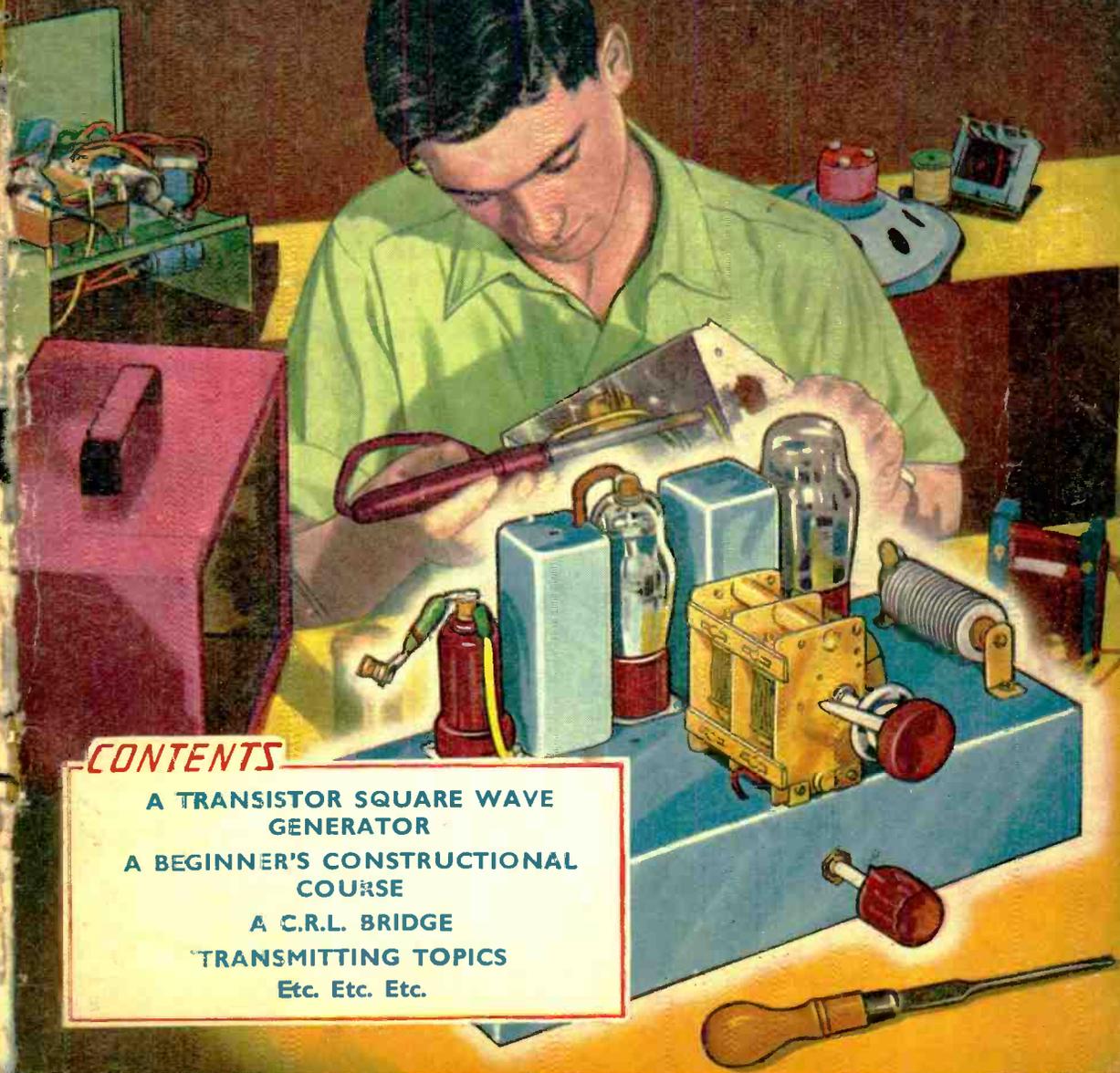


A BEGINNER'S 200-1600 METRE SUPERHET

PRACTICAL ^{1/3} WIRELESS

JANUARY
1958

EDITOR: F.J. GAMM



CONTENTS

A TRANSISTOR SQUARE WAVE
GENERATOR

A BEGINNER'S CONSTRUCTIONAL
COURSE

A C.R.L. BRIDGE

TRANSMITTING TOPICS

Etc. Etc. Etc.

MAXI-Q
REGD.

COIL PACKS

CP.3/370pF and CP.3/500pF. These 3 waveband Coil Packs are available for use with either 370pF or 500pF tuning condensers. The coverages are : Long Wave 800-2,000 metres, Med. Wave 200-550 metres, Short Wave 16-50 metres. Designed for use with "MAXI-Q" Glass scale type S2. Retail Price of each unit : 32/- plus 12 9 P.T.—Total 44 9.

CP.3 G. As above but with Gram. position, suitable for use with 500pF tuning condenser : 39/- plus 15 7 P.T.—Total 54 7.

CP.3 F. This Coil Pack is for use with a 500pF tuning condenser and covers the standard Long, Med. and Short wavebands with the addition of the band 50/160 metres. This covers the Trawler Band, Aeronautical and the 80 and 160 metre Amateur bands : 49 - plus 19 7 P.T.—Total 68 7.

CP.3 F G. As CP.3 F but with gram. position : 57 - plus 22 9 P.T.—Total 79 9.

CP.4 L and CP.4 M. These compact 4-station Coil Packs are available for either 1 Long Wave and 3 Medium Wave stations (CP.4 L) or 4 Medium Wave stations (CP.4 M). They are fully wired and require only four connections for use with any standard frequency changer valve. 25/- plus 10/- P.T.—Total 35/-.

CP.4 G and CP.4 M G. As CP.4 L and CP.4 M but with provision for Gram. position. 31/- plus 12 5 P.T.—Total 43 5.

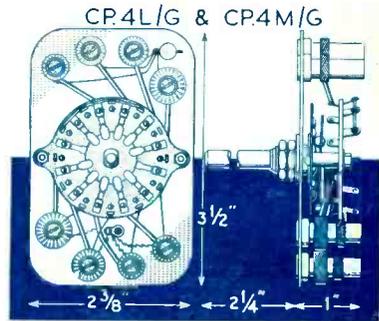
See Technical Bulletin DTB.9 for details of all Coil Packs, 1/6.

GENERAL CATALOGUE covering technical information on full range of components. 1 - post free.

DENCO (CLACTON) LTD. (Dept. P.W.), 357/9 Old Road, Clacton-on-Sea, Essex

STOP PRESS : MAXI-Q PRE-SET F.M. TUNER completely assembled. £12. VARIABLE VERSION, £11. COMBINED POWER PACK AND AMPLIFIER. £5.10.0.

Trading Terms for direct postal orders : C.W.O. plus appropriate postal charges.



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- ★ mA Test
- ★ Valve Test

Use the PIFCO All-in-One RADIOMETER for the practical testing of all types of radio and electrical apparatus. You can carry out continuity and resistance tests, check H.T., L.T., and G.B. voltages, also Household Appliances, Car Lighting Systems, Bell Circuits, etc. May be used on A.C. or D.C. mains.

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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 oval 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. Tuned, 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 unused. Circuit diagram supplied. 39 6 plus.

Note that the above three chassis although unused still need tuning. On account of low price an allowance is given. Not, or small, 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. 2 6 each or 2 - dozen.

Midjet I.F. Coils. dust coated, size 12 x 1 in. 465 Kcs. 4 6 pair.

Standard size I.F. Coil. dust coated 465 mcs. 4 6 pair.

Coil Pack for Superhet. 465 Kcs. I.F. Medium and 2 short waves. 9 6.

Cathode Ray Tube. VCR 97. Instrument type, new. 7 6 each, out make 3 6.

Bakelite 5 amp. electric wall switch. "Hivault" 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 III. contains one double triode and one triode. 6 6. post and insurance 2 6. Connecting wire, PVC covered 24 swg. copper, 2 6 per 100 ft. or 7 coils different colours for 10 s.

Sensising coils. by very good make, new and unused. 4 6 complete.

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

10 v. Superhet 13 meters. ex-Govt., but unused. Complete with valves. Easily converted for Band III. 39 6. carriage and packing 7 6.

Mains Transformer. 250-0-250, 60-470 m.a. 6 3 v. Standard mains input. Half-branded, 12 6. post and insurance 2 6.

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

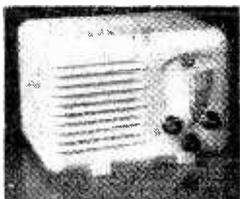
Cathode Ray Tube. VCR 517, 8 6 each, carriage 2 6.

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

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

Midjet 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

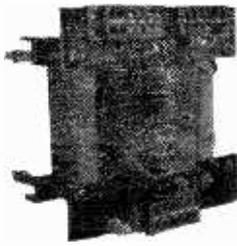
Uses high-efficiency coils, covers long and medium wave-bands and fits into the neat white or brown bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, £4 10 0. plus 3 6 post. Constructional data free with the parts, or available separately 1/6.

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**

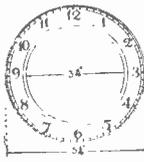
With output tapped from 110 v.-155 v. in 3 volt steps—massive transformer which will stand considerable overloading. Price 45 - plus 5 - carriage up to 250 miles.



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 mid. in two ranges. Resistance 0-2 meg. in two ranges. Inductance 0-1,000 H. Decibels -20 to +46. Complete with test probe. Price £4 15 0. Post and insurance 3 -.

**THIS MONTH'S SPECIAL BARGAINS**

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

FLUORESCENT TRANSFORMER. 200-210 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.

YANLEY SWITCH. 4 position, 6 pole, 3 bank. 2 6.

500 Kcs. CRANK. 10X E 500, Plug-in type. 6 6.

5-0-5 CENTRE zero millimeter. 2 1/2 in. 12 6.

BALANCE METER. 10D 137-2, will function as highly sensitive 7-34v. 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 bath 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. 1 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. Ostran miniature valves—low loss iron coils—permeability—tuned I.F.S.—tall A.V.C.—variable negative feedback—gram. position—4 watts output—partially fine-tune. 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:

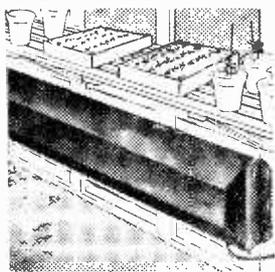
- Mains transformer..... 22/6
 - 5-amp. rectifier..... 17/6
 - Regulator Stud Switch..... 3/6
 - Resistance Wire..... 2/6
 - Resistance Former..... 2/6
 - Mains on off Switch..... 2/6
 - 0.5 amp. Moving Coil Meter..... 12/6
 - Construction Data..... 1/6
- or if bought all together price is 52/6. plus 3/6 post and packing.

MINIATURE MOTOR



Size only 2 1/2 ins. long by 1 1/2 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



Convecter 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.

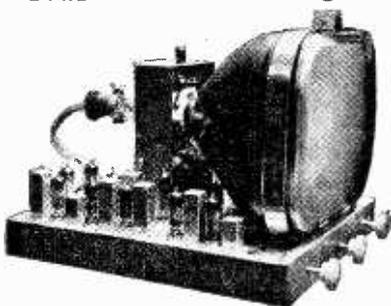
2 KW MODEL. Free standing thermostatically controlled, £5.17/6.
500 WATT MODEL. For very small greenhouses, 27/6. Carriage 5/-.

CRYSTAL MICROPHONE

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



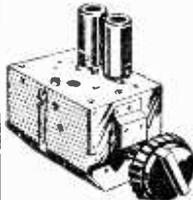
Build This in an Evening



Undoubtedly the most up-to-date television 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.
 - ★ Ferrite cube, E.H.T. and scan coils.
 - ★ 36/38 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 2/-.. All parts guaranteed 12 months. Full information and data, price 3/6.

Turret Tuner

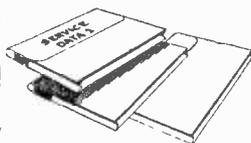


Brand new stock, not surplus, with coils for Band I and III complete with valves PCC84 and PCF90—1.F. Output 33/38 Mc's with instructions and circuit diagram, 79/6. With knobs 3/6 extra, post and insurance 2/6.

THIS MONTH'S SNIP

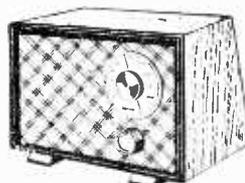
TAPE DECK.—Made by the famous Truvox Company. This contains exactly the same essentials as the current model. Only the styling is different. It also takes the stereophonic head. Specification: 3 E.P.H. shaded pole motors with silent friction drive eliminating wow and flutter. Push-button controls, electrically 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 14 1/2" x 12 1/2" 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 free. 15/- Post and insurance.

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



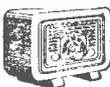
Powerful three-valve Mains amplifier ideal for dances, parties, etc. Complete less chassis, cabinet and speaker (available if required)—data 1/6 (free with parts). Price 19/6, plus 2/6 post and insurance.

'CHIMELITE' 19/6



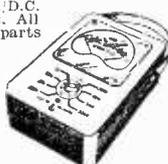
It is a hall light, as well as a double chime and you can make it in a couple of evenings for the total cost of only 19/6 including instructions, post 2/-—data available separately price 2/-

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 printed in 19/6 plus 1/0 post and insurance.

ELECTRONIC PRECISION EQUIPMENT, LTD.

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

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

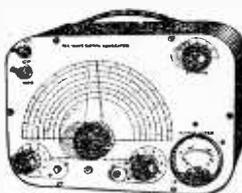
42-48, Windmill Hill, Friar-chip, Middx. Phone: RUISLIP 5780. Half day, Wednesday.

152-3, Fleet Street, E.C.4. Phone: FLEET 2843. 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 6 $\frac{1}{2}$ in. x 4 $\frac{1}{2}$ in. Size of scale, 6 $\frac{1}{2}$ in. x 3 $\frac{1}{2}$ in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 200 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. output continuous variable 100 millivolts. 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 3m'thly payments 25/- P. & P. 4/6 extra.

COMMERCIAL TELEVISION CONVERTER SUITABLE

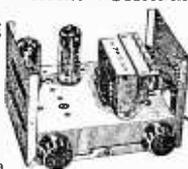
ANY T.V. (except Philips) WITHIN 35 MILES OF I.T.A. TRANSMITTER. ALL CHANNELS NO ALTERATIONS TO SET. Complete with built-in power supply 230-250 v. A.C. mains. Crackle finish case 5 $\frac{1}{2}$ in. long, 3 $\frac{1}{2}$ in. wide, 4 $\frac{1}{2}$ in. high, incorporating gain control and band switch. 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, IR5, IS3

3V4. Complete kit of parts (less

batteries).

£5.19.6

Plus Post & Packing 3/6



COMPLETELY BUILT PORTABLE AMPLIFIER

approx. size 6 $\frac{1}{2}$ in. x 2 $\frac{1}{2}$ in., 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. 3/6

5 T.M. SPEAKER & O.P. TRANSFORMER, if purchased

with the above, 18/6. Plus P. & P. 1/6.

COLLARO 4-SPEED AUTOMATIC CHANGER

Model 458 (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 metal

rectifier, A.C. mains

200-250 v. Medium

and Long waves. In

pastel blue or brown.

Valve line-up: 2

VR65s and VT52.

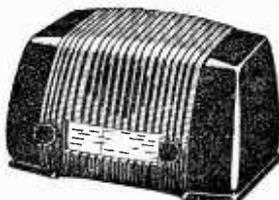
Size 15 $\frac{1}{2}$ in. long by

9in. high by 7in. deep

£3.19.6

Plus P. & P. 7/6.

Point to point wiring diagram 1/6. Free with kit.



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

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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

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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

15-50m. RA4 RHF4 RO4

Ferrite Rod Aerial, Dual Range Type FRI ... 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.

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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.

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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 UNSURED 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
IA3	3/-	6AT6	8/6	6K8GT	9/6	11E3	15/-	30P12	13/6	CK506	6/6	ECC31	15/-	(Large)	12/6	UB41	12/7
IA5	6/-	6AU6	10/6		11/-	12A6	6/6	30P16	10/6	CK523	6/6	ECC32	10/6	EZ35	6/6	UBC41	8/5
IA7	15/-	6BA6	6/6	6L6G	9/6	12AH7	8/-	31	7/6	CV63	10/6	ECC33	8/6	EZ40	8/6	UBF80	9/6
ID6	10/6	6B7	10/6	6L7M	8/-	12AH8	10/6	33A/158M		CV85	12/6	ECC35	8/6	EZ41	10/6	UBF89	10/6
IH5	11/-	6B8G	4/6	6L18	13/-	12AT6	10/6		30/-	CV271	10/6	ECC40	15/-	EZ80	8/6	UCB85	10/6
IL4	6/6	6B8M	5/-	6N7	8/-	12AT7	8/6	35/51	12/6	CV429	30/-	ECC81	8/6	EZ81	10/6	UCH42	19/-
ILD5	5/-	6BA6	7/6	6Q7G	8/6	12AU7	7/6	35A5	11/-	DI	3/-	ECC82	7/6	EZ30	19/6	UCHS1	11/6
ILN5	5/-	6BE6	7/6	6Q7GT	9/-	12AX7	9/-	135L6GT	10/-	D42	10/6	ECC83	9/-	GZ32	12/6	UCH82	13/6
INS	11/-	6B16	8/-	6R7G	8/6	12BA6	9/-	35W4	8/6	D63	5/-	ECC84	10/-	GZ34	14/-	UCL81	11/6
IRS	8/6	6BR7	11/6	6SA7GT	8/6	12BE5	10/-	35Z3	10/6	D77	6/6	ECC85	9/6	H30	5/-	UF41	9/-
IS5	8/-	6BW5	8/6	6SG7GT	7/6	12E1	30/-	35Z4GT	8/6	DAC32	11/-	ECC91	5/6	H63	12/6	UF80	10/6
IT4	7/-	6BW7	9/-	6SH7	6/-	12J5GT	4/6	35Z5GT	9/-	DAF91	8/-	ECCF80	12/6	HABC80		UF85	10/6
IU5	7/-	6BX5	8/6	6S7	8/-	12J7GT	10/6	41MTL	8/6	DAF96	10/-	ECCF85	9/6	HK90	10/6	UF99	10/6
2A3	12/6	6C4	7/-	6SK7GT	6/-	12K7GT	7/6	50C5	12/6	DF33	11/-	ECH42	10/-	HL23	10/6	UL41	10/6
2A7	10/6	6C5	6/6	6SL7GT	8/-	12K8GT	6/6	50L6GT	9/6	DF91	15/-	ECH481	8/-	HL41	12/6	UL46	15/6
2C26	4/-	6C6	6/6	6SN7GT	7/6	14/-	61B7	15/-	DF96	10/-	ECH81	8/-	HL1	12/6	UL84	11/6	
2DI13C	7/6	6C8	12/6	6S7	7/6	12Q7GT	7/6	61SPT	15/-	DH53	8/6	ECL80	10/-	HL33DD		UY41	8/6
2X2	4/6	6C9	12/6	6U4GT	14/-	12S47	8/6	72	4/6	DH75	8/6	ECL82	13/6		12/6	UY85	10/6
3A4	7/-	6C10	12/6	6USG	7/6	12S7	7/6	77	8/6	DH77	8/6	EF36	6/-	HVR2	20/-	YL507	5/6
3A5	12/6	6CH5	7/6	6U7	8/6	12S7	7/6	78	8/6	DK32	15/-	EF37A	9/-	HVR2A	6/6	YL5492A	£3
3B7	6/6	6D6	6/6	6V6G	7/-	12SH7	5/6	80	9/6	DK91	8/6	EF39	6/-	KL35	8/6	VMP4G	15/-
3D6	5/-	6E5	12/6	6V6GT	8/-	12S7	8/-	93V	15/-	DK92	12/6	EF40	15/-	KT2	5/6	VP2(7)	12/6
3Q4	9/-	6F1	15/-	6X4	7/-	12SK7	8/-	85A2	15/-	DK96	10/-	EF41	9/6	KT33C	7/6	VP4(7)	15/-
3QS5T	9/6	6F6G	7/-	6XS7	6/6	12SQ7	8/6	150B2	15/-	DL2	15/-	EF42	12/6	KT44	7/6	VP13C	7/6
3S4	8/-	6F6GT	8/-	6Z4/84	12/6	12SR7	8/6	807	15/-	DL3	9/6	EF50(A)	7/-	KT63	7/6	VP41	7/6
3V4	9/-	6F8	12/6	6Z5	12/6	12Y4	10/6	866A	13/6	DL92	8/6	EF50(E)	5/-	KTW51	6/6	VR150/30	9/-
5U4	8/6	6F12	9/-	6J30/12	12/6	14R7	10/6	956	3/-	DL94	9/6	EF54	5/6	KTW62	8/6	VT61A	5/-
5V4	12/6	6F13	12/6	7A7	12/6	14S7	14/-	1203	7/6	DL96	10/-	EF73	10/6	KTW63	8/6	VT50-	5/-
5X4	10/-	6F16	9/6	7B7	8/-	19AQ5	11/-	4033L	12/6	DL96	10/-	EF80	8/6	KTZ41	7/6	W76	7/6
5Y3G	8/-	6F17	12/6	7C5	8/-	19H1	10/-	5763	12/6	DM7J	8/6	EF85	7/6	KTZ63	10/6	X61	12/6
5Y3GT	8/6	6F32	10/6	7C5	8/-	20D1	16/-	7193	5/6	EAS0	2/-	EF86	14/6	L63	6/6	X65	12/6
5Y4	10/6	6F33	7/6	7H7	8/-	20L1	13/6	7475	7/6	EAT6	9/6	EF89	10/6	LN152	10/6	X66	12/6
5Z3	12/6	6C5	6/6	7Q7	9/-	25L6GT	10/-	9002	5/6	EABC80	3/-	EF91	9/-	MH4	7/6	X79	12/6
5Z4G	10/6	6H6GT/G	7/6	7S7	9/6	25Y5	10/6	9003	5/6	EAC91	7/6	EF92	6/6	MHL4	7/6	X(1.5)	6/6
6A8	10/-		3/-	7V7	8/6	25Y5G	9/6	9006	6/-	EAF42	10/6	EL32	5/6	MHL5	12/6	XFW10	6/6
6AB7	8/-	6H6M	3/6	7Y4	8/6	25Z4G	9/6	AC6PEN	7/6	EB34	2/6	EL41	11/-	ML4	12/6	XFY12	6/6
6AB3	10/6	6I5G	5/-	8D2	3/6	25Z5	10/6	AC/HL		EB41	8/6	EL42	11/-	ML6	6/6	XH(1.5)	6/6
6AC7	6/6	6I5GTG	5/6	8D3	9/6	25Z6G	9/6	DDD	15/-	EB91	6/6	EL81	15/-	MU14	10/6	X5G(1.5)	6/3
6AG5	6/6	6I5GTM	6/-	9D2	4/-	28D7	7/-	AC/P4	8/-	EB33	7/6	EL81	10/6	OA10	12/6	Y63	7/6
6AG7	12/6	6I6	5/6	10C1	15/-	30	7/6	AP4	7/6	EBC41	10/6	EL91	5/-	OA7	5/6	Z63	10/6
6AJ8	8/-	6I7G	6/-	10F1	15/-	30C1	12/6	ATP4	4/-	EBF8J	9/6	EM34	10/6	OA71	5/6	Z66	20/-
6AK5	5/-	6I7GT	10/6	10F9	11/6	30F5	12/6	AZ31	12/6	EBF89	9/6	EM8J	10/6	OC72	3/6	Z77	9/-
6AL5	6/6	6K7G	5/-	10F18	12/6	30FL1	12/6	B329	7/6	EC52	5/6	EY51	12/6	P61	3/6	UABC80	10/6
6AM6	9/-	6K7GT	6/-	10LD3	8/6	30L1	12/6	BL63	7/6	EC54	6/-	(Small)	12/6	P61	3/6	UAF42	10/6

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.



Stern's "fidelity" TAPE RECORDER

IT HAS EVERYTHING—EXCEPT A HIGH PRICE

TESTED AND APPROVED AT THE TRUVOX LABORATORIES

IT INCORPORATES: The NEW TRUVOX Mk. IV TAPE DECK together with the "fidelity" MODEL HF/TR2 TAPE AMPLIFIER (both illustrated on this page), and a Rola 10in. x 6in. P.M. SPEAKER.

PRICE... including CRYSTAL MIKE and 1,200ft. reel of PLASTIC TAPE.

£49.10.0.

(OR £3 EXTRA WITH REV. COUNTER.)

(Plus £1/10- carriage and insurance, of which 1/- is refunded on return of Packing case.)

● BEFORE CHOOSING YOUR TAPE RECORDER YOU SHOULD HEAR THIS MODEL—TRULY "HI-FI" RECORDINGS ARE OBTAINABLE and it is comparable to much higher priced Recorders.

Alternatively send S.A.E. for ILLUSTRATED LEAFLET.

CREDIT SALE: Deposit £12/8- and 9m'thly payments of £4/10/8.
HIRE PURCHASE: Deposit £24/15/- and 12 monthly payments of £2/5/11.

ADVANCE NEWS!!

Our "fidelity Junior" Tape Recorder will be available mid-January. It incorporates the TRUVOX MK III Deck and the correctly matched HF/TR1 A Tape Amplifier.

Price is only 39 gns. complete with ACOS crystal mike and 1200ft. of Plastic Tape. **39 Gns.**

The "fidelity" TAPE AMPLIFIER Model HF/TR2 WITH POWER SUPPLY UNIT

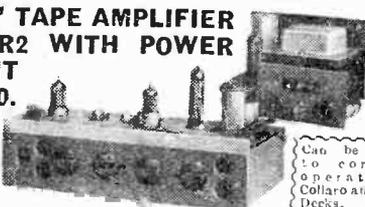
PRICE **£16.0.0.**

(Carr. and ins. 6/-)

H.P. TERMS: Deposit £3 and 13 months of £1.

CREDIT TERMS: Deposit £4 and 9 monthly payments of £1/0/4.

When ordering, please advise make of deck in use. Send S.A.E. for full details.



(Can be supplied to correctly operate with Collaro and Truvox Decks.)

HOME CONSTRUCTORS

We can supply a COMPLETE KIT OF PARTS to build this TAPE AMPLIFIER for £12 (plus 5/- carr. and ins.). The Assembly Manual, Practical Diagrams, etc., are available for 2/6. WE MAKE SPECIAL PRICES TO PURCHASERS OF TAPE EQUIPMENT (i.e., buyers of Deck and Amplifier together, etc., etc.). SEND YOUR ENQUIRY TO US... H.P. and CREDIT SALE TERMS ARE AVAILABLE.

The NEW TRUVOX MkIV TAPE DECK

ONE OF THE BEST DECKS ON THE MARKET.

PRICE **£27.6.0.**

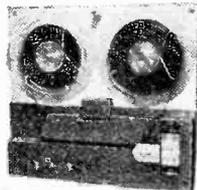
(Plus 10/- carr. and ins.)

CREDIT TERMS: Deposit £6/17- and 9 monthly payments of £2/10-.

H.P. TERMS: Deposit £13/13- and 12 monthly payments of £1/5/4.

WE ALSO HAVE A FEW DECKS WITH REV. COUNTERS. Price £30/9-.

Send S.A.E. for details.



A TAPE PRE-AMPLIFIER and ERASE UNIT

STERN'S MODEL HF/TR1.—A completely assembled Pre-amplifier with

own Power Supply. Can be supplied correctly matched for use with Truvox or Collaro Decks and incorporates Recording Level Indicator and Monitoring facilities. Please send S.A.E. with any enquiry. Price £11.10.0. (Plus 5/- carr. and ins.)

SPECIAL PRICE REDUCTION WHEN PURCHASED WITH TAPE DECK.

WE HAVE THE FULL RANGE OF DULCIS CHASSIS IN STOCK

THE MODEL H.4, is illustrated but all Chassis and Tuners are similar—send S.A.E. for leaflets. H.P. and CREDIT SALE TERMS are available. Send S.A.E. for details.

RADIOGRAM CHASSIS These two Chassis are really well designed and reproduce most excellent quality on both Radio and gram.

MODEL H.3. A 3 Waveband AM/FM CHASSIS **£20.17.0.**

MODEL H.4. A 4 Waveband AM/FM CHASSIS **£24.6.6.**

MODEL H.4.T. A 4 Waveband AM/FM TUNER with self-contained POWER SUPPLY **£20.17.0.**

RECORD PLAYERS

at Greatly Reduced Prices

Send S.A.E. for ILLUSTRATED LEAFLET

"CASH ONLY" **£8.7.6.**

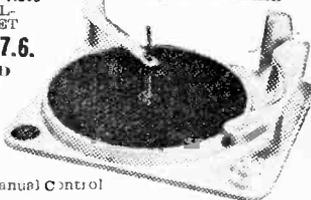
(plus 5/- carr. & ins.)

THE NEW 4-SPEED B.S.R. MONARCH

● A "MIXER" Auto-changer complete with High Fidelity Crystal "Turn-over" head.

● Incorporates the Manual Control position.

THE VERY LATEST MODELS OFFERED



MODERNIZE YOUR OLD RADIOGRAM

The NEW ARMSTRONG PB. 409 A.M./F.M. Radiogram Chassis

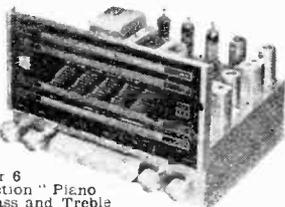
"A chassis for those who want the highest quality." ● A 9-valve line up employing the latest MULLARD preferred-type valves. ● Provides complete coverage of the V.H.F./F.M. Transmissions plus the Short, Medium and Long Wavebands. ● Has Push-Pull Output with Negative Feedback for 6 watts peak Output. ● Quick Action "Piano Key" Selectors and separate Bass and Treble Controls. ● Has "Magic Eye" Tuning Indicator. ● Dimensions 13in. x 9 1/2in. x 8in. high. Dial size 11 1/2in. x 5 1/2in.

PRICE **£29.8.0.**

Credit £7.7.0 and 9 monthly payments of £2.14.0.

(Plus 6/- carr. & ins.) H.P. £14.14.0 and 12 monthly payments of £1.7.3.

SEND S.A.E. FOR ILLUSTRATED LEAFLET.



STERN'S "F.M." TUNING UNIT

A 5-valve Tuner incorporating the latest Mullard Permeability Tuning Heart and a "Magic Eye" Tuning Indicator.

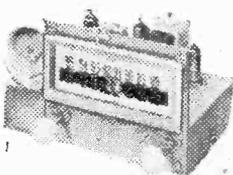
PRICE ASSEMBLED **£14.10.0.**

READY FOR USE:

(Plus 7/6 carriage and insurance.)

TERMS: (a) Hire Purchase: Deposit £7.5.0 and 9 monthly payments of 18/4.

(b) Credit: Deposit £3.12.6 and 9 monthly payments of £1.6.7.



HOME CONSTRUCTORS—You can build this unit for Full Assembly Instructions are available for 1/6.

£10.0.0.

STERN RADIO LIMITED

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

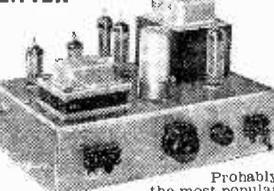
STERN'S REMOTE CONTROL UNIT

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. Input on back for Radio and Gram, and Gram equalising is incorporated. FULL DATA is contained in the 5-10 MAIN AMPLIFIER MANUAL at 16.



The MULLARD "5-10" MAIN AMPLIFIER

Probably the most popular certainly needs no recommendation from us. Our kit is complete to MULLARD'S 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 £16.0.0 an extra



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) STEPCUT 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.

CALLERS ONLY

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

(Dept. P.W.)

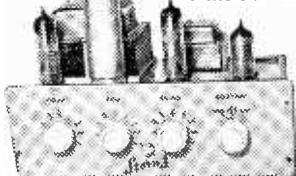
109 & 115 FLEET ST., LONDON, E.C.4.

Telephone: FLEet 5812 3 4.

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**
 - (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**
 - 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 £1.5.0. H.P. TERMS, £7 Deposit and 9 monthly payments of 17/9.
 - (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, £9.0.0 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

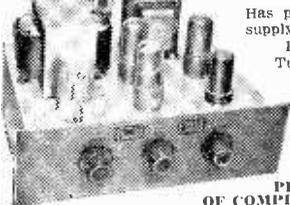


A small compact Amplifier capable of HIGH QUALITY REPRODUCTION on both RADIO and GRAM.

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 75 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 8V6s 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 3 1/2" P.M. SPEAKER, ALL FOR **£8.7.6** ONLY (plus 7/6 carr. & ins.).



The Amplifier consists of a 2 Stage design incorporating the modern B.V.A. valves types ECC83, EL81 plus E200 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 Resine.

WE ALSO SUPPLY SEPARATELY—

- (a) The 2-Stage (plus Rectifier) AMPLIFIER..... **£4.2.6**
- (b) The PORTABLE CARRYING CASE..... **£3.17.6**
- (c) 3 1/2" P.M. SPEAKER..... **16/9**

Carriage and insurance, extra.

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

SEE THESE FINE BARGAINS AT *The Walk-around Shop*

TRANSMITTER/RECEIVER AN/APN.1

Frequency Approx
400-470 Mc/s.

TRANSMITTER.
Containing two 955
(VT121) Acorn valves
and Moving Coil
Transducer

RECEIVER. Con-
taining two 9304 Acorn
valves.

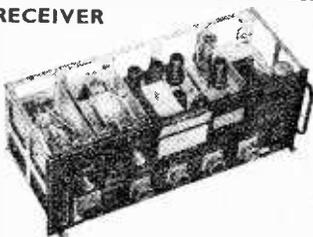
A.F. AMPLIFIER. Containing two 125H7 and one 125J7 valves. The above chassis are housed in a Black crackle case which contains three Relays Resistors, Potentiometers, and the following valves: 3-125H7's, 1-125J7, 1-VR150/30, and 2-12H6's making a total of 14 valves in all. Brand New, Priced, 30/-, plus 7/6 carriage.

No. 19 SET TRANSMITTER/RECEIVER

Frequency coverage 2-8 Mc/s for R/T.MCW. C.W. Superhet Receiver 465 kc/s. I.F. B.F.O., etc. Receiver line up:—6K7 R.F., 6K8 Mixer, 2-6K7 I.F.'s, 6B8 Det. Transmitter line up:—6K8 Mixer, VFO EF50 buffer, EB.34 ADC, 870 P/A. This unit incorporates a TX/RX 229 to 241 Mc/s with a local range of one mile. Valve line up:—CV.6, 2-6K7's and 6V6. Also intercom. set two valve AF amplifier 6K7 and 6V6. As New condition and of American manufacture. Fully Valved, £3/5/-, plus 10/- packing and carriage.

38 SET TRANSMITTER/RECEIVER

7.4 to 9 Mc/s. This Walkie Talkie is offered complete with throat microphone, headphones and collapsible aerial. Fully valved with 4 VP23 and 1 ATP4. Including leads and canvas carrying bag. Brand New 65/-, plus 5/- p. & p.



RECEIVER UNIT Ex 1143A

10.72 Mc/s I.F.s. Frequency 100-120 Mc/s, suitable for conversion to 2 metres and Wrotham. Owing to a large purchase we can offer these units fully valved, with circuit diagram, at 25/- each, plus 3/- post/packing. Valve line-up: (4) EF50, (1) EL32, (2) EF39, (1) EBC33, (1) EA50.

Crystal Microphone Inserts. Suitable for connection directly into pick-up sockets of Radio or Gramophone Amplifier. No transformer required. Very sensitive. Guaranteed. 4/6 each, post paid.

ANTENNA RELAY UNIT

U.S. manufacture, containing change-over relay, 2in. panel mounting meter (measuring aerial current) with separate thermo-couple, vacuum condenser 50 pF. 7.5 K.V. Meter movement 2mA basic contained in metal case 3 1/2 x 4 1/2 x 3 1/2 in. with ceramic stand off terminals. 12/6 post paid.

SIGNAL GENERATOR AND WAVEMETER

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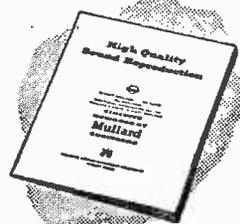
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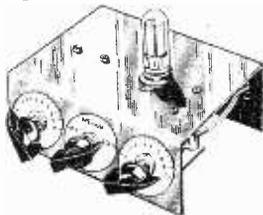
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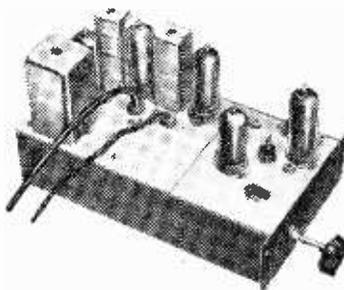
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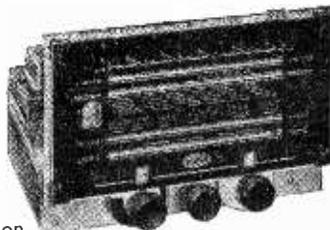
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A well-tryed portable, using high efficiency ferrite rod aerial. 2 waveband. 4 valves. Build it during the dark evenings ready for the spring. Full constructional data and price list 1/6. Total building cost £7-10-0.

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We are stockists for : EDDYSTONE receivers and components, PANDA transmitters, including the CUB and EXPLORER. Also the PANDA G4ZU MINIBEAM.

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 5v. 1 amp. 19/9
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 6v. 2 amps. 28/9
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 Above ready for use. Carr. 3/6. With mains and output leads.

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 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 Carr. 3/9. **47/9**

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

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 200-0-250 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
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 All with 200-230-250 v. 50 c/c.s. Primaries:
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SPECIAL OFFERS: Electrolytics, 32-32-32 mfd. 50 v. Duffiler small can, 2/9 ea. 150 mfd. 450 v. 8/9. 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 110 yd.

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 100 mA. 5 H 100 ohms 3/11
 80 mA. 10 H 150 ohms 3/11

EX-GOVT. E.H.T. SMOOTHING CONDENSERS. 102 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 250-250 v. A.C. Mains receiver with selenium rectifier. It consists of a variable Mu high-gain H.F. stage followed by a low distortion audio band detector. Power pentode output is used. Valve line-up being 6X7, 6V6, 6X4. 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 6 1/2 x 5 1/2 in.

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6SJ7GT	6/9	35Z4GT	9/9	EL84	10/6
6SL6GT	8/9	MH4	4/9	FW4 500	9/9
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16μF 500 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.	1/9	16-16μF 450 v.	4 11
50μF 50 v.	1/9	32-32μF 350 v.	4/9
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Type BM1. An all-dry battery eliminator. Size 8 1/2 x 4 1/2 in. approx. Completely replaces hottricks supplying 1.1 v. and 90 v. where A.C. mains 200-250 v. 50 c/c.s. is available. Suitable for all battery portable receivers requiring 1.1 v. and 90 v. This includes latest low consumption types. Complete kit with diagrams, 39/9, or ready to use, 46/9.



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 8in. 2-3 ohms, 35/9.
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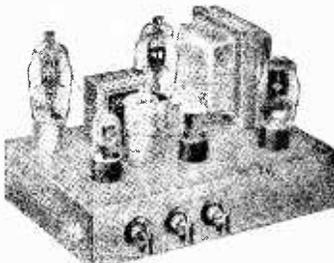
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R.S.C. A8 ULTRA LINEAR 12 WATT AMPLIFIER

High-Fidelity Push-Pull Amplifier with "Built-in" Tone Control. Pre-amp stages, High sensitivity. Includes 3 valves (637 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 3 db., 30-30,000 c.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 FEEDBACK KIT. Size Cutout 2.5-7 in. For A.C. mains 200-250 v. 50 c.s. Output for 8 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Unassembled Carriage 10. If required louvred metal cover with 2

£7-15-0



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. Keep cash prices or I.L.T. 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.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, EF88, 6CC6, 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.s. A.C. Mains and has outputs for 8 and 15 ohm speakers. Complete kit of parts with fully punched chassis and point-to-point wiring diagrams and full 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.

10 GNS.

COLLARO RC54 3-SPEED AUTOCLEANERS with Studio Pick-up. Brand new. For 110 v. 50 c.s. A.C. mains. Price with 110 v. to 200-250 v. Auto Trans. only 7 Gns. Carr. 5.6.

COLLARO RC 457 4-SPEED AUTOCLEANERS with high fidelity Studio Pick-up. Latest model. Brand new. For 200-250 v. 50 c.s. A.C. mains. Our price £219.6. 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 to RC457. For 200-250 v. A.C. mains. £4-12.6.

LAG 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.s. A.C. mains. Overall size 4 1/2 x 4 1/2 in. Controls: Vol. and Tone with switch. Guaranteed 12 months. Only 49.9.

PORTABLE CABINETS. Exceptionally attractive appearance. Take any amplifier and/or 4 speed auto-change or single player. 5/6. Carr. 4.6.

SUPERHETERODYNE Design of a high quality Radio Tuner Unit, specially suitable for use with any of our Amplifiers. Delayed A.V.C. employed. The Controls are Tuning, W.C. 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. 9-7 in. 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 L45 MINIATURE 4.5 WATT QUALITY AMPLIFIER**. Suitable for use with Collaro, B.S.H. or any other record-playing unit, and most microphones. Negative feedback 12 db. Separate Bass and Treble Controls. For A.C. mains input of 200-250 v. 50 c.s. Output for 2-3 ohm speaker. Three miniature Mullard valves used. Size of unit only 6-5 in. high. Output for 2-3 ohm speaker. Guaranteed for 12 months. Only 25 19.6. Send S.A.E. for illustrated leaflet. Credit Terms. Deposit 22.6 and 5 monthly payments of 22.6.

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PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXIII, No. 613, JANUARY 1958
COMMENTS OF THE MONTH

EDITOR : F. J. CAMM

25th YEAR
OF ISSUE

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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PRACTICAL WIRELESS

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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 in a stamped and addressed envelope if enclosed. All correspondence intended for the Editor should be addressed: The Editor PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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Round the World of Wireless



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.

By "QUESTOR"

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.

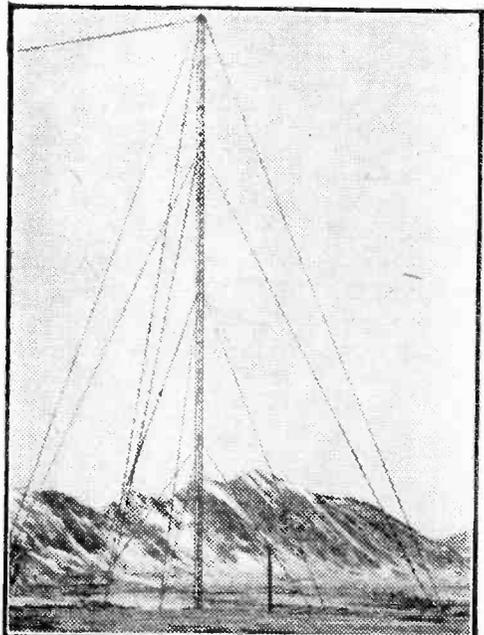
Television receiver sales were greater by 10 per cent., radiogram sales by 30 per cent. and radio receiver sales by 22 per cent.

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.

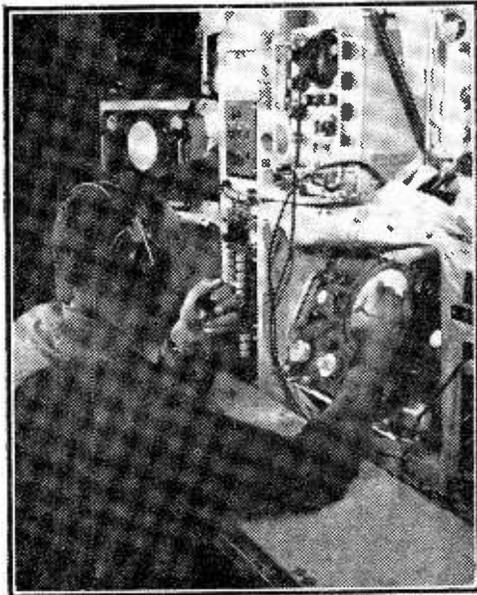
B.I.R.E. Meetings

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.



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 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 manoeuvres to defending ships, planes and ground stations.

Toy Sputnik

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

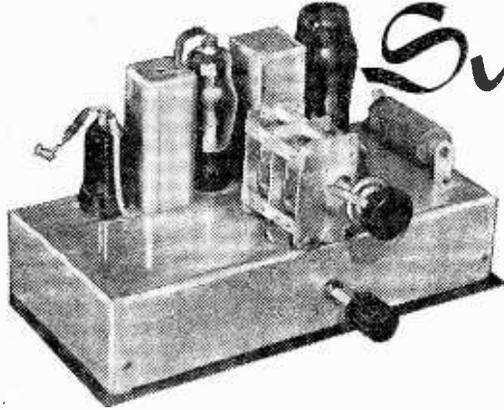
BBC Scottish V.H.F. Station

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 .0005 μ F 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 bypass 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 $\frac{1}{2}$ in. 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,

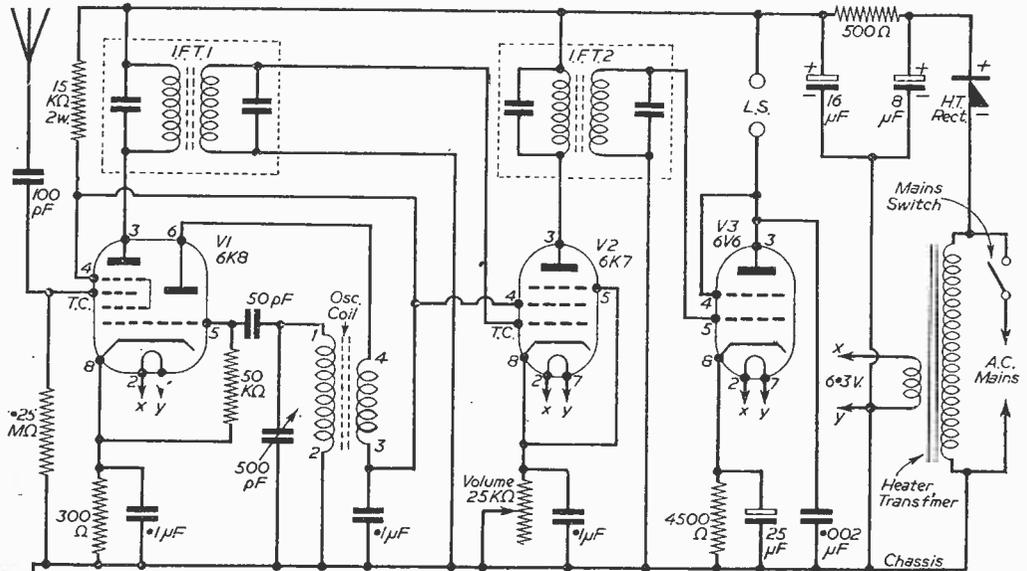


Fig. 1.—The circuit of the receiver described in this article.

with about $\frac{1}{4}$ in. 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 dimensions are not very important, but a chassis about 10 in. \times 5 $\frac{1}{2}$ in. will be satisfactory. A suitable chassis can easily be purchased ready made. Alternatively, it may be constructed by bending 2 in. runners on a piece of 18 s.w.g. aluminium 10 in. \times 9 $\frac{1}{2}$ in., or by screwing 2 in. wooden runners to a sheet 10 in. \times 5 $\frac{1}{2}$ in.

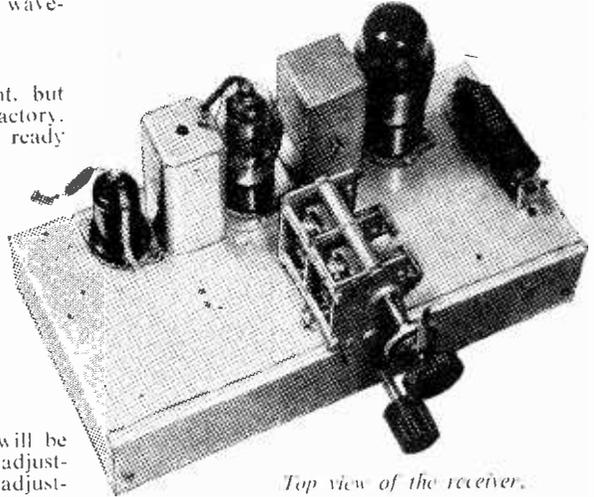
The components are positioned as in Fig. 3. If a tuning condenser is to be obtained, the two-gang type is recommended, because it will be readily obtainable at low cost from surplus stores. It will also prove convenient if the effect of tuning the aerial circuit is at some future date investigated.

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 paddler (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

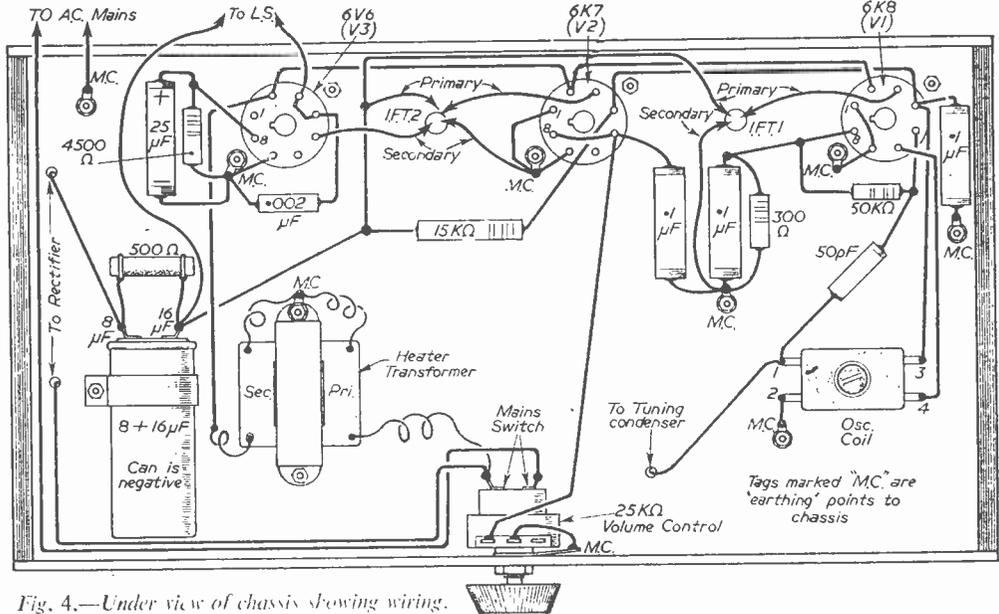


Fig. 4.—Under view of chassis showing wiring.

single $\frac{1}{16}$ in. 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.

Adjustments

These are very simple, but will nevertheless considerably influence results. A station should

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

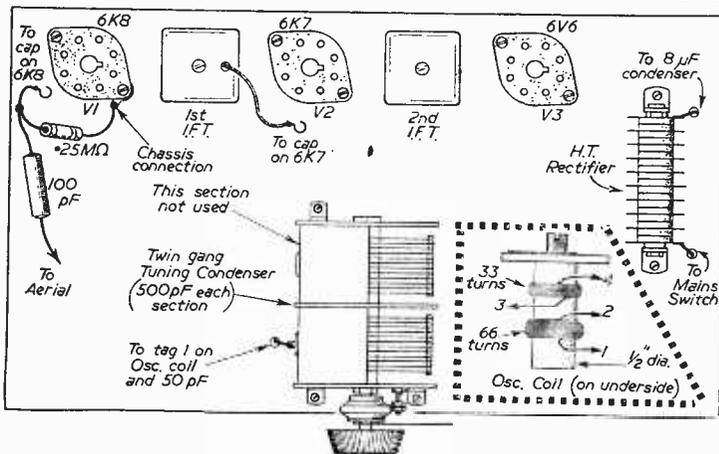


Fig. 3.—Top of chassis layout and inset (Fig. 2) the oscillator coil.

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 $.05\mu\text{F}$ 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 $.0001\mu\text{F}$ to $.001\mu\text{F}$ 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.
- $.0005\mu\text{F}$ tuning condenser with reduction drive and knob.
- 300 ohm, 4,500 ohm, 50 K, and .25 megohm $\frac{1}{2}$ -watt resistors.
- 500 ohm 1-watt resistor. 15 K. 2-watt resistor.
- 50 pF and 100 pF mica condensers. $.002\mu\text{F}$ condenser.
- Three $.1\mu\text{F}$ condensers.
- $25\mu\text{F}$ 25 v. bias condenser.
- $8\mu\text{F}$ plus $16\mu\text{F}$ 350 v. smoothing condensers.
- 25 K. potentiometer with switch. Knob.
- 6.3 v. $1\frac{1}{2}$ amp. heater transformer.
- 250 v. 60 mA metal rectifier.
- M.W. oscillator coil.
- 6K8, 6K7 and 6V6 valves.
- Three octal valholders.
- Chassis about 10in. x 5 $\frac{1}{2}$ in.

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

JOIN THE PRACTICAL GROUP

Edited by F. J. CAMM

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A Transistor Square Wave Generator

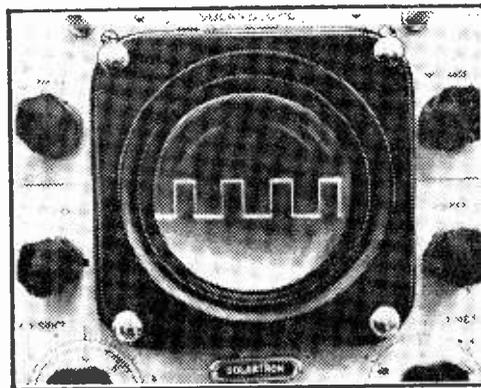
CHECK YOUR AMPLIFIER WITH THIS
HANDY UNIT

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 actual waveform from the unit described here.

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.

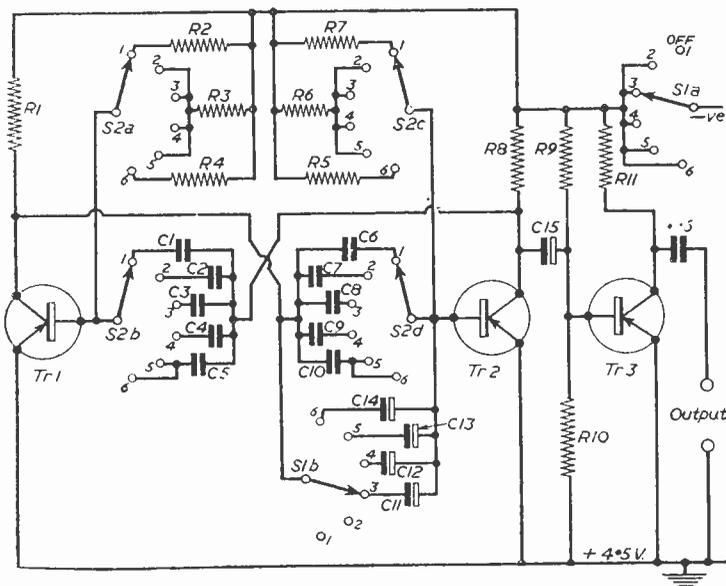


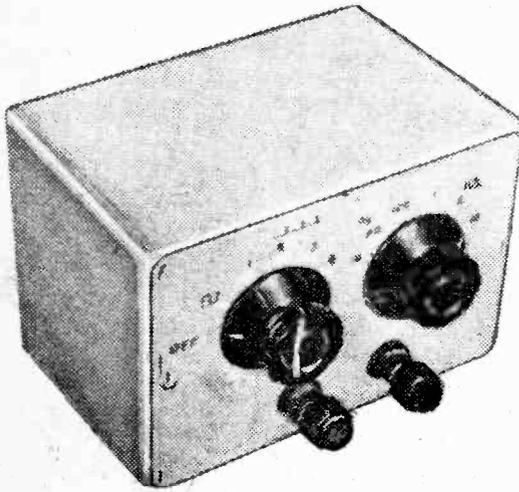
Fig. 1.—Theoretical circuit of the generator.

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.



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,

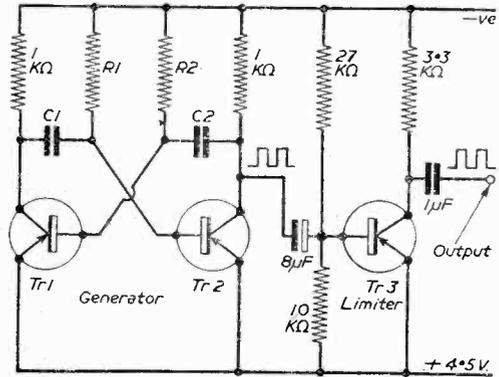


Fig. 5.—Basic arrangement.

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

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-

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

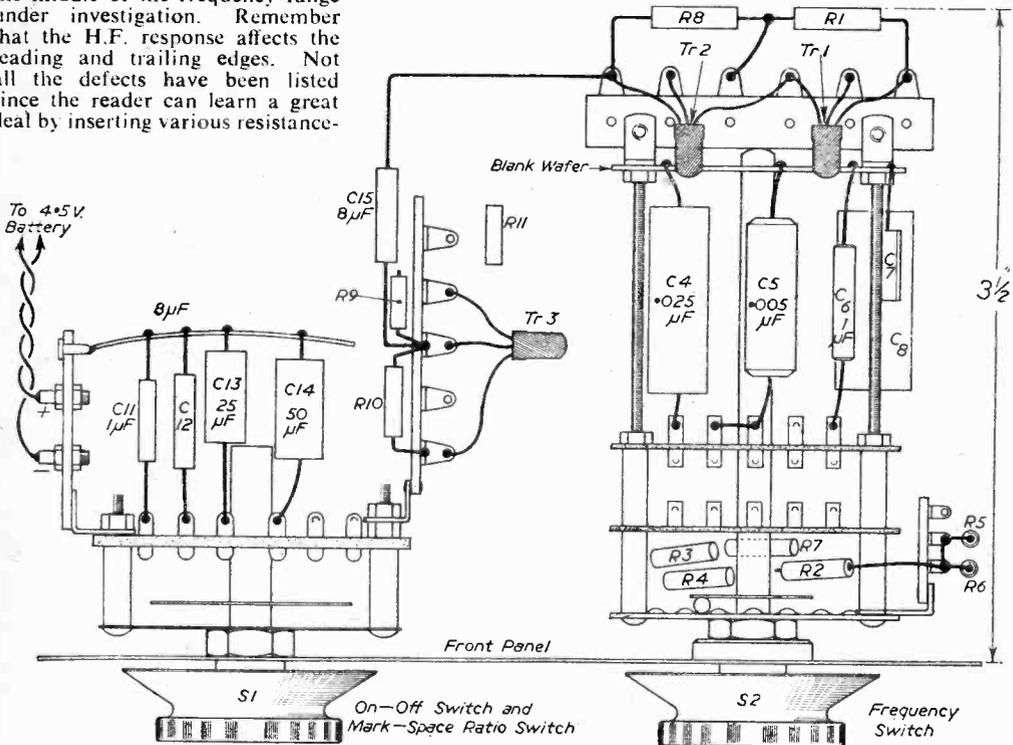


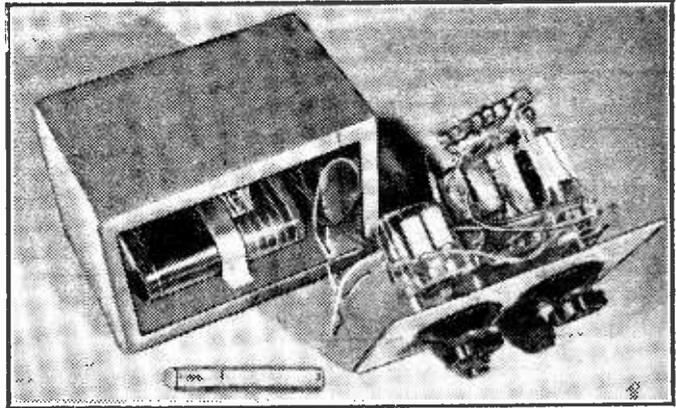
Fig. 6.—Actual wiring details of the unit.

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 $\frac{1}{16}$ in. 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.

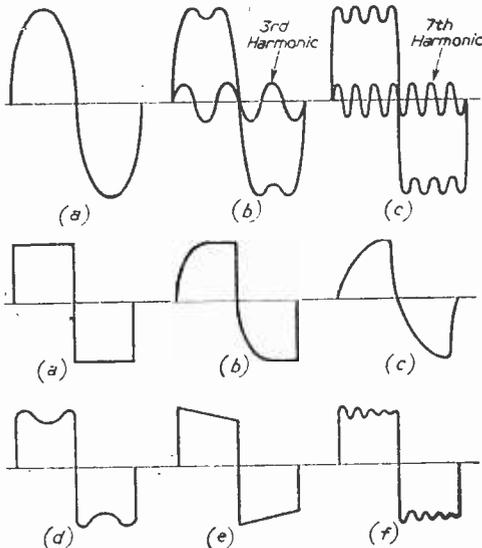
For example, if a spot frequency of, say, 400 c/s is required then:—

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

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

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

If we conveniently keep R constant, and 27K



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

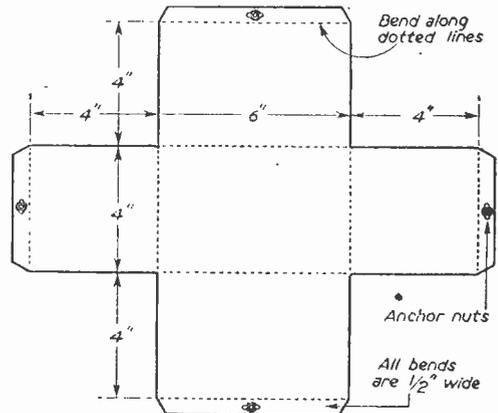


Fig. 4.— Details of the case or cabinet for the unit.

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

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

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

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

$$C = .071 \mu\text{F}$$

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

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 connected 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

LIST OF COMPONENTS

R1—1 K	R8—1 K	C4, C9—.025 μF	Tr1—OC71
R2—30 K	R9—27 K	C5, C10—.005 μF	Tr2—OC71
R3—27 K	R10—10 K	C11—1 μF	Tr3—OC71
R4—15 K	R11—3.3 K	C12, C15—8 μF	S1—2 pole-6 way
R5—15 K		C13—25 μF	S2—4 pole-6 way
R6—27 K	C1, C6—1 μF	C14—50 μF	Battery 4.5 volts Ever Ready D888
R7—30 K	C2, C7—.5 μF	C16—1 μF	
	C3, C8—.25 μF		

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

housing the generator but the case shown, measuring 6in. \times 4in. \times 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 3 $\frac{3}{4}$ in. \times 5 $\frac{1}{2}$ in. 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.

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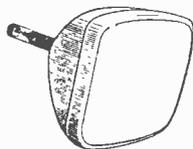
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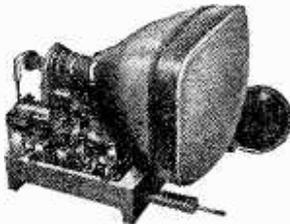
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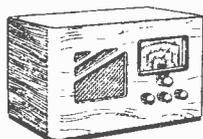


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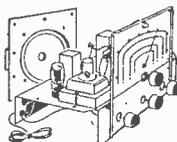
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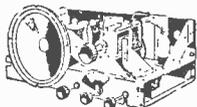
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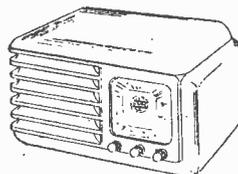


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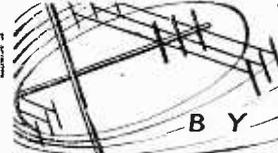
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Credits

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.T.V. programmes, has another aspect. The BBC and the I.T.V. 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.T.V. 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.T.V. 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

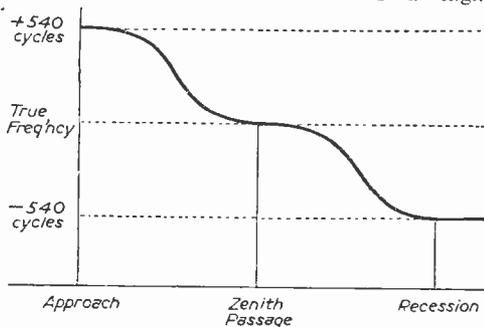


Fig. 1.—Observed frequency variation of satellite. Initially the frequency of 20 Mc/s will be observed 540 cycles high in the initial approach stages for a velocity of 18,000 miles an hour. The final frequency shift when receding will be the same amount low. For any given satellite speed, the maximum 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.

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.

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

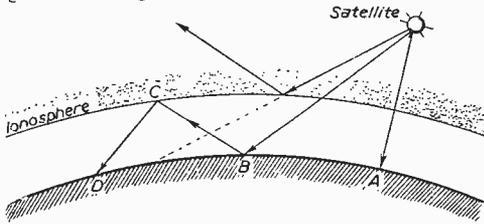


Fig. 2.—Possible modes of reception of the satellite signals. The observer at A hears the satellite by direct path through the ionosphere, as also does the observer at B. The waves reflected from Earth at B are again reflected back to Earth to an observer at D from a point C in the ionosphere. Between 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.

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.

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 $1\frac{1}{2}$ 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

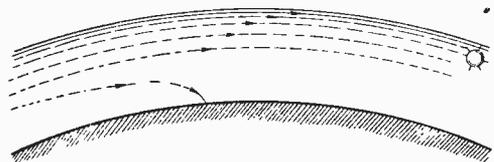


Fig. 3.—The orbit of a satellite close to Earth becomes slowly smaller due to the effect of residual air drag losses. At the same time, however, the orbital speed of the satellite actually increases, contrary to popular ideas, thus increasing the effect of air drag. This process rapidly augments until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

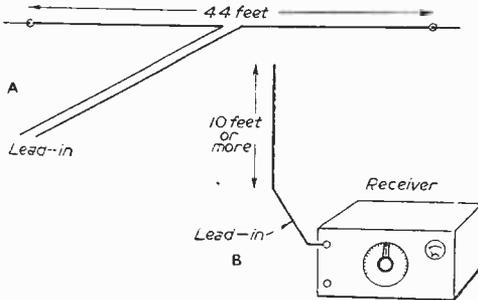


Fig. 4.—Two simple aerial systems. A gives the dimensions of a dipole for 20 Mc/s use. The vertical aerial at B will be found useful for "extreme range" detection of the satellite. For the 40 Mc/s transmissions, a conventional Band I television aerial may be used. Detuning a turret tuned domestic receiver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

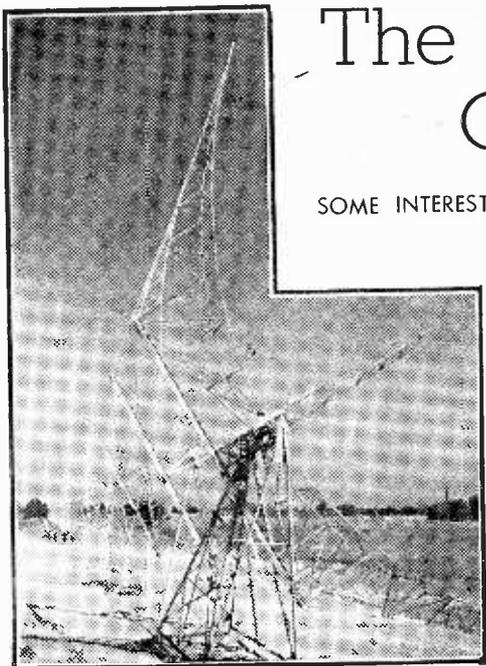
(To be continued)

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.

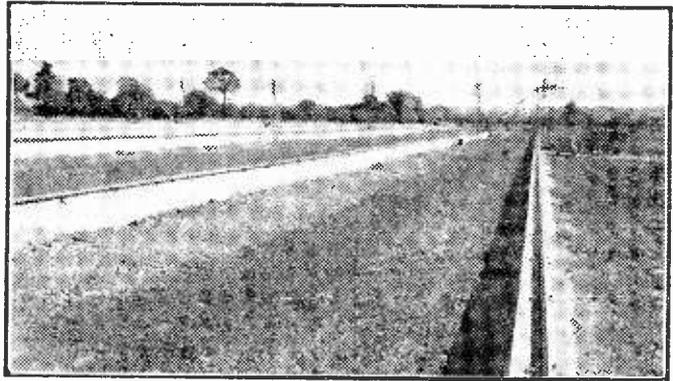
The Cambridge workers consider that their observations point to the conclusion that at very great distances the "radio stars" are closer together. If their conclusion is correct it would seem to favour a theory in which the Universe is supposed to be expanding from an initial highly condensed state, 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 aeri-als. It was realised that the renting of this site and the construction of the aeri-als 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 aeri-als 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

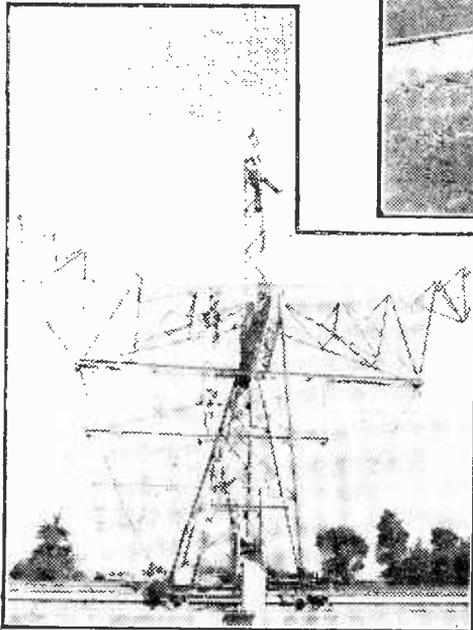
The radio-star interferometer, which is designed for a wave-length of 1.7 m., comprises a fixed



The moving aerial and railway tracks of the radio star interferometer during construction. The steel-work 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.

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 aeri-als 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.



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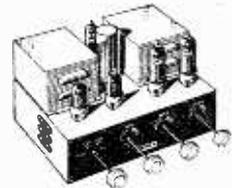
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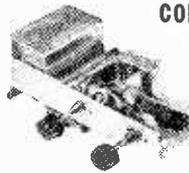
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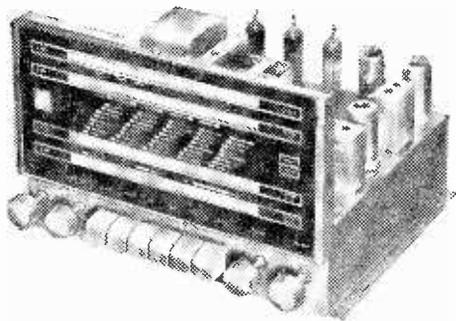
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5V4	12 1	6J4GT	10 1	10P3	21 1	25L6GT	9 1	15 1	15 1	DL94	8 1	EP22	16 1	EZ40	8 1	KT68	10 1	PY82	8 6	U281	17 6	W81M	18 6
5Y3GT	8 1	6K7GT	10 1	10P9	12 6	25V5	10 6	AC/TP	29 6	DL96	8 9	EP36	6 6	EZ41	10 6	KT68	10 1	PY82	8 6	U281	17 6	W142	9 1
5Z4	10 1	6K8GT	12 3	10LD11	25Z4	9 1	AZ1	15 6	EAS0	2 1	EP37	9 6	EZ80	8 1	KT66	18 6	PY83	8 6	U282	20 1	W719	8 6	
6A8	10 1	6K25	18 6	14 9	25Z5	10 1	AZ31	15 6	EABCS0	EP37A	10 3	EZ81	8 1	KTW61	9 1	PZ36	17 6	U301	21 1	W727	8 6		
6A7	13 6	6L9	7 6	10P13	23 6	25Z9	9 6	B38	15 6	1	9 6	EP39	7 6	EZ90	7 6	KTW62	8 1	Q21	8 6	U403	9 6	X18	11 9
6A8S	9 6	6L8	12 6	10P11	18 6	30 1	8 6	B65	8 6	EAC91	10 1	EP40	15 1	PC3	14 6	KTW63	9 1	Q22	13 1	404	9 6	X61	12 6
6AJ8	9 6	6L19	21 1	12 1	6 32	8 6	B329	9 1	EAF42	10 1	EP41	9 6	FC13	14 6	KTZ1	9 1	Q120	17 6	U801	27 6	X65	15 1	
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6AN5	9 1	6Q7GT	10 6	12AX7	9 1	30P4	23 6	CL33	18 6	EBF89	9 6	EP89	10 1	H63	10 1	MH4	8 6	SP11	3 1	UBF90	9 6	Y63	9 6
6AQ5	7 6	6A7GT	8 6	12BA6	8 9	30P12	12 6	CY1	15 6	EBL21	21 1	EP91	8 6	HBC90	8 1	MH4	8 6	SP42	2 6	UCB85	10 1	Z21	10 6
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6BR7	12 1	6U4GT	11 6	12 3	35Z4GT	8 6	PAC32	9 9	ECU35	8 6	EL35	15 1	10 1	10 1	10 1	10 1	10 1	10 1	10 1	10 1	10 1	10 1	10 1

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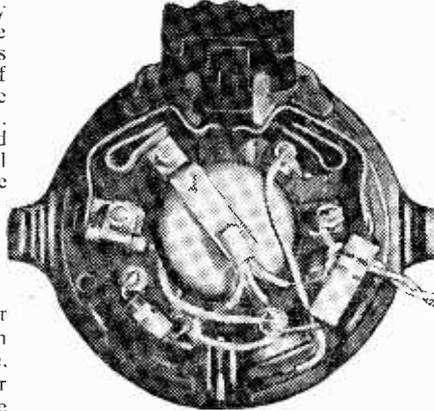
THERE are many ex-Government microphones available very reasonably priced. Probably the main reason for their cheapness and availability is their comparative lack of sensitivity. Most of these microphones were manufactured for use in fairly rough conditions, so that the robustness of the instruments 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

A TRANSISTOR MICROPHONE



AMPLIFIER

By B. E. Wilkinson

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.

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

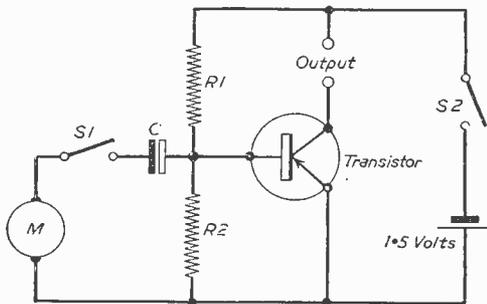


Fig. 1.—The circuit diagram of the amplifier.

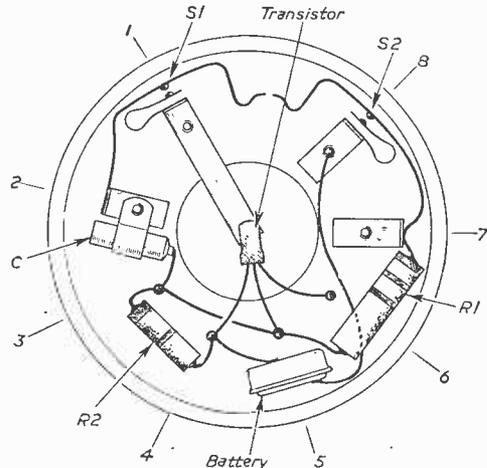


Fig. 2.—General layout; the radial numbers indicate the terminals.

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 $\frac{1}{4}$ in. 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 $\frac{1}{4}$ in. to $\frac{1}{2}$ in. 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 (47K Ω), 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 $\frac{1}{4}$ watt, but this is not necessary. The particular one was chosen only on account of its small size. The 8 μ F 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 $\frac{1}{2}$ in. in diameter and is just less than $\frac{1}{4}$ in. 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 $\frac{1}{2}$ 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 1 in. in diameter. If it is found that this aperture still distorts the sound, one should increase its diameter until it is about $\frac{1}{2}$ in. 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

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

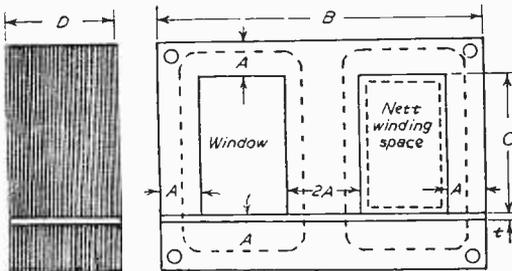


Fig. 1.—Laminations of the E & I type, especially suitable for a choke. The length of magnetic path, l , is that of either dotted line. Effective gap = $2t$. Volume = $2AD(B+2C)$.

the best choice for heater windings of thick wire.

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

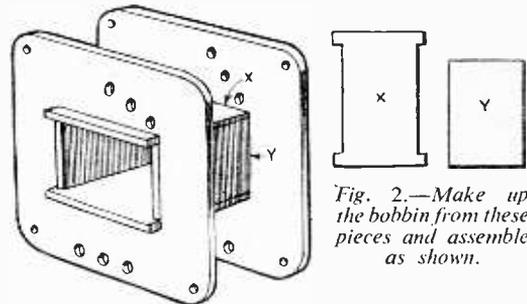


Fig. 2.—Make up the bobbin from these pieces and assemble as shown.

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.

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:

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

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 $1\frac{1}{2}$ henrys (with zero gap) to $2\frac{1}{2}$ 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 $1/16$ in. 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

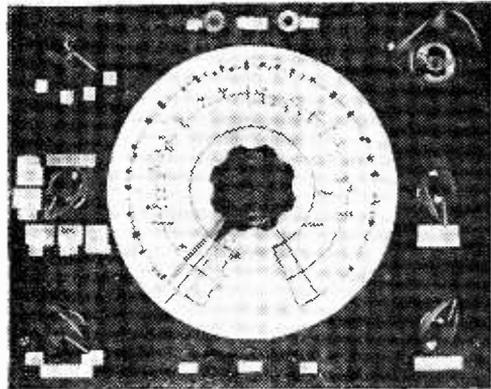
* At 1,000 amp./sq. in. (This current density is occasionally doubled.)

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

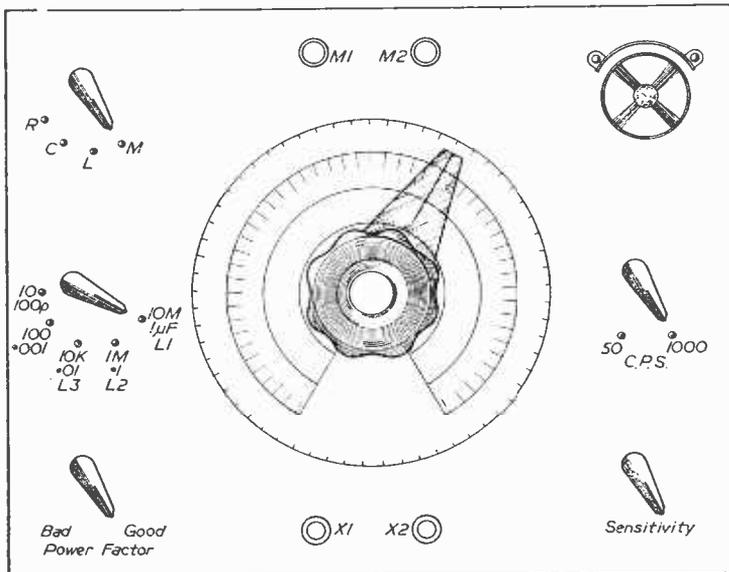


Fig. 1.—Details of the panel shown in the illustration above.

paint should have cracked, 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 1 in.

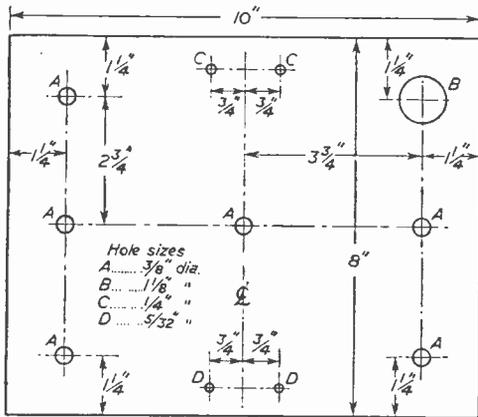
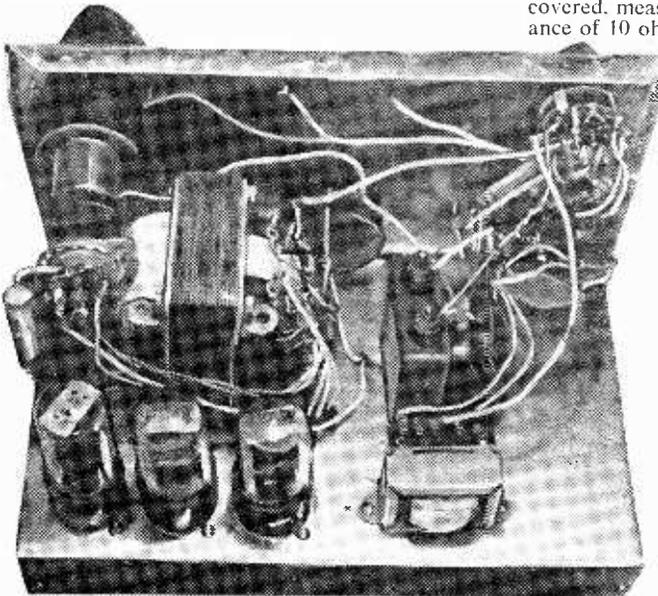


Fig. 2.—Panel drilling data.

end at right angles. Now fit the panel components and chassis parts. wrap a piece of sponge rubber 7/8 in. wide and 3 1/2 in. 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,



General view of the chassis layout.

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 valveholder from below the chassis. The terminals M and X are insulated sockets. The resistor R6 is

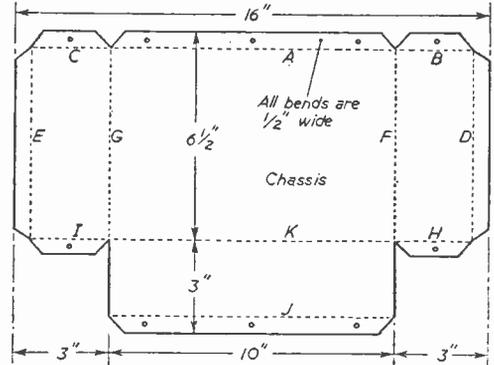


Fig. 3.—Details of the chassis.

not a commercial one, but is easily made up as follows. Take some 31 s.w.g. Eureka or Constantan resistance wire, preferably silk and enamelled covered, measure off 56 1/2 in., 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

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
R8-10k ohm precision.	wound
R9-1 megohm precision.	VR2-2 meg.]
R10-10 megohm precision	carbon
	VR3-3k pot
	carbon
C1-8 μ F 350 v. tubular	
C2-.001	
C3-.001	
C4-1 μ F block paper	
C5-.1 mica or tubular	
C6-.01 mica	
C7-.001 mica precision	
C8-100pF " " "	
C9-.1	
C10-.1	
C11-8 μ F 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

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

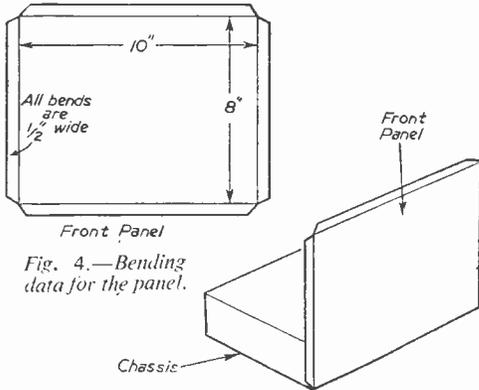


Fig. 4.—Bending data for the panel.

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

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

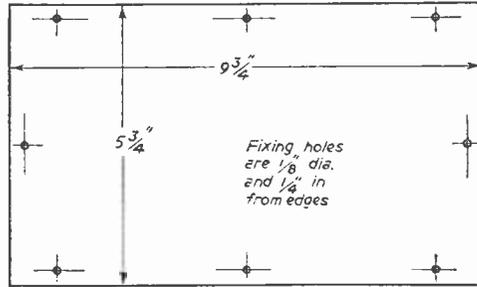
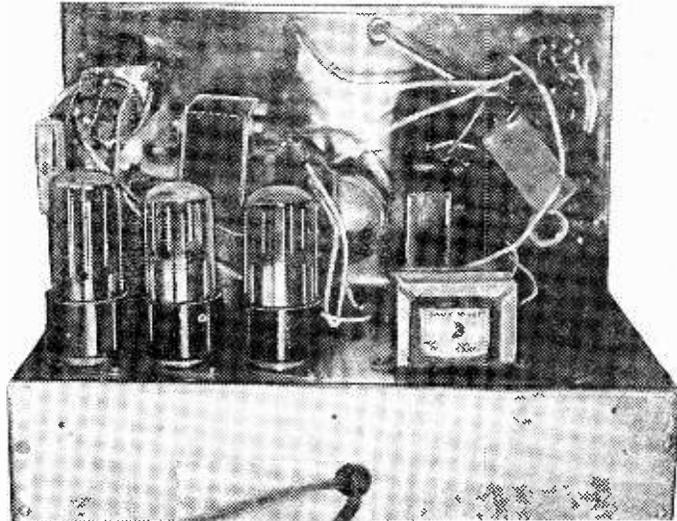


Fig. 6.—"Lid" for the bottom of chassis.

IST

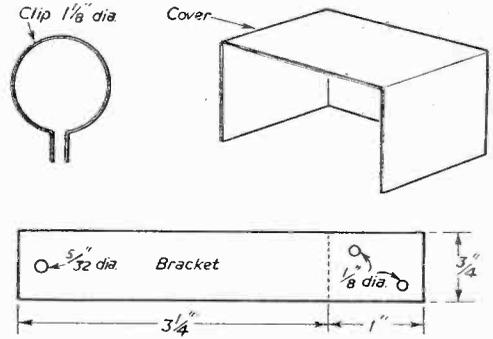
- 1 midget output transformer
- 4 insulated sockets
- 4 Int. octal valveholders
- 1 mains transformer
- 2 1 amp. fuses
- 1 Twin fuseholder
- 1 3 pole, 5-way switch S3
- 1 3 pole, 4-way " S2
- 1 2 pole, 2-way " S1
- 1 DPST toggle switch S4
- 5 small pointer knobs
- 1 large round knob
- 2 wander plugs
- 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.

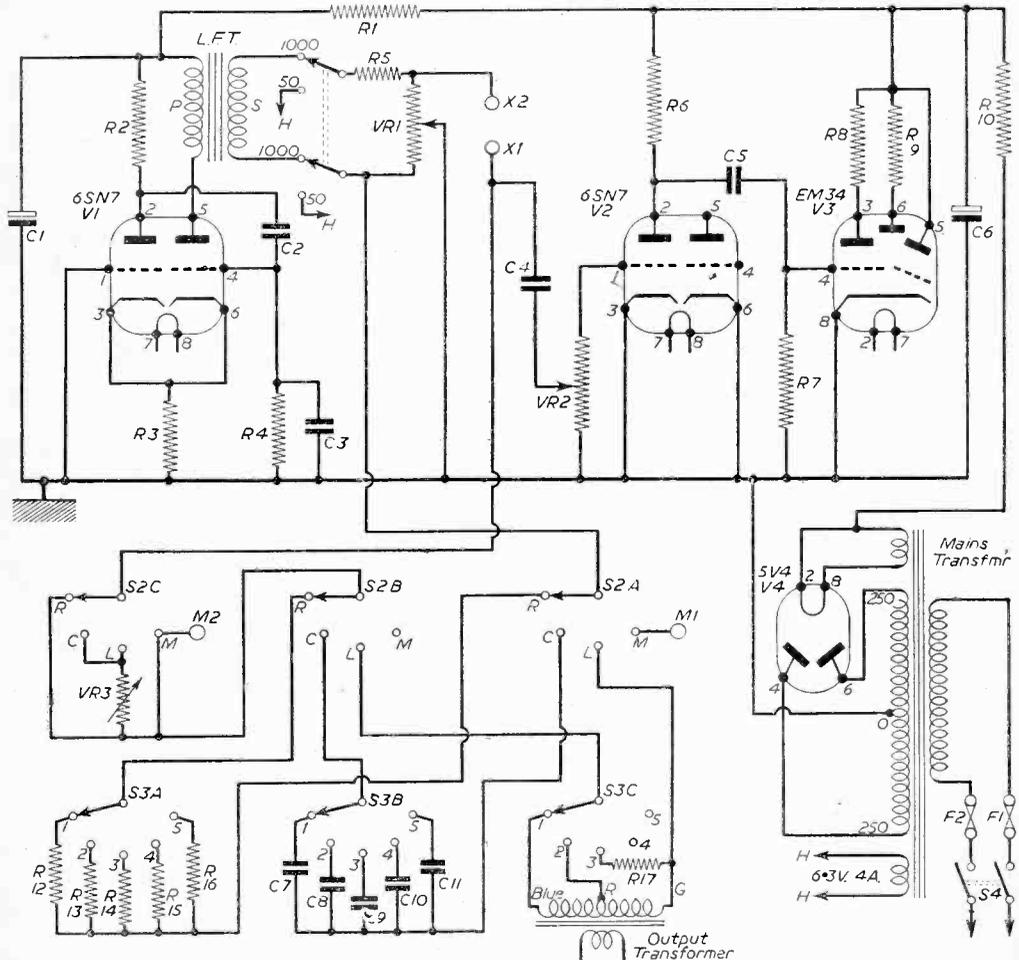


Fig. 10.—Theoretical circuit of the test set. A list of parts will be found on the previous page.

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.

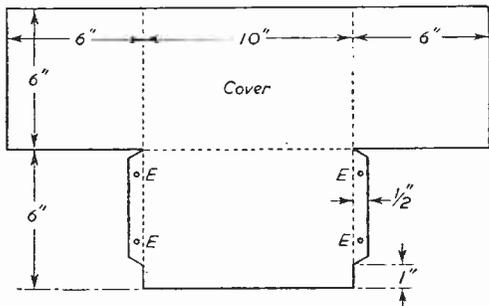
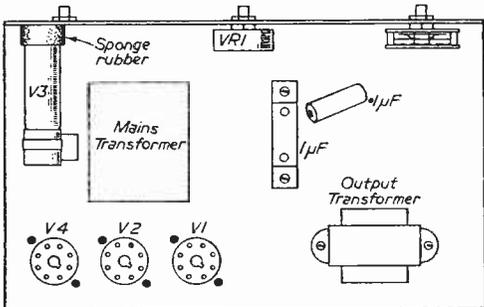
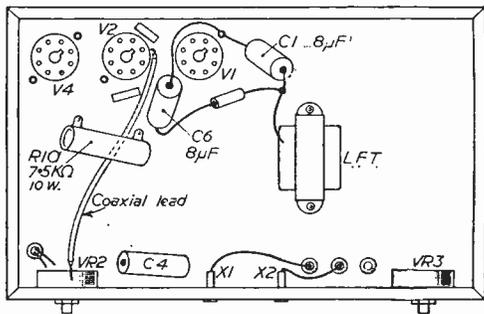


Fig. 7.—Details of the cover.

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

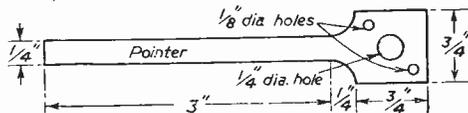


Fig. 13.—Pointer details.

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

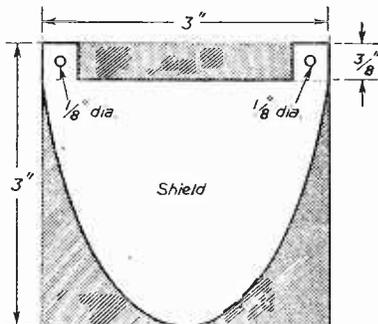


Fig. 15.—Details of the indicator shield.

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 (Continued on page 801)

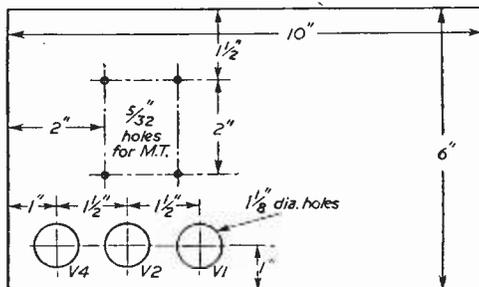


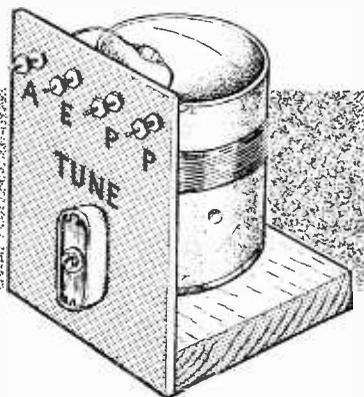
Fig. 14.—Chassis drilling details.

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)



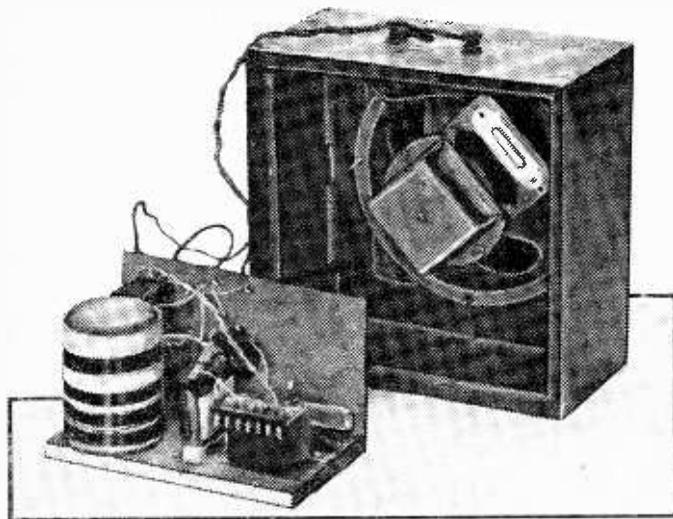
THE original set will now have been modified to include variable selectivity, a volume control and one transistor, and it is hoped that the beginner will have carried out the experiments suggested. These may be carried out again with advantage when the transistor has been fitted as more volume will be 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.

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).



The finished set connected to the loudspeaker.

(Continued on page 793)

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A Suggested Plan for the Beginner to Follow
Refer to Figs. 27, 28 and 29. Note that in

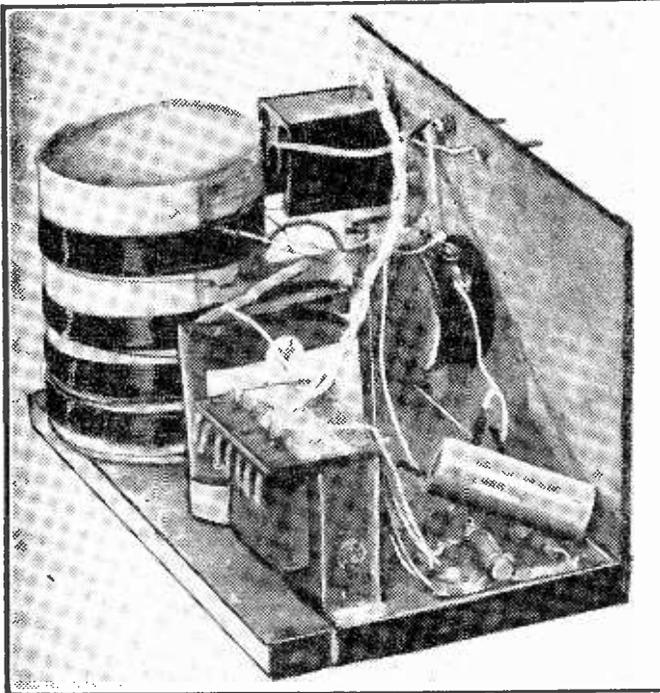
and positive busbar. The long strip (minus) of the torch battery is then connected to the negative busbar.

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 1 in. 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.



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

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.

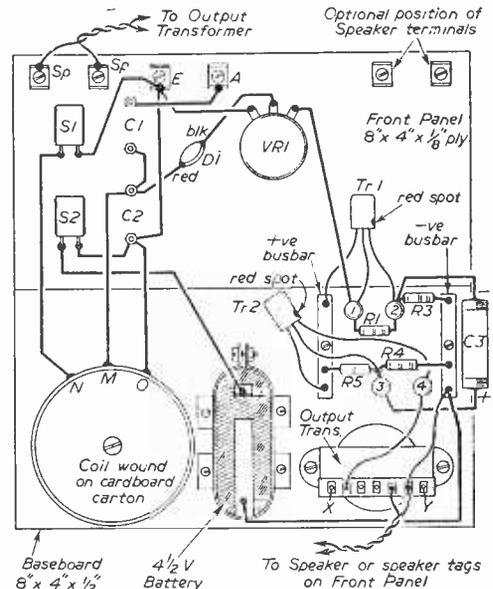


Fig. 29.—The practical wiring diagram.

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!

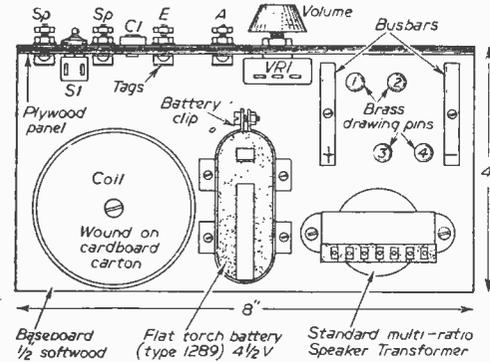
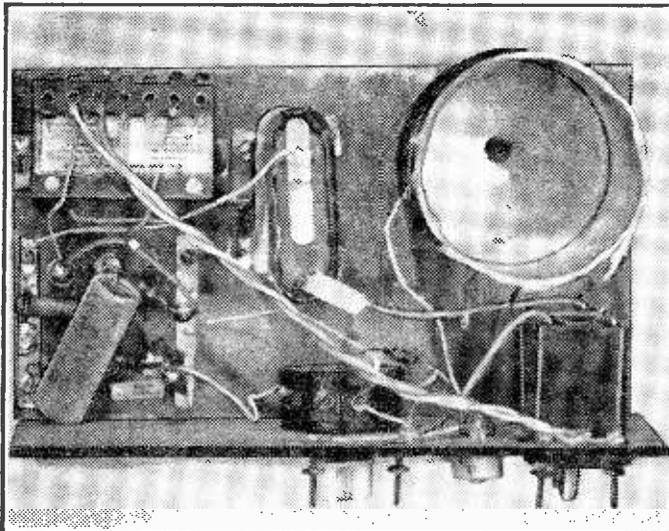


Fig. 27.—Top view of two transistor layout.

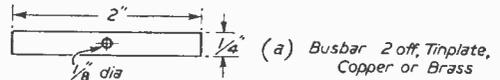
Fixing the Transistors

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.

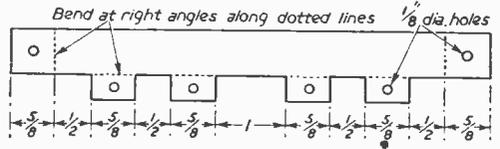
Never shorten the leads. solder in positions quickly. leave them suspended "in air." Make sure there are no shorting wires.



Plan view of the final stage of construction.



(a) Busbar 2 off, Tinplate, Copper or Brass



(b) Battery Clip 1 off, Tinplate etc.

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)

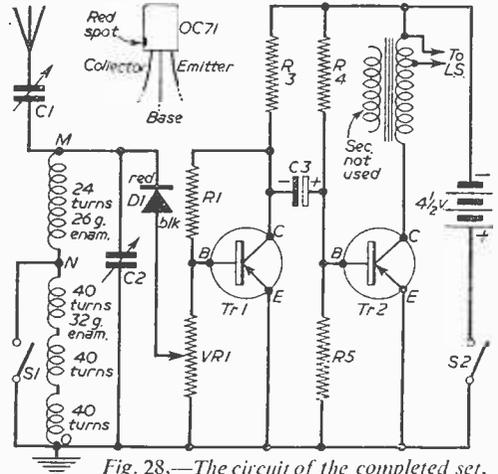


Fig. 28.—The circuit of the completed set.

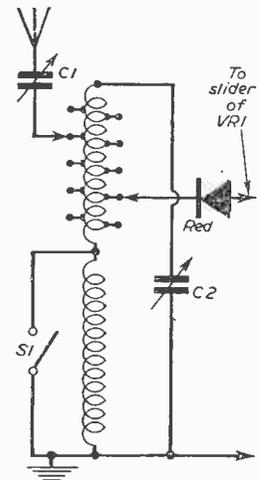


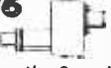
Fig. 31.—Circuit of an improved tuner.

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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 $500 \mu\text{A}$, there could be a base current of the order of a thirtieth of that current, say $17 \mu\text{A}$. 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., $17 \mu\text{A}$.) say $200 \mu\text{A}$. 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 $200 \mu\text{A}$, 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 ($500 \mu\text{A}$ 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 K Ω , and the other limb, R1, must be five sixths, or 25 K Ω —the nearest common values, 4.7 K Ω and 22 K Ω will actually be chosen. R2, at 4.7 K Ω , is large compared with the input resistance of the transistor (1 K Ω) 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 $1\frac{1}{2}$ 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 $200 \mu\text{A}$, by increasing R1, and at $500 \mu\text{A}$, 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

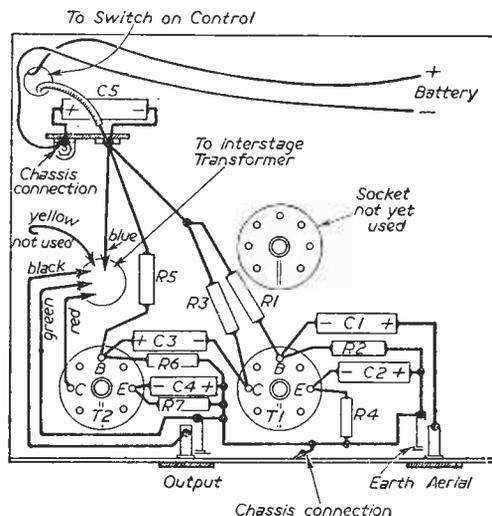


Fig. 17.—Wiring diagram of the circuit shown in Fig. 15 last month.

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, 470 Ω , 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 470 Ω) 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 K Ω 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 K Ω , 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 K Ω and 6 volts will drive a current of about 360 μ A., which is large compared with the base current of 50 μ A for the average OC71.

Capacitances

It remains to determine the sizes of the electrolytic by-pass and coupling capacitors. The reactance of 10 μ F at 100 cycles is around 160 ohms. This is reasonable by comparison with the resistances of the order of 1,000 Ω 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, 50 μ F 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 centre-tap 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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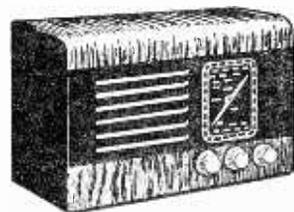
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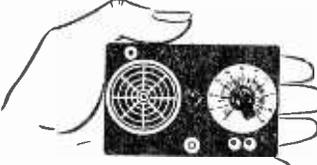
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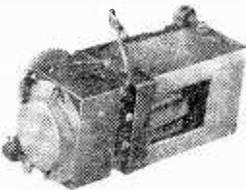
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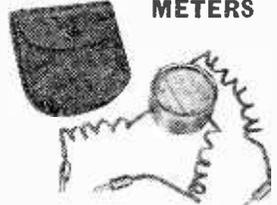
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rule for all time. C1, however, has its negative terminal connected to the base of T1 because it is assumed that the input signal has no D.C. component.

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).

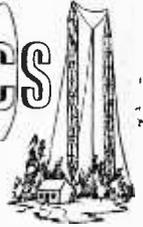
A C.R.L. BRIDGE

(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 3K 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. tube, 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)

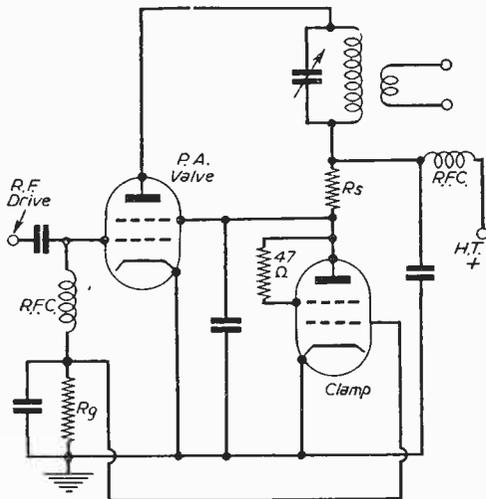


Fig. 1.—The simple clamp-valve circuit used to "hold down" a P.A. stage when excitation is removed, and no fixed bias source is used.

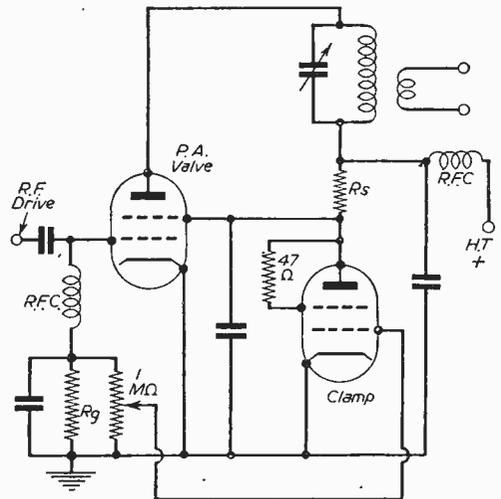


Fig. 2.—A potentiometer enables the clamp-stage setting to be adjusted on C.W. so that the P.A. stage runs at any desired power setting within the range determined by the circuit conditions.

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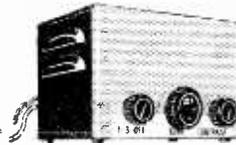
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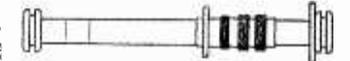
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overmodulation. If the clamp-valve introduces serious clipping of positive peaks, then splatter will be introduced far below the 100 per cent modulation level. If the gain is turned down until splatter ceases, then the overall modulation level may 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

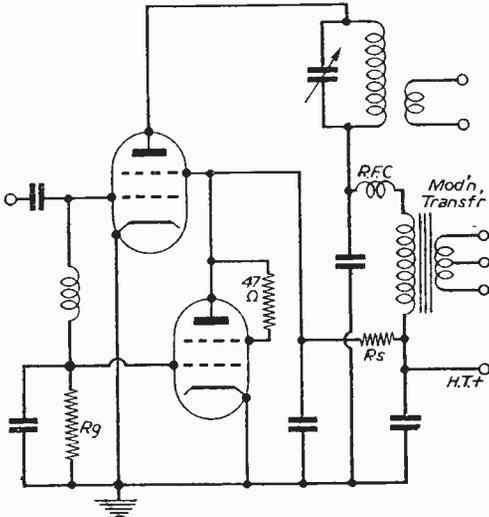


Fig. 3.—Returning the screen to the unmodulated supply prevents the clamp-valve clipping positive modulation peaks. However, this connection does not permit full modulation as the screen supply is unmodulated.

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 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 6Y6 is held to ensure that the 6Y6 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 peaks, with possible conduction on modulation peaks, the

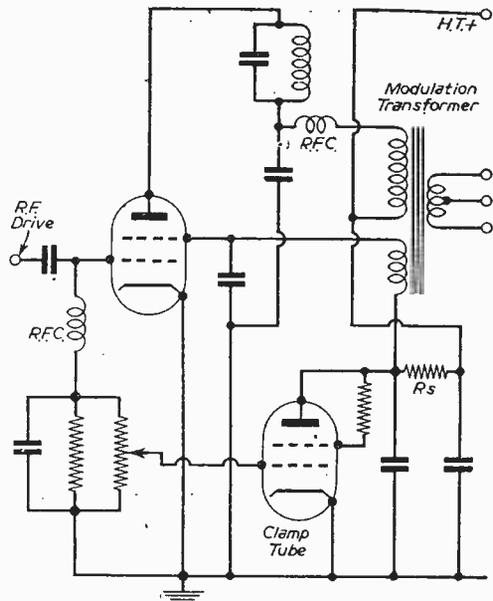


Fig. 4.—The screen may be modulated from an independent winding, thus enabling full clamp-valve control to be retained without any difficulties on modulation peaks.

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.

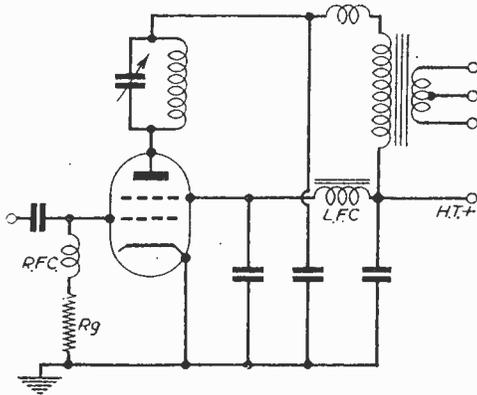


Fig. 5.—The self screen system of modulation enables the screen to develop its own modulation voltage when the anode is supplied with modulated H.T.

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 condi-

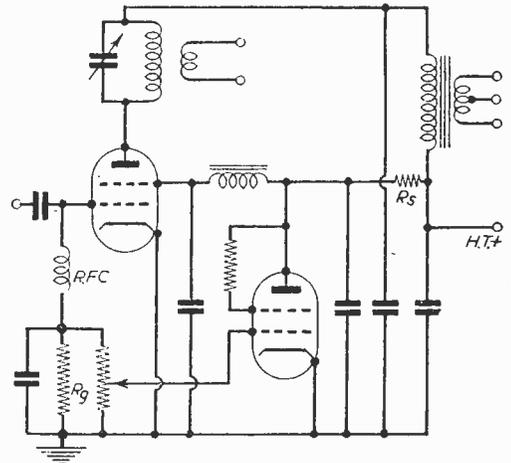


Fig. 6.—The self screen system applied to the clamp circuit.

tions of the P.A. stage. Generally the fraction would be calculated on the ratio of the screen voltage to the anode voltage.

(To be continued)

News from the Clubs

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Hon. Sec. : W. Farrar (G3SP), 6, Hensworth Road, Aekworth, 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 (G3FL), 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.



FOR VALVES—
Guaranteed New and Boxed

024	5/6	6AK7	8/-	ATP4	3/6	6Y3	8/-
1A3	3/6	6AK7	8/-	CV73	5/6	6Y4	8/6
1A5GT	6/-	6AN7	7/6	DAF96	9/6	6Y5	8/6
1A7	12/6	6AQ7	9/3	DF96	9/6	6Y6	8/6
1B2	9/6	6I4GT	14/-	DH73M	9/-	6Y7	8/6
1H5GT	10/6	1H5G	8/6	DK96	9/6	6Y8	8/6
1L4	6/6	6L5	8/6	DL96	9/6	6Y9	8/6
1LDS	3/6	6L7G	8/6	DM70	8/6	6Y12	8/6
1N5	10/6	6V6G	7/-	EACB80		6Y13	10/-
1R5	8/-	6V6GT	7/-	EACB91	10/-	6Y14	10/-
1R4	10/6	6X4	7/6	EAF42	10/6	6Y15	10/-
1R5	7/6	6X5G	7/-	EB41	9/-	6Y16	10/-
1T4	7/6	6X3GT	7/-	EB43	10/-	6Y17	10/-
2PA	15/-	6J0L2	12/6	EB90	10/6	6Y18	10/-
2X2	4/6	7B7	8/6	EBF90	11/-	6Y19	10/-
3A4	7/-	7C5	8/6	EBF90	11/-	6Y20	10/-
3A6	5/-	7C9	8/6	EC84	9/6	6Y21	10/-
3Q4	9/-	7H7	9/-	EC84	12/6	6Y22	10/-
3Q5	9/6	7Q7	9/-	EC85	10/6	6Y23	10/-
3R1	8/-	7R7	9/6	EC91	6/-	6Y24	10/-
3V4	9/-	7Y4	8/6	EC90	14/6	6Y25	10/-
4D1	3/-	7E	11/6	EC92	15/-	6Y26	10/-
4TSA	10/6	7E	9/-	EC93	15/-	6Y27	10/-
4Z	8/-	80	8/6	EC93	10/6	6Y28	10/-
5R4GY	9/6	807	6/6	EC94	10/6	6Y29	10/-
5U4G	8/-	812	2/6	EC94	11/-	6Y30	10/-
5V3G	8/-	912	3/6	EC95	9/6	6Y31	10/-
5V3GT	9/-	9001	5/6	EC95	12/6	6Y32	10/-
5Z4G	10/-	9003	5/6	EC95	13/6	6Y33	10/-
6A7	13/-	9004	5/6	EC95	13/6	6Y34	10/-
6A8G	10/6	9006	5/6	EC95	13/6	6Y35	10/-
6A7	6/6	954	2/-	EC95	13/6	6Y36	10/-
6A85	5/6	955	4/6	EC95	13/6	6Y37	10/-
6AK5	6/6	956	3/6	EC95	13/6	6Y38	10/-
6AK7/6A47		10F1	12/6	EC95	13/6	6Y39	10/-
		11D5	6/-	EC95	13/6	6Y40	10/-
6AL5	6/6	12A6	6/6	EC95	13/6	6Y41	10/-
6AM6	9/-	12A8H	11/6	EC95	13/6	6Y42	10/-
6AQ5	7/6	12A7G	10/6	EC95	13/6	6Y43	10/-
6AT6	8/6	12A7	9/6	EC95	13/6	6Y44	10/-
6AU6	10/6	12A7	9/6	EC95	13/6	6Y45	10/-
6B4	5/-	12A7	8/6	EC95	13/6	6Y46	10/-
6B4G	4/-	12B4G	6/6	EC95	13/6	6Y47	10/-
6B4G	7/6	12B4G	10/6	EC95	13/6	6Y48	10/-
6B4G	8/6	12B4G	11/6	EC95	13/6	6Y49	10/-
6B4G	9/6	12B4G	12/6	EC95	13/6	6Y50	10/-
6B4G	10/6	12B4G	13/6	EC95	13/6	6Y51	10/-
6B4G	11/6	12B4G	14/6	EC95	13/6	6Y52	10/-
6B4G	12/6	12B4G	15/6	EC95	13/6	6Y53	10/-
6B4G	13/6	12B4G	16/6	EC95	13/6	6Y54	10/-
6B4G	14/6	12B4G	17/6	EC95	13/6	6Y55	10/-
6B4G	15/6	12B4G	18/6	EC95	13/6	6Y56	10/-
6B4G	16/6	12B4G	19/6	EC95	13/6	6Y57	10/-
6B4G	17/6	12B4G	20/6	EC95	13/6	6Y58	10/-
6B4G	18/6	12B4G	21/6	EC95	13/6	6Y59	10/-
6B4G	19/6	12B4G	22/6	EC95	13/6	6Y60	10/-
6B4G	20/6	12B4G	23/6	EC95	13/6	6Y61	10/-
6B4G	21/6	12B4G	24/6	EC95	13/6	6Y62	10/-
6B4G	22/6	12B4G	25/6	EC95	13/6	6Y63	10/-
6B4G	23/6	12B4G	26/6	EC95	13/6	6Y64	10/-
6B4G	24/6	12B4G	27/6	EC95	13/6	6Y65	10/-
6B4G	25/6	12B4G	28/6	EC95	13/6	6Y66	10/-
6B4G	26/6	12B4G	29/6	EC95	13/6	6Y67	10/-
6B4G	27/6	12B4G	30/6	EC95	13/6	6Y68	10/-
6B4G	28/6	12B4G	31/6	EC95	13/6	6Y69	10/-
6B4G	29/6	12B4G	32/6	EC95	13/6	6Y70	10/-
6B4G	30/6	12B4G	33/6	EC95	13/6	6Y71	10/-
6B4G	31/6	12B4G	34/6	EC95	13/6	6Y72	10/-
6B4G	32/6	12B4G	35/6	EC95	13/6	6Y73	10/-
6B4G	33/6	12B4G	36/6	EC95	13/6	6Y74	10/-
6B4G	34/6	12B4G	37/6	EC95	13/6	6Y75	10/-
6B4G	35/6	12B4G	38/6	EC95	13/6	6Y76	10/-
6B4G	36/6	12B4G	39/6	EC95	13/6	6Y77	10/-
6B4G	37/6	12B4G	40/6	EC95	13/6	6Y78	10/-
6B4G	38/6	12B4G	41/6	EC95	13/6	6Y79	10/-
6B4G	39/6	12B4G	42/6	EC95	13/6	6Y80	10/-
6B4G	40/6	12B4G	43/6	EC95	13/6	6Y81	10/-
6B4G	41/6	12B4G	44/6	EC95	13/6	6Y82	10/-
6B4G	42/6	12B4G	45/6	EC95	13/6	6Y83	10/-
6B4G	43/6	12B4G	46/6	EC95	13/6	6Y84	10/-
6B4G	44/6	12B4G	47/6	EC95	13/6	6Y85	10/-
6B4G	45/6	12B4G	48/6	EC95	13/6	6Y86	10/-
6B4G	46/6	12B4G	49/6	EC95	13/6	6Y87	10/-
6B4G	47/6	12B4G	50/6	EC95	13/6	6Y88	10/-
6B4G	48/6	12B4G	51/6	EC95	13/6	6Y89	10/-
6B4G	49/6	12B4G	52/6	EC95	13/6	6Y90	10/-
6B4G	50/6	12B4G	53/6	EC95	13/6	6Y91	10/-
6B4G	51/6	12B4G	54/6	EC95	13/6	6Y92	10/-
6B4G	52/6	12B4G	55/6	EC95	13/6	6Y93	10/-
6B4G	53/6	12B4G	56/6	EC95	13/6	6Y94	10/-
6B4G	54/6	12B4G	57/6	EC95	13/6	6Y95	10/-
6B4G	55/6	12B4G	58/6	EC95	13/6	6Y96	10/-
6B4G	56/6	12B4G	59/6	EC95	13/6	6Y97	10/-
6B4G	57/6	12B4G	60/6	EC95	13/6	6Y98	10/-
6B4G	58/6	12B4G	61/6	EC95	13/6	6Y99	10/-
6B4G	59/6	12B4G	62/6	EC95	13/6	6Y100	10/-

THE "EKE" QUALITY 3 WATT AMPLIFIER



Three International Octal Valves 6B8GT, 6V6GT, 6X5GT. A.C. mains fully isolated, negative feed back (voltage and current) controls, volume and tone, input network for modern crystal. Really low hum level and even frequency response. Price 84/- plus 3/- Packing and Post.

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CLR Low resistance type 120 ohms, 7/6 pair.
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High Resistance Phones, 4,000 ohms, 13/6 pair.
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This attractive walnut finished cabinet is available for 8 1/2 in. or 5 in. speaker units. Metal speaker feet, complete with back and rubber feet.
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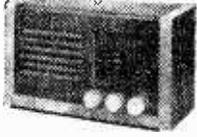
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Model H.F. 1012
10 in. Die-cast unit, incorporating 12,000 gauss magnet. Handling capacity 10 watts. Frequency response 30 c.p.s. 14,000 c.p.s. base resonance, 35 c.p.s. 24.15.9.

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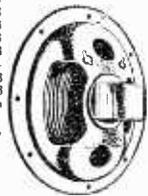
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Four speed automatic record change unit. Plays 7 in., 4 in., and 12 in. records automatically with "MAGNIPUSK" Selector Turn-over Pick-up. Unit Plate 12 1/2 in. x 10 1/2 in., £8.15.0.
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LOUDSPEAKER UNITS

Make	Type	Size	Price each
Elac	Square	3 1/2 in.	19/6
Lecturna, Plessey	Round	5 in.	17/6
Goodmans, Plessey	Round	6 1/2 in.	18/6
Goodmans, R. & A.	Round	8 in.	19/6
Plessey, R. & A., Elac	Round	10 in.	25/6
Plessey	Round	12 in.	35/-
Rola	Elliptical	6 in. x 4 in.	19/6
Elac	Elliptical	10 in. x 6 in.	25/6
All the above are PM units with 2 to 3 ohm speech coils.			
KT2 12 in. Heavy Duty 20 watts model, 15 in. Ohms.			
Speech Coil, £5.5.0.			
5 in. Mains Energised Speaker, 2L.			
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All have field coils of approx. 600 ohms.			
SPECIAL OFFER			
Just a few 8 in. units by Goodmans and Lecturna fitted with standard output transformer, £11.6 each.			



COLLARO Model 3/544

Three speed single player. Automatic stop, fitted with "Studio T" pick-up. Cream Finish. £6.19.6.
Carriage on above unit, 4/6.



COLLARO
Four speed automatic record change unit. A fully mixing automatic changer with many advanced features. Unit plate 12 in. x 13 in., £9.15.0. Carriage on above unit, 4/6.

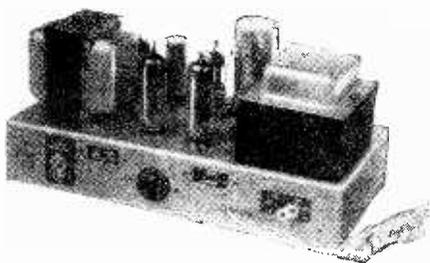


103 LEEDS TERRACE WINTON STREET LEEDS 7

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 1/-; 20/- add 1/6; 40/- add 2/-; £5 add 3/- unless otherwise stated. Minimum C.O.D. fee and postage 3/-. All single valves postage 6d. Personal Shoppers Monday-Friday 9 a.m. to 5 p.m. Saturday 10 a.m. to 1 p.m.

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10-14 watts. Built strictly for Ultra Linear High Fidelity with choice of control unit or pre-amplifier. A superb laboratory-designed amplifier, modern styled and of precision quality for domestic use or in assembly halls holding up to 500 people. Incorporates every facility for the reproduction of high quality sound from radio, records, tapes or microphone. *DPA 10 only £12.12.0. DPA 10 with Control Unit £15.15.0. DPA 10 with Pre-amplifier*

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Ferrite Slab Aerial Type FS2. Designed for Long and Medium Wave reception with transistor portable superhet receivers. Slab size 5 1/2 in. x 2 in. x 5/32 in. Complete with fixing brackets, 13/6.
Combined Oscillator and 1st I.F. transformer Type OT1. 13/16 in. sq. x 1 1/2 in. I.F. Frequency 315 kc/s., 11/6.
2nd I.F. Transformer (315 Kc/s.), Type TT2. 5/-.
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I.F. Transformers enclosed in iron dust pots with slug tuning.
Push Pull Interstage Transformer Type TT4. Ratio 1 : 1 C.T. Stack size 1 1/2 in. x 1 1/16 in. x 7/16 in., 8/6.
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Ferrite Slab Aerial Type FS3. Medium Wave only. With fixing grommets. Size 3 in. x 2 in. x 5/32 in., 7/6.
Oscillator Coil Type XO8. Medium Wave only. Overall size 3/8 in. dia. x 1 in. Enclosed in Ferrite pots, 5/-.
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TRANSRECEIVERS. Type "38" (Walkie Talkie) complete with 5 valves, etc. New condition, untested by us but serviceable. No guarantee. £12.6 each.

ATTACHMENTS for Type "38" Transreceivers. ALL BRAND NEW. Headphones, 15/6; Throat Microphones, 4/6; Junction Boxes, 2/6; Aerials No. 1, 2/6; No. 2, 5/-; Webbing, 4/-; Haversacks, 5/-; Valves—A.R.P.12, 4/6; A.T.P.A. 3/6. Set of FIVE VALVES, 19/- the set.

TRANSRECEIVERS. Type "18" Mark 'II. Two Units (Receiver & Sender). Six Valves, Microammeter, etc., in Metal Carrying Case. Untested, without guarantee but COMPLETE. £2.18.6.

ATTACHMENTS for "18" Transreceivers. ALL BRAND NEW. Phones, 15/6; Microphones, 12/6; Aerials, 5/- Set of SIX VALVES, 30/-.

RECEIVERS RI09. S.W. Receiver in Case. 8 valves. Speaker and 6-v. Vibrator Pack. Untested. No guarantee but COMPLETE, £2.18.6.

RESISTANCES. 100 Assorted useful values. New wire end, 12/6
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BOMBSIGHT COMPUTERS. Ex-R.A.F. NEW. Hundreds of Components, Gears, etc. Ideal for Experimenters, £3.

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QUARTZ CRYSTALS. Types F.T.241 and F.T.243. 2-pin, 1/2 in. Spacing. Frequencies between 5,675 kc/s. and 8,650 kc/s. (F.T.243.) 20 Mc/s and 38.8 Mc/s (F.T.241, 54th Harmonic), 4/- each. ALL BRAND NEW. TWELVE ASSORTED CRYSTALS, 45/-.

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MORSE TAPPERS. Standard type, 3/6; Extra Heavy on Base, 5/6; Midget, 2/9.

TRANSPARENT MAP CASES. Plastic, 14 in. x 10 1/2 in. Ideal for Maps, Display, etc., 5/6.
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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!

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. SWEENEY (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

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.

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

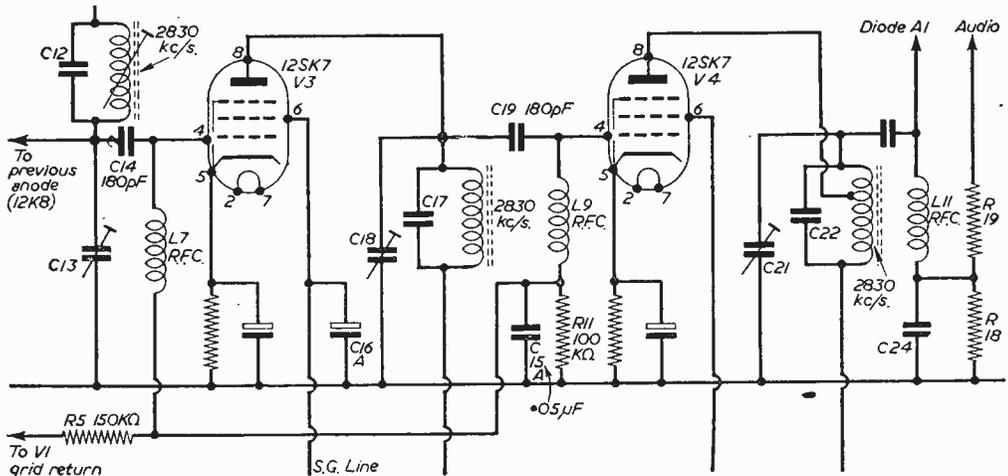
simple valve amplifiers to more complicated push-pull circuits: they can be presented with the problems that confronted the pioneers in radio and amplifier design and will perhaps appreciate the way in which these problems were overcome by the power of human endeavour. I rather fancy that there is something 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 1:1.20 giving a 25% boost on secondary.

Type B. Mains input 220/240 volts. Multi Output 2, 4, 6, 8, 10 and 13 volts.

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Type J. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type K. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type L. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

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Type N. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

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Type Z. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AA. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AB. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AC. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AD. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

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Type AF. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AG. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AH. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AI. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

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Type AO. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AP. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AQ. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AR. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AS. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

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Type AX. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AY. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type AZ. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BA. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BB. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BC. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BD. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BE. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BF. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BG. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BH. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BI. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BJ. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BK. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BL. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

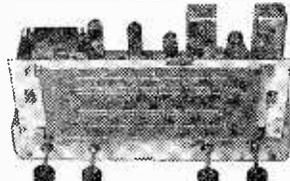
Type BM. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BN. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

Type BO. Low capacity wound transformer for use with 2 volt Tubes with falling emission.

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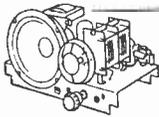
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Whether you plan to have your own business, to become an electronics engineer or to take up a career in industry, an I.C.S. Course will help you to succeed. You learn at home in your own time, under expert tuition. Moderate fees include all books.

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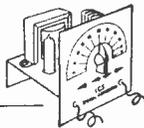
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(sensitivity
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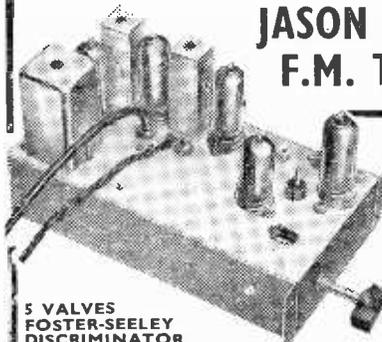
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**5 VALVES
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When built, this new Jason F.M. Tuner provides choice of the three B.B.C. programmes at the turn of a switch, with a fourth position for "OFF". It is a stable unit, free from drift and of high quality. The Switch Tuned Front End is supplied wired, tested and aligned, complete with 2 valves and station-indicating plate. Chassis ready punched. In conformity with all Jason F.M. Units, this model is completely stable and offers the highest possible standards of reproduction.

**CONSTRUCTOR'S
 SWITCH-TUNED
 KIT** including assembled Front End with two valves and all parts as specified and ap. **£9.0.0**

**SWITCH-TUNED
 FRONT END** with two valves, complete. **£6.5.0**
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Data Publication Book of the Tuner (Post Paid) **2/-**

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41, CALL LANE, LEEDS, I

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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 louvered 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.

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 1A4D4); 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.



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

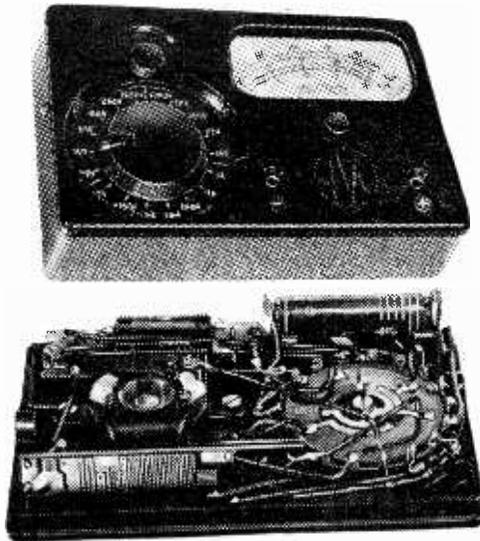
A NEW EARTH CLAMP

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

* 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: 5 $\frac{3}{8}$ in. x 3 $\frac{3}{8}$ in. x 1 $\frac{3}{8}$ in. (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.

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Programme Pointers



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

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

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 experience.

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.

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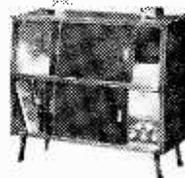
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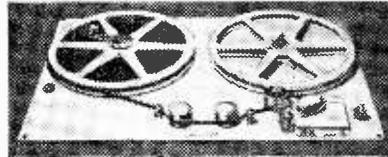
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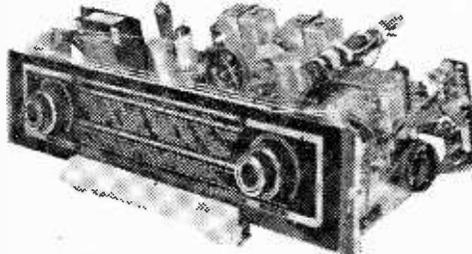
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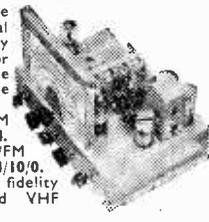


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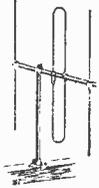
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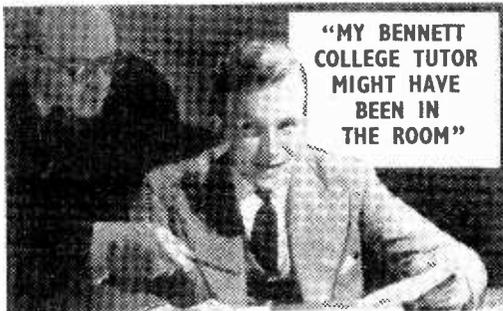
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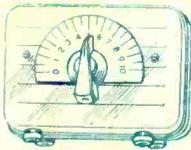


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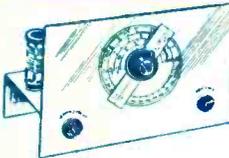
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