel operated trimmer, to modify the note, and select upper or lower beat frequencies. A value of about 25pF to 50pF is generally satisfactory. If the B.F.O. cannot be mounted near the receiver panel, this condenser is operated through an extension spindle. C2 is fixed, and allows the B.F.O. coil to tune to the receiver intermediate

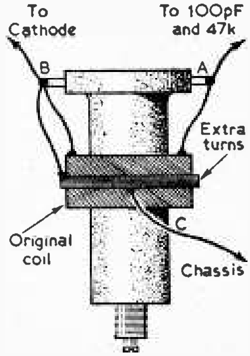


Fig. 2.—The windings on the B.F.O. coil.

frequency when C1 is about half closed. C3 in Fig. 1 is a very small capacity, formed by looping an insulated lead round the anode connection.

B.F.O. Coil

Any coil tunable to the receiver I.F. is suitable. This may be from a disused I.F. transformer, or may be an ordinary aerial or oscillator coil which will tune to the intermediate frequency. A coil with an adjustable core is handy, as this allows easy setting of the frequency.

The B.F.O. coil has a few extra turns added, as in Fig. 2. The end of this additional winding goes to chassis. The junction of the original winding and additional winding forms the cathode tap B. The extra turns must be in the same direction as those on the original coil, and about 4 turns will generally be satisfactory. If the coil has aerial couplings or other windings, these are ignored.

Many receivers have an I.F. of about 465kc/s. This is about 645m. Some medium-wave coils will reach this, with a 500pF condenser for C2 which should be a silver mica condenser. For a coil with more turns, or an I.F. transformer winding, C2 will be less than 500pF. If the I.F. transformer winding were intended for the same frequency as the receiver, the fixed condenser already fitted will, of course, be correct.

B.F.O. Layout

Fig. 3 shows the unit built upon a chassis 4in. x 2in. x 1½in. The coil can be mounted on the top, back, or either side runner, so that it can be reached easily when the unit is installed in the receiver.

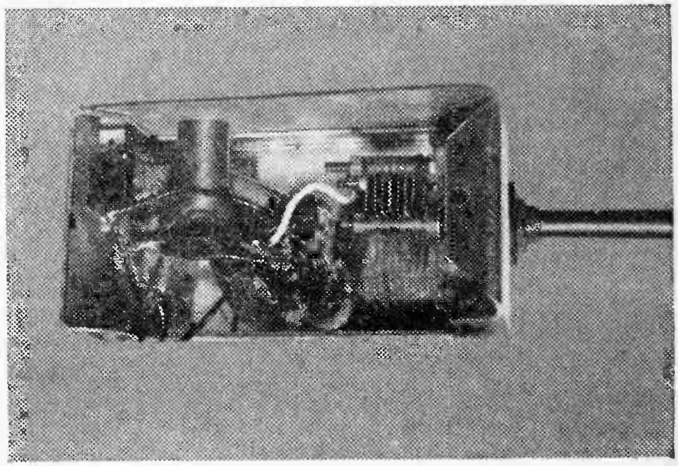
A chassis this size can be made by bending 1½in. flanges on a piece of aluminium 7in. x 5in. Leave extra to form flanges to bolt to the receiver chassis, or use small angle brackets for this. The side plates of the unit are then 4in. x 1½in. When completed and fixed to the chassis, the whole is screened. This is recommended, or harmonics of the B.F.O. frequency will be heard at multiples of about 464kc/s or 466kc/s.

Connections

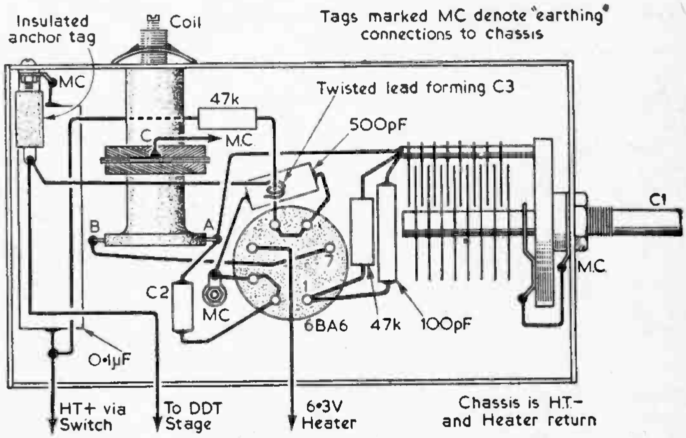
Wiring should be reasonably short and direct. Leads are provided as in Fig. 3, to connect to the receiver power circuits. The most suitable position for the unit is near the double-diode-triode stage of the receiver.

The unit should be tested before permanently bolting it in place. The lead marked "to DDT stage" is taken to the detector diode. It should be noted particularly that a very strong signal from the B.F.O. is *not* wanted, as this will reduce sensitivity. Coupling may, therefore, be quite loose. For C3, a 1 or 2-turn loop should do. Coupling may be sufficient if the lead to the DDT stage is similarly looped round the detector diode connection. This depends on the receiver circuit, and H.T. voltage used with the B.F.O.

To adjust initially, tune in any ordinary programme on the receiver. Switch the B.F.O. on, and adjust C1, or the coil core, or both, until an



Above is shown the under-chassis wiring—details of which are given in Fig. 3 (below)—of the prototype unit.



audio oscillation is heard. If possible, adjust the coil core so that zero beat comes with C1 about half closed. If this is not possible, the value of C2 may need changing.

A fairly weak signal should then be tuned in, and the coupling into the DDT stage modified for maximum results. This coupling is not critical,

(Continued on page 47)

Servicing All-Dry and Mains/Battery Portables

A FAULT-FINDING GUIDE

By G. J. King

BASICALLY there is virtually no difference between servicing "all-dry" and "mains/battery" portables and standard mains-operated receivers. Nevertheless, portables require extra care during the course of servicing to avoid damaging the relatively delicate valve filaments. Moreover, they also tend to develop faults which are only characteristic to receivers using 1·4V valves.

All-dry Receivers

The circuit diagram of a typical all-dry receiver is given in Fig. 1. This uses four valves in a conventional superhet circuit. V1 is the frequency-changer, V2 the I.F. amplifier, V3 the detector and A.F. amplifier and V4 the output valve. In this particular receiver the valves are of the very low consumption type.

The current range of 1·4V valves show a major advance over the former ranges. They employ the B7G base, and have filament consumptions as low as 25mA at 1·4V. These valves are used extensively in present-day valve portables, and owing to their low filament power can work on batteries at least half the capacity (and size) of those required in the older portable. The filaments are connected either in series or parallel, requiring a 7·5V or 1·5V L.T. battery, and in the circuit of Fig. 1 the filaments are all connected in parallel. The output valve, V4, will be seen to have a tapped filament. When the battery is connected across each section, as the circuit shows, the consumption of that particular valve is 50mA. However, if the two sections were connected in series (ignoring the tap), it would then take 25mA at 2·8V. The series method is invariably adopted in mains/battery versions. These very low consumption valves are designated DK96, DF96, DAF96, DL96, etc. In spite of the filament power difference between the various 1·4V valves there is hardly any difference in circuit design among receivers using the different valves. One practical difference, however, is that in most modern receivers a ferrite rod aerial is used instead of the frame aerial of earlier receivers.

No Signals

This is a common symptom with this type of set. The first action should be to establish whether the circuits appear to be "live". One way of doing this is to hold an ear close to the loud-

COMPONENTS LIST for Fig. 1

Resistors

R1	27k	R6	1M
R2	33k	R7	4·7M
R3	33k	R8	6·8M
R4	2·2M	R9	2·2M
R5	4·7M	R10	560 Ω
VR1	1M potentiometer log-law with D.P. switch		

Capacitors

C1	100pF	C11	65pF
C2	100pF	C12	65pF
C3	65pF	C13	200pF
C4	65pF	C14	0·001 μF
C5	532pF	C15	0·05 μF
C6	200pF	C16	200pF
C7	280pF	C17	0·01 μF
C8	0·05 μF	C18	2 μF or 1 μF
C9	0·05 μF		
C10	0·1 μF		

Inductors

L1	M.W. Frame Aerial
L2	L.W. Frame Aerial
L3	M.W. Loading Coil
L4	L.W. Loading Coil
L5, L6	M.W. Oscillator Coil
L7, L8	L.W. Oscillator Coil
L9, L10	1st I.F. Transformer
L11, L12	2nd I.F. Transformer
L13	Aerial Coupling

Miscellaneous

S1	Wavechange Switch
T1	Output Transformer

Variable Capacitors

TC1, TC2	4-70pF Two Bank Squash Plate Trimmers
TC3	528pF Swing Two Gang
TC4, TC5	4-70pF Two Bank Squash Plate Trimmers

Valves

V1	Mullard DK96	V3	Mullard DAF96
V2	Mullard DF96	V4	Mullard DL96

Table 1.—The list of components for the receiver in Fig. 1.

speaker and gently tap the DAF91 or DAF96, etc., valve. This is always slightly microphonic, and if a ringing sound can be heard the A.F. and output sections are in order. Alternatively, if the volume control causes slight crackling when operated, the same applies.

If the set uses a 7·5V L.T. battery, indicating that the filaments are connected in series, then a positive result from the above test would indicate that the filaments of the first two valves are also in order. However, if a 1·5V battery is used, in spite of the A.F. and output stages being in order, the filament of either the frequency changer or I.F. amplifier valve may be open-circuit. An open-circuit filament in one or more valves would not affect the operation of the other valves in a parallel-connected filament circuit, but this, of course, does not follow in a series-connected filament circuit.

condition, it may be found to operate only at the extreme end of the dial or on one waveband only, usually medium-wave.

These troubles are aggravated, however, by a low emission frequency-changer valve. This fault also makes it necessary to replace the L.T. battery before it is completely exhausted, since the oscillator may fail due to the low emission valve when the L.T. drops to about 1·3V, whereas with a normal valve the set may continue working with the L.T. down to about 1·1V.

Low Volume and Distortion

There are three components which are prone to cause trouble if they develop a fault. Referring to the circuit of Fig. 1, these are R6, R7 and C17. R6, which is in the region of 1M, is rather difficult to check on an ordinary medium resistance test-meter in terms of measuring the voltage at V3 anode, owing to the loading effect of the meter across the high resistance. The same applies to the screen feed resistor, R7, and in both of these cases only a very low voltage is indicated, even if the resistors are in order. With some meters no reading at all will be obtained at the screen grid of V3, since R7 may be as high as 4·7M. If in any doubt, it definitely pays to check these resistors by substitution.

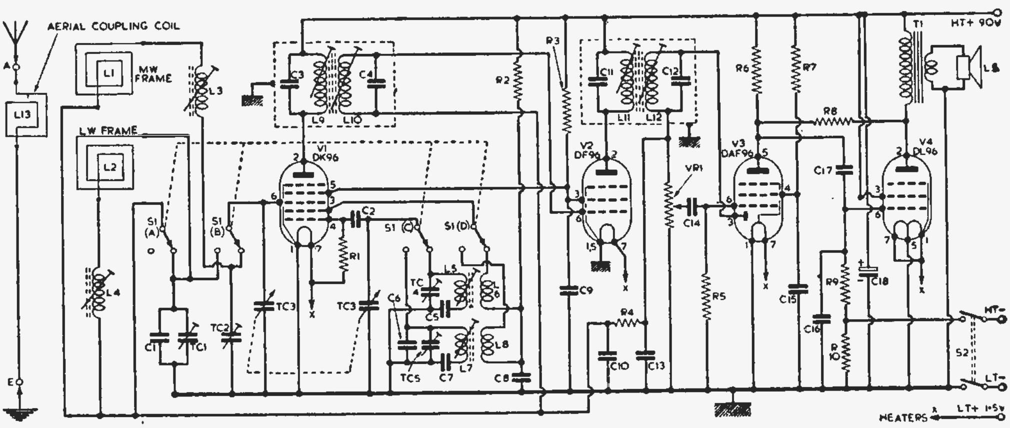


Fig. 1.—The circuit diagram of a typical all-dry battery portable.

The filament is connected across pins 1 and 7 on B7G type valves, and can be checked easily by connecting an ohmmeter across the pins. A low resistance ohmmeter, however, must never be used for this test, as the current in the ohmmeter circuit may exceed 25mA and thus either overrun or open-circuit the filament of the valve under test. If in any doubt, it is desirable to take the suspect valves to a dealer for testing.

If all the valves are in order and the set appears to be "live" but will not pick up stations, the most likely cause of the trouble is failure of the local oscillator associated with the DK-type valve (frequency changer). In most cases insufficient L.T. voltage is the primary trouble. If the L.T. battery is tested off-load with a high resistance voltmeter or multimeter it may well indicate the full 1·5V, but on-load it may be well below this value. It is essential, therefore, always to measure battery voltages when the batteries are connected to the set and with the set switched on.

Some all-dry portables will operate with the L.T. voltage as low as 1·1V, but others cease operating when the on-load L.T. is around the 1·3V figure. Another symptom of low L.T. voltage is that the set may operate satisfactorily for about five or ten minutes and then suddenly cut off. Under this

The coupling capacitor C17 may leak slightly and reflect a small positive potential on the control grid of the output valve V4. This cannot usually be measured, again owing to the very high associated resistances involved, but even an apparently negligible leak in this component causes severe distortion and low volume. This fault also causes a higher than normal H.T. current in the output valve, which not only ruins the valve after a while, but also causes the H.T. battery to be discharged quicker than it should.

Mains Battery Receivers

Fig. 2 shows the circuit diagram of a typical mains/battery portable (the Double Decca). Apart from the mains power pack and switching arrangements, it will be seen that the basic circuit is rather like its battery-only counterpart. The troubles which have already been described apply also to the mains/battery type portable, but in addition other troubles often occur which are associated with the mains H.T. supply.

When switched to "mains", switch S6 directs the power supply to the H.T./L.T. rectifier; switch S5 picks up the rectified voltage, via the required tapping on the voltage dropper, R13/14/15, and directs it to the H.T. line; switch S7 switches the series-connected valve filaments also across the H.T. supply, via the filament dropping resistor R12. The switch sections are, of course, ganged.

This arrangement of operating the valve filaments from the H.T. supply, via a dropping resistor, is common practice, though on certain

should be an immediate suspect, especially if the set has been operating correctly for a considerable period before the fault develops. An approximate measurement of the H.T. voltage may not reveal the trouble, but if the rectifier is at fault, the voltage across each valve filament will be below the required 1·4V.

This trouble is aggravated if the power supply voltage falls, as it does in many areas these days of heavy mains demands. A contributory factor is also a low emission frequency changer valve, as has already been discussed under battery receivers.

In order to enhance the filament voltage distribution, resistors are sometimes connected in parallel with the filaments. Such a resistor is R18

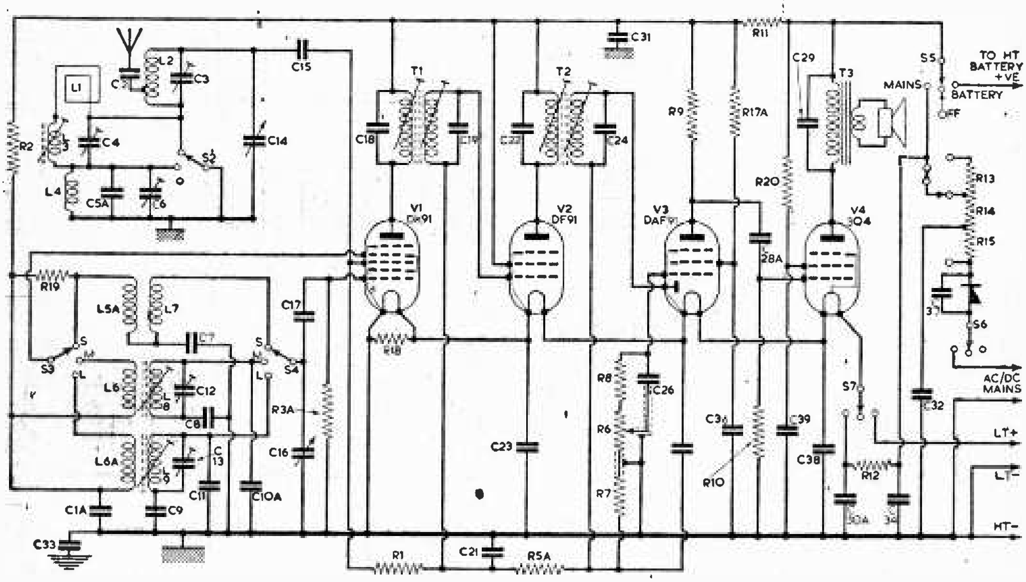


Fig. 2.—Circuit diagram of a mains/battery portable.

receivers a separate L.T. power pack is provided, including a small transformer and rectifier. The rectifier is, therefore, called upon not only to supply H.T. power, but also filament power, and the total can add up to almost 100mA.

The most critical part of the circuit is the filament chain, for if the current is less than, or in excess of, the filament rating of the valves, each filament will either have too little or too much voltage across it. Insufficient voltage will give low volume and possibly prevent the local oscillator from working, while too great a voltage will ruin the valves and prevent them from operating when normal voltage is restored. At this stage it should be carefully noted that once the filament of the all-dry type of valve is overrun, the valve might just as well be thrown away, for it will never operate again under correct conditions. Thus, when servicing, extreme care should be taken not to short out the filament dropper or by-pass part of the filament circuit. The receiver should also be adjusted carefully to suit the applied mains voltage.

In the event of the set suddenly cutting out after operating for, say, an hour or so, the H.T. rectifier

in Fig. 2. These should never be removed or changed in value in order to obtain a greater voltage across a filament. If the voltage differs between each filament, and the filament resistors are of correct value, then one or more of the valves may have been overrun at some time causing an alteration in filament resistance.

Hum and Distortion

Adequate smoothing is essential in order to eliminate mains ripple from the H.T. and L.T. lines, and this is accomplished by the use of relatively low voltage, high capacitance electrolytic capacitors. Excessive hum accompanied by distortion should, therefore, first lead to a check of these components, not forgetting those in the L.T. circuit.

Finally, a word of warning, as the chassis is connected direct to one side of the mains supply on most mains/battery portables, care must be taken when making tests with the set connected to the supply. It is desirable first to check the chassis with a neon bulb to make sure that it is connected to the neutral of the supply.

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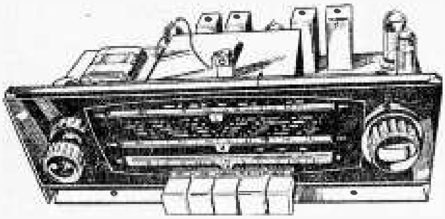

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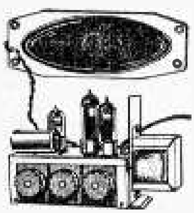

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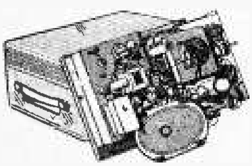

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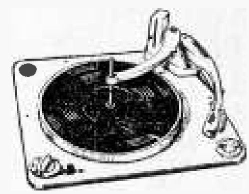

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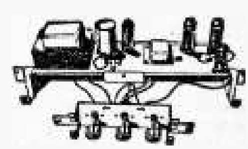

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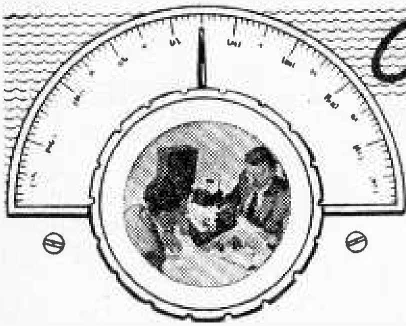

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Aerial Design

I RECENTLY visited a country district and saw something which reminded me of the very early days of broadcasting, and awakened in my mind a problem which has worried me for some time. Attached to the roof of a house was what at first sight appeared to be a home-made sweep's brush, attached to the outside of a chimney. I looked closer, and sure enough it was one of those aerials which was all too familiar in the early days, made up of a number of lengths of the stranded copper wire which were known as 7/22's, soldered to a small ring and attached to the end of a down-lead. It brought back memories of many novel aerial designs which were not only published in the early issues of this and other magazines, but which were used successfully and which had many fantastic claims made for them.

There was the type made from a length of wire, similar to an ordinary inverted "L" aerial, and hanging on to it, were small clusters of short wire, at intervals of 18in. or so. Then there was the aerial made from two hoops (about 2ft in diameter) supported on a pole, with the aerial attached firmly to one hoop and then run up and down round the hoops. No doubt some of the older readers can remember others, but they all had one good feature—they gave improved results at that time. Valves were, of course, not so efficient as they are to-day, and it was common to use a two or three valve set and receive over remarkable distances. The air was clearer, of course, and there were not so many stations, so that selectivity did not have to be so good as it is to-day. The performance of these aerials all appeared to rely upon the added amount of wire which was "up aloft" and the very few experiments which I carried out seemed to indicate that it mattered very little how this extra wire was accommodated — whether it was soldered together in a bunch, or hung from another wire at short intervals.

I believe that, round about the time of which I am speaking, there was a commercial aerial on sale in the U.S.A. which consisted of a flat sheet of copper about 2ft square, for which most remarkable claims were made. To-day, of course, as I have mentioned before, a very short wire, supported vertically seems to be most productive of a really reliable all-round all-wave performance. Many of to-day's transmitters use the metal mast as a radiator, and, in fact, a very prevalent trouble (known as the "Luxembourg effect") can be avoided by using such an aerial. On television the same thing now appears to be happening in the U.S.A. in an endeavour to produce an aerial which will be equally efficient on all bands, but, of course, the very short wavelengths, which are used, complicate the problem.

"Pocket" Portables

I must thank reader Gilbanks for writing to me concerning the nuisance caused by the popular transistor portables referred to in my notes in the February issue. Amongst other things, he reminds me that the L.C.C. has a bye-law in all their parks covering the use of radios, record players and other musical instruments, which states that they must not be used if they are a nuisance to other people. He rightly anticipates that at the rate at which the use of these sets is increasing, there will shortly be such laws introduced at most seaside resorts and beauty spots. If the nuisance becomes too great then I can foresee the portable practically killing itself and I believe the Noise Abatement Society have this type of set quite high on their list of public "nuisances".

A printed circuit designer at the St. Albans Works of Marconi Instruments, draws up an Astrofoil master. Subsequently, the design is photographed; from the negative, any number of printed circuit boards can be run off.

An Introduction to Stereo

THEORETICAL AND PRACTICAL CONSIDERATIONS

By N. A. Walter

THIS article is intended to give guidance firstly to those about to enter the field of stereophonic sound, and secondly to enable mono hi-fi enthusiasts to convert their present systems to stereo by adding another amplifier.

The Complete System

A complete system is shown in Fig. 1. Radio has been included, although stereophonic radio is, at the moment, only being broadcast on an experimental basis.

Stereo recordings give us two separate sets of intelligence on the record, and these are kept separate throughout the two amplifier and loudspeaker systems. Our ears recombine these two sets of information and give the illusion of depth and breadth of music.

A study of the block diagram of a stereo system Fig. 1, shows that it comprises a turntable, a pick-up, pre-amplifier and tone control unit, the main amplifiers (preferably identical), the two loudspeaker systems, radio feeder unit (if fitted), and the power supply.

The Turntable

If the reader already possesses a turntable, it is advisable to write to the manufacturer to ensure that the unit is suitable for stereo. Some of the earlier 3-speed units are not suitable for conversion. If, on the other hand, a new unit is to be purchased, there is a large choice.

Transcription Motor

If expense is no object, a transcription type motor is undoubtedly the best, but, for the majority of readers, a good quality autochanger or single player will be more than adequate and the money saved can be put to good use on the loudspeaker system.

Autochanger

Since their first appearance many years ago, fierce arguments have taken place over the merits and otherwise of autochangers. However, modern changers are vastly superior to their earlier counterparts, and if the reader requires to play a number of records without the need to keep putting records on, an autochanger is the obvious choice.

Before deciding upon a unit, the following points should be borne in mind:

1. it should be a four speed (78, 45, 33 and 16rev/min.) unit.
2. it should be possible to adjust the playing weight of the pick-up to between, say, 4 and 8gm.
3. both the stylus and the cartridge should be easy to change.
4. there must be sufficient clearance both above and below the baseboard for the unit of your choice (6in. above and 2in. below is a typical value).

Before finally deciding, hear each unit working and listen for the following three points.

"Wow"

This consists of slow changes in the speed of rotation of the turntable and may best be heard on a long sustained sound, or on piano music, the ear being very sensitive to slight changes of pitch on a continuous note.

"Flutter"

This is a high frequency modulation superimposed on the music, resulting in a "roughness" to the tone of the recording. It is usually less noticeable than "wow".

"Rumble"

Rumble is of a very low frequency—hence the name—and is best heard on a record with no, or only light modulation, such as a light violin passage. An electrical filter is given later, which can be used to minimise the effect.

The Pick-up

If an autochanger is purchased, a pick-up will normally be fitted. This will almost invariably be of the crystal type, and have advantages of a good frequency response (40-12,000c/s is quite

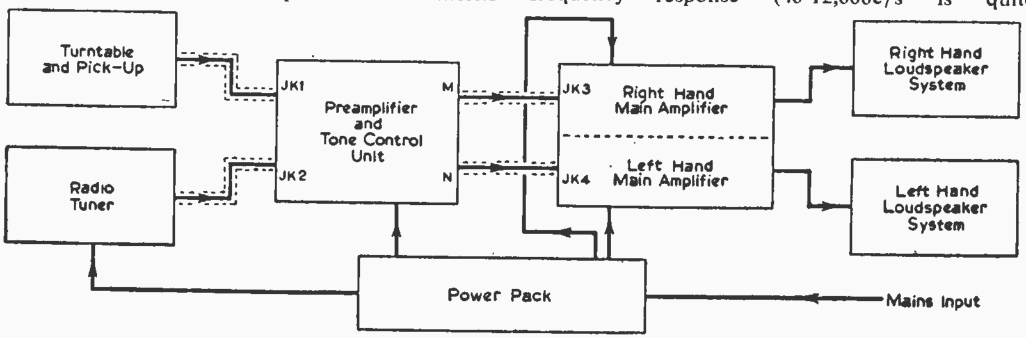


Fig. 1.—Block diagram of the complete system.

common); a good output (100 to 300mV from each channel in stereo); and be inexpensive and quite robust.

However, it must be remembered that crystal pick-ups are high impedance devices and a few elementary precautions can bring excellent results. First, they should be fed into an impedance of 1M if possible, but certainly not less than 0·25M, or a falling off of the bass response will result. Secondly, the shorter the leads from the pick-up to the pre-amplifier the better, and a maximum of two feet should be allowed. This lead can represent quite a high capacity in shunt with the pick-up and can result in heavy losses. A screened lead should be used to prevent hum pick-up, but the screening should be insulated and earthed only at the pre-amplifier input. If hum is objectionable, the main power transformer should be re-orientated to find the optimum position.

As a general rule, a crystal pick-up can be represented as a capacity of the order of 0·01μF in shunt with several megohms. For this reason, shunting of the pick-up output by a capacitor does not result in a high frequency cut, as in the case of a magnetic pick-up, but only in a reduction of the output as a whole. Also, in some cases, a correction circuit is recommended by the pick-up manufacturer and this usually consists of a simple capacity/resistance circuit.

Before leaving the subject of turntables and pick-ups it is worth mentioning a few of the faults of stereo cartridges.

They are more responsive to turntable rumble, owing to the fact that they must respond to a vertical as well as horizontal component of the recording. Acoustic feedback through the cabinet can be a serious problem, unless the baseboard and cabinet are very substantial, and the speakers well shielded from the turntable, and unless there is a definite reason against it, the loudspeakers should be separately housed.

The Radio Feeder Unit

The only decisive factor to bear in mind here is whether to use F.M. or A.M. for reception. F.M. is the obvious choice, and unless there are any other strong reasons, A.M. may be ignored.

The H.T. and L.T. requirements are dealt with under the power-pack section, but in general, most units require an H.T. between 200 and 250V and take 30 to 50mA.

Pre-amplifier and Tone Control Unit

The function of this single valve unit is to provide some measure of gain, to provide switching for stereo records, mono records and radio (if desired another position can be included if tape is to be used), and tone, volume and balance

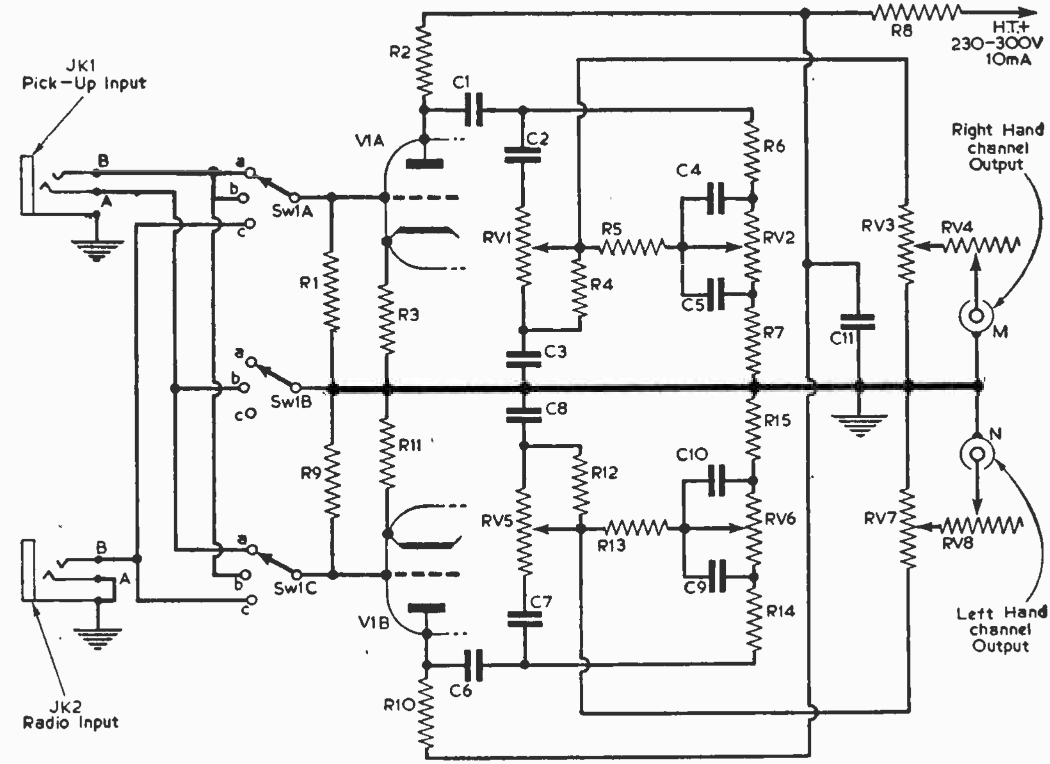


Fig. 2.—Circuit of the pre-amplifier and tone control unit. (Note: RV4 is connected so that when the spindle is turned clockwise, the resistance decreases; RV8 is connected in the opposite sense. The cables linking the pre-amplifier to the main amplifier (to be described in a future issue) should be single-core, flexible, screened cable. Position (a) of SW1 is for stereo; position (b) for mono; and position (c) for radio.

COMPONENTS LIST

R1, R9	1M ¼W high stability
R2, R10	100k ½W high stability
R3, R11	1500Ω ¼W
R4, R12	47k ¼W
R5, R13	39k ¼W
R6, R14	68k ¼W
R7, R15	6·8k ¼W
R8	(common to both units) 15k ½W
RV1, RV5	dual, ganged, 250k linear potentiometer
RV2, RV6	dual, ganged, 250k linear potentiometer
RV3, RV7	dual, ganged, 250k log. potentiometer
RV4, RV8	dual, ganged, 500k linear potentiometer
Note: See text for function of each variable control	
C1, C6	0·25μF 350VW
C2, C7	600pF
C3, C8	8200pF
C4, C9	300pF
C5, C10	3300pF
C11	(common to both units) 0·25μF 350VW
V1	ECC81 or 12AT7 (heater connected for 6·3V operation)
JK1, JK2	2-pole earth input jack sockets
SW1	3-pole, 3-way, rotary type

Valveholder: B9A, nylon loaded, skirted and resiliently mounted
Chassis to suit components:
3ft of light, twin-core, screened cable (for wiring pick-up to input socket)
Suitable length of single-core screened cable to connect output of each channel to main amplifier

controls. In this particular design, this has been kept as a separate chassis since all the amplifier controls are on this unit, and can, therefore, be bolted to the control panel of the radiogram, leaving the heavier units such as power pack and main amplifiers to be housed at the bottom of the cabinet. This arrangement is also less likely to suffer from hum pick-up, as the pre-amplifier can be kept close to the pick-up and well away from the mains transformer.

If we now consider the detailed circuit (Fig. 2) we see that a single double triode valve (12AT7) is used. This is purely for economy purposes, and two EF86's connected as triodes would be a slightly better arrangement. One half of the valve is used as a pre-amplifier for the right hand channel and the other half for the left hand channel, each circuit being identical.

Taking one half of the circuit, it can be seen that the pick-up is fed into a 2-pole jack, JK1, on to the "selector switch" SW1. This selector switch arranges that in position "A" the common lead of the pick-up is earthed, and the left and right hand channel leads are connected to their respective grids.

With the cathode resistors R3 and R11 not bypassed, a gain of 26 is obtained (if bypassed by a 50μF 12VW capacitor, a gain of 40 is obtained), and the amplified signal is fed via C1 to the tone control circuits. Network C2, C3 and RV1 forms the treble boost and cut control and R6, RV2, R7, C4 and C5 constitute the bass boost and cut circuits. RV3 is the master volume control, and RV4 the balance control. The tone control circuits introduce a loss of approximately 10 to 1, so that the overall gain of the pre-amplifier is of the order of two. This is adequate since the main amplifiers need only 100mV for full output. The overall distortion of the pre-amplifier circuit is less than 0·2per cent.

Let us now consider each control and its function in a little more detail.

Selector Switch (SW)

As has been said already this has three positions, "stereo", "mono", and "radio" and a fourth ("tape") can be added if needed.

Treble

RV1, RV5, is a twin-gang, linear, ¼M potentiometer and provides a boost of approximately 10dB and a cut of 10dB, continuously variable (measured at 10kc/s relative to 1kc/s).

Bass

RV2, RV6 is a twin-gang, linear, ¼M potentiometer and provides a boost of approximately 10dB and a cut of 5dB continuously variable (measured at 50c/s relative to 1,000c/s).

Master Volume Control

RV3, RV7 is a twin-gang, logarithmic law, potentiometer, providing simultaneous volume control of each channel. A log law potentiometer is needed here in order to avoid the "fierceness" at the minimum volume position which would result if a linear potentiometer were used.

Balance Control RV4, RV8

This is a twin-gang 500k linear potentiometer, the function of which is to adjust the volume from the two loudspeakers for equal level. In theory, if everything in the amplifiers and loudspeakers were identical, this control would not be needed, but owing to tolerances in components, and room acoustics, this control will be found very useful.

Reverse Stereo

A reverse stereo control has not been fitted. The function of such a control is to reverse the output to the speakers, i.e. to change the right hand channel to the left hand loudspeaker and vice versa, if such a control is considered necessary, a simple change-over switch can be fitted to change over the outputs M and N (Fig. 2) in such a way that, in one position, M can be fed into the right hand channel main amplifier and by reversing the switch into the left hand main amplifier. N is simultaneously changed over in the opposite sense.

Precautions in Wiring

The following points should be considered standard practice in any high quality sound reproducing equipment and if followed, hum and noise will be inaudible.

(Continued on page 54)

A VHF TUNER

By
E. H. Berney

THE POWER SUPPLY

(Continued from page 1122 of the April issue).

THE tuner requires a power supply of about 50mA at 250V and it must be well smoothed. This is rather a large demand to make upon an existing amplifier and so the design includes a built-in power pack, the circuit of which was given in Fig. 2 last month. The prototype uses a 6X5 rectifier but others such as 5Z4, EZ80 etc., will serve equally, the only requirement being that the appropriate heater voltage is available from the transformer. Resistance smoothing is used and the value of R27 may need some adjustment to produce the correct H.T. rail voltage of 250. This resistor must be mounted above the chassis in a position where its heat is easily dissipated; in the prototype it is mounted on a tag strip bolted to the top of the mains transformer. No mains switch is included, the supply being controlled by a switch in the associated A.F. amplifier.

Construction of the Tuner

The tuner is a little more complicated than some and the constructor with VHF experience will be at an advantage. It is advisable, generally, to adhere to the layout and wiring given but minor departures are not likely to cause trouble in view of the comprehensive screening below the chassis. The controls, input and output sockets, etc., are in the positions best suited to the service for which the prototype was built but the tuning switch for instance, which is mounted on a bracket underneath the chassis, can be reorientated so as to bring the control out at the front; or if it is desired to keep the long sides clear, the input and output sockets can be repositioned on the deck of the chassis so that the cables plug in vertically. The performance will not be affected so long as the connections are kept short.

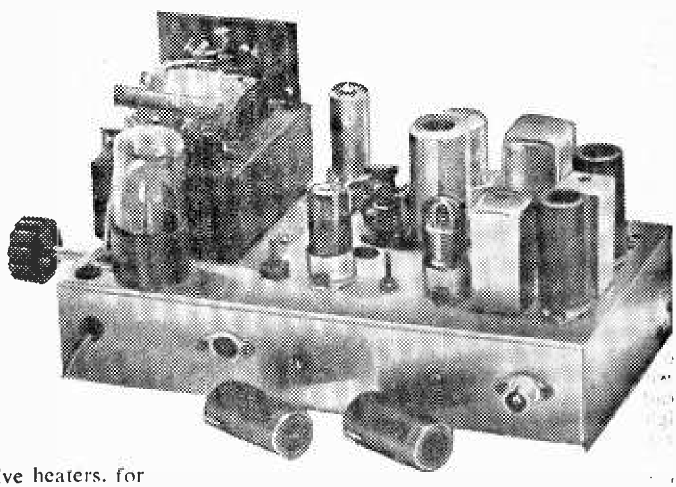
It is necessary to observe VHF technique throughout the construction. This means short direct connections, especially in the case of by-pass and decoupling components. It is not necessary to go to extremes but connections should not exceed ½in. in length unless it is unavoidable. Miniature components should be used, care being taken not to damage them when soldering. An iron of the instrument type, having a bit, about $\frac{3}{16}$in. in diameter, is the most suitable tool.

Wiring

In the wiring diagrams, Figs. 3 and 4, some of the connections appear rather long because they have been opened out for clarity. In construction, they should be as short and direct as possible, without regard to appearance. One or two of the connections in the oscillator circuit are in fact rather longer than might be thought permissible but in these cases, the inductance of the wire merely adds to the inductive reactance of the circuit and no harm results. Tinned copper wire of 22s.w.g. is suitable for all wiring except the valve heaters, for which 5A flexible p.v.c. covered is recommended. It should be noted that although, in the circuit diagram—Fig. 1, last month—the aerial was shown with the normal aerial symbol, it is in fact a conventional F.M. dipole. In order to improve stability, the heater and screen pins of V1 should be by-passed to the cathode of the valve, and not to chassis, as in Fig. 1. The value of C19 (which was indistinct in Fig. 1) is 10pF.

It must be emphasised that the wiring diagram (Fig. 3, last month) must not be followed exactly; as is usual at VHF, leads must be as short and direct as possible if instability is not to occur. In Fig. 3, the wiring was shown opened out for clarity, and in particular, the by-pass capacitors, C1, C2 and C4, should be taken to a common point at cathode potential. This common point is by-passed to chassis via C3.

In view of the amount of detailed work required below the chassis, it is an advantage to make a rough wooden box into which it can be placed upside down, suspended by the end flanges. The valve holders should be fitted first, followed by the transformers and electrolytics. The screens should then be made



The completed receiver.

and fitted and their positions marked on the chassis; after which they may be removed until construction is practically complete. Commence wiring with the valve heaters and their associated by-pass capacitors, after which work can proceed stage by stage from aerial to output and power supply. Take care to place all components clear of the screen positions. Dropping and decoupling resistors can conveniently be mounted vertically (except for V2a) so that when the screens are in position the H.T. rail can be run round above them to each stage in turn.

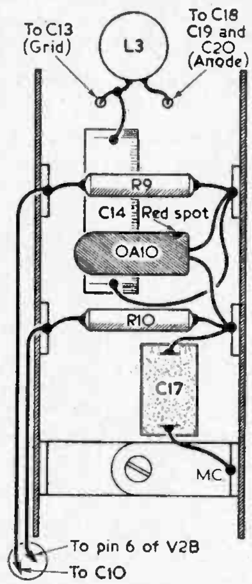


Fig. 4.—Wiring of the oscillator coil and tuning correction assembly.

Chassis

The tuner with its power supply is built on a chassis measuring 9in. x 5in. x 2in., a plan of which is given in Fig. 5. Aluminium of 18s.w.g. is suitable. Note that the long sides are only 1¾in. deep so that there is a space of ¼in. through which air can enter to pass out through the vents provided in the deck for the purpose.

Screens

The dimensions of the screens which are also of 18s.w.g. aluminium, and a plan showing their assembly, is given in Fig. 6. The three pieces should be bolted or riveted together and the whole assembly placed in the chassis and secured in four places with bolts or self-tapping screws; the holes for these are best drilled with the screens in position, through both thicknesses of metal in one operation. Cut-outs are provided in the screens for the three wiring connections which must pass beneath them.

The oscillator coil L3 and the tuning correction network, are mounted above the chassis. No radiation from this source has been detected in the prototype, but if trouble is experienced, the whole assembly should be covered with a light aluminium screen.

Components

Ceramic capacitors are suitable for most positions and are generally to be preferred for their small physical size. C14, 15, 17 and 20 should be silver mica. The electrolytic, C35, must be a wire ended type as neither end is at earth potential, and the working voltage should be not less than 50. C36 and 37 may be one double component if it can be accommodated. The resistors may be all ¼W except R20 (½W) and R27 (10W). The junction diode, OA10 is an industrial type not usually stocked by component dealers, but is obtainable to order at short notice. The valves should be screened except for V6 and V7.

The Coils

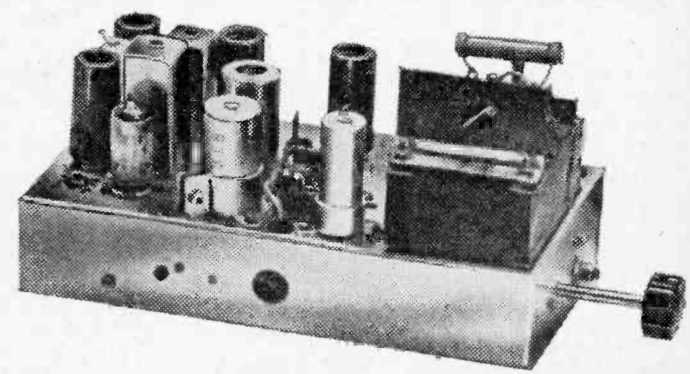
The signal frequency coils are wound with 20s.w.g. tinned copper wire on formers ⅜in. in diameter, having ¼in. dust cores. L1 consists of 3½ turns and L2, 3 turns which should be spaced at slightly more than one wire diameter. The aerial coupling coil on L1 is one turn of 22s.w.g. enamelled wire. The oscillator coil, L3, is 4½ turns of 20s.w.g. with the same spacing on a $\frac{5}{16}$in. former with ¼in. core. Details of the windings are shown in Fig. 7. All the windings must be fixed firmly in position with polystyrene cement and it is an advantage to wind the wire first on a slightly smaller former, putting on an extra turn. It can then be transferred to the proper former where it will fit tightly and the turns can be adjusted for number and spacing.

I.F. Alignment

When construction is complete, check first that the correct H.T. rail voltage is present and adjust R27 if necessary. Alignment can then be commenced, after allowing about 15 minutes for warming up. A high resistance D.C. voltmeter is required and also if possible an A.M. signal generator. The procedure is as follows.

Detach the automatic tuning control lead from R21 and solder it to earth in the vicinity. Connect the voltmeter on the 10V range across C35 and inject, at the grid of V4, an unmodulated signal of 10·7Mc/s. Adjust the top core of the ratio detector transformer and both cores of I.F.T.2 for maximum response. The generator signal should be reduced progressively as the circuits come into line so that the meter indication does not exceed 5V. Now connect the meter between point "Z" (Fig. 1) and earth and adjust the bottom core of the detector transformer for zero. This will affect the adjustment of the top core which should therefore be readjusted for maximum. Only a small adjustment should be required.

Now transfer the generator to the grid of V3 and adjust both cores of I.F.T.1. Finally, with injection at V3, check that all cores are properly peaked and that the output at point "Z" is zero. Care is necessary with the bottom core of the detector transformer.



Another view of the tuner.

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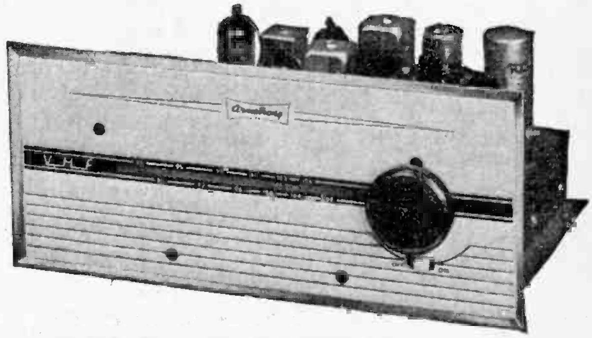

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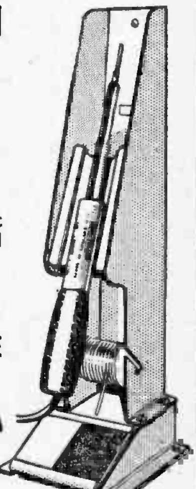

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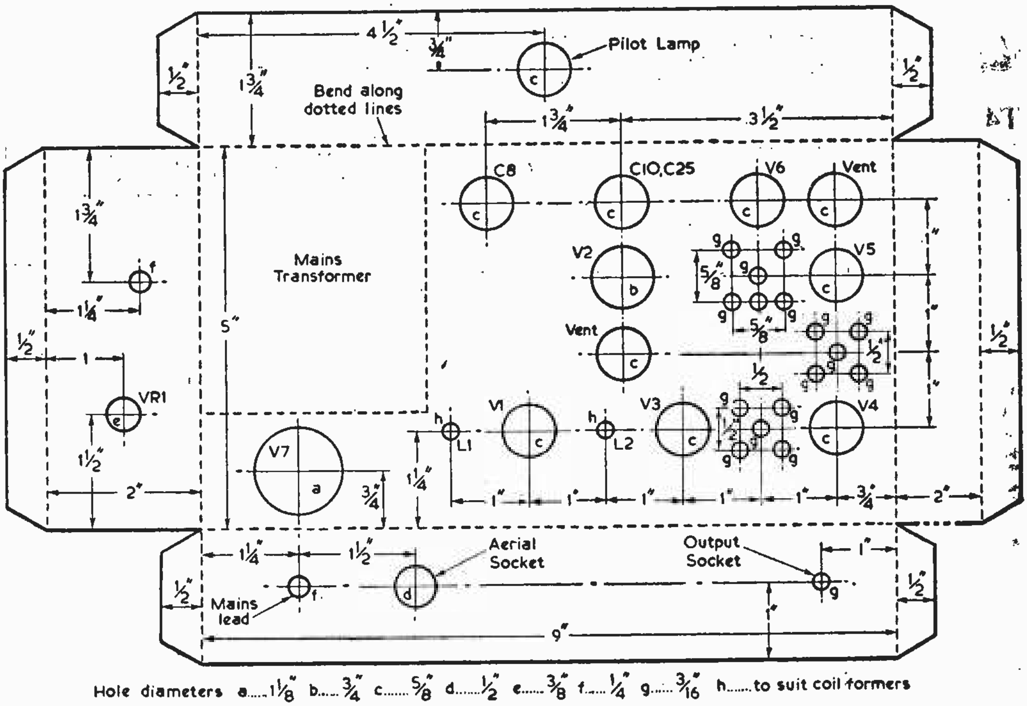


Fig. 5.—Plan of the chassis.

As it enters the former, the meter reading will rise to a maximum, decline to zero and then rise to a reverse maximum. The zero between the two maxima is the correct position.

Acceptance Bandwidth

The acceptance bandwidth should now be checked. With the meter connected between point "Z" and earth and injection at V3 grid, move the signal generator slowly over the range 10·5 to 11Mc/s. If the alignment is symmetrical, as it should be, the meter will show a maximum reading at about 10·6Mc/s zero at 10·7Mc/s and a maximum of inverse polarity at 10·8Mc/s. The two maxima should be of equal magnitude and equidistant from zero.

Oscillator

To set the oscillator, connect the tuner to an aerial and an audio amplifier. Set the tuning switch in the centre position and advance the volume control of the amplifier. A subdued "rushing" noise should be heard in the speaker, indicating that V2a is oscillating. If it is not, the fault must be found and rectified before proceeding further. Commencing with the core of L3 fully engaged, withdraw it slowly until the highest frequency transmission is received. Tune this accurately with the aid of the meter between point "Z" and earth. Now turn the switch to each of the other positions in turn and tune in the remaining transmissions with the trimmers C9 and C11. Repeat the process to ensure that all three are properly tuned.

It will be found that there are two positions of the core of L3 in which programmes are received. The oscillator frequency should be below that of the received signal and the core position giving the greater inductance is the correct setting. If in doubt about this, set the generator to a frequency about 22Mc/s below that of the transmission and inject a signal at the aerial socket. An image signal should be heard.

Signal Frequency Circuits

Set the switch to receive the centre frequency transmission (normally the Third programme) and inject at the aerial socket a signal of appropriate frequency and of strength enough to show two or three volts on the meter connected across C35. Adjust the cores of L1 and L2 for maximum reading.

Automatic Tuning Control

Connect the positive lead from the voltmeter to C10 and the negative to C25. Adjust VR so that the meter reads −15V. Detach the meter, remove the control voltage line from earth and connect it to point "Z". Replace the aerial, connect the meter between point "Z" and earth and observe whether the control maintains the tuning accurately. It will be appreciated that depending upon the connections at the secondary of the detector transformer, the control voltage may not be of the right polarity and if this is so, the receiver will be held permanently off tune. The remedy is to reverse the diode so that the red spot is adjacent to R10 and alter the bias by means of VR to make C25 15V positive with respect to C10.

Alignment Without a Generator

The tuner can be aligned satisfactorily without a signal generator but this should not be attempted in areas of poor signal strength unless pre-tuned transformers are used. Connect a good aerial and proceed first as already described for adjustment of the oscillator. When any transmission is heard, tune it for maximum strength on the voltmeter by adjusting the I.F. and detector cores; adjust the bottom core of the detector transformer as already described. The meter indication must be kept below 5V and it will be necessary to attenuate the signal in some way as the circuits come into line, as for instance, by connecting a less efficient aerial. The signal frequency circuits can be aligned in the same way, using the centre frequency transmission in place of the generator signal. If pre-tuned transformers have been used, the adjustment will be limited to those necessary to compensate for differences in stray circuit capacities and will be quite small as a rule.

If pre-tuned transformers have not been used, the operation is more difficult but may nevertheless be achieved if a good aerial and a strong signal are available. First make sure that V2a is oscillating. A rough approach can then be made to alignment by setting L1 core almost fully engaged and L2 about a quarter engaged; both cores of I.F.T.2 and the bottom core of I.F.T.1, ¼in. deep in the formers and the top cores of I.F.T.1 and the detector transformer ½in. deep. Ignore the bottom core of the detector transformer at this stage. Connect an aerial and amplifier and with the volume control fully advanced, search for a transmission by manipulating the core of L3. Some perseverance is necessary and the signal when received will probably be weak and distorted, but it can be "nursed" by careful core adjustment until it registers on the meter, when alignment can proceed as described before. The intermediate frequency arrived at in this way will not be accurate but provided all the cores are properly peaked and the output at point "Z" is zero, the discrepancy will be of no consequence.

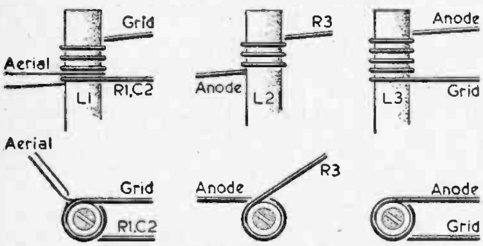


Fig. 7.—Construction of the coils.

Drift Test

The automatic frequency control is capable of maintaining accurate tuning over a wide range but it will be appreciated that if the thermal drift of the oscillator is excessive, there will be difficulty in "locking on" to the new transmission when the tuning switch is operated. In the extreme case, the receiver will "hunt" between adjacent transmissions. If this trouble is experienced, carry out a drift test as follows.

Detach the control line from point "Z" and connect it to earth. Solder a short length of wire to point "Z" for connecting the voltmeter and place the tuner

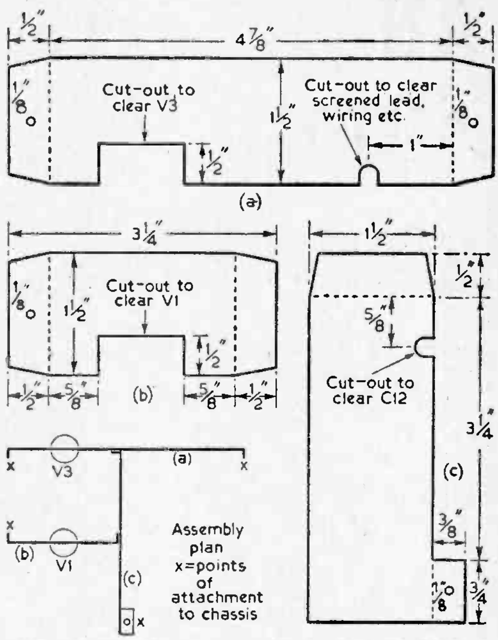


Fig. 6.—Details of the screens and their assembly.

right side up on the bench to simulate service conditions. Set the tuning switch to receive the lowest frequency transmission, switch on and tune the transmission accurately for zero on the meter by manipulating L3 core. Observe the meter at 15-minute intervals thereafter and note whether the correction of drift requires an increase or decrease in the inductance of L3. If it is an increase, the negative co-efficient in the parallel combination C19, C20 must be reduced; if a decrease, it must be made larger. Whatever alteration is made, the total capacitance of the combination should be maintained within the limits 20-24pF. Exact compensation is not necessary.

Operation

Many constructors will no doubt install the tuner in a cabinet with other equipment. Reasonable ventilation is necessary and space is required to bring the tuning control to a convenient operating position together with some means of programme identification. A simple pointer knob will serve for this, but, if desired, spare contacts on the tuning switch may be used to control indicator lamps. Suitable lamps for this purpose are the 6V 0·04A type as used for cycle dynamo rear lights.

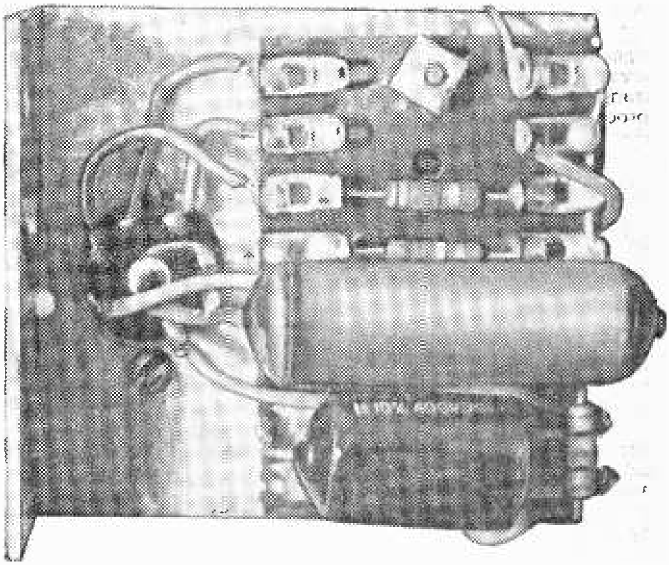
Aerial

Within the primary service area of the transmitter, a "picture rail" aerial will usually suffice. This can be formed from a length of flat twin flex by parting the conductors over a length of 2ft 6in. and extending them along a picture rail etc., to form a rough dipole 5ft long, the remainder of the flex being used as a down lead. At greater distances, or in poor reception conditions, a loft mounted dipole with reflector is recommended.

AN AUDIO BOOSTER STAGE

By R. Murray-Shelley

INCREASING THE SENSITIVITY OF AN AMPLIFIER



ALTHOUGH this unit was designed in the first instance to increase the output which could be obtained from a tape recorder amplifier, it can be used to give a very worth-while increase in sensitivity to almost any amplifier into which it is connected.

The Circuit

The circuit was designed to be as simple as possible, consistent with good results. It is not intended to produce the maximum gain which can be obtained from the valve used, since too much gain only results in overloading of the output stage of the main amplifier with resultant distortion. It will be seen that a single valve is used, a 6AT6, which is a double diode triode, and which fits a B7G base. In this case the diodes are not used and are connected to the chassis. The choice of valve which may be used is by no means limited, and almost any small triode such as a 6C4 or EC90 will give good results.

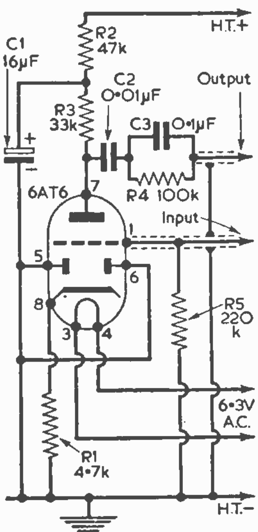


Fig. 1 (left).—The basic circuit of the booster unit.

Noise

Decoupling of the anode of the valve does much to reduce hum, and the omission of a cathode bypass condenser introduces a measure of negative feedback over the stage, which, though reducing the effective gain of the circuit, adds to its stability and reduces any distortion which may be introduced by the unit.

The resistor, R4, was introduced to attenuate the output of the unit further, since the gain

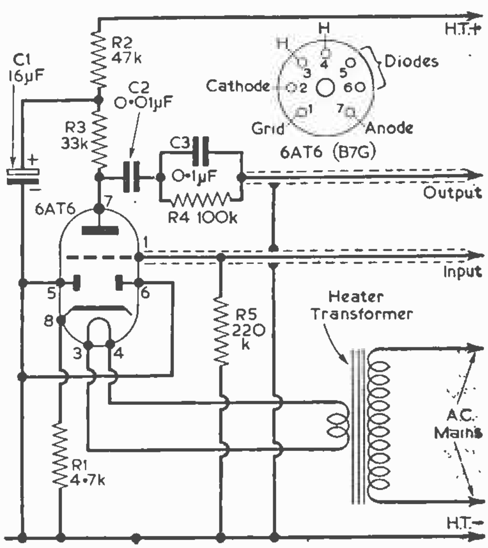


Fig. 2 (right).—A modified circuit for A.C./D.C. amplifiers.

was found to be greater than that which was required, and with C3, it adds a degree of treble boost to the output. This was found to be necessary in the particular application for which the booster was designed. The inclusion of R4 and C3 is entirely optional, but if these components are omitted it is then considered advisable to include a 10 or 20k resistor between C2 and the grid of the output valve.

Power Supplies

The power requirements of the unit are very modest, 250V D.C. are required at only 1 or 2mA with 6·3V at 0·2A for the valve heater. This power can usually be taken from the amplifier which is being modified. High tension power can very often be easily located at the main smoothing condensers on the amplifier side of the smoothing choke or resistor, or, alternatively, at the output transformer primary. The heater supplies can usually be obtained at the heaters of the valves already present. The heater wiring can be readily identified, since in most cases it consists of a pair of tightly twisted wires—this twisting is intended to reduce the hum produced by induction caused by the A.C. carried in the heater wires. The heater connections are often coloured brown to the BSI specification.

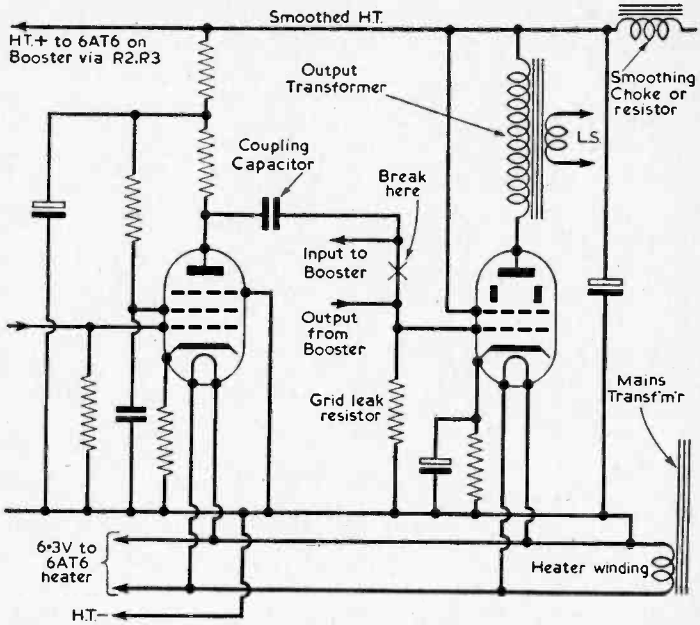


Fig. 3.—The circuit of a typical amplifier, showing the booster unit connections.

COMPONENTS LIST

V—6AT6 valve
R1—4·7k
R2—47k
R3—33k
R4—100k
R5—220k
C1—16µF 350 VW (electrolytic)
C2—0·01 µF 500 VW
C3—0·1 µF 250 VW
B7G valveholder, tag board etc.
Heater transformer—Primary to suit A.C. mains; Secondary 6·3V, 0·5A

Note: With A.C./D.C. receivers, an earth must not be used and the mains should be wired so that the neutral lead is connected to the chassis.

The unit that has been considered so far may only be used on amplifiers which have parallel connected heaters, since amplifiers with series heaters, or having A.C./D.C. types of circuit are not capable of supplying the necessary heater current. The same unit may, however, be used with this type of amplifier, the only modification to the design that is then necessary, is that a small heater transformer must be provided. The modified circuit is shown in Fig. 2. The primary of the transformer must then be connected to the A.C. mains on the set side of the mains switch. This switch is usually carried on the volume or tone control. The high tension supplies are, as before, taken from the main amplifier.

Construction

The unit was, in the writer's case, constructed on a small aluminium sub-chassis, size 2½in. x 2¼in., with a 1in. deep flange on the shorter side. The components are mounted on a tag board, which must be insulated from the chassis, and the result is a small compact unit which can be mounted in any convenient position, either on or near to the existing amplifier.

There are six connections which must be made to the unit, two for the heaters, one each for the high tension positive and negative, and for the signal input and output to the unit. Screened lead should be used for the input and output connections to the chassis, the screening being bonded to the H.T. line. The chassis on which the unit is built should be bonded to the chassis of the original amplifier.

Fitting

When fitting the unit in place, only one connection in the main amplifier should be cut. This is the existing feed to the control grid of the output valve. A valve data book is invaluable when locating the control grid pin on the output valveholder. In case such a book is not available, the grid may easily be located in the following manner:—using an insulated screwdriver, touch each of the tags of the valveholder in turn with the blade. On touching the control grid, a click will be heard in the loudspeaker. One should be careful not to short any of the tags to each other or to the chassis when making this test. The unit

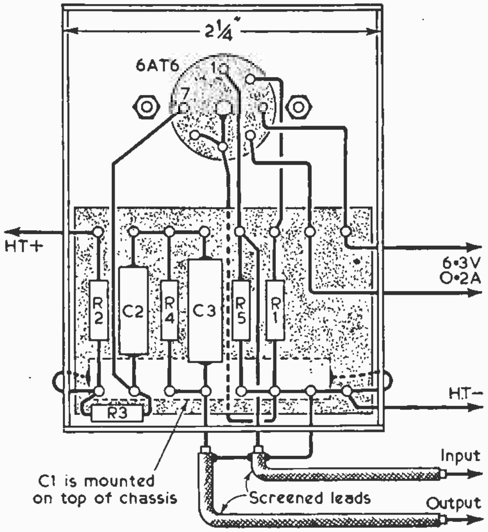


Fig. 4.—The wiring diagram of the unit (see Fig. 1).

should then be connected as shown in Fig. 3. The existing output valve grid leak resistor should be retained as shown.

Components

All resistors should be of ¼ or ½W rating. The coupling condenser, C2, should be a new component of high voltage working, and beyond question as regards leakage. A nylon-loaded valveholder should, if possible, be used for the 6AT6 valve. The connections to the unit itself are shown in Fig. 4.

Using with a Record Player

This additional stage is also very useful for boosting such small amplifiers as are found in many small record reproducers now on the market. The amplifiers in these consist in most cases of only one valve having a high slope, such as an EL84 or, more commonly, a UL84. Connections in this case are made as before, only now the pick-up is connected to the input. When the booster is used in such circumstances, R5 should be increased to 470k.

Uses for the unit can also be found in boosting the audio stages of radio receivers, etc. The same unit can also be used as a microphone preamplifier. (In this case, R5 should be increased to 470k, and R3 to 100k.)

THE P.W. SIGNAL GENERATOR

(Continued from page 27)

Make Cc about 20pF and switch on the R.F. oscillator with the modulation switch off. Rotate the condenser. Heterodyne whistles should be heard. If they are not heard, the valve is not oscillating and the circuit must be rechecked.

The whistles are high pitched and each reduces in pitch and then increases again as the condenser is rotated. Pick out the whistle (actually, a pair of whistles) which is obviously the loudest. This oscillator will then be at 200kc/s when the zero pitch position is reached. The vanes of the oscillator tuning condenser should be about half-way in. Calibration will be carried out later.

In parts of Southern England, very near the Channel, it may not be possible to pick out the whistle corresponding to 200kc/s. This does not matter much at this stage, but if the receiver is selective enough, and tuned to one station *only*, there will be no doubt.

To the beginner, who has not used a signal generator before, this exercise is of great interest and he should spend many hours experimenting and trying to work out what station is causing each heterodyne (there are about 16 or so stations broadcasting on the L.W. band, the Moscow transmitter being the most powerful on 173kc/s).

Testing the Modulation

Without an oscilloscope it is not easy to check the depth of modulation or the waveform. The best test for the beginner to apply is as follows. Tune the receiver to a position on the long wave band where no station is received. Switch on the R.F. unit modulation switch. Rotate the tuning condenser and one position will be found where the modulation note will come over the receiver loudly. If the receiver is calibrated you can tune in either end of the receiver band and thus gain an idea of the spread of the wave lengths over the oscillator condenser control (dial not yet fitted).

Remaining Wiring

Now that it has been established that the oscillator and modulator circuits work using coil L1, the remaining coils, L2, L3 and L4, may be wired in circuit together with the switch S8/9. All wiring is shown clearly in Figs 9 and 10. Note that all coil top leads are "G" and bottom leads—all earthed—are "E".

Coils L3 and L4 must have short leads taken exactly as shown, or the ranges obtained may be incorrect.

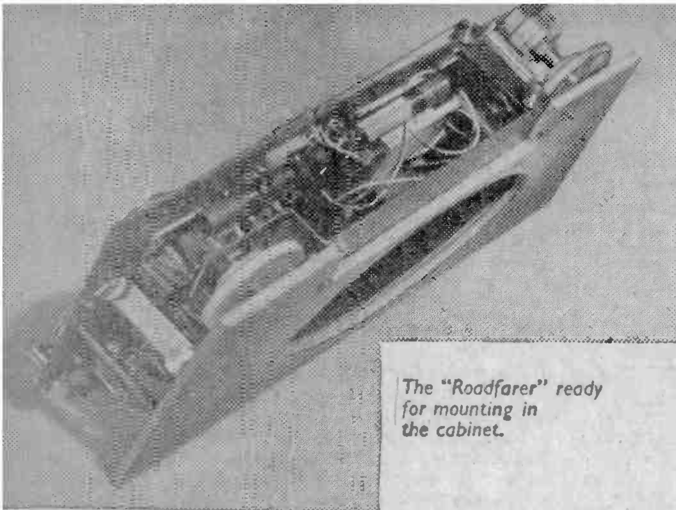
When wiring is complete, re-test L1—with S8/9 at position 1.

A COMPACT ADD-IN B.F.O. UNIT

(Continued from page 29)

but if the signal from the B.F.O. is too strong, weak C.W. signals will be lost.

The B.F.O. control switch can be mounted at any convenient point. If the B.F.O. signal is kept down, it will not have any significant effect on the AVC system of many receivers. But if the AVC system is very sensitive (e.g. has little or no delay voltage) the B.F.O. signal will bring the AVC circuit into action, and reduce signal strength of stations tuned in. A trial will soon show if this is happening. If it should be found to arise, an AVC switch should be fitted. This may be ganged with the B.F.O. switch, or may be separate. It renders the AVC circuit inoperative by shorting the AVC line to the receiver chassis. With slow C.W., such a switch is also helpful, as it prevents the receiver trying to follow the C.W. signals, and thereby giving bursts of increased volume after each interval.



The "Roadfarer" ready for mounting in the cabinet.

The P.W.

THE F.M. SECTION

F.M. Tuner Construction

Strip the insulation from the lead-out wires of the transformer T3 and mount this component on to the board. The component locations printed on the board should be followed and the appropriate components inserted and soldered.

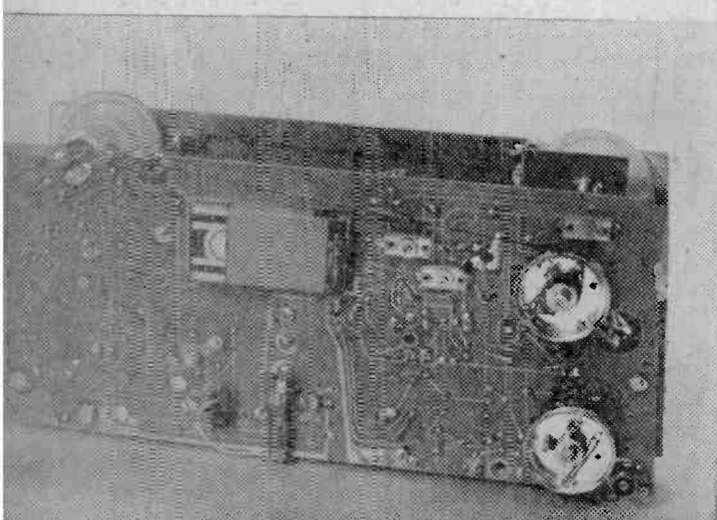
Some slight modifications have been found advantageous in this section of the receiver since the prototype design, which is shown in the blue-print was completed. A resistor of 680Ω has been substituted in place of the coil L9, and the value of C26 altered from 0·04μF to 10μF. The value of resistor R24 has been increased to 8·2k and the value of R26 reduced to 10k. For ease of tuning C24 has been increased to 5pF. The telescopic whip aerial has been found to give excellent results without the use of the loading coil L7, and the value of C33 has been reduced to 1pF.

Having mounted the components shown on the printed board, the tuning capacitor C25 may now be fitted. Having ensured that the capacitor is correctly positioned, the fixing nut should be secured. A short length of tinned copper wire should connect one of the rotor solder tags of C25 to one end of C32. This is clearly shown in the illustration of the tuner unit, given on the blue-print. The coil L4 should now be mounted using two 6B.A. screws for fixing. Solder the capacitor C 28 across the terminations of this coil; one end of the coil terminates on the upper tag ring and one end on the lower tag ring. A short length of tinned copper wire should be connected from the coil termination on the lower tag ring, to the hole marked "Z" on the printed board; this hole is near one of the coil former fixing holes. The capacitor C24 should now be soldered across the tuning capacitor which has already been fitted. It is vital that this capacitor and all other components in this section are mounted exactly as shown in the blue-print. The tuning coil L3 should now be fitted across the tuning capacitor in the position shown. The coupling coil L8 may also be soldered into position. The end of the coupling coil which

THE F.M. tuner employs a 2N502 VHF transistor which is capable of amplification up to frequencies of several hundred megacycles per second. Because of the cost of this type of transistor, conventional circuitry becomes very expensive and the circuit chosen uses only the single transistor to carry out the functions of R.F. amplification, demodulation of the F.M. signal and also A.F. amplification. This is achieved by using a super-regenerative circuit. Whilst basically unconventional, the functioning of this circuit is relatively simple.

Battery Mains Power Unit

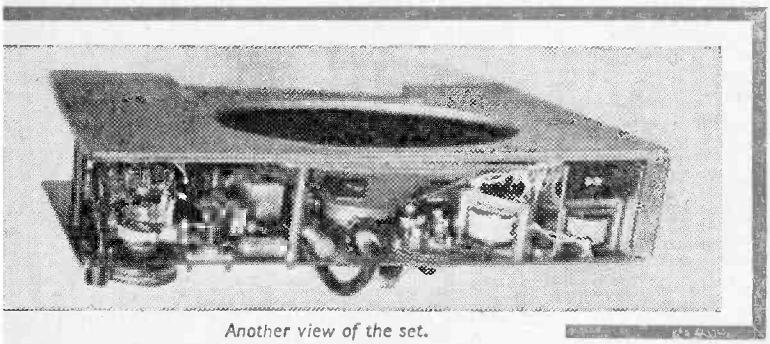
The power unit consists of a subminiature mains transformer, T4, with a tapped primary for mains voltages from 200 to 250. The secondary is centre-tapped to give full wave rectification using two semi-conductor diodes D2 and D3. Because of the extremely fast response time of semi-conductor diodes they must be protected against switching surges. This is achieved by including the resistance-capacity network C34/R28.



Rear view of the "Roadfarer".

"Roadfarer" A.M./F.M. Portable

fits in the aerial socket must at this stage, be left free until the socket itself has been fitted. The VHF transistor TR7, type 2N502 should now be soldered into position. This high performance transistor should be soldered with extreme care and under no circumstances should the lead wires be overheated since this will, immediately, either destroy the transistor or impair its properties. Each wire as it is being soldered should be held with a pair of long-nosed pliers which will act as a heat shunt and so prevent damage to the transistor by overheating. In spite of this precaution the soldering of the leads should be carried out as rapidly as possible. *The importance of the foregoing warning cannot be overstressed and the constructor is well advised to exercise the utmost care when dealing with this particular transistor.*



Another view of the set.

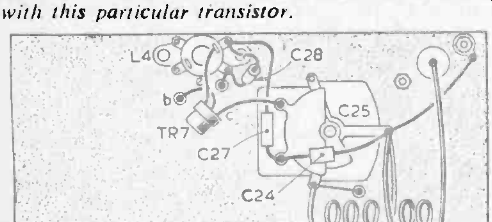
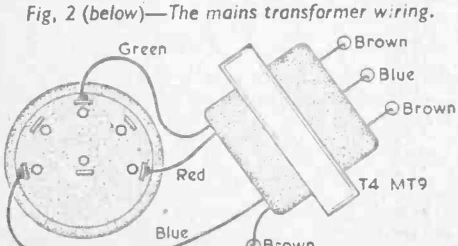


Fig. 1 (above)—The revised F.M. unit wiring (changes from the prototype wiring given on the blueprint are shown).

Fig. 2 (below)—The mains transformer wiring.



Once TR7 has been fitted the capacitor C27 may be soldered into position as illustrated. Again, when soldering one end of C27 on to the other terminating tag of the coil L4, to which the emitter of TR7 is already soldered, considerable care should be taken not to overheat the transistor lead.

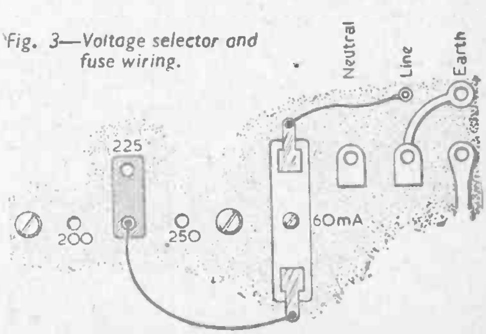
One end of the telescopic aerial coupling capacitor C33 should now be soldered to the pillar of the tuning capacitor C25 as illustrated. The tuner is now complete except for the aerial connections which are made after mounting the front baffle.

Power Unit Construction

Mount the voltage selector panel using two 4B.A. fixing screws Now insert the mains transformer. T4, into the board, bend over the fixing lugs and solder to the copper circuit. Before soldering, check that the transformer has been fitted the correct way round. From the side of the transformer nearest the heat sink for the amplifier, three wires emerge and these should be passed through the appropriate holes in the board and soldered. From the other side of the transformer four leads will be found. The brown lead should be inserted into the appropriate hole in the board and soldered. The three remaining leads should be connected to the voltage selector panel, the colours being located as shown. The two rectifier diodes D2 and D3 should be bolted to the board using the two 4B.A. nuts and washers provided. The solder tags should be fitted to the screw terminals and a short length of tinned copper wire soldered between each tag and the hole in the board directly beneath each tag. The resistor R28, capacitor C34 and C21 should now be fitted. Mount the fuse holder securely in position.

Next Month: Alignment

Fig. 3—Voltage selector and fuse wiring.

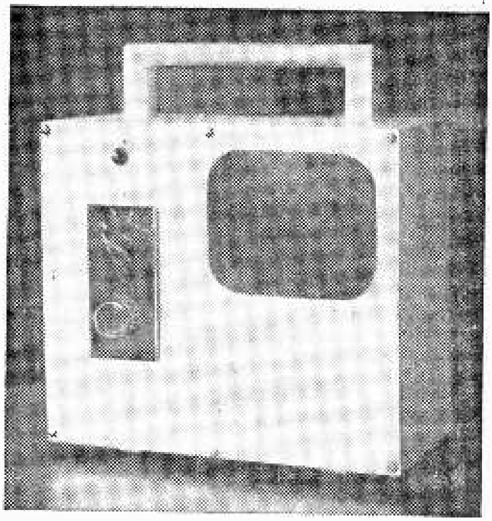


A SWITCH TUNED TRF RECEIVER

TUNING PROCEDURE AND POSSIBLE MODIFICATIONS

By J. Harrison

(Continued from page 1072 of the April issue)



ALTHOUGH it was stated last month that this receiver employed the "live chassis" technique, the power supply circuit given below incorporates a transformer which has a separate winding for the H.T. The mains is thus isolated from the chassis and the receiver is safe to handle, there being no possibility that the chassis will be live. The transformer should have a tapped mains primary and supply 6·3V at 2A and 200-250V at about 60mA.

Tuning Procedure

The tuning of the receiver is quite simple, the following procedure being followed. A length of wire, as long as possible, is connected via a 100pF capacitor to the anode of V1, to act as a temporary aerial. The trimmers C6, C7 and C8 are then adjusted to receive the stations chosen for the switch positions. The temporary aerial is then removed and the trimmers C1, C2 and C3 adjusted to give the maximum output in each case. Fine adjustments are then made to the detector trimmers to compensate for the removal of the capacity of the wire aerial. After the final adjustments are made, each trimmer is locked by applying a dab of paint to its screw.

Performance

The receiver constructed gives reception of the local medium-wave Home and Light services of the BBC with more than adequate volume, it being possible to overload the output valve if the gain is advanced too far. The audio output of the final valve under these conditions is about 4W. However, it is difficult to estimate how much of this is radiated by the small speaker.

The receiver has been tuned to receive the Radio Luxembourg transmitter with the switch in its fourth position, which it does quite efficiently when propagation conditions are good. The lack of any form of AVC does, of course, render reception of this station a little erratic. It has also been used to receive various other transmissions, among the more successful being the BBC Third programme and the Hilversum programmes.

The use of a ferrite rod aerial has resulted in the receiver being somewhat directional. In use, therefore, it has to be turned into the position which gives the greatest output.

The complete apparatus, in its case, weighs about 8lb, which is quite light enough to be moved frequently from one room to another.

The consumption of power from the mains is of the order of only 25W, and thus, the cooling is quite adequate.

Possible Modifications—Addition of Further Switch Positions

There is no reason at all why a receiver of this type should not be constructed with more than three pre-set tuning positions. All that would be necessary for this modification would be the provision of a four-pole switch with as many ways

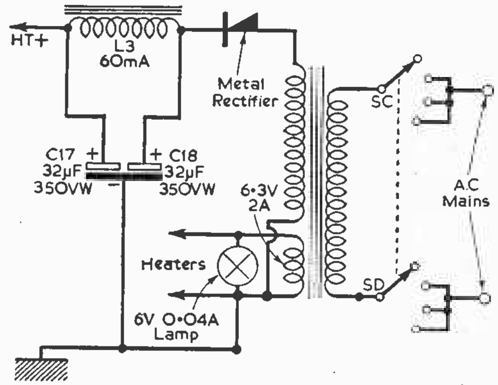


Fig. 7.—The circuit of the power supply. (Although the transformer specified last month was adequate if the "live chassis" technique were to be employed, this circuit shows a transformer with an H.T. secondary winding which enables the receiver to be isolated from the mains supply.)

as required, and two trimmers for each position.

If extension beyond five stations is contemplated, it must be remembered that the cost of the switching assembly and the amount of space which it will occupy will become inconveniently large. A double-gang variable capacitor with padding and trimming capacitors would probably represent a better solution.

Addition of Long-wave Switch Position

The receiver which has been described was intended for use in London, where the reception of the medium-wave Light programme is quite satisfactory. In some districts this would not be the case and it would be necessary to provide for reception of the Light programme transmission at 1500m. It would not be possible, in practice, to do this by providing very large capacities to tune the existing coils and a larger inductance would have to be incorporated in the aerial and detector coils. It is possible, at the cost of a loss of sensitivity, to switch in the extra inductance by using the existing switch arrangement. This method was shown in Fig. 6. The long-wave winding should consist of 130 turns of Litz wire, pile wound on the short length of ferrite rod exposed between the end of the medium-wave winding and the receiver chassis. This is not a good method of providing the extra range since there is bound to be a loss of sensitivity and selectivity and there may be some cross-talk between the ranges. A much better method would involve the use of extra switch wafers. Such an arrangement is shown in Fig. 8.

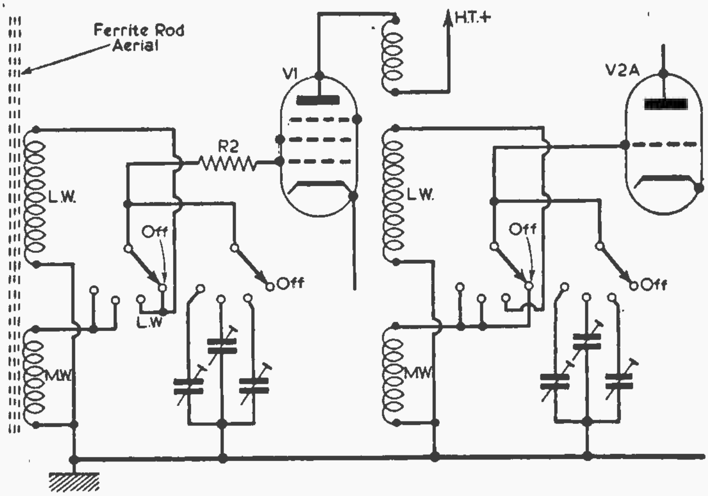


Fig. 8.—A circuit more satisfactory than that of Fig. 6 (last month) for reception of one L.W. station. Two extra switch wafers are required.

Use of a Larger Speaker

This circuit is capable of giving an audio output of high quality and so it might be considered worth while using a larger speaker unit. This would, however, defeat one of the original objects of the design, which was to keep the cost as small as possible. If a suitably loaded 8in. or 10in. unit were available, it would be worth while improving the bass response of the A.F. amplifier by increasing the values of C11 and C12 from 0·01μF to 0·1μF.

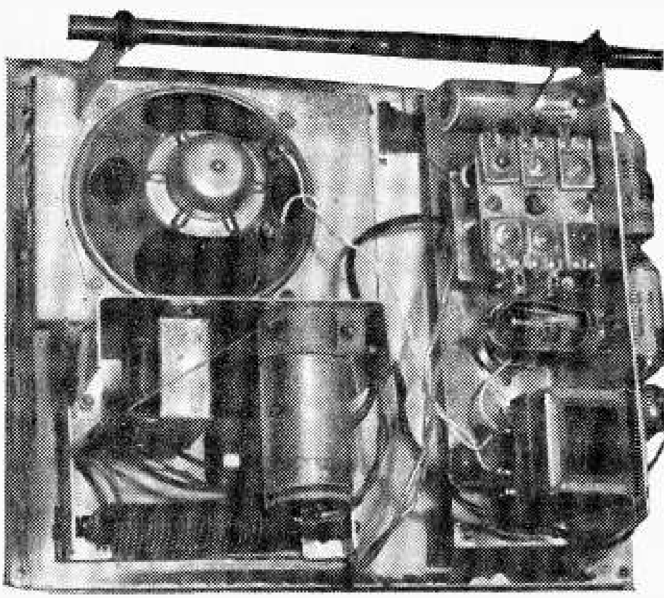
Alternative Valves

If the following valve substitutions were made, no modifications to the circuit would be necessary, other than changing the value of the cathode bias resistor of the output valve.

V1	V2	V3	R12
EF36	6SQ7GT	6V6	220Ω
(EF50)	6SU7GTY	KT63	410Ω
(SP61)	6SL7GT		

Any combination of these valves could be used and many other types are suitable, but it must be remembered that the total heater current drawn by them is likely to be greater than that needed originally. The rating of T2 must therefore be adjusted accordingly.

Note: The values of capacitors C4 and C14 (see Fig. 1, last month) should be increased from 0·01μF to 0·1μF to increase stability and bass response.



The construction of the receiver.

Transistor Characteristics

A SERIES OF TESTS, WITH WHICH THE READER MAY OBTAIN HIS OWN SET OF RESULTS

By P. Westwood

IN completing the following series of tests to obtain the characteristics of a transistor, the author has attempted to include all details which will enable the reader to carry out similar experiments with a minimum of basic instruments. The results are analysed and some guidance is given to enable appreciation of the various points which arise.

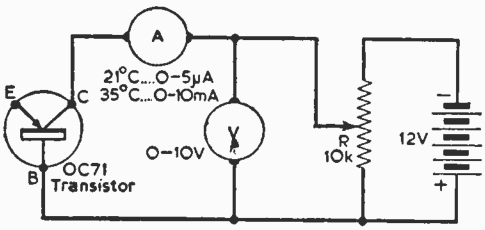


Fig. 1.—The collector-diode test circuit.

When considering a junction transistor; e.g. an OC71, in common base configuration, it can be looked upon as two distinctly separate emitter-base and collector-base diodes representing the "input" and "output" of the transistor. In this sense, their separate characteristics can be obtained with the following apparatus (which will not be beyond the scope of the average enthusiast): one microammeter having a maximum reading of about 5μA, and two milliammeters which will indicate fairly accurately small currents up to 10mA, a multi-range voltmeter, and a few potentiometers and batteries as shown in the circuit diagrams.

TABLE 1

Transistor Temperature			
21°C		35°C	
Collector P.D. (−V)	Collector Current (μA)	Collector P.D. (−V)	Collector Current (mA)
0·1	1·8	0·1	6·4
0·15	1·88	0·15	6·75
0·2	1·89	0·2	6·8
0·25	1·9	0·25	6·81
0·5	1·9	0·5	6·89
0·75	1·9	0·75	6·9
1·5	1·93	1·5	7·0
2·0	1·94	2·0	7·0
4·0	1·98	4·0	7·0
6·0	2·0	6·0	7·0
8·0	2·05	8·0	7·05
10·0	2·075	10·0	7·1

Collector-diode results

Determination of the increase in collector current for increases in applied voltage.

The circuit should be wired as shown in Fig. 1 and the following point noted. The polarity of the battery is such that the negative side is connected to the collector. It cannot be stressed too strongly that in all transistor experiments, correct battery connections are essential if permanent damage to the transistors is not to result. It is suggested that, at this stage, a table be drawn up for entry of the results which should, if possible, include the temperature of the transistor at the start of the experiment, i.e. room temperature. The significance of temperature will be realised later.

The collector-base P.D. should now be increased in small steps to a suggested maximum for this particular transistor of 10V. Each time an increase is made the readings of both instruments should be recorded. Before disconnecting, the whole procedure should be repeated with the transistor held tightly in the palm of the hand, which will cause a temperature rise of about 15°C. From the new results thus obtained, together with the original set, collector-diode characteristic curves can be constructed as shown in Fig. 2. From these, several important facts emerge; firstly, the curves can be recognised as being similar in shape to those of a pentode valve, which immediately suggests that the collector-base "slope" resistance is very high. In other words, a small change of collector current will cause a large change in collector voltage. Further, it has been shown that when the temperature of a transistor is increased by approximately 15°C, the collector current increases by some four times

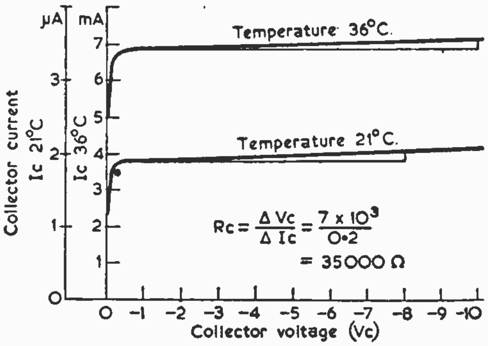


Fig. 2.—Collector-diode curves.

that for the same given collector voltage. This illustrates the need for the use ot "heat sinks" to dissipate any excessive heat which may be built up. No doubt the reader is already familiar with the many simple types which are used in commercial equipment.

Emitter-Base Characteristics

If we now rewire the test circuit so that it corresponds to that shown in Fig. 3, we can, by taking a few simple readings, obtain sufficient information to plot the emitter-base diode characteristics. Eight or nine steps of voltage

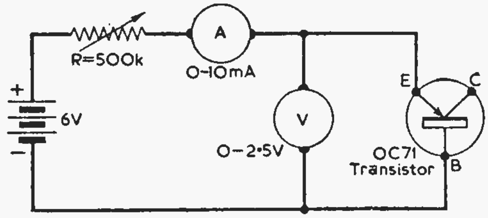


Fig. 3.—Emitter-diode test circuit.

increase with their corresponding current readings are sufficient, as is indicated by the writer's table of results. By taking the slope of the characteristic curve constructed, we can determine the emitter-base resistance; in this case approximately 76·5Ω. It should also be noted that for small emitter voltages, the curve becomes extremely non-linear.

So far, we have taken a transistor and treated it as two entirely separate diodes, and have shown that the input resistance of one (emitter-base) is fairly low and that the output resistance of the other (collector-base) is very high. We have also shown that potential across each respective "diode" is in the opposite sense for conduction in common base connection. Finally, it has been seen that, in general, transistors are extremely temperature sensitive.

Now, once again, we shall plot the collector-base characteristics, but instead of the emitter being left disconnected, emitter-base currents will be set up by an associated circuit and their effect on the collector current examined; that is to say, we shall try to find out if there is any difference in the collector current when its applied voltage remains constant and the emitter current is varied, say from 1mA to 4mA. (The circuit used is given in Fig. 4.)

TABLE 2

Emitter Current Ie (mA)	Emitter P.D. (Ve)
1·0	0·35
2·0	0·48
3·0	0·58
4·0	0·66
5·0	0·74
6·0	0·81
7·0	0·87
8·0	0·92

Emitter-diode results

To carry out this part of the experiment we increase the emitter-base voltage until the milliammeter in that part of the circuit reads 1mA. The collector voltage rheostat should be adjusted to give a reading of (−5)V. Maintaining the emitter current at 1mA, the collector P.D. is reduced in steps of 1V until zero potential is reached. At each stage, as before, all instrument readings are recorded. The whole procedure should be repeated using fixed emitter currents of 1 to 4mA. If the method still appears a little hazy to any reader, examination of the results table will give a clearer picture of what has been done.

The characteristic curves of collector current against collector voltage, constructed from the table of results we have just drawn up, show clearly that when the emitter is no longer left disconnected, the collector current is not of the order of a few microamperes as previously found, but has increased considerably, and within the limits of the accuracy of the measuring instruments used, would appear to follow the value of the fixed emitter currents: when an emitter current of 2mA was flowing we found that the collector current was also 2mA and remained constant at that figure even when the collector potential was reduced from (−5)V to (−1)V. It can be seen that under "diode" conditions (−5)V produced a current of only 2μA, and now, with a zero collector potential, this figure is considerably exceeded. It is quite obvious that under the new test conditions we have set up, the

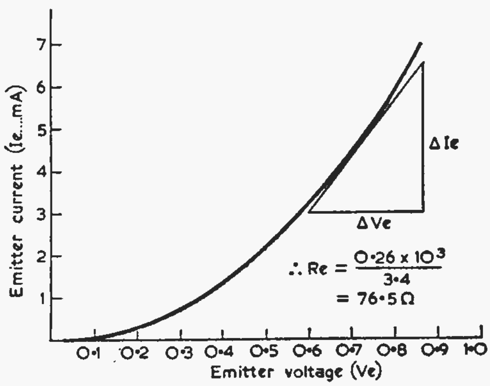


Fig. 4.—Emitter-diode curve.

OC71 transistor can no longer be considered as two separate diodes since there has been some interaction between the "input" (emitter) and "output" (collector) circuits.

It would also seem reasonable that as the only thing which is common to the emitter and collector is the base, that is where we should look for a possible explanation, and so without offering any highly technical or long-winded theories the phenomenon can be reasonably understood using the information already gained as follows.

From the relevant circuit diagram it can be seen that the emitter is biased in a forward or positive direction with respect to the base and thus an emitter-base current flows, this current consisting of conduction by "holes" is diffused in a random manner across the common base, many of these "holes" reaching the base-collector junction, just as the reader has come to accept such terms as "electron charges" and "free electrons" so he must accept that current flowing in transistors causes a proportional number of "holes" or "positive charges" to be made available in the base particularly at the collector-base junction.

It can also be seen that the collector circuit is biased in the opposite sense to the emitter with respect to the common base and so collects the positively charged "holes" when they arrive at the junction. Thus, the current flowing in the emitter-base input circuit causes a similar value of current to flow in the collector-base output circuit. In reality, the collector current is slightly less than that of the emitter, the difference being due to the small base current flowing. It would, therefore, seem reasonable to ask how amplification can be said to have taken place when in fact a current loss has been experienced.

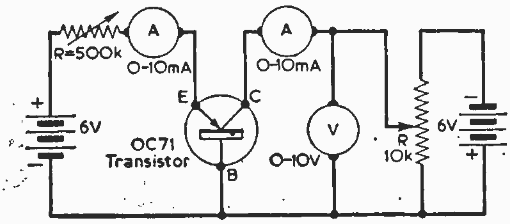


Fig. 5.—Transistor test circuit.

The answer to this question is simple, we have shown that the emitter-base or input resistance is relatively low and that the collector-base output resistance is very high. Our characteristic curves showing collector current against collector voltage under transistor conditions would suggest that there is no detectable current change for a potential difference of 5V but it must be appreciated that a current change of 0·01mA would give a "slope" resistance of 500,000Ω which emphasizes the need for care in taking all readings and constructing the graphs. We have the same current, in fact, in two circuits, one having a high resistance and the other low. Voltage is equal to current multiplied by the resistance through which it flows (I × R), and for maximum power transfer, the resistance of the external circuits of the transistor should be equal to the internal resistances of the transistor, it follows

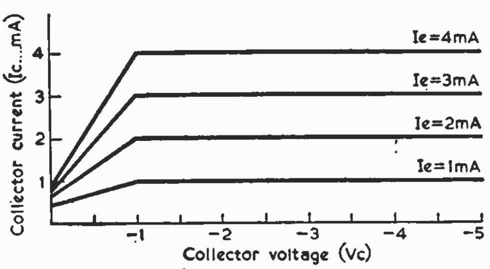


Fig. 6.—Transistor curves.

TABLE 3

Collector P.D. (—V)	Collector Current (mA) for four values of Emitter Current (mA) 1	2	3	4
—5	1	2	3	4
—4	1	2	3	4
—3	1	2	3	4
—2	1	2	3	4
—1	1	2	3	4
0	0·43	0·63	0·8	0·975

Transistor results

that although there has been a slight current reduction there has also been a high voltage gain. The collector load, of course, in many instances consists of an inductance having a high impedance at the working frequency and providing a low D.C. path so that small battery potentials may be used. The emitter is provided with a standing bias to ensure that the superimposed alternating signal operates over the straight portion of the emitter curve.

This completes the work we have set out to do and, although a number of points have been left unexplained, a far better understanding of working of a transistor from a practical point of view should have been achieved enabling the reader readily to understand more complex circuits.

An Introduction to Stereo

(Continued from page 38)

1. High stability resistors should be used where shown in the circuit diagrams, otherwise carbon composition types are quite suitable.
2. The valveholder should be of the loaded nylon, resilient type, and if the loudspeakers are housed in the same cabinet, acoustic shielding in the form of a wooden partition should be arranged between the loudspeakers and the pre-amplifiers.
3. The mains power transformer should be kept as far away from the pre-amplifier unit as possible, and if hum is found, re-orientation of the transformer may cure the trouble.
4. A good earth bus-bar of 12 or 14s.w.g. tinned copper wire should be run on insulators around the chassis and earthed to the chassis at one point only, the input jack, JK1. All earth connections should be made to this bus-bar and not to the chassis.
5. Heater leads should be twisted closely together, kept close to the chassis and well away from input and grid leads.
6. Input leads to the grid circuits should be kept as short as possible, and if the above instructions are carried out, no screened leads need be used in the pre-amplifier and no internal shielding will be required.

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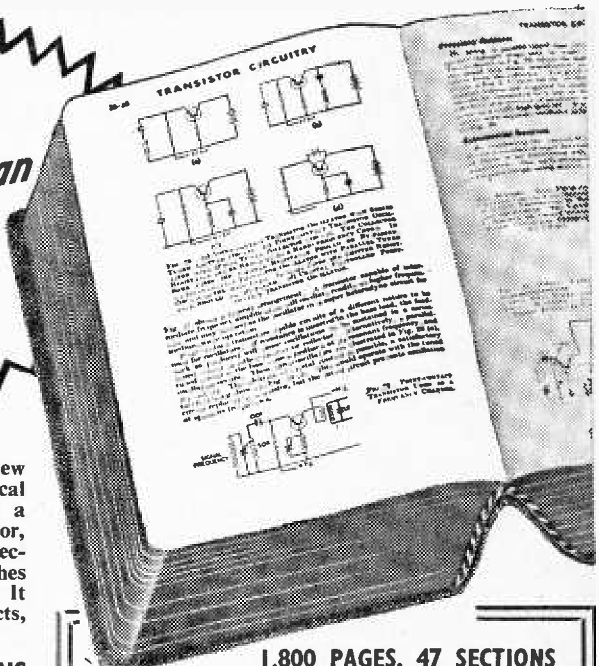

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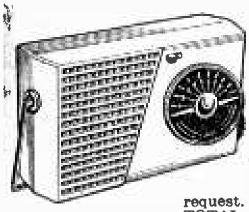

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TRANSMITTING TOPICS

END-FED TRANSMITTING AERIALS

By Amateur Transmitter

THE end-fed transmitting aerial, in which one end is brought right to the transmitter, has the advantage of simplicity. It is also quite efficient. This does not mean that stations already equipped with centre-fed dipoles, or other aerials, should abandon them in favour of an end-fed wire. But it does mean that an end-fed aerial is extremely easy to erect, so that a transmitter may be brought into action without delay. It can also be operated on its harmonics, permitting working on more than one band, with the single wire.

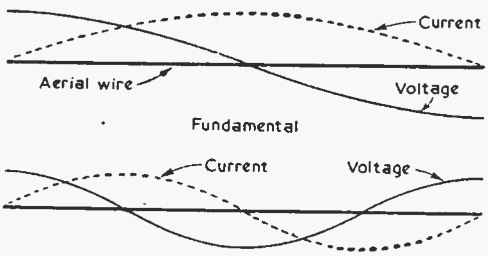


Fig. 1.—Voltage and current distribution for fundamental and second harmonic.

Popularity

A record kept of about one hundred contacts on the 80m band showed the following percentage of aerials:

40 end-fed Hertz, or longer.
15 Marconi types.
34 centre-fed dipoles.
11 various other types.

This appears to show that the end-fed aerial is quite popular. These figures do not necessarily represent the aerials used on other bands, where the harmonic efficiency may be undesirable, and where other types of aerial are popular.

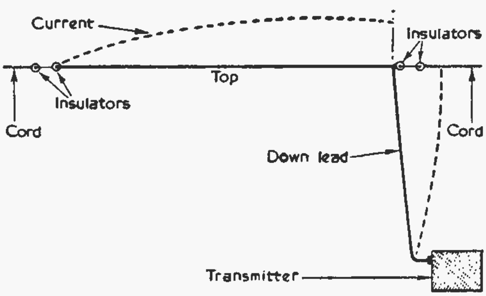


Fig. 2.—A practical end-fed aerial.

The aerial will probably be supported at the house, and a distant pole, tree, or other building. It is thus easy to fix, and among the least conspicuous of out-door transmitting aerials. The length can also be varied considerably.

As would be expected, an increase in aerial height increases radiation efficiency. This may be calculated approximately, but the simplest method is merely to support the aerial as high as possible. It will often be something between about 15ft and 30ft high.

The aerial will also be directional, the pattern changing with harmonic operation. The bearing of the various lobes can be calculated, but this again is scarcely worth while. Instead, it can be assumed that for general use there is no need to pay much attention to the directional characteristics. Briefly, radiation is greatest away from each side of the antenna, and smallest in line with it, when it is used on its fundamental. When used on harmonics, the side lobes break up into smaller lobes.

End-fed Hertz

Fig. 1 shows an end-fed Hertz operating on its fundamental. This ideal will not be achieved in practice, but each end will correspond to a point of relatively high voltage, and low current. This is the equivalent of a high impedance. The actual figure may be 1,000Ω or more, depending on aerial height, and other factors.

When the aerial is operated on its second harmonic (e.g. 40m, for an 80m aerial) it is still voltage-fed at its termination with the transmitter. This remains so with higher harmonics. The same wire can thus be used on two or more bands.

Its efficiency as a harmonic radiator makes this type of aerial an unwise choice for the higher frequency bands. For example, harmonics of the 21Mc/s or 28Mc/s bands can readily cause TV interference.

A typical end-fed Hertz is shown in Fig. 2. The downlead and connection to the transmitter actually form part of the aerial. For practical

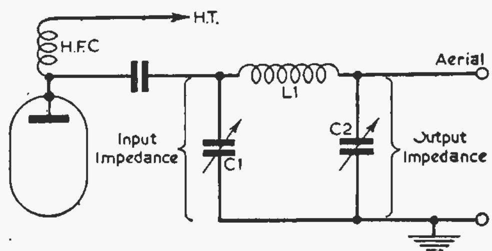


Fig. 3.—π network used for loading

heights on 80m most of the aerial will be horizontal.

Aerial Length

The calculated length will be approximately 124ft for the 3·8Mc/s end of the band, and around 133ft for the 3·5Mc/s end of the band. A "middle" length will easily allow satisfactory working through the whole band.

When the aerial is bent, as in Fig. 2, the actual total length of top and down lead needs to be a little longer. For average purposes, 132ft to 136ft will be satisfactory. Current and voltage distribution will then be approximately as in Figs. 1 and 2. Should the actual length vary somewhat from these figures, the resultant reactance can be tuned out at the transmitter end, and effective operation still obtained. Longer wires may, of course, be used, when space permits. For example, 266ft would be approximately full-wave at 3·6Mc/s, and would thus be working on its second harmonic, on this frequency.

For the actual aerial, 14 s.w.g. hard-drawn wire is often used. About two insulators can be used each end, with cord or wire from the house, pole, or other supports.

Impedance Matching

The end-fed Hertz is high impedance, as explained, and thus needs a high impedance feed point. Many popular transmitters employ a π-output circuit, as shown in Fig. 3. This allows an impedance transformation from the valve to the aerial.

Standard formulae will give the impedance transformation from input to output, for known values of C1, L1, and C2, but it is sufficient to know that changing from a high to a lower impedance requires that C1 be smaller than C2.

From the point of view of simplicity, it is highly convenient to attach the aerial directly to the output point shown in Fig. 3. Capacitor C2 will then usually have to be at quite a low value. It may, in fact, be found that C2 has to be opened so far that resonance can no longer be reached by means of C1. If so, one solution is to increase the value of C1, or to add another condenser of suitable high voltage rating in parallel with it.

In some transmitters it may be inconvenient to increase C1. If so, an external means of obtaining the necessary high impedance output for the aerial can be used. One such method is shown in Fig. 4. This is a reversed π network, C1 being large, and C2 small. For C1, a standard 2-gang 500pF broadcast receiver condenser will be satisfactory. C2 should resemble C1 in Fig. 3. That is, have wide plate spacing (for other than low power) and be of about 140pF to 250pF capacity. Coil L1 is resonant at the operating frequency.

It is now possible to leave C2 in Fig. 3 at fairly high capacity, and difficulties in obtaining resonance with C1 in the P.A. output circuit will then no longer arise. C1 in Fig. 4 is adjusted to moderate capacity, and C2 set to obtain resonance. It will be noted that if the coupler in Fig. 4 is closely wired to the π circuit in Fig. 3, the two large capacity condensers are in parallel. In these circumstances it is sometimes possible to omit C1 in Fig. 4.

Another method of matching the low impedance transmitter output to the high impedance aerial is shown in Fig. 5. The coil is tuned to resonance. Loading can be adjusted by tapping the antenna down the coil, by changing the number of turns on the link, or by adjusting the loading controls on the transmitter. The latter should, however, usually be set for fairly low impedance. That is, C2 in Fig. 3 at fairly high capacity.

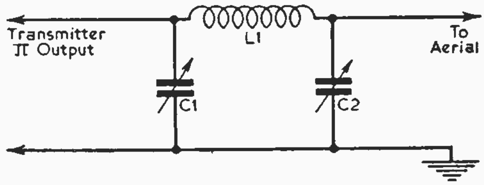
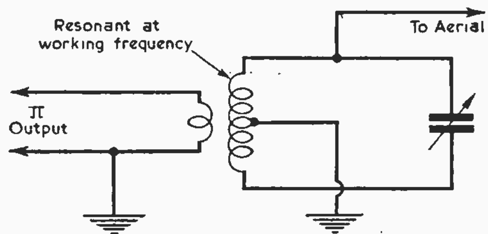


Fig. 4 (above).—A coupling circuit for transforming to a high impedance.

Fig. 5 (below).—A second tank for impedance matching.



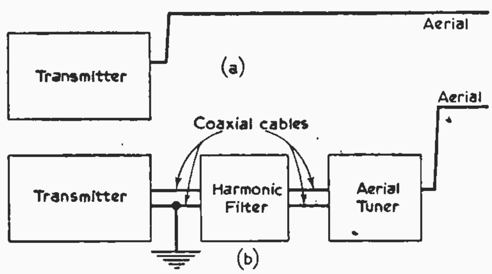


Fig. 6.—Two methods of connecting the aerial.

Harmonic Suppression

The method of feeding the aerial directly from the transmitter is shown at "A" in Fig. 6. When C2 is reduced to a low value, to obtain loading of the high impedance aerial, the harmonic suppression becomes poor. If harmonic interference is not caused, this form of working may be adopted, for its convenience.

If harmonic interference arises, it may prove sufficient to use one of the circuits in Figs. 4 and 5. These provide some harmonic rejection themselves. They also allow the transmitter π tank to work into a low impedance, which improves its harmonic suppression.

If harmonics remain troublesome, it is usual to add a harmonic filter between transmitter and aerial tuner, as at "B" in Fig. 6. Such filters are normally designed to work in a low impedance line, and cannot be included in series with the aerial, at "A".

(Continued on page 78)

Trade News

NEW PRODUCTS AND DEVELOPMENTS

VARIPHASE STROBE UNIT

THE Type 1208 Variphase Strobe Unit has been specifically designed to enable components or equipment, undergoing vibration test, to be viewed stroboscopically in "slow motion," irrespective of the drive frequency, within the range 5c/s to 5kc/s.

The equipment can also be used to facilitate the optical calibration of vibration pick-ups or to provide a calibrated, continuously variable phase sine wave from a single phase sine wave input.

Used with the Dawe Type 444 Automatic L.F. Sweep Oscillator, a suitable power amplifier, a vibration generator and a Dawe stroboscope, it provides the basic equipment needed for vibration resonance search and endurance tests called for in British Standards BS2011 and G100. This Strobe Unit is produced by *Dawe Instruments Ltd., Harlequin Avenue, Great West Road, Brentford, Middlesex.*

PRECISION POTENTIOMETERS

PRECISION potentiometers with infinite resolution, even at the lowest resistance values, incorporating CIC-SuperCon Film elements are now available for application in analogue computers, industrial instrumentation and control, following many years of military usage.

Originally restricted for use in missile and fire-control projects, supplies are now adequate to permit a new concept of reliability and accuracy to be introduced into servo- and control systems.

Multiple fingered wipers tracking on the resistance element, integral with the interior periphery of the case, provide absolutely smooth output even under vibration and shock. Patented internal trimming process reference to the male pilot, eliminates errors caused by misalignment, and there is no error build-up in ganged assemblies.

Linear models to a linearity accuracy of 0·01per cent and sine-cosine models to a conformity of 0·025per cent, are in current production. There is also a range of rectilinear potentiometers up to 16in. in track length.

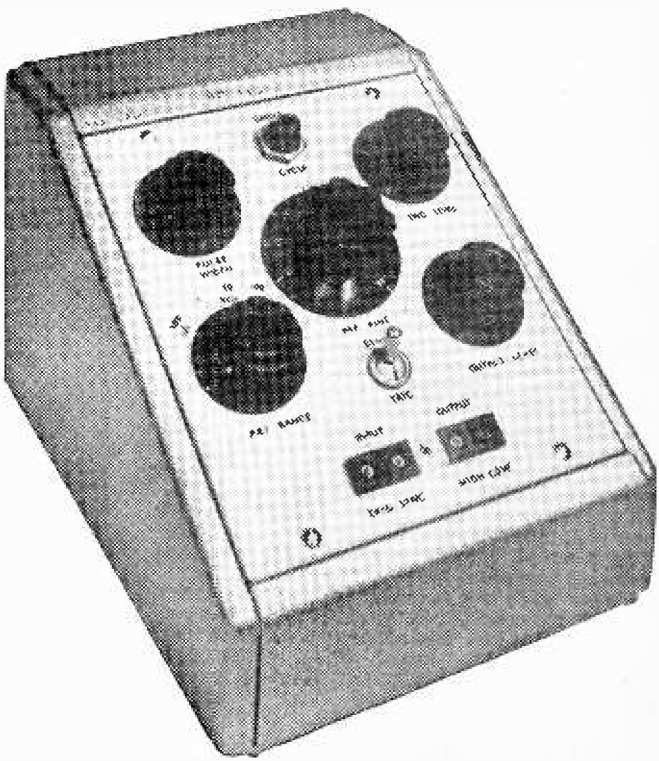
CIC-proprietary, these potentiometers are made by *Computer Controls Ltd., 91, Buckingham Street, Strand, London, W.C.2.*

PORTABLE TRIGGER GENERATOR

TO fulfil the need both in the laboratory and in the field for a compact portable trigger generator at low cost, yet which is capable of delivering fast high-voltage triggering pulses from a low source impedance, the new Winston Portable Pulse Generator Type M.640 has been developed. Through the use of semi-conductor devices and printed circuits the usual bulk and power consumption associated with this type of instrument has been eliminated.

Another important point is that the load capacity has a negligible effect on the rise time. In fact, the only effects are a small reduction in the size of the output pulse and a slight shift in the Pulse Recurrence Frequency. Although appearing contrary to the normal rules of pulse techniques this has been made possible by the use of a unique circuit. Both positive and negative going pulses are available.

This pulse generator has been developed by *Winston Electronics Ltd., Shepperton, Middlesex.*



The Winston portable trigger generator.

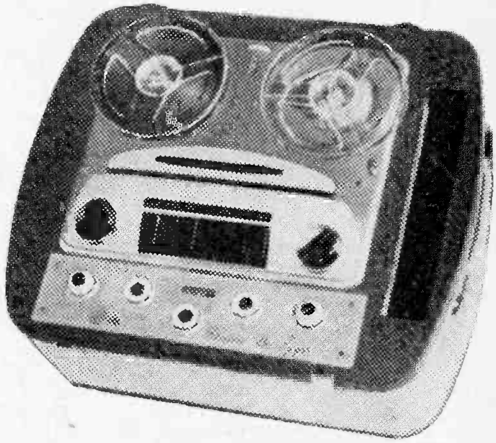
NEW TAPE RECORDERS

SOUND Tape Recorders are exhibiting their range of versatile Tape Recorders, including twin and four-track models on Stand 25 and Demonstration Room 115.

The "Sound Master" tape recorder provides 10W undistorted reproduction from an acoustically-designed reflex loudspeaker system giving a full range frequency response. An ultra-linear 10W (13W peak) amplifier, plus separate amplifier for recording, give professional quality and the many features include mixing, monitoring and multiple superimposing, for every possible sound effect.

A "Sensimatic" level recording meter is provided for precise control when recording, and a unique feature of this tape recorder is that recording and play back can be effected simultaneously, such a feature being invaluable for example for cine-commentaries and learning languages.

The "Sound Master" has 3 speeds—$1\frac{7}{8}$in., $3\frac{3}{4}$in. and $7\frac{1}{2}$in. per second, and four tracks give maximum tape economy. The recorder is housed in a polished wood case, which is designed to stand on top of the reflex loudspeaker system and for storage purposes is detachable and contained in the bottom of the speaker enclosure. The price is 105 guineas complete with all accessories, and the technical specification is attached. The "Sound Master" is made by *Sound Tape Recorders (Electronics) Ltd., 784-788 High Road, Tottenham, London, N.17.*



The new "Sound Master" tape recorder is a 3-speed, 4-track model.

RING-TYPE LOUDSPEAKERPHONE

PROVIDING immediate two-way loudspeaking contact between positions without dialling, the A.E.I. "Ring Type" Loudspeakerphone is a fully intercommunicating system for offices, factories, laboratories and other similar locations. It is completely independent of a telephone switchboard and can, therefore, relieve an operator of the responsibility for connecting calls.

The system consists of a number of ten-line master control units with a single common amplifier. A complete installation incorporates eleven master control units, but any number up to eleven can be employed. Special units can be supplied if a larger system is required.

The "Ring Type" Loudspeakerphone operates from 200/250V A.C., 40-60c/s. Installations can be supplied to operate from 100/110V supplies or from 18V D.C. (e.g. a battery supply). Consumption of a complete installation is 70W in operation, and 35W in the "standby" condition.

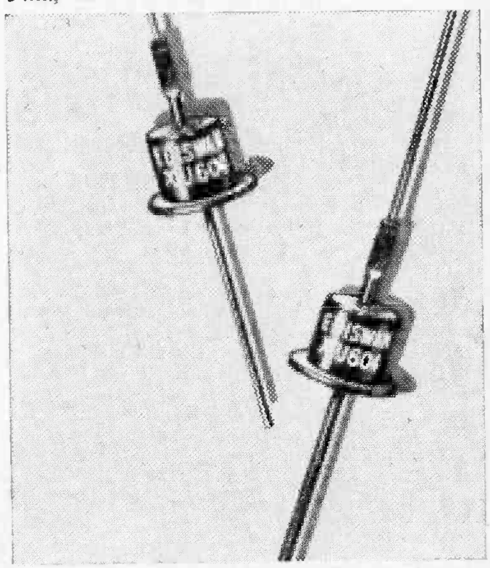
Two fuses in the amplifier give protection against component damage and fire. The equipment is completely safe as the voltage on the line under all conditions never exceeds 25V D.C.

Master units are supplied in attractive cream coloured moulded plastic housings with light grey loudspeaker grilles. The dimensions of these units are: width 12in., height $6\frac{3}{4}$in., depth $9\frac{1}{4}$in. Amplifier units are "hammer" finished in dark grey and silver grey, and their dimensions are: width $10\frac{1}{2}$in., height 7in., depth 14in. *Special Products and Radio Components Department, A.E.I. Radio and Electronic Components Division, 155, Charing Cross Road, London, W.C. 2.*

NEW SEMI CONDUCTOR DEVICES

FIRST of a series of silicon-diffused junction type power rectifiers, the Ediswan Mazda Type XU604 is suitable for use in television receiver and similar power supplies. It is hermetically sealed in a metal can with axial leads.

Maximum overall can dimensions are: length 0·34in., diameter 0·4in.



The Ediswan Mazda XU604 is a silicon p-n junction type power rectifier.

Maximum peak inverse voltage is 400V, an absolute value for 100°C working. Maximum mean rectified forward current is 500mA at an ambient temperature of 75°C or less, 150mA at an ambient temperature of 100°C. Maximum re-current peak forward current is 5A at an ambient temperature of 75°C or less, 1·5A at an ambient temperature of 100°C. *A.E.I. Ltd., 155 Charing Cross Road, London, W.C.2.*

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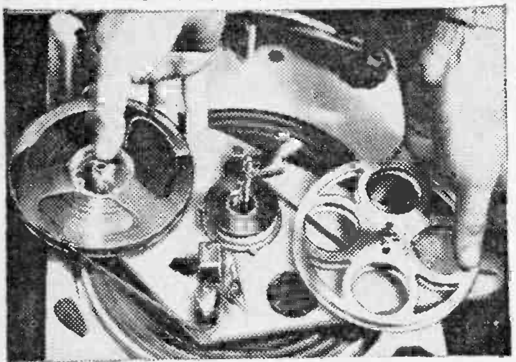

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PUSH-PULL SIX

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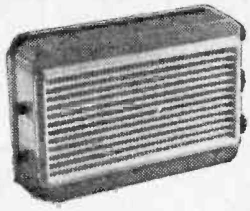
MEDIUM, LONG WAVE AND TRAWLER BAND EXTENDING TO 80 METRES WITHOUT COIL CHANGING.



350 Mw XC101's push-pull output Transistors. Powerful magnet 3in. high grade speaker. Miniature push-pull transformers. This is a top performing receiver. Nearly 30 stations listed in one evening including Luxembourg loud and clear. A pleasure to listen to. Has **FERRITE ROD AERIAL.** All parts sold separately including pale blue gleaming polystyrene case with duo-diffusion grilles in red. Uses 4½ volt flash-lamp battery that lasts for ages. Sockets for car aerial. Parts £6.19.6. Size 6⅛ x 4⅛ x 1½in.

"Agreeably surprised with Trawler Band reception. Luxembourg as loud as local. Your easy build diagrams helped a lot . . . my first attempt."—H.S., Penzance, Cornwall (poor reception area).

PUSH-PULL FIVE

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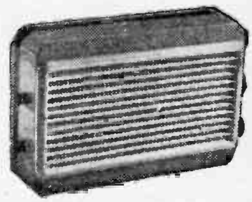
(5 Ediswan Transistors)

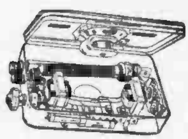
Now greatly improved. Sensitive FERRITE ROD AERIAL. Pale blue polystyrene case with speaker grille in red. Volume/sensitivity control. Noiseless compression tuning condenser. Miniature push-pull transformers. 350 Mw XC101's in push-pull. Sensitivity R.F. stage for station selection. Parts £5.19.6. P.P. 2/6.



New P.P.6 may be built for **£5.19.6.**

"RECO" PUSH-PULL FOUR

(MW/LW and 2 S.W. Coils)



Ediswan Transistors, 350 Mw XC101's push-pull output, new miniature push-pull transformers. Volume/sensitivity control. Fine toned 3in. alni magnet speaker. Very simple to build with our easy-build plans. Uses 4½ volt battery. Parts for **£4.19.6.**

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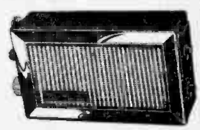
Miniature speaker. **FERRITE ROD AERIAL.** MW/LW and Trawler Band coverage down to 80 metres. On test tuned in over 30 stations. This sensational new radio is simple to build with our easy-build plans. Handsome pocket case may be built for **65/-.** P.P. 2/6.



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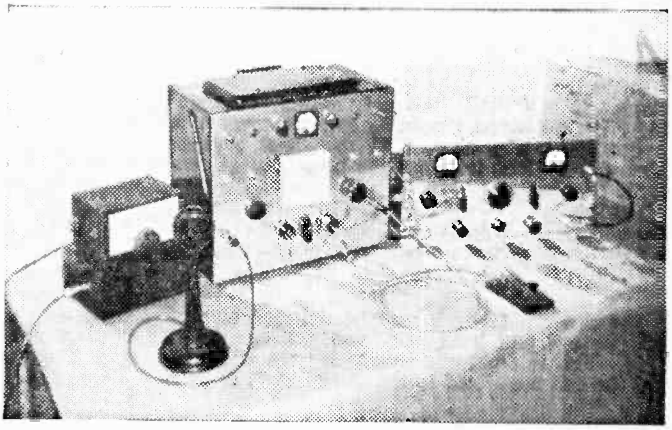

A COMPREHENSIVE INSTRUMENT OF MODERATE COST

(Continued from page 1094 of the April issue)

By G. Favour

THE H.T. output passes through the low H.T. switch to L.F.C.1, C1 and C2 (8 + 16μF). This voltage supplies all stages except the P.A. One section of transmit/receive switching paralleled by the net switch applies voltage to the VFO. The mains to T2 may be connected to the 200V tap to increase the output. This works perfectly, and never causes even slight heating on full load. The H.T. secondary winding is connected to the metal rectifiers, the centre tap being left disconnected. This bridge rectifier system enables the voltage across the whole of the winding to be rectified, giving about 750V output. The H.T. output passes through the high H.T. switch and transmit/receive switch to the smoothing circuit L.F.C.2, C3, C4, C5 and C6. Since high capacity, high voltage condensers are expensive, small surplus electrolytics are used in series, halving the capacity and doubling the working voltage. Each pair should be identical, new stock, and one of the pair have a thick insulating covering. The high H.T. output goes only to the 807 anode.

The 12V output from T3 is connected to a small 1A bridge rectifier. The D.C. (unsmoothed) output is switched either to the relay or the charging terminals by the second section of the Tx/charge switch. The insulated terminal may be made by putting a rubber grommet in the hole first.

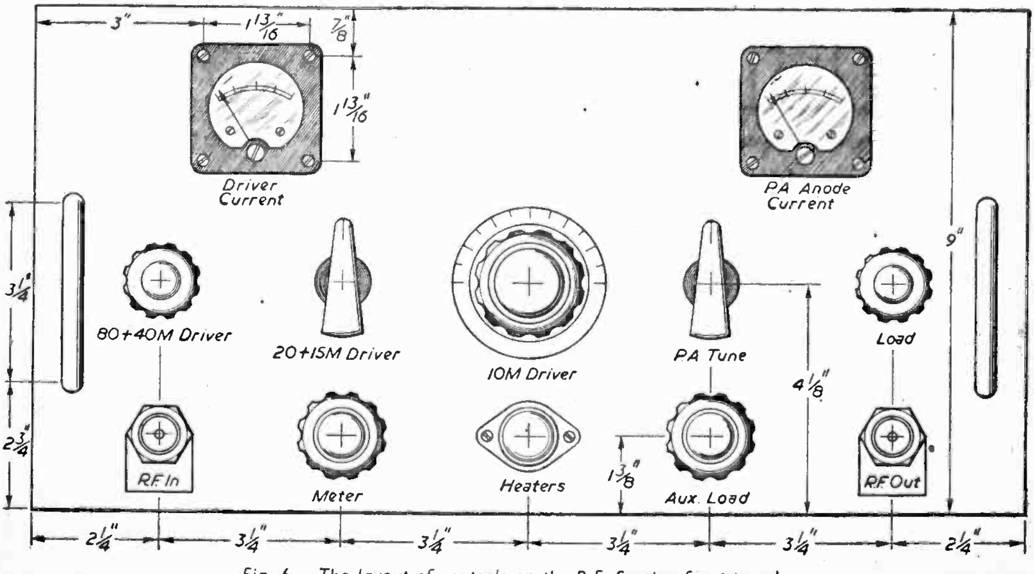

Fig. 6.—The layout of controls on the R.F. Section front panel.

The keying switch is the old 1154 function switch with all wafers except the front one removed. When only the oscillator is being keyed, it earths the driver cathode and connects the VFO screen to the key contact; when oscillator and drive are keyed, the driver cathode connection is broken, and connected to the front contact; when driver alone is keyed, the back contact connection is broken.

The 'phone/C.W. switch earths the front contact, disconnects the back contact, and, applies H.T. to the speech amplifier when in the 'phone position.

Meters

The meter M1 which may be switched to read grid current and both H.T. voltages, is also ex 1154. The internal thermocouple was removed, and the coil connected to the terminals. The FSD receive. The earthy end of the existing R.F. (and I.F. if necessary) receiver gain control is disconnected from earth and taken, together with the power leads to the four-pin Jones socket. If the receiver has a power unit of its own, only two leads need be taken to it.

Speech Amplifier

The speech amplifier is quite conventional, employing one pentode and one triode-connected pentode. Alternative input circuits are given for moving coil, or crystal microphone inputs. The prototype uses a moving coil microphone (ex headphones) mounted on a lamp stand with a small transistor amplifier in the base, but it works perfectly without this amplifier if the gain is turned up further. The output from V3 is passed through screened wire to a section of the

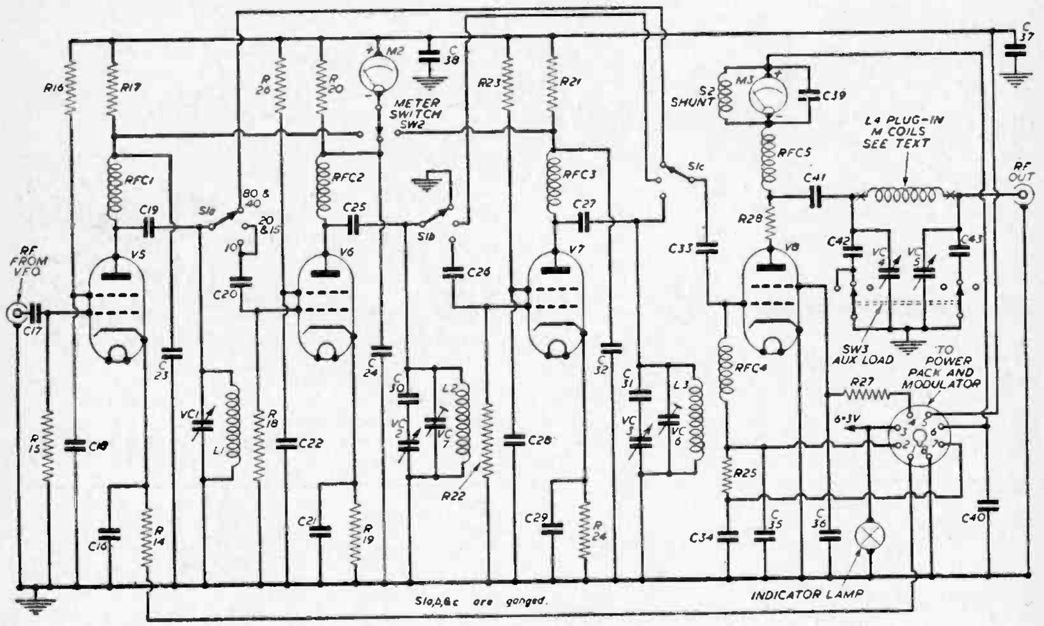

Fig. 7.—The circuit of the R.F. Section.

was found to be around 500μA, although this may vary with transmitters. Since the resistance could not be determined accurately, the shunt and series resistance could not be calculated correctly. To make the shunt S1, a testmeter was wired in series with the meter, and the resistance of the shunt altered until the FSD was 15mA. H.T. should be switched off, while adjustments are made, to avoid damage to the meter. Great care should also be taken to prevent contact with the nearby metal rectifiers which are at H.T. potential even when both H.T. switches are off. It is safest temporarily to disconnect the leads from the secondary of T2. The H.T. voltage indicated on the meter is only required to be qualitative, to indicate the presence of short circuits, blown fuses, etc., so a calibrated scale need not be made.

The receiver listen-through control is a 10k wire-wound potentiometer which is short circuited on 'phone/C.W. switch. The grid of V4A is connected to this output on phone, and acts as a positively biased direct-coupled amplifier. In the more usual series gate circuit where the standing carrier is well below the peak output, some distortion is caused by rectification in this stage, but with low biasing voltage, and the grid leak returned to earth instead of cathode, this is eliminated. V4B acts as an infinitely variable resistance supplying screen voltage to the P.A. On C.W. with the key up, V4A is positively biased, causing partial P.A. cut-off. Application of drive causes negative biasing, giving full screen voltage. A small neon in this circuit might give more positive control, but this has not been tried.

The power unit should not be operated without a load, with H.T. switches on, as voltage surges may break down the insulation of the electrolytics.

(Continued on page 81)

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I.F. TRANSFORMER, IFT.15

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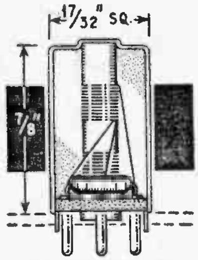
Bandwidth of single transformer at —6 dbs is approx. 250 kc/s. Unloaded 'Q' of winding 70. **Price 10/6**



ACTUAL SIZE

RATIO DISCRIMINATOR TRANSFORMER, RDT.2

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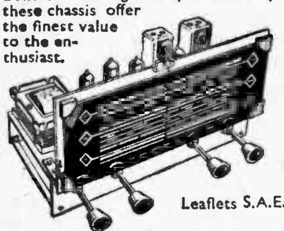

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7in. 1,200ft. ...	25/–	5in. 1,200ft. ...	37/6
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25 FOAMCOURT WAY, FERRING, WORTHING, SUSSEX

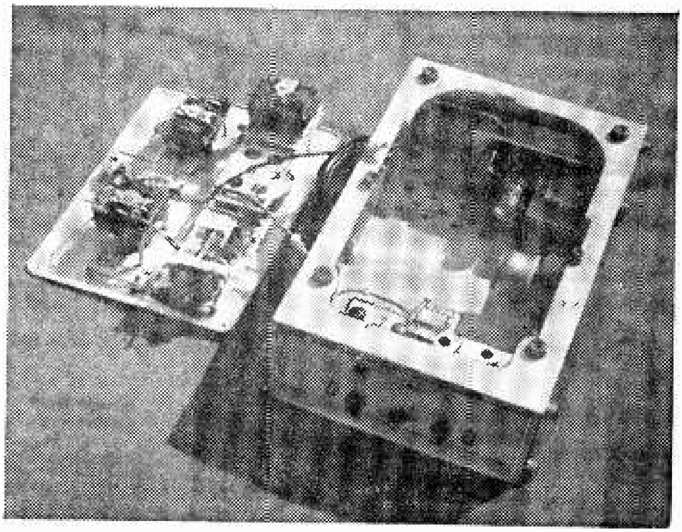
A Versatile TAPE RECORDER

CONSTRUCTING THE CABINET

By D. L. Woolley

(Continued from page 1126 of the April issue)

THE cabinet described here is easy to make, but a commercially built cabinet can be used if of a suitable size. If such a cabinet is used, the amplifier may be mounted with the front panel horizontal and reduced in size. It cannot be made less than 5½in. deep unless care is taken not to allow the tops of the valves to catch on anything, but it can be made shorter, say to 8½in. or 9in. For a wider tape-deck, the front panel can be up to 13in. wide. The layout of the components remains the same for any size of panel down to the absolute minimum. Details of the home-made cabinet are given in Figs. 23 to 28. Care must be taken to make all parts of the cabinet square before gluing. Simple joints are used, but these can be elaborated by more proficient woodworkers, as long as the cabinet dimensions remain the same.



Finishing

The cabinet can be finished in a variety of ways; the simplest being varnish, or paint. Contact plastic is the most convenient, although the original was finished in paint, with the front panel, mains input panel and speaker grille painted to match the tape-deck; the rest of the cabinet being a light pastel green. Whichever method of finishing the box is chosen, the wood surface must be well prepared.

Expanded aluminium grille was used for the loudspeaker cut-out and to cover ventilation holes drilled in the base panel of the cabinet. Ventilation holes should be drilled under the rectifier valve and the tape-deck drive motors. A removable ventilation grille is fitted above the amplifier

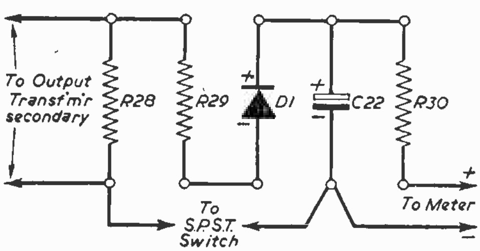


Fig. 20.—Layout of the record-level indicator components—see page 899 of the February issue and page 1075 of the April issue.

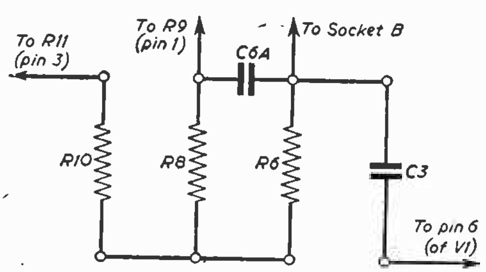


Fig. 21.—The layout on the tag-strip of the alternative equaliser circuit—see page 1021 of the March issue.

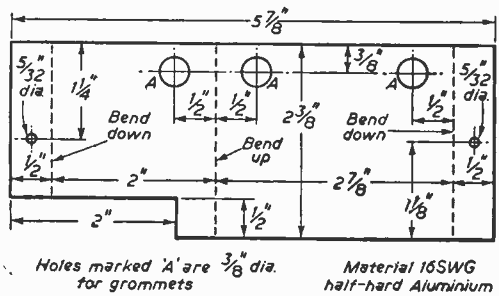


Fig. 22.—The aluminium screen to surround L1 and V4 (see Fig. 11, page 991 of the March issue).

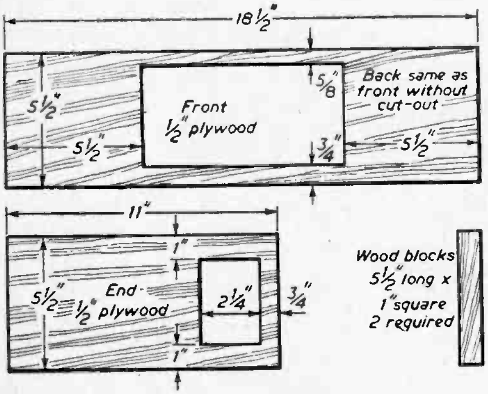


Fig. 23.—Constructional details of the end, front and back.

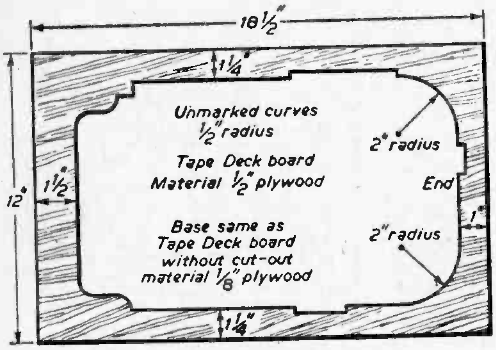


Fig. 24.—The tape-deck supporting board.

to enable the valves to be withdrawn without taking the recorder to pieces.

Fastenings for the cabinet can be of any neat, reliable kind—split-hinges were used to allow the lid to be removed entirely. The handle is fitted last of all in a position that enables the recorder to be lifted without being unbalanced.

The amplifier, power-pack, mains input panel and loudspeaker are now fitted, using wood-screws (Fig. 27). Power leads from the power-pack to the amplifier are cut and connectors fitted. These enable the amplifier to be removed without the power-pack. The record-playback and erase heads are now connected to two lengths of coaxial cable fitted with coaxial plugs, of sufficient length to reach from the amplifier to tape-deck when the latter is in position. The mains supply to the deck is taken, via a connector, from the switch on the mains input panel.

(Continued on page 78)

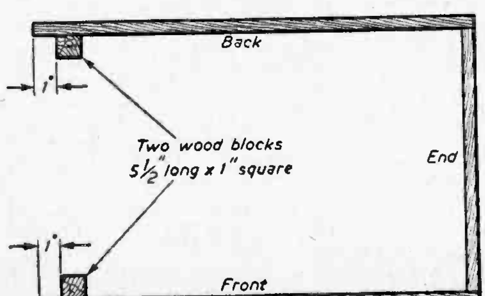


Fig. 25.—The end, front and back are glued as shown.

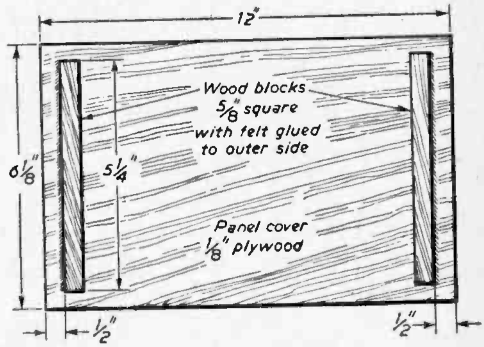


Fig. 26.—Felt glued to the wooden battens, makes the front panel a push-fit.

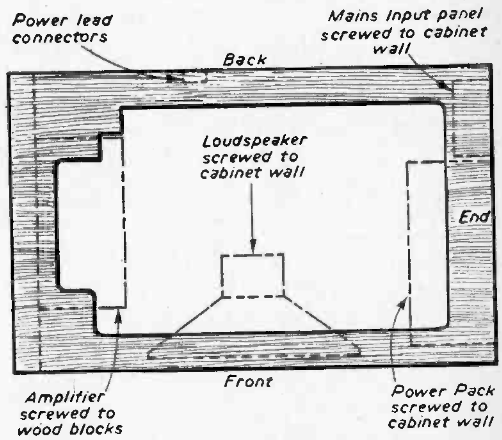


Fig. 27.—The position of the various parts, assembled in the cobinet.

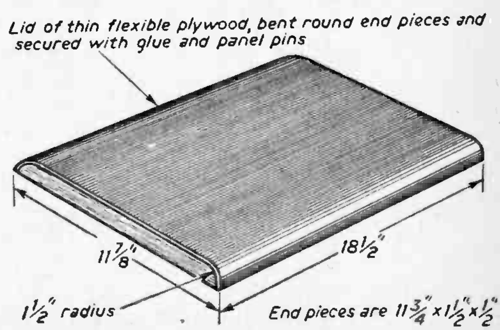


Fig. 28.—The cabinet lid is formed round two shaped battens.

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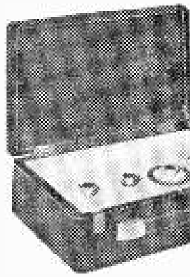

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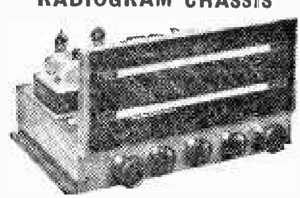

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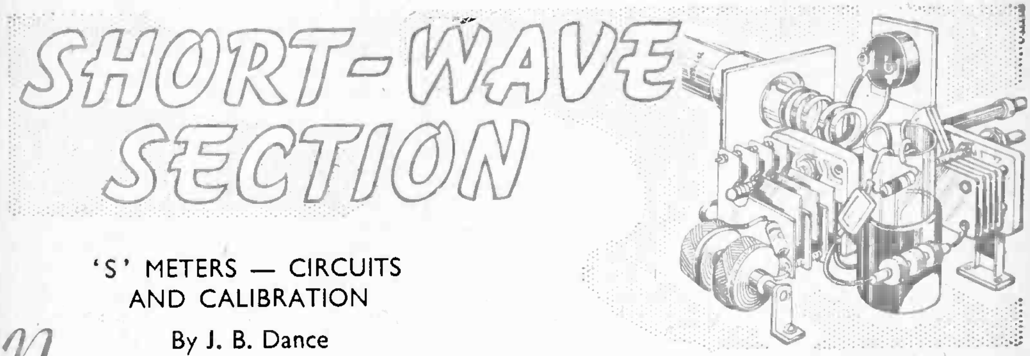

'S' METERS — CIRCUITS AND CALIBRATION

By J. B. Dance

NORMALLY, 'S' meters are intended to give only a very approximate indication or comparison of signal strength and also serve a useful purpose as tuning meters. The signal must be amplified before it can operate an 'S' meter, but because the gain of all receivers varies with frequency, a signal input of a certain voltage at one frequency will not normally give the same deflection of the 'S' meter as a signal of the same strength but of a different frequency. Within any one amateur band, however, an 'S' meter in a properly aligned receiver gives a fairly accurate comparison of signal strengths.

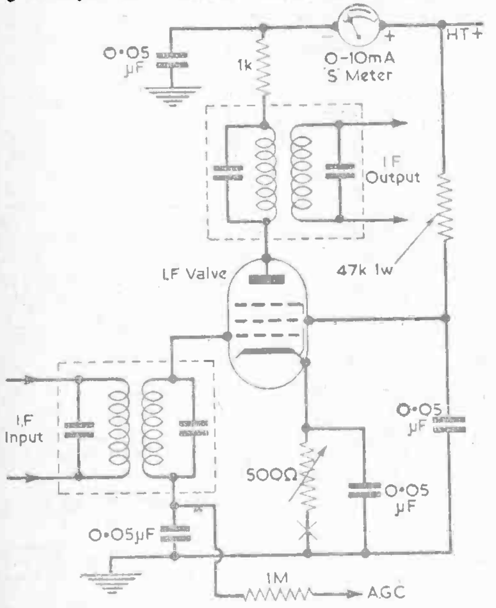

Fig. 1.—Circuit of a simple "S" meter.

Principle of Operation

All common 'S' meter circuits operate from the AGC line. They depend on the fact that the AGC bias increases with increasing signal input from the aerial. The meter to be used as an 'S' meter cannot merely be connected directly from the AGC line to earth, as the internal resistance of the source of the AGC line voltage is usually of the order of 1M and the meter would therefore effectively short-circuit the AGC line. Also the AGC line voltage is too small to operate a high resistance voltmeter.

Some form of valve circuit which has a high input impedance is required. The simplest and most economical method of feeding the 'S' meter involves the use of one of the existing I.F. (or R.F.) valves to which AGC is applied. The meter is included in the anode or cathode circuit of the valve and is operated by the AGC voltage which has been amplified by the valve. The scale of dB indications is not evenly spread out owing to the variable-μ properties of the I.F. valve. A separate valve fed from the AGC line may be used, if desired, to give a rather more useful scale of readings.

In all of the circuits to be described the component values shown for the I.F. amplifiers are suitable for the 6K7 or EF39 types of valve. If an EF93 (or 6BA6) is used, the value of the cathode resistor could be reduced to about 68Ω in order to obtain more gain.

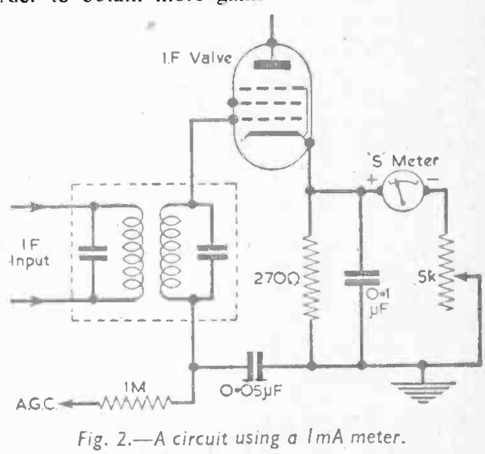

Fig. 2.—A circuit using a 1mA meter.

Economical Circuits

One of the simplest possible 'S' meter circuits is shown in Fig. 1. The meter could either be placed in the anode circuit as shown or alternatively at the point marked with a cross in the cathode circuit. In either case the performance will be very similar. Alternatively, if it is desired to use a 0—1mA meter, the circuit shown in Fig. 2 may be used.

As the signal strength increases, the AGC voltage becomes more negative. This not only reduces the gain of the receiver but also reduces the anode and screen currents of the I.F. valve. An increase of signal strength therefore results in a decrease in the current passing through the meter. A large deflection of the meter occurs when the signal strength is small. This is a disadvantage of this type of circuit. In order to arrange that the meter shall deflect towards the right as the signal strength increases, special meters have been used in which the needle is on the right-hand side at zero current and moves to the left as the current increases. Such meters are quite expensive and therefore some constructors have used an ordinary meter in an inverted position in order to obtain a left to right reading with increasing signal.

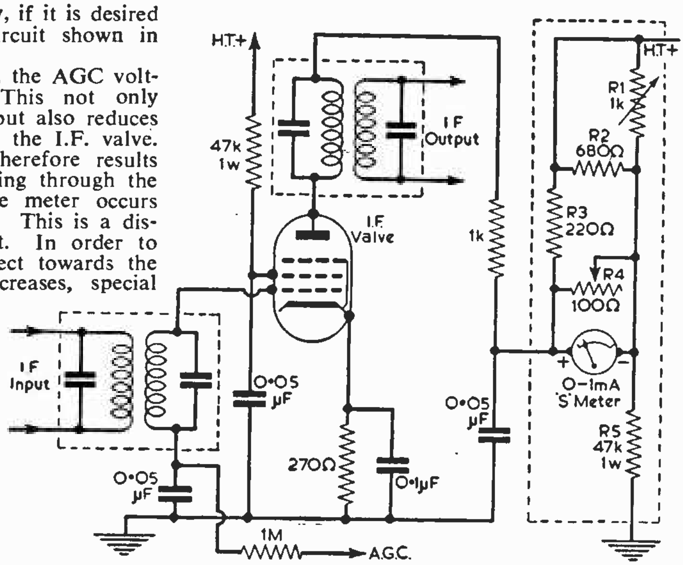

Fig. 3.—A forward-reading circuit.

Bridge Circuits

Simple bridge circuits can be employed with ordinary meters so that they read in a forward direction. An example is shown in Fig. 3 in which the bridge is in the anode circuit of one of the I.F. amplifiers. This circuit can be redrawn as a bridge in which the anode resistance of the I.F. valve is one arm; it varies with the changes of AGC voltage.

It is quite easy to add the 'S' meter circuit of Fig. 3 externally to an existing receiver. There are only three connections between the receiver and the meter, namely earth, H.T. positive and the H.T. supply to the I.F. valve. The parts which can conveniently be placed in the meter case outside the main receiver are shown within the dotted lines in Fig 3.

Preliminary Adjustments

The circuit of Fig. 3 should be adjusted as follows before use. First the I.F. valve should be removed and the resistor R4 adjusted for full scale deflection. Then the valve should be replaced and the resistor R1 adjusted with no signal input to the receiver so that current does not pass through the meter. The bridge is then balanced, and if a signal is applied to the input, the increase of the negative AGC voltage will cause the anode resistance of the valve to increase and the bridge to become unbalanced. The current passing through the meter depends on the degree of the unbalance which in turn depends on the signal strength.

No matter how strong the signal, the meter cannot be deflected off the scale, as the initial adjustment for maximum deflection was made at zero anode current (i.e. the I.F. valve was removed) and the strongest signal cannot produce enough negative AGC voltage to reduce the anode current of the I.F. valve to zero.

'S' Meter Valves

Instead of using an I.F. amplifier valve controlled by the AGC it is possible to use an additional 'S' meter valve to provide the current required to operate the 'S' meter. Such a circuit is shown in Fig. 4. A 0—1mA or a 0—2mA meter should be used in this circuit. R1 should be adjusted so that the meter is fully deflected when the 'S' meter valve, V1, has been removed. The valve should then be replaced and the AGC line shorted to ground whilst the cathode resistor, R2, is adjusted to give zero reading on the meter. It is claimed that this circuit gives a linear dB scale; the distance between each 'S' point on the meter scale is constant.

Double Triode Circuit

Another good circuit is shown in Fig. 5. This employs a 12AU7 double triode which obtains its input from the cathode of one of the AGC controlled I.F. valves. The internal anode resistance of the two triodes and the cathode resistors form a bridge circuit. When an input voltage is applied to the first triode, its anode resistance is altered and the bridge is thrown out of balance. The anode resistance of V1(b) remains constant.

Before use, R2 is adjusted to balance the bridge at zero signal so that no current passes through the meter. The connection to the anode of V1(a) is then removed and R1 is adjusted for full scale deflection. When the anode of V1(a) is reconnected, the meter should deflect in a forward direction according to the strength of the signal being received.

Calibration By Ear

Various people have different ideas about what they mean by, say, S9. It is doubtful whether a really accurate calibration is worthwhile. Those who do not possess a signal generator which incorporates an accurately calibrated attenuator can best calibrate their 'S' meter by ear as described below. This method is probably as good as any.

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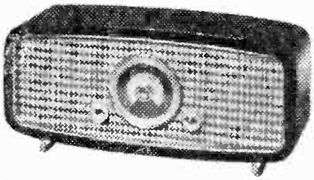

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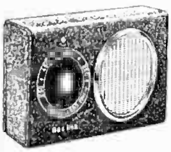

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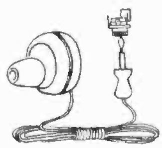

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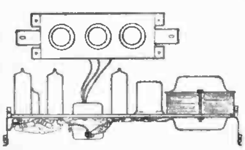

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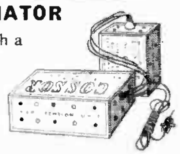

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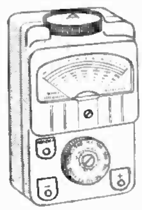

A must for all home constructors. Basic movement 300μA. Sensitivity 1,000/V. A.C. and D.C. Ranges 10-50-250-500-1,000V. D.C. and A.C. 1-100-500mA. D.C. 2K/200K ohms. Accuracy: 3% FSD and D.C. 5% F.S.D. and A.C. 10% on. Resistance scale. Dimensions 5¼ x 3¾ x 2¼in. Complete with test leads, prods and 1.5V cell. **69/6** P. & P. 2/-

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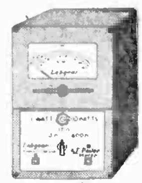

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First check that, with no signal input to the receiver, the 'S' meter reads only a little above zero. Then tune in a number of strong local amateur signals, noting their meter readings. There should be virtually no background "sharsh" noise on these signals. The average 'S' meter reading of the weakest signal giving no background noise is about S8 or S9.

Then tune in a weak signal (preferably a fairly local one which does not fade) in which the level of background noise is very high so that the signal can only just be heard. The meter reading will correspond to about S3. Before marking this point on the meter as S3, check with a number of other weak signals.

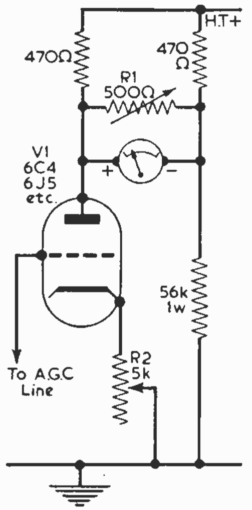

Fig. 4.—A circuit which requires an extra valve.

S6 should now correspond to a reasonably strong signal with a fairly small amount of background hiss. Finally all of the remaining 'S' points should be marked on the scale. The markings 10dB and 20dB above S9 will probably be spaced a little farther from each other than the 'S' points.

Accurate Calibration

The following method of calibration may be employed by those who have a good quality signal generator with a calibrated attenuator.

It is first necessary to choose the input level in microvolts which will correspond to S9. This will normally be between about 50 and 200μV; 100μV is a good figure for normal amateur work.

The R.F. gain control should be fully advanced and a signal fed into the aerial terminal of the receiver from the generator. The signal should be exactly 100μV or whatever level is chosen as corresponding to S9. This allows the S9 point to be marked on the scale. The generator input is then halved whilst the S8 point is being found, halved again for S7 and so on until the calibration is completed. This gives a calibration in steps of 6dB per S point at the frequency of calibration. Now, 10dB above S9 is the point at which the input voltage is 3·16 times greater than at S9; this point can therefore also be marked using the generator. Above S9, 20dB is 3·16 times greater than 10dB above S9 and so on.

However accurately the receiver has been calibrated at one frequency, this calibration will not be exactly correct at other frequencies, especially on other bands. It is thus very doubtful whether calibration by means of a signal generator is of any more value than calibration by ear. Even at the one frequency of accurate calibration, the accuracy will decrease with time, as the receiver goes slightly out of alignment and as the gain of the valves alters.

If desired, the meter can be switched to perform other functions, e.g. measuring receiver H.T. and other currents and voltages so that any faults in the receiver could be found more quickly. It could also be switched to show the percentage modulation of the signal being received.

Use a Good Aerial for SWL

Simple receivers, such as 1, 2 or 3 valve TRF sets, are often used for S.W. listening. With these, a good aerial can make a great deal of difference to reception. This is very noticeable on 80m and top band (160m). Here, a TRF receiver, or even a sensitive superhet, fitted with a short aerial, may be tuned over the band and give only very poor results. The band may seem dead, or may seem to carry local stations only. If a long aerial is substituted, the band can become alive with dozens of transmissions which were previously unheard. For 160m, anything under 80ft or 100ft of aerial can be considered rather short. For shorter wavelengths, shorter wires are satisfactory.

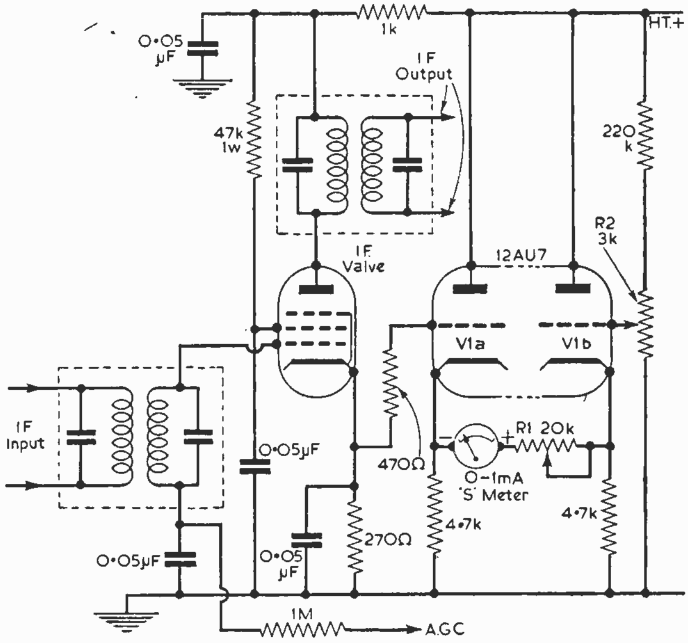

Fig. 5.—A circuit which employs a double triode.

Short-wave Listeners' Log—7

THOUGH conditions on the amateur bands vary considerably, according to season, time of day, and other factors, each band has its own particular characteristics. As a guide to the short wave listener who has only recently become interested in this form of reception, the band characteristics may be listed as follows:

169m

Sparingly used, and mostly for fairly local contacts. The listener is most likely to hear stations working within a range of 50 miles or so. With darkness, the range increases, and transatlantic contacts have been made, but it is not very usual to hear distant stations on this band.

80m

Very popular for daylight contacts up to a few hundred miles. During daylight hours it is unusual not to hear at least a few stations working. At weekends, the band is often very fully occupied. As darkness falls, European stations often build up greatly in strength, and few local transmissions will be heard. Some activity is usual very early (before 7a.m.); from about midnight to early morning some long-distance contacts are possible.

40m

During daylight, skip may give best reception at a distance of some hundreds of miles, though ground wave or short range signals may be heard from locals. When darkness falls, the number of powerful commercial stations in or near the band makes the reception of amateur stations difficult. Through midnight and up to early morning, long-distance reception may cover most continents.

20m

This band is usually good for very long-distance contacts. Results depend a lot on sunspot activity. During the hours of darkness, world-wide reception may be possible. Sometimes during summer, the band gives good results during the afternoon. Results tend to change from hour to hour, or day to day. This is the highest frequency band which many popular "all-wave" receivers will cover, and if often worth checking for possible long-distance reception.

15m

Conditions may result in no signals being heard on this band at some hours, or for several days at a time. But it is expected that changes in the sunspot cycle will make this band very useful for long-distance reception during coming years. At present it can furnish very good long-distance results, when conditions are good.

10m

This band is also very variable, but can also give excellent reception over very great distances. When the band is usable, the listener may hear many distant countries. There are also periods when the band seems quite dead, but conditions can change rapidly during the day.

TRANSMITTING TOPICS

END-FED TRANSMITTING AERIALS

(Continued from page 58)

Feedback Prevention

The end-fed Hertz has high voltage at the point where it is joined to the transmitter. Good insulation should be used here, and the lead should be taken away from the equipment as directly as possible. If near microphone or leads, or early stages of the transmitter, feedback may cause oscillation, or other troubles. This is particularly likely with fairly high power.

If this arises, and cannot be prevented by normal means (e.g. screened microphone leads, and reasonable separation of circuits) then an aerial coupler may be added. This coupler can use the circuit in Fig. 4, or that in Fig. 5. A few feet of coaxial cable are used between transmitter and tuner, and the tuner is situated a little clear of the transmitter, near the entry point of the aerial. The high impedance, voltage fed wire will then be well clear of the microphone, etc.

A Versatile TAPE RECORDER

(Continued from page 70)

Now, mount the tape deck into the base of the cabinet, using four rubber buffers to mount the deck off from the top surface of the motor-board. Four chrome-plated screws secure the deck in place.

In making the connections from the tape-deck to the amplifier, only one earth connection must be used. The metal parts of the deck are bonded together by the manufacturer and the one earth connection should be made via the outer screening of the record/playback head coaxial cable. If multiple earths are used, there is a possibility of a high hum level on playback.

Final testing can now take place. A shorting plug for socket A can be made from a coaxial plug with the centre connector soldered to a piece of bare copper wire which is then shorted to the body of the plug.

Experience will soon show the correct indicator reading for good quality recordings.

Club News

REPORTS OF CURRENT ACTIVITIES

BURY RADIO SOCIETY
Hon. Sec: G. Winter, 269 Lever Street, Radcliffe, Manchester, Lancashire.

As from April 11th, meetings will be held at the Knowsley Hotel. Kay Gardens, Bury.

Future Events:
April 11th—My First 18 Months by G3NNW.
May 9th—Junk Sale.

FLINTSHIRE RADIO SOCIETY
Hon. Sec: L. W. Barnes, 1 Bryn Coed Park, Rhyl.

At the Annual General Meeting the following officers and committee were elected: President F. G. Southworth, GW2CCU, Chairman H. T. Jones, GW3NQP. Hon. Sec.. L. W. Barnes, Hon. Treasurer W. Davies. Committee, J. T. Lawrence, GW3JGA/T, J. Nicholas, GW3OIN, K. Schofield, GW3KYT.

Future meetings will be held at the Bee Hotel on the last Monday in each month.

MITCHAM AND DISTRICT RADIO SOCIETY
Hon. Sec: M. Pharaoh, G3LCH 1 Madeira Road, Mitcham.

The Annual General Meeting was held on 24th February and was well attended. The RSGB Affiliated Societies contest was held on February 4th and 5th. The G5UX key award can be won by any transmitting member of the Society. Points are scored on the bases of one point per country worked on any of the amateur bands. Proof of contact is not required but inspection of station log entries may be required. Scores should be sent to the Hon. Sec.. for inclusion in the News letter each month.

Future Events:
April 7th—Junk Sale.
April 21st—National Field Day arrangements.
May 21st—National Field Day dummy run.
June 3rd/4th—National Field Day.
June 30th—National Field Day post-mortem.

NORTHERN MOBILE RADIO RALLY
Hon. Sec: J. Charlesworth, G3IJC, 23 Craven Lane, Gomersal, Leeds.

The fourth Northern Mobile Radio Rally will again be held at Harewood House, (near Leeds) on Sunday May 28th.

REIGATE AMATEUR TRANSMITTING SOCIETY
Hon. Sec: F. D. Thom, G3NKT, 12 Willow Road Redhill, Surrey.

The Annual Dinner was held on February 11th, when 35 members and friends were present. The G8KW Trophy for the first place in the Open Class of the constructional contest was awarded to BRS 20809. The "XYL" Cup donated by mothers and wives of members was awarded to R. Wells for the Junior Class. Informal meetings are now being held on the first Thursday in the month at The Tower, Redhill, for seniors, and at the homes of transmitting members in rotation on the first Saturday in the month for juniors.

Future Event:
April 15th—G3BCM will demonstrate his "Top to Ten" Transceiver.

THE SLADE RADIO SOCIETY
2 Orchard Road, Erdington Birmingham 23.

Meetings are held at the Church House High Street, Erdington, Birmingham 23.

Future Events:
May 5th—Application of Electronic Devices in Industry by W. and T. Avery.
May 19th—Map Reading for Direction Finding by D. S. Chapman.

SOUTH YORKSHIRE AMATEUR RADIO SOCIETY
Hon. Sec: E. Brailsford. 15 Ayrsome Walk Cantley, Doncaster.

The R.A.E. course being held at the Doncaster Technical College is proving very popular and has 16 students. Meetings are held at the Palace Buffet, Silver Street, Doncaster every second and fourth Thursday in the month at 8 p.m.

Future Events:
April 13th—Ragchew.
April 27th—Talk on Receivers by Joe Clennell G3HNJ.
May 11th—Free Night.
May 25th—Supersonics by L. Bennett G2BOJ.

In the near future the society will be operational under its own call sign.

AN ALL BAND 75W TRANSMITTER

(Continued from page 66)

R.F. Section

The input from the VFO is by airspaced coaxial cable through a Pye elbow and socket. A short piece of similar cable goes from the input socket to a point adjacent to V5 valveholder. Since the input is at high impedance, this cable causes some mismatch, but this is not important if the length is made about four feet.

COMPONENTS LIST FOR POWER UNIT AND MODULATOR
(Fig. 1, page 1091 of the April issue)

R1	1k ½W	R9	220k ½W
R2	1M ¼W	R10	220k ½W
R3	270k ¼W	R11	100k ¼W
R4	47k ½W	R12	about 1·5M ¼W
R5	180k ¼W	R13	about 700k ¼W
R6	1k ½W	R14	3·3M ¼W
R7	22k ½W	R15	100k ¼W
R8	220k ½W	RX	0·8 Ω (see text)
S1	see text		
C1	8 μF 450VW elec	C9	8 μF 250VW elec
C2	16 μF 450VW elec	C10	0·01 μF mica
C3	8 μF 450VW elec	C11	8 μF 25VW elec
C4	8 μF 450VW elec	C12	0·05 μF mica
C5	16 μF 450VW elec	C13	100pF mica
C6	16 μF 450VW elec	C14	0·01 μF ceramic
C7	0·1 μF paper 350VW		
C8	8 μF 25VW elec	C15	0·01 μF ceramic
VR1	0·5M	VR2	10k w.w.
LFC1	10H, 250mA	LFC2	10H, 250mA

V1	5R4GY or 5Z4G	V3	VR65 (SP61)
V2	VR65 (SP61)	V4	6F8 or 65N7
M1	500 μA FSD (see text)		
T1	350-0-350V, 5V 2A or 6·3V 2A with series resistor (RX)		
T2	350-0-350V, 6·3V 4A		
T3	12V 1A charger transformer		
MR1, MR2, MR3	Bridge rectifier rated at 700V, 150mA. (This may be made up from four half-wave types each rated at 350V)		
MR4	12V 1A rectifier		
F1	250mA	F2	150mA

3 Mazda octal valveholders
3 International octal valveholders
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2 valvebases (plugs)
2 2-pole, 3-way switches
5 1-pole, 1-way toggle switches
1 2-pole, 2-way toggle switch
1 single contact jack socket
1 double contact jack socket
Aluminium knobs, hardware, chart frame, wire, etc

(To be continued)

Letters to the Editor

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

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

MODULATION

SIR,—During the last two months, I have received an overwhelming number of replies to my queries raised in the January PRACTICAL WIRELESS. All the letters except two were against the motion; one sent me a circuit of a transmitter based on my lines that "really worked" and the other pointed out its applications in the field of SSB, and in high power B/C installations where the problem of producing several kW of audio for modulation purposes is by no means small.

For the benefit of any readers who may want to know the values of the tuning capacitor referred to in my original letter, they are 50—5pF, 50—5pF, 35—5pF.

In conclusion I would like to thank all those who took the trouble to write such an interesting selection of letters to me. — J. R. MILLER (Somerset).

RADIO HOGS

SIR,—May I heartily endorse the comments about the use of pocket radios made by Thermion in February PRACTICAL WIRELESS?

These people are on holiday to enjoy themselves as much as they can without breaking any law. Nobody else matters! They are the only people who count (or so they seem to think!) and if they inconvenience anybody else, that doesn't matter.

These "radio-hogs" have their radio sets so loud that everybody (except the stone deaf) in the vicinity is compelled to listen to the personal choice of the owner of the offending set. The choice is not, as a rule, a very good one. It is quite possible to walk along the sea-shore in August and hear the whole of a radio programme without missing one demisemiquaver as one is never very far from a radio blaring the strains of some jazz band. It is surely time that the big-wigs concerned realised this and did something about these selfish people. May their valves burn out and their loudspeakers disintegrate!—D. A. PICKETT London S.W.4).

RADIO MOSCOW

SIR,—I think T. Roeves (March issue) is wrong when he says that Moscow broadcasts on 1734m, because the Voice of America broadcasts jazz on this wavelength at 23·15 G.M.T. every day. On the same wavelength it also broadcasts news and discussion programmes in English and in a number of foreign languages.—J. LOWRIE (Edinburgh).

CRYSTAL SETS

SIR,—I have read with interest the various letters sent in by readers concerning crystal sets and the exceptional reception obtained.

However, if one gave thought to the subject it may not be so remarkable as it may seem.

I possess a crystal receiver and am able to receive (under favourable conditions) Radio Moscow, Voice of America, Luxembourg and many other transmissions, including Morse. The reason for this is as follows.

It is a well known fact that crystal sets only make the more powerful transmissions audible such as the Home Service; depending where you are situated and depending on the coil, e.g. 92 turns on a 1¾in. former with capacitor at approximately 490-500pF; now when the capacitor is at minimum capacitance, the natural wavelength of the aerial in conjunction with the coil is obtained, which the diode converts to an audio signal.

Radio Moscow may be beaming a transmission to the U.K. and under favourable conditions will be at maximum strength, ideal for the crystal receiver to pick up clearly. Owing to atmospherics and the influence the ionosphere has on reception, it may fade out completely to be taken up by, say, the Voice of America, which in its turn drifts out for another station taking prominence such as Radio Luxembourg; and so it goes on. In fact this "exceptional reception" is a perfectly natural phenomenon based on the fact that crystal receivers when operating on a natural aerial wavelength only make audible the strongest signal. It all depends on the natural wavelength of the aerial and coil and conditions between the crystal receiver and radiating transmitter mast.—A. DYSON (Sheffield).

QUARTZ CRYSTAL ETCHING

SIR,—I have read with interest an article in PRACTICAL WIRELESS entitled "Quartz Crystal Etching", by J. B. Dance.

I feel that the author of this article has not stressed strongly enough the dangers of using the chemical, ammonium bifluoride, for the purpose of etching silica. He points out the danger of using hydrofluoric acid without stating that ammonium bifluoride etches by virtue of its dissociation into ammonium fluoride and hydrofluoric acid thus:—

$$NH_4HF_2 \rightleftharpoons NH_4F + HF$$

and therefore in solution ammonium bifluoride is potentially just as dangerous as hydrofluoric acid. To the chemist hydrofluoric acid is not a strong acid as measured by its dissociation constant: nevertheless it is extremely active chemically owing to its tendency to replace oxygen and complex formation. It is therefore *extremely dangerous* to

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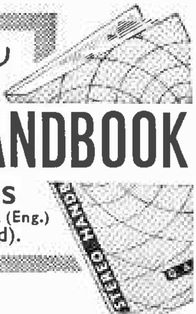

BY G. A. BRIGGS

Technical Editor R. E. COOKE, B.Sc. (Eng.)
PRICE 10/6 (11/6 post paid).

The High Fidelity Magazine Dealer Library, Jan. 1961 says:

To high fidelitarian and dealer alike. G. A. Briggs needs no introduction. The author is well known for both his work and writing on loudspeakers. The Stereo Handbook is written in Briggs' customary salty style and is, for a hard-cover, technical book profusely and interestingly illustrated.
The book is much to be recommended to anyone wishing to put stereo in an intelligent perspective. Additionally, it will serve as a guide to dealers plagued with customer questions about how to set up a system for optimum effect. Stereo Handbook is "must" reading for anyone who does not believe that there is room in the overall subject of stereo and high fidelity for a hearty chuckle. Highly entertaining and informative.
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handle and it is essential that protective clothing and eye shields should be worn when handling hydrofluoric solutions, especially as this acid has the insidious property of eating through flesh without any initial warning that acid has contaminated the skin. Such wounds, to my certain knowledge, are difficult to treat and take a considerable time to heal, even with hospital treatment.

In my opinion, it would be advisable for non-technical readers of PRACTICAL WIRELESS to leave such a potentially dangerous chemical as ammonium bifluoride strictly alone,—it would be safer and cheaper in the long run to buy the required crystal and keep one's fingers and eyes intact.—G. P. MITCHELL B.Sc. G3OFJ (Wallington).

A PLEA FOR PLASTICS

SIR,—Why are wax and pitch still used in the manufacture of some components? The only answer seems to be that they are both highly "moistureproof". They are also extremely thermoplastic, and are thus very messy to use. Why cannot plastics take their place? With such an excellent range of plastics at the manufacturers' disposal, there is no apparent excuse. The smaller the component, the larger the case weight. or so it would seem. This could be avoided by using more plastic and less metal etc.—N. J. CORNFORD (Beaconsfield).

THE 4W AMPLIFIER

SIR,—A friend and I both built the 4-watt amplifier described in the January 1961 issue. On completion, we both experienced the same fault. This had the effect of producing "beating" at a constant rate in the loudspeaker. By experiment, it was found that by connecting the 270k resistor directly across the treble control, the fault cleared.

We now have good results on both VHF/F.M. radio and with a record player.

This may interest other constructors.—J. B. C. (R.A.F., Scotland).

THE P.W. SUPERHET

SIR,—After some set-backs I have completed the construction of the P.W. Pocket Superhet Transistor Set, and I am very pleased with its performance. I derived much help in the adjustment of it from the article in the December issue. The article on "Checking Transistor Circuits" in the March issue was also of great value. I have built many sets in my time but none has given me greater pleasure or more satisfaction. It is remarkable that a set employing such a small battery can give such a loud signal.—W. LYNCH (Glasgow).

TRANSISTOR HOLDERS

SIR,—In reply to Mr. E. Krell (February), on transistor bases, I can only think that he is not very interested in his hobby. Whilst I was in Malta for a time, I had the opportunity of building a transistor radio and in the kit complete with transistors were their bases. Besides, Mr. Krell, surely as an enthusiast you must have come across a little tool called a "thermal shunt". If one of these is clipped against the base of the transistor, hardly any damage at all can be caused by heat from the soldering iron.—E. AVERY (Fareham).

REFLEX CIRCUITS

SIR,—In the days when valves were very expensive an arrangement known as reflexing became popular, as it enabled one to use a single valve for two purposes. It appears to me that the present position with transistors is parallel with the period of which I am thinking. and the use of transistor reflex circuits should be possible. Many old hands will remember the old S.T. circuits in which even two H.F. stages were reflexed for use as two audio stages, and I would think that some similar scheme would be practicable with *good* transistors (to avoid the disappointment and waste of time of using "surplus" transistors). Is there any "snag" in this suggestion. or is this yet another way in which the valve still holds precedence over the transistor?—G. TREEBY (Bath).

"ROADFARER" COMPETITION

AS announced in the Editorial of the previous issue, a prize of £100 will be awarded for the "Roadfarer" receiver which, in the opinion of a committee, is judged to be the most efficiently constructed and presents the neatest appearance. Consolation prizes will be awarded to runners-up.

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Mark your envelopes "Competition" in the top left-hand corner.

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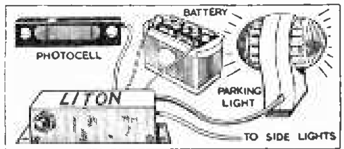

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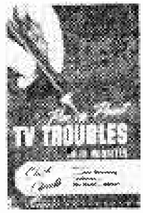

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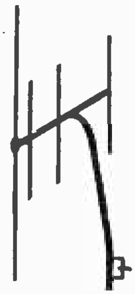

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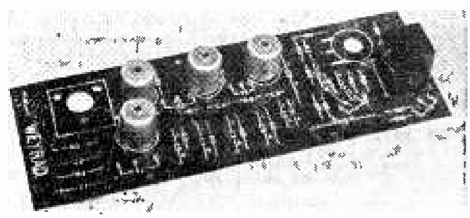

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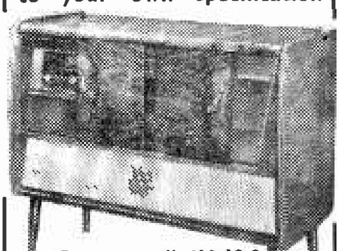

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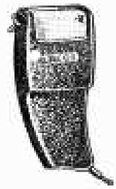

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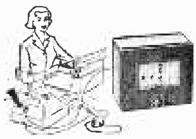

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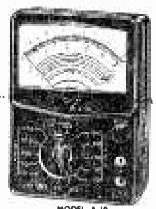
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465 kc/s I.F. Amplifier, 2-OC169 Transistors. Double tuned I.F.T.'s. Diode Detector, A.V.C., etc. Printed circuit. Size 3½ x 1½ x 1in. Ready to use. PRE-ALIGNED AND TESTED. 92/6. P.P. 1/-.

UNIT 3
4 Transistors, 1 watt Audio Amplifier 60-1600 c/s ±3dB. 5mV input for 1 watt. 2-OC71, 2-OC74 Transistors. Printed circuit. Size 3 x 2.2 x 1.2 in. Ready to use. 92/6. P.P. 1/-.

SUNDRIES (FOR ABOVE UNITS)
8 x ⅜in. M.L.S. Ferrite Aerial and Coils. 12/6.
176pF ... 176pF Tuner, 9/6. 2-15 pF Trimmers, 1/- each. 7 x 4in. 3 ohm Speaker, 20/-.
Fully Illustrated Booklet 2/6

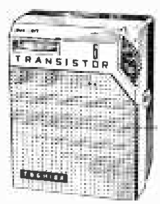
6-TRANSISTOR RADIO

Size 3 x 2¼ x ⅞in.

★ **THE WORLD'S SMALLEST RADIO with Speaker**

FITS INTO VEST POCKET or PURSE

Complete with Batteries Leather Case, Earphone, or Presentation Box.



● All your favourite stations including Luxembourg.
● Superhet Circuit with Push-Pull output on 2in. speaker.
● 540 to 1600 kc/s coverage.

BUILT & READY TO USE

CASH OR C.O.D.
12 gns Reg. Post Free

TRANSISTORS
From 3/6 each

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FULLY GUARANTEED

We can supply a Transistor for every need!

PRACTICAL TRANSISTOR CIRCUITS 3/6 post free

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★ *Designed for the Home Constructor*

RANGER-2

PERSONAL POCKET RADIO

★ **Two High Gain Transistor Version of "Ranger-3"**—See back page. Similar in appearance and performance.

ALL PARTS **59/6** P.P. 1/6. Everything supplied.

● **Pictorial plans and description FREE ON REQUEST**

LET US HAVE YOUR ENQUIRIES FOR COMPONENTS

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SEE BACK PAGE

Free Lists by Return. Valves, Quartz, Crystals, Transistors and Components.

Practical Wireless

—BLUEPRINT— —SERVICE—

ALL OF these blueprints are drawn full-size and although the issues containing descriptions of these sets are now out of print, an asterisk in the list below denotes that constructional details are available free with the blueprint.

The index letters which precede the Blueprint Number indicate the periodical in which the description appeared. Thus PW refers to PRACTICAL WIRELESS; AW to *Amateur Wireless* and WM to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

SPECIAL NOTE

THE following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. *The majority of the components for these receivers are no longer stocked by retailers.*

Title	*Number*	*Price*
CRYSTAL SETS		
Junior Crystal Set	PW94*	2/-
Dual-wave Crystal Diode ...	PW95*	2/6
STRAIGHT SETS		
Battery Operated		
Modern One-valver	PW96*	2/6
All-dry Three	PW97*	3/6
Modern Two-valver	PW98*	3/6
SUPERHETS		
Mains Operated		
A.C. Band-pass Three	PW99*	4/-
A.C. Coronet-4	PW100*	4/-
A.C./D.C. Coronet	PW101*	4/-
MISCELLANEOUS		
The PW 3-speed Autogram ...	—*	8/-
The PW Monophonic Electronic Organ	—	8/-
TELEVISION		
The PT band III converter ...	—*	1/6

Title	*Number*	*Price*
A.C. Fury Four	PW20*	2/6
Experimenter's Short Wave ...	PW30a*	2/6
Midget Short Wave Two ...	PW38a*	2/6
Band-Spread Three (Battery) ...	PW68*	2/6
Crystal Receiver	PW71*	2/-
Signet Two (Battery)	PW76*	2/6
Simple S.W. One-valver	PW88*	2/6
Pyramid One-valver	PW93*	2/6
BBC Special One-valver	AW387*	2/6
Short-Wave Two	AW429*	2/6
Short-Wave World Beater ...	AW436*	3/6
Standard Four Valve S.W. ...	WM383*	3/6
Enthusiast's Power Amplifier ...	WM387*	3/6
Standard Four Valve	WM391*	3/6
Listener's 5-Watt Amplifier ...	WM392*	3/6

QUERY COUPON

This coupon is available until 5th May, 1961, and must accompany all queries in accordance with the notice on our "Letters to the Editor" page.

PRACTICAL WIRELESS, APRIL, 1961.

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★ RANGER 3 ★

NO EXTERNAL AERIAL OR EARTH
3-TRANSISTOR and 2-DIODES

PERSONAL POCKET RADIO with 5 stages giving clear reception on medium wave, amateur top band and shipping. Only first grade components used throughout.

Size 4⅜ x 3 x 1¼in.

ALL COMPONENTS
79/6 P.P. 1/6
NO EXTRAS TO BUY
Everything Supplied.

- Easy to follow instructions with pictorial layout.
- Reception of Radio Luxembourg guaranteed (most areas).

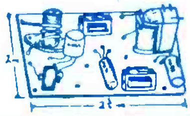
Free Instructions and Price List on request. Easy to build.

● **AFTER SALES SERVICE, GUARANTEED SUCCESS** ●

27 Mcs. MODEL CONTROL RECEIVERS

● **"SUPERTONE 1-C"**

New design 3-transistor transformer coupled receiver for 27 Mc/s model control. Uses OC169/OC71/OC72 transistors. Overall size 2⅜ x 2 x 1¼in. Range about ¼ mile. Easy to build.



● **OUTPUT to MIN. RELAY 4½-VOLT OPERATED "SUPERTONE 3-C". (3-CHANNEL VERSION AVAILABLE, 69/6 P.P. 1/6.)**

★ **GUARANTEED RESULTS—DIAGRAM FREE** ★

Total Cost of Parts
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New, with new circuit design.

ALL TRANSISTOR BABY OR INVALID ALARM

Battery operated, push-pull, 250mW output. Low impedance microphone enables unit to be used up to 200 yards. Output on 5in. speaker.

● GUARANTEED for 6 MONTHS and 100% SALE.

● Microphone is placed within 6 ft. of Baby: twin flex is taken to amplifier unit and placed in any room required.

COMPLETELY BUILT AND TESTED **£5.10.0** P.P. 2/6.

● **Used All Night, Every Night, Battery Life 3 to 4 months**

750mW TRANSISTOR AMPLIFIER

OVER 1 WATT PEAK OUTPUT

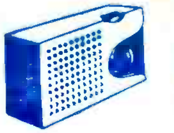
● Uses OC71, OC81D and, 2—OC81 matched transistors on Printed Circuit. Size 4 x 2⅜ins. 3 ohms output. Very sensitive.

Ideal for Record Player, Intercomm, T.R.F. or Superhet Tuners, etc.

★ **BUILT AND TESTED**
79/6
P.P. 1/-

Supplied with diagrams showing uses.

REPANCO MINI-4



- 4-Mullard Transistor 5-stage medium and long-wave superhet.
- 2½-inch SPEAKER.
- Easy to build and use.
- Moulded Case Size: 5¼ x 3¼ x 1½ins.

ALL PARTS **£6.19.6** P.P. 1/6

● NEW EASY DIAGRAMS, 1/6 plus post. PARTS LIST FREE ON REQUEST

★ TRANSISTOR FM ★

Pre-built Tuner Units Fully Tunable
● **DETAILS ON REQUEST** ●

★ 'PW' ROADFARER ★

(as described in April edition of *Practical Wireless*)

A.M. and F.M.

7-transistor mains/battery portable in attractive moulded case. Slow motion tuning; telescopic aerial; 7 x 4in. speaker; Ferrite aerial, etc.

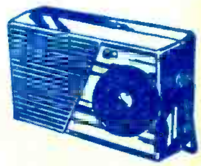
- Full tuning medium wave and VHF F.M. for clear reception of all programmes anywhere in the country.
- 500mW push-pull output with Mains or Battery supply built in.
- PRINTED CIRCUIT—SEVEN TRANSISTORS.
- **FULLY ILLUSTRATED BUILDING INSTRUCTIONS**

All Parts as Specified
18 GNS. P.P. 3/6
All components sold separately. List on request.

★ 'PW' 6-TRANSISTOR ★

MEDIUM AND LONG WAVE SUPERHET

(as described November *P.W.*)



- A sensitive superhet with 150mW push-pull output on 2½in. speaker. Uses 6 first grade Mullard transistors and printed circuit. Moulded cabinet.
- All parts sold separately. Send for list. Illustrated Building Plans, 1/6 plus post.

Size 5¼ x 3 x 1⅝in.

ALL PARTS REQUIRED **£9.19.6**

★ **NO EXTRAS TO BUY—EVERYTHING SUPPLIED** ★

3-TRANSISTOR and DIODE PERSONAL POCKET RADIO ★ SUPER 3 ★

A simple to build local station radio with personal earphone output. Built-in Ferrite Aerial and Battery lasting 9 months.

QUALITY OUTPUT ON PERSONAL EARPHONES.

ALL PARTS
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● NO EXTRAS TO BUY
Size 4⅜ x 3 x 1¼in.

★ **IDEAL for BEGINNERS**

● CONTESSA ●

COMBINED PORTABLE AND CAR RADIO

6 TRANSISTOR MEDIUM AND LONG WAVE SUPERHET
TERRIFIC SENSITIVITY

UNBEATABLE IN PERFORMANCE AND APPEARANCE

SPECIFICATION

- 425mW Push-Pull Output
- 6 "Top-Grade" Ediswan Transistors
- New Type Printed Circuit with all Components marked
- Full Medium & Long Wave Tuning
- High "Q" Internal Ferrite Aerial
- Car Radio Adaption and AVC
- Slow Motion Fingertip Tuning with Station Names
- "Hi-Fi" Quality Speaker
- Attractive Rexine Covered Cabinet

TOTAL COST OF ALL PARTS
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Call for demonstration. No technical knowledge necessary. All parts sold separately. New Descriptive Leaflet and Prices on request.

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