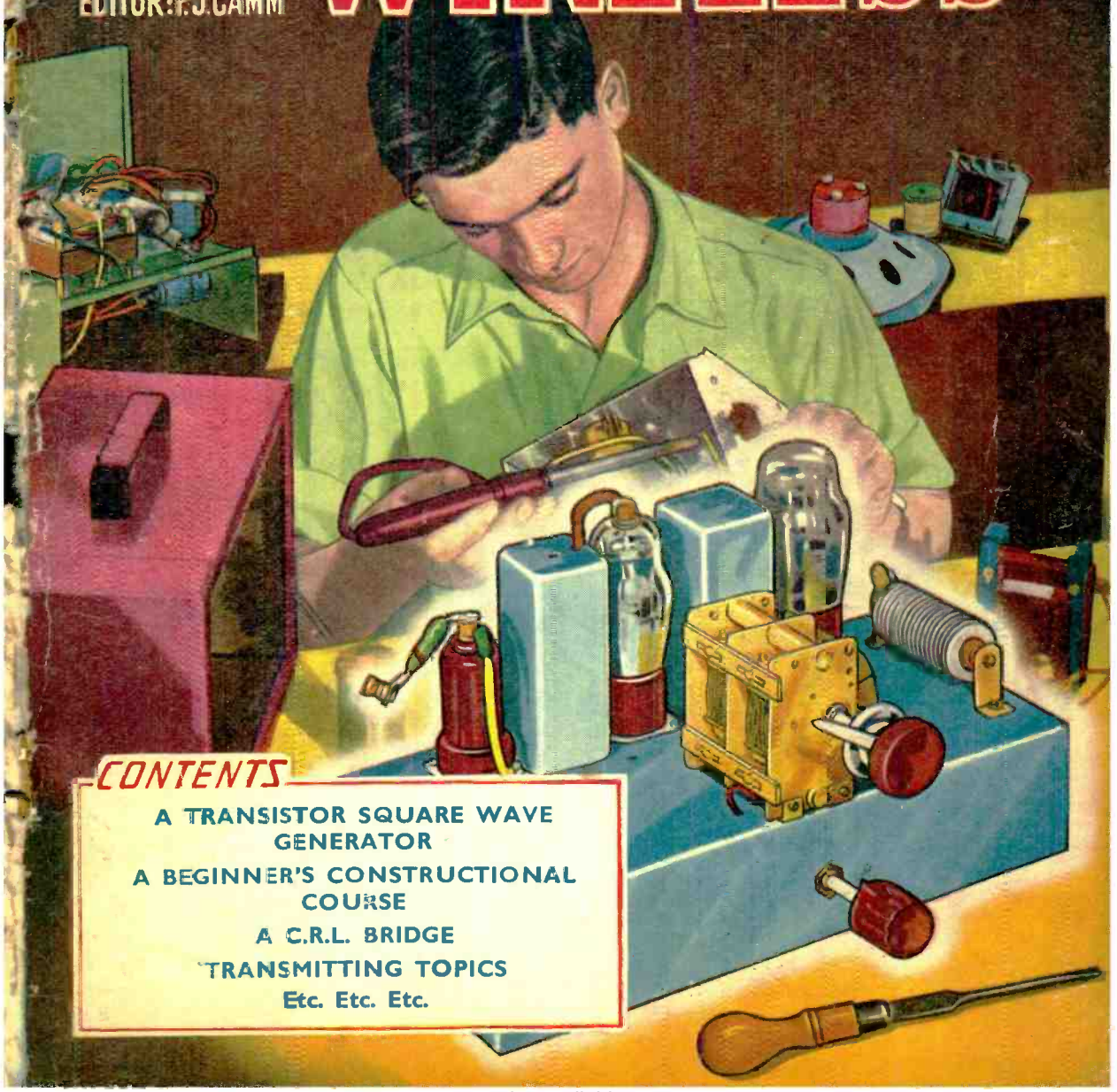
A BEGINNER'S 200-1600 METRE SUPERHET

PRACTICAL WIRELESS

1/3

JANUARY 1958

EDITOR: F. J. CAMM



CONTENTS

BARGAINS TO CLEAR

4 watt 3 valve Amplifier. Built to Hi-Fi standards with a control panel which can be used separately or fixed to chassis. Separate bass and treble controls. A.C. mains operated. **£4 19 6** plus 5/- post and insurance.

A.C. Superhet 5 Valve Chassis. Medium and two Short, unused but less valves and mains transformer. Uses standard octal range. **27 6** again coil pack worth much more!, non-callers add 6/6.

A.C. Superhet 7 v. 5 Waveband Chassis. H.F. stage. Unused, less valves and power pack. Slightly soiled. Coil pack worth twice as much, circuit diagram supplied. **£2/15/-**, carriage and insurance 7/6.

A.C. 4 Valve Superhet, complete with valves but less scale and pointer, unused. Circuit diagram supplied. **39 6** plus.

Note that the above three chassis although unused will need checking On account of low price no guarantee is given. Nor, re carel, can technical assistance be given.

.1 mfd. 350 v. small tubular metal. Made by Dubilier. **2 6** per dozen.

Germanium Diodes. B.T.H. with wire ends. **10d.** each or **9/-** dozen.

Midget I.F. Coils, dust cored, size 1¼ x 1in. 465 Kc/s. **4 6** pair.

Standard size I.F. Coil, dust cored 465 m/s. **4 6** pair.

Coil Pack for Superhet. 465 Kc/s I.F. Medium and 2 short waves. **9 6.**

Cathode Ray Tube. VCR 97. Instrument type, new. **7 6** each, carriage 3/6.

Bakelite 5 amp. electric wall switch, "Bi-tait," **9d.** each or **8/-** per dozen.

Series, parallel and off-electric wall switch, made by Crabtree. Price **1 3** each or **13 6** per dozen.

Amplifier, ex-Government unit 11.84 contains one double triode and one triode, **6 6**, post and insurance 2/-.

Connecting wire, PVC covered 24 swg. copper, **2 6** per 100 ft. or 7 coils different colours for **10/-**.

Scanning coils, by very good maker new and unused, **4 6** complete.

Choke, 200 m.a., first-class. Made for Services—new, **6 6**, post 1/6.

10 v. Superhet 1½ metre, ex-Govt., but unused. Complete with valves. Easily converted for Band III, **39 6**, carriage and packing 7/6.

Mains Transformer, 250-0-250, 80-90 m.a., 6.3 v. Standard mains input. Half-shrouded, **12 6**, post and insurance 2/6.

R.F. 25 Tuning Unit. New, unused and complete with valves, **9 6**, post 2/6.

Cathode Ray Tube, VCR 517, **8 6** each, carriage 2/6.

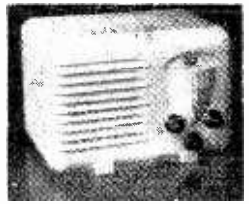
Mains Lead, metal screened to stop interference, **9d.** yard.

Thermo-couple, mounted on valve base, useful for experiments and schools, **6 6** each.

Midget push-pull input transformer and push-pull output transformer to match, **8/-** the pair.

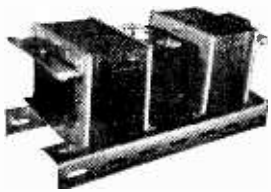
Note: Orders for small components over £2 are post free, otherwise please add sufficient.

MAINS-MINI



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

MAINS ISOLATION TRANSFORMER



Makes servicing safe, also makes the adjustment for differences in mains voltages very simple. Input tapped 200-250 v., output tapped 200-250 v. Continuously rated at 500 watts, intermittent rating 2,000 watts. Cable entry by terminal blocks, two separate screens for suppressing mains interference. Size approximately 14 in. x 6 in. x 6 in., weight approximately 40 lbs. Price **£5 12 6**. Carriage and insurance 7/6 (up to 250 miles).

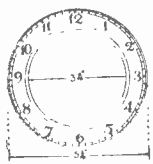
500 WATT STEP DOWN TRANSFORMER

With output tapped from 110 v.-155 v. in 3 volt steps, massive transformer which will withstand considerable overloading. Price **45/-** plus 5/- carriage (up to 250 miles).

6 ft. UNBREAKABLE MAINS LEAD. This is the type of lead which is fitted to electric razors and similar appliances, makes fine lead for test meters and any other devices where the flex is subject to continuous bending and kinking. Twin figure eight construction, soft cream P.V.C. covered. Normally costs 2/- per yard—we offer three leads for **3 9** post free; special quotes for large quantities.

CLOCK CASE

Also suitable for barometer or other instrument. Nicely polished. Price **4 6**, post and packing 1/6.



Clock numerals to suit these cases etched on metal, **2 6**.

Post 9d. if ordered separately.

THIS MONTH'S SNIP

19 RANGE TEST METER

Fine instrument in bakelite and metal case, large easily-read scale and long pointer. 2,000 ohms per volt movement, brand new and recent manufacture. Voltage ranges 0-1,200 volts A.C. and D.C. in five ranges each. D.C. current 0-300 m.A. in three ranges, capacity 0-1 mfd. in two ranges. Resistance 0-2 meg. in two ranges. Inductance 0-1,000 H. Decibels —20 to +46. Complete with test prods. Price **£4 15 0**. Post and insurance 3/-.

THIS MONTH'S SPECIAL BARGAINS

E.S. HOLDER, panel mounting, bakelite insulated, **2/-**.

FILAMENT TRANSFORMER, 200-240 v. tapped mains input; 6.3, 3 amp. output. Ex-equipment but unused, **6 6** each.

THERMAL DELAY UNIT, 6.3 v. operated, switches on or off, **3/6**.

YAXLEY SWITCH, 4 position, 6 pole, 3 bank, **2 6**.

500 Kcs CRYSTAL 10X E 500). Plug-in type, **6 6**.

5-0-5 CENTRE zero milliameter, 2½in., **12 6**.

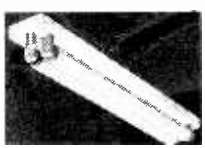
BALANCE METER, 10D 1352, will function as highly sensitive relay, **45/-** each.

12 in. HIGH FLUX (12,000 lines) SPEAKER

3 ohm speech coil, **37 6**, plus 3/6 post and insurance.

Wrap our heater cable around the pipes in your loft to prevent a freeze-up. 21 yards **£1 1** - post free.

FLUORESCENT LIGHTS



These are complete fluorescent lighting fittings. Built-in ballast and starters—stove enamelled white and ready to work. Ideal for the kitchen, over the work-bench and in similar locations.

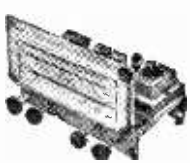
Single 40. 4 ft. 3 in. long, uses a 40 watt tube.

Twin 20. Uses 2 20-watt standard tubes.

Price for either type **39 6**; with tubes.

Carriage and ins. up to 150 miles 5/6, up to 250 miles 7/6.

THE CLEVELAND ORGANTONE



5 valve 3 waveband superhet covering Long, Medium and Short waves. Osram miniature valves—low loss iron cores—permeability—tuned I.F.S.—full A.V.C.—variable negative feed-back—gram. position—4 watts output—particularly fine tone. Chassis size 7 in. x 7 in. x 7 in. approx. Tested in difficult areas where exceptional results have been obtained. Price **£11 10 0** or **£2/0/0** deposit, plus 7 payments of **£1 10/0**. Carriage and ins. 10/-.

DON'T BE CAUGHT LIKE THIS

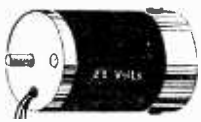
CAR STARTER CHARGER KIT

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

Mains transformer.....	22 6
5-amp. rectifier.....	17 6
Regulator Stud Switch..	3 6
Resistance Wire.....	2 -
Resistance Former.....	2 6
Mains on off Switch.....	2 6
0-5 amp. Moving Coil Meter.....	12 6
Construction Data.....	1 6

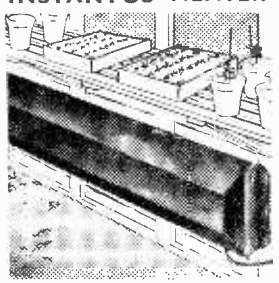
or if bought all together price is **52 6.** plus 3/6 post and packing.

MINIATURE MOTOR



Size only 2½ ins. long by 1½ ins. diameter—American made—laminated poles and armature—intended for 28 volt D.C. but O.K. on lower D.C. voltages and A.C. mains, through step-down transformer—price **10'6,** post, etc., 2/-. Transformer to suit, **12 6** post free.

INSTANTUS HEATER



Convector heater, 1 kW. rating, 4 ft. long, made from heavy gauge sheet steel (galvanised). Can be used for greenhouse, workshop, aviary, etc., etc. Price **£2 10'-,** or with thermostat, **£4 5 -,** carriage 5/-. GUARANTEED 5 YEARS.

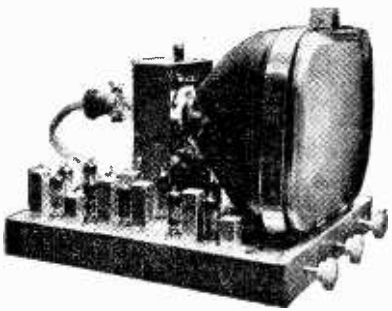
2 KW MODEL. Free standing thermostatically controlled, **£5 17'6.**

500 WATT MODEL. For very small greenhouses, **27/6.** Carriage 5.-.

CRYSTAL MICROPHONE

Miniature crystal type has high gain and is suitable for all purposes—tape recorders—amplifiers. Price **4'9,** post and ins. 9d.

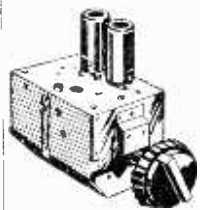
Build This in an Evening



Undoubtedly the most up-to-date televisor for the home constructor. You can build it in an evening and the set when finished will be equal to a factory-made equivalent. What other constructor T.V. has all these features ?

- ★ No technical knowledge required.
- ★ All miniature valves.
- ★ Metal rectifier.
- ★ Turret Tuner.
- ★ 12-channel circuitry.
- ★ Multi-vibrator time bases.
- ★ Ferruxcube, E.H.T. and scan coils.
- ★ 34/38 Mc's I.F.
- ★ Suitable for any modern 12, 14 or 17" tube.

The building cost (less tube) is only **£29.10.0,** plus 10/- carriage and insurance, or **£16** deposit & 12 monthly payments of 27/-. All parts guaranteed 12 months. **Full information and data, price 3'6.**



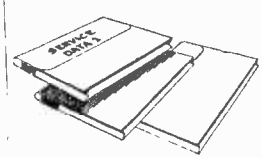
Turret Tuner

Brand new stock, not surplus, with coils for Band I and III complete with valves PCC84 and PCF80—I.F. Output 33/38 Mc's with instructions and circuit diagram, **79'6.** With knobs **3/6** extra, post and insurance 2/6.

THIS MONTH'S SNIP

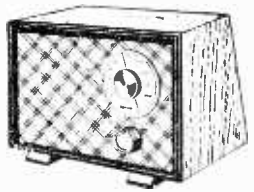
TAPE DECK.—Made by the famous Truvox Company. This contains exactly the same essentials as the current model. Only the styling is different. It also takes the stereophonic head. **Specification :** 3 B.T.H. shaded pole motors with silent friction drive eliminating wow and flutter. Push-button controls, electrically and mechanically interlocked. Patented electric type push-button controlled brake. Tape loading on the drop-in principle accommodation for reels of 7" diameter. Tracking sense to British and American standards. Playing times : up to 3 hours with L.P. Tape or 2 hours with Standard Tapes. Two tracks side by side with safety gap. Positive Azimuth adjustment of Record/Player head. High Impedance Heads. Overall size 14½" x 12½" x 5" approx. 120 only of these fine decks offered at non-repeatable price of **£17.10.0** or **£3.10.0** down and eight monthly payments of **£2.** Non-callers add 10 - carriage and insurance.

T.V. SERVICE SHEETS



100 sheets covering the most popular post-war Televisors by leading makers—Cossor, Ekco, Ferguson, Pye, etc., etc. Special 25% reduction to P.T. readers who order this month will receive the complete 100 sheets printed, 15'- post free.

OUR 19/6 COLUMN



THE SKYSEARCHER

This is a 2-valve plus-metal receiver set useful as an educational set for beginners, also makes a fine second set for the bedroom, workshop, etc. All parts, less cabinet, chassis and speaker, **19 6.** Post and ins. 2 6. Data free with parts or available separately **1'6. 3-valve battery version also available at the same price.**

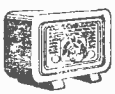
ALL-MAINS AMPLIFIER

Powerful three-valve Mains amplifier ideal for dances, parties, etc. Complete less chassis, cabinet and speaker (available if required)—data 1'6 (free with parts). Price **19/6,** plus 2'6 post and insurance.

"CHIMELITE" 19/6

It is a hall light, as well as a double chime and you can make it in a couple of evenings for the total cost of only **19'6** including instructions, post 2/--data available separately price 2 -

Simplex Transistor Kit



Makes ideal bedroom radio, uses one transistor and one crystal diode. Complete less case **19/6,** case 5/- extra, post and ins. 1/6.

A.C./D.C. Multimeter Kit

Measures A.C./D.C. volts and ohms. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instruction- ri c **19'6** plus 1/9 post and insurance.

ELECTRONIC PRECISION EQUIPMENT, LTD.

Post orders to E.P.E., LTD., Dept. 5, 66, Grove Road, Eastbourne.

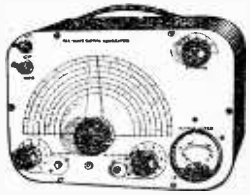
266, London Road. Croydon.
Phone : CRO. 6558.
Half day, Wednesday.

42-46, Windmill Hill, Ruislip, Middx.
Phone : RUISLIP 5780
Half day, Wednesday.

152-3, Fleet Street, E.C.4.
Phone : FLEet 2833.
Half day, Saturday.

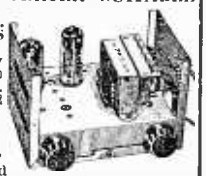
29 Stroud Green Rd., Finsbury Park, N.4.
Phone : ARChway 1049
Half day, Thursday.

SIGNAL GENERATOR



Coverage 120 kc/s, 84 Mc/s. Metal case 10in. x 6¼in. x 4¼in. Size of scale, 6¼in. x 3¼in. 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 continuous variable 100 milli-volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Grey hammer finished case and white panel. Accuracy plus or minus 2%.
£4/19/6 or 34/- deposit and 3 m'thly payments 25/-. P. & P. 4/6 extra.

COMMERCIAL TELEVISION CONVERTER SUITABLE ANY T.V. (except Philips) WITHIN 35 MILES OF I.T.A. TRANSMITTER. ALL CHANNELS NO ALTERATIONS TO SET.



Complete with built-in power supply 230-260 v. A.C. mains. Crackle finish case 5¼in. long, 3¼in. wide, 4¼in. high, incorporating gain control and band switch. Illus. with cover removed.

£3.19.6 Plus P. & P. 2/6.
Hire purchase available.
3 element folded dipole I.T.A. LOFT AERIAL 15/-. P. & P. 2/-. Coax cable 8d. yd

AC/DC MULTI-METER KIT

Comprising 2in. moving coil meter, scale calibrated in A.C./D.C. volts, ohms and milli-amps. Voltage range AC/DC 0-10, 0-100 and 0-500, Milli-amps 0-10, 0-100. Ohms 0-1,000 and 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting) two toggle switches, resistors and meter rectifier. In grey hammer-finish case.

19/6 Plus P. & P. 1/6.

Point to point wiring diagram 1/- free with kit.

4 VALVE ALL-DRY SUPERHET PORTABLE KIT

incorporating Ferrite rod aerial
Medium and long waves. In grey leatherette. Size 9in. x 7in. x 6in. Valve line-up: 1T4, 1R5, 1S5 3V4. Complete kit of parts (less batteries).

£5.19.6 Plus Post & Packing 3/6

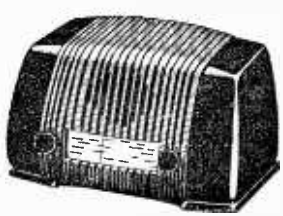
COMPLETELY BUILT PORTABLE AMPLIFIER

approx. size 6¼in. x 2½in., incorporating 2 valves, contact-cooled metal rectifier, bass and treble lift controls **39/6** Plus P. & P. 3/6 and double wound mains transformer 230-250 v. 5" **P.M. SPEAKER & O.P. TRANSFORMER,** if purchased with the above. **18/6.** Plus P. & P. 1/6.

COLLARO 4-SPEED AUTOMATIC CHANGER

Model 456 (suitable for use with above amplifier). A.C. mains, 200-250 v. turnover crystal head. Brand new, fully guaranteed.
£8.19.6 Plus P. & P. 5/-. or 25/- deposit, plus P. & P. 5/-, and 7 monthly payments of £1-5-0.

T.R.F. KIT in PLASTIC CABINET



3 valve plus meta' rectifier, A.C. mains 200-250 v. Medium and Long waves. In pastel blue or brown. Valve line-up: 2 VR65s and VT52. Size 15¼in. long by 9in. high by 7in. deep.
£3.19.6 P. & P 7/6.
Point to point wiring diagram 1/6. Free with kit.

RADIO & T.V. COMPONENTS (Acton) LTD.

23 HIGH STREET, ACTON, LONDON, W.3
GOODS NOT DISPATCHED OUTSIDE U.K.

REPANCO HIGH GAIN COILS

Dual Range Crystal Set Coil, Type DRX1 ...	2/6
Dual Range Coil with Reaction, Type DRR2 ...	4/-
Matched Pair Dual Range T.R.F. Coils, Type DRM3 ... ... pair	8/-
Pair Dual Range Superhet Coils, Type SH4 pair	8/-

Miniature Iron Dust Cored Coils, Type "R":—

Range	Aerial	H.F.	Osc.	
800-2,000m.	RA1	RHF1	RO1	
190- 550m.	RA2	RHF2	RO2	
70- 230m.	RA3	RHF3	RO3	each 3/3
15- 50m.	RA4	RHF4	RO4	

Ferrite Rod Aerial, Dual Range Type FR1 ...	12/6
Miniature I.F. Transformers, Type MSE (465 Kc/s) ... ... pair	12/6
Standard I.F. Transformers, Type TCG (465 Kc/s) ... ... pair	13/6
Three Waveband Superhet Coil Pack, Type LMS	26/-
F.M. Coil Set	29/6

(All components boxed complete with circuits.)
Send S.A.E. for complete list of Repanco components.

Making your own radio set as featured on B.B.C. Children's Television. All components for this receiver in Stock. Send S.A.E. for complete price list.

RADIO EXPERIMENTAL PRODUCTS LTD.

33 MUCH PARK ST., COVENTRY.
Tel. 62572.

radio upkeep and repairs

By Alfred T. Witts, A.M.I.E.E., etc., 8th Edition. This practical handbook explains in an easy-to-follow style how to locate faults, how to remedy them and how to keep modern radio receiver apparatus in the best possible working condition. It forms a most valuable book for radio service engineers and mechanics, and for all who require a practical book of "do's and don'ts." 15/- net. "This little book is a god-send . . ."—Engineer.

PITMAN Parker St., Kingsway, London, WC2

TOP QUALITY FULLY GUARANTEED VALVES BELOW MANUFACTURERS' PRICES

EXPRESS SERVICE ! ! !
C.O.D. ORDERS RECEIVED BY 3.30 P.M. EITHER BY LETTER, PHONE OR WIRE, DESPATCHED THE SAME AFTERNOON. ALL ORDERS RECEIVED BY FIRST POST DESPATCHED SAME DAY

FOR ONLY 6d. EXTRA PER ORDER WE WILL INSURE YOUR VALVES AGAINST DAMAGE IN TRANSIT. ALL UNINSURED PARCELS AT CUSTOMER'S RISK.

OZ4	6/-	6AQ5	7/6	6K8G	8/-	10P13	17/6	30P4	15/-	CK505	6/6	EC70	12/6	EY51		PABC80		UAF42	10/6
1A3	3/-	6AT6	8/6	6K8GT/G		11E3	15/-	30P12	13/6	CK506	6/6	ECC31	15/-	(Large)	12/6		15/-	UB41	12/7
1A5	6/-	6AU6	10/6		11/-	12A6	6/6	30P16	10/6	CK523	6/6	ECC32	10/6	EZ35	6/6	PCC84	8/-	UBC41	8/6
1A7	15/-	6B4G	6/6	6L6G	9/6	12AH7	8/-	31	7/6	CV63	10/6	ECC33	8/6	EZ40	8/-	PCC85	12/6	UBF80	9/6
1D6	10/6	6B7	10/6	6L7M	8/-	12AH8	10/6	33A/158M		CV85	12/6	ECC35	8/6	EZ41	10/6	PCF80	12/6	UBF89	10/6
1H5	11/-	6B8G	4/6	6LI8	13/-	12AT6	10/6		30/-	CV271	10/6	ECC40	15/-	EZ80	8/6	PCF82	12/6	UCC85	10/6
1L4	6/6	6B8M	5/-	6N7	8/-	12AT7	8/6	35/5!	12/6	CV428	30/-	ECC81	8/6	EZ81	10/-	PCL82	12/6	UCH42	10/-
1LD5	5/-	6BA6	7/6	6Q7G	8/6	12AU7	7/6	35A5	11/-	D1	3/-	ECC82	7/6	GZ30	10/6	PCL83	12/6	UCH81	11/6
1LN5	5/-	6BE6	7/6	6Q7GT	9/-	12AX7	9/-	35L6GT	10/-	D1	10/6	ECC83	9/-	GZ32	12/6	PEN40DD		UCL82	13/6
1N5	11/-	6BJ6	8/-	6R7G	8/6	12BA6	9/-	35W4	8/6	D42	5/-	ECC84	10/-	GZ34	14/-		25/-	UF41	9/-
1R5	8/6	6BR7	11/6	6SA7GT	8/6	12BE6	10/-	35Z3	10/6	D63	6/6	ECC85	9/6	H30	5/-	PEN45	19/6	UF80	10/6
1S5	8/-	6BW6	8/6	6SG7GT	7/6	12E1	30/-	35Z4GT	8/-	D77	6/6	ECC91	5/6	H63	12/6	PEN45	7/6	UF85	10/6
1T4	7/-	6BW7	9/-	6SH7	6/-	12J5GT	4/6	35Z5GT	9/-	DAC32	11/-	ECF80	12/6	HABC80		PL82	9/6	UF89	10/6
1U5	7/-	6BX6	8/6	6SJ7	8/-	12J7GT	10/6	41MTL	8/-	DAF91	8/-	ECF82	12/6		13/6	PL83	11/6	UL41	10/6
2A3	12/6	6C4	7/-	6SK7GT	6/-	12K7GT	7/6	50C5	12/6	DAF96	10/-	ECH35	9/6	HK90	10/-	PM2B	12/6	UL46	15/-
2A7	10/6	6C5	6/6	6SL7GT	8/-	12K8GT		150L6GT	9/6	DF33	11/-	ECH42	10/-	HL23	10/6	PM12	4/-	UL84	11/6
2C26	4/-	6C6	6/6	6SN7GT	7/6		14/-	61BT	15/-	DF91	7/-	ECH81	8/-	HL41	12/6	PM12M	6/6	UY41	8/6
2D13C	7/6	6C8	12/6	6SS7	7/6	12Q7GT	7/6	615PT	15/-	DF96	10/-	ECL80	8/6	HL133DD		PY80	9/-	UY85	10/6
2X2	4/6	6C9	12/6	6U4GT	14/-	12SA7	8/6	72	4/6	DH76	7/6	ECL82	13/6		12/6	PY81	9/-	V1507	5/-
3A4	7/-	6C10	12/6	6U5G	7/6	12SC7	7/6	77	8/-	DH77	8/6	EF36	6/-	HVR2	20/-	PY82	9/-	VL5492A	£3
3A5	12/6	6CH6	7/6	6U7	8/6	12SG7	7/6	78	8/6	DK32	15/-	EF37A	9/-	HVR2A	6/-	PY83	9/6	VMP4G	15/-
3B7	8/6	6D6	6/6	6V6G	7/-	12SH7	5/6	80	9/-	DK91	8/6	EF39	6/-	KL35	8/6	QP21	7/-	VP2(7)	12/6
3D6	5/-	6E5	12/6	6V6GT	8/-	12SJ7	8/-	93V	9/-	DK92	12/6	EF40	15/-	KT2	5/-	QP25	15/-	VP4(7)	15/-
3Q4	9/-	6F1	15/-	6X4	7/-	12SK7	6/-	85A2	15/-	DK96	10/-	EF41	9/6	KT33C	19/-	QS150/15		VP13C	7/-
3Q5GT	9/6	6F6G	7/-	6X5GT	6/6	12SQ7	8/6	150B2	15/-	DL2	15/-	EF42	12/6	KT44	7/-		10/6	VP41	7/6
3S4	8/-	6F6GT	8/-	6Z4/84	12/6	12SR7	8/6	807	7/6	DL33	9/6	EF50(A)	7/-	KT63	7/-	QVO4/7	15/-	VR150/30	
3V4	9/-	6F8	12/6	6Z5	12/6	12Y4	10/6	866A	13/6	DL92	8/-	EF50(E)	5/-	KTW61	6/6	R12	12/6		9/-
5U4	8/6	6F12	9/-	6/30L2	12/6	14R7	10/6	956	3/-	DL94	9/-	EF54	5/-	KTW62	8/-	SD6	12/7	VT61A	5/-
5V4	12/6	6F13	13/-	7A7	12/6	14S7	14/-	1203	7/-	DL96	10/-	EF73	10/6	KTW63	9/-	SP4(7)	15/-	VT501	5/-
5X4	10/-	6F16	9/6	7B7	8/-	19AQ5	11/-	4033L	12/6	DLS10	10/6	EF80	8/6	KTZ41	6/-	SP41	3/6	W76	7/6
5Y3G	8/-	6F17	12/6	7C5	8/-	19H1	10/-	5763	12/6	DM70	8/6	EF85	7/6	KTZ63	10/6	SP42	12/6	X61	12/6
5Y3GT	8/6	6F32	10/6	7C6	8/-	20D1	16/-	7193	5/-	EA50	2/-	EF86	14/6	L63	6/-	SP61	3/6	X65	12/6
5Y4	10/-	6F33	7/6	7H7	8/-	20L1	13/6	7475	7/6	EA76	9/6	EF89	10/-	LN152	10/-	TP22	15/-	X66	12/6
5Z3	12/6	6G6	6/6	7Q7	9/-	25L6GT	10/-	9002	5/6	EABC80	8/-	EF91	9/-	MH4	7/-	U16	12/-	X79	12/6
5Z4G	10/6	6H6GT/G		7S7	9/6	25Y5	10/6	9003	5/6	EAC91	7/6	EF92	6/6	MHL4	7/6	U22	8/-	XD(1.5)	6/6
6A8	10/-		3/-	7V7	8/6	25Y5G	9/6	9006	6/-	EAF42	10/6	EL32	5/6	MHLD6	12/6	U25	13/6	XFW10	6/6
6AB7	8/-	6H6M	3/6	7Y4	8/-	25Z4G	9/6	AC6PEN	7/6	EB34	2/6	EL41	11/-	ML4	12/6	U31	9/6	XFY12	6/6
6AB3	10/-	6J5G	5/-	8D2	3/6	25Z5	10/6	AC/HL/		EB41	8/6	EL42	11/-	ML6	6/6	U50	8/-	XH(1.5)	6/6
6AC7	6/6	6J5GTG	5/6	8D3	9/-	25Z6G	9/6	DDD	15/-	EB91	6/6	EL81	15/-	MU14	10/-	U52	8/6	XSG(1.5)	6/6
6AG5	6/6	6J5GTM	6/-	9D2	4/-	28D7	7/-	AC/P4	8/-	EBC33	7/6	EL81	10/6	OA10	12/6	U76	8/-	Y63	7/6
6AG7	12/6	6J6	5/6	10C1	15/-	30	7/6	AP4	7/6	EBC41	10/-	EL91	5/-	OA70	5/-	U78	7/-	Z63	10/6
6AJ8	8/-	6J7G	6/-	10F1	15/-	30C1	12/6	ATP4	4/-	EBF80	9/6	EM34	10/-	OA71	5/-	U251	15/-	Z66	20/-
6AK5	5/-	6J7GT	10/6	10F9	11/6	30F5	12/6	AZ31	12/6	EBF89	9/6	EM80	10/6	OC72	30/-	U404	10/6	Z77	9/-
6AL5	6/6	6K7G	5/-	10F18	12/6	30FL1	12/6	B329	7/6	EC52	5/6	EY51		UABC80				Z719	12/6
6AM6	9/-	6K7GT	6/-	10LD3	8/6	30L1	12/6	BL63	7/6	EC54	6/-	(Small)	12/6	P61	3/6		10/6	Z729	14/6

TERMS OF BUSINESS :—CASH WITH ORDER OR C.O.D. ONLY. ORDERS VALUE £3 OR MORE SENT POST/PACKING FREE. ORDERS BELOW £3 PLEASE ADD 6d. PER VALVE C.O.D. ORDERS :—MINIMUM FEE, INCLUDING POST AND PACKING, 3/-. WE ARE OPEN FOR PERSONAL SHOPPERS. MON.-FRI. 8.30-5.30. SATS. 8.30-1 p.m.

ALL VALVES NEW, BOXED, TAX PAID, AND SUBJECT TO MAKERS' GUARANTEE. FIRST GRADE GOODS ONLY, NO SECONDS OR REJECTS. GOODS ARE ONLY SOLD SUBJECT TO OUR TERMS OF BUSINESS, OBTAINABLE FREE ON REQUEST. CATALOGUE OF OVER 1,000 DIFFERENT VALVES 3d.

We specialise in VALVES—of every kind and description—serving the industry for years. More than 2,000 different types in stock for IMMEDIATE DELIVERY—including hard-to-get and discontinued numbers. All valves exhaustively tested in our fully equipped laboratories, and re-tested at time of despatch. FULL NINETY DAY GUARANTEE. All valves individually boxed.

BENTLEY ACOUSTIC CORPORATION LTD.

THE VALVE SPECIALISTS

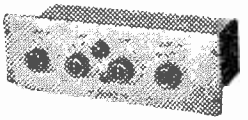
38 CHALCOT ROAD, LONDON, N.W.1

PRImrose 9090

PLEASE ENQUIRE FOR ANY VALVE NOT LISTED. 3d. STAMP. PLEASE.

COMPLETE KITS of PARTS for the "Hi-Fi" ENTHUSIAST

STERN'S REMOTE CONTROL UNIT

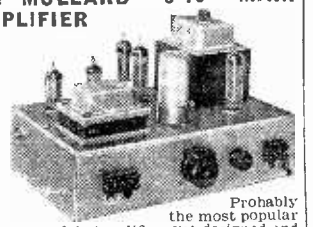


Designed in particular for use with the MULLARD 5-10 Main Amplifier

Ideally suited for simple domestic installation as an alternative to the more elaborate Pre-amplifier (shown and described opposite). Tone Control facilities are really excellent and in conjunction with the "5-10" Main Amplifier reproduction is of very high quality. Perfectly suitable for use with all the popular Record Players (B.S.R., Collaro, Garrard) and the modern Radio Tuner Units. Front Panel contains: (a) Coloured Indicator, (b) Separate BASS and TREBLE CONTROLS, (c) 3 position Selector Switch, (d) Volume control. Inputs on back for Radio and Gram. and Gram equalising is incorporated.

FULL DATA is contained in the 5/6 MAIN AMPLIFIER MANUAL at **1/6.**

The MULLARD "5-10" MAIN AMPLIFIER



Probably the most popular and successful Amplifier yet designed and certainly needs no recommendation from us. Our kit is complete to MULLARDS specification including the latest ULTRA LINEAR OUTPUT TRANSFORMER and the recommended Mullard Valve line-up.

PRICE OF COMPLETE KIT OF PARTS (Plus 5/- carr. & Ins.) **£9.10.0**

or alternatively we supply — FULLY ASSEMBLED and TESTED for **£11.10.0** (Plus 5/- carr. & ins.).

The ASSEMBLY MANUAL containing FULL SPECIFICATION is available for **1/6.**

We also offer the "5-10" incorporating the latest PARTRIDGE ULTRA LINEAR OUTPUT TRANSFORMER for an extra ..... **£1.6.0.**

STERN'S "fidelity" PRE-AMPLIFIER TONE CONTROL UNIT

"A design for the Music Lover"

This unit can be used with any Main Amplifier. Briefly it has inputs for all types of MICROPHONES, HIGH and LOW GAIN PICK-UPS and a RADIO TUNING UNIT. It incorporates (a) GRAM EQUALISING CONTROL. (b) STEEPCUT FILTER. (c) Continuously variable BASS and TREBLE CONTROLS, a variable OUTPUT CONTROL which enables its use with any type of Amplifier, and Jack Sockets on Front Panel for TAPE RECORD and TAPE PLAYBACK.

Used with the "5-10" the reproduction is comparable to that normally associated only with the very expensive commercially made High Fidelity Amplifiers. PRICE OF COMPLETE KIT OF PARTS **£6.6.0**

WE ALSO OFFER IT ASSEMBLED READY FOR USE, **£8** (plus 5/- carr. & ins.).

The ASSEMBLY MANUAL contains full specification and is available for **1/6.**

BRITAIN'S FINEST "Hi-Fi" AMPLIFIER

THE GENUINE WILLIAMSON

STILL SETS THE STANDARD FOR ALL AMPLIFIERS

Many versions of the Williamson have been offered to the public at various low prices, but the "only Williamson" is the Amplifier built to the designer's specification and employing only the very high grade Components, i.e., PARTRIDGE TRANSFORMERS, CHOKES, etc., that he specifies. It is only in doing this that the exceptionally high standard that has made this Amplifier so famous, particularly in America, is obtained . . . WE HAVE DONE THIS ! ! . . . and we offer these KITS OF PARTS including Partridge and other high grade Components as follows :

(a) To build the MAIN AMPLIFIER ONLY (Illustrated above), **£14.10.0**

(b) To build the TWIN POWER SUPPLY UNIT ONLY (insufficient space to illustrate this). **£13.10.0**

(c) COMPLETE KIT to build both above. **£27.0.0**

We will also supply both **COMPLETELY ASSEMBLED** and will be pleased to quote. Credit and H.P. Terms are available. The complete SPECIFICATION and general ASSEMBLY INSTRUCTIONS are available for **3/6.**

Our "fidelity" PREAMPLIFIER illustrated and described above (or alternatively the R.C.A. Pre-amplifier at **£16.5.0**) is recommended for use with the Williamson.

SPECIAL PRICE REDUCTIONS . . . WE OFFER YOU . . .

Prices are subject to **£1.6.0.** extra if PARTRIDGE TRANSFORMER is preferred.

(a) **The COMPLETE KIT of PARTS** to build both the **MULLARD 5-10** and the **REMOTE CONTROL UNIT** for..... **£11.11.0**

CREDIT SALE TERMS, £3.10.0 Deposit and 9 monthly payments of £1.5.8. H.P.

(b) **The COMPLETE KIT of PARTS** to build both the **MULLARD 5-10** and the "Fidelity" **PRE-AMPLIFIER TONE CONTROL UNIT** for..... **£15.15.0**

TERMS, £7 Deposit and 9 monthly payments of 17/9.

ALTERNATIVELY WE WILL SUPPLY ASSEMBLED and FULLY TESTED, as follows—

(a) **The MULLARD 5-10** and the **REMOTE CONTROL UNIT** for..... **£14.0.0**

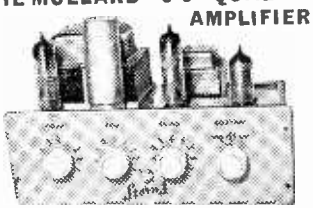
CREDIT SALE TERMS, £3.10.0 Deposit and 9 monthly payments of £1.5.8. H.P.

(b) **The MULLARD 5-10** and the "Fidelity" **PRE-AMPLIFIER-TONE CONTROL UNIT** for..... **£18.18.0**

CREDIT SALE TERMS, £4.15.0 Deposit and 9 monthly payments of £1.14.7. H.P. TERMS, £9.9.0 Deposit and 12 monthly payments of 17/6.

WHEN ORDERING PLEASE INCLUDE 7/6 to cover cost of Carriage and Insurance.

THE MULLARD "3-3" QUALITY AMPLIFIER



A small compact Amplifier capable of HIGH QUALITY REPRODUCTION on both RADIO and GRAM.

PRICE FOR COMPLETE KIT OF PARTS, £6.19.6 (plus 6/6 carr. & ins.)

Alternatively supplied ASSEMBLED and READY FOR USE **£8.12.6** (plus 6/6 carr. & ins.).

The Complete SPECIFICATION and ASSEMBLY DIAGRAMS are available for **1/6.**

Developed from the very popular 3 valve 3 watt Amplifier designed in the MULLARD LABORATORIES. We strictly adhere to the specification list : in addition we have added switched equalising for L.P. and 78 Records and a position for Radio Inputs, plus additional power to feed a Radio Tuning Unit. Extremely simple to assemble and ideally suitable to incorporate with an F.M. Tuner or Record Player in a small installation.

STERN'S "HIGH QUALITY" 8-10 WATT AMPLIFIER

Has power supply for Radio Tuning Unit

PRICE OF COMPLETE KIT OF PARTS (Plus 5/- carr. & ins.) **£7.10.0**

SUPPLIED ASSEMBLED and READY FOR USE **£9.10.0**

Proved one of the most popular models yet offered to the HOME CONSTRUCTOR. Provides excellent reproduction up to 8 watts, employing 6V6's in push-pull, incorporating negative feedback. Provides for use of both 3 and 15 ohm speakers.

SPECIAL CASH ONLY OFFER !!

This very attractive **PORTABLE AMPLIFIER CASE** together with a good quality **GRAM AMPLIFIER** and a matched 6½ in. **P. M. SPEAKER**, ALL FOR ONLY **£8.7.6** (plus 7/6 carr. & ins.).

The Amplifier consists of a 2 Stage design incorporating the modern B.V.A. valves types ECC83, EL84 plus RZ90 Rectifier and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger, and is attractively finished in Maroon and Grey colour Rexine.

WE ALSO SUPPLY SEPARATELY—

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

(b) The **PORTABLE CARRYING CASE** £3.17.6

(c) **6½in. P.M SPEAKER** 16/9

Carriage and insurance, 4/- extra.

We also have a smaller **PORTABLE CASE Ideal for Record Players.** PRICE ONLY £3.3.0 (plus 3/- carr. & ins.).

CALLERS ONLY

We have in stock various designs for HOME CONSTRUCTORS including F.M. Tuners, A.M./F.M. Tuners, Midget Battery Portable, Mains Units, etc., etc.

(Dept. P.W.)

109 & 115 FLEET ST., LONDON, E.C.4.

Telephone: FLEet 5812 3 4.

R.S.C. BATTERY CHARGING EQUIPMENT

All for A.C. Mains 200-250 v., 50 c/cs. Guaranteed 12 months.

ASSEMBLED CHARGERS

6 v. 1 amp..... 19/9
6 v. or 12 v. 1 amp..... 27/9
6 v. 2 amps..... 29/9
6 v. or 12 v. 2 amps..... 38/9
6 v. or 12 v. 4 amps..... 59/9
Above ready for use. Carr. 3/6. With mains and output leads.

SELENIUM RECTIFIERS F.W. BRIDGE TYPES

6/12 v. 1 a. 4/11	L.T. Types H.W.
6/12 v. 2 a. 8/9	2-6 v. 1 a.. 1/11
6/12 v. 3 a. 11/9	6-12 v. 1 a, H.W..2/6
6/12 v. 4 a. 14/9	H.T. Types H.W.
6/12 v. 6 a. 19/9	150 v. 40 mA. 3/9
6/12 v. 10 a. 25/9	250 v. 50 mA. 5/9
6/12 v. 15 a. 35/9	250 v. 80 mA. 7/8
	250 v. 250 mA. 11/8

BATTERY CHARGER KITS

Consisting of Mains Transformer. F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, Fuse-holders. Grommets, panels and circuit. Carr. 2/9 extra.

6 v. or 12 v. 1 amp..... 22/9
6 v. 2 amps..... 25/9
6 v. or 12 v. 2 amps..... 31/6
6 v. or 12 v. 4 amps..... 53/9

BATTERY CHARGER KIT

Consisting of F.W. Bridge Rectifier, 6/12 v. 5 a. Mains Trans., 0-9-15 v. 6 a. output and Ammeter, 49/9. Post 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 **47/9** Carr. 3/9.

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 finish. **75/-** Fused and ready for use with mains and output leads. Carr. 3/9.

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

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

TOP SHROUDED DROP THROUGH

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

FULLY SHROUDED UPRIGHT

250-0-250 v. 60 mA. 6.3 v. 2 a. 5 v. 2 a. Midget type 2½-3-3in. 17/6
250-0-250 v. 100 mA. 6.3 v. 4 a. 5 v. 3 a. 26/9
250-0-250 v. 100 mA. 6.3 v. 6 a. 5 v. 3 a. for R1355 conversion 31/-
300-0-300 v. 100 mA. 6.3 v. 4 a. 5 v. 3 a. 26/9
350-0-350 v. 100 mA. 6.3 v. 4 a. 5 v. 3 a. 29/9
300-0-300 v. 130 mA. 6.3 v. 4 a. 6.3 v. 1 a. for Mullard 510 Amplifier 35/9
350-0-350 v. 150 mA. 6.3 v. 4 a. 5 v. 3 a. 33/9
350-0-350 v. 150 mA. 6.3 v. 2 a. 6.3 v. 2 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. Suitable Williamson Amplifier, etc.... ... 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. 3 a. or 24 v. 1.5 a. 17/6.

JUNCTION TRANSISTORS. Red Spot Audio Type only 7/6 each. R.F. Type 17/6.

VOLUME CONTROLS with long (1in. diam.) spindle all values less switch, 2/9; with S.P. switch, 3/9; with D.P. switch, 4/6.

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

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

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a. 11/9; 0-9-15 v. 3 a. 16/9; 0-3-5-9-17 v. 3 a. 17/9; 0-9-15 v. 5 a. 19/9; 0-9-15 v. 6 a. 23/9.

SMOOTHING CHOKES

250 mA, 5 H 100 ohms 12/9
150 mA, 7-10 H 250 ohms... ... ... 11/9
100 mA, 100 H 200 ohms... ... ... 8/9
80 mA, 10 H 350 ohms 5/9
60 mA, 10 H 400 ohms 4/11

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.... ... ... 3/9
Small Pentode, 5,000Ω to 3Ω... ... 3/9
Small Pentode 7/8,000Ω to 3Ω ... 3/9
Standard Pentode 5,000Ω to 3Ω ... 4/9
Standard Pentode, 7/8,000Ω to 3Ω... 4/9
10,000 Ω to 3Ω 4/9
Push-Pull 10-12 watts 6V6 to 3Ω or 15Ω 15/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω 16/9
Push-Pull EL84 to 3 or 15Ω 16/3
Push-Pull 15-18 watts, 6L6, KT66 ... 22/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 or 15Ω 47/9

MAINS TRANSFORMERS

Manufacturers' surplus. Primaries 200-250 v. 50 c/s. 250-0-250 v. 70 mA, 6.3 v. 2.5 a. Drop through type, 11/9. 375-0-375 v. 150 mA, 6.3 v. 4 a, C.T. 6.3 v. 1 a. Fully shrouded, 22/9. Postage 2/9 on either type.

SPECIAL OFFERS: Electrolytics. 32-32-32 mfd. 250 v. Dubilier small can, 2/9 ea. 150 mfd. 450 v., 3/9. Small .0005 mfd. 2-gang, 4/9 ea. Westinghouse Rectifiers, 250 v. 250 mA, 7/9. **CO-AXIAL CABLE.** 75 ohm. 1in. 8d. yd. Twin-Screened Feeder 11d. yd.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagrams, 39/9, or ready to use, 46/9.

Type BM2. Size 8 x 5½ x 2½in. Supplies 120 v. 90 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed. **Thereby completely replacing both H.T. batteries and L.T. 2 v. accumulators.** When connected to A.C. mains supply 200-250 v. 50 c/s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit of parts with diagrams and instructions, 49/9, or ready for use, 59/6.

MINIATURE MOTORS. 2½ 2⅜ v. D.C. or A.C. made by Hoover Ltd., Canada. Size only 2¼ x 1¼in. Spindle 1¼in. long, ⅛in. diam. Brand New, 9/9.

HEADPHONES. Brand new. Low resistance, 7/9 pr. High Resistance, 15/9 pr.

EX-GOVT. 50 WATT SPEECH AMPLIFIERS. For normal 200-250 v. A.C. mains. Complete with hand 'mike' with good length of lead and all valves. Ready for use, in wood transit cases. Only 9 Gns., carr. 15/-.

TANNOY RE-ENTRANT 8 WATT SPEAKERS. For use with above. 27/6 ea.

EXTENSION SPEAKERS

Ready for use in walnut veneered cabinet.

8in. 2-3 ohms, 35/9. Very limited number.

EX-GOVT. METAL BLOCK (PAPER) CONDENSERS.

4 mfd. 350 v., 2/9; 4 mfd. 1,000 v., 4/9; 8 mfd. 500 v., 4/9; 10 mfd. 500 v., 3/9;

EX-GOVT. SMOOTHING CHOKES

300 mA. 20 H 200 ohms 19/9
250 mA, 5 H 50 ohms 12/9
150 mA, 10 H 100 ohms 11/9
150 mA, 6-10 H 150 ohms Trop. ... 6/9
120 mA, 12 H 100 ohms 9/9
100 mA, 5 H 100 ohms 3/11
80 mA, 10 H 150 ohms 3/11

EX-GOVT. E.H.T. SMOOTHING CONDENSERS, .02 mfd. 5,000 v. Cans, 2/9; .1 mfd. 2,500 v. Bakelite Tubulars, 3/3.

THE SKYFOUR T.R.F. RECEIVER. A design of a 3-valve Long and Medium wave 230-250 v. A.C. Mains receiver with selenium rectifier. It consists of a variable-Mu high-gain H.F. stage followed by a low distortion anode-bend detector. Power pentode output is used. Valve line-up being 6K7, SP61, 6V6G. Selectivity and quality are well up to standard, and simplicity of construction is a special feature. Point-to-point wiring diagrams, instructions and parts lists, 1/9. This receiver can be built for a maximum of £4/19/6, including attractive Brown or Cream Bakelite or Walnut veneered wood cabinet 12 x 6½ x 5¼in.

EX-GOVT. DOUBLE WOUND STEP UP/STEP DOWN TRANSFORMERS. 10-0-100-200-220-240 v. to 5-0-75-115-135 v. or REVERSE. 80-100 watts. Only 11/9, plus 2/9 post. 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or REVERSE. 200 watts, 35/9, plus 7/6 carr. Both 50 c.p.s.

EX-GOVT. MAINS TRANSFORMER. Primary 0-110-120-200-210-220-230-240-250 v. 50 c.p.s. Secs. 275-0-275 v. 100 mA. 6.3 v., 7 a, 5 v. 3 a, Govt. rating, 18/9. Following with 230-250 v. primaries, 400-0-400 v. 200 mA, 5 v. 3 a, 5 v. 2 a, 19/9; 230-0-230 v. 100 mA. 12.6 v. 1.5 a, 5 v. 2 a, 11/9; 12.6 v. 3 a, 5 v. 3 a, 9/9. Postage 2/9 on any type.

EX-GOVT. CASES. Size 14-10-8½in. high. Well ventilated, black crackle finished, undrilled cover. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE. OR COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 postage. Size 8½ x 13½ x 6½ ins. with undrilled well ventilated cover, finished in stoved grey enamel. Suitable for charger or instrument case, 7/9, plus 2/9 post.

EX-GOVT. VALVES (NEW)

1T4	7/9	6V6G	7/9	EB91	4/9
1S5	7/9	6X4	6/9	EF91	8/9
3S4	8/9	6X5GT	8/9	EF36	4/9
5Y3G	8/9	6L6G	11/9	EL32	3/9
5U4G	8/9	807	7/9	EL91	5/9
5Z4G	9/9	12A6	7/9	KT44	8/9
6K7G	5/9	15D2	4/9	EZ90	6/9
6SJ7GT	6/9	35Z4GT	9/9	EL84	10/6
6SLGT	8/9	MH4	4/9		
6SN7GT	8/9	ECC83	9/9	FW4 500	9/9
6AT6	7/9	ECC91	4/9	SP61	2/9
6J6	4/9	EF80	7/9	35Z4	8/9

ELECTROLYTICS (current production) NOT EX-GOVT.

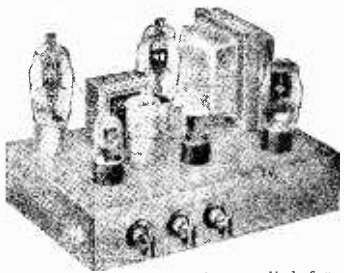
Tubular Types	Can Types
8µF 450 v. ... 1/9	16 mfd. 350 v. 1/11
8 mfd. 500 v. 2/6	16 mfd. 500 v. 2/9
16µF 350 v. ... 2/3	16µF 450 v. ... 2/9
16µF 450 v. ... 2/9	32µF 350 v. ... 2/11
16µF 500 v. ... 3/9	32 mfd. 450 v. 4/9
32µF 350 v. ... 3/9	100 mfd. 450 v. 4/9
25µF 25 v. ... 1/3	8-8µF 450 v.... 2/9
50µF 12 v. ... 1/3	8-16µF 450 v. 3/11
50 mfd. 25 v. ... 1/6	16-16µF 450 v. 4/11
50µF 50 v. ... 1/9	32-32µF 350 v. 4/9
100 mfd. 12 v. 1/9	32-32µF 450 v. 5/9
100 mfd. 25 v. 2/3	100-100 mfd. 350v. 4/9
1,500 mfd. 6 v. 1/6	64-120 mfd. 350v. 7/9
3,000 mfd. 6 v. 3/9	100-200 mfd.
6,000 mfd. 6 v. 3/9	275 v. ... 6/9

Many others in stock.

R.S.C. A8 ULTRA LINEAR 12 WATT AMPLIFIER

High-Fidelity Push-Pull Amplifier with "Built-in" Tone Control. Pre-amp stages, High sensitivity. Includes 5 valves (807 outputs). 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 3db., 30-30,000 c.p.s. Six negative feedback loops. Hum level 71 db. down. ONLY 70 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and practically all 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. 20 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c.p.s. Outputs for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unapproachable value at **£7 15 -** or factory built **45 -** extra. Carriage 10 -.

£7-15-0



If required louvred metal cover with 2 carrying handles can be supplied for **18/9.** Additional input socket with associate Vol. control so that two different inputs such as Gram and "Mike" or Tape and Radio can be mixed, can be provided for **13 -** extra. Guaranteed 12 months.

TERMS on assembled two input model: **DEPOSIT 25/6** and nine monthly payments **23/4.**

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

R.S.C. 30 WATT ULTRA LINEAR HIGH-FIDELITY AMPLIFIER A10

A highly sensitive Push-Pull high output unit with self-contained Pre-amp. Tone Control Stages. Certified performance figures compare equally with most expensive amplifiers available. Hum level 70 db. down. Frequency response – 3 db. 30-30,000 c.p.s. A specially designed sectionally wound ultra linear output transformer is used with 807 output valves. All components are chosen for reliability. Six valves are used, EF86, EF86, ECC83, 807, 807, GZ33. Separate Bass and Treble Controls are provided. Minimum input required for full output is only 12 millivolts so that **ANY KIND OF MICROPHONE OR PICK-UP IS SUITABLE.** The unit is designed for **CLUBS, SCHOOLS, THEATRES, DANCE HALLS or OUTDOOR FUNCTIONS,** etc. For use with Electronic **ORGAN, GUITAR, STRING BASS,** etc. For standard or long-playing records. **OUTPUT SOCKET PROVIDES** L.T. and H.T. for a **RADIO FEEDER UNIT.** An extra input with associated vol. control is provided so that two separate inputs such as Gram and "Mike" can be mixed. Amplifier operates on 200-250 v. 50 c.p.s. A.C. Mains and has outputs for 3 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and instructions. If required cover as for A8 can be supplied for **18/9.** The amplifier can be supplied, factory built with 12 months' guarantee, for **£12 19/6. TERMS: DEPOSIT 35/9** and 9 monthly payments of **28/11.**

ONLY 10 GNS. Carr. 10/-

COLLARO RC54 3-SPEED AUTO-CHANGERS with Studio Pick-up. Brand new. For 110 v. 50 c.p.s. A.C. mains. Price with 110 v. to 200-250 v. Auto Trans. only **7 Gns.** Carr. 5/6.

COLLARO RC457 4-SPEED AUTO-CHANGERS with high fidelity Studio Pick-up. Latest model. Brand new, Cartoned. For 200-250 v. 50 c.p.s. A.C. mains. Our price **£8.19.6.** Carr. 5/6. Credit Terms. Deposit **3 gns.** and 6 monthly payments of **21/6.**

COLLARO JUNIOR 4 SPEED SINGLE PLAYER, with separate pick-up, as fitted RC457. For 200-250 v. A.C. mains. **£4.17.6.**

1.63 MINIATURE 2-3 WATT GRAM AMPLIFIER. For use with above or any other single or auto-change units. Output for 2-3 ohm speaker. For 200-250 v. 50 c.p.s. A.C. mains. Overall size 6½ x 4½ x 2½in. Controls: Vol. and Tone with switch. Guaranteed 12 months. Only **49/9.**

PORTABLE CABINETS. Exceptionally attractive appearance. Takes above amplifier and 3 or 4 speed auto-changer or single player. **53/6.** Carr. 4/6.

SUPERHET FEEDER UNIT. Design of a high quality Radio Tuner Unit specially suitable for use with any of our Amplifiers). Delayed A.V.C. employed. The W.Ch. Sw. incorporates Gram position. Controls are Tuning, W.Ch. and Vol. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Simple alignment procedure. Point-to-point wiring diagrams, instruction and priced parts list with illustration, **2/6.** Total building cost, **£4 15 -.** For descriptive leaflet send S.A.E.

LINEAR 1.45 MINIATURE 4-5 WATT QUALITY AMPLIFIER. Suitable for use with Collaro, B.S.R. or any other record-playing unit, and most microphones. Negative feed-back 12 db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2-3 ohm speaker. Three miniature Mullard valves used. Size of unit only 6-5-5½in. high. Output for 2-3 ohm speaker. Guaranteed for 12 months. Only **£5 19 6.** Send S.A.E. for illustrated leaflet. Credit Terms. Deposit **22/6** and 5 monthly payments of **22/6.**

LINEAR "DIATONIC" 10-14 WATT HIGH FIDELITY PUSH-PULL ULTRA LINEAR AMPLIFIER. For 200-230-250 v. 50 c.p.s. A.C. mains. Valve line-up ECC83, ECC83, EL84, EL84, EZ81 miniature Mullard. The unit has self-contained Pre-amplifier Tone Control stages and separate Bass and Treble Controls, independent "Mike" and Gram. input sockets are provided. Size is only 9-7-6in. Output Matchings for 3 and 15 ohm speakers. Only **12 GNS.** or Deposit **26/9** plus 10 - carr. and 9 monthly payments of **26/9.** Send S.A.E. for leaflet.

R.S.C. 4-5 WATT AS HIGH-GAIN AMPLIFIER

A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all "mikes". Separate Bass and Treble Controls are provided. These give full long-playing record equalisation. Hum level is negligible being 71 db. down. 15 db. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c.p.s. Output for 2-3 ohms speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with Blue hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only £4.15 -, or assembled ready for use 25 - extra, plus 3/6 carr.; or Deposit 22/6 and 5 monthly payments of 22/6 for assembled unit.

B.S.C. TA1 HIGH QUALITY TAPE DECK AMPLIFIER. For Tape Decks with High or Low Impedance, Playback and Erase Heads, such as Lane, Truvox, Aspden, Collaro, Brennell, etc. For A.C. Mains 230-250 v. 50 c.p.s. Positive compensated identification for recording level by Magic Eye. Recording facilities for 15, 7½ or 3¾ in. per sec. Automatic equalisation at the turn of a Knob. **Linear frequency response of** +3 db., 50-11,000 c.p.s. Negative feed-back equalisation. Minimum microphony and hum. High output with completely effective erasure and distortionless reproduction. Sensitivity is 15 millivolts so that any kind of crystal microphone is suitable. Only 2 millivolts output required from Recording head. Provision is made for feeding a P.A. amplifier. Illustrated leaflet 6d. Special price can be quoted for Amplifier and a Deck. When ordering please state make of Deck to be used.

Ready for Use, ONLY 11 GNS. Carr. 7/6.

R.C.A. 20 WATT RE-ENTRANT SPEAKERS, 15 ohms or 600 ohms matching. For Outdoor work. Only **8 GNS. P.M. SPEAKERS.** All 2-3 ohms, suitable for use with LG3, L45, A5, or A7 amplifiers, 5in. Goodmans, **17/9.** 7 x 4in. Elliptical Elac., **19/9.** 6½in. Goodmans, **17/9.** 8 in. Rola, **19/9.** 10in. Goodmans, **27/9.** 10 x 6in. Elliptical Goodmans, **27/9.** 12in. Plessey, **29/11.** 10in. W.B. "Stentorian" 3 or 15 ohms type HF1012 10 watts, hi-fidelity type. Recommended for use with our A8 Amplifier. **£4/10/9.** 12in. Plessey 3 ohms 10 watts. (12,000 lines), **59/6.**

PLESSEY DUAL CONCENTRIC 12in. 15 ohm HIGH FIDELITY SPEAKER with built-in tweeter (completely separate elliptical speaker with choke, condensers, etc.), providing extraordinarily realistic reproduction when used with our A8 or similar amplifier. Rated 10 watts. Price complete, only **£5/17/6.**

M.E. SPEAKERS 2-3 ohms, 8in. R.A. Field, 600 ohms **11/9.**

R.S.C. 3-4 WATT A7 HIGH-GAIN AMPLIFIER

For 230-250 v. 50 c.p.s. Mains input. Appearance and Specification, with exception of output wattage, as A5. Complete Kit with diagrams, £3 15 -. Assembled 32/6 extra. Carr. 3/6.

AM/FM RADIOGRAM CHASSIS

HIGH QUALITY 6-8 WATT PUSH-PULL OUTPUT

For 200-250 v. Mains, Long wave, Medium, F.M. and Gram. Complete with 8 B.V.A. valves. Guaranteed 12 months. Only **22 GNS.** Or Deposit **£2 12 -** and 9 monthly payments of £2 12 -.

Terms: C.W.O. or C.O.D. NO C.O.D. under £1. Post 1/9 extra under £2; 2/9 extra under £5. All goods supplied subject to terms and guarantee as detailed in current catalogue.
Open 9 to 5.30; Sats. until 1 p.m. Catalogue 6d. Trade list 5d. S.A.E. with all enquiries

RADIO SUPPLY CO. (LEEDS) LTD. 32, THE CALLS, LEEDS, 2

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXIII, No. 613, JANUARY 1958

EDITOR : F. J. CAMM

25th YEAR OF ISSUE

COMMENTS OF THE MONTH

BY THE EDITOR

"What Shall We Do With The BBC?"

THE Publicity Department of Transport House recently issued a statement to the Press under the above heading, which is presumably to be interpreted as "what *we* shall do with the BBC"! Mr. Anthony Wedgwood Benn, M.P., thinks that radio and television services should be run by four public corporations, and if this new set-up is to succeed every one of these four corporations must receive a share of the licence fee.

He further suggests that these four public corporations should be (1) the BBC, which will broadcast two basic national programmes in sound only, rather like the Home Service and the Third Programme, plus all overseas broadcasting as at present. (2) The "Independent Broadcasting Authority" (IBA), which would take over the Light Programme as a second competitive national programme. "It would also be responsible for a technical co-operation with the regions," he says. (3) BBC television would be hived off as the "British Television Corporation" (BTC). "This would broadcast one or more national programmes. . . ." (4) The existing Independent Television Authority would be strengthened and given the right to produce its own programmes. Mr. Benn further suggests that school broadcasting ought certainly to be borne on the Ministry of Education vote and that overseas broadcasting should be paid for by the Foreign Office. Thus, we should have the BBC, ITV, IBA, BTC. The BBC is certainly not short of critics and one would have thought that it could have rectified those things in need of improvement within its own organisation, without the aid of members of parliament whose minds should be occupied with more important subjects, and there are plenty of them! The internecine conflict and sniping which would go on if four bodies controlled broadcasting and television can easily be imagined. One can, of course, see the political drift of Benn's remarks. We think that sound and vision programmes should be independent of any political influence whatsoever. Only chaos can follow if each party had its own ideas as to how these services should be run. There would be no stability about the programmes, for each party would repeal its predecessor's efforts. Mr. Benn is one of those political schemer-dreamers whose ideas are nearly always wide of the beam.

"PRACTICAL HOME MONEY MAKER"

OUR new companion monthly magazine, *Practical Home Money Maker*, was an immediate success and a very large print order for the first issue was rapidly absorbed by the public. It is evident from correspondence that a journal to co-ordinate the spare-time activities of the nation and of the industry which supports them was needed. The journal appeals to women as well as to men, to young as well as to old. In fact, to all those who have time on their hands which they wish to employ and enjoy profitably. It costs 1s. 3d. every month.—F. J. C.

Our next issue, dated February, will be published on January 7th.

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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, Strand, W.C.2. Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.*

Round the World of Wireless

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of September, 1957, 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	1,129,016
Home Counties	1,142,275
Midland	860,937
North Eastern	1,129,324
North Western	831,362
South Western	716,729
Wales and Border Counties ...	452,965
Total England and Wales ...	6,262,608
Scotland	816,714
Northern Ireland	189,934
Grand Total	7,269,256

B.I.C.C. Unit Radio Masts in the Far North

THE Norwegian Telegraph Service Radio Station at Isfjord, on the coast of West Spitzbergen, Svalbard, is the most northerly coast service station in the world. It is well within the Arctic Circle, having a latitude of 78° 3′ 45″ North.

Four B.I.C.C. unit radio masts, each 120ft. high, support the station's aerial. These galvanised steel masts, designed and supplied by British Insulated Callender's Construction Co. Ltd., and fabricated by their associated company, Painter Bros. Ltd., are of triangular formation with tubular corner members and welded rod bracings. Built to an extremely economical design, these masts are much in demand wherever inexpensive, light, transportable, easily erected aerial structures are required, and are at present in use in more than 25 different countries.

Ideal Home Exhibition

THE Daily Mail Ideal Home Exhibition of 1958 will be held at Olympia from March 4 to March 29.

The Exhibition was founded in 1908, so next March is its Golden Jubilee.

Radio Show, 1958

THE Radio Industry Council announces that the 25th National Radio and Television Exhibition will be held at Earls Court, London, from Wednesday, August 27th, to Saturday, September 6th, with a pre-view on Tuesday, August 26th.

New British Standard

A NEW standard on improved testing techniques and a re-grouping of "types" are the main features in this revision of the standard for ebonite which was first published 15 years ago.

B.S. 234 deals with ebonite in the form of sheets, rods, tubes and mouldings suitable for electrical purposes and composed substantially of good quality natural rubber and sulphur, with or without the addition of suitable compounding ingredients.

The more significant alterations to the 1942 edition are that the ebonite is now classified in three types, grouped according to their chemical loading.

TV and Radio Sales

RETAIL sales of radio receivers, radiograms and television receivers all showed substantial increases during the first nine months of the year, as compared with the same period last year, according to the monthly retail survey published recently by the British Radio Equipment Manufacturers' Association.

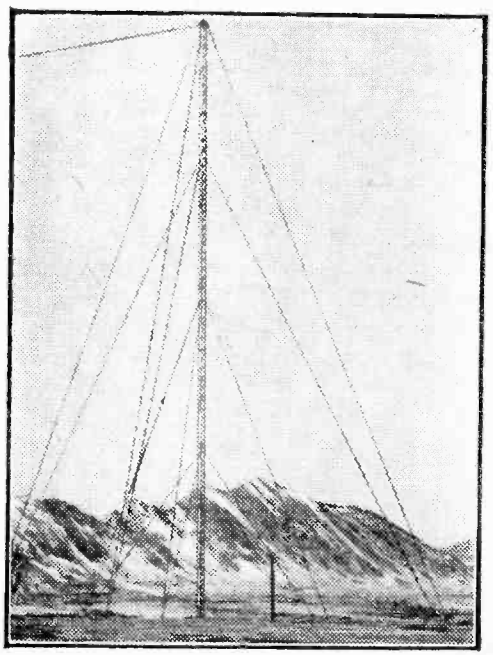
Television receiver sales were greater by 10 per cent., radiogram sales by 30 per cent. and radio receiver sales by 22 per cent.

The sales of radiograms, 21,000, were 24 per cent. above those of both the previous month and of September, 1956. In the third quarter the sales were 19 per cent. higher than those in the third quarter of 1956.

For radio receivers, the sales in September at 105,000 were four per cent. below those of August, but 22 per cent. above those of September, 1956. In the third quarter sales were 27 per cent above those in the same quarter of 1956.

The Radio Trades Examination Board

THE Radio Trades Examination Board has been



One of the B.I.C.C. masts referred to in the first column.

granted a licence by the London County Council for the operation of an Appointments Service.

This service, which will be free to employers and employees, will be limited to holders of the Board's Radio or Television Servicing Certificate.

Over 2,500 candidates have now passed the Board's examinations and employers in industry and trade have shown interest in wishing to interview these candidates.

Further information regarding the Appointments Service may be obtained from: The Secretary, The Radio Trades Examination Board, 9, Bedford Square, London, W.C.1.

Less Electricity in the Air

ACCORDING to a director of the Magnetic Observatory on Manhay, at the University of Liege, in Belgium, the air one meter above the ground has been found to have a potential of 15 volts, whereas in the past it had a potential of 100 volts relative to ground. This points to an increase in ionization which could lead to a new kind of radio blackout. It could also result in a reduction of the discharges during a thunderstorm and lightning terrors would tend to disappear. There is some doubt as to whether this change is natural or the result of the injection of radioactive material into the atmosphere.

£75,000 Export Order

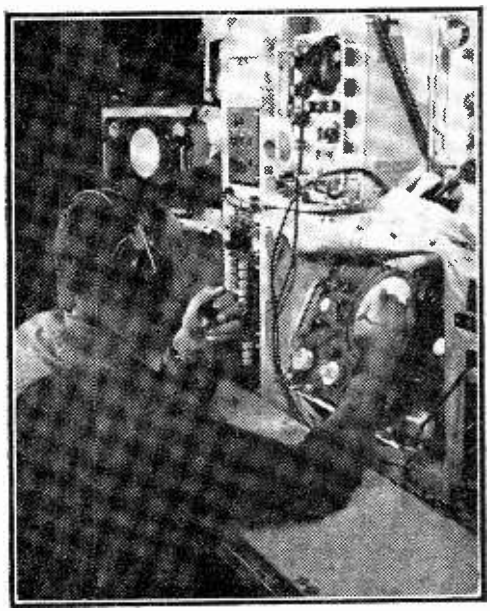
THE Selectogram, which made its debut at the Radio Show, is the new way of keeping gramophone records.

It enables one to find any one of a hundred gramophone records in seconds and to keep them all in good condition permanently. An American buyer passing through London on his way back to the U.S.A. saw a sample, and as a result placed an order worth £75,000.

British Transmitters for Khartoum

AN important order for high-frequency radio telecommunications equipment to a value of nearly £50,000 has been awarded to Marconi's by the Sudan Posts and Telegraphs Department for the Khartoum Communications Centre. The new installations, when completed, will represent a major step forward in the modernisation of Sudan's communications system, providing a greatly expanded and extended service. With the new Marconi transmitters, direct communication will be possible with the capital cities of Europe and many important centres in Africa and Asia.

The order includes three 3½kW H.F. Transmitters Type HS31 with their associated drive, keying and monitoring equipments, and a 30kW linear amplifier. Special switch-gear will permit the amplifier to be used with any of the transmitters. Six receivers will be supplied, two for independent-sideband operation, two for single-sideband operation and two double-diversity telegraph receivers, one of which will be adapted for frequency shift Diplex signals.



Here is the heart of the radar plane's electronic warning and control system. Sitting at a master radar scope, the Combat Information Officer co-ordinates search work of his corps of radar observers and directs the over-all operation. With his equipment and backed up by a well-schooled crew of assistants he keeps track second by second of unidentified or "enemy" crafts' movements and directs the flow of reports on their manœuvres to defending ships, planes and ground stations.

B.I.R.E. Meetings

THE following institution meetings will take place during December, 1957:—

London: At the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1. Wednesday, December 18th, at 6.30 p.m. Recent Developments in Electronic Instrument Design—a paper by E. Garthwaite, M.B.E., and A. G. Wray, M.A., A.M.Brit.I.R.E.

North Eastern Section: At the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne. Wednesday, December 11th, at 6 p.m. Stereophonic Sound and Tape Recorders—a paper by D. H. McBean.

North Western Section: At the Reynolds Hall, College of Technology, Sackville Street, Manchester 1. Thursday, December 12th, at 6.30 p.m. Process Heating—a paper by M.O'C Horgan, O.B.E., T.D., M.Sc.

Toy Sputnik

A TOY Sputnik, or "baby moon," has been made by a Hungarian factory and will be on sale in time for Christmas.

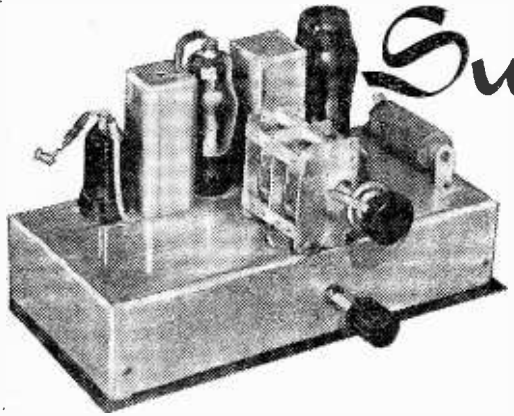
BBC Scottish V.H.F. Station

THE BBC's new Very High Frequency sound broadcasting station which is shortly to be opened at Kirk o'Shotts will radiate the Scottish Home Service on 94.3 Mc/s, the Light Programme on 89.9 Mc/s, and the Third Programme and Network Three on 92.1 Mc/s, each with an effective radiated power of 120 kW. The transmissions will be horizontally polarised, and therefore receiving aerials must be fixed horizontally.

Beginner's 200-1600m. Superhet

A SIMPLE THREE-VALVE SET FOR A.C. MAINS OPERATION ONLY

By F. G. Rayer



A RECEIVER of the type described here has the great advantage that no aligning difficulties arise, because the aerial circuit is aperiodic. Only the oscillator is tuned, the usual padder being omitted so that a coverage of about 1,965 to 650 kc/s is obtained with the .0005μF variable condenser. This allows reception on a continuously-tuned band of 150 to 185 kc/s, or about 200 to 1,600 metres, so that no separate long-wave band is required for the 1500 metre Light Programme transmitter. Further to simplify the circuit, a type of detector is employed which will easily operate the loudspeaker direct, thereby avoiding any separate A.F. stage, and associated components and wiring. This arrangement gives results approaching those obtained from a diode detector followed by an A.F. output stage, but is simpler. Further components are eliminated by the absence of A.V.C., and by using a common dropper for screen grids and oscillator anode.

The circuit, shown in Fig. 1, is thus much less complicated than that of the usual superhet. It has a very good degree of adjacent-channel selectivity, interference of this nature which is troublesome on T.R.F. circuits being absent. The 25K potentiometer provides volume control and on/off switching, so that there are only two controls in all. It is important to note that the output valve bias resistor is much higher in value than would be the case for normal A.F. amplification. If other output valves are used, this must be remembered. The anode by-pass condenser in this stage is also essential, though its value is not critical.

Oscillator Coil

A standard medium-wave oscillator coil with separate windings is satisfactory, or it may be wound as shown in Fig. 2. A ½in. dia. former, with dust-iron core, is required, and both windings are in the same direction, and of 34 s.w.g. D.S.C. wire. Each winding is in a compact pile,

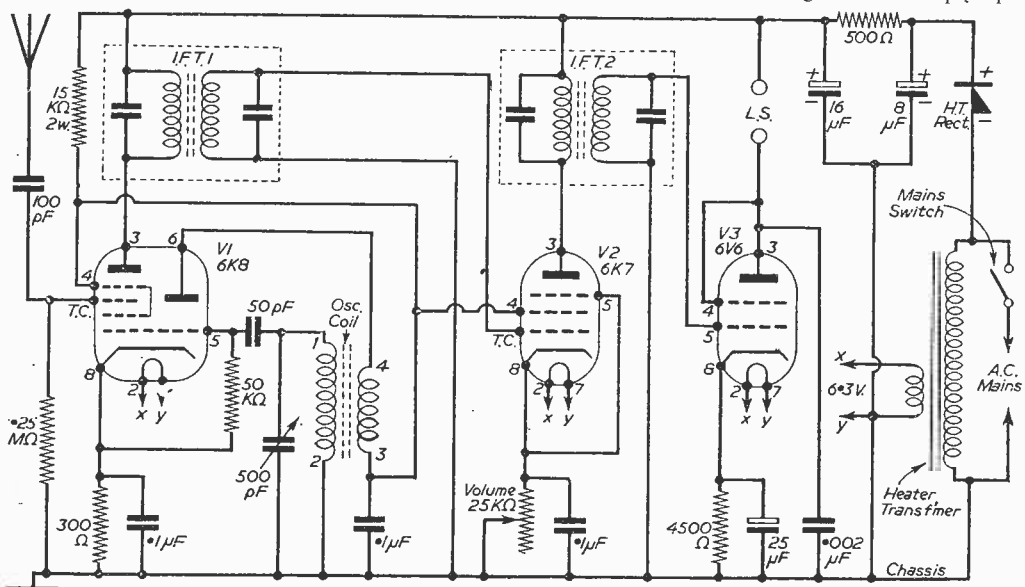


Fig. 1.—The circuit of the receiver described in this article.

with about ¼in. clear space between them. An adhesive such as Durofix will hold the ends secure. The leads may be taken directly to the various components in the receiver, or may be soldered to the tags usually provided on this type of former. The larger winding should be so situated that when the core is screwed right in it is centrally placed in the winding. If the winding is too far from the core the higher wavelengths will not be reached.

Chassis Construction

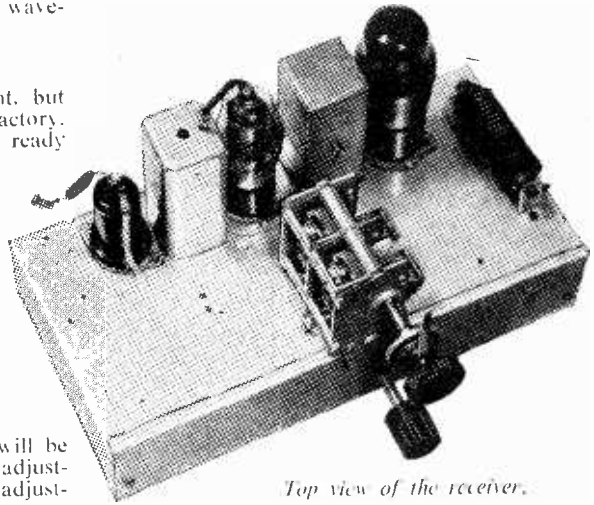
Exact dimensons are not very important, but a chassis about 10in. × 5½in. will be satisfactory. A suitable chassis can easily be purchased ready made. Alternatively, it may be constructed by bending 2in. runners on a piece of 18 s.w.g. aluminium 10in. × 9½in., or by screwing 2in. wooden runners to a sheet 10in. × 5½in.

The components are positioned as in Fig. 3. If a tuning condenser is to be obtained, the two-gang type is recommended, because it will be readily obtainable at low cost from surplus stores. It will also prove convenient if the effect of tuning the aerial circuit is at some future date investigated.

Any pair of 465 kc/s I.F. transformers will be satisfactory, with top or side trimmers or adjustable cores. If the transformers have side adjustment, they are positioned so that the cores may be reached from the back of the receiver.

Short leads are required at the frequency-changer grid cap, to avoid hum, and the 100pF condenser should be of mica type. Only a very short aerial wire is necessary.

The tuning condenser frame must be in contact with the chassis. A simple form of reduction drive, with pointer, is required, ready-made dials with stations or wavelengths marked not being suitable. If circumstances make it unnecessary to tune into the long-waveband, the simplified circuit may still be retained, but the usual oscillator padder (normally 500pF) may be included. This will reduce coverage to the medium-waveband only.



Top view of the receiver.

Chassis Connections

All other wiring appears in Fig. 4, points marked "M.C." being taken to tags securely bolted to the chassis. Connecting wire of about 20 s.w.g., with lengths of insulated sleeving, will be convenient.

If I.F. transformers with leads are fitted, a

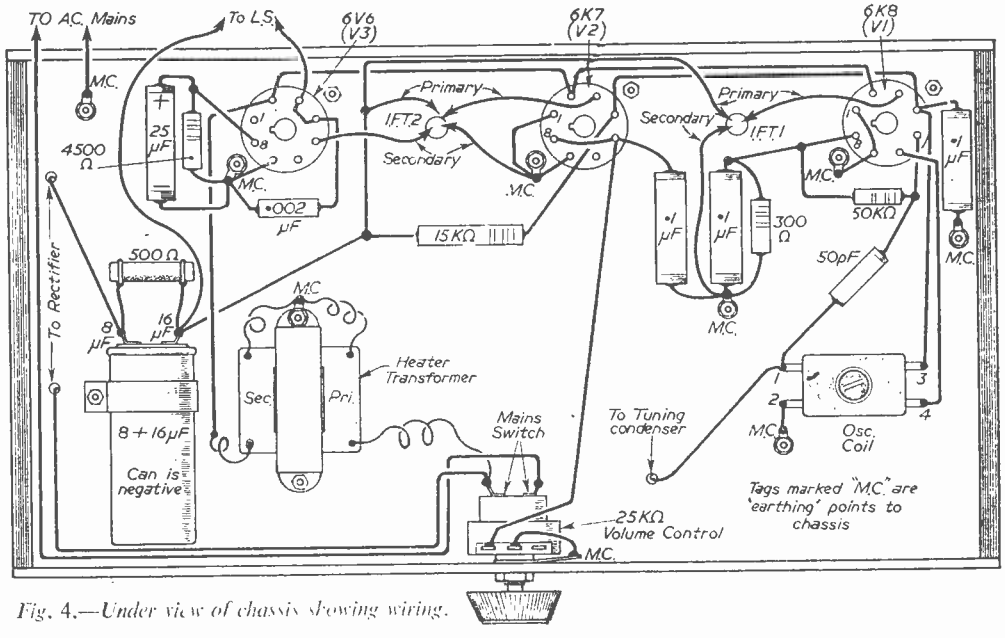


Fig. 4.—Under view of chassis showing wiring.

single ¼in. hole under each transformer will suffice. Other transformers may have projecting tags, and a clearance hole for each tag will then be necessary. With the first transformer, the primary goes to 6K8 anode and H.T. positive. The secondary is taken to 6K7 grid cap and chassis, the latter tag or lead normally being marked as the A.V.C. connection. The second transformer similarly has its primary wired to 6K7 anode and H.T. positive. The secondary is usually marked for diode and diode-load connections. If so, the "diode" lead is taken to the 6V6 grid, and the "diode-load" lead to chassis.

If a small smoothing choke is to hand, this can replace the 500 ohm resistor. As the valves consume only 1.05 amp., sufficient current is available to operate a 6.3v. dial or indicator bulb wired in parallel with the heaters.

To reduce chances of shocks if the chassis is touched it is worth while taking the "Neutral" main to the chassis, and to use a non-reversible plug. The receiver should also be totally enclosed in an insulated cabinet with control spindles, bushes, and knob set-screws out of reach. With suitably shaped knobs it will only be necessary to see that the set-screws are short, or to insert a little insulating compound into the set-screw holes after tightening.

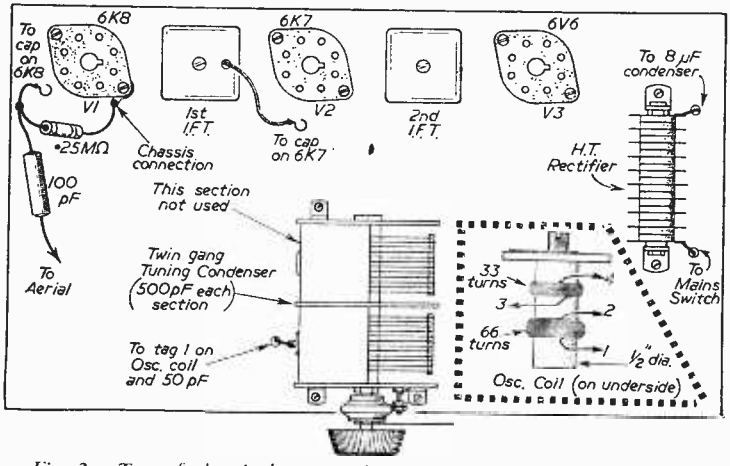


Fig. 3.—Top of chassis layout and inset (Fig. 2) the oscillator coil.

Adjustments

These are very simple, but will nevertheless considerably influence results. A station should be tuned in, the volume control being set to a low level. The I.F. transformer trimmers or cores are then adjusted for maximum signal strength. It is essential that an insulated blade, such as can be made from a piece of ebonite rod, be used for this adjustment. No trimmer (or core) should be at the limit of its adjustment in either direction. If such is the case, all the trimmers (or cores) should be adjusted until this is no longer necessary.

The set can be lined up with equal success at any intermediate frequency within the limits tunable by the transformers. It is not necessary to employ any particular frequency. Due to the manner in which the F.C. stage operates, any station higher or lower in frequency than the oscillator frequency, to the extent of the I.F. selected, will be received. If a local station on the second channel chances to interfere with some other transmitter, this can be corrected by re-aligning the I.F. transformers at a slightly different frequency.

In some circumstances modulation hum may be troublesome. If so, it can usually be reduced by wiring a .05μF 750v. condenser from rectifier negative to chassis. If some modulation hum remains, the aerial lead in Fig. 1 can be taken to a dual-wave H.F. choke returned to the chassis, and a further aerial-isolating condenser of .0001μF to .001μF added for the aerial. The need for this depends upon local conditions, and especially upon any stray mains leakage to the aerial or lead-in.

COMPONENT LIST

- Two 465 kc/s I.F. transformers.
- .0005 μF tuning condenser with reduction drive and knob.
- 300 ohm, 4,500 ohm, 50 K, and .25 megohm ½-watt resistors.
- 500 ohm 1-watt resistor. 15 K. 2-watt resistor.
- 50 pF and 100 pF mica condensers. .002 μF condenser.
- Three .1 μF condensers.
- 25 μF 25 v. bias condenser.
- 8 μF plus 16 μF 350 v. smoothing condensers.
- 25 K. potentiometer with switch. Knob.
- 6.3 v. 1½ amp. heater transformer.
- 250 v. 60 mA metal rectifier.
- M.W. oscillator coil.
- 6K8, 6K7 and 6V6 valves.
- Three octal valveholders.
- Chassis about 10in. x 5½in.

A Transistor Square Wave Generator

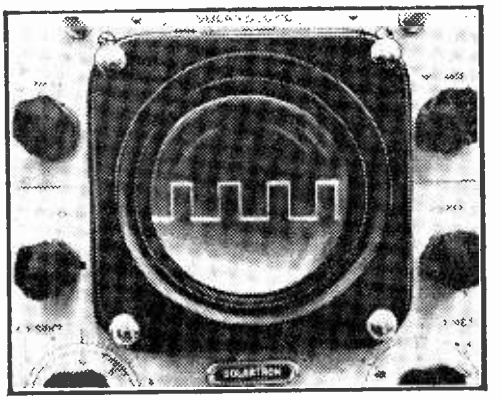
CHECK YOUR AMPLIFIER WITH THIS HANDY UNIT

By R. E. Bebbington, Grad. Brit.I.R.E.

THE harmonic composition of square waves renders them ideally suitable for the rapid checking of amplifier response (the operative word being "rapid") since the overall frequency characteristics can be displayed by a single trace on an oscilloscope. If a square wave is injected into an amplifier having linear frequency response and negligible phase shift a square wave will be displayed if the output is "scoped." Any departure from the "ideal" will result in a distorted square wave. Without delving into the mathematics of Fourier's analysis of square waves it would be as well to see how they are built up in order to help in the interpretation of these distorted wave-forms.

Square Waves

Briefly recapping, a square wave consists of a fundamental sine wave with the addition of odd harmonics, theoretically to infinity. This is never realised in practice but the frequency spectrum of the generator to be described gives an excellent square wave. A sine wave of the chosen fundamental frequency is shown in Fig. 2 (a), whilst Fig. 2 (b) shows the effect of adding to this the third harmonic. Note the steeper sides and the dip in the horizontal portions. When the fifth and seventh harmonics are added as in Fig 2 (c) the rising and falling edges sharpen up considerably and the horizontals tend to flatten out. Thus the effect of various frequency components on the final waveshape provides a useful basis for the analysis of amplifier or network characteristics. A few typical waveforms are illustrated in Fig. 3. The resulting pattern when a square wave is applied to an amplifier or network having linear frequency response and negligible phase distortion is, as might be expected, a square wave. In Fig. 3 (b) the significance of the rounded leading edges is poor high frequency response, and the waveform at (c) shows an even further deterioration of H.F. Low frequency deficiencies are characterised by the concave horizontal portions as at Fig. 2 (d), whilst a preponderance of fundamental would result in convex horizontals. Phase distortion at low frequencies is indicated by the sloping horizontals (Fig. 2 (e)). This slope is very significant in that it provides a most sensitive measurement of phase distortion, a phase error of only 2 per cent. at the fundamental frequency giving a slope of one in ten. The "ringing" on the horizontals at (f) is due to excessive high frequencies.



The actual waveform from the unit described here.

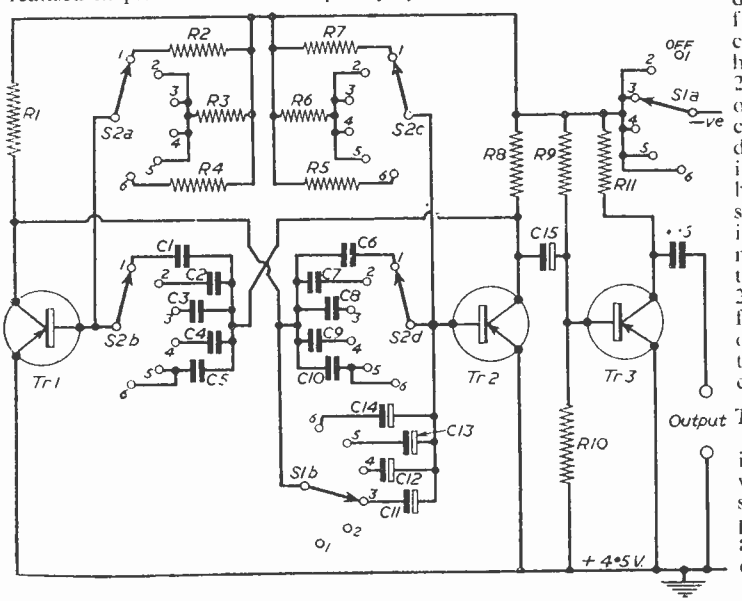


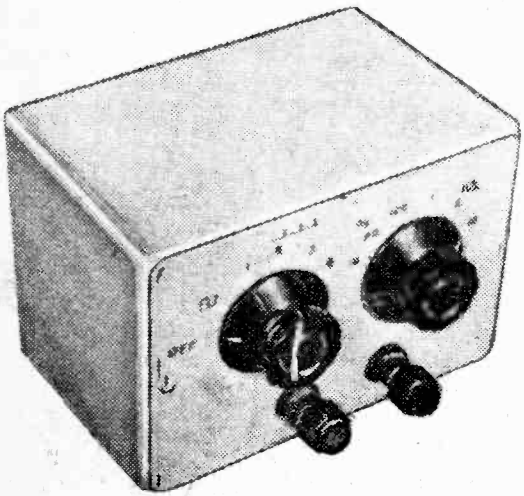
Fig. 1.—Theoretical circuit of the generator.

Test Procedure

Connect the generator to the input of the amplifier or network under observation using short low capacity leads to prevent high frequency attenuation. Similarly connect an oscilloscope to the output.

For low frequency checking a low fundamental frequency

is injected and a sloping top will indicate time-delay or phase errors at the low frequencies.



Excess or deficient fundamental will be apparent by a convex or a concave top.

High frequency response is best checked by choosing an input of fundamental frequency about the middle of the frequency range under investigation. Remember that the H.F. response affects the leading and trailing edges. Not all the defects have been listed since the reader can learn a great deal by inserting various resistance-capacity networks between generator and "scope," making notes of the results. Once the principles of square wave testing have been thoroughly mastered a mere glance at the C.R.O. will suffice,

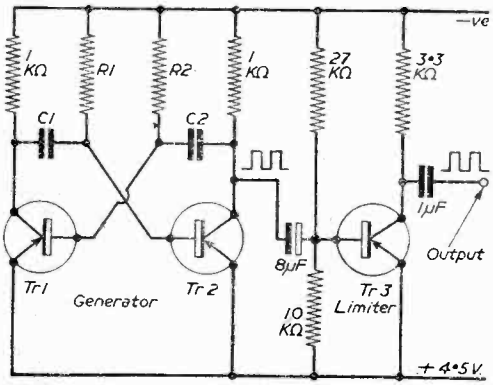


Fig. 5.—Basic arrangement.

for every picture tells a story. That is, of course, if one understands the language.

The Square Wave Generator

The generator to be described was designed to give square-wave spot frequencies at 10 c/s, 50 c/s, 100 c/s, 1 kc/s, 5 kc/s and 10 kc/s, at 4½ volts amplitude. An additional facility is a

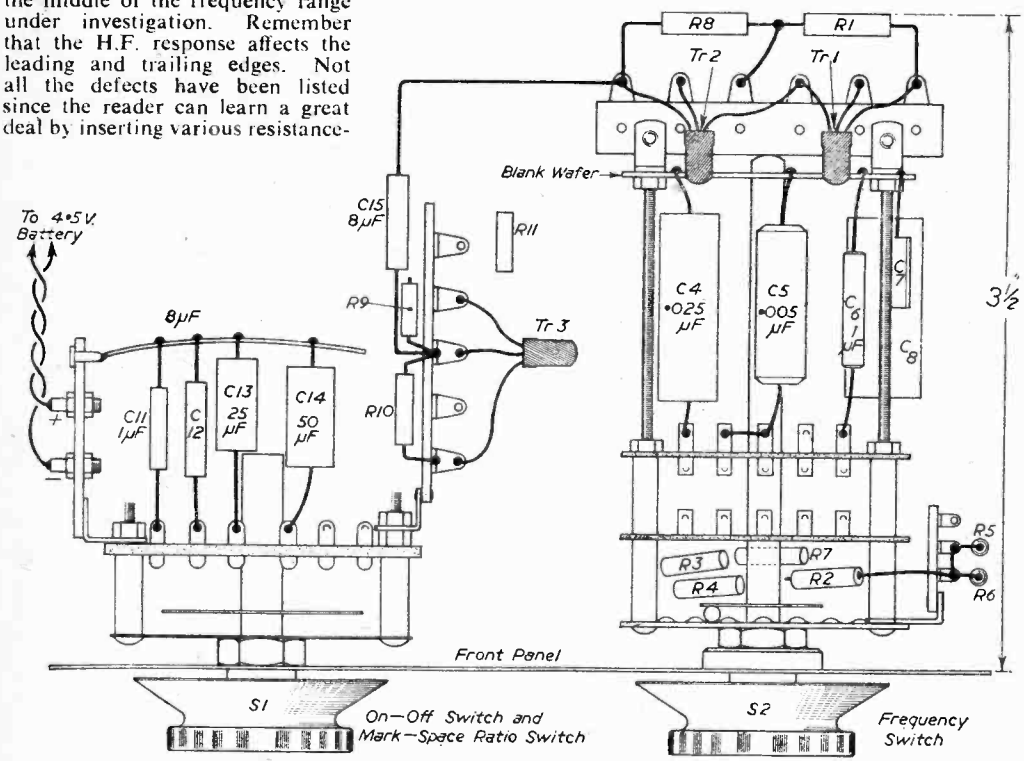
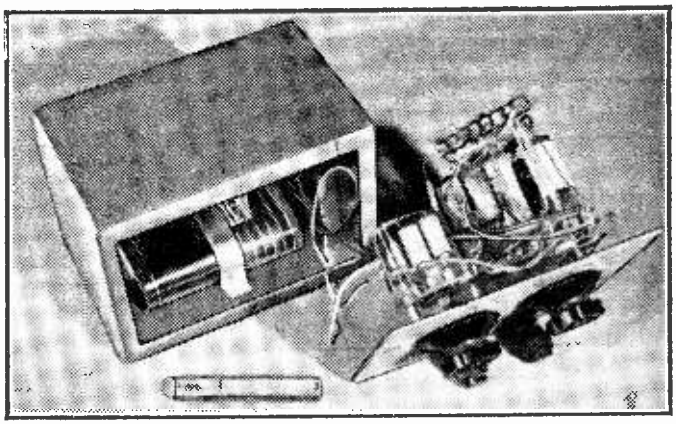


Fig. 6.—Actual wiring details of the unit.

variable mark-space ratio switch converting the output into sharp pulses, useful as marker pips, if desired. The circuit is similar to its valve counterpart and consists of two OC71's in a multivibrator circuit followed by a further OC71 employed as a limiter to sharpen up the verticals. The current gain of the transistors is not very important but for ease of adjustment the two employed in the multivibrator should have similar characteristics. In point of fact those used by the writer were production spread rejects having current gains of 40, 40 and 20, the latter value being used for the limiter stage. These values of gain were obtained on a Transistor test set as described in the October issue of PRACTICAL WIRELESS by my colleague, Mr. B. E. Wilkinson.

Whilst on the subject of testing transistors I must pass on a novel method of labelling them in terms of current gain. It consists of threading ¼in. lengths of small diameter coloured plastic sleeving on to the base lead-in wire, the colours conforming to the resistance colour code. For example, a transistor having a current gain of 35 would have an orange, and then a green sleeve slipped on to the base connection. Furthermore, the sleeving performs a dual role in that it serves to insulate the emitter, collector and base wires from one another.

To understand the operation of the circuit more clearly Fig. 5 shows the basic generator with the switching omitted. If we consider initially that Tr1 is fully conducting, then in the "bottomed" condition almost the whole of the battery voltage is across its collector load. As C1 charges, the base of Tr2 goes negative until it conducts. Tr1 is now cut-off due to C2 discharging through R2 but as Tr2 conducts C2 charges and the base of Tr1 goes negative until it again conducts. This cyclic switching depends upon the time constant of R1 C1 and R2 C2, the frequency of operation being approximately equal to .77 divided by CR. Although the spot frequencies given are useful



The completed unit and its case. The small piece of rule in front is 3in. long.

for most purposes there must be other applications that call for other frequencies. By applying the formula readers may readily determine values of C and R to suit their own requirements.

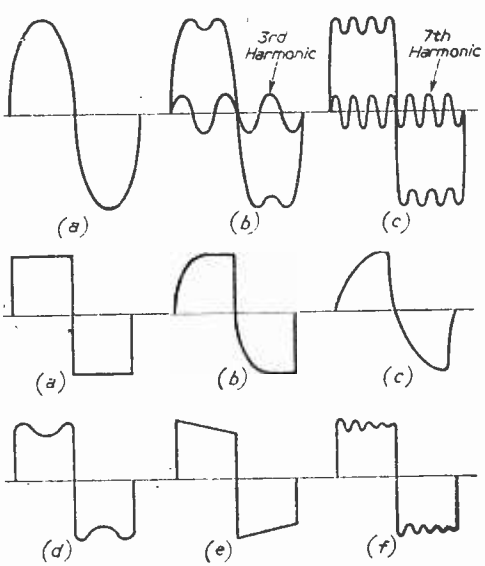
For example, if a spot frequency of, say, 400 c/s is required then:—

$$\text{Since } f = \frac{.77}{CR}$$

$$\text{then } CR = \frac{.77}{f}$$

$$\therefore CR = \frac{.77}{400}$$

If we conveniently keep R constant, and 27K



Figs. 2 and 3.—The production of a square wave.

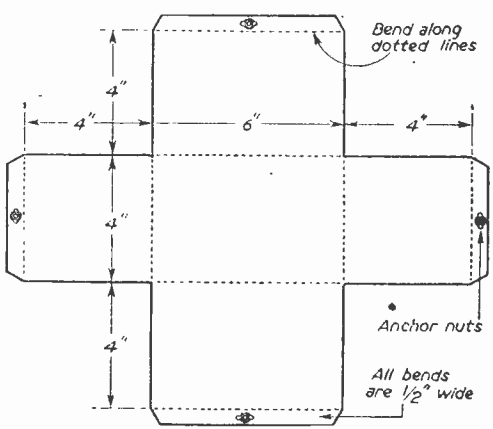


Fig. 4.— Details of the case or cabinet for the unit.

ohms seems an optimum value around this frequency, we have:—

$$C \times 27{,}000 = \frac{.77}{400}$$

$$\text{therefore } C = \frac{.77}{400 \times 27{,}000}$$

$$= \frac{.77 \times 10^6}{4 \times 27 \times 10^5\ \mu F}$$

$$C = .071\ \mu F$$

Since the formula is only an approximation there is no point in pursuing the value of C any further than .07 μF.

The output from the collector of Tr2 is a reasonable square wave except that the trailing edges tend to fall exponentially. The limiter stage, however, is most effective in cleaning this up and the resultant waveform is exceptionally good throughout the entire frequency range.

Construction

As can be seen from the illustrations the circuit is constructed around the two rotary switches used for on/off, mark-space and frequency selection. The latter consists of two wafers to accommodate the four-pole, six-way action necessary for selecting the appropriate resistors and capacitors. The resistors R2—R7 are grouped around the first wafer of S2 and a short tag strip serves to anchor these to the common 4.5v. negative line. This is clearly visible in the bottom right hand corner of the layout showing principal components. Care should be taken when wiring these components to make sure that the same value of resistor is being simultaneously switched on S2a and S2c since as these lie on opposite sides of the wafer this can lead to some confusion. The same warning applies when wiring the capacitors as it is most disconcerting to discover that when S2b is switched to C1, S2d is connected to C10 instead of C6. The capacitors are wired from their appropriate contact on the second wafer to a blank wafer on the end of the side strut about 2in. from the former. If 1/16in. diameter holes are drilled around the periphery of the blank opposite the capacitors, the wire ends can be inserted and bent over to form soldering lugs. The two generator transistors are mounted on a six-way tag strip behind the blank wafer and affixed to the side-strut ends. The collector load resistors R1 and R8 are also mounted on this strip as shown in the lay-out.

The other rotary switch carries a five-way tag strip on which is mounted the limiter transistor and associated components. One side of the wafer is used as the on/off switch connecting the battery negative to the common negative line in all positions except number one which is the "off" position. The other side of the wafer (S1b) is used for the mark space ratio facility. The "mover" contact is conected to Tr1 collector and positions 3, 4, 5 and 6 are connected through their various capacitors to a common line connected to Tr2 base. Switch contacts 1 and 2 are spare since 1 is the "off" position and 2 is the "square wave" position. No difficulty need be experienced in construction if the theoretical diagram is followed closely and the lay-out sketch used as a guide to the disposition of components.

Readers will no doubt have their own ideas on housing the generator but the case shown, measuring 6in. × 4in. × 4in., makes a very compact unit. It is made from a sheet of 18 s.w.g. aluminium as shown in the sketch. The dotted lines indicate the right-angle bends. All these are made in the same direction, the four outer flanges being bent first. The edges were finally welded and rounded off with a file. However, if welding facilities are not available, angle pieces may be inserted along the four butted edges and riveted inside the box. The front panel measures 3¾in. × 5¾in. and holds the two switches and output terminals. It is affixed to the box by four 4 B.A. countersunk screws.

The case and front panel were finally given a grey crackle finish, producing a professional appearance that the excellent results, surpassed only by the more costly generators, demand.

LIST OF COMPONENTS

R1—1 K
R2—30 K
R3—27 K
R4—15 K
R5—15 K
R6—27 K
R7—30 K
R8—1 K
R9—27 K
R10—10 K
R11—3.3 K

C1, C6—1 μF
C2, C7—.5 μF
C3, C8—.25 μF
C4, C9—.025 μF
C5, C10—.005 μF
C11—1 μF
C12, C15—8 μF
C13—25 μF
C14—50 μF
C16—1 μF

Tr1—OC71
Tr2—OC71
Tr3—OC71

S1—2 pole-6 way
S2—4 pole-6 way

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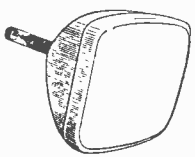

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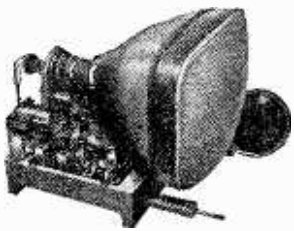

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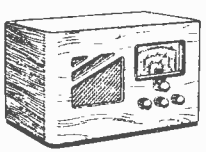
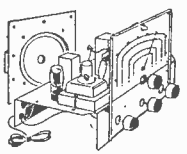


HOME RADIO 79/6

5 valve (octal), superhet, 3 waveband receiver. A.C./D.C. Universal mains can be adapted for gram. P.U. In wooden cabinet. 18½in. x 11½in. x 8½in. Ins., carr., 7/6.



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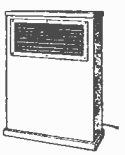

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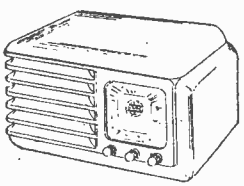

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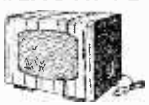

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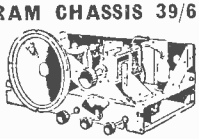

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On Your Wavelength

BY THERMION

Credits

ONE reader, Mr. Donald S. Wallace, of Forest Gate, bemoans the long list of credits which are given at the end of every item broadcast by the BBC, which at the same time omits important information. In this respect, the BBC seems to be aping the cinema, where a long list of credits is run off at high speed, either at the end or the beginning of the film. These credits are quite meaningless, although they may flatter the vanity of some of the halfwits responsible either for the production of the film or for acting in it. Fortunately, they are run off at such a rate that one scarcely has time to read them, never mind remembering. The American tendency is to give credit to everyone associated with the film, however unimportant their task. But for the name of the leads I doubt if any member of the public ever remembers any of the names, few of which seem to be English and require to be sneezed rather than pronounced. Even the office boy may be referred to at the end as the director of communications. As the names of the leads have already been broadcast in the newspapers and by trailers, there really is no need for a list of credits at the end at all. The BBC could usefully include the titles of the incidental music used in plays and documentaries. The title and composer would be sufficient. The BBC is altogether too rapid in its method of flashing the cast over the screen at the end of a programme. In any case, it wastes programme time, and I really do not think that the public cares two hoots who produced the programme. Now that the listening audience is rapidly turning to viewing, I suggest that credit time be devoted to an increase in news summary time. The BBC news summary is always very sketchy, a point which no doubt pleases the newspapers!

The 1958 Radio Show

THE 25th National Radio and Television Exhibition is to be held at Earls Court from Wednesday, August 27th, to Saturday, September 6th, 1958, with a preview on August 26th. The R.I.C. having decided on the date, I think that they should settle down at once to improving the amenities of the exhibition in directions which I have criticised before. One of the most important of these amenities is the catering, which annually gives rise to serious complaints, particularly of poor quality and over-charging. The catering is undertaken by outside catering contractors and sponsors of exhibitions take no interest in feeding the public that they attract to their exhibitions. It is my view that they have a moral responsibility to do so. It is easy for those who have season tickets to have their meals outside, since they do not have to pay for readmission. The public, however, is trapped in the exhibition and must pay the extortionate charges for food and drink or go without. For many the Radio Show is an annual event where wives and families are taken out for the evening. A good meal at a reasonable price is part of the evening's entertainment. In spite of the very poor service and the poor quality of the food, the prices charged exceed those of a high-class west-end restaurant. Those who like to enliven the evening with a modicum of alcoholic inspiration will find that they pay 2s. 8d. for a whisky, the measure of which does not seem to conform to any imperial standard, and 2s. for a bottle of light ale. Wishy washy tea is retailed at 5d., and seems to be made according to the formula, 1lb. of tea to a hundred gallons of water. In some of the catering rooms conditions are anything but hygienic. I maintain, therefore, that the R.I.C. should take this matter in hand themselves. These high prices may prevent a lot of people from visiting the exhibition—or invite them to take a packet of sandwiches. Earls Court has never quite captured the atmosphere of Olympia. Perhaps one day the exhibition will return there.

BBC Worries

THE admission of the BBC that where people have a choice of television programmes, more and more are watching I.TV programmes, has another aspect. The BBC and the I.TV are both competing for the TV public. The TV public is expanding and this means, as the figures prove, that the listening public is declining. It logically follows that the majority of those who refrain from listening are changing over to I.TV and not to BBC television programmes. The BBC is thus losing on both counts, and it needs therefore not only to improve its TV, but also its sound service. There is plenty of room for it and I'll wager that if there were to be an alternative sound programme on commercial lines, similar proportions would exist between the two services, which as far as television is concerned is 28 per cent. BBC, 72 per cent. I.TV. Whilst the BBC had no competition in TV, its programmes were considered excellent. When you have a yardstick such as a competitor with which to compare them the story is different. As far as I can see, that position will remain, because it cannot be denied that each is working to different standards. The BBC is more idealistic than the commercial people. The BBC programmes in general are good. The ideal behind them is sound, even if the execution is bad in some cases. I strongly feel that the BBC should depart from party games and it should cease from aping America.

Observe the Satellites–1

HOW TO PICK UP AND TRACK THE ARTIFICIAL MOONS

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

THOUSANDS of amateurs the world over hastily tuned to 20 Mc/s as soon as the dramatic news of the artificial satellite burst upon an unsuspecting public.

It would appear that a considerable number of satellites operating upon the 20.005 and 40.002 Mc/s frequencies will be launched. As we all know, the original emission consisted of 0.3 second pulses, each frequency pulse alternating with the other. Presumably a simple multivibrator circuit provided the keying impulses, with a possibility that transistors were employed partly or wholly in the transmitter circuitry. The good signal strength of the transmissions indicates that a "reasonable" power was available, although this need not have exceeded a fraction of a watt, owing to the "line of sight" propagation conditions that exist. Thus the "optical path" range of a satellite at 500 miles altitude is some 1,500 miles, although ionospheric effects could provide an extension of this range in some cases, while in other cases ionospheric absorption or reflection could reduce the observable range by reflecting the waves back into space instead of letting them penetrate. However, the observable range of a satellite even under conditions of a highly reflecting ionosphere is likely to be several hundred miles about the zenith point. The 40 Mc/s frequency would be almost unaffected by the ionosphere under average conditions. Note that paradoxically the "range" of audibility of a satellite is greatest when normal DX conditions are bad, as this implies that the ionosphere is of poor reflective intensity, so that the satellite radiations will penetrate even at glancing angles. Under conditions of extreme ionisation—as evinced by abnormal propagation in the 50 Mc/s band—even the 40 Mc/s emissions might be absorbed or reflected to an extent that would cut down the distance to which the signals would be heard from the satellite.

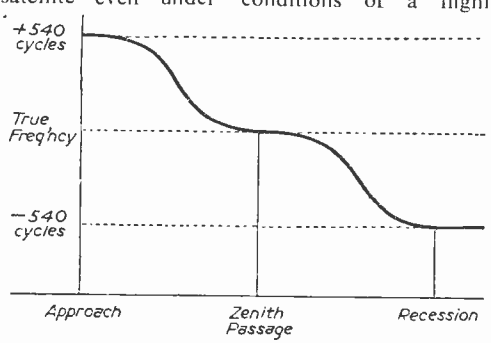


Fig. 1.—Observed frequency variation of satellite. Initially the frequency of 20 Mc/s will be observed 540 cycles high in the initial approach stages for a velocity of 18,000 miles an hour. The final frequency shift when receding will be the same amount low. For any given satellite speed, the maximum observable frequency shifts will be proportional to satellite velocity. For other frequencies of transmission, the frequency shift will be proportional to the transmission frequency. Thus for the 40 Mc/s frequency, the frequency shifts will be twice the above figures. The American satellite frequency of 108 Mc/s will provide over 5 kc/s shift for the above conditions.

Canadian amateur radio operator Cecil Ludlow picked up the radio signal of the Russian satellite on the 20-metre band as it passed over Toronto and recorded it on his tape recorder as pictured here. He was able to make a very good quality recording of the signal.

Merely listening to the satellite signals serves very little purpose, although a careful note of the times of initial audibility, maximum signal strength and final disappearance of the signal on any one transit are of value. A careful note of fading, echo or skip effects on the two frequencies, plus a record of the different behaviour of the two frequencies, will be even more valuable. In fact, observations of this sort may give valuable evidence of ionospheric conditions that could not be obtained by any other methods, as for the first time we are able to observe what happens to a signal coming through the ionosphere from outside! A tape recorder for recording the signals is, of course, an almost indispensable item, as details

may become apparent upon a replay that were unnoticed at the actual time the recording was made. Furthermore, do not switch off the instant the satellite signals have "finally" faded into inaudibility, a little extra time might reveal some extraordinary anomalous ionospheric echo or exceptional skip-distance effect. If newspaper accounts are to be relied upon, the satellite signals have been heard at a range of some 6,250 miles, clearly due to ionospheric effects. Moreover, even at the 18,000 miles per hour velocity of the satellites, this distance represents audibility some twenty minutes after the satellite has passed overhead. Thus, with all factors taken into account, the satellite signals might be heard some twenty minutes earlier than expected, and remain audible some twenty minutes after they should have disappeared. This means that the satellite signals could very well be audible for over an hour all told, and under exceptional conditions heard over the major portion—or even the whole—of an orbital passage. Thus even straight "listening" offers a whole host of fascinating possibilities.

Making Observations

It should be noticed that from straight "listening" we have gradually shifted the emphasis over to "observing." There are many valuable observations that may be made in the peace and quiet of the shack, particularly if a tape recorder is available. The most fascinating observation that may be simply made with no additional apparatus at all is that of the relative speed of the satellite.

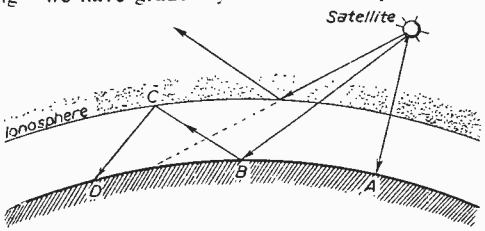


Fig. 2.—Possible modes of reception of the satellite signals. The observer at A hears the satellite by direct path through the ionosphere, as also does the observer at B. The waves reflected from Earth at B are again reflected back to Earth to an observer at D from a point C in the ionosphere. Between the points D and B a "silent zone" may exist due to the ionosphere reflecting the satellite signals into space instead of transmitting them through to Earth.

By employing the well-known Doppler principle a very good estimate of the velocity of the satellite relative to the observer may be made. The Doppler principle is known to us in the familiar phenomenon of the sudden drop in pitch of a train whistle as the train passes at speed, or nowadays the change in pitch as a jet plane sweeps overhead. Briefly, as a sound wave or radio wave emitting source approaches us, the frequency appears higher than it is, similarly a receding source appears of slightly lower frequency than it really is. Naturally, this effect depends upon the ratio between the velocity of the object and the velocity of propagation of the waves it emits. Thus with sound waves crawling at a mere 1,000 feet per second, slight pitch changes are easily observable even with trains, while with light waves and radio waves propagated at 186,000 miles per second a very fast moving source is necessary to produce much frequency shift. However, the use of single sideband communication systems on fast jet aircraft has already run into carrier reinsertion troubles due to Doppler shifts becoming noticeable at the higher frequencies and higher speeds both being used by modern aircraft!

Briefly, a velocity of 1,000 miles an hour relative to the observer for a frequency of 20 Mc/s produces an apparent frequency shift of 29.87 cycles. This is near enough to 30 cycles for a good degree of accuracy. Thus we may postulate a shift of 1½ cycles per megacycle in frequency for each 1,000 miles an hour of velocity. One can easily see that modern jet planes using single sideband will call for quite a sizeable amount of retuning at present day speeds. Note that a radio source approaching the receiver will be apparently slightly increased in frequency, and a receding source will be received at a slightly lower frequency than the true frequency. In reception of a C.W. transmitter in a satellite, as the signal is first heard, it will be at frequency higher than the true frequency by an amount depending upon the velocity of approach. Thus a satellite coming directly towards the receiving point at an orbital velocity of 18,000 miles an hour will be received as a frequency 18 × 29.87 cycles higher than the true frequency. To half per cent. accuracy this is 540 cycles. As the satellite is at first distant from the receiving point, there will be little shift in frequency. As the satellite approaches the frequency will drop, at first slowly, and then faster. Instantaneously, as the satellite passes overhead, the change in frequency will slow down, remain fractionally steady and then commence to drop faster in note again, finally settling to a steady note now 540 cycles lower than the true frequency until it passes outside optical range. Fig. 1 illustrates this graphically. The duration of the initial and final periods during which the observed frequency is steady will depend largely on propagation conditions. At a conservative one thousand miles radius of audibility, however, the signal would be heard over a total of 2,000 miles of path, which at 18,000 miles an hour would

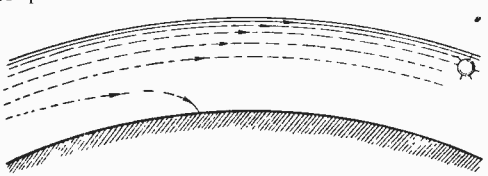


Fig. 3.—The orbit of a satellite close to Earth becomes slowly smaller due to the effect of residual air drag losses. At the same time, however, the orbital speed of the satellite actually increases, contrary to popular ideas, thus increasing the effect of air drag. This process rapidly augments until finally the satellite crashes catastrophically, probably being partly vaporised by air drag in the process.

represent an audibility of 1/9th of an hour, or just over six minutes. As audibility from times ranging from a few minutes up to over twenty minutes has been reported, it is clear that propagation conditions have a large effect, and the time the signal is heard, plus any possible skip effects, should be noted. Thus the satellite might easily traverse a skip zone, and be heard weakly (after first fading out) by ionospheric reflections.

Measuring the Velocity

Thus the amateur may now ponder the most expeditious means of making accurate frequency

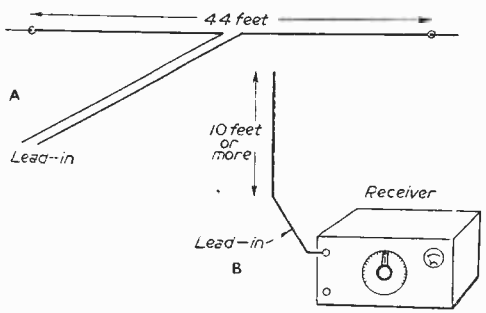


Fig. 4.—Two simple aerial systems. A gives the dimensions of a dipole for 20 Mc/s use. The vertical aerial at B will be found useful for "extreme range" detection of the satellite. For the 40 Mc/s transmissions, a conventional B.and I television aerial may be used. Detuning a turret tuned domestic receiver might enable the signals to be heard on the sound channel of a TV receiver.

measurements to obtain his own measurement of the velocity of the satellite.

The amateur wishing to make a velocity measurement is thus faced with measuring a small shift in frequency, amounting in all to just over a kilocycle at 20 Mc/s, twice this value if the 40 Mc/s frequency is observed, while for the American 108 Mc/s satellite frequency, a shift of over five kilocycles will be observed. The USA satellites, with stable receivers, offer the chance of really good speed determinations. However, the vast majority of amateurs and S.W.L.s are able to receive at 20 Mc/s, whereas they are not at the moment equipped for the higher frequencies. Thus we have the problem of measuring just over a kilocycle difference in frequency accurately. The lucky possessors of tape recorders may record the beat note observed on the satellite signal, and "measure at leisure." Here a stable calibrated audio oscillator may be used to observe the recorded beat frequency by the method of beats. Provided the oscillator is really accurately calibrated—as by a cathode ray method against standard frequencies—it is possible to determine the frequencies accurately. A good tape recorder should be quite reliable. However, any measurement better than ten cycles will give accuracies better than one per cent. A simple method is to provide the received B.F.O. with a calibrated vernier. To do this a small variable of only a pF or so should be used. Such a condenser may be improvised by removing vanes and increasing the spacing if necessary from a small V.H.F. receiving type capacitor. Use a straight line capacity type having semi-circular moving vanes to provide a linear variation of B.F.O. frequency with angular rotation. Most B.F.O. oscillators in communication receivers are of the E.C.O. or similar type, and to fit such a condenser all that is necessary is to run a lead to the grid of the B.F.O. tube, and earth the other side of the vernier condenser. If desired, the condenser may be shunted directly across the B.F.O. tuned circuit. A sweep that gives a comfortable variation of well over the desired range should be selected. With such a calibrated control, the B.F.O. may be set to zero beat at the moment the satellite is first heard, and continuously adjusted to maintain zero beat until the note has settled down to its final value on passing out of radio range. This difference in initial and final settings gives the two frequency values needed for calculating the satellite speed.

Estimating Height

Further details and methods of estimating height of the satellites are left for a further article, as it is clear that the unexpected arrival of a real live satellite caught most of us unprepared. Also the average amateur and S.W.L. had little interest in preparing elaborate 108 Mc/s gear in this country, as it was not expected that the American satellites would be observable from England. However, such is the present "satellite race" that it is possible that there may be more opportunities than expected for interesting observations on both the American and the Russian frequencies. In any case the 20 Mc/s transmissions enable any keen amateur and S.W.L. to participate without elaborate equipment or special receivers. It is now possible that American satellites may also operate on 20 Mc/s to enable all amateurs to receive them. Unfortunately, the early impression was that elaborate installations would be necessary to observe the satellites, particularly as only weak signals were envisaged. Now it would seem that much more than listening to a "bleep" is possible for almost any amateur, even if the precision possible at V.H.F. is reduced at the lower frequencies now being used. It is perhaps unfortunate that while the American frequencies were widely publicised well in advance, the Russian frequencies were only revealed a short time before the satellite was launched.

(To be continued)

Books Received

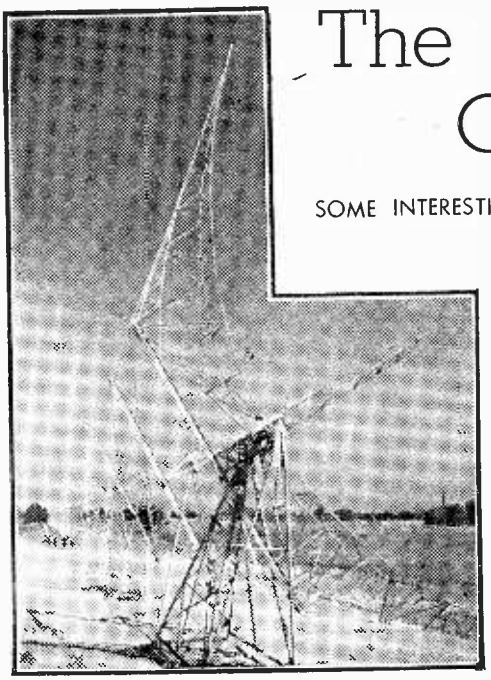
THE BOYS' BOOK OF RADIO, TELEVISION AND RADAR. 143 pages, 78 illustrations. Published by Burke Publishing Co. Ltd., Price 9s. 6d. net.

ALFRED HITCHCOCK PRESENTS. 25 stories, 372 pages. Published by Max Reinhardt Ltd. Price 18s. net.

FUN WITH RADIO, by Gilbert Davey. 64 pages, 34 illustrations. Published by Edmund Ward Ltd. Price 10s. 6d. net.

The Mullard Radio Observatory

SOME INTERESTING DETAILS OF THE LATEST ADDITION TO THE UNIVERSITY OF CAMBRIDGE



The fixed aerial of the radio star interferometer during construction. The end tower is complete. Length of the aerial is 1,450 feet and the distance across a parabola 65 feet.

THE release of the Russian Earth Satellite brought into prominence in this country the new Mullard Radio Laboratory at Cambridge. This was, in fact, the first British station to pick up both the first and second satellites, and in some respects it has proved of more use than the much publicised giant Radio Telescope at Jodrell Bank. No doubt many readers will be interested in this Mullard project and the following notes and accompanying illustrations have been supplied to us by Mullard.

The observatory was opened by Sir Edward Appleton on July 25th. This Observatory has been provided, through the far-sighted generosity of Mullard Ltd., who are to provide, over a period of ten years, the sum of £100,000, and with the help of the Department of Scientific and Industrial Research, to provide facilities for an extension of the work which Mr. M. Ryle has been carrying out in the Cavendish Laboratory at Cambridge since the war. This work has been concerned with the investigation of the radio waves reaching the earth from outer space, a subject which is now given the name of Radio Astronomy.

To obtain the greatest amount of information from the radio waves from outer space two requirements must be satisfied. First, the radiations must be received with the greatest possible strength: that requires the largest possible aerial for their reception. Second, the aerial must be of a kind which will provide an accurate measure of the angle of arrival of the waves. The power to make this measurement is called the "resolving power" and a great resolving power requires a large aerial. The obvious way to make observations in Radio Astronomy is thus to construct the largest possible aerial. Comparatively small aerials of this kind are in existence in Holland, Germany and the U.S.A.

The "Interferometer"

Although the construction of the largest possible aerials would seem to be the best way of getting the strongest reception and the greatest resolving power, for some purposes they have insufficient resolving power. For many investigations a different type of aerial known as an "interferometer" is to be preferred. Its method of working can be understood as follows. The "resolving power" of an aerial depends on the interaction or "interference" of the radio waves received at its edges, and the farther apart these edges are, the greater is the resolving power. Suppose therefore that an aerial is made as large as possible, so that because of its large *area* it collects a large power and because of the large *distance* between its edges it has great resolving power. Now suppose it to be split into two halves which are then moved apart some considerable distance. Then the total area of the aerial is unaltered so that the total power received is the same as before; but if the waves received in the two halves are properly combined they will, by their "interference" effect, provide a resolving power which is increased proportionally to the distance between them. In this way it is possible to increase the resolving power far beyond what is practicable with a single large aerial, and at the same time to keep the collecting power the same.

An interferometer aerial of great resolving power was constructed at the Cavendish Laboratory, Cambridge, in 1948, to make a survey of the distribution of "radio stars" over the sky. The measured positions of the two strongest radio stars were sufficiently accurate to lead to the discovery, with the great 200in. optical telescope at Mt. Palomar, U.S.A., that one of the radio stars was, in fact, two galaxies in collision. This astronomical object is so far away that it has taken light 200 million years to travel from it to the earth.

2,000 Radio Stars

In 1952 a new and much larger radio telescope of the interferometer type was built, with the

aid of a grant from the Department of Scientific and Industrial Research. The total collecting area of this is equal to the collecting area of the large single aerial constructed at Manchester, and its resolving power is that appropriate to the distance, 1,900ft., between its two halves. About 2,000 radio stars have been detected with this instrument, but only about ten of these can be identified with visual objects. The nature and distribution of the remainder present a problem of the greatest interest to astronomers and cosmologists.

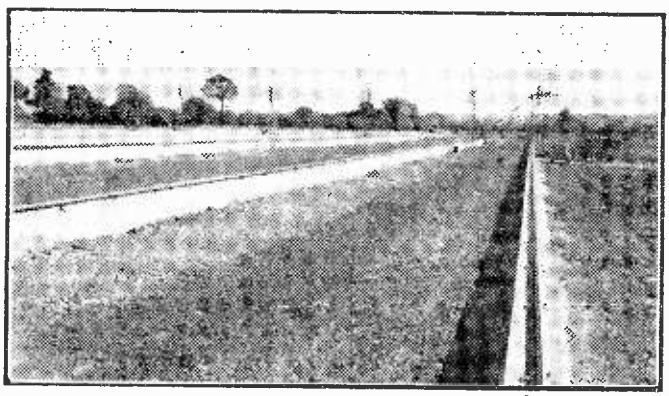
The Cambridge workers consider that their observations point to the conclusion that at very great distances the "radio stars" are closer together. If their conclusion is correct it would seem to favour a theory in which the Universe is supposed to be expanding from an initial highly condensed state, and to conflict with one in which there was supposed to be continuous creation of matter. Workers in Australia have criticised these results, and have stated that, with a different type of radio telescope, they have not been able to repeat the Cambridge observations. The matter is so important for cosmological theories that every effort is being made to extend and improve the observations so that it can be decided without doubt which view is correct.

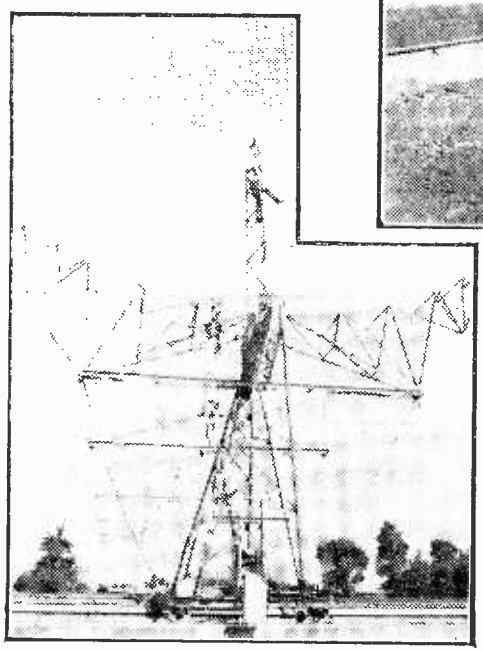
Plans were made in Cambridge to extend the observations by constructing an even larger "interferometer" in which both the collecting power and the resolving power would be increased. This was too large to be put on the same site as the existing interferometer and it was necessary to plan in terms of a new "Radio Astronomy Observatory" covering an area large enough to contain both this and other large aerials. It was realised that the renting of this site and the construction of the aerials was too costly for the University to undertake, and astronomers everywhere were delighted to hear that the Mullard Valve Company had found it possible to finance a large portion of the scheme, and the D.S.I.R. would finance the remainder. The site for the new "Mullard Radio Astronomy Observatory" is at Lord's Bridge, about five miles from Cambridge. A small Observatory building contains the associated complex electronic equipment which makes the records and which, in fact, recorded signals from the second Russian satellite automatically during the early hours of the morning. The equipment is run and the records are analysed by a small team of about 15 research workers under Mr. Ryle, who has inspired all this work. These workers have to be fully familiar with the latest techniques in the use of aerials and electronic devices of considerable complexity, and it is hoped that the Observatory will prove to be not only a place where astronomical results of the greatest importance will be obtained, but also a training ground for experts in modern radio techniques.

Interferometer Details

The radio-star interferometer, which is designed for a wave-length of 1.7 m., comprises a fixed east-west aerial 1,450ft. long and 65ft. wide; the moving aerial is 190ft. long in the east-west direction and 65ft. wide, and moves along north-south railway lines which are 1,000ft. in length. Both aerials are cylindrical paraboles made as in the earlier Cambridge interferometer by stretching wires across parabolic tubular steel frames which can rotate about an east-west axis.

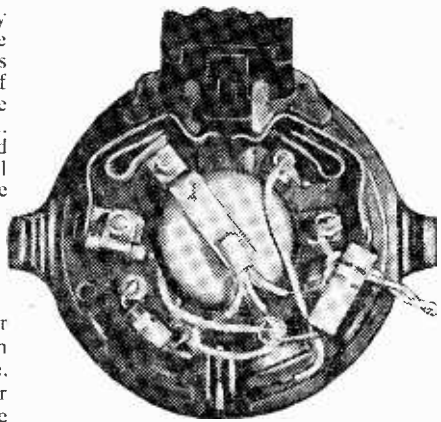
The resulting envelope pattern will have a width to half intensity of approximately 25 × 35 min. of arc, and this will contain an interference pattern in right ascension having a lobe separation of about 8 min. of arc.





The moving aerial and railway tracks of the radio star interferometer during construction. The steelwork is complete and part of the dipole assembly in place. Length of the railway tracks is 1,000 feet and the length of the aerial (i.e., the width across the railway track) is 190 feet. Distance across a parabola is 65 ft.

A TRANSISTOR MICROPHONE AMPLIFIER



By B. E. Wilkinson

THERE are many ex-Government microphones available very reasonably priced. Probably the main reason for their cheapness and availability is their comparative lack of sensitivity. Most of these microphones were manufactured for use in fairly rough conditions, so that the robustness of the instruments is achieved at the cost of sensitivity. Three types are available, namely carbon, balanced armature and moving coil, though we shall concern ourselves with the latter type.

The sensitivity of a microphone can be increased by the use of a pre-amplifier which provides a larger signal for the main amplifier than would the microphone alone. Transistors are admirable for A.F. pre-amplifiers because of their compactness, small power supply and low current consumption. It is intended that the pre-amplifier be built inside the microphone itself. The type of microphone chosen for the purpose is of the moving coil variety and is fitted with a press switch. This latter feature is extremely useful, as it may be used to switch in the pre-amplifier battery supply.

The Circuit and Components

The components required are as follows: Moving coil microphone type No. 13.2.A.17605 (if this particular type is not obtainable there are many other ex-Government types which are admirable), one A.F. red spot transistor, 47 KΩ resistor, 4.7Ω resistor, 8μF condenser, one L.T. deaf aid battery (Mallory RM 625). The circuit, which is very simple, is shown in Fig. 1. Since the amplifier has only a single stage, we require a fair amount of current from it, with which to feed the first stage of the main amplifier. If we decide upon 2 milliamps and assume the load resistor to be 200 ohms (this will be the primary of the input transformer to the main amplifier), then our voltage drop will be given by:

$$E = I \times R = \frac{2 \times 20}{100} = \frac{2}{5} = 0.4 \text{ volts}$$

The actual collector voltage then, is (1.5 − 0.4) = 1.1 volts, since the transistor is an OC71 equivalent. Study of the Ic/Vc characteristic for this type of transistor shows that a base current of 40 microamps is necessary. The bias resistor necessary to produce this is given by:

$$R = \frac{E}{I} = \frac{1.5}{40 \times 10^{-6}} = \frac{1.5 \times 10^{6}}{40}$$

$$= 37.5 \times 10^{3} \text{ ohms} = 37K\Omega$$

R is thus 37 KΩ, though higher values up to 50KΩ will not impair the efficiency of the amplifier. In the list of components 47KΩ is recommended, since this is a common value, easily obtained.

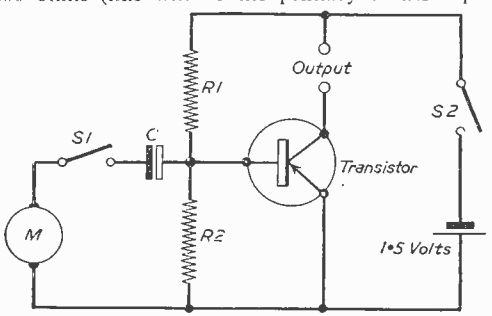


Fig. 1.—The circuit diagram of the amplifier.

Constructional Data

The plastic case of the microphone is made up in three pieces. The front piece can be unscrewed, while to take off the back piece it is necessary to remove three screws. The centre piece now looks like Fig. 2. Eight terminal bolts (6 BA) are visible and are numbered, for convenience, in an anti-clockwise direction from 1 to 8. Terminals 2 and 7 and 1 and 8 form the two-pole switch operated by the black plastic plunger. Terminal 1

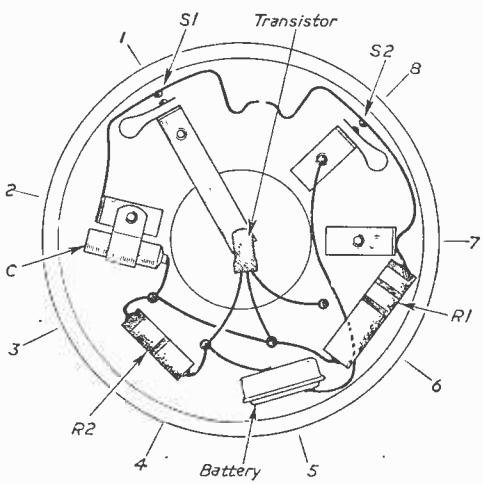


Fig. 2.—General layout; the radial numbers indicate the terminals.

also connects to one side of the microphone insert. The other connection to the microphone is taken from terminal 4. The small lead joining terminals 6 and 8 should be removed. The leaf spring from terminal 8 to the microphone insert is too long, and ½in. should be removed from the free end with a pair of tin snips.

Initially, the transistor should be connected up. The leads should be trimmed until the base (centre lead) measures ½in. to ¾in. The emitter and collector leads should be left slightly longer. For neatness, and to prevent the possibility of short circuiting, short sleeves can be put over the leads. The transistor leads are soldered in, emitter, base and collector to terminals 4, 5 and 6 respectively. The transistor should just rest on the spring leaf. R1, the bias resistor (47KΩ), is connected between terminals 5 and 7, the switch part of 7 being used. R2 is connected between terminals 3 and 4 and a lead taken from 3 to either 5 or the positive side of C. In the illustration this resistor is shown as being ¼ watt, but this is not necessary. The particular one was chosen only on account of its small size. The 8μF electrolytic condenser is connected between terminals 2 and 5 (base connection). The two output leads come from terminals 6 and 7.

Finally, the installation of the battery. The RM 625 is a deaf aid L.T. battery (1.5 volts) and measures just over ½in. in diameter and is just less than ¼in. thick. The positive pole is marked, so that no confusion should arise over this point. The battery will press comfortably in the recess just below terminal 5. The positive pole towards the transistor. Before it is installed, however, connection must be made to it. Two leads are soldered, one to the positive and the other to the negative pole. The soldering should be done quickly, since the battery should not be heated unduly. It is recommended that each pole be slightly trimmed first to ensure a good, quick, clean connection. The battery installed, the positive lead is taken to terminal 4, while the negative goes to terminal 8.

The circuit is now complete.

One point, however, must be carefully noted. Never switch on until a load is connected across the output leads. If this occurs, excessive base current may flow, ruining the transistor.

At this point, difficulty may be experienced in fitting the back of the microphone case in position. This is due to the battery and R (if this should be ½ watt resistor). With a small file, or a sharp knife, the offending pieces in the back can be modified easily, and the case will then fit together. The front of the case may now be screwed up tight and the microphone is complete.

It will be readily appreciated by those who have had much experience of microphones that the quality of reproduction is very greatly affected by the characteristics of the case in which the instrument is fitted. Most Government microphones are primarily designed to work fairly close to the source of sound and to exclude background noise. For this reason most are fitted with a projector or mouthpiece through which the sound must pass to reach the diaphragm. The projection has the effect of distorting the sound to a certain extent, so that the result is not unlike sound heard over a telephone. Fortunately this can be overcome by removing the projection. The front of the microphone should be removed, and the projection sawn off with a hacksaw. The plastic is fairly tough, but care should be taken not to grip it too tightly in the vice. The hole left in this part of the case is now about 1in. in diameter. If it is found that this aperture still distorts the sound, one should increase its diameter until it is about ¼in. short of the diameter of the microphone insert. A grille or mesh can be fitted over the aperture if desired. The instrument complete, it can now be tested. The two output leads should be taken to the primary of the matching transformer of the main amplifier. Pressing the microphone switch, switches on the preamplifier. If there is a loudspeaker at the output of the main amplifier, then the sound input at the microphone may be checked directly against the output from the speaker. One final point—releasing the microphone switch switches off the preamplifier. If occasions are met with when it is inconvenient to hold the switch continuously, a strong elastic band around the microphone will keep it closed.

Brooms and Bombers

ALTHOUGH the connection between brooms and bombers would at first sight appear to be slight, a recent investigation by Post Office engineers shows how the manufacture of the humble household broom nearly swept special aircraft from the skies.

Bombers and other aircraft of the Royal Air Force use radio telephone channels to keep in touch with their control centres on the ground, and these channels were being jammed by radio noise on the same wavelength.

Aircraft flying over Devon, Wales, Northern Ireland and the Home Counties were affected and the Air Ministry asked the Post Office Interference service if they could help to discover the source of the noise. As the radio noise could not be detected on radio receivers used on the ground, special recording apparatus was fitted in one of the aircraft which then flew over some of the affected area and brought back a record of the noise. From these recordings the Post Office engineers were able to deduce the nature of the apparatus likely to produce the interference. Widespread checks were made of hospitals, factories and other organisations likely to use radio-type apparatus which would, perhaps fortuitously, generate and transmit the radio frequency which was causing the trouble.

The cause was ultimately traced to a factory in Sussex where electronic apparatus was used for drying wooden billets used for making ordinary domestic broomheads. Co-operation by the factory director and the manufacturers of the equipment, the R.A.F. and the Post Office enabled modifications to the equipment which successfully cleared the trouble.

Choke and Transformer Winding Methods

DETAILS OF SOME OF THE MORE IMPORTANT POINTS TO BE CONSIDERED WHEN WINDING YOUR OWN COMPONENTS By "Waveguide"

TRANSFORMERS and chokes are not quite so difficult to wind as some beginners imagine. At first sight the winding of, say, a thousand turns, seems to involve a great deal of work, but usually several turns can be wound in a second and several thousand in an hour. It is also possible to use a geared winder, but it is then more difficult to guide the wire by hand, and the machine would require to be made semi-automatic.

The winder can, however, be very satisfactory while taking a simple form, but a turns counter of some kind is almost essential. This is preferably geared to the shaft so that it can add turns wound or subtract if some should have to be unwound. A zero reset is unnecessary. A horizontal bar may be added to steady the hand when guiding the wire.

Choice of Wire

Enamelled wire is not the best for home-made transformers. Paper interleaving has to be added and the winding will then take up more space than when double silk covered wire is used. On gauges as thick as 16 s.w.g., enamel is liable to crack at bends. On the other hand, E. & S.S. (enamelled and single silk covered) or E. & S.C. wire is adequately protected and will not corrode. Double cotton covered wire usually takes up too much space, but is probably the best choice for heater windings of thick wire.

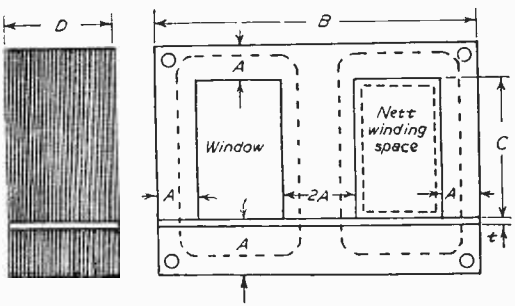


Fig. 1.—Laminations of the E & I type, especially suitable for a choke. The length of magnetic path, l, is that of either dotted line. Effective gap=2t. Volume=2AD(B+2C).

The transformer bobbin can be constructed of pieces cut with a fret saw from 1/16in. insulating material. The construction shown in Fig. 2 involves six pieces. Once these have been put together and some adhesive strip wrapped round the former, the projections will prevent it from coming apart, and so eliminate this source of trouble. A series of holes should be drilled where the leads are to emerge. If there is any doubt as to the positions, the holes can be elongated by using a tension file in a hacksaw frame. Holes at the corners can be used for fastening tags or tag strips.

Except in very large transformers it is safe to use D.S.C. wire without interleaving, providing that the bobbin is evenly filled. With fine wire it is not necessary to wind the turns exactly side by side, but with thicker gauges this is desirable, and a piece of interleaving should be inserted whenever the winding is becoming uneven. The more rounded the former, the easier it is to wind the turns closely side by side. The thicker heater windings of a mains transformer must, of course, be on the outside where sharp bends are unnecessary.

Ideally, a transformer core would be circular in cross-section, and a square centre-limb approaches this more nearly than an oblong, but in some circumstances it may be necessary to use a deeper stack of laminations to reduce the number of turns or to increase the power-handling capacity.

On the completion of a winding it can be covered with empire cloth or ordinary insulating tape. When space is limited, one layer will often be sufficient, but only if no interstices are left.

Wax-dipping

Impregnation of the transformer is worth while to avoid corrosion and to improve the insulation resistance. The application of varnishes during the winding is inconvenient, and special varnish is necessary. Shellac in methylated spirit cannot give a high insulation resistance since it is difficult to drive out all the spirit even by prolonged baking. Some oil varnishes also refuse to oxidise or polymerise and remain sticky. This in some cases actually causes corrosion.

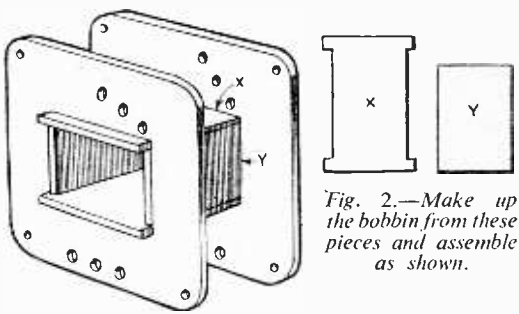


Fig. 2.—Make up the bobbin from these pieces and assemble as shown.

Wax-dipping is a much better method, assuming that the transformer in use will not heat enough for the wax to melt and run out. The process consists of heating a quantity of paraffin wax until the wax can travel up a strip of paper dipped into it (but not any hotter than necessary). The transformer, complete with laminations, can then be lowered into this. Air in the windings expands and emerges in bubbles.

When the wax cools, the remaining air contracts and wax infiltrates into the windings. The transformer is removed before the wax begins to congeal. The laminations are also protected from corrosion and vibration is prevented even when the clamping arrangements are not perfect, which is often the case when the laminations are without holes for securing bolts. (Some loudspeaker transformers give quite an audible output with the speaker disconnected.)

Enamelled wire stands up sufficiently well to wax-dipping, but it must not later be unwound and used again, since the enamel may show a tendency to flake away.

Designs

The turns per volt of the windings in a mains transformer is obtained by dividing 7 by the core area in square inches (i.e., by the cross section of the centre limb). The power-handling capacity in watts is taken as 31 times this area squared. Larger outputs can be drawn but at lower efficiency. Some allowance may have to be made for the resistive voltage drops in the windings, but the exact number of turns in a heater winding is probably best adjusted by experiment, when supplying the required current. An accurate moving-iron voltmeter may be used for the purpose. Normally one finds that the output from one secondary winding is only slightly affected by the current drawn from another winding.

Leakage inductance is the part of the inductance of a winding which is not coupled into another winding. It has little effect at mains frequency, but in a loudspeaker transformer it may cause a large drop in the amount of power transferred at the higher frequencies. For this reason output transformers for an extended frequency response have the secondary sandwiched between primary sections, and a double bobbin with balanced windings is best for a push-pull output stage. The mutual cancellation of the D.C. ampere-turns due to the two valves preserves a high primary inductance which is necessary to maintain the primary input at low frequencies.

The voice-coil resistance, taken at some nominal figure rather larger than the D.C. value, is stepped up by the square of the transformer turns ratio to give the anode load recommended for the valve. The application of a substantial amount of negative feedback reduces the effect of mismatching.

When a single output valve is employed, the loudspeaker transformer has to be gapped like a choke. In making a smoothing choke the volume, V, of the iron in the laminations (c. in.), and the average length, ℓ inches, of either of the two magnetic circuits should be calculated. Then the following inductance can be obtained:

$$L = 0.05 \frac{V}{I^2} \text{ henrys,}$$

where I is the direct current in amperes.

To accomplish this, the number of turns should be:

$$N = 96 \frac{l}{I}$$

and it will be necessary to adjust the gap carefully. To do this the choke should be inserted in circuit with the load connected, but without the output smoothing condenser. An indicator such as a vacuum tube voltmeter is connected across the load, and the thickness of the gapping material is adjusted until the ripple voltage across the load is at a minimum. The inductance will then be the maximum obtainable with that amount of direct current flowing. With a smaller direct current the inductance would be higher. Accurate adjustment of the gapping can produce a considerable increase in inductance. For example, with a current of 240 mA. through a choke it was found possible to raise the inductance from about 1½ henrys (with zero gap) to 2½ henrys with the optimum gap. E & I laminations have the advantage that the three gaps are in line, but V and T laminations can be utilised when necessary.

Accommodating the Windings

Leads taken out from a transformer should consist, in the case of thin wire, of at least four strands. The strands are bared at the end, twisted with, and soldered to the wire of the coil. A piece of insulation tape is placed below and another piece pressed over the junction, which should not have any sharp projections, such as spikes of solder.

It is simpler to abandon the double-windings and heater windings which a full-wave valve rectifier requires, by using metal rectifiers instead. In fact, quite a small secondary will suffice with a voltage-doubler, but the wire should be thicker than the primary in order to secure a low resistance and good regulation.

For a transformer of round about 30 watts (core area 1 sq. in.) the primary may be of 32 to 30 s.w.g., according to the room available. A secondary supplying a voltage-doubler rectifier could then be of, say, 26 s.w.g. This gauge would also serve in a heater winding to supply a single 0.3 amp. valve. Larger currents, up to at least 6 amperes, can be obtained from a single 16 s.w.g. winding.

The net winding space will be less than the "window" of the laminations by at least 1/16in. all round, and inter-winding insulation must also be allowed for. The wire table enables the turns per layer, and depth of each winding to be calculated, but in practice the latter may be somewhat exceeded owing to the springiness of the wire. Mean turns can be roughly estimated by placing a piece of wire loosely about the former and measuring its length. The two columns on the right then enable the resistance and weight of each winding to be assessed.

S.W.G.	mA.*	Turns / Inch (Close Wound)		Ohms per 1000'	Oz. per 1000'
		D.C.C.	E. & S.C.		
16	3,200	13.2	13.4	0.210	16.5
18	1,800	17.0	17.3	0.374	9.29
20	1,000	21.3	21.8	0.664	5.23
22	620	25.6	26.4	1.10	3.16
		D.S.C.	E. & S.S.		
24	380	40.0	39.0	1.78	1.95
26	250	48.8	47.5	2.66	1.30
28	170	57.8	55.3	3.93	0.883
30	120	67.1	67.1	5.59	0.621
32	92	75.2	76.2	7.39	0.470
34	66	85.5	88	10.2	0.341
36	45	99	102	14.9	0.233
38	28	118	126	23.9	0.145
40	18	137	147	37.4	0.0929
42	13	161	166	53.7	0.0647
44	8	185	200	84.2	0.0413
46	4.5	217	242	150	0.0232

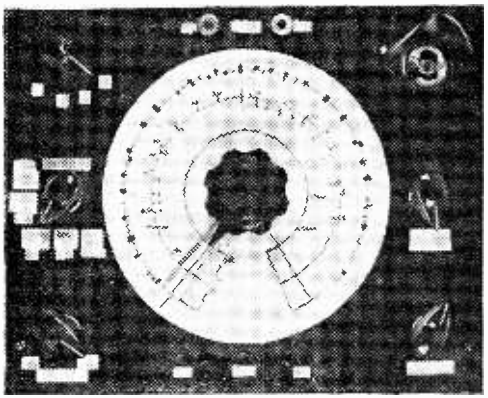
* At 1,000 amp./sq. in. (This current density is occasionally doubled.)

A C.R.L. Bridge

MEASURE CAPACITANCE, RESISTANCE AND INDUCTANCE WITH THIS HANDY TEST SET

By J. Hillman

THIS is a conventional bridge completely self-contained, enabling measurements of resistance, capacitance and inductance to be made. It employs an amplified null indicator, thus enabling a better balance point to be obtained, and has a choice of two oscillator frequencies, namely 50 cycles and 1,000 cycles. On the resistance range, from 0.1 ohm up to 100 megohms can be measured, whilst on the capacitance range, from 3pF to 100μF can be measured. On the inductance range, from 10 m. henries to 100 henries can be measured. Provision is also made for matching resistors or capacitors. A power factor control is fitted and gives an indication of the quality of both capacitors and inductors. The accuracy of the instrument depends on the accuracy of the standards used and, if possible, only 1 per cent. components should be employed and they should be stable. The null indicator can be used separately by connecting leads to X1 and chassis, with S2 in the M position, and so can be used as an output meter when aligning sets and also can be used to check A.V.C. The



View of the panel.

1,000 cycle oscillator can also be used separately by connecting leads to X2 and M1, with S2 in the M position, and thus can be used to give an audible note for testing amplifiers and loudspeakers. Its output is approximately 8 volts.

Construction

Mark out as Fig. 4 and bend up the half-inch edges at right angles. Now mark out chassis, as Fig. 3, and bend in alphabetical order, A bend first, then B and so on to K. Secure H and I to J with 6 B.A. bolts and nuts and then proceed to mark out front panel as Fig. 2. Drill and cut out holes as shown and then bolt up the front panel to the chassis, when it should appear as Fig. 5. Now mark out the chassis as Fig. 14 and drill and cut out holes as shown, then mark out and cut out cover as Fig. 7, then bend to form shape as Fig. 9, securing with 6 B.A. bolts and nuts. Now place cover in position over chassis and front panel and mark position of two holes only, drill these 3/32in. and secure cover with self-tapping screws, 6 B.A. Then proceed to drill rest of holes and fit screws as each hole is drilled. This method ensures a good fit and avoids errors in marking out and drilling. Now make bottom panel as Fig. 6 and fit in same way to bottom of chassis. Before proceeding further it is a good plan to paint the outside of the instrument and if a black crackle finish is needed then the procedure is as follows. Use "Panl" crackle paint, sold in tins at 3s. a tin, and apply like ordinary paint, but only do one side at a time. Having applied the paint to one side suspend that side horizontally over a small paraffin lamp so that there is a slight tract of smoke from the lamp. Leave for an hour or so, when the

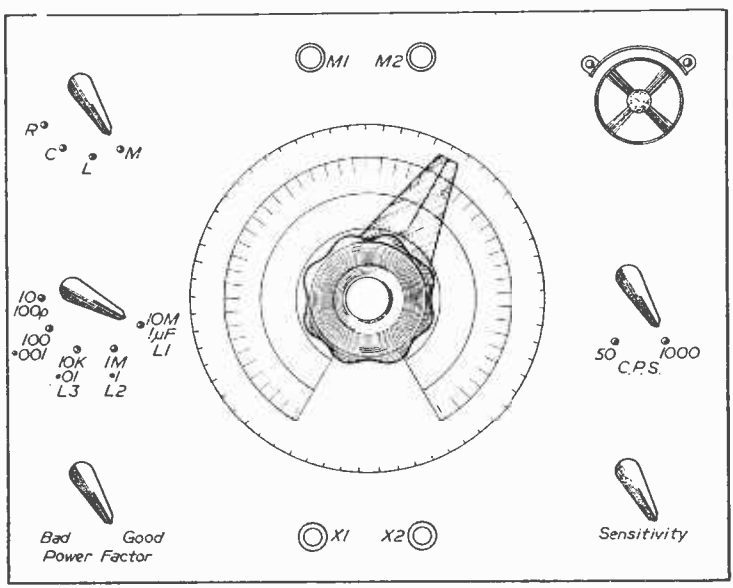


Fig. 1.—Details of the panel shown in the illustration above.

paint should have crackled, and it can be placed aside to dry. Do the other sides in the same way and when thoroughly dry the next operation can be tackled. Make up a bracket as Fig. 8 and secure clip to base of EM34, having first bent up the 1in.

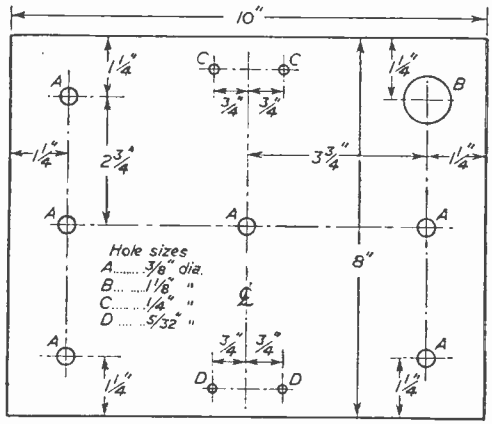


Fig. 2.—Panel drilling data.

end at right angles. Now fit the panel components and chassis parts. wrap a piece of sponge rubber 7/8in. wide and 3¾in. long around the top of the EM34 to form a cushion and make a snug fit against the front panel and place it in position so that the top of the valve is central in the hole in the panel. Now mark off the two holes in the bottom of the EM34 bracket and drill and fit screws. Cut out and drill pointer as Fig. 13, then place on knob and mark out and drill two holes, tap 6 B.A. and fit pointer; this can then be fitted to VR1. Fit components as Figs. 11 and 12, the L.F. 5:1 transformer is fitted below the chassis and near to V1. The 10-watt resistor R15 and condenser C11 are also fitted below and near V4. It will be noted that only half of V2 is used and a 6J5 could be used here, but is not so handy to wire up as the grid is a top cap. On the circuit diagram Fig. 10 (page 788) the valve pins are numbered as they appear looking at the valve-holder from below the chassis. The terminals M and X are insulated sockets. The resistor R6 is

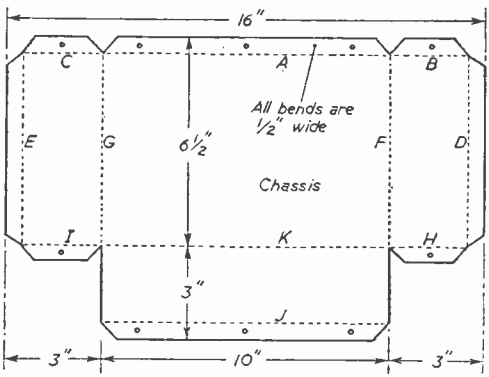
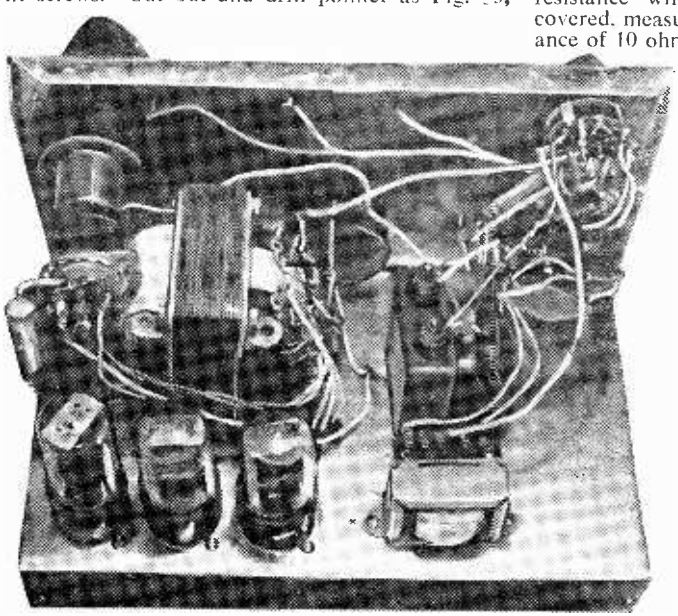


Fig. 3.—Details of the chassis.

not a commerical one, but is easily made up as follows. Take some 31 s.w.g. Eureka or Constantin resistance wire,. preferably silk and enamelled covered. measure off 56½in.. and this gives a resistance of 10 ohms. Allow about half an inch at each end for soldering and solder a piece of 20 s.w.g. T.C. wire at each end. Thread the ends through a piece of Paxolin half an inch



General view of the chassis layout.

PARTS

R1-4.7k	R11-10k
R2-47k	R12-2 meg.
R3-1k	R13-1 meg
R4-100k	R14-1 meg.
R5-10	R15-7.5k 10 w
R6-10 ohm precision.	R16-1k
R7-100 ohm precision.	VR1-10k pot w wound
R8-10k ohm precision.	VR2-2 meg. carbon
R9-1 megohm precision.	VR3-3k pot carbon
R10-10 megohm precision	
C1-8 μF 350 v. tubular	
C2-.001	
C3-.001	
C4-1 μF block paper	
C5-.1 mica or tubular	
C6-.01 mica	
C7-.001 mica precision	
C8-100pF " " "	
C9-.1	
C10-.1	
C11-8 μF 350 v. tubular	

wide and 2in. long. then get the centre point of the wire and double it back on itself to form a Bifilar winding when wound on the Paxolin. The reason for using a thin piece of Paxolin and a Bifilar winding is to counteract the inductive effect of the winding as otherwise its resistance would not be stable but would vary according to the frequency of current passing through it. Precision resistors can be obtained fairly easily and capacitors in the lower values. but some difficulty may be experienced in getting some higher values. Up to 5.000pF capacity the price is 2s. each, but above this value the

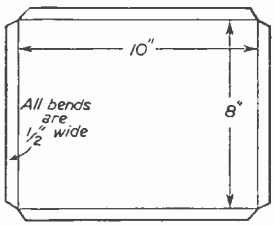


Fig. 4.—Bending data for the panel.

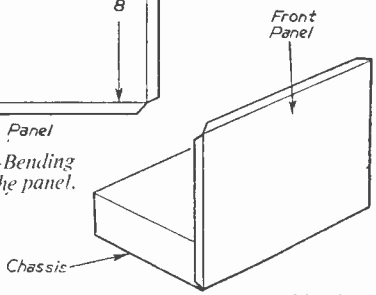


Fig. 5.—General assembly data.

price rises rapidly; however. for 0.01 use two 5.000pF in parallel. With the 0.1 a mica one can be expensive and the next best thing is to select a good paper one. preferably oil filled. If you have several to choose from then leave this range until the 0.01 range has been calibrated and use it to select the most accurate one and the one with the least losses. Similarly for the 1μF use a selected block paper component. It will be noted that no reservoir condenser is fitted to the smoothing circuit, and the reason is to keep the H.T. voltage down and to avoid having to

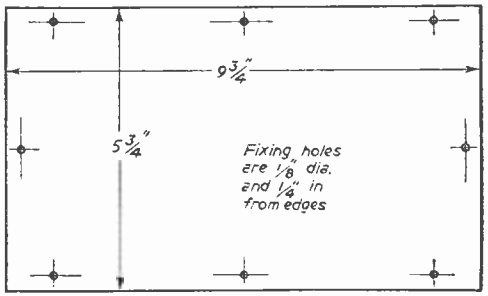
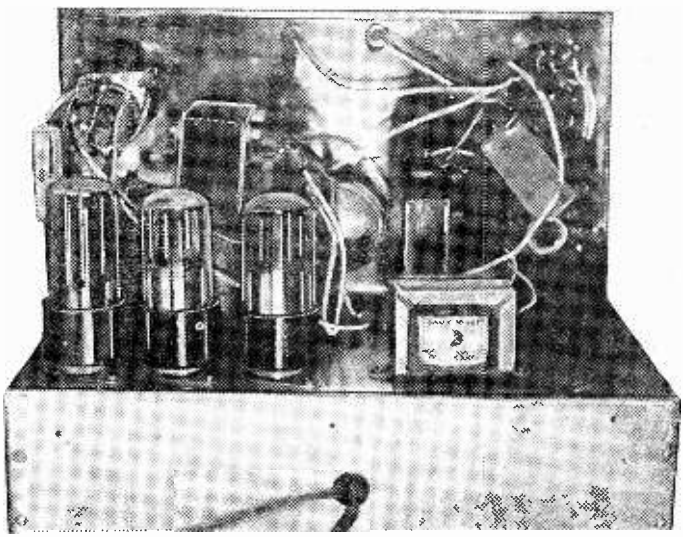


Fig. 6.—"Lid" for the bottom of chassis.

use too high a voltage dropper. With 150 volts at junction R1. R2 the oscillator will give roughly 1,000 cycles. The frequency is not critical and need not be stable, as it does not affect the accuracy of the bridge. for whatever frequency is used it passes through both the standard and the unknown and although their reactance varies according to frequency their ratio remains the same and it is in the measurement of the ratio that the bridge is calibrated. The reason for having two test frequencies is that on some ranges a better null point can be obtained with 50 c.p.s., whilst on others the reverse is the case. With inductors it is much more difficult to get accurate standards and as most of the data for ordinary service work is merely concerned with whether a choke or coil is the required value no great accuracy is required. For the first two

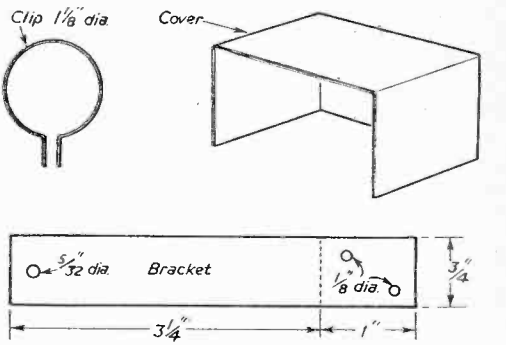
1ST

- 1 midget output transformer
- 4 insulated sockets
- 4 Int. octal valveholders
- 1 mains transformer
- 2 1 amp. fuses
- 1 Twin fuseholder
- 1 3 pole, 5-way switch S3
- 1 3 pole, 4-way „ S2
- 1 2 pole, 2-way „ S1
- 1 DPST toggle switch S4
- 5 small pointer knobs
- 1 large round knob
- 2 wander plugs
- 2 crocodile clips
- Aluminium, 7/33 flex, 23 36 flex, 20 s.w.g. TC, as required.
- 4 and 6 B.A. nuts and bolts. self-tap 6 B.A. screws, as required.
- 2 6SN7gt valves, V1, V2
- 1 EM34 valve V3
- 1 5Y3GT valve V4
- 1 mains lead
- 1 tin black crackle paint



A rear view of this test set.

ranges covering the L.F. chokes a small output transformer is used as a standard, and with this it is quite easy to distinguish between a 5- and 10-henry choke as the distance between their calibration marks is about one and a half inches. The third range has a 1K resistor as a standard, and with this on the 1,000 cycle input the lowest reading on the scale is 2,000 micro-henries. Readings below this figure are not possible because the reactance of the inductor is far less than its D.C. resistance, and you would be measuring resistance rather than inductance. Take, for example, a 2,000 micro-henry coil. Its D.C. resistance is about 40 ohms, whilst its reactance at 1,000 cycles is only 13.8 ohms, whilst at 50 cycles it is only 0.69 ohm. With, say, a 10-henry choke, its D.C. resistance may be 250 ohms, but its reactance at 50 cycles would be 3,141.6 ohms, whilst at 1,000 cycles it would be 62,832 ohms, and therefore its D.C. resistance is only a small fraction of its A.C. one. The D.C. resistance of the coil depends on the number of turns of wire and also on the diameter of the wire, so that



Figs. 8 and 9.—Details of the condenser clip and cover for the set.

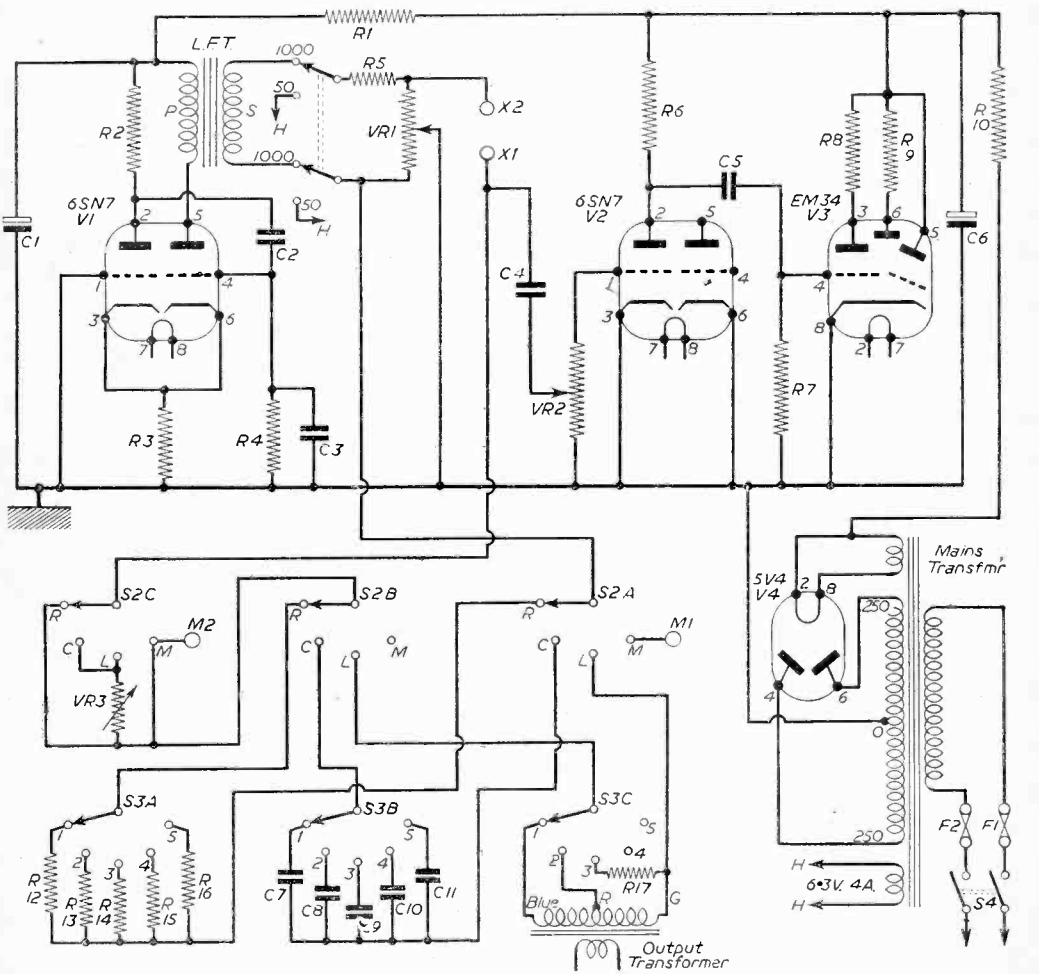


Fig. 10.—Theoretical circuit of the test set. A list of parts will be found on the previous page.

although two coils may have the same inductance. but wound with different gauge wire, their resistance to D.C. would be different. On A.C. the D.C. resistance remains the same. with the addition of the reactance, and unless this D.C.

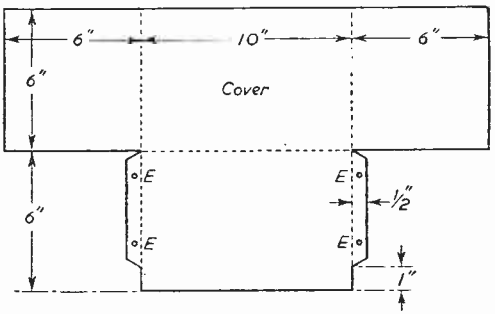
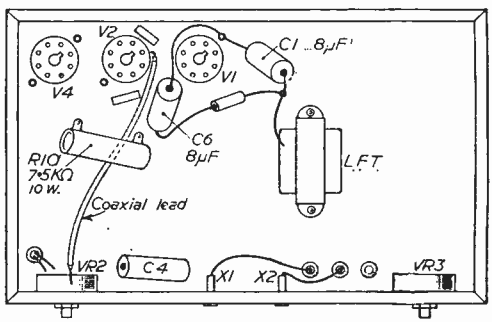
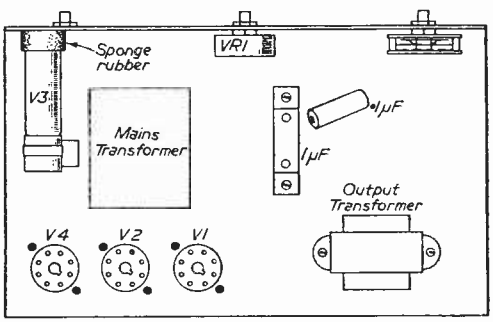


Fig. 7.—Details of the cover.

resistance is only a small part of the total. the true inductance cannot be found. One point to note in calibrating on range 3L is that two different readings will be obtained with the two test frequencies. but as a null point will only be obtained with the 1.000 cycles frequency. use this for test and calibration. Separate scales are used for the three inductance ranges, each individually calibrated. For wiring up the components use 7/33 PVC coloured wire except for the standards, and for this use 20 s.w.g. T.C. Make up two test leads from single 23/36 flex about three inches long and having at one end a wander plug and at the other a crocodile clip.





Figs. 11 and 12.—Top and underside of chassis layout.

Calibration

Start with resistor range first, place S2 to R, S1 to 50 c.p.s., S3 to 10K range. Ideally the best method is to use precision resistors in 20 steps to get the scale accurate at all points. but it is most unlikely that these will be available. In my case I only had three precision resistors, 50K, 5K

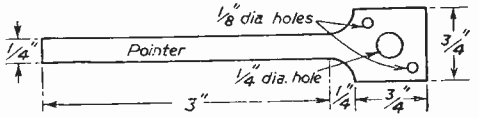


Fig. 13.—Pointer details.

and 1K. Using the 10K range. connect up the 5K resistor to X1 and X2. switch on the bridge and advance VR2 until shadow on EM34 commences to close. then move VR1 until shadow opens again. advance VR2 to close shadow then re-adjust VR1 to open shadow. Continue this until a definite point is reached on the scale of VR1, at which the shadow closes either side of it. mark this point on the scale 0.5 for use when the range is multiplied by the reading. Thus 10K by 0.5 the answer is 5K. Do the same with 50K, the mark in this case being 5, whilst for 1K the mark will be 0.1. We now have three marks on the scale and by connecting the 5K and 1K in series we get a fourth mark 0.6. Now mark off the centre of the scale and mark this 1. Now divide the distance between 5 and 1 in half and mark this point 2. Now use a number of 10 per cent. resistors and by taking the average of the markings mark off the points in between. The scale will not be uniform, but will be cramped slightly at each end. The only points that need be marked are from 1 to 10. and from 1 to 0.1. The spaces between these marks can be divided up

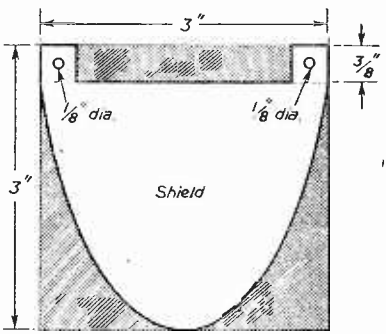


Fig. 15.—Details of the indicator shield.

(*Continued on page* 801)

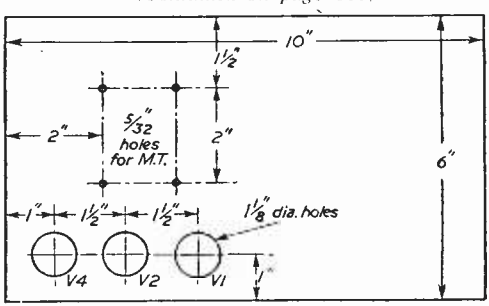
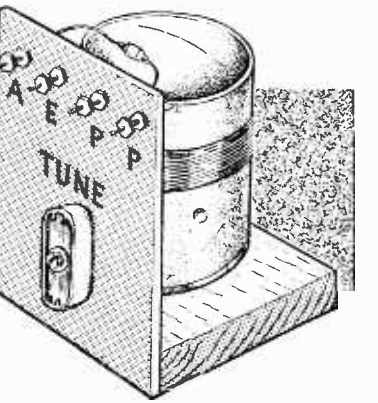


Fig. 14.—Chassis drilling details.

A BEGINNER'S CONSTRUCTIONAL COURSE

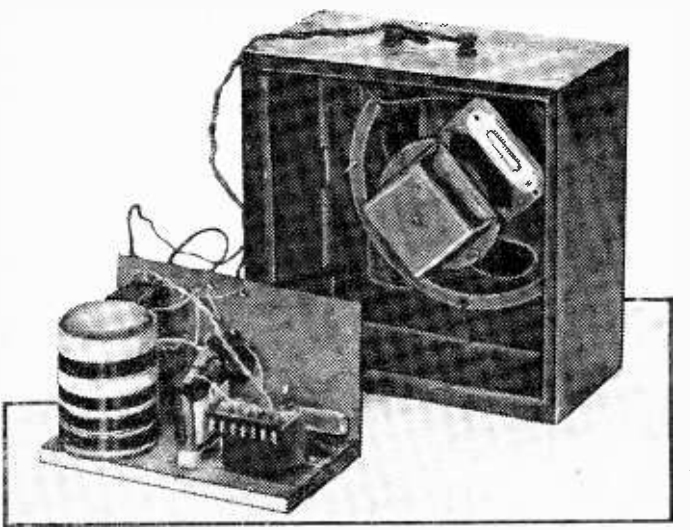


AS DISTINCT FROM A THEORETICAL COURSE, THIS SERIES STARTED WITH A SIMPLE CRYSTAL SET, IN THE OCTOBER ISSUE, WHICH HAS GRADUALLY BEEN MODIFIED IN STAGES, AND IS NOW COMPLETED AS A CRYSTAL AND TWO TRANSISTOR LOUDSPEAKER SET

By E. V. King

(*Concluded from page 688, December issue*)

THE original set will now have been modified to include variable selectivity, a volume control and one transistor, and it is hoped that the beginner will have carried out the experiments suggested. These may be carried out again with advantage when the transistor has been fitted as more volume will be available. If you have not made the receiver you could do so now, and remember that the transistor stages can be fitted to any crystal set provided you put the crystal the right way round (trial and error will do). Never carry out a modification until the previous one is working well; this is advice essential to the beginner and not to be laughed at by the expert. A complete circuit diagram is given in Figs. 28 and 29.



The finished set connected to the loudspeaker.

How to Get Loudspeaker Volume from the Crystal Set

A further transistor may now be added to bring the volume up to loudspeaker strength. Naturally you cannot expect the loudness to be suitable for a rowdy party or large hall, but for the den or bedroom it is very suitable indeed. The circuit has been especially kept simple and is dead easy to get working, but with experience the experimenter could fit push-pull output and get added volume.

The tuning arrangements and diode are left intact. The T2 battery is not required, the transistor and 220K resistor are temporarily removed. An ordinary multi-ratio transformer is then fitted (see Fig. 29). A battery clip is made (Figs. 30b and 27) from cocoa-tin material, which may be cut with scissors. Two busbars of the same material (Figs. 30a and 27) are made and fixed to the wooden base with tacks or screws. Four brass drawing pins are pushed into the base as shown in Fig. 27, they act as very convenient tags for fixing the transistors, but these are actually left in the spares box until everything else is wired up.

It is usual, and good policy, to fit speaker and aerial terminals remotely from each other, but the writer found no ill effects on leaving the original phone terminals for the speaker. However, you may either move them to the other end of the panel or take the speaker leads direct from the transformer (Fig. 29).

(*Continued on page 793*)

RETURN-OF-POST SERVICE

MULLARD TAPE AMPLIFIER TYPE "C"

THE MULLARD TAPE AMPLIFIER TYPE C is a new version of the Type B Amplifier. It comprises a recording amplifier and a play-back Pre-Amplifier, and is intended to use an existing amplifier for play-back. It uses a Ferroxcube Inductor in the treble boost circuit and has a switch for the speed equalising circuits in place of the plug-in unit on the Type B Amplifier. The circuit gives details for use with Brenell, Collaro, Truvox and Lane Tape Decks.

INSTRUCTION MANUAL is available from us free of charge. Please send 4d. in stamps to cover cost of postage.

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PLUGS AND SOCKETS.—Belling Lee. L734S. 1/-. L804S. 1 3. L734P Plugs. 1 3. Elcom. PO4 Chassis Plug. 3 6. S04T Flex Plug. 5 3. Igranic Jack Sockets. P71. 3/4. P72. 3 10. Bulgin P38 Jack Plugs. 3 -.

VALVE HOLDERS.—McMurdo. BM9/U, 10d. XM9 UG1. 1/7. XM9 UG1. 2 3.

KNOBS.—Bulgin K370. 1/6. **CERAMIC INSULATORS.** 1/-. **ESCUTCHEON FOR EM81.** 2 6. **SUNDRIES KIT.**—Nuts. Bolts. Wire, etc., 7/6.

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KIT A.—With alternative valves. £14.0.0.

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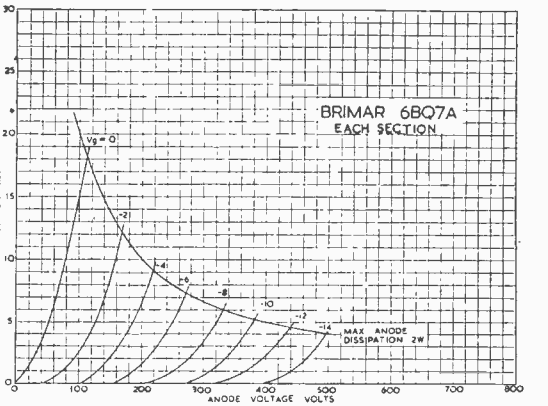
BRIMAR 6BQ7A

The Brimar 6BQ7A is a double triode consisting of two independent high slope sections with similar characteristics. The valve is particularly useful as a cascode R.F. amplifier for television receivers and also as a combined oscillator and mixer for frequency modulation receivers. It can, of course, be used wherever high slope triodes are required, and features low interaction between the sections as an internal screen is provided which is brought out to a separate base pin.



TYPICAL CHARACTERISTICS

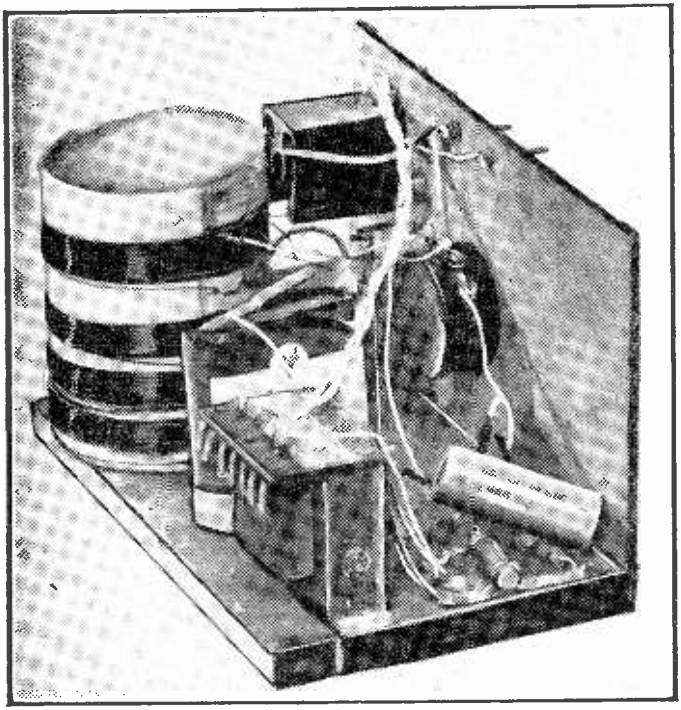
Heater voltage	6.3 volts
Heater current	0.4 amp
Anode voltage	150 volts
Cathode bias resistor	220 ohms
Anode current	9 mA
Mutual conductance	6.4 mA V
Amplification factor	39
Anode resistance	6,100 ohms
Grid cut-off voltage (I_a—10μA)	—10 volts approx.

Write to the Publicity Department for a data sheet.

Standard Telephones and Cables Limited **FOOTSCRAY SIDCUP KENT** **Footscray 3333**

A Suggested Plan for the Beginner to Follow

Refer to Figs. 27, 28 and 29. Note that in



Another view of the complete set.

Fig. 29 the front panel has been laid flat and some of the wires are shown longer than they really are.

Wire the earthy side of the volume control VR1 to the plus busbar. Wire the short tag (plus) of the battery (Ever Ready. flat torch. No. 1289) to S2, and the other side of S2 should already be earthed via C2. The other side of the volume control is connected to Drawing Pin 1. Solder R1 to pins 1 and 2, R3 between Pin 2 and the negative busbar. Solder R5 between pin 3 and positive busbar. The long strip (minus) of the torch battery is then connected to the negative busbar.

Now recheck that the battery is connected the right way round. The carbon rods are positive and the zinc casing is negative.

C3, the coupling electrolytic condenser, is now connected between pins 2 and 3 and is left "in air" on leads about 1in. long. There is always a mark of some kind on these condensers and it must be connected the right way round. Do not use an old one for this job.

The transformer is now connected. The writer used an ordinary multi-ratio speaker transformer which he had to hand. The method of use (auto-transformer) is rather unusual. The tags which are shown for use with a pentode are taken to Pin 4 and the negative busbar (Fig. 29). The speaker tags are not used. The speaker is connected to the tag normally used for "power valves" and the other to the adjacent pentode tag (there will thus be two wires on this tag).

Of course, if you wish you may use a special transistor transformer, in which case the primary winding goes to Pin 4 and the negative busbar. The speaker going directly to the secondary. In any case the ratio of these transformers is not very critical and you will do no harm by experiment on this part of the set.

Torch battery, flat type. Ever-Ready 1289, 4½ volts.
R3—2.2 k. ½ w. resistor.
R4—25 k. ½ w.
R5—10 k. ½ w.
C3—Electrolytic condenser, 25 v. 25 µF.
Tr2 Transistor OC71 or red spot.
Speaker Transformer, Standard Multi-ratio (R.S.C.) (or special transistor output transformer).

Parts required if the one transistor receiver has not been made

Detergent Box, 24 turns 26 s.w.g. enam. copper wire and 3 x 40 turns of 32 s.w.g. enam. copper wire.
C1 and C2—500 pF trimmers (R.S.C.).
D1—Crystal diode.
R1—220 k. ½ w. resistor.
VR1—Volume control, 50 or 30 k.
Tr1 transistor, OC71 or Red Spot.
S1 and S2—Toggle switches.
Four terminals.

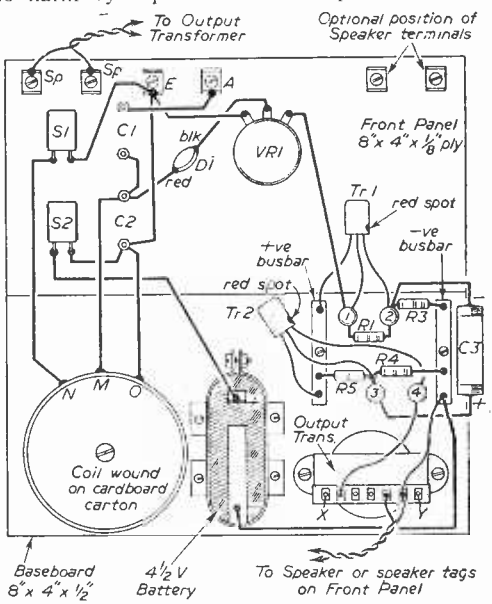


Fig. 29.—The practical wiring diagram.

How to Check the Wiring

When using transistors it is even more important than with mains receivers that you check the wiring carefully before switching on or connecting the transistors in circuit. A good method which the author uses is to copy out the circuit on a piece of paper in pencil and to ink it in bit by bit as it is checked. Everyone makes mistakes, but this method will find them!

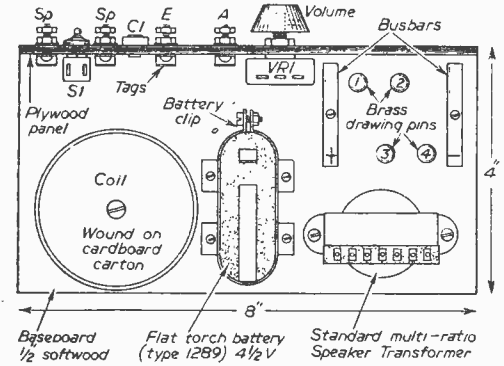


Fig. 27.—Top view of two transistor layout.

Fixing the Transistors

Wire in the OC71s or Red Spot transistors. remembering the safety precautions necessary with these delicate parts. Here is a suggested plan to follow. Switch off S2. Wire Tr. 1 with emitter (remote from red spot) to positive busbar, base to pin 1 and collector (red spot) to pin 2. Wire Tr. 2 with emitter to the positive busbar, base to pin 3 and collector to pin 4.

Never shorten the leads. solder in positions quickly, leave them suspended "in air." Make sure there are no shorting wires.

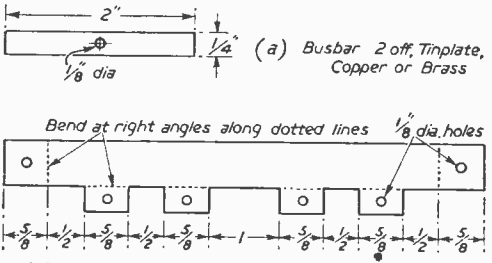


Fig. 30.—Details of the busbars and battery clip.

Testing the Receiver

Connect up in the usual way, tune with C2 and adjust C1 for best results with your aerial,

(*Continued on page 801*)

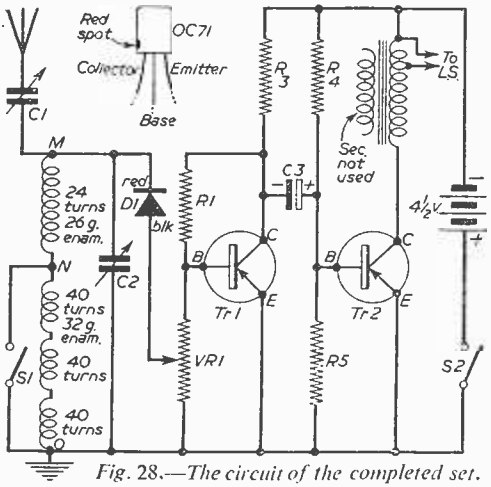
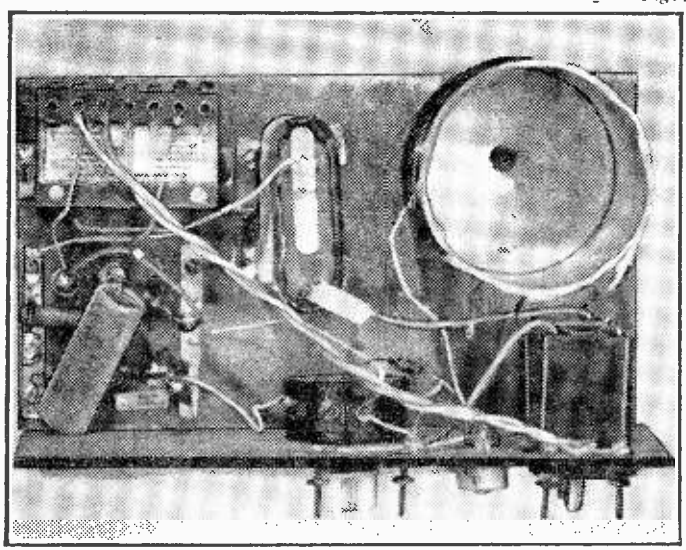


Fig. 28.—The circuit of the completed set.



Plan view of the final stage of construction.

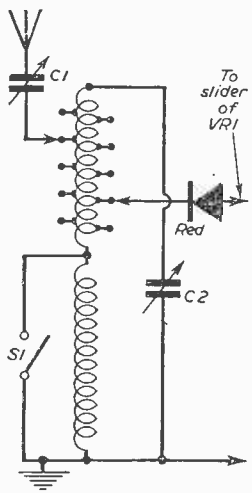
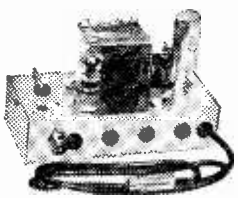


Fig. 31.—Circuit of an improved tuner.



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Linear Ratio, 10,000 ohms — 2 Megohms. Less switch, 3/- each. **Coax plugs**, 1.2. **Coax sockets**, 1/-. Couplers, 2.3. **Outlet boxes**, 4/6.

TWIN-FEEDER, 80 ohms, 6d. yd.; 300 ohms, 8d. yd. **TWIN SCREEN FEEDER**, 80 ohms, 1/3 yd.

TRIMMERS, Ceramic, 4 pf.—70 pf., 9d.; 100 pf., 150 pf., 1/3; 250 pf., 1/6; 400 pf., 1/9. **PHILIPS** Beehive Type—2 to 8 pf. or 3 to 30 pf., 1/- each.

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CARBON		WIRE-WOUND	
20% Type, ½ w., 3d.; ¼ w., 5d.; 1 w., 6d.; 2 w., 9d.		5 w.	25 ohms—1/3
		10 w.	10,000 1/6
		15 w.	ohms 2/-
10% Type, ½ w., 9d.; 5% Type, ½ w., 1/-; 1% Hi-Stab, ½ w., 2/-.		5 w.	15,000 — 1/9
		10 w.	33,000 ohms 2/3

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3w. LAB. COLVERN, etc. Standard Size Pots, 2½in. Spindle. High Grade. All Values, 100 ohms to 50 K., 5/6; 100 K., 6/6 **W/W EXT. SPEAKER CONTROL**, 10 Ω, 3/-.

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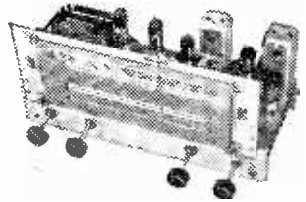

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6Q7	8/6	EBC41	10/6	EL84	11/6
6SN7	8/6	ECC83	9/6	EY51	10/6
6V6	7/6	ECC84	12/6	EZ40	8/6
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7C6	9/-	ECH42	10/6	PCC84	10/6
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PCF82	10/6	PL82	10/-	U22	8/6
PCL83	12/6	PL83	11/6	U25	11/6
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8/450 v. B.E.C.	2/3	8+8/450 v. T.C.C.	4/6
8/500 v. Dub.	2/9	8+16/450 v. Hunts	5/-
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16/500 v. Dub.	4/-	32+32/450 v. T.C.C.	6/6
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SPEAKERS.—PM-3 ohm. 2½in. Elac., 16/6. 3½in. Goodmans, 18/6; 5in. R. & A., 17/6; 6½in. Celestion, 18/6; 7 x 4in. Goodmans, 18/6; 8in. Rola, 20/-; 8in. Special Cone 6/mans., 21/6; 10in. R. & A., 25/-.

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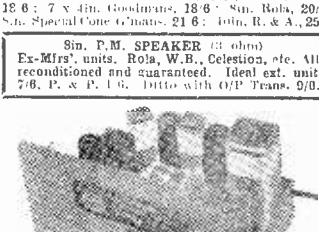

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2-day alignment service now available 7/6 plus P.&P.

TRANSISTORS in Practice

AN EXPERIMENTAL TRANSISTOR CHASSIS

By R. Hindle

(*Continued from page 696, December issue*)

AS pointed out last month, due to manufacturing tolerances, the current gain can vary. For a collector current of 500 μA., there could be a base current of the order of a thirtieth of that current, say 17μA. This current flows through R1 in addition to the current drawn by the potentiometer R1 and R2 in series across the battery. For good regulation it is necessary for the potentiometer current to be many times the base bias current. The smaller these resistors are made the greater will be the potentiometer current and the greater will be the stability of the circuit, but there is a lower limit set by the need for economy in battery current. Another point is that R2 is in parallel with the input of the transistor and so will rob it of signal if made too small. A reasonable proposition will be to make the potentiometer current ten times the base current for the lower limit quoted for current amplification (i.e., 17 μA.) say 200 μA. This is not likely to upset any battery used for power. Base current through R1 having thus been made negligible compared with the potentiometer current, there is no point in splitting hairs by introducing it into calculations and so the combined value of R1 in series with R2 is calculated by Ohms Law to drop 6 volts at 200 μA, i.e., 30,000 ohms. The base has to be slightly more negative than the emitter to give the base bias in the correct direction, and the emitter is .9 volts negative with regard to the earth line (500 μA. through 1.8 K ohms). Actually the base to emitter voltage is .1, so the base to earth line potential must be 1 volt. R2 must therefore be a sixth of the total potentiometer resistance, i.e., 5 KΩ, and the other limb, R1, must be five sixths, or 25 KΩ—the nearest common values, 4.7 KΩ and 22 KΩ will actually be chosen. R2, at 4.7 KΩ, is large compared with the input resistance of the transistor (1 KΩ) and, though some signal current will be lost in this lower potentiometer resistor, R2, it will not be serious.

The voltage of the battery will drop with use below its nominal value and this will cause a drop in voltage across R3, R4 and T1 in equal proportions. Supposing that the battery is to be allowed to drop by about 25 per cent. before being replaced. There will then be 1½ volts across T1, which will still be satisfactory for the small signal current condition. The emitter voltage will drop by a quarter but will still give adequate stabilisation and the base voltage will drop in like proportion to hold the base/emitter voltage at a reasonable level. The permissible output current will also fall, but the following transistor will have suffered similarly, and as a consequence will be able to accept only a reduced input before distortion attains serious proportions. The stage will be able to accept only a smaller input signal before overloading, as the battery runs down because of the reduced current swing available at the collector, but in practice it will be the subsequent output stage that governs the limit in signal input to this amplifier, which will be able to load the output stage down to the level that the battery will be used.

On the other hand, supposing the circuit had to be worked on a higher voltage than that specified? The current conditions having been set up satisfactorily for the 6-volt supply, all that need be done is to mop up the excess voltage by increasing R1 and R3. A 9-volt supply, for instance, would require the extra 3 volts to be dropped at 200 μA. by increasing R1, and at 500 μA. by increasing R3; the resistors at the lower end of the circuit remain unchanged. Quite likely, however, if 9 volts were to be used it would be in conjunction with an output stage, and then some decoupling between that stage and those in this amplifier would be necessary. The extra 3 volts would then conveniently be dropped in the decoupling resistor.

Second Stage

The next stage is working under somewhat different conditions. It will be accepting a higher input signal by virtue of the amplification of the first stage and therefore, so that its output may be relatively undistorted, it will have to be set up for higher collector current. The larger output current swing that it is to give must still keep the collector current at all times above the leakage current level. A collector current of 3 mA. will allow this stage to deliver reasonable power to

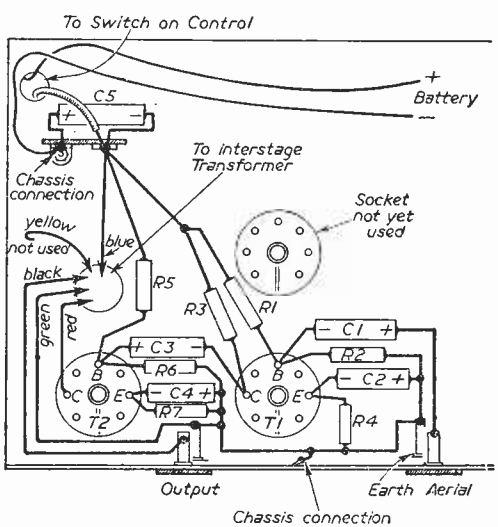

Fig. 17.—Wiring diagram of the circuit shown in Fig. 15 last month.

drive a pair of earphones and also will give adequate output to feed an output stage such as is likely to be needed by a speaker in a portable receiver, when this is built in due course.

The transformer that will be needed to feed the next stage eventually to be added is included in the design at the present stage. The primary resistance of this transformer must be low to avoid too great a drop in voltage. In fact, the specified transformer has a primary resistance of 200 ohms and so, at 3 mA., only .6 volt is lost here. R7 is the D.C. feedback resistor, but it will have to be less than R4 because of the current flowing—3 mA. through 1,800 ohms does not leave much out of 6 volts. The value chosen, 470Ω, provides adequate feedback because the greater current drops across it a voltage of the required order for stabilisation. The voltage drop across this and the transformer primary leaves about 4 volts for the transistor itself, which is satisfactory for this higher order of signal at the second stage. The potentiometer current through R5, R6 also has to be increased to give satisfactory stabilisation. R6 must not be made too small, however, if excessive loss of signal current through it is to be avoided. The base has to be at the emitter voltage of 1.4 (3 mA. through 470Ω) plus the required base to emitter voltage which, according to the curves, can be expected to be about 170 mV., indicating an overall voltage around 1.6. Taking a value of 4.7 KΩ for R6, which will not be unduly wasteful of signal current, the value of R5 is calculated by referring to the relative voltages to be dropped. As stated above, 1.6 volts is across R6, so 4.4 volts must be dropped in R5. If the same current were flowing through the two resistors the value of R5 would need to be:

$$\frac{4.4}{1.6} \times 4.7 \text{ K}\Omega = 12.9 \text{ K}\Omega$$

The next lower standard value, 12 KΩ, is chosen, and this compensates to some degree for the additional current flowing through the upper limb in the form of base current. The total resistance is thus 16.7 KΩ and 6 volts will drive a current of about 360 μA., which is large compared with the base current of 50 μA for the average OC71.

Capacitances

It remains to determine the sizes of the electrolytic by-pass and coupling capacitors. The reactance of 10μF at 100 cycles is around 160 ohms. This is reasonable by comparison with the resistances of the order of 1,000Ω involved in this circuit and components of this size are used at positions C1 to 4. In a portable system there is little point in attempting to retain the lowest of audio frequencies as the speaker will not reproduce them. C4 is across a resistor of 470 ohms and consequently its value could be increased to, say, 50μF with advantage if the amplifier were to be used with higher output powers to feed into reproducing systems capable of delivering lower frequencies.

The battery resistance increases as it runs down and this resistance is common to all stages fed from it. C5 across the battery limits the coupling effect by its low reactance, about 30 ohms at 100 cycles.

Construction

The two parts of the chassis are fixed together using the volume control with switch and the tuning capacitor. If the constructor at the present stage does not wish to provide these components a switch could be used in the volume control position and a nut and bolt used in the position indicated for the tuning control. The three miniature 7-pin valve holders can now be mounted, these being turned until the pins are in the positions indicated in Fig. 17 and then bolt holes marked and drilled. Now, so that no mistake can be made when the chassis is being wired and when subsequently being used, clearly mark the pins to be used, both above and below the chassis, indicating which connection of the transistor goes to each pin used. Take care that the marking above the chassis agrees with that below the chassis, remembering that when the chassis is turned over the pin that was to the right is now to the left, and that pin numbers, which are counted clockwise below the chassis are counted anti-clockwise above! Pin 2 is used for collector, pin 4 for base and pin 6 for emitter. The transformer can now be clamped to the chassis with leads projecting through the hole provided, and the two socket strips for aerial/earth and output mounted. The tag strip is screwed to the chassis to form an anchor for supply leads.

It will be noted that the aerial/earth sockets are used at the present stage for audio input signals —C1 will be disconnected from the aerial socket eventually, so do not make too good a mechanical joint before soldering at this point or the capacitor will be damaged when removing the connection. The output sockets are used as a convenience whilst the chassis is operated without a power output stage. The leads from one side of the secondary and the centre-tap are connected to these sockets, the other end of the secondary being left disconnected. Later, when a push-pull output stage is brought into use, these three secondary leads will go direct to it instead of passing to an output socket. None of them will then go to the earth line. The centretap is, of course, the point at which the base current is introduced to the push-pull stage.

A busbar of 18 gauge tinned copper wire between one socket of each of the socket strips forms a convenient anchor for the earth end of components and is put on first. This is connected to the chassis at one point only, actually to a soldering tag at one of the holding down bolts of the aerial/earth strip. All earths go to this busbar except the battery positive lead, which is conveniently taken to earth via the earth tag of the tag strip.

Wiring is very simple, as shown in Fig. 17 and will present no difficulties. The components are not necessarily held in the relative positions shown on this diagram, which has to be drawn in this open manner for the sake of clarity. In practice, the leads and components take the shortest path from point to point. It must be remembered that electrolytics have to be connected according to their polarity. C2, C4 and C5 are connected directly to a terminal of the battery and so the polarity is obvious. C3 is connected with positive to the base of T2 because this point is at a potential nearer to earth than the collector of T1. This is not always so in the case of transistor circuits, so it must not be taken as a golden

(Continued on page 801)

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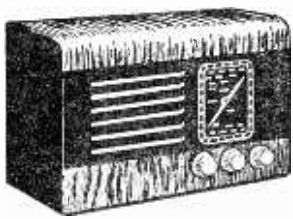

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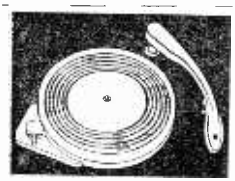

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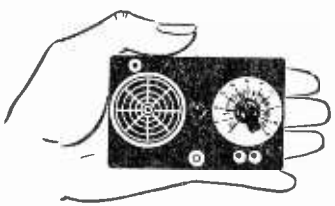

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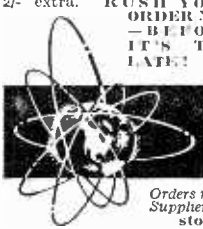

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rule for all time. C1, however, has its negative terminal connected to the base of T1 because it is assumed that the input signal has no D.C. component.

Using the Amplifier

This amplifier was tested using a pair of low resistance earphones across the output socket. Phones were also operated directly in the collector circuit of T2, without the transformer in circuit. High resistance phones would provide a better match to T2 when operated directly in the collector circuit but would drop a considerable proportion of the available voltage and would result in the transistor operating on a lower current condition than intended, giving a lower output, so that the benefit of better matching would not materialise. Low resistance phones are better, but if only high resistance instruments are available they can be used. Results are better with the transformer than without.

The amplifier, without any additional stage, has driven a loud speaker. It will be realised that the total power dissipated in the second stage is only $6 \times 3 = 18$ milliwatts, and not all this by any means is available as audio power, so normal loudspeaker volume cannot be expected, but quite readable signals are available and it is more convenient to use this than a pair of headphones. No attempt is made to try to match speaker to transistor. Conditions have been set up for the complete design and this is just a makeshift method of trying out the first part. Actually, one of the surprising discoveries from these tests is the high sensitivity of modern speakers. The input signal used for the tests was from a simple audio test oscillator. Any source of audio, provided that it has no D.C. component, or so long as there is a blocking capacitor to prevent the D.C. from getting to the amplifier, can be used. In the case of a pickup a series resistor will be needed both to provide the proper load to the pickup and to ensure that the input current to the amplifier follows the voltage signal produced by the pickup. The series resistor should be that quoted as the correct load for the pickup, if it is the crystal variety. A lantern type 6 volt battery was used for the tests.

We shall now proceed to develop this amplifier into a complete, but simple, receiver.

(To be continued)

A BEGINNER'S CONSTRUCTIONAL COURSE

(Continued from page 794)

and in your locality, remembering that each will affect the other to some extent. If you are fortunate enough to have a milliammeter you may connect it in one of the battery leads, when it should show about 2mA and not on any account more than 5mA. This drain on the battery is only 1/150th of the consumption of a torch bulb, so the life will be very long indeed.

Other Arrangements With This Circuit

Some readers may like to make this into a semi-portable unit for campers, cyclists, boy scouts, etc., for it is easy to stick a skewer into damp soil and hang some wire from a tree. The writer used an ordinary 8in. P.M. speaker, but for portable use he tried and got good results with an ordinary low resistance balanced armature type ear-piece mounted behind the front panel with a fabric-covered hole in front. Using this earpiece no output transformer was used, the phone being connected in place of the primary (between battery minus and the collector of the second transistor). The volume is quite good, but bass notes are lacking, as in any small speaker.

Having made up the unit you may like to box it into a permanent cabinet or to rebuild it into your own design, fitting variable condensers in place of trimmers, an internal speaker and terminals at the back of the cabinet.

Improving the Tuned Circuit

A further refinement which the author found not in the least necessary, is to rewind the medium-wave coil, making taps (small twists in the wire) every five turns. The lead from C1 then goes to one of the taps, the best one being found by trial and error. The red side of the diode may also be tapped in on one of the taps, again by trial and error. This will only affect the medium wave band (Fig. 31).

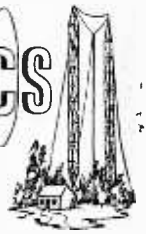
A C.R.L. BRIDGE

(Continued from page 789)

into five or ten parts, but not marked. Another method is to mark out the first three precision marks, then select ordinary resistors of these values and check them to select the ones that agree with the marks made, then put, say, the precision 1K and the selected 1K in series to give the 2K mark. The two 50K resistors will give the 100K mark if placed in series, and the 25K mark if put in parallel. The two 5K in series will give the 10K mark, and in parallel the 2.5K mark. Using a third resistor of 1K will give 3K in series, and by various combinations the whole scale can be calibrated. As a matter of interest, the minimum number of precision resistors required to give the whole 20 calibration points is as follows; eight resistors are required, namely 1K, 2K, 2K, 5K, 10K, 20K, 20K, 50K, by using various combinations in series the whole twenty points are covered. Having completed the resistor range, the next one to do is that for the capacitors. For this you can use capacitors if you like, but it is not necessary if you have calibrated the resistor range accurately, for by taking the reciprocal of the mark on the resistor range and marking it at the same point on the capacitor range the readings will be accurate for capacitors. For instance, take the 5 mark on the resistor range, this will be 0.2 on the capacitor range, similarly for 0.2 on the resistor range it will be 5 on the capacitor range. To change resistor value to capacitance value divide the number into one, thus 5 divided into 1 is 0.2 and 0.2 divided into 1 is 5. For the inductance range use various chokes and coils to get the calibration points. The most useful points on range L1 are 3, 5, 10, 20, 40 henries.

If the bridge is operated where direct light falls on the indicator it is best to make a shield for it, as Fig. 14, where the shaded parts are cut out and the aluminium bent round to form a shield.

TRANSMITTING TOPICS



METHODS OF USING THE CLAMP-VALVE

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

THE use of a clamp-valve circuit in "holding down" the P.A. stage has become almost universal. A typical circuit arrangement is shown in Fig. 1, where a triode-connected pentode is used as the "clamp-valve." In the absence of any R.F. grid drive, the clamp-stage runs without bias, and thus tends to draw a heavy current. The screen resistor of the P.A. stage has to pass the current drawn by the clamp-valve, so that a large voltage drop occurs, and the effective screen potential of the P.A. stage becomes very low. With the very low screen voltage caused by the current flow in the clamp-valve, the P.A. stage will only draw a small anode current, and this may be arranged so that the anode dissipation of the P.A. tube is not exceeded.

When R.F. drive is applied to the P.A. stage, the negative bias developed across the clamp-tube cuts off the clamp-valve, so that only screen current flows in the screen resistor, and the normal screen potential is developed for amplifier operation. Thus the value of the screen resistor used in the clamp-valve circuit is the normal value employed for Class C operation of the P.A. valve. A smooth control of C.W. power level may be obtained by a potentiometer arranged to adjust the bias applied to the clamp-tube, as shown in Fig. 2. By this means the C.W. operating level may be lowered by letting the clamp-valve conduct to an extent determined by the setting of the potentiometer. As the clamp-valve conducts, the current passing through the screen resistor lowers the screen voltage and thus lowers the anode current and power level of the P.A. stage. This facility is often incorporated in transmitters to enable a quick adjustment of power output to be made.

However, we have been careful to refer to the C.W. level of output, as there are some sizeable snags. Firstly, if anode and screen modulation is employed, then if the clamp-stage is used to cut off the screen voltage to a lower figure, when the screen voltage rises under modulation, the clamp-valve will conduct more, and may clip the modulation waveform on the positive peaks. This results in a serious loss of modulation capability, and will also result in appreciable distortion due to the heavy clipping of the positive going peaks of screen voltage. Judging by some modulation circuits which have been suggested for amateur use, there may be some amateurs who have no objection to radiating splatter caused by distortion products. However, their fellow amateurs will certainly object. Moreover, the effective percentage of modulation is severely restricted and may be even more so if the operator turns down the audio level until splatter is not heard, under the mistaken belief that the splatter is caused by

(*Continued on page* 805)

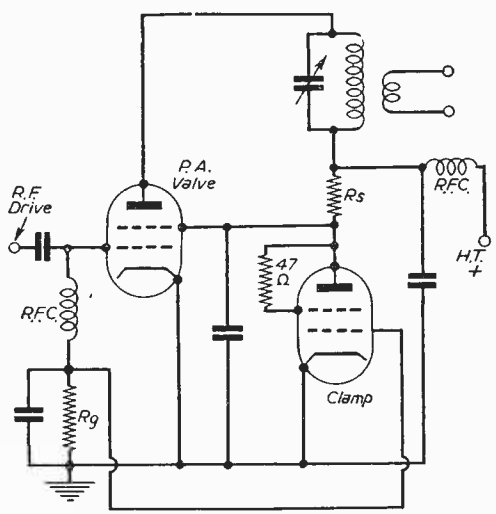


Fig. 1.—The simple clamp-valve circuit used to "hold down" a P.A. stage when excitation is removed, and no fixed bias source is used.

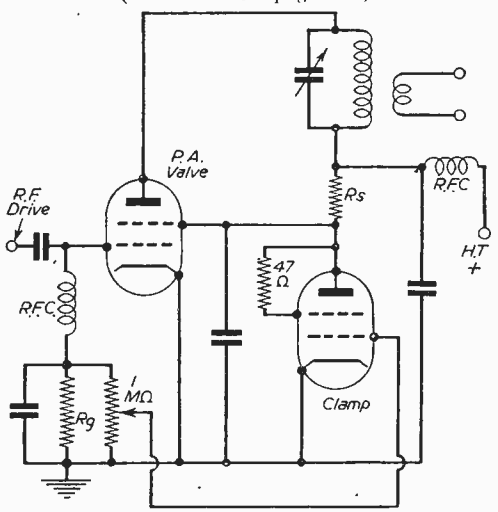


Fig. 2.—A potentiometer enables the clamp-stage setting to be adjusted on C.W. so that the P.A. stage runs at any desired power setting within the range determined by the circuit conditions.

overmodulation. If the clamp-valve introduces serious clipping of positive peaks, then splatter will be introduced far below the 100 per cent. modulation level. If the gain is turned down until splatter ceases, then the overall modulation level may be very low indeed. The fact should be noted that if the grid drive is at all low, then there is a danger of the clamp-tube not being cut off fully. If the clamp-valve is not cut off fully, then the P.A. screen volts will be lower than they should be, and output will fall off. Thus

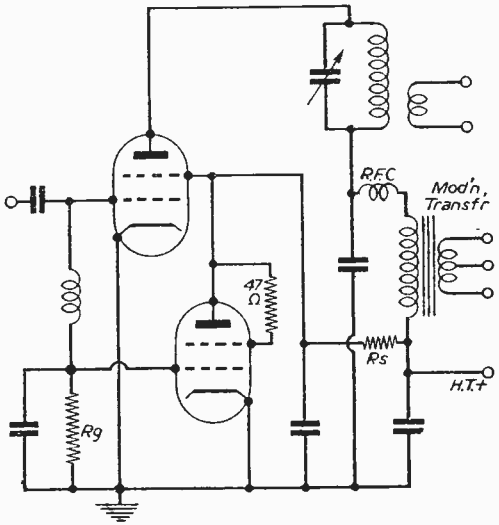


Fig. 3.—Returning the screen to the unmodulated supply prevents the clamp-valve clipping positive modulation peaks. However, this connection does not permit full modulation as the screen supply is unmodulated.

below a critical drive figure, a clamp-valve protected P.A. stage will be very sensitive to a fall in grid drive and output will drop off very quickly as grid drive falls too low. Clearly, for telephony working, plenty of grid drive is necessary to ensure that the clamp-stage remains cut off, even when the modulated H.T. line doubles its potential on modulation peaks.

The Valves

Unfortunately it would seem very clear that it is sometimes difficult to ensure that the clamp-stage will not start to conduct on positive modulation peaks. Various combinations of valves are employed for clamp service. Thus for the 807 valve, a 6L6 is often used to "hold down" one or a pair of 807s, while a 6Y6 is a rather better choice. The KT66 is also excellent as a clamp-valve. In all cases there is the possibility of positive peak clipping occurring on the positive peaks of anode and screen modulation. In some cases a definite backwards flicker of the plate current meter needle may be observed on modulation, and the modulation may appear to lack punch, despite the fact that adequate audio is available. In some cases the use of a tube such as the 6Y6 for the clamp-valve has been resorted to for "'phone use only," despite the fact that this does not give as good a cut off on standby as the 6L6. However, the shorter grid base of the 6V6 is held to ensure that the 6V6 valve is held in a cut-off state even on modulation peaks. With a 6V6 clamp-valve, however, a pair of 807s with 500 volts on the plate draw just about their maximum rated dissipation under "key-up" conditions. Thus the clamp-stage becomes merely a protection failure device that protects the P.A. stage from excessive dissipation should the drive fail. To save running the P.A. at full dissipation all the time during "standby" periods it is then necessary to switch the H.T. supply. Switching the H.T. supply is not a bad idea, of course, but if this is done then one might just as well omit the clamp-valve and arrange for a few volts of protective bias to be developed by a small cathode resistor, so that the P.A. valves will not burn out in the absence of drive.

As the troubles of the clamp-valve commence with the application of modulation, and as the clamp is otherwise a very convenient way of adjusting power level, the above expedients of "'phone only" type clamp-valves that merely act as P.A. protectors, or the use of standby cathode bias are not too attractive. What is needed is a foolproof method of providing flexible clamping operation with full power level control that will work satisfactorily on anode and screen modulation. One such circuit arrangement that the author can confidently recommend is shown in Fig. 3. In order to prevent the clamp-valve anode voltage being affected by modulation, with possible conduction on modulation peaks, the

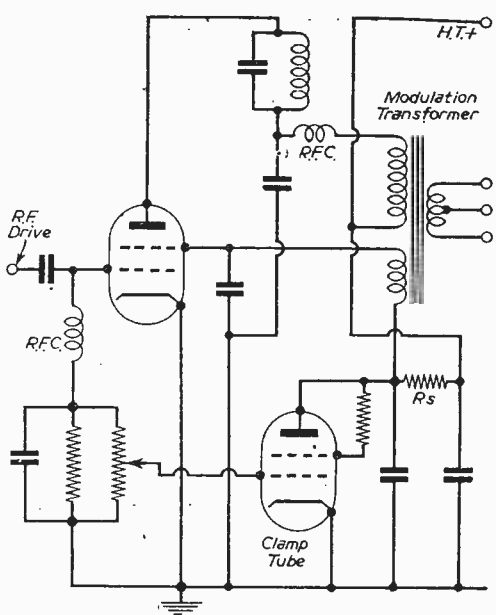


Fig. 4.—The screen may be modulated from an independent winding, thus enabling full clamp-valve control to be retained without any difficulties on modulation peaks.

P.A. screen supply is taken from the unmodulated supply line. Normally it would not be possible to obtain satisfactory full modulation by modulating the anode alone, although quite good speech may be obtained in this way.

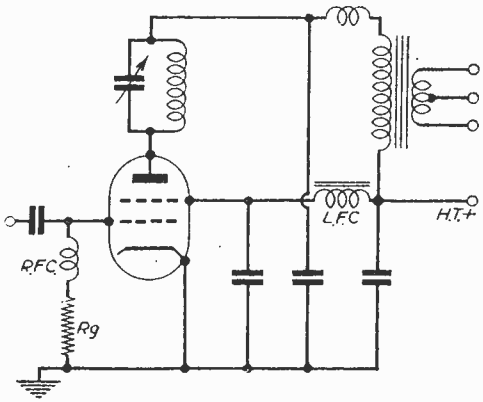


Fig. 5.—The self screen system of modulation enables the screen to develop its own modulation voltage when the anode is supplied with modulated H.T.

Satisfactory Circuits

Satisfactory "plate and screen" modulation is assured in the circuits of Figs. 4 and 6. In Fig. 4 a separate winding is used to modulate the screen. The use of a separate winding requires that the screen winding supplies the correct fraction of audio to the screen, and at one time modulation transformers were made with separate screen windings provided. As may be expected, however, these windings were designed for a specific type of valve and were something of a compromise, as the fraction of audio voltage depended somewhat upon the operating conditions of the P.A. stage. Generally the fraction would be calculated on the ratio of the screen voltage to the anode voltage.

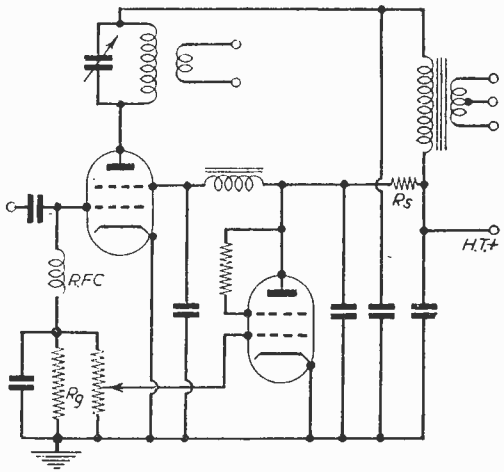


Fig. 6.—The self screen system applied to the clamp circuit.

(To be continued)

News from the Clubs

PONTEFRACT AREA TRANSMITTING GROUP

Hon. Sec.: W. Farrar (G3ESP), 6, Hemsworth Road, Ackworth, Pontefract, Yorkshire.

A CLUBROOM is now in use at the Queen's Hotel, Pontefract, and the call-sign G3FYQ has been re-issued. The club is already "on the air" and when completely fitted out should be active on all bands from 1-8 to 144 Mc/s with telephony and telegraphy.

Meetings are held on the first, third and, where applicable, fifth Thursdays of each month from 8 p.m. Morse-code practice and talks and discussions form a part of all meetings. New members are very welcome.

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: Geo. Western (G3LFL), 118, Salisbury Avenue, Barton, Torquay.

THE meeting held at the Y.M.C.A., Torquay, in September, proved most interesting. The principal speaker being Mr. W. Jones (G3BBF), Newton Abbot, whose constructive talk for beginners was particularly appreciated by the many new members present.

ROCH VALLEY RADIO CLUB

Hon. Sec.: D. J. Power, 2, Clement Street, Rochdale, Lancs.

A NEW club to be known as the "Roch Valley Radio Club" has been formed in Rochdale. Meetings will take place each Tuesday at 8 p.m. in the Windmill Hotel, Sudden, Rochdale. All those interested will be made welcome. For the present all enquiries to be made to D. J. Power, Esq., 2, Clement Street, Rochdale.

SPEN VALLEY AND DISTRICT RADIO AND TELEVISION SOCIETY

Hon. Sec.: Norman Pride, 100, Raikes Lane, Birstall, Nr. Leeds.

IT is proposed to organise a Northern Mobile Rally on Sunday, April 27th, 1958, to be centred on the West Riding. Plans are in hand for a suitable location and offers of support should be sent to the Hon. Sec.

BURY RADIO SOCIETY

Hon. Sec.: Mr. L. Robinson, 56, Avondale Avenue, Bury, Lancs.

THE Bury Radio Society will meet at 8 p.m. on Tuesday, December 10th, at the George Hotel, Kay Gardens, Bury, for the Annual General Meeting followed by a Junk Sale.

BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: Mr. R. Purdy, 37, Bond Street, Brighton 1, Sussex.

AT the recent Annual General Meeting, the following new Committee was elected:—

Hon. Sec.: Mr. R. Purdy, 37, Bond Street, Brighton 1, Sussex.
Chairman: Mr. C. Fairchild, G3YY.
Treasurer: Mr. R. Langridge. Also Vice-Chairman and fifth member.

The Club will continue to meet on Tuesdays at the "Eagle Inn," Gloucester Road, Brighton, 8 p.m., where all visitors and prospective members will be most welcome.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: Mr. C. H. Bullivant, G3DIC, 25, St. Fillans Road, Catford, S.E.6.

THE tenth anniversary of the Society was celebrated with a Dinner, attended by members, their ladies and guests to a total of more than 50. The guests were welcomed by the Chairman of the Clifton Amateur Radio Society (Mr. J. Lambert, G3FNZ), accompanied by Mrs. Lambert, and during dinner the health of the guests was proposed by Mr. D. French, G3HSE. Dancing and musical entertainment after dinner was provided by Billy Mulvaney.

An "Open-Evening" is being held at the clubrooms on Friday, December 13th, during which entries in the annual constructional contest will be judged. A cordial invitation is extended to visitors on this evening to meet members of the Society at home.

The Christmas morning round-up of club members on Top Band will take place as usual this year.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Road, London, S.E.14. Details of membership can be obtained from the Hon. Secretary.

Open to Discussion

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

Amateur Communications Receiver

SIR,—You may be interested to hear that since constructing the communications receiver given in your issues of June, July and August, I have logged amateur stations in 26 countries. Apart from almost all the European Continent, good reception has been obtained from such places as Peru, Brazil, the Virgin Islands and a large number of W stations in America. I live in a flat where aerial facilities are severely limited, the above countries being obtained on a short length of wire hanging over the curtain rail!

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

As this is the first receiver I have ever constructed, I feel the results speak well for the clarity of description and the hobby has gained a firm addict. The only main changes I have made in the original circuit are the insertion of a tone control and a further audio stage using a 6SJ7. I find the latter very considerably improves the speaker volume.

I feel sure I am not the only one who would like to see circuit details for adding a noise limiter and an "S" meter. A short description of the theory and calibration of the latter would be appreciated.—J. ACTON, M.Sc., A.R.I.C. (W.14).

An Amateur's Results

SIR,—I have recently completed a radio-gram with an almost identical circuit to that on page 46 of March PRACTICAL WIRELESS; but using ex-Government equivalents *of some valves*, a phase splitter and two VT52 valves in push-pull output, with a 12in. speaker. Separate coils and switch used for 3-wave range, in lieu of coil pack.

Results *incredibly* good and reproduction better than anything else I have heard; with which many friends agree.

The set was built in a cabinet I made, with side cupboards for records.—A. J. SWEENY (Gloucester).

Results from Indonesia

SIR,—I would like to know from your readers about the reception from our radio stations here. When I was in Europe last I failed to receive any Indonesian station. I would be glad to supply any information you may need about our stations here.—MR. CHIA FOEN FOE, Djalan Merdeka, No .348 Palembang, Sumatra, Indonesia.

Identifying Stations

SIR.—As an occasional but fervent S.W.L. I find it difficult to locate or identify particular stations on my commercial receiver. The distance of the pointer behind the dial causes parallax and the flywheel tuning precludes fitting a calibrated knob. Fixing a length of plastic transparent ruler is not much better. Perhaps some of your readers have solved this problem? My set deserves better, having brought in Australia at lunch-time on an indoor copper rod, on the ground floor! In anticipation of your readers' remarks.—DESMOND O'BRIEN (Dublin).

Wavebands of P.C.R. Set

SIR.—I shall be grateful if any reader can advise me what are the wave-bands of the P.C.R. Communications Receiver (a war-time model). I understand two versions were made, one of which has two short-wave bands and a medium-wave band.—W. E. RIGG (P.O. Box 36, Luanshya, Northern Rhodesia).

A Peculiar Fault

SIR.—I have just been reading the letter from E. Yeates (Bromsgrove) in "Open to Discussion" in the December, 1957, issue of PRACTICAL WIRELESS. He writes to say there was a time-lag of five to six seconds between two receivers both taking the same programme but on different frequencies on A.F.N. Germany.

The solution is simple. During the Second World War the Germans had all programmes recorded and put out about 10 seconds later than the actual transmission. This was in case someone gate-crashed the transmission and made uncomplimentary remarks about the Third Reich or its rulers.

The control engineer was able during that time-lag to switch off the transmission before it was transmitted.

As Mr. Yeates was in B.A.O.R. about 10 years ago it is probable that A.F.N. just took over the German transmitting stations as they stood.

Of course, one station would be transmitting the actual occurrence and the other a recorded occurrence 10 seconds later, hence the time-lag.—W. C. GREEN (G3QG), Luton.

Command Receiver Circuit

SIR.—I should like to give a corrected circuit diagram of the I.F. section of the Command Receiver BC455 (ref. "P.W." 11/'57, p.606), which

is different from that published. The one published is that of the QS-er. BC453, which has an 85 Kc/s I.F., and therefore much narrower band circuits.

The circuit is copied from the official U.S.A.A.F. publication, it is not a modification, and I have checked it against my own BC455 receiver. The I.F. is 2.830 Kc/s. and it will be noted that tuned anode couplings are used, choke capacity coupled to the following grid circuits. These chokes are mounted inside the I.F. cans, and these I.F.T.s have single tuned coils only.

Therefore the circuit shown by you on page 606 of PRACTICAL WIRELESS as that of the BC455 is *not* correct. Your correspondent has confused the issue and supplied that of the BC453, which is quite a different job. I know all these Command receivers very well, and I have all the official manuals on the whole series to refer to.—F. W. HATTEMORE (Penarth).

Music and Movement

DEAR THERMION,—I work as a teacher of English in a secondary modern school and, during the winter months, I help with a youth club which teachers and boys attend voluntarily one evening per week to follow leisure-time activities. Having been interested in radio communication for many years I run a small section where boys can learn the elementary principles of wireless and apply them in practice. I cannot agree that the value of set construction is as negligible as your correspondent maintains.

It is very true, as he says, that a new interest may be aroused in mathematics; it is most rewarding to a teacher when a boy, through the translation of a theoretical diagram to a practical, everyday piece of equipment, comes to realise that elementary algebra is a precise, concise and purposeful language. I would say that when this occurs, as it does, then the teacher has taught to some purpose.

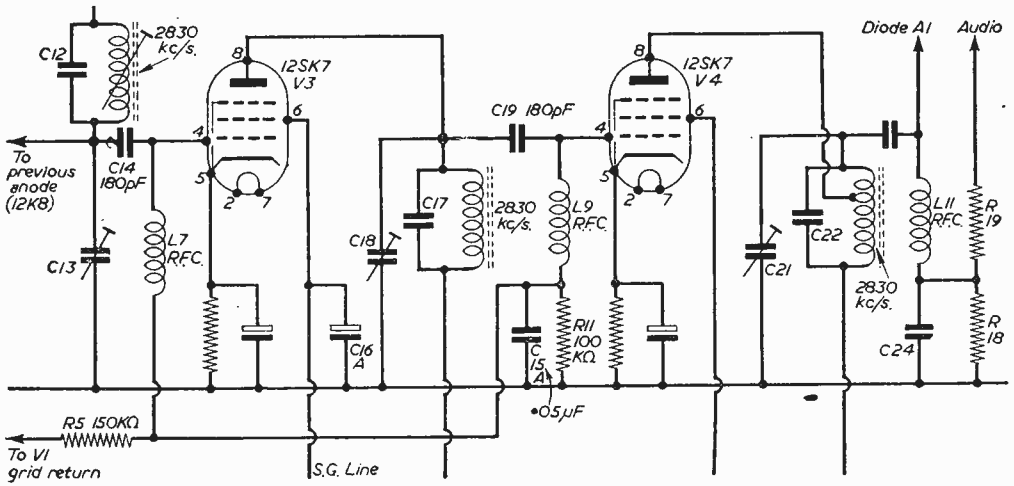
Again, one does not limit the children to the building of one small set. They can be led through the stages of crystal to super-het, from simple valve amplifiers to more complicated push-pull circuits; they can be presented with the problems that confronted the pioneers in radio and amplifier design and will perhaps appreciate the way in which these problems were overcome by the power of human endeavour. I rather fancy that there is something of educational value here.

Children can be trained to think diagnostically by means of the elementary principles of radio servicing; they love to trace a fault which has been introduced deliberately into a piece of equipment. They can be brought to appreciate the meaning of the words "consecutive" and "consequent," and will learn, let us hope, not to use such a syllogism as you quoted in your October article.

Some pupils, through having some knowledge about the control of current, might become interested in stage lighting. If there are any they will certainly discover another stimulating experience as back-stage workers in school theatricals. They will be able to work with their colleagues, the actors, and will learn the value of co-operation in a worthwhile enterprise.

Although I do not regard my room as a vocational training centre I find that many boys have found jobs in the radio trade. Surely a valuable by-product? Finally, there is the obvious benefit of teaching children to value their leisure time and to use it profitably.

These things can develop from the building of "one small radio," but, of course, it is no use for the teacher to keep his eye close to that one small piece of apparatus only. He will become short sighted. Not that I am recommending set construction for all. The same benefits can accrue from a multitude of leisure-time activities and from all the usual subjects of the school curriculum. Success is attendant upon the interest the teacher has in his subject, academic or practical, upon the depth of his knowledge and upon his ability to cultivate an infectious enthusiasm in himself for what he is trying to teach.—P. L. UGLOW (N. Devon).



The corrected circuit of the Command Receiver according to reader Hattemore. See letter above.

C.R.T. ISOLATION TRANSFORMER

Type A. Low leakage windings. Ratio 1 : 1·25 giving a 25% boost on secondary. 2 v., 10/6 ; 4 v., 10/6 ; 6.3 v., 10/6 ; 10·8 v., 10/6 ; 13.3 v., 10/6.
Ditto with mains primaries, 12/6 each.
Type B. Mains input 220/240 volts. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Input has two taps which increase output volts by 25% and 50% respectively. Low capacity suitable for most Cathode Ray Tubes, 21/- Ditto for 6 v. C.R. Tubes only, 17/6.
Type C. Low capacity wound transformer for use with 2 volt Tubes with falling emission. Input 220 240 volts. Output 2-2½-2½-2½ volts at 2 amps. With Tag Panel, 17/6 each.
NOTE.—It is essential to use mains primary types with T.V. receivers having series-connected heaters.

TRIMMERS, Ceramic. 30, 50, 70 pf., 9d. ; 100 pf. 150 pf., 1/3 ; 250 pf., 1/6 ; 500 pf., 750 pf., 1 9.
RESISTORS. Preferred values. 10 ohms to 10 meg., ¼ w., 4d. ; ½ w., 4d. ; 1 w., 6d. ; 1½ w., 8d. ; 2 w., 1/-.
HIGH STABILITY. ½ w., 1%, 2/-. Preferred values 100 ohms to 10 meg. Ditto, 10%, 6d.

5 watt	WIRE-WOUND RESISTORS	1 3
10 watt	25 ohms—10,000 ohms	1 6
15 watt		2/-

15,000 ohms—50,000 ohms, 5 w., 1/9 ; 10 w., 2/3.

12/6 PURETONE RECORDING TAPE

1,200 ft. on standard 7" Metal reels. Spools 5" metal, 1/6, 7" metal, 2/3.

FERROVOICE 1,200ft. Plastic Tape 25/- on Plastic Spools.

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HEATER TRANS. Tapped prim., 200/230 v. 6.3 v. 1½ amp., 7/6 ; tapped sec., 2, 4, 6.3 v., 1½ amp., 8.6 ; prim. 230 v. Sec. 6.3 v. 3 amp., 10/6.
ALADDIN FORMERS and core, ½in., 8d. ; ¾in., 10d. 0.5in. **FORMERS 5937/8** and **Cans TV1/2.** ¾in. sq. x 2in. and ¾in. sq. x 1¾in., 2/- ea., with corse.
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CRYSTAL DIODE G.E.C., 2/-. **GEX34,** 4/-.
HIGH RESISTANCE PHONES. 4,000 ohms, 16/6 pr.
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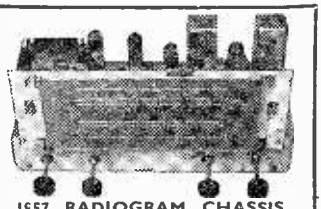
3S4	8/6	6S67	8/6	ECC84	12/6
3V4	8/6	6V6G	7/6	ECF80	10/6
5U4	8/6	6V6GT	8/6	ECF82	10/6
5V3	8/6	6X4	7,6	ECH42	10/6
5Z4	10,6	6X5	7/6	ECL80	8/6
6AM6	8/6	12A6	7/6	ECL82	12/6
6B8	5/6	12AH8	10/6	EF39	7/6
6BE6	7/6	12AT7	10/6	EF41	10/6
6BH6	10/6	12AU7	10/6	EF50	5/6
6BW6	8/6	12AX7	10/6	Equip.	
6BW7	8/6	12BE6	10/6	EF50	5/6
6C4H6	10/6	12BH7	10/6	Sylv.	8/6
6D6	7/6	12K7	8/6	EF80	10/6
6F6	7/6	12Q7	8/6	EF92	5/6
6H6	3/6	35Z4	10/6	EL32	5/6
6J5	6/6	80	8/6	EL84	10/6
6J6	7/6	954	1/6	EY51	11/6
6J7	8/6				
6K6	6/6	EA50	1/6	EZ40	10/6
6K7	5/6	EABC80	8/6	EZ81	11/6
				UF41	8/6
				UL41	8/6
				UY41	8/6
				U22	10/6
				X79	10/6



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12 month guarantee.
A.C. 200/250 v. 4-way Switch ; Short-Medium-Long-Gram. A.V.C. and Negative Feedback 4.2 watts. Chassis 13½ x 5½ x 2½in. Glass Dial 10 x 4½in., horizontal or vertical available. 2 Pilot Lamps, Four Knobs, Walnut or Ivory. Aligned and calibrated. Chassis isolated from mains.

10 gns. Carr. & Ins. 4/6.

TERMS : Deposit **£5.5.0** and six monthly payments of **£1.**
MATCHED SPEAKERS FOR ABOVE CHASSIS. 8in., 17 6 ; 10in., 25/- ; 12in., 30/-.

RECOMMENDED FOR ABOVE CHASSIS
★ COLLARO ★
HIGH-FIDELITY AUTOCHANGER 1957 Model RC456
7in., 10in., 12in. Records
16, 33, 45, 78 r.p.m.
4 SPEEDS—10 RECORDS
With Studio "O" pick-up
BRAND NEW IN MAKER'S BOXES
OUR PRICE £9.15.0 post free
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Space required 14in. x 12½in. 5in. above and 2in. below. Cut Out board, 6/-.

GARRARD 4-SPEED RECORD CHANGERS RC120/4H 1957 MODELS
Brand new and fully guaranteed 12 months.

AUDIO PERFECTION

Designed to play 16, 33, 45, 78 r.p.m. Recordr. 7in., 10in., 12in. Lightweight Xtal pick-up, turnover head, two separate sapphire styli, for Standard and L.P., each plays 2,000 records Voltage 200/250 A.C.

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AMPLIFIER—RECORD PLAYER CABINETS. Cabinet size 18½ x 13½ x 11½. Ht. 8½in., with motor board 14 x 12½in., £3.3.0. post 3/-.

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TRANSISTORS. Audio, 10/-. R.F. 2.6 Mc/s, 21/-. Mullard OC71, 20/-.

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COLLARO. 4-speed Motor and Turntable with selecting switch for 16, 33, 45, 78 r.p.m. records. 200-250 v. A.C. 50 cps. Also **HIGH FIDELITY** Lightweight Pick-up Acos Xtal turnover head, separate Sapphire styli or L.P. and Standard records. **SPECIAL OFFER, THE TWO : £4.12.6,** post 2/6. Cut Out Board, 14 x 12½in., 6/-.
SUITABLE AMPLIFIER-PLAYER CABINET. Ready cut out for above, 45/-.

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5 Mullard valves and superhet tuning heart. Maroon and cream receiver styled cabinet 12 x 6 x 6in. Features : This is a self-powered 200/250 v. A.C. VHF (FM) Adaptor with operating and servicing data and a screened lead for connection to pick-up sockets of any radio, radio-gram, or amplifier.
Brand new with 12 months' guarantee. List price, 16 gns. Our price, **10 gns.,** carr. 4/6.

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80 ohm CABLE COAX
Semi-air spaced Polythene insulated. ¼in. dia. Stranded core. Losses cut 50%. **9d.** yd. Fringe Quality Air Spaced, **1/6** yd.

COAX PLUGS ... 1/- **DOUBLE SOCKET** 1 3
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BALANCED TWIN FEEDER yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/-. 80 ohms only.
WIRE-WOUND POTS. 3 WATT. Pre-Set Min. T.V. Type. All values 25 ohms to 30 K., 3/- ea. 50 K., 4 -. (Carbon 50 K. to 2 m., 3/-.)
WIRE-WOUND 4 WATT. Pots 2½in. Spindle. Values, 100 ohms to 50 K., 5/6 ; 100 K., 6 6.
CONDENSERS. New stock. .001 mfd. 7 kV. T.C.C., 5/6 ; Ditto, 20 kV., 9/6 ; 100 pf. to 500 pf. **Micas 6d.** ; Tubular 500 v. .001 to .01 mfd., 9d. ; .05, .1, 1 - ; .25, 1 6 ; .5/350 v., 1/9 ; .1 350 v., 9d. ; .1/600 v., 1/3 ; .1 mfd., 2,000 volts, 3/6.
CERAMIC CONDS. 500 v., .3 pf. to .01 mfd., **10d.**
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/- ; 600 pf. to 3,000 pf., 1,3. Close tolerance (± 1 pF.) 1.5 pF. to 47 pF., 1/6. Ditto, 1% 50 pF. to 815 pF., 1/9 ; 1,000 pF. to 5,000 pF., 2/-.

I.F. TRANSFORMERS 7/6 pair
465 Kc/s Slug tuning Miniature Can. 2½in. x 1in. x 1in. High Q and good bandwidth By Pye Radio. Data sheet supplied.
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1 350 v. 2 -	100 25 v. 2/-	8+16 500 v. 5·6
2/250 v. 2 3	8+8/500 v. 4 6	16+16,500 v. 6/-
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SFNTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK VOLTAGES. K3/25 2 kV., 5/- ; K3/40 3.2 kV., 7/- ; K3/45, 3.6 kV., 7/6 ; K3/50 4 kV., 8/- ; K3 100 8 kV., 14/6. 50 c.p.s. voltage, 30% of above.
MAINS TYPE CONTACT COOLED 250 v. 50 mA., 8,6 ; 250 v. 85 mA., 9/6.
COILS. Wearite, " P " type, 3/- each. Osmor Midget " Q " type adj. dust core, from 4/-. All ranges.
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T.R.F. COILS. A HF. 7 - pair. **H.F. CHOKES,** 2/6.
FERRITE ROD Sin. x 3/8in. dia., 2,6.

JASON F.M. TUNER COIL SET. 26/-. H.F. coil, aerial coil, Oscillator coil, two I.F. transformers 10.7 Mc/s. Detector transformer and heater choke. Circuit book using four 6AM6, 2/-. J.B. Chassis and Dial, 19/6.
Complete Jason F.M. Kit, **£5.18.6.**
With Jason superior calibrated dial, **£6.15.0**

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VALVE and **T.V. TUBE** equivalent books, 5/-.
TOGGLE SWITCHES. S.P. 2/-. D.P. 3,6. D.P.D.T. 4 -
WAVECHANGE SWITCHES.
5 p. 4-way 2 wafer long spindle 6 6
2 p. 2-way 3 p. 2-way short spindle 2 6
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VALVEHOLDERS. Pax. Int. Oct., 4d. EF50, EA50, 6d. B12A, CRT, 1/3. Eng. and Amer. 4, 5, 6, 7, and 9 pin, 1 -. **MOULDED** Mazda and Int. Oct., 6d. B7G, B8A, B8G, B9A, 9d., B7G with can, 1 6. VCR97, 2/6, B8S with can, 2 6. CERAMIC EF50 B7G, B9A, Int. Oct., 1/-. B7G with can, 1·9
BLACK CRACKLE PAINT, air drying, 3,- tin.

A MERRY CHRISTMAS TO ALL READERS OF PRACTICAL WIRELESS

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RADIO COMPONENT SPECIALISTS

337 WHITEHORSE RD., WEST CROYDON

Shop closed 25th, 26th, 27th December.
OPEN ALL DAY—(Wed. 1 p.m.) *Catalogue 6d.*

Tel. THO 1665. Buses 133 or 63 pass door. 48-hour postal service. P.&P. 1/-, over £2 post free. (*Export Extra.*) C.O.D. *Service* 1/6

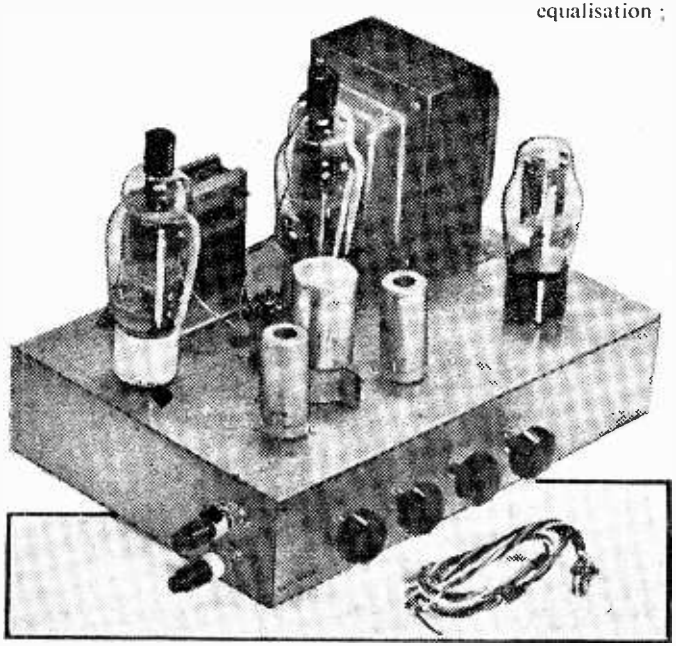
News from the Trade

R.S.C. 30-WATT AMPLIFIER

THERE are often occasions when something more powerful than the usual 20-watt amplifier is needed, and the majority of amplifiers of this rating on the market are quite expensive. We recently had the opportunity of trying out a unit made by the Radio Supply Co., of Leeds, which is not only rated at an output of 30 watts, but employs the now popular ultra linear feature and in addition costs only £12 19s. 6d. Employing two EF86 input stages and an ECC83 phase splitter, with two 807s in the output stage, good quality components and well-rated resistors are used throughout, and there are two inputs of the coaxial type with separate volume controls—one labelled High Gain and the other Low Gain. In addition, a comprehensive tone control is fitted prior to the phase splitter, and this provided both bass and top cut and lift. The output transformer, which is made by the company, might look rather small for an amplifier of this type, but it certainly does its work. The amplifier is rated at 30-20,000 c.p.s., with hum and noise 70 db down. An output socket is provided for feeding a pre-amplifier or similar unit, and if desired a louvred cover may be obtained to fit over the complete unit. The chassis in the model tested was finished in a light blue, and there was a cover plate fitted below to provide complete screening and avoidance of stray pick up.

We tested the unit both with pick-ups and microphones and finally on an electronic organ. It gave surprising results from these, dealing very well with the pedal 32 cycle note, and with the bass boost at maximum, the output stages handled the output without distress. On the top notes of the organ with the flageolet stop in action the result was clean cut, and passing the two tones through the amplifier resulted in both coming through cleanly with little intermodulation distortion. At maximum volume from the organ, with pedals and both manuals in action, the amplifier was as good as many very much higher-priced units we have tried.

If desired, the amplifier may be obtained in kit form for home assembly for 10 gns.—Radio Supply Co. (Leeds) Ltd., 32, The Calls, Leeds 2.



The R.S.C. A.10 Ultra Linear 30w amplifier.

TECHNICAL CERAMICS MARKET NEW CERAMIC PICK-UP

A NEW Sonotone ceramic pick-up cartridge, to be known as the type 2T, will shortly be introduced to the commercial market by Technical Ceramics.

Designed for long playing and standard 78 r.p.m. records, the new 2T will eventually replace the company's existing type 9980 cartridge. Employing a barium titanate element as the transducer material, the new pick-up cartridge, of rugged construction, is suitable for use in any part of the world, as it is unaffected by conditions of high temperature and humidity.

Change of stylus is accomplished by rotating the dual tip of the cantilever arm to bring the appropriate tip into use, while the complete stylus assembly may be easily replaced by the user. The frequency response of this new medium compliance cartridge is a close match to the B.S.1928 characteristic without any equalisation; moreover, it provides the necessary degree of output to avoid any difficulties due to hum pick-up.—Technical Ceramics Ltd., Towcester, Northants.

NEW RANGE OF DIRECTLY HEATED SUBMINIATURE VALVES

HIVAC, LIMITED, are marketing an augmented range of directly heated subminiature valves, many of which are exact equivalents of American types used in portable radio communication equipment.

The range includes the XFY14, Output Pentode (U.S. equivalent 5672); the XFR1 R.F. Amplifier Pentode (U.S. equivalent 1AD4); the XFR3 R.F. Oscillator Triode (U.S. equivalent 5676); and the XR4 R.F. Power Amplifier (U.S. equivalent 6397). All the valves, with the exception of the XR4, are 38.1 mm. long, 10.1 mm. wide and 7.6. mm. in thickness. The filament voltages are 1.25. The XR4 is 40.64 mm. long and has a diameter of 10.16 mm. The R.F. amplifier pentodes have metallised screening.—Hivac, Ltd., Stonefield Way, Victoria Road, South Ruislip, Middx.

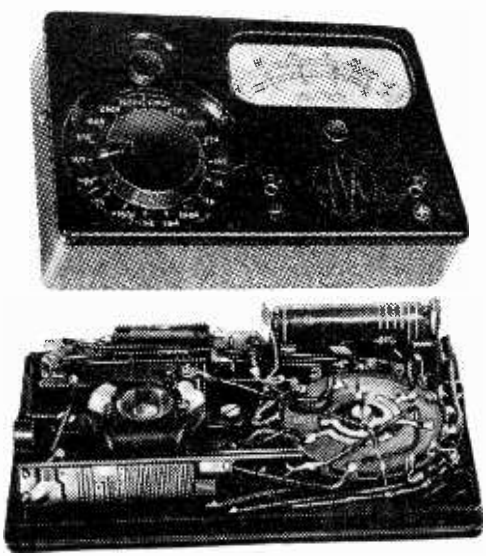
A NEW EARTH CLAMP

IN response to the increased demand for a safer, simpler and more durable earth clamp, Cable Covers have developed the CCL Universal Earth Clamp—world patents pending.

The completed assembly provides a clamp of streamlined design and efficient in appearance as well as in performance. The clamp is supplied with 6in. of cadmium-plated copper strip and is suitable for all pipe diameters in the B.S.S. 951 range. Stocking of various sizes is, therefore, eliminated, and prices are more competitive. A fully descriptive leaflet showing the simple method of fixing and other useful data is available on request.—Cable Covers Ltd., St. Stephen's House, Westminster, London, S.W.1.

THE NEW MULTIMINOR

TO meet growing competition in world markets "AVO" have produced a new pocket size instrument, the Multiminor. Two models are available: (a) the Multiminor Model 1, for use in temperate climates, and (b) the Multiminor Model 2, for use under adverse climatic conditions. The Multiminor is the first meter of its type, and is being mass produced in London.



Two views of the interesting new AVO meter—the Multiminor.

All components which could be moulded have been made on precision moulding presses, using a recently developed moulding powder, which endows the finished product with a very high factor of electrical insulation, even when working under conditions of extreme humidity. Moreover, this new material resists the growth of fungus, an enemy of instruments used under humid conditions, and a very common cause of failure. The indicating movement has been neatly constructed in a dust-proof casing, and all wiring is termite proof.

One of the weakest components in inexpensive multi-range meters is the selector switch. In this instrument the switch is quite unique in design, a series of 18 fixed, silver plated contacts being rigidly held in a ring of high-grade moulding material, and wiped by a double-contact rotor arm.

The most outstanding feature of the instrument is the employment of printed resistors, produced from a special metallic alloy. It is the first time that such resistors have been made and used on any mass-produced apparatus. In one instance it has been possible to combine a printed resistor with an auxiliary switch-plate as an integral part of the selector switch mechanism, another printed resistor forming the universal meter shunt.

Ranges

Range selection is by means of a rotary switch, there being only two connection sockets for all measurements. The instrument has 19 ranges

Table of Ranges

D.C. Voltage	A.C. Voltage	D.C. Current
Sensitivity (10,000Ω/V) First indication 2 mV.	Sensitivity (1,000Ω/V) First indication 200 mV.	First indication 2μA.
*0-100 mV.	0-10 V.	0-100 μA
0-2.5 V.	0-25 V.	0-1 mA.
0-10 V.	0-100 V.	0-10 mA.
0-25 V.	0-250 V.	0-100 mA.
0-100 V.	0-1,000 V.	0-1 A.
0-250 V.		
0-1,000 V.		

* The 100 μA range corresponds to 100 mV.

Sensitivity

All D.C. voltage ranges have a sensitivity of 10,000 Ω/V.

A.C. voltage ranges have a sensitivity of 1,000 Ω/V.

Accuracy

D.C. ±3 per cent. of full scale.

A.C.±4 per cent. of full scale.

(Instruments can be supplied to a higher degree of accuracy for a small charge.)

Approximate weight: 1 lb. (0.45 kg.).

Overall size: 5⅝in. x 3⅝in. x 1⅜in. (14.3 cm. x 9.2 cm. x 3.5 cm.).

The instrument is attractively presented in a coloured box, which can be used for display purposes, and working instructions are provided in 6 languages. A handsome ever ready leather case can also be supplied for the protection of the instrument.—Price £9-10-0.—AVO, Ltd., 92-96, Vauxhall Bridge Road, London, S.W.1.

STANDARD PRICE FOR PRINTED CIRCUITRY

IN the past the cost of manufacturing a printed circuit has usually been quoted only after detailed study of the type of circuit and quantity required.

Now, however, Printed Circuits Limited announce that they are prepared to undertake the quantity production of almost any form of printed circuit at a fixed cost of 1d. per square inch. This figure, based on lengthy experience of the process, includes such factors as raw materials, all the necessary processing, but excluding the cost of special tools.—Printed Circuits Ltd., Stirling Corner, Barnet By-Pass, Borehamwood, Herts.

Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

Third Programme

"A ROSE by any other name would smell as sweet." "Third Programme," "Network Three." What has been achieved by all the retiming, regrouping and re-arranging of programmes to which, I suppose, we have now all become accustomed? To me, personally, as a humble listener, nothing, other than annoyance and frustration at finding most of my favourite items moved around ten minutes earlier here, half an hour later there, and occasionally to a different day, compelling me to forgo it altogether. What they have done to the internal economy of the BBC I wouldn't know.

It all seems very unnecessary to me, but then, I always was a peculiar sort of chap who liked his eggs and bacon not only served regularly, but at an unchanging hour. The only thing which would have made all these changes compelling would have been an inability to switch from one programme to another on the same set; had we had to own a separate set for every wavelength it would have to have been done years ago. However, it is done now; let us hope they will leave us in peace this time. If they switch the "Critics" about many more times my digestion will be impaired through the too-often changing of my meal times, forcing me to lodge a complaint with the Ministry of Health. I wouldn't like to say offhand how many timings they and the repeat have had.

As to the network three, which was heralded as a sort of highbrow home, or lowbrow third—a *mezzo voce*, in fact, in which either one's brain could relax without becoming too idle, or it could be aroused without being called upon for too great energy, according to the direction from which you approached it. So far, it shows nothing to warrant its creation. It is very like the woman's page in the papers; the only thing they do is to deprive men of one page of reading; women nowadays taking part in most walks of life and therefore finding a whole issue to be suitable material.

The Rattigan Festival

The Rattigan Festival has brought six first-class plays on the air, namely, *The Browning Version, French Without Tears, The Deep Blue Sea, The Winslow Boy, Adventure Story* and *While the Sun Shines*. Mr. Rattigan is one of our most versatile as well as accomplished playwrights. His work covers a wide range of character and emotion. Whilst that indispensable ingredient of all good theatrical work, entertainment value, is seldom absent.

The performances varied in quality. Perhaps the best known of the six plays is *The Winslow Boy*, and it was the least satisfactory of the festival. The great scene of the interview between young Ronnie Winslow and the overpowering lawyer Sir Robert Morton—which, on the stage, was one of the most dramatic *coups-de-théâtre* of recent years, fell singularly flat. On the other hand, Sir John Gielgud, as the master in the beautiful *The Browning Version*, was perfect.

The Deep Blue Sea was excellently produced and acted, but *French Without Tears* lost some of its Criterion vivacity and sparkle. *Adventure Story*—a deep dip into history—interested rather more than it entertained, but *While the Sun Shines* tripped along as merrily as could be wished.

Altogether a most enjoyable and rewarding experienced.

Tony Shryane's and E. J. Mason's word game doesn't seem quite so funny as when it first started under John Arlott's umpireship. The parodies of famous quotations are getting easy to anticipate, whilst the Norden-Muir cracks, always bearing the same stamp, wear just a little thin.

The first of a new monthly series called "Workshop" promises to be most interesting. Purporting to be a magazine about "Britain at Work," and very fluently presented by Kenneth Harris, it contains four diverse features: cotton, elections in the Electrical Trades Union, the North Somerset coalfields and the self-portrait of a shop steward.

We learned such facts as that Lancashire cotton is the only unprotected cotton in the world, and that through lack of modern equipment it works shorter hours than any other. We were told that almost all the executive posts in the E.T.U. were filled by Communists. And that in the North Somerset coalfields there had not only been no stoppages for ten years, but that they were the first to employ foreign labour.

Symphony Orchestra

Rudolf Schwarz seems firmly in Sir Malcolm Sargent's saddle as conductor of the Symphony Orchestra. It is axiomatic that no chief directs anything but a body of tip-top musicians, each a virtuoso in his own department, and all conversant with every note of his score. So far so good; half a conductor's battle may be said to have been fought and won for him. But his main task has still to be faced: to blend ninety or a hundred diverse units into a perfect whole, slaves to his will, and able to obey his interpretative commands in every bar and every note.

RECEIVERS & COMPONENTS

MIDDLESBROUGH. Largest stocks on N.-East coast. Radio TV components. FM Kits, Gram. Cabinets, Tape Decks. Leak Amplifiers, Valves, etc. Callers only. PALMERS, 106. Newport Road. (Phone: 3096.)

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FOR SALE, White Ibbotson Projection T.V. Set, suitable for use in staff recreation room. Can be inspected at City Hospital, Chester. Offers to: SECRETARY, Chester and District Hospital Management Committee, 5, King's Buildings, Chester.

SPECIAL TAPE OFFER at Great Saving! 1,200ft. of Plastic Recording Tape on 7in. reels, listed 35/-, our price, 22/6, p. and p. 1/6; also 850ft. (long play) Plastic Tape on 5in. reels, listed 28/-, our price 19/6, p. and p. 1/6. PHOTO OPTIX (LONDON) LTD., 73, Praed St., London, W.2. (PAD 2891.)

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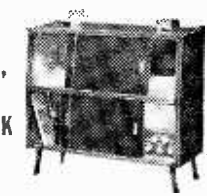

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The "TYANA"

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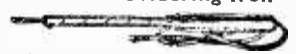

- Adjustable Bit.
- Weight approx. 4 oz.
- Heating Time 3 min.
- 40 Watt economy Consumption.
- Standard Voltage Ranges.

16/9

Replacement Elements and Bits always available.

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Lightweight High Resistance (4,000 ohms). Complete with cord. **17/6**

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AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

Battery Operated

One-valve : 2/6

B.B.C. Special One-valver AW387*

Mains Operated

Two-valve : 2/6 each

Consoelectric Two (D, Pen), A.C. AW403

SPECIAL NOTE

THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk 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 appears. Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. 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, Strand, W.C.2.

No of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve : 2/6 each

S.W. One-valver for 'American AW429*

Two-valve : 2/6 each

Ultra-short Battery Two (SG, det Pen) WM402*

Four-valve : 3/6 each

A.W. Short Wave World-beater (HF Pen, D, RC, Trans) AW436*
Standard Four-valver Short-waver (SG, D, LF, P) WM383*

Mains Operated

Four-valve : 3/6

Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) WM391*

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