A TRANSISTOR SOUND TUNER

Practical Television

1'6

AND TELEVISION TIMES

FEBRUARY 1960

CONTENTS

D.C. OSCILLOSCOPE

A.C. MAINS 200-250 VOLTS

SIMPLIFIED SERVICING PROBLEMS WHEN USING THE

'TESTGEAR' SCOPE

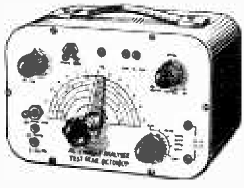
3in. D.C. OSCILLOSCOPE

Engineered to precision standards, this high-grade instrument is made available at the lowest **possible price,** incorporating the essential features usually associated with luxury instruments.

This **"SCOPE"** will appeal particularly to Service Engineers and Amateurs. **A high gain, extremely stable differential Y-amplifier** (30 mV C.M.). Provides ample sensitivity with A.C. or D.C. inputs. Especially suitable for **measurement of transistor operating conditions** where maintenance of D.C. levels is of paramount importance. Push-pull X amplifier; Fly-back suppression; Internal Time-base Scan Waveform available for external use; **pulse output** available for checking **T.V. Line O.P Transformers,** etc.; Provision for external **X I/P** and **CRT.** Brightness Modulation. Size 10in. high, 6¾in. wide, 9in. deep. Wgt. 11½ lbs. **£15.15.0,** plus P. & P. 7/6, or **30/-** deposit, plus P. & P. 7/6 and 12 monthly payments of **26/6.**

FULL 12 MONTHS' GURANTEE INCLUDING VALVES AND TUBE.

ALIGNMENT ANALYSER TYPE MC12



A.C. mains 200/250V. Provides: **"Wobbulator" (Swept Frequency) operation,** for FM/TV alignment linear frequency sweep up to 12 Mc/s. From 400 kc/s-80 Mc/s. **Capacitance Measurement.** Two ranges provided 0-60 pF and 0-120pF. **Special Facility** enables true resonant frequency of any tuned cct. I.F. transformer, etc., to be rapidly determined. Cash price **£6.19.6,** plus 5/- P. & P. H.P. terms **25/- deposit plus 5/- P. & P. and six monthly payments of 21/6.**

WOLSEY 3-ELEMENT FOLDED DIPOLE

I.T.V. Aerial less mounting bracket for External use, complete with 12 yds. of coaxial cable, 15/-; 4 element, 17/6; 5 element, 25/-. P. & P. on above, 3/6.

E.H.T. Smoothing Condenser 500 p.f., 18 KV. D.C. working, **1/6.**

LINE E.H.T. TRANSFORMER

By famous manufacturer. 14 Kv. Complete with built-in line and width controls. Winding for EY51 Rectifier. **19/6** Plus P. & P. 2/6.

LINE E.H.T. TRANSFORMER

With built-in line and width control and winding for EY51. 14 KV. Scan coil, 90° deflection, on ferrite yokes. Frame O.P. transformer 500 pf. 18 KV. smoothing condenser. Can be used for 14in., 17in. or 21in. tubes. Complete with circuit diagram. **29/6** Plus 4/- P. & P.

Focus Magnet suitable for the above (state tube). 10/- Plus 2/6 P. & P.

17in. **PERSPEX MASK,** 8/6. Plus 2/6 P. & P.

F.M. TUNER UNIT

Permeability tuned, by famous German manufacturer. Coverage 88-100 Mc/s. Complete with ECC85, size 4in. x 2in. x 2in.

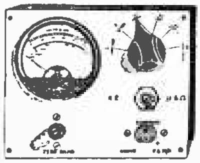
25/- P. & P. 1/6. Circuit Diagram 1/-. FREE with Unit.

10.7Mc/s. I.F. and Discriminator Coil, 2/6 pair.

MAINS TRANSFORMERS

All with tapped primaries, 200-250 volts, 0-160, 180, 200 v., 60 ma., 6.3 v. 2 amps. **10/6.** 320-0-320 v. 75 ma., 6.3 v., 2.5 amp., 5 v., 2 amp., **10/6.** 280-0-280, 80 ma. 6.3 v. 2 amp., 6.3 v. 1 amp., **10/6.** Postage and packing on the above, 3/-.

AC/DC POCKET MULTI-METER KIT

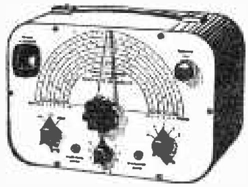


Comprising 2in. moving coil meter scale calibrated in AC/DC volts, ohms and milliamps. Voltage range AC/DC 0-50, 0-100, 0-250, 0-500. Milliamps 0-10, 0-100. Ohms range 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting), toggle switch, resistor and rectifier. In grey hammer finish case.

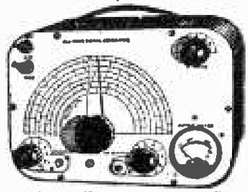
19/6 Plus P. & P. 1/6. Built and tested 7/6 extra.

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

SIGNAL GENERATORS

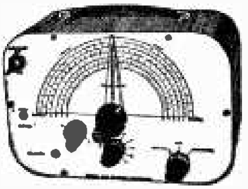


£6.19.6 or 25/- deposit and 6 monthly payments of 21/6. P. & P. 5/- extra. **Coverage 100 Kc/s-100 Mc/s on fundamentals and 100 Mc/s to 200 Mc/s on harmonics.** Metal case 10in. x 6½in. x 5½in., grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250. Internal Modulation of 400 c.p.s. to a depth of 30%; modulated or unmodulated R.F., output continuously variable. 100 milli-volts. C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.



Cash **£4.19.6** or **25/-** deposit and 4 monthly payments of **21/6.** Plus Postage and Packing, 5/-.
Coverage 120 Kc/s-84 Mc/s. Metal case 10in. x 6½in. x 4½in. Size of scale, 6½in. x 3½in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30%, modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch variable A.D. output and moving coil output meter. Grey hammer finished case and white panel. Accuracy plus or minus 2%.

SIGNAL & PATTERN GENERATOR



£6.19.6. P. & P. 5/-.

Or 25/- deposit. P. & P. 5/- and 6 monthly payments of **21/6.** Coverage 7.6 Mc/s.-210 Mc/s. in five bands, all on fundamentals, slow motion tuning audio output. 8 vertical and horizontal bars, logging scale. In grey hammer finished case with carrying handle. Accuracy ± 1% A.C. mains 200-250 v.

13 CHANNEL TU NER

16-19 Mc/s. These have been removed from chassis. Valves used PCF80 and PCC84.

13/- complete with knobs, less valves.

P. & P. 3/6 extra.

CHANNEL TUNER

Will tune to all Band I and Band III stations. BRAND NEW by famous manufacturer. Complete with P.C.C. 84 and P.C.F. 80 valves (in series). **I.F. 16-19** or **33-38.** Also can be modified as an aerial converter (instructions supplied). Complete with knobs. Plus 3/6 P. & P. **22/6**

HEATER TRANSFORMER to suit the above, 200-250 v., 6/-. Plus 1/6 P. & P.

8-WATT PUSH-PULL AMPLIFIER

COMPLETE WITH CRYSTAL MIKE AND 8in. LOUDSPEAKER

A.C. mains 200-250 v. Size 10½in. x 6½in. x 2½in. Incorporating 6 valves. H.F. pen., 2 triodes, 2 output pens and rectifier. For use with all makes and type of pick-up and mike. Negative feed back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. Response flat from 40 cycles to 15 Kcs., ±2 db; 4 db down to 20 Kcs. Output 8 watts at 5% total distortion. Noise level 40 db down all hum. Output transformer tapped for 3 and 15 ohm speech coils. For use with Std. or L.P. records, musical intruments such as Guitars, etc. **£4.19.6** Plus P. & P. 7/6.

Or 20/- deposit Plus P. & P. 7/6, and 4 monthly payments of 23/-.

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

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

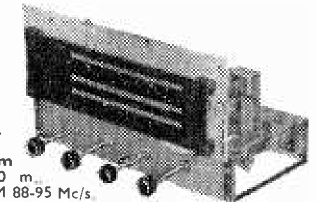
All enquiries S.A.E. GOODS NOT DESPATCHED OUTSIDE U.K.

7-VALVE AM/FM RADIOGRAM CHASSIS

Surplus Bargain Offer

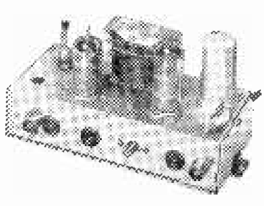
TRS

Valve Line up :
ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.



3 waveband and switched gram positions. Med. 200 m.-500 m. Long 1,000 m.-2,000 m., VHF/FM 88-95 Mc/s. 4 Controls. Vol., On-off, Tone, Tuning, Wavechange. P.U., Ae. and E., and speaker sockets. Magic eye tuning. Philips continental tuning insert with permeability tuning on FM, and combined AM/FM IF transformers, 460 Kc/s and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry, including AVC and Neg. Feedback. 3 watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½in. x 6½in. Height 7½in. Edge illuminated glass dial 11½in. x 3½in. Vertical pointer, Horizontal station names, gold on brown background. A.C. 200/250 v. operation.

£13.10.0 *Carr. and Ins. 5/-. Complete with 4 knobs walnut or ivory to choice.*



BAND 3 TV CONVERTER

All channels 7-13 (180-205 Mc/s).
Mk. 2 Model. Latest cascode circuit using ECC84 and EF80 valves. 18db. gain over standard circuits. Built-in Power Supply 200-250 v. A.C. Size 6¼in. x 3in. x 4in. Simple to fit—only external plug-in connections. Wired and aligned ready to use. Only **79/6.** P. & P. 2/6.
B1-B3 changeover Sw. and BBC Aerial Socket fitted and wired, **8/-** extra.
Band 3 Aerials. Single Dipole with 4 yds. cable, **13/9**, 3 Element Beam, **25/-**, 5 Element, **32/6**, etc. B1-B3 Crossover Units, **7/6.**

RECORD PLAYER BARGAINS

NEW RELEASE by E.M.I.—4-speed Single Player Unit fitted with latest stereo and monaural Xtal cartridge and dual sapphire stylii. Auto stop and start. A fidelity unit and bargain buy at only **£6.19.6.**

BSR—UA8 Model.—4-speed autochanger with crystal turnover cartridge, etc., wired for stereo, Bargain **£6.19.6.**

Garrard—Latest RC121/D/Mk 2—fitted with GC8 Xtal cartridge, plug-in monaural head. Auto/manual selector, etc. The connoisseur's choice for audio perfection. Bargain **10 gns.**
Plug-in stereo head GC8/10 **£2** extra.

All above are ***brand new, fully guaranteed*** models. Carr. and Ins. 4/6.

Comprehensive bargain range of Collaro, BSR and Garrard Units in stock. Send for comprehensive bargain lists.

RE-GUNNED TV TUBES

New Reduced Prices!

And now 12 months' Guarantee!

12in.	£6	17in.	£8.10.0
14in.	£7	21in.	£10.10.0
15in.	£7.10.0	*Carr. and Insur.* 10/-.	

All tubes Rebuilt with new Heater Cathode and Gun Assembly—**reconditioned virtually as new!** Full 6 months' unconditional Guarantee. As used by our own Service Dept. Comprehensive stocks—quick delivery. **10/- part exchange allowance on your old tube.**

FULLY GUARANTEED VALVES NEW REDUCED PRICES

1R5, 1T4	7/6	DAF96	9/-	EF80	9/6	PCF82	10/6
1S5	7/6	DF96	9/-	EF86	13/6	PCL83	12/6
3S4, 3V4	8/-	DK96	9/-	EF91	8/6	PL81	12/6
5Z4	9/6	DL96	9/-	EL41	10/6	PL82	9/6
6K7	5/6	EABC80	9/6	EL84	9/6	PL83	11/6
6K8	8/6	EBC41	9/6	EM81	9/6	PY80	7/6
6Q7	8/6	ECC83	9/6	EY51	10/-	PY81	9/6
6SN7	8/6	ECC84	10/6	EY86	10/-	PY82	7/6
6V6	7/6	ECF80	11/6	EZ80	7/6	PY83	10/6
6X4	7/6	ECF82	11/6	EZ81	7/6	U25	12/6
7C5	9/-	ECH81	10/6	MU14	9/6	U191	12/6
7Y4	8/6	ECL80	10/6	PCC84	10/6	UCH42	10/6
35L6	9/6	ECL82	11/6	PCF80	10/6	UF41	10/-

Send for List.

SPECIAL PRICE PER SET

1R5, 1T4, 1S5, 3S4 or 3V4	27/6
DK96, DF96, DAF96, DL96	35/-
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5	35/-

RECORD PLAYER CABINETS

Contemporary styled, rexine covered cabinet in two-tone fawn and brown, or mottled red with white polka dot. Size 18¾ x 13¾ x ht. 8½in., fitted with all accessories, including baffle board and anodised metal fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 x 13in. supplied.

Cabinet Price £3.3.0. Carr. and Ins. 3/6

COAX 80 OHM CABLE.

Stand ¼in. diam. Low Loss Semi-Air Spaced Aeraxial.

SPECIAL REDUCED PRICES

20 yds. **12/6**, p. & p. 1/6 ; 60 yds. **32/6**, p. & p. 3/- ; 40 yds. **22/6**, p. & p. 2/6 ; All other lengths **8d.** per yard.

Coax Plugs 1/-, Sockets 1/-, Couplers 1/3, Cable End Sockets 1 6, Outlet Boxes 4/6.

C.R.T. Heater Isolation Transformers

New Improved types—mains prim. 200/250 v. tapped.

All isolation Transformers now supplied with alternative *no boost plus* 25%, and *plus* 50% boost taps, **at no extra charge.**

2 v.	2A type	**12/6**	(P. & P. 1/6)
6.3 v.	.6A „	**12/6**	„
10.5 v.	.3A „	**12/6**	„
13 v.	.3A „	**12/6**	„

Other voltages available at same prices.
Small size and tag terminated for easy fitting.

2-valve AMPLIFIER Mk. 2

Latest developed circuit giving a higher fidelity response and greater output (2-3 watts) using twin stage valve ECL82 and neg. feedback Tone Control. Complete with knobs, etc., wired and tested ready to fit in above cabinet.

ONLY £2.17.6. P. & P. 1/-.

6in. speaker and matching transformer, **22/-.** P. & P. 1/6.

SENTERCEL RECTIFIERS. E.H.T. Type Flyback Voltages K3/25 2 kV., **5/-** ; K3/40 3.2 kV., **6/9** ; K3/45 3.6 kV., **7/3** ; K3/50 4 kV., **7/9** ; K3/100 8 kV., **13/6. MAINS TYPES.**—RM1, 125 v. 60 mA., **4/9**; RM2, 125 v. 100 mA., **5/6**; RM3, 125 v. 120 mA., **7/6**; RM4, 250 v. 250 mA., **16/-**; RM4B type 270 mA. **17/6** ; RM5, 250 v. 300 mA., **21/-.**

SPEAKER FRET.—Expanded Bronze anodised metal 8 x 8in., **2/3** ; 12 x 8in., **3/-** ; 12 x 12in., **4/6**; **12 x 15in., 6/-** ; 24 x 12in., **9/-**, etc.

Listed above are only a few items from our **very large stock.** Send 3d. stamp today for Complete Bargain List.

TRANSISTOR 'ONE-WATT' AMPLIFIER

6 v. Battery operated

Latest Push-Pull, 4 Transistor circuit giving full 1 watt Output into standard 3 ohm speaker. Good sensitivity and improved freq. response. Neg. feedback. Var. Tone and Volume Controls. Chassis Size 6¾in. x 3¾in. x 1½in. Current consumption 10 mA quiescent—250 mA at 1 watt.

2 matched GEC GET15 Transistors ..	**42/-** pr.
2 GEC GET3 Transistors	**21/-** pr.
Driver Trans.	**8/6**
Output Trans. (to 3 ohms)......	**10/6**

Complete Kit of Parts incl. circuit etc. less speaker.
ONLY **99/6** P. & P. 2/6.
Circuit and instruction booklet 1/6 post free.

JASON FM TUNER UNITS (87-105 Mc/s)

Designer-approved kits of parts for these quality and highly popular tuners available as follows.

STANDARD MODEL (FMT)—as previously extensively advertised. COMPLETE KIT, **5 gns.**, post free. Set of 4 spec. valves, **30/-**, post free.

LATEST MODEL (FMT2)—attractively presented shelf mounting unit to enclosed Metal Cabinet with Built-in Power Supply. COMPLETE KIT, **£7**, p. & p. 3/6. Set of 5 spec. valves, **39/6.**

NEW JASON COMPREHENSIVE F.M. HANDBOOK, 2/6 post free. **48 hr. Alignment Service, 7/6**, p. & p. 3/6.

VOLUME CONTROLS

10,000 ohms—2 Megohms. All long spindles. Morganite Midget type. 1⅛in. diameter. Guar. 1 year. Log or Lin. Ratios. Less Sw. **3/-**. D.P. Sw. **4/9.** Twin Ganged controls, ¼ meg., ½ meg., 1 meg., less Sw. **8/9** ea.

TYGAN FRET (Murphy pattern) 12 x 12in., **2/-** ; 12 x 18in., **3/-** ; 12 x 24in., **4/-**, etc.

SPEAKERS P.M. 3 ohm 2½in. Elac, **16/6.** 3½in Goodmans, **18/6.** 5in. R. & A., **17/6.** 6in. Celestion **18/6.** 7 x 4in. Goodmans, **18/6.** 8in. Rola, **20/-.** 8in Special Cone G'mans, **21/6.** 10in. R. & A., **25/-**

Terms : C.W.O. or C.O.D. Kindly make cheques, P.Os, etc., payable to T.R.S. Post/Packing up to ½lb 7d., 1lb. 1/1, 3lb. 1/6, 5lb. 2/-, 10lb. 2/9.
Hours : 9 a.m.-6 p.m. 1 p.m. Wed. Open all day Saturday.

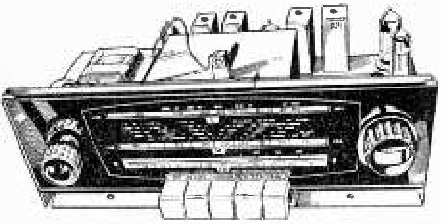
TRS

RADIO COMPONENT SPECIALISTS (Est. 1946)

70 BRIGSTOCK ROAD, THORNTON HEATH, SURREY (*THO 2188*)

50 yards Thornton Heath Station. Buses : 133A, 133, 159, 166 and 190

BRAND NEW A.M.-F.M. (V.H.F.) CHASSIS AT £13.6.8. (P. & P. 10/-)



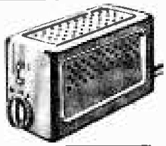
Why buy a F.M. Tuner at the same price ? Tapped input 220-225 v. and 226-250 v. A.C. ONLY. Chassis size 15" x 6½" x 5½" high. New manufacture. Dial 14½" x 4" in gold and black. Pick-up. Extension Spaker, Ae., E., and Dipole sockets. Five " piano " push buttons—OFF, L.W., M.W., F.M. and Gram. Aligned and tested With all valves & O.P. Transformer. Tone Control Fitted. Covers 1,000-1,900 M. ; 200-500 M. ; 88-89 Mc/s. Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85. Speaker & Cabinet to fit chassis, 47/6.

10" x 6" ELLIPTICAL SPEAKER, 20/-.

TERMS :—(Chassis) £4.16.8 down—10/- carr. and 6 Monthly Payments of 30/-, or with Cabinet & Speaker £5.9.2 down and 7 Monthly Payments of 32/-.

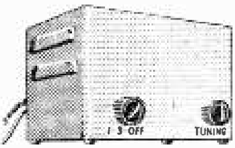
We are specialists in I.T.A. Converters. Our converters give direct switching I.T.A. to B.B.C., metal rectifier, co-axial plug, can be fitted in 5-10 mins., and need no alteration to your set. ALL AREAS. ALL SETS. ALL CHANNELS. 12 months' guarantee (3 months on valves).

" READY TO USE " I.T.A. CONVERTER

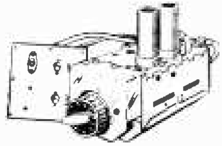


Separate gain controls. Valves PCF80 and PCC84. Switch positions I.T.A. (1)—I.T.A. (2)—B.B.C. Bakelite moulded cabinet 8½" x 4" x 6". £5.5.0. P. & P. 3/-.

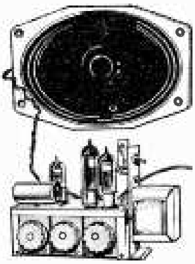
For the last 200 I.T.A. Converters of this type (Brand New and Fully Guaranteed) we will accept the " Below Cost " figure of ONLY 60/-, (3/- P. & P.) Reduced from £4.7.6. Two valves ECC81—grey hammer finish—Switch positions OFF, I.T.A., B.B.C. Own Power supply. BUY IT NOW.



60/- (3/- P. & P.)



THE BRAYHEAD TURRET TUNER, £7.7.0 post free. Complete with booklet and fitting instructions. State set and model no. when ordering. Converts your 5-channel B.B.C. only set to receive I.T.A. as well.

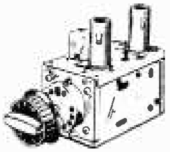


3-VALVE AMPLIFIER (INCL. RECT.). Capable of giving 6 watts. Mains and output transformers. Valves ECC81, EL84 and Rect. 3 Controls, volume, bass and treble. On/Off switch. Fully guaranteed. Chassis size. 6½" x 3" x 2½". ; with 7" x 4" elliptical speaker or 6½" round (Goodmans) ; state which.

Only 67/- (3/- P. & P.)

I.T.A. AERIALS clipping to existing mast 1-2" dia. 3-element, 27/- ; 5-el., 35/- ; 9-el., 55/- : Loft mounting. 3-el., 20/- ; 5 el., 27/6 ; Combined single B.B.C. and 5-el. I.T.A., 75/- with chimney lashings ; Co-axial cable semi-air-spaced, 8d. yd. or 20 yds., 12/6. aerial and cable prices carr. paid.

50 SILVERED MICA AND CERAMIC CONDENSERS, 10/-. 50 RESISTORS, 5/-. ALL NEW.

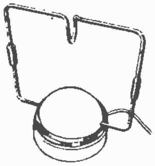


BRAND NEW INCREMENTAL TURRET TUNER by famous manufacturer for 35 to 38 Mc/s with knobs. Valves PCC84 and PCF80, or valves UCC84 and UCF80. LAST FEW DOZ. REDUCED ONLY 40/-.

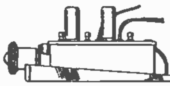
A few 10 Mc/s **CYLDON TURRET TUNERS** complete with contrast control panel and knobs. New and Boxed. Listed at £7.7.0. OUR PRICE £5, post paid. ONLY E10L, P10L and U10L are available.

NEW WAXED TUBULARS, 350 v. or above, 3 of each. .001 .002, .005, .01, .02, .05, .1 mF. Total 21 for 4/6, post paid.

I.T.A. TABLE TOP AERIAL



An I.T.A. table top aerial with amazing performance. The Wolsey Hi-Q at 19/6 (2/6 post). Gives good reception up to 20 miles, and has cross-over unit in base with socket for B.B.C. aerial. Same model but very slightly tarnished for ONLY 12/6 (2/6 post).



NEW I.T.A. AND B.B.C TUNER. By well-known manufacturer for superhet TVs with 35-38 Mc/s I.F. For all areas ; covers all 13 channels. Switch gives B.B.C. and two I.T.A. selections. Suits G.E.C. sets BT4543, 4544, 5146, 5147, 5543, 5642 and 6641 without alteration. Easily adapted as aerial converter, and instructions can be provided free. Has I.T.A. and B.B.C. co-axial sockets and separate gain controls. WITH VALVES PCF80 and PCC84, 22/6 (p. & p. 3/-). Some without valves at only 12/6 (p. & p. 3/-).

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Practical Television

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CONTENTS :

COLOUR VISION

EARLY last year, in the Lecture Theatre of the Science Museum, London, a lecture was given by Dr. E. H. Land and the experiments which he described and demonstrated have aroused a great deal of interest and discussion. They concerned colour photography and the theory of colour vision. In the experiment which interests us most, a brightly coloured subject was photographed, two pictures being taken at once. The film used in both instances had a normal black and white panchromatic emulsion but one picture was taken through a green filter (removing wavelengths longer than 580 millimicrons) and the other through a red filter (removing wavelengths shorter than 580 millimicrons). From the negatives, black and white positives were made.

With the aid of two identical projectors, these two positives were projected simultaneously on to the same screen so that the two images were exactly superimposed. The positive which had been taken using a red filter was projected through a red filter but the one taken through a green filter was projected without a filter—with a white light. Although only black and white images were projected, the subject appeared on the screen in all its natural colours.

Dr. Land projected several other images using wavelengths other than 580 millimicrons to divide the visible spectrum ; the colours of the projected image were hardly changed but 580 millimicrons gave best results. He also altered the brightness of the white projector but the colours remained visible.

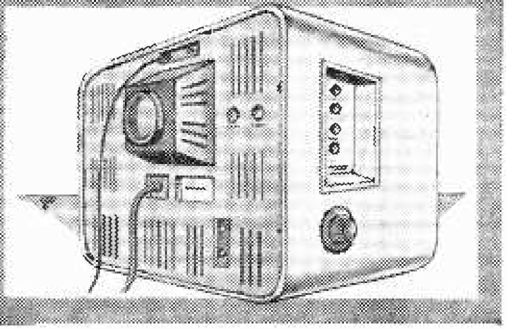
In explanation, Dr. Land himself says, "These experiments and others in which colour might be expected to appear but actually does not appear, suggest that colour vision involves a mechanism for the comparison of independent total images. It is as if the eye receives two (possibly more but certainly no less than two) geometrically identical but separate images of the scene, one in terms of the longer wavelengths of the spectrum, the other in terms of the shorter wavelengths. Once received, each of the records is subjected, independently, to a normalising process in the course of which each one is standardised or normalised, (a) for overall brightness, (b) for overall contrast and (c) for any systematic differences in wavelength composition.

"Then, and only then, after all systematic, predictable differences have been stripped away, it is as if the two images have been compared. The remaining differences, which are random, as they inevitably must be for the individual objects in the outside world, are thereupon seen as colour."

It seems to us that the way lies open for the application of some aspect of the phenomenon to the field of television ; present systems of colour television are complex and technicians are in need of some new field for colour television circuit design.

Our next issue, dated March, will be published on February 19th

Servicing Television Receivers



No. 52.—THE FERGUSON 992T SERIES

By L. Lawry-Johns

THIS series includes the 992T 14in. table model, the 994T 14in. console and the 996T 17in. table model. The 998T 12in. table model has a similar layout, but there are several differences. Confusion arises when it is not realised that during the production run of these models, several major circuit changes were made. For example, many readers, having one of these receivers, send away for a service sheet. They receive, say, a "Trader" sheet 1108/T42 which they find does not apply in all respects, particularly as far as the line timebase is concerned. Therefore, it would perhaps be of value to clear the air and detail the differences.

The initial production run carried no schedule letter on the rear of the chassis and it is to this model that the above sheet applies. A minor modification to the C.R.T. grid circuit to incorporate flyback suppression resulted in the schedule letter B on the chassis (not on 998T models which were virtually unchanged until fitted with provision for receiving a type A tuner unit, when the schedule letter B was added).

The addition of an extra ECL80 time oscillator, resulting in the rearrangement of valve positions on the left of the tube and the modification of the video amplifier stage (EF80 in place of the PL83, a single anode load resistor, etc.) resulted in the schedule C models.

A line drive capacitor (C62) was added and C25 changed from 0.01μF to 150pF in the schedule D models.

Finally, provision for receiving a type A tuner unit was incorporated in schedule E models. All these variations are fully described in Newnes "Radio and Television Servicing" volumes.

Common Faults

Having received the majority of the variations which can be expected, the more common faults which occur on these receivers may now be discussed. There is little doubt that the most common symptom is that of sound O.K., no picture or raster when the brilliance is advanced.

The first thing one does in such a case is to operate the line hold to make the line whistle vary and more audible. If the whistle is heard it can be assumed that the timebase is functioning and that V7 and V8 are in order. The rear cover is removed, and the black cover under the tube, to expose valves V7 and V8. If the whistle is audible, a spark will be present at the PL81 and PY81 top caps, but the doubt is whether a spark is available at the cap on the side of the tube. If a spark cannot be drawn from this cap, remove it (holding the plastic insulation of the cable, of course) and advance it to a chassis member or the outer coating of the C.R.T. If a weak, inter-

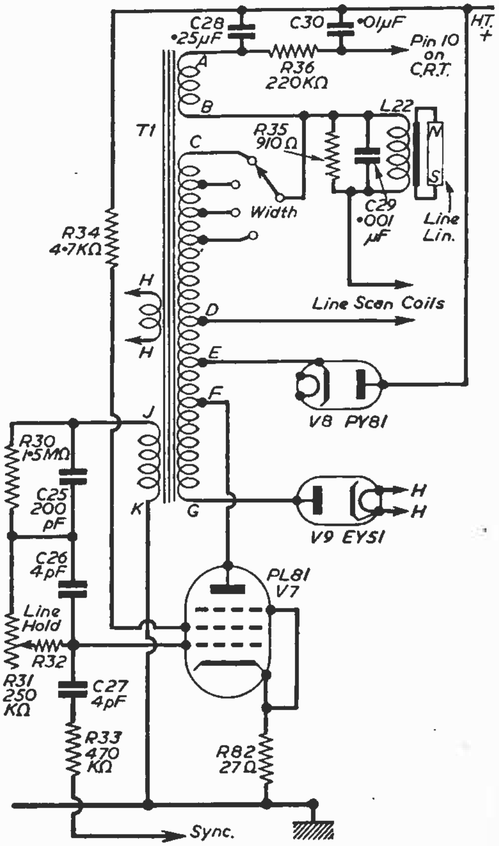


Fig. 1.—Line output circuit.

mittent spark only is coaxed from the cap, leave it and check the spark at the EY51 anode (the end near the V7 and V8 valves). This can be done by passing the test tool between V7 and V8 into the black plastic box. If a sizzle greets the entry of the tool, it can be assumed that the EY51 is being properly supplied but is defective in itself with an open-circuited heater.

Replacing EY51

Replacement may appear a difficult task, but really is not. Remove the V7 and V8 top caps (the EHT cap is already off), lay the receiver on its side, remove the bottom cover and inspect the centre screened section which contains the line output transformer T1. It will be seen that it is secured by four P.K. screws. Remove these, and gently ease out the transformer, feeding the EHT lead through the hole at the top as it is rather stiff. It is only necessary to ease it out sufficiently to take off the top lid and thus gain access to the EY51.

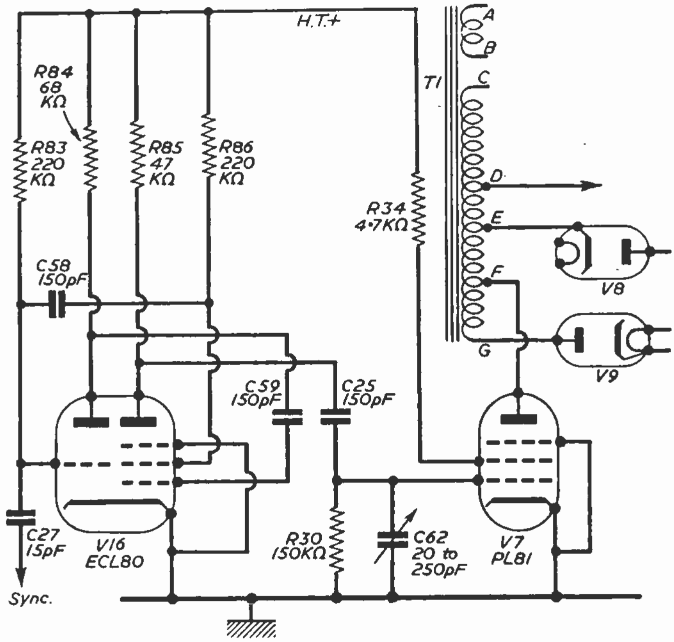


Fig. 2.—Line timebase circuit.

When replacing the EY51 do not think that, because it is in a plastic box, the joints can be carelessly soldered. This is most important since if brushing occurs the whole box can become conductive and therefore useless. Make the EY51 connections short and with rounded blobs of solder (not forgetting to join the EHT cable back to one side of the EY51 heater). Ease back the transformer and check the soldering posts on the sides. How many leads have come off?

Shorted EHT Rectifiers

Now an open-circuited heater is not the only trouble which can afflict the EY51. It can be internally shorted and this condition presents a

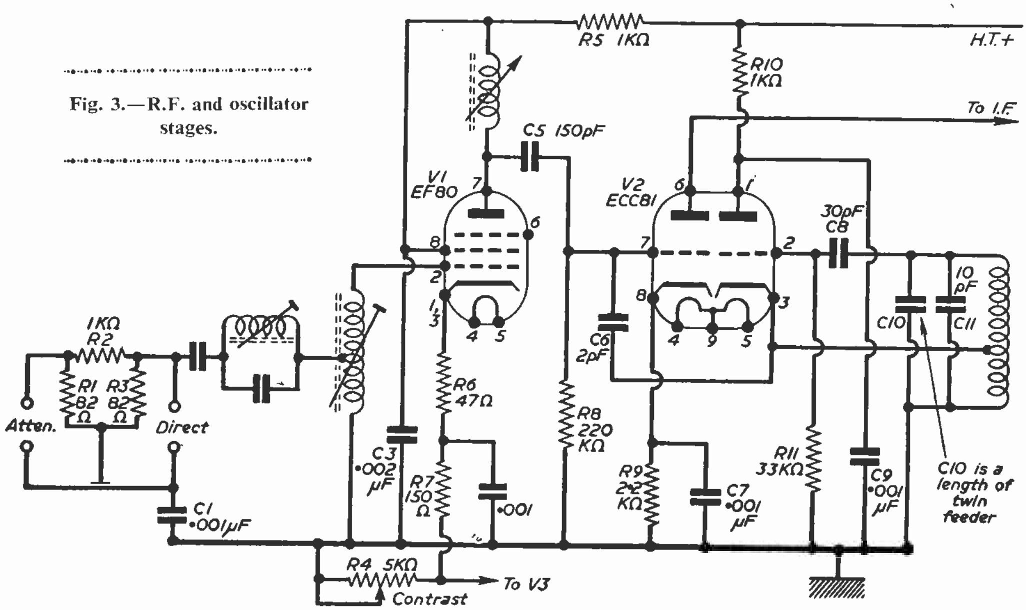


Fig. 3.—R.F. and oscillator stages.

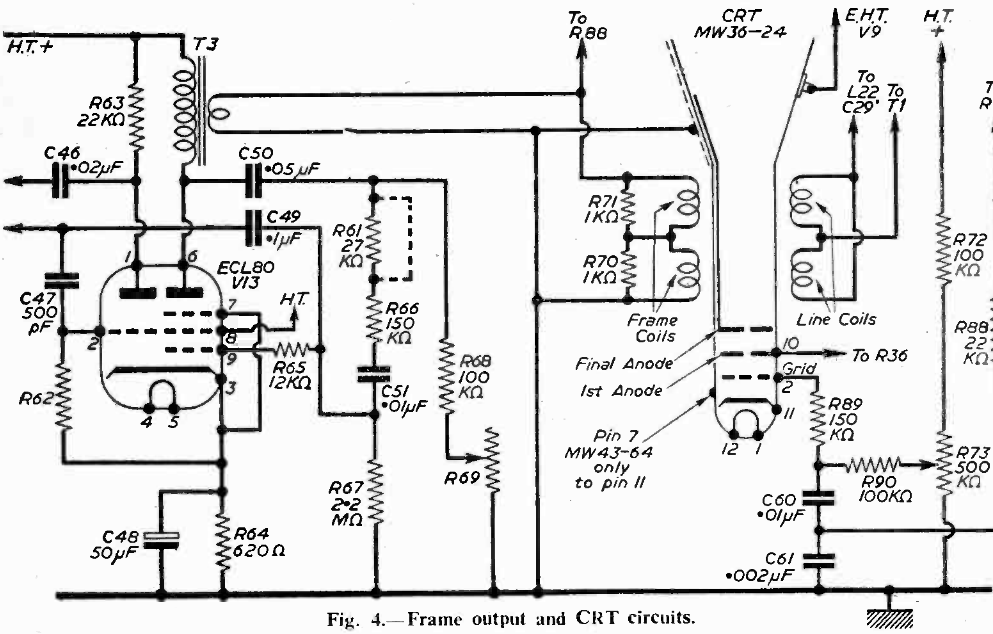


Fig. 4.—Frame output and CRT circuits.

totally different set of symptoms except, of course, that the primary complaint is the same inasmuch as there is no picture.

In this case, the line whistle may be totally absent and the PL81 may be overheated, presenting a red-hot anode plate. The first thing to do is again to remove the anode cap of the tube. If the PL81 cools off and the line whistle starts, the cap will probably commence to spark viciously to all surrounding chassis points. The spark being identical to that obtained at the EY51 anode. This is the symptom of a shorted EY51 and it must be replaced as outlined above.

Complications

Things are not always so straightforward, however, as one thing can directly cause another. For example, the above-mentioned short in the EY51 could cause a breakdown in the PL81 so that even with the anode cap removed from the tube the PL81 may continue to glow hot. Replacement of the PL81 restores normal working until the cap is replaced on the tube when the original cause then shows up.

Again, the EY51 is often blown or damaged by a short in the tube itself. In this case, replacement of the EY51 restores EHT until the cap is put on the tube when the internal short causes such a heavy flow of current that the EY51 and the line output stage is completely overloaded, the EY51 goes out and the line whistle, if present at all, sounds strained and harsh. If the tube is suspected, remove the tube base socket and short pins 1 and 12 to preserve the continuity of the heater chain. If the EHT is restored by this method, the tube can be fairly blamed and the base wiring modified as for a grid-cathode short with the lead to pin 7 removed (if fitted); pin 10 lead reconnected to 7; pin 2 lead reconnected to 10, and tag 2 strapped to pin 11. Where pin 7 is not fitted, merely remove the lead to pin 10 and tape it up, wiring as above, 2 to 10, strapping empty tag 2 over to pin 11.

Rapid Failure of PL81 Valves

If the PL81 seems to have a short life, check the 4.7k (R34) resistor to pin 8 and, on schedule D and E models, ensure that the C62 trimmer is unscrewed to a point where a white kink appears down the centre and then slightly screwed in to clear the kink.

Faint, Dull Picture

Models fitted with sprung ion-trap magnets rarely display the symptoms given when this item is displaced but some have a fibre strap which tends to snap occasionally allowing the magnet to slip round the tube neck, putting the picture out completely or making it very dull. It is easy to check this point. Where the trap magnet is in the correct position and no further increase of brilliance can be obtained here, turn up the brilliance control. If the picture still presents a dull appearance with fuzzy outlines and perhaps turns negative, the tube can be assumed to have lost emission and should be replaced. Boosting is unlikely to have much effect, at any rate, not for more than a few weeks. In some cases boosting the heater results in a complete loss of emission. With rebuilt and new tubes so reasonably priced, replacement is always more satisfactory.

When advancement of the brilliance causes the picture to expand and fail completely, the tube is not at fault and the EY51 must be replaced.

(To be continued)

The Interlace Problem

AN ARTICLE MAINLY FOR THE BEGINNER, EXPLAINING THE IMPORTANCE OF INTERLACE AND ITS EFFECT ON THE PICTURE

By "Serviceman"

THE beginner to the study of television, the home-constructor who has completed his first set, and even those who like to know about the technical side of TV, all probably have some idea about the interlaced picture radiated by the BBC and how it is reproduced on the screen of their own receivers.

Not so many, however, are certain of the degree of interlace to be expected on their own particular receivers, or, in fact, how to ascertain that they are obtaining optimum interlace and, indeed the beginner often wonders whether his receiver is interlacing at all! It is hoped, therefore, that this article will shed more light on the problem.

Quality

At the outset it may be advisable to emphasise the fact that a receiver which is not interlacing is throwing away 50 per cent. of the transmitted signal. Nevertheless, although a good interlace is of utmost importance, a perfect interlace is not as essential, and probably the experimenter has already discovered that, even though the popular-priced older style commercial receiver provides a good picture, the quality of interlace is not all to be desired. A variation in interlace quality frequently occurs after this type of receiver has been operating for any length of time, or if the frame hold control is moved slightly from its extremely critical optimum position.

With the more common use of interlace filter circuits, and with advancing design of the time-base section of the receiver, modern receivers, even though popularly priced, achieve a remarkable degree of interlace, and many of them hold it so firmly that the lines tend to pair only when the frame hold control is deliberately maladjusted to the extent of frame break up (to the point where the picture commences slowly to roll).

Poor Interlace

A perfect interlace is only achieved when successive horizontal scanning lines comprising a complete picture are exactly the same distance apart on the screen (see Fig. 1). A picture with an extremely bad interlace may also satisfy this requirement, however, but for this to happen the lines which should be interlacing between successive frames pair so closely that the picture appears composed of hard solid lines, separated equally by comparatively wide, firm black lines. This condition is absolutely obvious and leaves little doubt in the mind of the observer that the interlace quality is sadly lacking (see Fig. 2).

To newcomers to television viewing difficulty is often encountered in detecting interlace conditions of a picture by closely scrutinising the picture-tube screen in an endeavour to trace out the interlaced lines. The eyes quickly become fatigued, and often convey the illusion that the whole line formation is on the move, with lines weaving in and out of each other, and the picture (or preferably a plain synchronised unmodulated raster) seems intermittently to go in and out of interlace.

The degree of interlace varies considerably among receivers, but as previously mentioned, the modern competitively priced receiver provides an excellent interlace, and a constant 100 per cent. interlace should be expected from the more expensive modern set. By interlace other than 100 per cent., is meant that the spaces between successive lines of one scan are not equal either side of the lines of the other scan—100 per cent. interlace meaning, of course, that the spaces above and below the interleaving line are equal as in Fig. 1.

The precise degree of interlace can, therefore, be considered as a ratio; for instance, where the ratio 5 : 5 indicates a perfect interlace, the ratio

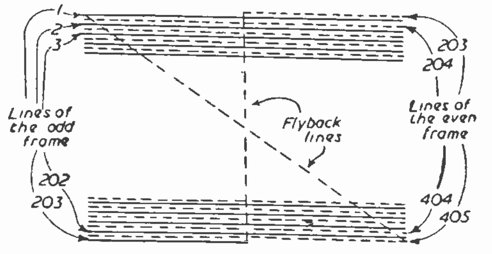


Fig. 1.—A perfect interlace showing scanning line formation and numbers.

of 4 : 6 would imply that the interleaving line is out of balance in the space provided by the lines of the previous scan, in that same ratio. Or in other words, four-tenths of the space is above, and six-tenths is below the interleaving line. It is very unlikely that a 4 : 6 interlace would be observed by the average viewer as a poor interlace. From the practical aspect it is quite a good interlace, and provided the receiver can hold it throughout a programme sequence, the receiver may be considered to have a satisfactory interlace.

The critical viewer should not tolerate an interlace ratio any higher than this, however, owing to the tendency for the paired lines to coincide and appear as a very broad single line, which gives rise to a distinctly "liny" picture of poor definition. A receiver operating under extreme conditions such as this is often characterised by displaying any straight or curved black to white edge of picture composition (which may resolve inclined from the vertical) in the form of prominent steps, as the image cuts across the line structure.

Checking Interlace

One way of providing a comparison between a suspected non-interlace and a known non-interlace is by adjusting the frame hold control until the timebase repetition frequency is made slightly faster than that of the sync pulses. Under this

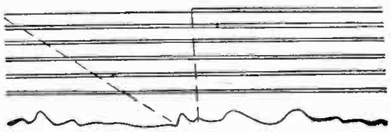


Fig. 2.—The obvious condition of a non-interlace.

condition the picture slips very slowly downwards, and if the eyes are allowed to follow it the total inertness of the line structure and the empty spaces between them, indicating a perfect example of non-interlace, are conspicuously revealed. If now the picture is suddenly brought into lock, the resulting interlace—or lack of interlace—is clearly visible in comparison with the mental image of the known non-interlace.

We have already seen that when a receiver is interlacing to any degree the whole line structure appears to be moving up or down the screen and, although this is really an illusion, it is possible to follow the apparent line movement with the eyes. When this is done the separate scans (frames) can be picked out and the picture appears out of interlace momentarily.

Practice

Although this ocular check for interlacing is simple and almost automatic, once the art has been acquired, it takes a little practice to transfer the gaze up the screen at just the right speed, and in this respect some people find it easier to keep the eyes fixed and raise the head to cause the eyes to scan the screen. Until one has really discovered the knack of this method, however, the difficulty is eased somewhat by following the apparent line movement with the point of a pencil, and provided the eyes are kept fixed on the pencil point the same effect is observed.

By increasing the amplitude of frame scan it is often possible to discern clearly a section of a synchronised raster, and thereby tell sufficiently whether or not a satisfactory interlace is occurring. The experimenter should beware if this method is adopted, however, for it sometimes happens, on receivers of certain types, that if the picture height control is advanced too far, the picture goes out of interlace. Opening the frame only slightly is generally sufficient to produce the desired effect without upsetting interlacing, and an additional aid in the form of a piece of cardboard in which a viewing aperture is cut, greatly facilitates this method of observing interlace conditions without the eyes becoming tired. The employment of a convex lens suitably positioned over the viewing aperture further assists the viewing process.

The Production of an Interlaced Picture

At this point it might be instructive to consider how the transmitted picture is actually interlaced on the picture-tube screen. A complete picture is made up of two frames (two separate scans), and for the purpose of identification one is known as the "odd" frame and the other as the "even" frame. Now, since the number of lines per complete picture in the BBC signal is 405, both frames are composed of 202½ lines, and, as we have already seen, if the picture is interlacing, the lines of the "even" frame occupy the spaces in between the lines of the "odd" frame, and thus the complete picture of 405 lines is resolved. If interlacing is not occurring, however, the picture has only 202½ lines, and half the picture is lost.

Referring again to Fig. 1, we can see that the scanning spot starts at the top left-hand corner of the screen to trace out the horizontal scan of line number 1, which constitutes the beginning of the "odd" frame. On arriving at the right-hand side of the screen the line flyback occurs and the

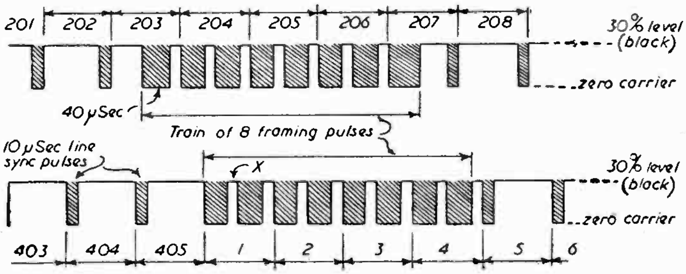


Fig. 3. (above).—A section of the sync pulse train that would occur at the start of the "even" frame, and Fig. 4. (below) at the start of the "odd" frame.

scanning spot commences to trace out line number 2—the frame timebase is, of course, deflecting the spot relatively slowly down the screen at the same time so that it is in the correct position for the commencement of successive lines.

This continues until line number 203 is started, when, instead of being completed, only one-half of it is traced by the spot, and the first or "odd" frame is concluded. The spot is then initiated by flyback to line number 203, which is finished at the top of the picture, and thus the first half line of the "even" frame commences. This process continues down to line 405 to conclude a *complete* picture, after which the spot is prompted to flyback to re-commence tracing a further interlaced raster.

It is evident from this, perhaps, very well-known explanation, that the degree of interlace is controlled solely by flyback. This is, indeed, the case and it is probably already known that the sync pulses radiated together with the picture signal have the effect of initiating this flyback.

Waveform

Now, if we look at the sync pulse train of Fig. 3 we shall have a better idea of how this happens. Actually, this is only a section of the sync pulse train of the composite signal which would occur at the start of the "even" frame (for the sake of convenience we have not shown any picture modulation on this waveform). By studying this waveform we can see that at the end of line 202—as at the end of any line—the carrier falls from 30 per cent. (black level) to zero, and remains there for 10μs.

This is a line sync pulse, and it is the leading edge of this pulse which initiates the line flyback. After the flyback, which must take place within the 10μs period, the scanning spot starts tracing line 203, but in the middle of this line the carrier again falls to zero level and remains there for 40μs. The resulting pulse constitutes one of the series of eight framing pulses, which initiate the "firing" of the frame generator to produce the frame flyback so that the remainder of line 203 is traced at the top of the screen as shown in Fig. 1.

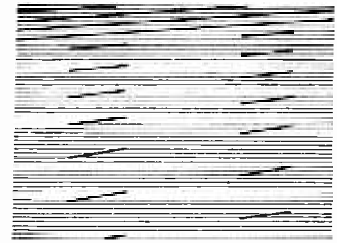
At this point it should be noted that the line flyback does not occur half-way along line 203, but that the frame flyback is the prompting factor of the half line. The line flyback occurs regularly during the framing pulses owing to the 10μs spacing between them and, although they do not resemble the normal line sync pulses, their leading edges serve to "fire" the line generator at the correct time. It is necessary to maintain line synchronism during the framing period in this way so that the generator will be operating precisely at the correct frequency at the commencement of the following line scan.

The sync pulse train of an "odd" frame is shown in Fig. 4, where it will be seen that the only differences between this and Fig. 3 are that in the latter the framing pulses commence and finish in the middle of a line, while in Fig. 4 the first 40μs framing pulse is also the initiating pulse for line number 1. This simply means, then, that to secure good interlace between successive frames the start of a frame scan must coincide with the start of a line scan every other frame only.

Causes of Bad Interlace

It would seem from this rather brief description that, provided the sync pulses are in actual control of the timebases, the system is bound to create a perfect interlace. Unfortunately, this is not the case, for the line and frame sync pulses need to be separated by various circuit networks in the receiver for application to the appropriate timebases. Furthermore, it is the voltage built up by the sync pulses which "fires" the generators (timebases) to initiate the flyback; and when it is realised that to provide sufficient voltage to "fire" the frame generator the framing pulses progressively charge up a capacitor to a critical potential (the "firing" potential), it is easy to see that any minor disturbances, such as fluctuation of signal or mains voltage, may cause the generator to "fire" slightly off time to seriously impair the interlace.

There are still other sources of undesirable



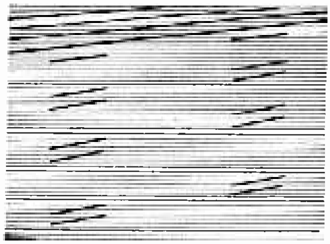


Fig. 5 (left).—The formation of flyback lines indicating a possible interlace. Fig. 6 (right).—The formation of flyback lines indicating a definite lack of interlace.

coupling by which the line pulses might reach the frame circuits. For instance, a coupling might exist between a section of circuit wiring, or transformer—the line output transformer particularly—carrying currents at line frequency, and connections or components directly associated with the frame generator. Defective or insufficient decoupling in the H.T. line used to supply power to the timebase circuits represents another way by which line pulses may upset the timing of the frame generator—but a suspicion in this respect could easily be proved by operating the timebase section from a separate isolated power source.

In some of the older receivers a large degree of coupling exists between the line and frame scanning coils, and, due to this, it has been known for line pulses to gain admittance to the frame generator via the negative feedback path provided in certain circuits to make the frame scan linear. If it is thought that line pulse coupling is the cause of a poor interlace, a pair of headphones connected in turn to various parts of the frame generator circuit should soon establish whether this is a fact. For this test the frame generator should be stopped and one lead of the 'phones connected, through a suitably rated isolating capacitor, to the receiver chassis, the other lead should also be isolated by a similar capacitor and used as a probe for making contact to the more critical parts of the generator in an endeavour to trace any line pulse leakage, which, of course, will be heard from the 'phones in the form of the familiar 10,000c/s whistle.

The Frame Flyback

It was once considered definite that provided the frame flyback lines, which can be displayed across a picture or modulated raster by advancing the brightness control (in certain receivers, mainly current models, this is not possible owing to the inclusion of a flyback trace blanking circuit), are

(Continued on page 238)

Test Card C

ASSESSMENT OF RECEIVER PERFORMANCE

As most readers will be aware, both the BBC and ITV transmit programmes on weekday mornings designed to assist in the adjustment of receivers. A special test pattern is included in these test transmissions. This pattern is known as "Test Card C" and is designed to give an immediate indication of the performance of the whole transmitting and receiving chain. As the performance of the transmitting equipment is maintained in accordance with agreed standards, during the normal periods of radiation for test purposes. Test Card C serves as a check on propagation and the performance of the receiving apparatus.

The card, which bears the identification letter C, incorporates a number of patterns each designed to assess one particular characteristic, and they are listed as follows:

Aspect Ratio

Concentric black and white circles surrounding the five-frequency gratings will appear truly circular when the width and height of the picture are adjusted to the standard aspect ratio of 4 : 3.

Resolution and Bandwidth

Within the circles there are two groups of frequency gratings, each consisting of five gratings having black and white stripes corresponding to fundamental frequencies of 1.0, 1.5, 2.0, 2.5 and 3.0Mc/s. In the left-hand group the 1.0Mc/s grating is at the top, the frequency increasing towards the bottom, and in the right-hand group the order is reversed. The response of the whole system is required to be uniform to 2.7Mc/s, so that the 2.5Mc/s gratings should be clearly reproduced, but the 3Mc/s gratings may be blurred. The picture must just fill the viewing aperture during the test, with the black and white border visible.

Contrast

A five-step contrast wedge appears in the centre of the test card. The top square is white, corresponding to 100 per cent. modulation, and the lowest square is black, corresponding to 30 per cent modulation. The three intermediate squares should be reproduced as pale, middle and dark grey.

Scanning Linearity

The background of the test card is a middle grey, bearing a graticule of white lines. The areas enclosed between the lines should be reproduced in all parts of the picture as equal squares.

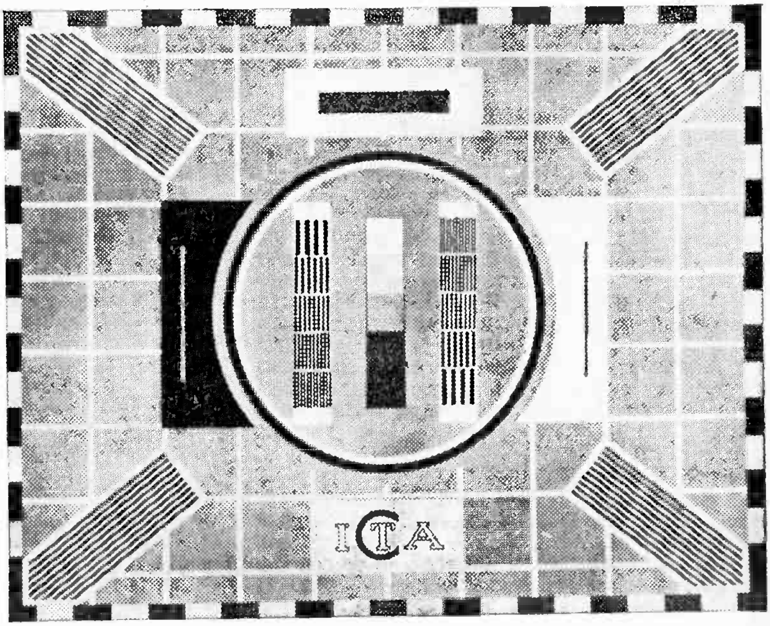
Synchronisation Separation

The border consists of alternate black and white rectangles, which facilitate recognising interference between the picture signals and synchronisation.

Low-frequency Response

A black rectangle within a white rectangle is provided at the top and in a perfect system it would be reproduced as a rectangle of uniform blackness on a clean white background. At present, imperfections in the transmitting system result in a slight streaking at the right-hand side of the black area, even with a perfect receiver,

(*Continued on page* 238)



Test Card C

Cathode Followers

By J. Peake

DESIGN AND OPERATION OF THESE STAGES

IN this article it is proposed to examine the functions of the very widely used cathode follower circuit, and to show how it may be used in a variety of different ways, thus enabling experimenters to design their own circuits incorporating this useful arrangement where applicable.

Many would-be designers often feel a trifle frustrated when they wish to depart from component values specified in a particular circuit merely because they lack the know-how when it comes to rearranging them to their own liking or convenience. The rule " It's easy when you know how " could not be more true in this particular case, provided that one or two elementary rules are not overlooked, and since the cathode follower is such a very useful electronic tool the process is laid out below.

The Circuit

The invention of this arrangement is generally attributed to one of Britain's leading " back-room boys", Blumlein, who lost his life on a radar test flight during the war, and it is interesting to note that such a useful circuit requires only three components in its simplest form.

Why " cathode follower " ?

Well, the secret lies in its name. It is common knowledge, of course, that in a valve application of a negative-going signal to the control grid causes the anode current to decrease. Thus in the normal amplifying stage shown in Fig. 1 the decreasing anode current through the anode load causes the anode potential to rise towards the H.T. potential, and this same current through the cathode load causes the latter potential to fall. Summarising, a negative signal on the grid causes the anode to go positive and the cathode to go negative ; that is, the cathode " follows " the grid. This is all rather obvious and at first glance a little puerile, but let us examine the process more analytically.

If we take our output from the cathode rather than from the anode as in a conventional amplifying stage we can dispense with the anode load R_L and this just leaves us with the circuit in Fig. 2.

From this an immediate disadvantage of this circuit becomes apparent. We can see that the input voltage is the sum of the voltages Eg (appearing between grid and cathode) and Ek, the output voltage appearing across the cathode load Rk. This means, of course, that the output voltage is always less than the input voltage and hence the gain $\frac{Ek}{E}$ is less than one.

This apparent snag, however, is well compensated. Before we can go any farther we have to make use of an established relation within the valve which tells us what happens when we vary the voltage on the grid. The mutual conductance or Gm is the parameter we require, since this ties up anode current variations with grid voltage swings, for any given anode voltage. For example, a valve having a Gm of 5 mA per volt would have an anode current change of 5 mA if we changed the grid potential by 1 volt. This change in anode current flowing through the cathode load Rk produces a voltage change equal to the product of current and resistance—just Ohm's Law. This information is all that is utilised in the analysis of the cathode follower. Admittedly we have neglected one or two things, such as the effect of the Ra of the valve, but the influence of such extras modifies the result to such a small extent that their omission is fully justified.

Having written the procedure in words, let us have it in figures, and so tie it all up with one or two simple formulæ. The output voltage Ek is the product of the anode current (Gm, Eg) and the cathode resistor Rk.

Thus $Ek = Gm.\ Eg.\ Rk$

But $E = Eg + Ek$

and substituting for the value of Ek in the first line.

$$E = Eg + Gm.\ Eg.\ Rk$$
$$= Eg[1 + Gm.\ Rk]$$

Then the stage gain G is :—

$$G = \frac{Ek}{E} = \frac{Gm.\ Eg.\ Rk}{Eg[1 + Gm.\ Rk]} = \frac{Gm.\ Rk}{1 + Gm.\ Rk}.$$

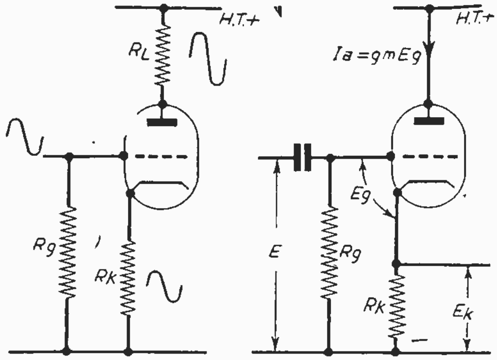


Fig. 1 (left).—Resistance-loaded amplifier with cathode bias. Fig. 2 (right).—Cathode follower.

If we rearrange this formulæ slightly we obtain another important result.

Dividing top and bottom lines of the fraction by Gm gives :—

$$\frac{Ek}{E} = \frac{Rk}{\left[\frac{1}{Gm} + Rk\right]},$$

showing that

$$Ek = \frac{Rk}{\left[\frac{1}{Gm} + Rk\right]} \times E$$

We can therefore draw the equivalent circuit of the cathode follower as in Fig. 3, which shows a generator or signal source providing an output E to a load Rk through an output impedance $\frac{1}{Gm}$.

If, in fact, the output voltage appearing across Rk is calculated it will be that given above.

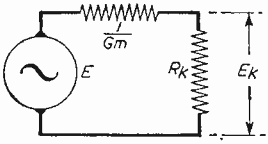
Thus the output impedance of a cathode follower may be said to be 1/Gm, and this is much less than the output impedance of a conventional anode-loaded amplifier as can be seen if we reconsider the value of Gm stated earlier, viz., 5 mA/V. A valve with this Gm as a cathode follower would have an output impedance of approximately 200 ohms.

It is this property that makes the cathode follower such a versatile instrument in such devices as valve-voltmeters, cathode ray oscilloscopes, and output stages of, say, pre-amplifiers feeding equipment over long lines, etc.

In fact wherever the effects of stray capacity are likely to become apparent due to the latter loading the output, then the cathode follower is the circuit generally used to overcome the difficulties.

A practical example illustrates this very well: Imagine that we wanted to examine the waveform appearing at the anode of the valve driving the C.R.T. in a television set; that is, the video output stage. Here the signal contains picture information of all frequencies up to, say, 3 Mc/s. Because of the inherent stray capacities appearing across its terminals connecting an oscilloscope directly from anode to earth of this stage would seriously load the output, resulting in a shunting to earth of the high-frequency components of the signal.

Connecting a cathode follower in circuit as a buffer amplifier, though resulting in a uniform reduction in signal level, does not present any appreciable load to the stage in the way of stray capacities. These "strays" are in fact less than those associated with a



$$E_k = \frac{R_k}{\left(\frac{1}{G_m} + R_k\right)} E$$

Fig. 3.—Approximate equivalent circuit of cathode follower. $Z_o = \frac{1}{G_m}$.

normal triode amplifier and by careful wiring can be made negligible. Furthermore, the output can now be taken down a relatively long piece of screened wire, (which in itself may have a very high stray capacity), to the 'scope which can now be located more conveniently away from the TV set in question.

How then do we go about designing a simple cathode follower which can be used for such a purpose?

Design Procedure

Obviously the best results are obtained using a valve with a high Gm. On the other hand, however, we do not want a valve which gives this high Gm at the expense of a large anode current. Choose, for example, the Mullard valve EC91. In tables this is quoted as having a Gm of 8.5 mA/V for an anode voltage of 250 volts and an anode current of 10 mA at a grid voltage of −1.5 volts. The simplest design would use the cathode load as the bias resistor as well. Hence to produce 1.5 volts across a resistor by passing 10mA through it requires a resistance of 150 ohms. We now know the approximate gain and output impedance of the cathode follower by applying the formulæ developed earlier.

From $G = \frac{Gm.\ Rk}{1 + Gm.\ Rk}$ the gain is 0.56

and the output impedance is simply 1/Gm and is thus $\frac{1000}{8.5}$ i.e., 117.5 ohms. say, 110 ohms.

The gain is seen to be rather low and a higher value could be obtained by the alternative method described below:

Assuming the H.T. supply is 350 volts; then for an anode voltage of 250 volts we can afford to drop 100 volts across the cathode load. Ohm's Law thus shows us that the total cathode load must be 10k. The grid-to-cathode voltage, however, must only be −1.5. One method of achieving this is to use two fixed resistors as shown in Fig. 4(a) between H.T. and earth, their junction potential being the necessary one and a half volts below the cathode potential. This is achieved in the circuit shown by the use of the two resistors of value 1.2M and 470k respectively.

A better method is illustrated in Fig. 4(b). Here we tap into the cathode load at that point which gives us the necessary grid-to-cathode voltage. The errors involved by departing from the strictly calculated values of resistance, so as to conform to the standard range of available resistors, are negligible, and so we retain the 10k cathode resistor, merely adding the 150 ohm resistor at the cathode end of the chain. We tap the grid leak in at this point and hence obtain the necessary bias for the stage. Condenser C merely decouples the bias resistor.

This method gives a slight improvement over the method outlined in Fig. 4(a), due to the fact that the input impedance to the stage is increased. This is not apparent from the circuit, but is a feature of this mode of connection.

In both cases the gain is found to be 0.99, or almost 1, while the output impedance remains as before, approximately 110 ohms.

"Experts" will point out here that in the value for gain given above, the effect of the anode impedance of the valve has been overlooked. Tables give this value as 12k and, in fact, this modifies the gain only very slightly, making it not 0.99 but 0.98, an error of about one per cent.

Why this difference in gain?

Well, although this circuit masquerades under the name of cathode follower, it is still nothing more than an amplifier, but the load is in the cathode instead of the anode. Furthermore, as an amplifier it is still subject to many of the shortcomings of a normal amplifier.

Reconsidering the first example, with Rk of 150Ω, some of the setbacks can be demonstrated by viewing the stage as a straightforward amplifier. To start with the valve cannot really see the input signal as we do. To the valve the applied signal is that appearing between its grid and cathode, which for purposes of this approach we will assume is of one volt amplitude. The current through the valve will promptly change by 8.5 mA when we apply this signal voltage, and hence the cathode voltage will be changed by 8.5 × 0.15 volts, i.e., by 1.275 volts. The valve does really give us a gain of greater than one; in this instance it gives us a gain of 1.275. But this is the story only as seen by the valve, since we know that the true input signal appears not merely between grid and cathode, but between grid and earth, and, therefore, any voltage output we get is reapplied as part of the input signal. The significance of this is obvious to those readers who first queried the relation

$$E = Eg + Ek$$

—the circuit is really an amplifier with a certain amount of negative feedback applied to it, the degree depending on the value of the cathode load.

Now look at the circuit of Fig. 4(b). Applying the signal of one volt here and passing the resultant current change through the cathode load of 10k causes the cathode voltage to change 85 volts. Here, then, is an amplifier with an "internal" gain of 85, and yet its "external" gain is barely 1. We must get something for all this effort! And we do get some advantages.

One of them is a low output impedance, while others include improved linearity and an increased grid base, and it is this latter feature we must now examine.

What is the limit to the input voltage?

The limits of the grid-cathode voltage of any amplifier are defined by the region of grid current in one direction and anode-current cut-off in the other. In symbols Vg=O and Vg=c.o. respectively.

If we were using the EC91 as a straightforward amplifier, then with a bias of —1.5 volts the nearest limit would be the grid current region at Vg=O, and we could, therefore, apply an input of 3 volts, measured peak to peak.

In a cathode follower, however, it is not directly obvious what the grid-cathode voltage is at any given instant, and the limits are, therefore, best determined from the "cut-off" anode current conditions.

In the cases under consideration the valve draws 10 mA. Application of a negative voltage to the grid decreases this current, cutting it off in the limit. Since this current is controlled by the product Gm.Eg. then the value Vg=c.o. is found to be $\frac{-10}{8.5}$ volts. This is a negative-going signal of 1.18 volts approximately. The maximum negative-going signal that could be applied between grid and earth is thus the sum of the standing cathode voltage and the grid base. In the case of the 150ohm cathode load this makes the maximum signal 2.68 volts on the negative excursion. And how much positively?

The permissible positive-going excursion will be greater since we can apply a grid-cathode voltage of +1.5 before we reach the condition Vg=O, and grid current. (Actually, in most valves, grid current starts to flow before Vg=O is reached.) Here the 1.5 volts change increases the current in the valve by 1.5×8.5mA, and the cathode voltage increases accordingly. For the 150ohm load the positive input signal could, therefore, be a maximum of 3.41 volts.

Since we normally design for an input waveform which is symmetrical about the bias point, the minimum limit is chosen, fixing the amplitude of the input waveform for the 150-ohm load at slightly less than twice 2.68 volts, measured peak to peak.

Things are, however, vastly improved with the larger value of cathode load.

With 10k in the cathode circuit a negative-going grid-cathode voltage of 1.18 volts is still sufficient to cut off the anode current by the same reasoning as in the previous case, but the true maximum input then becomes 1.18 volts, plus the standing cathode voltage of 100 volts.

The peak to peak input can thus be 200 volts approximately.

Note that in these simple calculations it has been assumed that the value of Gm has remained constant over the range of current swings. The Gm does, of course, vary, but the assumption of a mean value, such as that quoted in valve tables, gives reasonable results in practice. Another effect overlooked is that due to the variation of the "cut-off" grid voltage as the anode-cathode voltage of the valve alters. This can be ignored if a reasonable safety margin is allowed on the amplitude of the input signal catered for.

Summary

The foregoing has presented in some detail an explanation of one or two of the effects peculiar to the cathode follower. All the salient points for the design will now be crystallised and put in tabular form to enable the experimenter to lay his hands on the relevant information without having to peruse the article at length.

It is assumed that the following information is known before the design proceeds:

1. Amplitude of input signal.
2. Frequency of input signal, and if composite frequency highest and lowest frequencies involved.
3. Desired output impedance. (Zo.)
4. H.T. voltage and maximum H.T. current drain.

Items 3 and 4 will help decide the choice of valve, since Zo is approximately 1/Gm, and the latter will be

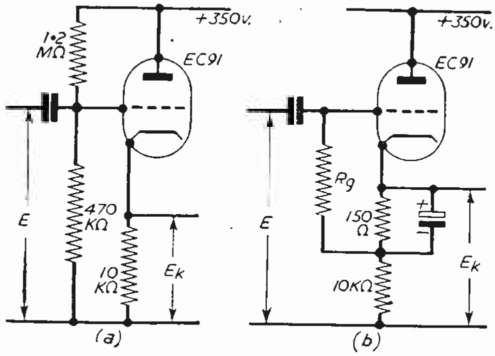


Fig. 4.—Improved cathode followers showing two methods of biasing.

decided, for any given valve, by the anode current.

Pentodes can be strapped as triodes to produce an increased Gm; in the case of the B7G-based pentode, Z77, the Gm of 7.5 mA/V can be increased to 9.4 mA/V by so doing.

Next consider the input amplitude. Say this is A volts peak to peak. Then, assuming the gain is 1, the minimum standing cathode voltage must be greater than A/2 volts. For the value of Gm fixed upon, the valve tables will quote a particular anode current, say, I mA. Then the cathode resistor is found by Ohm's Law to be A/I kilohms. The value of bias specified in the tables must now be produced by tapping in to the cathode load. Thus if V volts bias are required a resistor of value V/I kilohms is required. The cathode load now consists of two resistors; one from earth of value (A/I—V/I) kilohms, joined to the other of value V/I kilohms, and thence to the cathode. Tne circuit will then resemble that of Fig. 4(b).

A point to remember when calculating the resistors if a pentode is being used: the cathode current is the sum of the anode and screen currents. It is very easy to forget the screen current when doing the arithmetic. The screen is usually tied to the anode and the suppressor to the cathode in this mode of connection. There is seldom any necessity for using a pentode as a cathode follower, and so the method is not mentioned here.

Parasitic oscillation can occur with this circuit just as in any other, and hence care is required in its wiring up.

In conclusion it will be mentioned that the cathode follower is the heart of many a more involved circuit, some of which are mentioned below.

The Super Cathode Follower. This is a two-valve circuit by means of which extra low output impedance may be obtained.

The Long-tailed Pair. This exists in a variety of forms, the best known of which is the Paraphase amplifier used for driving push-pull output stages.

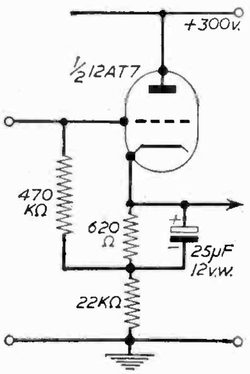


Fig. 5.—Cathode follower analysed in the table.

The Cathode-coupled Multivibrator. A square-wave generating amplifier driven from an input pulse.

The Cathode-coupled Amplifier. This is really a composite circuit comprising a cathode follower input stage and grounded grid output stage, each valve sharing the same cathode.

The design of all these different devices relies to some degree on the understanding of the analysis of the cathode follower.

A table of cathode follower characteristics

TABLE OF CHARACTERISTICS FOR CIRCUIT OF FIG. 5.

Ek	Ia	Eg	E	Ek (A.C.)	E (A.C.)
0	0	−8.5	−8.5	−102	−107.7
25	1.1	−6.5	18.5	−77	−80.7
50	2.21	−4.85	45.15	−52	−54.0
75	3.31	−3.8	71.2	−27	−28.0
100	4.42	−2.9	97.1	−2	−2.1
102	4.5	−2.8	99.2	0	0
125	5.52	−2.0	123.0	+23	+23.8
150	6.63	−1.25	148.8	+48	+49.6
175	7.73	−0.6	174.4	+73	+75.2
200	8.84	0	200.0	+98	+100.8

appears above for the circuit of Fig. 5. It was prepared from the Ia/Va curves of the 12AT7 valve, which is a double triode on a B9A base. Only one-half of the valve is used.

The first four columns are obtained direct from the valve curves. The outlined row corresponds to the conditions under which the valve draws current with no external signal applied to the grid. The fifth and sixth columns, corresponding to the actual A.C. working conditions, are then obtained by subtracting the datum values of Ek (i.e., 102V) and E (i.e., 99.2V) respectively from the remainder of the values in each column. The peak to peak input voltage is thus seen to be 200 volts and over this range the gain is nearly constant, demonstrating the linearity of the circuit.

TEST CARD C

(*Continued from page* 234)

but by experience it is possible to judge whether the reproduction is abnormal.

Reflections

Reflections, which may occur in propagation or in the receiving installation, are indicated by two single vertical bars, which should be reproduced without positive or negative images at their right-hand sides. The width of these bars represents a pulse of 0.25µs.

Uniformity of Focus

These are four diagonally-disposed areas of black and white stripes corresponding to a fundamental frequency of about 1Mc/s. and all four should be resolved uniformly throughout.

The size of the tuning signal and of test Card C will, of course, vary according to the size of tube. Each must completely fill the screen.

Of course, troubles develop in course of time, and readjustments are usually carried out by the dealer who is the agent for that particular make of receiver. When a new receiver is installed all that it should be necessary to do is turn on the picture. Just as one would turn up the sound volume on a normal broadcasting receiver. In course of time, however, valve deterioration takes place, or components may vary in value.

THE PROBLEM OF INTERLACE

(*Continued from page* 233)

evenly spaced, as in Fig. 5, a perfect interlace must be occurring. This, unfortunately, is not always the case, as it is possible—although extremely rare—for the frame timebase to be "fired" at the precise moment yet not to produce a perfect interlace. On the other hand, though, very unevenly spaced lines, as in Fig. 6, are a sure indication that the interlace is severely impaired, if occurring at all.

In this form, then, the experimenter has available another fairly accurate interlace checking aid, and provided it is used with a little thought it can be extremely useful in determining the approximate degree of interlace quality. The two sets of lines actually represent the path traced by the scanning spot during the flyback of the "odd" and "even" frames.

The formation of the short lines are due to the 10µs tops separating the eight framing pulses (marked "x" in Fig. 4), and the full lines above them correspond to the series of unmodulated lines which always follow the framing pulses. They show up horizontally, instead of vertically as would be expected, because the line generator is continually deflecting the scanning spot horizontally at a much faster rate, even during the frame flyback periods, and it is because the spot in tracing them actually crosses the same line twice that they show up at all (and even then only when the brightness of a modulated raster or picture is lifted above the black level).

TWO INTO ONE

F. E. Apps explains how two old, faulty TV sets can be serviced to provide one working receiver.

FROM letters received, it is apparent that many new readers, although conversant with radio servicing of their own or friends' receivers, have little or no practical knowledge of television servicing.

Here, then, is a good way, that is not expensive, in which to acquire this knowledge and, at the same time, to enjoy an interesting hobby that can in the future pay good dividends. For this purpose, it is necessary to possess or have available a reasonably good multi-range meter, capable of checking D.C. volts up to 500, A.C. volts to 250, D.C. current to 1A and ohms up to 1M.

Practically all big cities and most of the larger towns in this country have what are commonly known as "TV graveyards." They are shops where second-hand receivers, not in working order, can be purchased for as little as 10s. a set. Now the method suggested is to buy two of these sets.

Advice on Selection

If possible, try to buy two identical sets; that is, the same make and either the same model or models that are very similar. Generally makers' sets are very much alike in two consecutive years. Try also to procure sets with reasonably modern valves, such as B7G or B9A types. The older octal base types may be difficult to replace if this is necessary. It will be found better to purchase sets with small cathode ray tubes, such as 9in. or 12in. Both sets should be A.C./D.C. and superhets.

First Steps

Remove both chassis from their cabinets and place them side by side on a good sized table or work bench. Clean up as much as possible. A vacuum cleaner or blower is useful for this. Remove valves, being careful to note their correct positions on chassis. Procure, if possible, a service sheet for the two jobs. These can be obtained from advertisers in this journal.

All valves should now be checked with the meter for heater continuity and also a rough check made for heater-cathode shorts. Replace valves if found in order and exchange with the other set any with o.c. heaters. A little judgment is necessary to decide which set to work on first. A lot depends on luck here, but a careful look over each, especially underneath the chassis for signs of burning or overheating, should enable a decision to be made. Check now the mains voltage adjustment on the chassis on which you decide to work. Adjust to your own mains voltage, refit control knobs on spindles, connect up to mains and switch on, but *do not* touch the chassis as it may be alive. Check with a screwdriver neon tester and if the chassis is alive, reverse the mains leads. Switch on again. In a few minutes all valves should light up, but if not, check the heater circuit with the aid of the circuit diagram.

Now with some sets, all heaters are in series, starting from mains through the mains switch, the mains dropping resistance, then a thermistor, which looks like a small 1W resistor, through all heaters in turn, finishing up with the cathode ray tube heater, and then to chassis. In other sets where valves are mixed, consisting of 0.1, 0.2, and 0.3A valves, the heater circuit is a series parallel circuit. The 0.1A valves are in series with the 0.2A valves, then these combinations are wired in parallel with the remaining 0.3A valves and the C.R.T. Replace any of these heater circuit components that may be faulty from the other set. If the heater of the cathode ray tube is o.c. in both cases, then place a 20Ω, 5W wirewound resistor across the heater pins of the tube. All valves should now light up.

Next Step

The H.T. should now be checked. Now this may be obtained either by means of a rectifying valve or valves, or it may be obtained by means of a metal rectifier. H.T. is generally taken from the rectifier through an L.F. choke or the winding of a loudspeaker and is smoothed by an electrolytic condenser, generally of a double type, which is connected on either side of the winding. H.T. should be measured on the side farthest from the rectifier and in normal circumstances should read in the range of 200 to 250V, depending on the make and model. Should there be no, or very low, H.T. at this point, then the following may be suspect: the rectifier, which may be either valve or metal; the L.F. choke; the electrolytics which may be short circuit or low capacity, or there may be a short circuit to ground somewhere in the H.T. line. Having checked the choke and the electrolytics with the meter, if the voltage is still low, isolate the set from H.T. line by disconnecting it from the choke and with the meter check the H.T. line for shorts, concentrating on condensers connected anywhere in the H.T. line. The service sheet should assist greatly in this as they generally give the positions of the condensers on chassis. In making this test it may be necessary to isolate different H.T. lines from the main H.T. line. Overheated or burnt-out resistors are always a pointer to an H.T. short.

Sound Section

We will now presume that heater and H.T. volts are now available throughout the receiver. The next step is to make the sound section

(*Continued on page* 242)

Aligning with an Oscilloscope

THE TECHNIQUE DESCRIBED

By F. Palmer

MOST readers are by now aware that it is much more satisfactory to be able to observe the effect of a trimmer adjustment on a response curve displayed on the screen of a C.R.T. than to rely on the limited information given by an indication on an output meter at various spot frequencies. In the latter respect, however, a curve based on the output meter indication at various frequencies may be produced if desired, but this is surely a tedious process and one that cannot easily be performed.

Instructions

More TV set makers are now providing alignment instructions embracing the use of a wobbulator and oscilloscope. Some are even providing two sets of instructions, one relating to the 'scope method and the other to the spot frequency method where a signal generator and output meter are used.

The connection of the 'scope and wobbulator for TV alignment has been explained in these pages on many occasions. So far as the vision section of a TV receiver is concerned, however, the "Y" 'scope voltage is picked up either from across the vision detector load resistor or from across the output of the video amplifier valve. In the latter instance it is often more convenient to take the connection direct from the appropriate pin (cathode or grid, depending on how the tube is modulated) on the picture tube.

A Frequency Marker

When making trimmer adjustments in a vision channel while observing the response curve on the C.R.T. it is essential to know the range of frequencies covered by the curve. To aid in this respect a signal is applied to the receiver under test together with the normal wobbulated signal. This additional signal gives a little burst of R.F. at a point on the response curve corresponding to the frequency of the signal (see Fig. 1).

Clearly, then, the frequency at any significant point on the response curve can be determined simply by adjusting the tuning of the marker generator until the burst of R.F. (generally known as a marker pip) is at the required point on the curve, and then reading the frequency on the scale of the generator. As the frequency of the marker generator is swung from, say, the frequency corresponding to point A on Fig. 1 to the frequency corresponding to point B, the frequency marker will appear at point A, slide up the curve, along the top and then down the other side and disappear at point B. Thus a means is available of accurately determining the width of the curve in terms of frequency.

Some wobbulators designed for TV use have a terminal available for injecting into them a marker frequency. If an instrument of this kind is not available, however, it is quite a simple matter to inject the two frequencies simultaneously into the receiver by using a network such as that shown at Fig. 2.

If it is found that the frequency marker extends over a large area of the response curve and hides important contours of the curve, the marker can be sharpened up considerably by connecting a $0.001\mu F$ capacitor across the "Y" and earth terminals of the 'scope.

Fig. 3 shows how the 'scope, wobbulator and marker generator should be connected.

A Calibrated Graticule

Particularly during the operation of TV alignment, it is often necessary to know the relative amplitude of the displayed response curve at various points along the trace. For example, when aligning normal receivers it is general practice to arrange the alignment of the I.F. stages so that the response at the nominal vision carrier frequency is 6dB down.

A calibrated graticule which can easily be fixed in front of the C.R.T. screen is a considerable aid in this respect. Such a device can be made quite easily by scribing a piece of Perspex as shown at Fig. 4. The size of the Perspex should be such that it fully covers the front of the tube; some commercially produced 'scopes have sliders at the front of the instrument for taking a graticule by some other means.

If the deflection amplifier is fairly linear, the horizontal dB lines may be marked off as percentages of response amplitude as follows: 3dB 70 per cent.; 6dB 50 per cent.; and 20dB 10 per cent.

Method of Alignment

Full alignment procedure cannot be given in this article, as the alignment procedure varies considerably between receivers. As has been

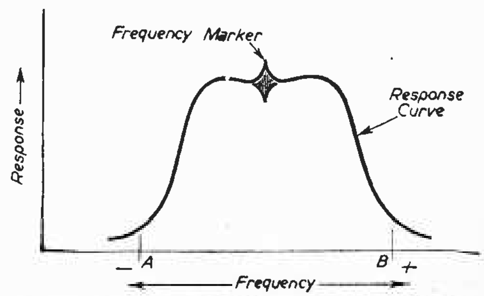


Fig. 1—The formation of a frequency marker on a response curve.

intimated previously in various articles, optimum results are attainable only if the procedure given in the maker's instructions is closely followed. This applies to service engineers as well as experimenters, for although a picture will undoubtedly be obtained by employing the "guess and adjust" method, the operation can never be

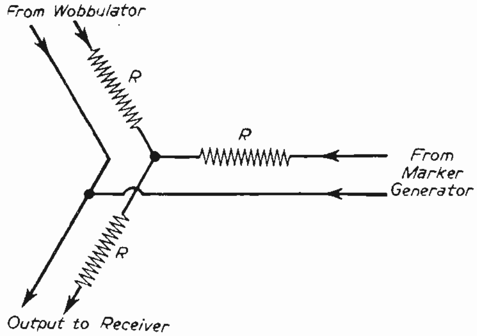


Fig. 4.—A network suitable for injecting two signals simultaneously into a receiver.

considered conclusive, and one is always tempted to readjust here and readjust there, always aiming for something a little better. Of course, if the instructions are really unobtainable then this course has to be adopted.

Even when employing the visual method of alignment it is always best to adjust the sound rejectors first by applying a spot frequency equal to the sound I.F. and setting the associated tuned circuits for minimum output from the vision channel. The 'scope may be used as an output indicator in this case by connecting the "Y" terminal across the diode load resistor as for wobbulator alignment, using a modulated input signal and adjusting for minimum amplitude trace, with the timebase running at about 50c/s.

Large Signal

Although a frequency marker can readily be produced at the sound rejection frequency on a displayed vision response curve, as shown at Fig. 5(a), it is necessary to tune the rejectors with a signal considerably larger than that obtained from the wobbulator to provide a response display. If it is endeavoured to adjust the rejectors, therefore, while observing the vision response curve (i.e., adjusting for maximum dip at the sound rejection frequency), one often finds that the optimum point of rejection is not registered on the curve. What happens is that the curve dips correctly as the rejectors are tuned towards the sound frequency, but from a certain point and up to the point of optimum rejection no further dip is indicated.

After adjusting the rejectors it is general practice to align the sound section of the receiver. This can be done by employing the 'scope and wobbulator method, as detailed some time ago in these pages. The more popular method, however, simply involves connecting the "Y" terminal of the 'scope across the sound detector load resistor, applying a modulated signal at the sound I.F. to the control grid of the first valve, which is common to both sound and vision (as when adjusting the rejectors) and adjusting the appropriate trimmers in the sound channel for maximum amplitude trace, after setting the timebase frequency at about 50c/s.

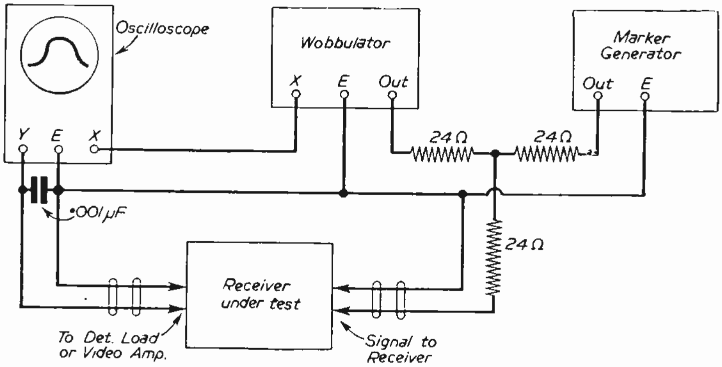


Fig. 3.—A block diagram showing how the 'scope, wobbulator and marker generator should be connected to a TV receiver.

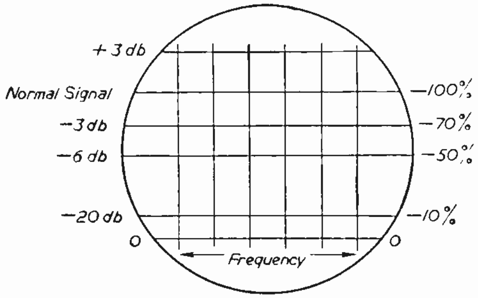


Fig. 4.—A suitable piece of perspex scribed to form a graticule, as shown, considerably eases visual alignment of TV receivers.

Using the arrangement as illustrated at Fig. 3, it is general practice next to connect the wobbulator output to the signal grid of the final vision I.F. valve. The wobbulator is adjusted to provide a frequency sweep in the region of plus or minus 4Mc/s relative to the nominal vision I.F., or as stipulated in the alignment instructions. With the timebase running between 12c/s and 50c/s the trimmers appropriate to the final vision should be adjusted, aiming for a curve something like that shown at Fig. 5(b)—it should be noted that this is for a single sideband vision characteristic.

The output of the wobbulator is then transferred to the signal grids of the preceding vision I.F. valves in turn, working back to the first valve in line, and adjusting the tuned circuits. Curves after the style of those at Fig. 5(c) and (d) should be resolved.

The I.F. transformer in the anode circuit of the frequency changer (or mixer) valve should be adjusted to produce a curve something like that at Fig. 5(e), when the wobbulator signal is applied to the signal grid of the valve concerned.

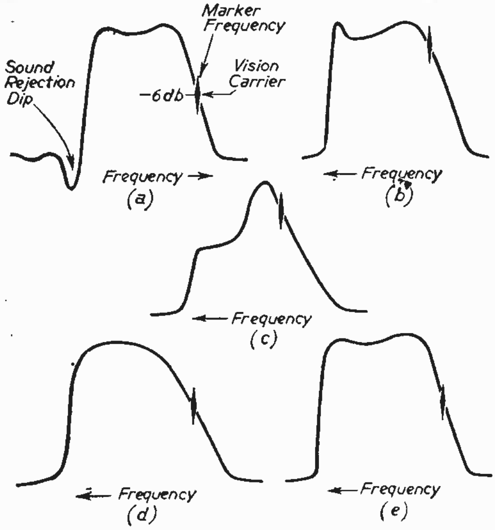


Fig. 5.—Response curves obtained during the process of TV alignment.

In cases corresponding to displays (b) to (e) it will be observed that the I.F. corresponding to the carrier is approximately 6dB (50 per cent.) down the right-hand side of the curve, as indicated by the frequency marker. This, of course, indicates that the I.F. stages are tuned and adjusted to have a single sideband characteristic. Moreover, as the arrows indicate a rising frequency from the right to the left of the response curves, it will be seen that the nominal I.F. falls on the lower sideband of the curve.

Oscillator Frequency

It is worth while bearing in mind that this I.F. scale will be produced only on receivers whose local oscillator frequency is higher than the carrier frequency; on sets of this kind the sound channel I.F. is always higher than the vision I.F. A mirror image of the overall vision characteristic is thus presented in the vision I.F. channel. When the wobbulator signal is applied to the aerial terminals, or injected before the frequency changer, the frequency scale of the displayed overall response curve will, of course, show a rising frequency from left to right.

TWO INTO ONE

(*Continued from page* 239)

function. Now, different makers have several ways of tapping off sound. Here a further inspection of the circuit diagram is necessary. Some have two or three stages of sound I.F.s, others only one, as the previous I.F. stages are for both sound and vision. In checking sound, where there are no signals, it is best to use the radio receiver method and start at the output stage, working towards the aerial from there. I should have mentioned before that, in all these tests, the lower frequencies (Band I) are best for first checks.

Whilst making this progressive test through the sound section, it may happen that a point is reached where there is a response from the speaker. Here check voltages at anode and screen (if any) of valve stage. Readings are generally given on the circuit diagram. Check also cathode voltage and coupling condensers. Very little trouble can be expected in I.F stages unless someone has interfered with trimmers. The frequency changer stage may cause some trouble. Here make certain that the frequency changer valve is good. Some valves may appear quite good in another stage but do not oscillate. Many manufacturers use an R.F. pentode as a frequency changer. This valve is the same type as used for I.F. stages, so valves may be changed over if the frequency changer is suspect. Again check anode, screen and cathode voltages if trouble occurs.

The R.F. Stage

This is generally an R.F. pentode stage with a control in the cathode circuit to govern amplification. This control in older sets is either the sensitivity control or the contrast control. Check these for continuity and contact of wiper to track throughout its travel. Refer to circuit diagram again, as this control often governs the first I.F. valve as well. Again check electrode voltage readings and compare with readings on circuit sheet. Check the coils for continuity and observe that the aerial connections are sound. Very small capacity-coupling condensers may be changed if suspect. If you live a good distance from a broadcasting station, it will, of course, be necessary in these initial stages to use an outdoor aerial if reception is expected. By this time I think that reception of sound could reasonably be expected so we will now proceed to the next stage, which is the vision section including the frame and line stages. Before tackling this it will be necessary to have the cathode ray tube working.

(*To be continued*)

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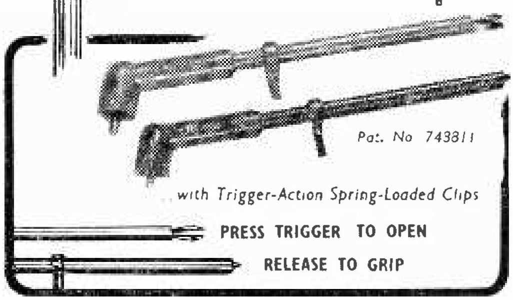

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Remote Volume Control

A SIMPLE CIRCUIT WHICH IS EASY TO WIRE

By W. J. Delaney

IN our May issue we described a remote switching device which has aroused considerable interest, and it appears that most viewers need to make adjustments from time to time during an evening's viewing without having to leave a comfortable chair. Normally it is possible to set brightness and contrast levels so that no adjustments are required during one period of viewing, but many object to the musical backgrounds to plays and travel pictures, etc., whilst many advertisements are much too loud and in many instances objectionable, if the general level of sound from the set is adjusted for the majority of the programmes. The following device enables one to adjust the volume without rising from one's chair, and although designed for use with my home-made receiver can be adapted to practically any set and normally should introduce no complications of any kind. It has the advantage that it can be plugged into the set when required, and upon removal the set is exactly as it was before, and can be used, if required, without the control.

The Circuit

The principle of the control is simply that another variable grid resistor is connected in parallel with the volume control in the set. In practically every set, the volume control is a variable grid resistor forming part of the coupling between the sound detector and the first audio stage (Fig. 1). If, now, a high value variable resistor is connected across this control it will have little effect at its maximum value, but as the resistance is reduced it will gradually put a short circuit across the volume control and have exactly the same effect as adjustment of the normal control. If the latter is set for maximum volume, and the extra resistance is set to minimum value, then the output from the receiver will be inaudible, or nearly so. Turning up the extra resistance without touching the volume control of the set will give exactly the same effect as the adjustment of the normal control, and there is one very valuable additional advantage which may be obtained with this idea. In Fig. 2 it will be noted that a condenser is shown in broken lines on the earthy side of the extra variable resistance, and this has two effects. Firstly, it will remove any risk of danger if the extra resistance is used with an A.C./D.C. receiver and is not enclosed in an insulated box, and secondly, it functions as a "loudness" control. As the value of the resistance is reduced, the higher notes will

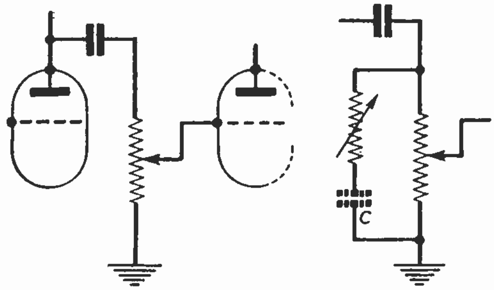


Fig. 1 (Left).—Conventional volume control circuit. Fig. 2.—Wiring of the extra control.

be bypassed, giving the effect of emphasis of the bass at low volume, thus counteracting the effects of normal hearing at low volume settings.

Construction

The construction of the device is simple. All that is required is a 1MΩ variable resistance at potentiometer, a plug and jack, and a few yards of normal 75ohm coaxial cable. The mounting arrangements can be left to the individual constructor. In my own case the control is mounted on a small piece of Paxolin to which is affixed a narrow strip of thin leather which hangs over the arm of an armchair. To avoid the coaxial cable being pulled away from the control, two holes ½in. apart are drilled in the Paxolin and the lead is threaded so that it grips tighter if pulled. The jack may be of any type, but a single contact only is required—for the tip of the plug. The body of the latter makes contact with the frame when the plug is inserted in the jack, and this is connected to the chassis of the receiver. To fit the device, access must be obtained to the volume control, and a short length of coaxial cable is used. The centre lead being connected to the "hot" end of the control (the end to which the coupling condenser is connected), and the screened braiding is joined to the nearest "earth" point. The jack is now mounted on the side of the cabinet, in a convenient position, on a small square of Paxolin which is itself attached to the wooden side of the cabinet by four small screws. This enables

(*Continued on page 260*)

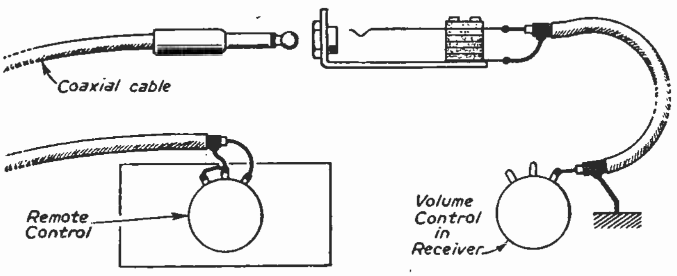
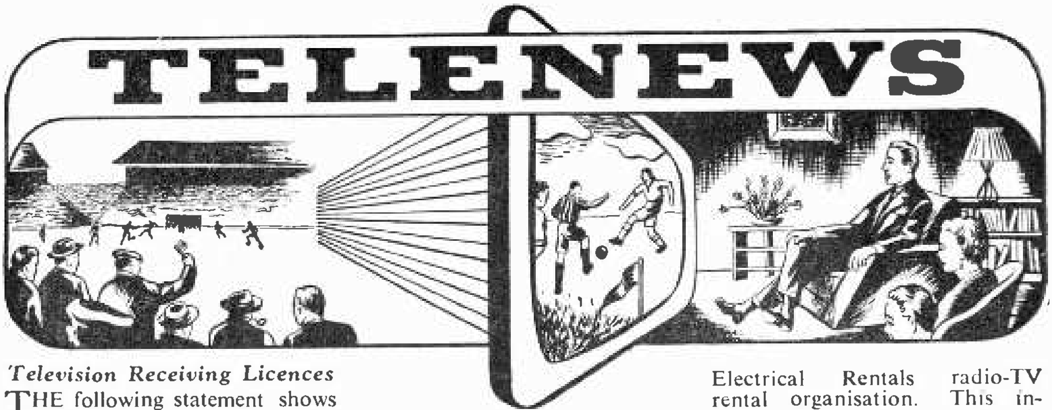


Fig. 3.—The complete wiring of the remote volume control.



Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of November, 1959, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London Postal	1,761,438
Home Counties	1,322,428
Midland...	1,533,149
North Eastern	1,629,282
North Western...	1,343,388
South Western...	343,473
Wales and Border Counties ...	596,149
Total England and Wales ...	9,015,307
Scotland	844,670
Northern Ireland	127,028
Grand Total	9,987,005

ITV in South-west England

THE INDEPENDENT TELEVISION AUTHORITY has decided to accept, subject to contract. the application of a group formed in South-west England under the chairmanship of Mr. Peter Cadbury to provide the programmes for transmission from its Devon and Cornwall stations. The group, which will be known as Westward Television, will have its headquarters and studios in Plymouth.

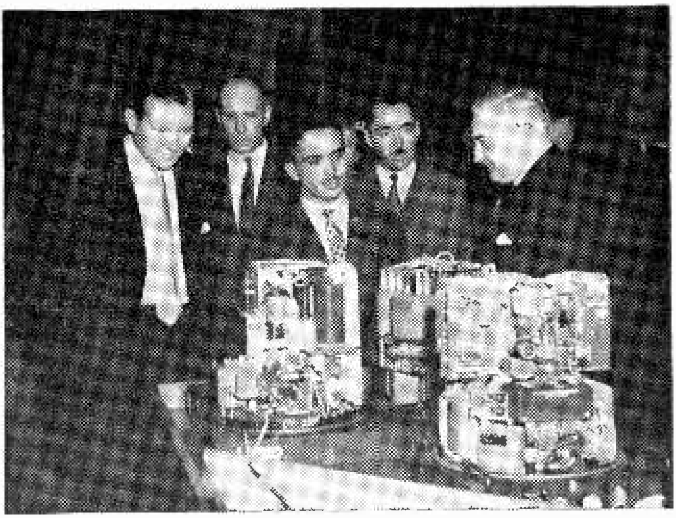
The authority plans to bring Independent Television to South-west England in the summer of 1961. Two stations are to be constructed, one at Axminster, in Devon, and the other near Liskeard, in Cornwall. Their service areas, taken together, will include over a million people. When the stations begin transmissions some 96 per cent. of the population of the United Kingdom will be within the combined service areas of the authority's thirteen transmitting stations.

Electronic Reading Machine

AN order has been received by Solartron Electronic Business Machines Limited, Farnborough, Hants, a subsidiary of the Solartron Electronic Group Ltd., Thames Ditton, Surrey for an electronic reading automaton from Domestic Electric Rentals Limited. This application of the machine introduces a new and streamlined method of rental and credit-sales accounting.

The Solartron ERA will read directly information recorded by National Cash Register machines at each branch of Domestic Electrical Rentals radio-TV rental organisation. This information, which will include the customer's account number and rental payment amount, will then be automatically punched at a far greater speed than is possible manually, on to 80-column ICT cards for subsequent use in a standard punched-card installation.

The Solartron ERA has been designed to recognise printed characters and to convert this information for use in punched-card or computer installations at a considerably lower cost than that of manual key punching. This reading and information conversion can take place at a speed of 200 to 300 characters



On December 14th, 1959, His Majesty King Hussein I of the Hashemite Kingdom of Jordan visited the Marconi Works at Chelmsford. In the picture he is seen (centre) examining units of an AD2000 Doppler Navigator. On the extreme right of the picture is Mr. F. N. Sutherland, C.B.E., the Managing Director of Marconi's and on the extreme left is Mr. R. Telford, the General Works Manager. Second from the left is Mr. H. J. H. Wassell, the Manager of Test Department.

per second with an accuracy far in excess of that achievable by human means, even after verification.

I.T.A.'s Dover Station

THE ITA regrets that it did not prove possible for the Dover Station to open as planned, but every effort has been made to overcome the technical problems associated with it. It was necessary to make special tests at the station in order to establish that the signal from the main directional aerial system would not cause an unacceptable degree of interference in the service areas of certain existing television stations on the continent. These tests began on Monday, 23rd November and did not follow the normal pattern of test transmissions as they were designed solely to enable field strength measurements to be made on the continent.

Appointment

THE BBC announces the appointment of Mr. G. Dukes as Engineer-in-Charge of the Les Platons television transmitting station Jersey, Channel Islands, in succession to the late Mr. J. J. Allen.

Mr. Dukes joined the BBC in 1944 and has served as a technical assistant and later as a maintenance engineer at a number of the corporation's transmitting stations in both the sound and television services.

He was appointed assistant engineer-in-charge of the Rowridge television and V.H.F. sound transmitting station in the early part of this year from which post he has taken up his new appointment.

Mullard Premium

IN order to encourage the presentation of original papers on various aspects of television, Mullard Limited are offering The Television Society a new yearly premium of £20.

This premium will be awarded by the Council of The Television Society to the author of the best paper submitted during the year and subsequently published in their journal.

Petrol-buying Survey

ANALYSIS of a petrol-buying survey carried out in all ITV areas shows that the proportion of ITV households buying petrol is higher than the comparable figure in respect of all homes in the survey area, TAM reports. The survey, carried out during June and July last year, showed that whereas 29 per cent. of the 14,848,000 homes in the area surveyed were petrol-buying households, 34 per cent. of the 7,494,000 ITV households were petrol-buying.

For purposes of the survey, every household using any motor-vehicle privately, from estate-car to scooter, was considered as petrol-buying. As earlier TAM analyses have shown, possession of a car was generally more likely to be found in ITV households. The latest figures reveal that 24 per cent. of all homes ran cars against 28 per cent. for ITV households. The difference was more evident in the London and Southern ITV areas, though not so marked in the Scottish, Northern and North Eastern ITV areas where possession of cars was less common.

Branches of the Westminster Bank in Manchester have been connected with each other by means of a closed-circuit TV system. Here the Lord Mayor of Manchester (Ald. H. Quinn), watches the start of the televising of accounts from Branch to Branch.

O.B. Units for Australia

THE first of two air-conditioned Outside Broadcast Units supplied by E.M.I. Electronics Ltd. to the Australian Broadcasting Commission left London docks recently for Adelaide.

The vehicle, which will use three of the latest E.M.I. Image Orthicon Cameras Type 203, will provide complete mobile studio facilities for the A.B.C.'s television outside broadcasts. These new cameras are designed to provide extremely stable signal output and thus ease the operator's task. They can be fitted with either 3in. or 4½in. Image Orthicon pick-up tubes, and in this instance use 4½in. tubes.

The lens turret has five positions—one of which can mount a diascope or an additional lens on a removable panel which allows the quick replacement of the pick-up tube.

Basically, the unit is divided into three areas—production area and control position, equipment compartment and driver's cab.

TRANSISTOR SOUND TUNE

RECEPTION OF BOTH BBC AND ITV CAN BE OBTAINED

By P. Gran

ALTHOUGH most readers are aware that transistors for operation on wavelengths employed for television transmission are expensive and often difficult to obtain, they may not realise that it is possible to build up a simple receiver for TV sound employing conventional transistors. A crystal diode is used as a detector and operates efficiently at the frequencies concerned.

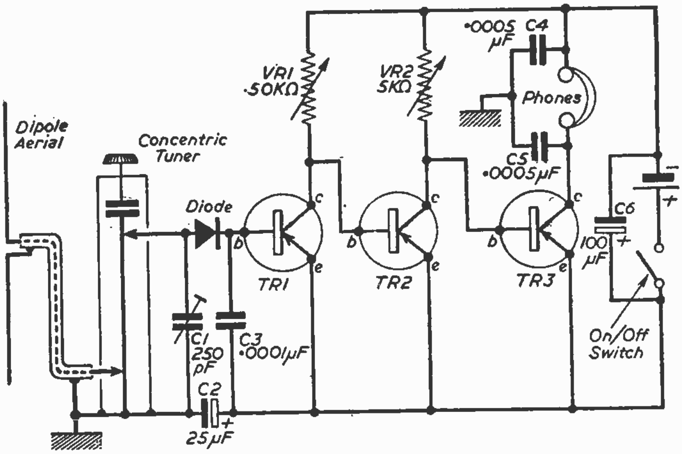


Fig. 1.—The circuit diagram. C1 is not in circuit for ITV.

Tuned Circuit

In order to secure adequate results with such a simple detector, the tuned circuit used in the receiver must be of very high efficiency. The one used in this receiver is a coaxial line made from a sheet of copper some 9in. × 5in. with a centre conductor of threaded brass rod. The copper sheet is bent into what might be termed four-fifths of a circle with a sheet of brass soldered to the earthy end and another at the "hot" end, bolted on with right angle brackets. The centre conductor was made from a threaded brass rod 3/32in. in diameter approximately. This rod was fixed with nuts to the centre of the shorted end of the coaxial line and the thread facilitated the mounting of the fixed disc of the tuning capacitor (which must, of course, be clear of the inside of the tube). The other disc of the capacitor was fixed to a short piece of the threaded rod passing through the bolted sheet of brass. To save the tapping of threads, nuts can be soldered on to the capacitor discs and to each side of the brass sheet for ease of mounting.

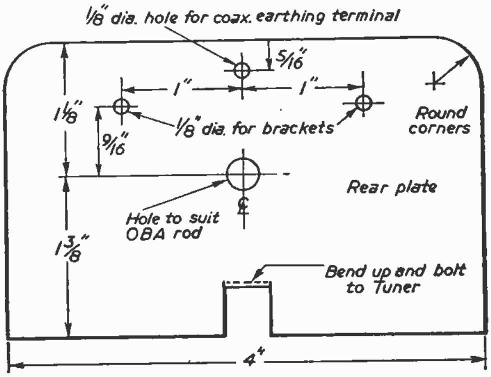


Fig. 2.—The rear plate.

The central conductor of the coaxial line may need some supporting and a small piece of plastic can be used for the purpose. It should be cemented in position as far towards the earthy, or shorted, end as possible in order to avoid reducing the efficiency of the tuned circuit.

The slot along the length of the tube is used to enable the aerial and diode tappings to be made easily. The best position for the connection to the diode seems to be close to the live capacitor disc and for the aerial nearer the earthy end.

A.F. Amplifier

The complete assembly stands on the end plates and the A.F. amplifier is arranged on a tray fixed to the top. This arrangement, although making the receiver bulky, keeps connections short and enables trial and error adjustments to be made with ease. Naturally much depends on local conditions of reception and some experiment will probably be needed before optimum results can be obtained.

Various types of audio amplifier were tried

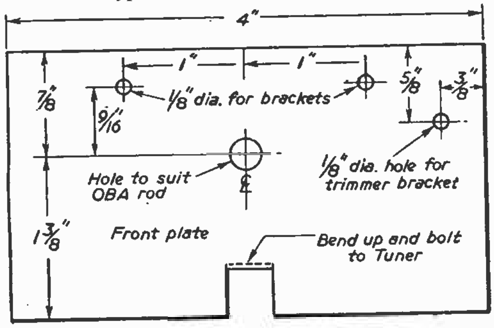


Fig. 3.—The front plate.

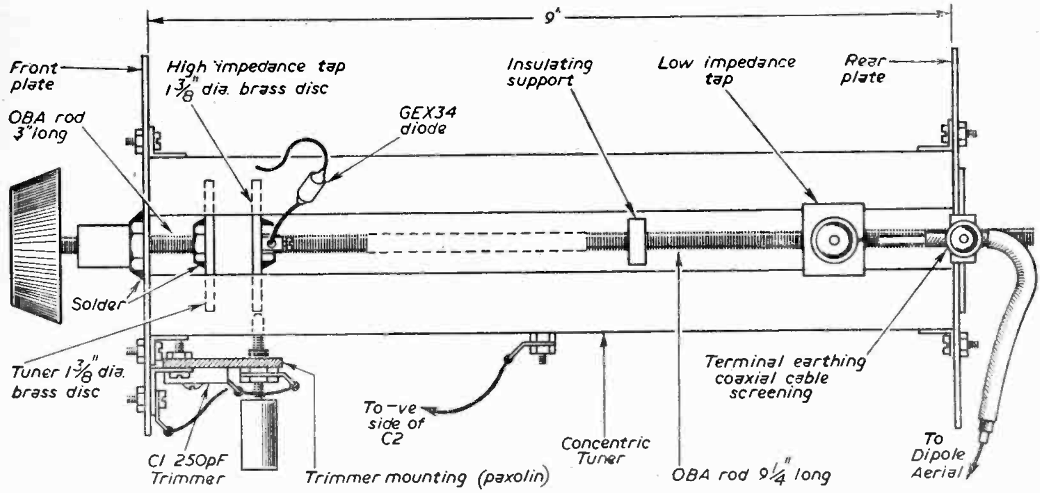


Fig. 4.—Sectional plan view of the tuner.

and the arrangement shown in the circuit diagram was finally evolved. With this circuit, by careful adjustment of the variable resistors, the signal to noise ratio is very much improved.

The crystal diode is connected at one end to the disc of the capacitor and the other straight to the base of the first transistor, a 25μF condenser being wired in the earth line. A 0.001μF condenser from the audio side of the diode to earth decouples any stray R.F. and similar capacitors can be wired at other points in the circuit where there is an undesirable R.F. signal.

Operation

Initially, when tuning the receiver, the variable resistors should be at the position of maximum resistance; VR1 is adjusted first, and then VR2. With the trimmer switch out of contact, ITV sound can be heard and with the trimmer switch in contact, BBC sound comes in over a wide band.

The construction of the receiver is relatively simple although it calls for a certain amount of skill when making the coaxial line. As previously stated, much depends on local conditions, but the illustrations show clearly the construction employed and worthwhile reception should be obtained from the outset.

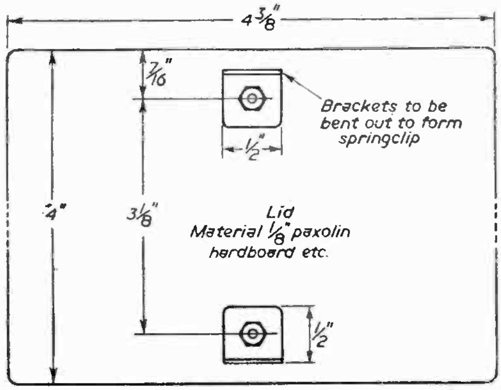
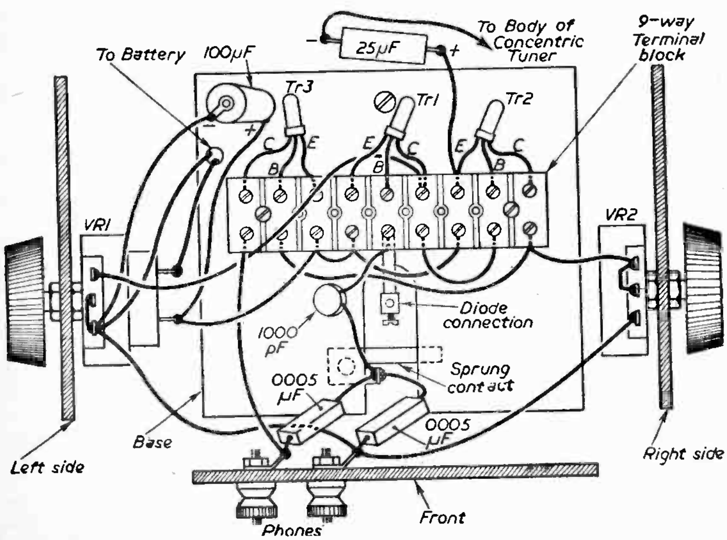


Fig. 6 (above).—Dimensions of the lid.
Fig. 5 (below, left).—Wiring above the wooden chassis.



Aerial

The aerial employed for this receiver will depend on the location on which it is to be used but in many instances the normal household aerial will be suitable. However, if it is desired to listen to programmes when this aerial is connected to the domestic television receiver then obviously a separate aerial will be required. In districts close to the transmitter an aerial can be made from, for example, a length of twin plastic extruded flex such as is available for mains use. This flex can be connected in place of the coaxial cable to the tapping on the tuned line. A simple dipole is made at the other end of the flex by splitting it down the centre until the two elements so formed are of the required length. Naturally the length of the elements required depends on the channels

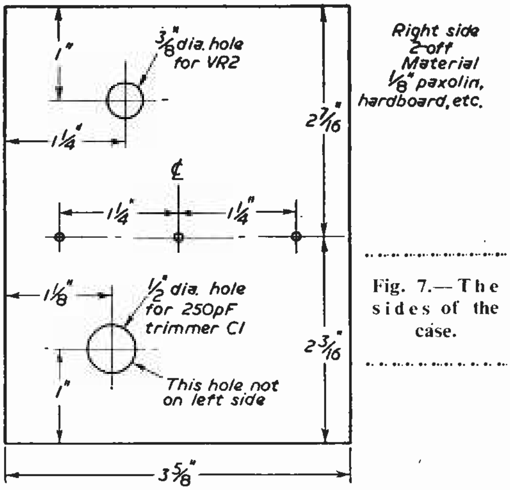


Fig. 7.—The sides of the case.

it is wished to receive. Dimensions for aerials were in any case given in a very illuminating article which appeared on page 182 of the January, 1960 issue. In that article comprehensive details were given of sound and vision frequencies for various channels together with the location of the stations and the polarisation of the transmissions. As reception of the sound only is required the lengths of the elements given in that article can be increased as they were calculated to give an acceptable compromise

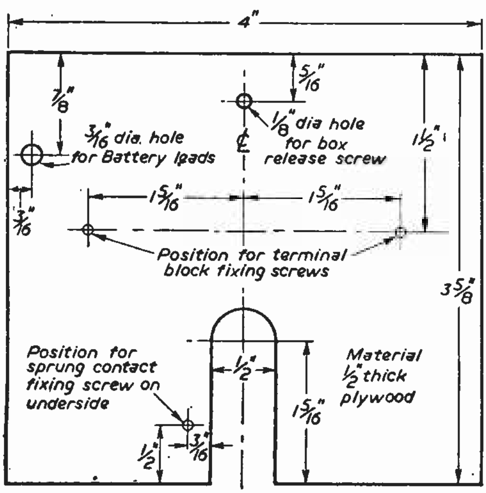


Fig. 8.—The wooden chassis.

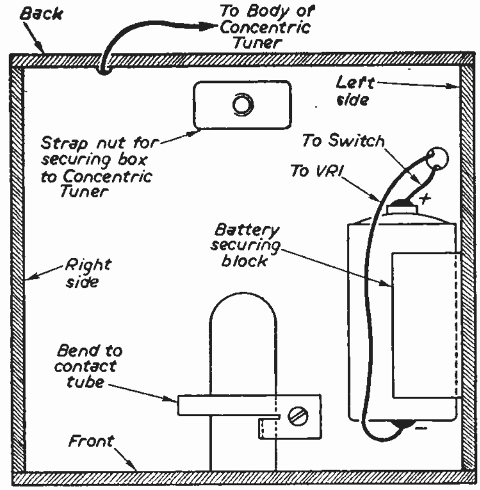


Fig. 9.—Under-chassis wiring.

between sound and vision frequencies. The increase should be of the order of, say, 2in. for channels in Band I and ½in. for channels in Band III.

Naturally when using different aerials it will be necessary in all probability to alter the position of the tapping point for the injection of the aerial signals into the tuned circuit. When the tapping point is moved towards the capacitor end of the tuned line however, selectivity will be poor, especially on Band I. At the other extreme, with the tapping towards the shorted end of the

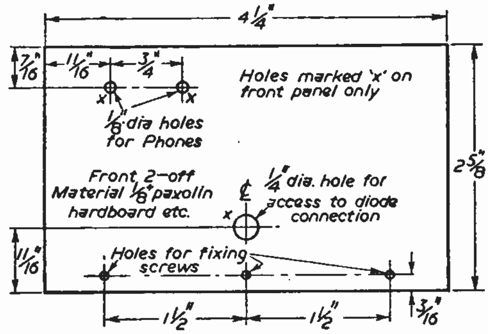


Fig. 10.—Dimensions of the front and rear panels.

line, signal strength will be reduced. The optimum position will be found to be within two or three inches of the shorted end.

Amplifiers

Although the audio amplifier described here has been found to give the best results with this particular type of circuit, it may be possible to employ a more conventional type of amplifier, but the signal to noise ratio may be insufficiently high and reduce the entertainment value of the programmes. If the receiver is made up as described it will be found to give good results in many locations, but the design gives plenty of scope for individual experiments.

Recent TV Developments

NEW CIRCUITS AND IDEAS

By G. J. King

THE most notable change in TV receivers during the past 12 months is the reduction in cabinet depth made possible by the advent of the 110deg. picture tube. Although it has been in service for some time in the United States, the 110deg. tube was only made available in Great Britain at the beginning of 1959, and at the end of the year, when this article was written, at least half the receivers in production made use of it.

New Cabinets and Chassis

As a corollary to the 110deg. tube, is the new-look chassis and layout, coupled with the change in general appearance of receivers. Printed circuit panels are now a common feature, and these are usually secured to a cradle frame which carries the tube, loudspeaker and other components, so that when the cabinet is lifted off, the complete assembly remains rigid and in an easily serviceable form. In some sets, the printed circuit panels are also hinged, thereby easing still further problems of servicing.

Cabinets are considerably slimmer: 17in. models have a reduction in cabinet depth of about 3in. over their 90deg. counterparts, while the depth of 21in. models has been cut by about 5in. The so-called transportable set is now made possible by these developments, and the majority of manufacturers already have a set of this type on the market.

Pictures have a better black-to-white contrast when viewed in daylight or even bright electric light. This is accomplished by "light filtering" implosion guards recently introduced by one of the leading manufacturers. The polarising element is sandwiched between a laminate of two sheets of clear toughened glass. The element polarises light passing through the implosion guard from outside the receiver, but any light reflected by the tube screen is returned to the element at such an angle to undergo appreciable attenuation and to an outside viewer the screen appears dark. Light produced by the tube itself, however, undergoes very little attenuation as it passes only once through the filter.

The Growth of Picture Tubes

Throughout the development of picture tubes the scanning angle has been progressively increased to allow for the larger screen sizes without increasing the overall length of tubes. The early 9 and 12in. tubes had a scanning angle of some 65deg. and an overall length approaching 16in. The introduction of the 14in. tubo brought the 70deg. angle without an increase in overall length. The 70deg., 17in. tube resulted in an increase in overall length to about 18in. but this remained almost the same with the 21in. tube and 90deg. scanning angle.

The 110deg., 17in. tube is only just over 12in. in overall length, while the 21in. tube of the same scanning angle is slightly shorter than the 17in., 90deg. tube—about 16in. The new 110deg. tubes are in two sizes only at present, 17in. and 21in., and they use a standard tetrode electrostatic-focus gun. There is one exception, however, and that is the Siemens Ediswan CME1705 tube. The neck is shorter than usual and a new design of electron gun assembly is mounted very close to the scanning coils. The overall length of this tube is just a little over 11in. One manufacturer, at least, has taken advantage of this and produced one of the slimmest receivers which is less than 12in. in depth.

Extra Scanning Power Required

The scanning power required is proportional to the square of the scanning angle, and an increase from 90deg. to 110deg. would normally

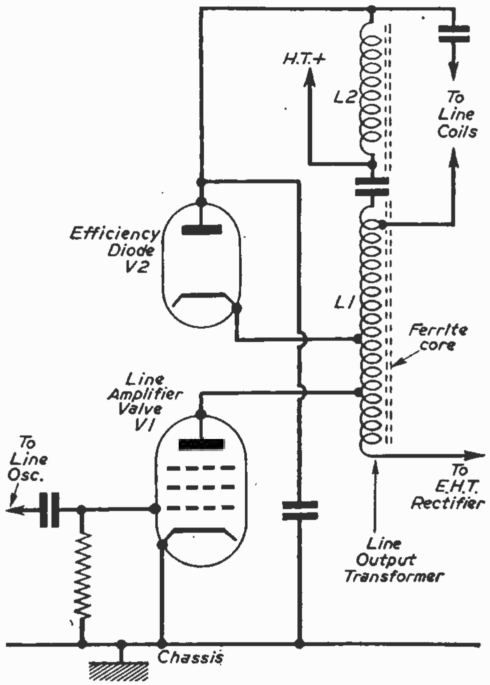


Fig. 1.—The flux produced by current in L1 is cancelled by the opposite flux produced by an opposite current in L2. This reduces the magnetic loading on the line output transformer and almost eliminates line whistle.

mean an increase of scanning power of approximately 50 per cent. In practice, however, part of the extra power requirement is offset by the narrower neck of the 110deg. tube, which is $1\frac{1}{8}$in. in diameter against the slightly larger $1\frac{1}{2}$in. diameter of the 90deg. tube. This makes possible a greater deflection sensitivity as the scanning coils can be placed nearer the electron beam.

Extra scanning power is required, nevertheless, and this is taken care of in several ways. Careful attention is given to the design of the line and frame output stages, including the transformers and scanning coils themselves. A slight increase in efficiency of the line output transformer is accomplished by an arrangement known as "D.C. cancellation." The D.C. supply to the anode of the line amplifier valve passes through the transformer primary winding in the usual manner, but there is in addition a further winding on the ferrite core through which the current

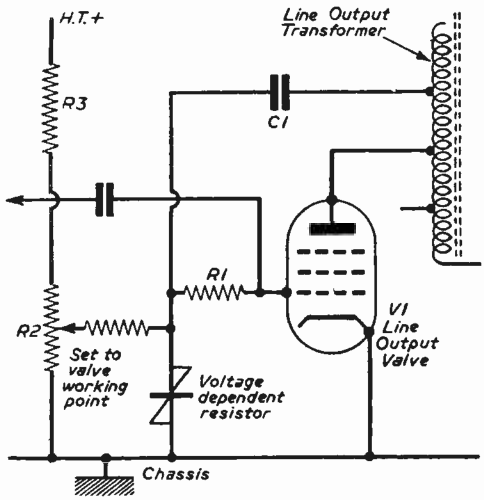


Fig. 2.—Automatic stabilisation of the line amplifier—a form of AGC.

is arranged to flow in the opposite direction. This is shown in Fig. 1. Here L1 is the normal primary section of the transformer and L2 the additional winding.

Less Resultant Flux

The action of current flowing in L1, via the efficiency diode V2, produces a magnetic flux in the ferrite core. However, this flux is cancelled by the opposite flux produced by L2. This keeps the transformer core away from magnetic saturation, reduces the magnetic loading, increases the transformer efficiency and—a most important point—largely eliminates the line timebase whistle which would otherwise be of disturbing strength in such a high power line amplifier stage.

The efficiency is further increased by the line output transformer being tuned on the third harmonic principle. In effect, it is the leakage inductance which is so tuned. It has been found that if the leakage inductance of the transformer is tuned to the third harmonic of the normal transformer resonance, during the period of the line flyback, the peak voltage on the efficiency diode and line amplifier valve is reduced and the peak voltage on the EHT rectifier valve is increased. This leads to a greater EHT voltage and allows the line amplifier valve and efficiency diode to operate under less stringent peak potential conditions. It also leads to improved efficiency by permitting higher turns ratios on the transformer. Indeed, even with 110deg. tubes, the majority of sets still use relatively small line outputs valves such as the PL81.

Frame Output Transformer

The greater power required for the frame scan is secured by the use of grain-orientated, low-loss steel for the core of the frame output transformer. The PL84 class of valve is used as frame amplifier. The deflector coils extend a good distance up the cone of the tube to allow the electron beam to be fully deflected over the large angle without being obstructed by the end of the tube neck. It will be recalled that corner cutting is a sure sign that the deflector coils are not pushed far enough along the tube neck. This trouble is aggravated considerably with the wide scanning angle.

One characteristic of a wide scanning angle is pin-cushion distortion, which takes the form of slight concavities at the sides of a picture. This is partly overcome by the use of specially designed scanning coils, with a cosine distribution of winding cross section. The remaining distortion is almost eliminated by small permanent magnets fixed close to the cone of the tube. These are carefully adjusted during manufacture and should not be altered in position without due reason.

Thermistors

Thermistors are now invariably used in series with the frame coils to correct the resistance changes of the windings caused by heating which would otherwise result in a steady reduction in picture height, a symptom frequently displayed on some older-type sets.

Automatic Stabilisation of Picture

One big problem in the past has been the maintenance of good EHT regulation and picture size. There has been that tendency for the picture to "breathe" (and in some cases to go out of focus) with changes in average picture brightness.

The circuit in Fig. 2 is used to provide automatic stabilisation on at least one make of receiver. Valve V1 is the line amplifier valve of which gain is controlled by the amplitude of the line flyback pulse. The pulse is picked up from a tap on the line output transformer and fed via C1 to a voltage dependent resistor. This resistor gives a rectifying action and an average value of the flyback pulse waveform is developed across it, and this value as applied to the grid of the valve, via R1, is slightly negative. The normal working condition of the line amplifier is set by the potentiometer arrangement R2 and R3.

Action

If the EHT circuit is suddenly loaded by a brightness increase, for instance, the flyback pulse amplitude will decrease, as also will the negative voltage at the valve grid. The gain of the valve will increase and the amplitude of the flyback pulse will be brought back to normal. Conversely, a reduction in EHT loading will increase the negative control voltage and reduce the valve gain. This is virtually an A.G.C. system in the line amplifier stage which controls not only EHT but also the line scanning current, since the flyback pulse depends on the current in the line scanning coils.

Letters to the Editor

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

SPECIAL NOTE : Will readers please note that we are unable to supply Service Sheets or Circuits of ex-Government apparatus, or of proprietary makes of commercial receivers. We regret that we are also unable to publish letters from readers seeking a source of supply of such apparatus.

VALVES

SIR,—Could any of your readers or the valve manufacturers explain why the present-day valves used in television receivers are so prone to early failure ?

This has puzzled me for some time. I am referring in particular to such types as PCF80, ECL80, PL81 and EY51 (or U25). In my experience in the older 12in. receivers, these valves lasted far longer than they do now. Perhaps other readers will confirm this. Could it be that they were designed for these smaller screen receivers and are unsuitable for the 17in. sets ? Or could it be that the quality is poorer ? The present-day valves are not to be compared with the old British 7 pin valves of 20 years ago, many of which, to my knowledge, are still giving good service, whereas you can fit a PL81 or EY51 valve in a television set and it often fails in less than six months !

One further point I am curious about. Why must some television manufacturers persist in using the EY51 (or U25) which has to be soldered in, in preference to the EY86 plug-in type, even in the latest models ?—R. WHILLANCE (Durham City).

REPLACING C.R. TUBES

SIR,—"Replacing C.R. Tubes" No. 6, in the July, 1959, issue, covering the Murphy 240, did not give full details of how to focus.

The box which covers the base of the tube is also the focus vernier control and can be turned clockwise or anticlockwise. This caused me a lot of trouble before I discovered this simple but elusive device. This fact may be of help to other readers.—B. JONES (Abertillery, Mon.).

TUBE CONVERSION

SIR,—I was rather intrigued by your advice to D. Jones in "Your Problems Solved" in which you invite him to convert his tetrode tube into a triode. This, of course, is a cure, but the picture can never be as good as it was originally and it is a far better plan to make some attempt to clear the inter-electrode short circuit. As the symptoms described by D. Jones would indicate that the short circuit was of an intermittent nature, probably caused by a flake bridging the electrodes in question, he would probably stand a very good chance of clearing the fault by the method which is now used throughout the trade, using no tools or equipment other than two well-insulated leads terminated in crocodile clips.

The idea is to flash the flake off the suspect electrode and the method is as follows: the tube holder is first removed and the heater leads to the holder short circuited in order that the set may operate with no supplies to the tube itself. The EHT anode cap is next removed from the tube and a lead connected to this with a crocodile clip, the other end of the lead being connected to the grid pin of the tube. The cathode pin is now connected to chassis with the other lead. The set is now switched on and as the EHT rectifier valve begins to conduct, an arc appears between the grid and cathode electrodes of the tube.

Other inter-electrode shorts can be cured in the same manner and I was once successful in clearing an open circuit heater. I should like to stress that, from some twenty tubes which have been "given the treatment" only one was a failure.—J. C. ASHLEY (Ash Vale, Surrey).

TV/RADIO CHANGEOVER DEVICE

SIR,—Mr. Wilmott's TV/radio changeover device (December issue) is very good but surely quite unnecessarily complicated. I have a V.H.F. tuner standing on my console TV set, with a two-valve amplifier in the cabinet itself. Power to both tuner and amplifier is fed by a d/p switch on the tuner itself, a natural and simple arrangement. A changeover relay in the amplifier connects the TV speaker speech coil to whichever of the two output transformers is in use. When the relay is unenergised the TV sound stage remains connected; when energised then the V.H.F. sound stage takes over. And that's all there is to it ! Admitted, one doesn't save an output transformer but the scheme is simplicity itself. Moreover, both output valves are properly loaded at all times; beginners should be warned against the slightest departure from Mr. Wilmott's scheme of switching.—N. V. DINSDALE (Crayke, York).

TIMEBASE FAILURE

SIR,—In the November issue (Your problems solved) R. J. Spencer of Belfast stated that all he had on his screen was a vertical white line. The model is a Sobell T121 and you suggested that either the PL81 or C43 capacitor were at fault. As the EHT is derived from line flyback, failure of the PL81 would result in no EHT. If C43 was faulty, that again would only affect EHT. Having a white line on the screen is an indication that EHT is present, so both these components can be ruled out. Thus, the line scan coil is probably at fault.—K. H. STONE (Leicester).

Inexpensive Components

PARTS FROM OLD RECEIVERS CAN BE USED AGAIN

By J. B. Willmott

THERE are considerable numbers of older type TV receivers on the market today at low prices. Advertisers in this magazine frequently offer sets (not working) at from as little as £2 upwards. In the main, these are the older type of 9in. or 12in. tube receiver, of which adaptation to Band I/Band III operation is difficult or uneconomic, and the owners of which have invested in a modern large screen receiver. Many of these sets are accepted by retailers in part exchange for a new model, and doubtless considerable quantities of these obsolete sets accumulate on their premises, of which they are only too glad to dispose. Also, in many large towns, regular auction sales of old receivers are held, at which it is often possible to secure sets at extremely low prices, the writer having frequently paid as little as 25s. to 30s.

Spares

The first and most obvious use for these receivers is as a possible source of "spares" for one's own domestic receiver, particularly if one is able to obtain a model of the same make and type; and indeed a number of manufacturers use near identical chassis over a lengthy period; here the owners of those invaluable volumes, Newnes' "Radio and Television Servicing" are in an advantageous position; they can quickly ascertain from the circuit diagrams and component value lists which models are likely to contain items of use as replacements in their own receiver, before making a purchase.

However, this article is mainly concerned with the uses to which the various components can be put by the average radio constructional enthusiast, and there is little doubt that these obsolete TV sets have considerable breakdown value as a source of components for construction of radio receivers, audio amplifiers, testgear, etc., and it is from this angle that the following notes should prove useful.

Purchase

At the start, resist the thought that there is probably "very little wrong with the set" (if purchased from a dealer, there is every possibility that there will have been a remark passed to this effect as part of the sales talk!). Attempts to repair it may well prove both costly and disappointing. True you *may* be able to make it work for a small outlay, but the only result will be to have your house cluttered up with a collection of, more or less, working TV receivers, for which you have no real use. Attempts to dispose of these to hard-up friends or relatives are usually futile, for whilst loath to purchase a set from you, they will be only too glad to accept one as a gift, or a free "loan" whilst their own is undergoing repair. So be warned, one must be hard hearted to proceed on these lines.

Possibly some 90 per cent. of the receivers on offer have been given up by their owners as the life of the C.R.T. has ended; and as this component is obviously of no use to the radio constructor, its disposal is the first consideration. If there is a firm in your neighbourhood which specialises in the sale of reconditioned tubes, you may find them prepared to offer a nominal sum of 5s. to 10s. for your surplus tubes, which is better than nothing. Failing this, the safest course is to destroy it. Do not leave tubes lying around the house or workshop, as they constitute a very real danger from accidental implosion.

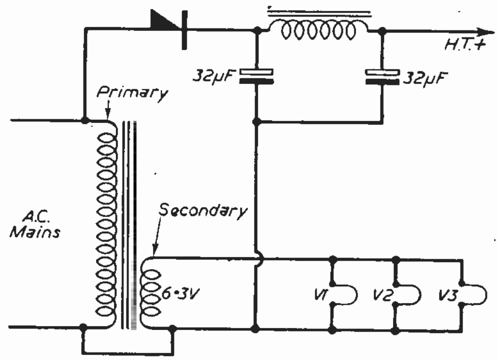


Fig. 1.—Using a frame output transformer as a heater transformer in a power supply circuit suitable for a small receiver or amplifier.

Disposing of the C.R.T.

The first action after unboxing the set from its cabinet then, should be the removal of the C.R.T. this should be carried out with great care. If possible, wear goggles whilst performing this task. It is usually simple to unfasten the straps holding the tube in position, but difficulty is often experienced in removing the scanning coils which are found stuck fast to the neck of the tube. On no account use force here, as the junction between the neck of the tube and the flare is the weakest point. A good tip is to place the offending chassis close to a source of warmth, such as an electric fire, for half an hour or so, after which it should be possible to withdraw the tube from the offending scanning coils. If you intend to take the tube to a dealer, carefully pack it into a stout carton; or, if it is to be destroyed, carry it out into the garden. Dig a hole deep enough to bury it well, and cover well with soil. It is then safe to plunge a crowbar or pickaxe through the soil to smash the tube, and the layer of soil will give adequate protection from the danger of flying particles of glass.

Having disposed of the tube, the next action is carefully to examine the chassis, and assess which components are likely to be of use. Doubtless it

(*Continued on page* 259)

will be necessary to remove a layer of dust and dirt and a soft brush can be used for this. Probably the first consideration will be that of valves. Most TV receivers will contain valves of the following types:—

R.F. pentodes (e.g., EF80, Z77, 6AM6, EF50, 6F1, etc.).

Output pentodes (e.g., 6V6, EL33, PL33, etc.).

Triode/pentodes (e.g., ECL80).

Double diodes (e.g., EB91, 6AL5, etc.).

All the above can, of course, be used for their normal functions in radio circuits, but it must be borne in mind that many TV receivers are of the A.C./D.C. design, and some valves will have "odd" heater voltages. They can, of course, be used in a radio receiver using series heater chain technique, provided the correct current flows. Consultation of any good valve manual will provide the necessary data.

Special Valves

Other valve types which will be encountered are of a specialised nature such as line output pentodes (e.g., PL38, EL38, PL81, etc.). These can be used as audio output valves in amplifiers, being capable of handling greater power than many conventional A.F. output valves, but a point to watch is that their combined anode and screen current is considerably greater, which will influence power supply requirements, and it will be necessary to ensure that the primary winding of the output transformer is capable of carrying the standing anode current.

Valve rectifiers removed from TV receivers are usually quite suitable for radio circuits, though here again "odd" heater voltages will usually require series heater chain methods; half wave rectification is thus necessary. Metal rectifiers are frequently found in TV receivers, and if in good condition, can be utilised; but it should be borne in mind that this component is usually worked under arduous conditions, and as a result, after a lengthy period of use, efficiency falls off and the voltage output drops considerably when "on load." A good metal rectifier should be capable of supplying, when on load, a D.C. output voltage slightly in excess of the A.C. input (r.m.s.) voltage, and this fact can easily be checked with a multimeter. It is fair to assume that if the D.C. output voltage is lower than the A.C. input, the rectifier is useless.

Other Valves

In some TV receivers, other valve types such as double triodes (e.g., 6SN7, 12AU7, etc.) will be encountered, and these again are perfectly suitable for radio circuit applications. There does not seem, however, to be any immediately obvious use for such specialised valves as efficiency diode, EHT rectifiers, etc.

Leaving the subject of valves, let us now turn to see what other components are of immediate use. The most obvious is perhaps the loudspeaker; except in a very few of the old pattern receivers, these will be of the standard low impedance, permanent magnet type, and therefore perfectly suitable. Where mains energised types are encountered, these are seldom suitable as the field coil requires some 150 to 200mA for energising, which will be well in excess of the H.T. current used in radio or amplifier circuits. The tendency in recent years has been to fit small speakers of the 5in. round or 7in. × 4in. elliptical type, but many of the older sets contain good quality 8in. or 10in. diameter speakers. Naturally there will be an output transformer present, either mounted on the speaker itself, or on the main chassis, which can, of course, be re-used for its normal function.

Power Circuits

The power supply circuits of some of the older receivers comprises a sturdy mains transformer, supplying heater power at 6.3V to the principal valves, frequently rated at 4 to 5A, with additional winding at 2, 4 or 6.3V to feed the C.R.T. heater, and possibly a further isolated winding for the H.T. rectifier heater. Usually half wave rectification by direct application of the mains to the anodes of the rectifier valve (or metal rectifier) is standard practice, but in a few of the more expensive models, a centre-tapped high voltage, usually about 350-0-350, is also present, and this will be rated at about 200mA. It will thus be seen that these mains transformers will be more than adequate for powering radio receivers, etc.

Whilst on the subject of transformers, it is as well to examine the uses to which the other types

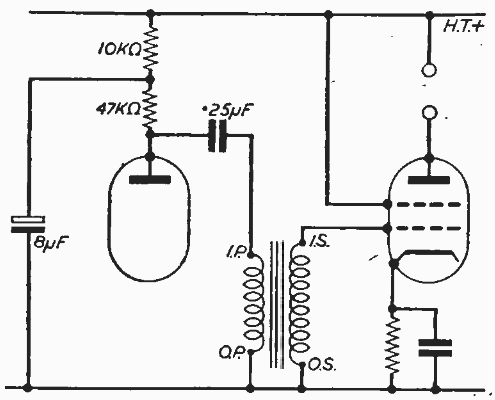


Fig. 2.—Using a blocking oscillator transformer as an intervalve coupling transformer between the A.F. amplifier and output stages of a receiver.

of transformers found on TV chassis can be put. Frame output transformers are similar in design to standard A.F. output transformers, and indeed may often be used as such where critical matching between output valve and speaker voice coil is not considered essential. An even more useful application in the author's viewpoint, is as a heater transformer. It will be found that if the original primary winding is fed from 220-240V A.C. mains, the secondary winding will give an output of about 4 to 7V A.C., depending, of course, on the turns ratio existing in the component, and this can be used as a source of heater supply for valves in small radio receivers (Fig. 1).

Oscillator Transformers

The blocking oscillator transformers, found in line and frame timebase circuits, can frequently be employed as inter-valve coupling transformers. They have a turns ratio of about 3 : 1. which gives a useful "gain" in simple circuits. In order to avoid saturation of the small mu-metal core. these transformers should be used only in parallel feed circuits (see Fig. 2). The primary and secondary windings can be identified by taking resistance readings with a meter. and as both are usually of similar gauge wire. the ratio of resistance between windings can be taken as a fair approximation of the turns ratio.

In TV receivers of the A.C./D.C. pattern, the valve heater chain is usually fed through a ballast

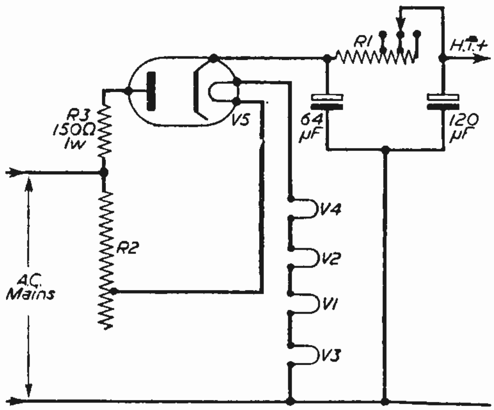


Fig. 3.—Using the ballast resistor (R1) rectifier valve (V5) and main electrolytic condensers and the power supply circuits of a five-valve superhet radio. Note the inclusion of the adjustable mains dropper resistor R2 and surge limiter R3.

resistor of the wire-wound type. provided with a number of tappings to facilitate adjustment for differing mains supply voltages. A use to which this component can be put is in place of a smoothing choke in the smaller type of receiver or audio amplifier, using the whole or part of the total resistance in order to give the desired output voltage and degree of smoothing (Fig. 3).

Choke

The smoothing choke found in TV receivers is usually a fairly bulky component capable of carrying some 200mA. When used in radio circuits. where the H.T. current is more likely to lie in the 50 to 100mA range. it will perform very efficiently. and provided its bulk is of no consequence. all will be well. The high value electrolytic smoothing capacitors usually associated with TV receivers may equally well be employed in radio circuitry where half-wave rectification is adopted. it is. however. important to include a series limiting resistor. see Fig. 3. to protect the rectifier during the initial surge when the reservoir capacitor is charging up. It is, of course. vital to test these electrolytics for possible short circuits or high leakage. before including them in any constructional project.

The uses to which the various small components on the TV chassis are self-explanatory. resistors and capacitors of all types being. of course. identical with those used in ordinary radio practice. It is of prime importance to test all capacitors stripped from old chassis, and a number of designs of suitable test units have appeared in *Practical Wireless* from time to time. It is strongly urged that one of these be built up, it will prove its worth many times over, as nothing is more annoying than to build a circuit and find it failing to work owing to the incorporation of a faulty component. quite apart from the irreparable damage that can be done to valves etc.. as a result.

Removal

When removing small resistors and capacitors from a chassis. it will be found preferable to snip off the connecting wires (leaving as long a lead to the component as possible) rather than attempt to unsolder it. as this latter process may need a lengthy application of the hot iron. with consequent risk of damage to components. It is a simple matter to solder a fresh length of tinned copper wire to the "stumps" left when the component has been snipped out as described above.

Practically the only remaining components, apart from the metal chassis itself. are the various potentiometers. which if in good condition may be utilised as variable tone and volume controls in radio circuits: and. the R.F. coils. I.F. transformers. etc. These have no direct application, though the coil formers. cores and screening can. can sometimes be used in winding short wave coils. and in particular. coils for use in Band II F.M. receivers.

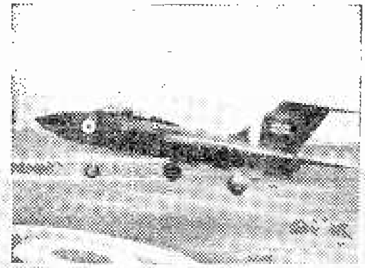
It will thus been seen that a considerable number of very useful components may result from the stripping down of a discarded TV chassis. and. even the resulting pile of nuts. bolts, P.K. screws. etc., is not to be despised !

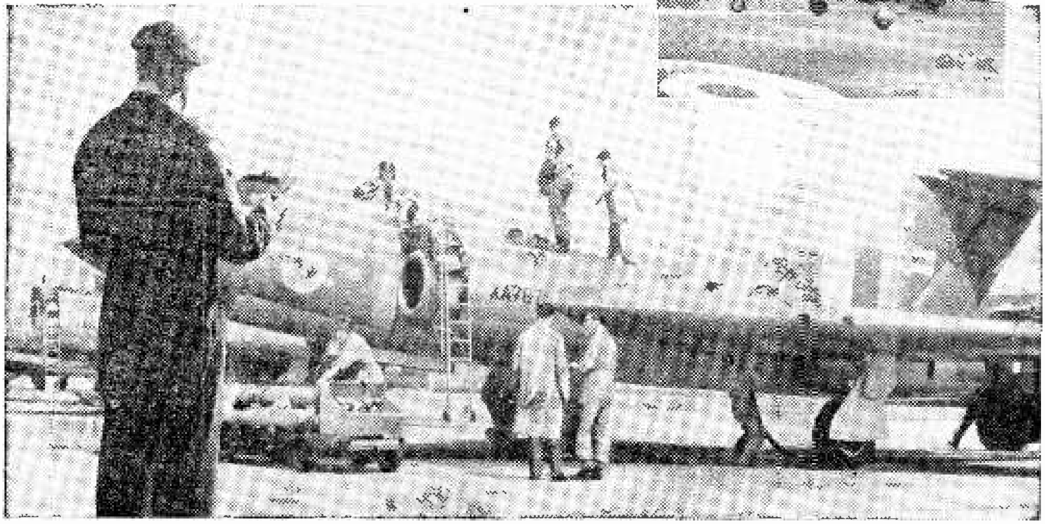
REMOTE VOLUME CONTROL

(*Continued from page* 245)

it to be easily removed if required. and the connections to it may more easily be made. The "remote" control has one end of the inner wire joined to one of the terminals, whilst the other two terminals are joined together and to the outer braiding. The other end of the cable is connected to the two contacts on the plug with the inner wire making contact with the tip of the jack.

If it is decided to include the condenser. this may be of any value from 0.001μF up to 0.25μF; the higher the value. the greater the bass boost effect at low volumes. At the remote end. a small plastic box may be used to enclose the resistance, to avoid risks of shock with A.C./D.C. apparatus, and the condenser. if it is used. should be inside the receiver. In use. the remote control is turned to minimum or "off ". the plug is inserted in the jack and the set turned on, with the volume control turned right up to maximum. The cable is rolled out to the required distant point. and then the sound may be turned up and down by the remote control. the minimum setting giving practically inaudibility. At the end of the viewing period. the set is turned off. the jack pulled out. and the control wrapped up for use again when needed.





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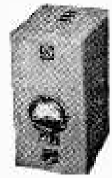

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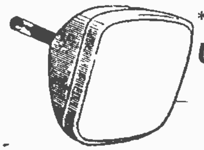

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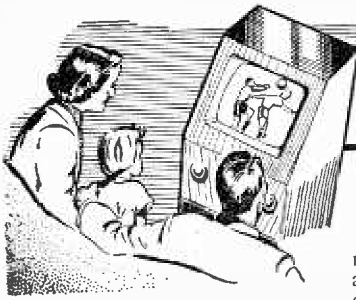

UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

By Iconos

IN these days of prosperity for the ITV programme companies, the trend seems to be for the four major organisations to expand internationally as well as nationally, and for the smaller companies to expand regionally outside the walls of their studios into the open air. The major organisations are coping with elaborate productions for the internal network, with increasing attention to recorded versions for export to other countries. The smaller contractors are expanding their outside broadcast activities, acquiring more equipment, microwave links, film units and the complex organisations to run them. There is no doubt that the regional flavours injected into their programmes are immensely popular and are inducing the BBC to follow their example in many regions.

BBC Regional Expansion

ALREADY the new Ulster TV studio at Belfast has won over the majority of viewers, who approve of the station's nightly "Roundabout" magazine as an addition to the network programmes. The BBC at Belfast are expanding the scope of their local studio programmes, notably "Studio Eight." In the Bristol area, a large expansion of studio facilities will shortly take place, including larger stages suitable for handling more elaborate regional plays. Plymouth and Southampton BBC TV Studios will increase facilities, especially for local news and film units, and the BBC's future plans may even include a small studio in Truro, Cornwall. These moves will be quite a challenge for TWW, whose new Bristol studio is getting into its stride for Southern Television, notable for its fine outside broadcast coverage and for the new ITA contractor for Devon and Cornwall. Larger local studio stages and more O.B. trucks are not the only means of putting over regional programmes. Greatly improved results have been achieved with 16mm film, which is possibly the least expensive method of coping with local events. Rank Precisions' unique combination of the 16mm German Arriflex camera with the Rank magnetic recorder attachment is proving highly popular with several organisations. This is the only 16mm camera which boasts a register pin movement, similar to the elaborate 35 mm studio cameras, which ensures the maximum steadiness of picture. The sound is recorded upon a magnetic stripe alongside the picture.

By means of a mirror shutter, the camera operator can see the image that is actually going on to the film, rather than depending upon a viewfinder. This refinement is especially useful when a zoom lens is operated for sporting events. Other lighter 16mm cameras are also used, such as the American Auricon, which records sound optically or can be modified for magnetic sound, the Swiss Bolex camera and the Bell and Howell. To be fully equipped for all occasions, whether it is a big open air event or an interview in a quiet room, the regional film units have to be prepared with a variety of camera equipment and accessories. Most regional centres now possess their own processing plant for developing the negative, which is edited in its negative state and put straight on to the telecine apparatus without a print being required.

The Palladium Show

IT is many months since "Sunday Night at the Palladium" has been mentioned in these columns. I have always regarded this programme as

Granada TV had an enthusiastic response from exhibitors from the recent Building Exhibition, held at Olympia, London. The Granada stand at the exhibition was an exact replica of a TV studio. Exhibitors were able to try out their own advertising "spots" featuring their products in programmes transmitted on closed-circuit to TV sets around the exhibition hall.

being first-class light entertainment, but it seemed to be settling down into a routine presentation, excellent of its kind, in which an overlong interlude was devoted to the "Beat the Clock" competition—an item which I personally found repetitive and boring. (My opinion is probably one of a small minority!) However, when Norman Wisdom occupied the stage for the major part of the programme, it took on a new look. For sheer personality, and making the most of good, but not outstanding material, Norman Wisdom must surely surpass any other comedian in British films, stage or television. In the recent Sunday Night at the Palladium he held the stage for almost the whole of the running time of the programme, excepting during the inevitable competition interlude. He coped easily with dancing, clowning, sketches, tumbling, and (aided by Bruce Forsyth) cross-talk and simultaneous dancing. He gagged with the conductor, played various musical instruments and sang most pleasantly.

It was an amazing display of comedy virtuosity, thoroughly enjoyed by the live audience of several hundred in the Palladium and, I am sure, by millions of viewers in their homes. Bruce Forsyth acted as a stooge for part of the time and he "fed" lines to Norman and danced with him in fine style. The whole show was a big success, camerawork and lighting being first class—not an easy matter as compared with working with the full facilities of a television studio. A pleasant little interpolation came at the end when Norman Wisdom presented Bruce Forsyth with a present—a cigarette case. This was well deserved, for Bruce Forsyth performed the not-too-easy rôle of foil with engaging ease and charm.

Flying Spot Progress

THE fantastically speedy acquisition and installations of Ampex video tape machines by the ITV companies and the BBC have tended to take attention away from improvements that have recently been made on telecine equipments for transmitting 35mm and 16mm film. Progress has been made with both flying spot and vidicon apparatus, and both types are now being used for various purposes in industry and instruction, as well as in the television entertainment field. The Central Office of Information recently acquired one of the latest E.M.I. flying spot telecine machines for closed-circuit operation at its headquarters. This organisation is responsible for an enormous amount of films of all types, for cinema and television use, for the propagation of the British point of view abroad, for internal instruction, etc. (e.g., Post Early for Christmas; The British House of Commons, etc.); and for training purposes for the defence forces. Thoroughly go-ahead, it has now in operation one of the most comprehensive closed-circuit telecine installations in England, outside of a television programme company. It can cope with 35mm film with normal Cinemascope-shaped pictures; with optical or magnetic sound tracks, including stereophonic tracks; with 16mm film picture: with optical or magnetic sound; and with $3\frac{1}{4}$in. × $3\frac{1}{4}$in. or 2in. × 2in. slides. Additionally, various separate sound tracks can be interlocked with the 16mm or 35mm film. Thus, at almost in any stage of production, a film intended for world-wide television distribution can be viewed with sound under proper conditions.

Telecine Problems

BOTH the BBC and I.T.A. programme companies have taken it upon themselves to help the cinemas and film companies by transmitting short excerpts from films on current release. They are supplied in various forms—with normal, wide-screen or Cinemascope shaped pictures and with different types of sound track, optical or magnetic single track or stereophonic magnetic multi-track. The wide Cinemascope 2.35 : 1 aspect ratio picture is handled either by transmitting the full width picture, which gives black margins above and below the picture on TV sets, or by selecting a section of the picture and panning this section to left or right, according to where the main action is taking place. The latter method only covers about 60 per cent. of the picture, but it does give a close view of the main action. Of these two systems, my preference is for the second method. Shortly, the backroom boys of telecine will be facing the problems of how to transmit 70mm film, used by Todd-AO, M.G.M. and others for films such as "South Pacific," "Solomon and Sheba" and "Ben-Hur." These films are photographed on film 65mm wide and printed on 70mm film, which also carries multiple stereophonic sound tracks. To complicate matters, some systems "squeeze" the picture with an anamorphic lens on the camera having a compression ratio of 1.5:1, and use a similar lens attachment on the projector for expanding it again. With M.G.M's system, used on "Ben-Hur," the picture ratio is 3:1 which gives an enormous width almost enveloping the audience. Just how to cope with these new shapes and sizes of film on their telecine equipment is puzzling many of the television engineers.

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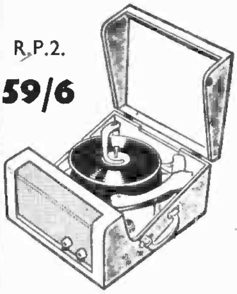

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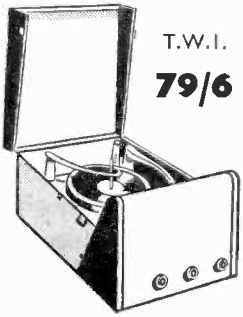

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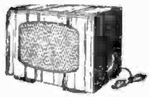

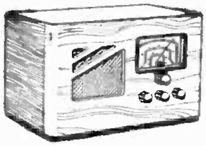

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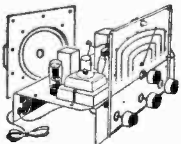

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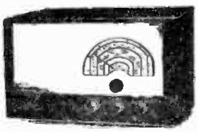

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KOLSTER BRANDES FV30L

There is no front lock on the above set, frame-hold control will make picture roll up or down. It can be almost made to lock by the focus control. I have replaced most resistors and condensers, valves, etc., with no improvement. The line will lock but it now seems to be getting touchy, but it still locks. I have the circuit.—A. Carter (Southall, Middx).

You do not say which components have been replaced. You should check the 1M resistor to pin 7 of the sync separator and the resistors for H.T. to pin 5 of the 6SN7. These are 330k and 150k. Check also the 270k grid circuit bias resistor from the junction of the above. We presume you have checked the 0.05μF, 0.001μF and 0.05μF capacitors, also the 220pF (pin 5 to pin 1).

MURPHY U240C

I have been having trouble with the above set for the past 18 months. Ten minutes after switching it on, the picture cuts out and I have to turn the contrast full on to bring it back and then it is very poor. I have just fitted a new tube and have changed valves 5X6, 30L1, 30C1 three times, but I still have the same trouble. Can you please advise me as to the cause of the trouble?—W. Pearson (West Hartlepool).

Your symptoms are those of a defective aerial system or lack of decoupling in the turret tuner of the I.F. strip. The decoupling condensers in the latter are easy to check by bridging each in turn with a good one. Try also changing the vision 10F1s with those in the sound I.F. stages and observe if the fault changes over with them.

MARCONI VT59DA

The set has sound but no raster. A line whistle is present. We replaced the PL81 and still no EHT. A 2.5V was connected across the heater winding of the EY51 and there is only sufficient voltage to cause it to glow. H.T. reading at other points in the set are approximately correct. This seems to suggest leaking condenser. Could you please suggest the most likely condenser or resistor to cause this trouble?—H. Mereer (Hove, Sussex).

Check the LN152 (ECL80) line oscillator. If in order, check the 2.7k resistor to pin 8 of the PL81, the 25μF from pin 3 to chassis and the 2μF from pin 3 of the U152 (PY80) to H.T. It would appear that the EHT smoothing capacitor (0.001μF) has already been checked by the EY51.

EKCO T164

My trouble is that the sound is very quiet. When I turn the volume up, the picture turns negative and disappears leaving the scan lines showing. I am boosting the tube and the picture is good. When I fitted the C.R.T. transformer three months ago both picture and sound were good. I changed valve number 6F15 which made no difference. My set is an old model for which I have no data sheet. I should be pleased if you can advise me.—L. Jones (Abertillery, Mon).

Your letter states that as the volume (not contrast) is advanced, the picture turns negative and then fails. If what you state is correct then you should check the 150k resistor which connects frame H.T. to the volume control. The volume control is a 25k. If the volume remains low and it is the contrast which has the above effect, check the 4.7M resistor (yellow/violet/green) which connects to the 20D1, the 10k which feeds the 6F15 and the 4.7k which feeds the 10F1. Also check the 2pF sound pick-off capacitor wired from the anode of V2.

BUSH TV53

While viewing the picture collapsed to a thin vertical line, then after a few moments the thin line disappeared leaving a blank screen. I discovered that the EY51 heater had burned out so I changed the valve and got the frame line back, and a heavy hum on sound and the frame line was distorted. I also found the EY51 heater was glowing brilliantly. I have had the scan coils checked for leak on a 500V megger. Ohms check on frame and line coils reads correct with service sheet and line output transformer checked on a meter made for the job. I cannot leave it switched on long for fear of burning out EY51.—T. Bassinden (Rotherham, Yorks).

The line scanning coils circuit is completed through the 1μF capacitor and 12ohm resistor and if the linearity coils reads correctly, the circuit must be broken at one of the above two components.

H.M.V. 1824

I have recently bought a second-hand TV set, but all I can obtain is sound and brightness, no picture. The tube has been tested and it is O.K. All the Z152s and the LN152 are in order. The only valve I have not been able to change is V13 U153, but there is H.T. at the anode of the tube. I have changed C60, C61, R65, R68 and also V15 valveholder and have checked TC1, 2

and 3 which seem to be all right.—T. Dulley (Walthamstow, E.17).

It would appear that V4 is at fault or the H.T. supply to it is defective. Check V4, then R18 (1k) C21 (0.001μF) then the XL1 crystal diode.

G.E.C. 1449

This TV set has a line fault and I would appreciate advice on a cure. The fault is as follows: a vertical line on the screen appears bent to the right at the top of the picture. Also over the complete length of the picture, the lines wobble from side to side of the normal position by up to half an inch. The effect is worse some days and sometimes is hardly noticeable. It is also worse on the Band III signal which is weak in this area. I have a circuit diagram and a test meter. I have already tried changing the line oscillator valve, line output, boost diode and phase discriminator (D77) valves.—J. T. Lawrence (Gillingham, Kent).

Check C80 0.1μF across part of horizontal form coil. It can also be due to a poor metal rectifier, reducing available H.T. voltage. This would give reason for variation when supply voltage drops. Aerial circuit connections should be examined, especially the coaxial plug.

PHILIPS 1746

This is a 17in. model. I can obtain sound but no raster or picture. The valves are in order and the C.R.T. heater is glowing. EY51 has been replaced and on inspecting the condition of the turret tuner I found a mass of molten yellow wax. We cannot obtain ITV in this area at present.—J. Hutton (Belfast).

There is no need to suspect the tuner unit if the EY51 is not lighting up. You must check the PL81 and the PY81, see that the EHT is still absent when the C.R.T. anode clip is removed from the tube.

CHAMPION TV12T

The above set has a 12in. screen and the tube is in very good condition. However, I am troubled with faulty interlace and a tendency for heads to become very high; the definition of the set is very poor also. A Cyldon converter is fixed in the rear of the set and is working from an X aerial. This converter has three adjustable screws which have not been touched.—P. Ford (Peacehaven, Sussex).

The poor definition may well be due to a failing tube. The lines at the top are due to a defective ECL80 frame timebase valve or an incorrectly set frame linearity control. The line hold control may be defective if operation causes a loss of raster, but this is not likely to be the cause if the line is imposed on the normal picture.

VIEWMASTER 12in. MODEL A

This set has EHT extra and constructed as sixth edition with increased frame and line amplitude which has been working for four years without trouble. The trouble which I am having at present is, I think, somewhere in the frame timebase. First, I cannot obtain a full scan, top and bottom by about 2in. otherwise the picture is first rate. Resistor and condensers have been renewed, frame transformers condensers C50, 51, 53, 54, 55, 42. Valves 11 and 12 tested O.K., variable resistors C4 and C5 renewed. I also reduced R56 to 220k, but still the same. I also have wired the tube with a transformer because of short.—C. T. Weddles (Tunbridge Wells, Kent).

From your description we suspect that the H.T. is low owing to MR4 having developed a high series resistance. We suggest replacing MR4. Also remove R67.

PYE V14

The above set is a 14in. model about four years old. It has a 13 channel tuner control on the set, but I have my doubt as to whether all coils are present in the models turret tuner. I have switched to Channel 11, but so far no response on either sound or vision, yet in the next street my friend regularly receives Anglia ITV test transmitter on a BBC aerial.—J. H. Ford (Norwich, Norfolk).

Your set may have a low gain PCC84 R.F. amplifier, or be out of alignment. As your turret tuner is of the incremental type, no coils are needed but Mendlesham may come up on channel 10, 11 or 12. At the moment the station is on a very low power which may not be sufficient for your set, which is a non-fringe model. Full power tests seem to be imminent and you would be well advised to wait for these before trying again. Check that the sensitivity control is right up. The Cyldon P38H will convert the BTS147, but check that there is room for it inside your set.

REGENTONE 15T

After the set warms up my picture becomes muzzy on distant shots even when the focus control is at its maximum position, but has a fairly clear definition on close up shots. I also have an intermittent black band of ½in. on the left-hand side of the screen.—R. Mullins (Blackwood, Mon).

The symptoms denote a failing 14A97 metal rectifier. The effects may well be aggravated by some loss of the tube emission, particularly if this is the original.

ALBA 394

The scan coils on the above set failed and the picture is wedge-shaped. The EY51 also failed. I replaced both the scan coils and the EY51 and had a good picture for about an hour then the same thing happened. I have bought another set of scan coils but will not put them in for fear of the same thing happening. I wondered if it has blown the new EY51, because when the picture went wedge-shaped, advancing the brightness made the picture enlarge. I have checked the two resistors from line scan coils to cathode of PY81, both measure even 10k ohms. Could there be another cause? There is a very good EHT spark.—C. A. Huxall (Leeds, 5).

We would agree that the EHT is probably too high. This is probably caused by an open-

(*Continued on page* 271)

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5Y3G	6/6	6D6	4/9	**6Q7G**	6/9	10P13	9/6	25Z6	9/-	9003	4/-	**EB91**	3/9		2/6	**HVR2**	6/6	PL83	8/-	U309	11/-		4/3
5Y3GT	6/6	**6F1**	6/9	6Q7GT	9/3	**10P14**	9/6	27SU	16/-	ATP4	2/9	EBC3	9/-	**EF54**	3/3	**KT32**	7/6	PL84	11/-	U329	12/6	W61M	9/9
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6A7	11/-	**6F12**	3/9	**6SG7**	4/9	12AH7	6/9	30FL1	9/6	**B65**	4/9	EBC81	7/9	EF86	11/-	**KT44**	9/6	PY32	11/-	U404	6/6	W81	5/9
6A8G	9/6	**6F13**	6/9	**6SH7**	4/6	12AH8	9/9	30L1	7/9	CBL31	23/3	EBF80	8/6	EF89	8/-	**KT45**	8/6	PY80	7/-	U801	17/-	X61M	12/6
6A8GT	13/6	6F14	9/6	6SJ7	6/-	12AT6	7/9	30P4	12/6	CCH35	7/6	EBF89	8/6	**EF91**	3/9	KT61	9/-	PY81	7/-	UABC80	9/-	**X63**	9/-
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6AG7	9/-	6F33	6/9	6SQ7	6/-	12BA6	8/-	35L6GT	9/-	**D77**	3/9	EC90	3/6	**EL33**	9/-	**KTW63**	4/9	R18	12/6	UBC81	10/6	X78	14/6
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6AL5	3/9	6J5	4/3	6U4GT	10/6	12BH7	10/6	35Z4GT	6/-	DA90	2/6	ECC31	9/6	EL37	11/6	**L63**	2/9	SD6	9/-	UBF89	8/6	Y63	6/-
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circuited capacitor or resistor associated with the coils or the line output transformer. The 394 is practically identical to the T304-T301 series shown in the volumes. Referring to these diagrams, check C66 if fitted, C54, R73, C55 and R70.

DEFIANT

I have the above set seven years and a fault has now developed in the tube. Normally when the set is switched off, there is a white point which fades away. Recently, however, the white pin point prior to fading away has tended to expand and spread over approximately 2sq. in. at the centre of the tube.—J. Brown (Glasgow, S.W.1).

The large spot now displayed denotes that the cathode of the tube is in bad condition, that the emission is failing and therefore the tube is in need of replacement.

TUBE CONVERSION

I intend to convert my Viewmaster to a 17in. tube and consider making a more modern cabinet on legs. I wish, however, to make the cabinet of aluminium and as I am a panel beater this presents no difficulties. I would also like to install in the cabinet a separate AM/FM wireless which would be fed from a separate aerial. What I am most concerned about is the question of the metal cabinet and whether this will affect the television in any way, and what precautions to take, if any.—H. J. Brown (Surrey).

We would on no account advise the use of a metal cabinet for a Viewmaster as we would regard it as being extremely dangerous and, in fact, lethal. The Viewmaster chassis in common with practically all modern television receivers, has its chassis connected to one side of the mains and must therefore be used in a well-insulated wooden cabinet.

MURPHY 240A

What should I check for the following? On switching on, the line hold will not lock in the correct position, but locks giving two pictures with a dark vertical band down the centre of screen. After approximately an hour, the line lock can be secured at the extreme end of the line hold control, i.e., line hold control fully clockwise. I have changed the following valves: V7, 10C2, V11, 20P4, V10, 20L1, V13, U329. When I replaced the U329 I lost the raster completely so have replaced old valve.—D. Murphy (Argyll, Scotland).

Suspect Metrosil 1 in the anode load of V8B (the 20L1 DC amp). If this is not easily obtained replace it with a resistor which will give the correct voltage (36) at V8B anode. This usually works out at 47k 1W.

EKCO T.C.268/1

If the set is switched to one of the programmes, the height control set correctly and the frame linearity set to the right proportions, a variation of signal or the change from one camera to another upsets the frame linearity and even appears to push the picture upwards causing a space at the bottom, this also happens on turning over to the other programme. Occasionally the picture will open in height at the bottom in a band which moves up the picture slowly causing a rather comical effect. When the picture moves upwards and is manually moved back by the picture centring control, it merely repeats its performance shortly after.—W. Marshall (Sheffield, 11).

Replace the 30P12 frame output valve, which has a heater-cathode short. This is situated in mid chassis just behind the metal H.T. rectifier.

H.M.V. 1821

When I purchased this set second-hand approximately two years ago it had a sound fault. I replaced the volume control, but this did not cure it. I then replaced V9, Z152 (EF80) and the set was O.K. Now after two years a similar fault has occurred. Replacing V9 has no effect this time and after switching the set on the sound becomes distorted. By switching the set on and off quickly or changing stations with the conveter, this distortion is rectified. If the set is left after switching on, this distortion fault continues for about one hour on both stations. Only occasionally does it repeat after this period. I should be grateful if you could supply me with the necessary information to rectify this fault.—E. Mobey (Eccles, Lancs).

Check V7 and V8, sound I.F. amplifier, R53, 1M resistor to noise limiter diode, both detector and limiter diodes and the 25μF V9 bias capacitor.

COSSOR 946

I recently had to change the EY51 in the above set. This rectified the loss of vision. However, after a few days the set has developed an intermittent fault, the picture breaks up and it is difficult to obtain horizontal lock. Eventually I can get a more or less locked position, but the picture is an inch or more to the right of where it should be. This may last for a few minutes or hours, before it locks again in its correct position. The set may then operate satisfactorily for two or three days before the fault again occurs. I have substituted the PY81 and the PL81 with no success. I have a service sheet.—H. Brazer (Ryde, I.W.).

Suspect the 12AU7 (ECC82) and 6AB8 (ECL80) valves in the flywheel sync and line oscillator stage. These are located at the front of the upper chassis near the inside corner of the EHT box.

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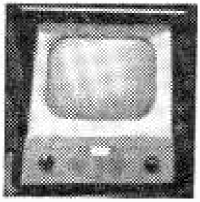

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