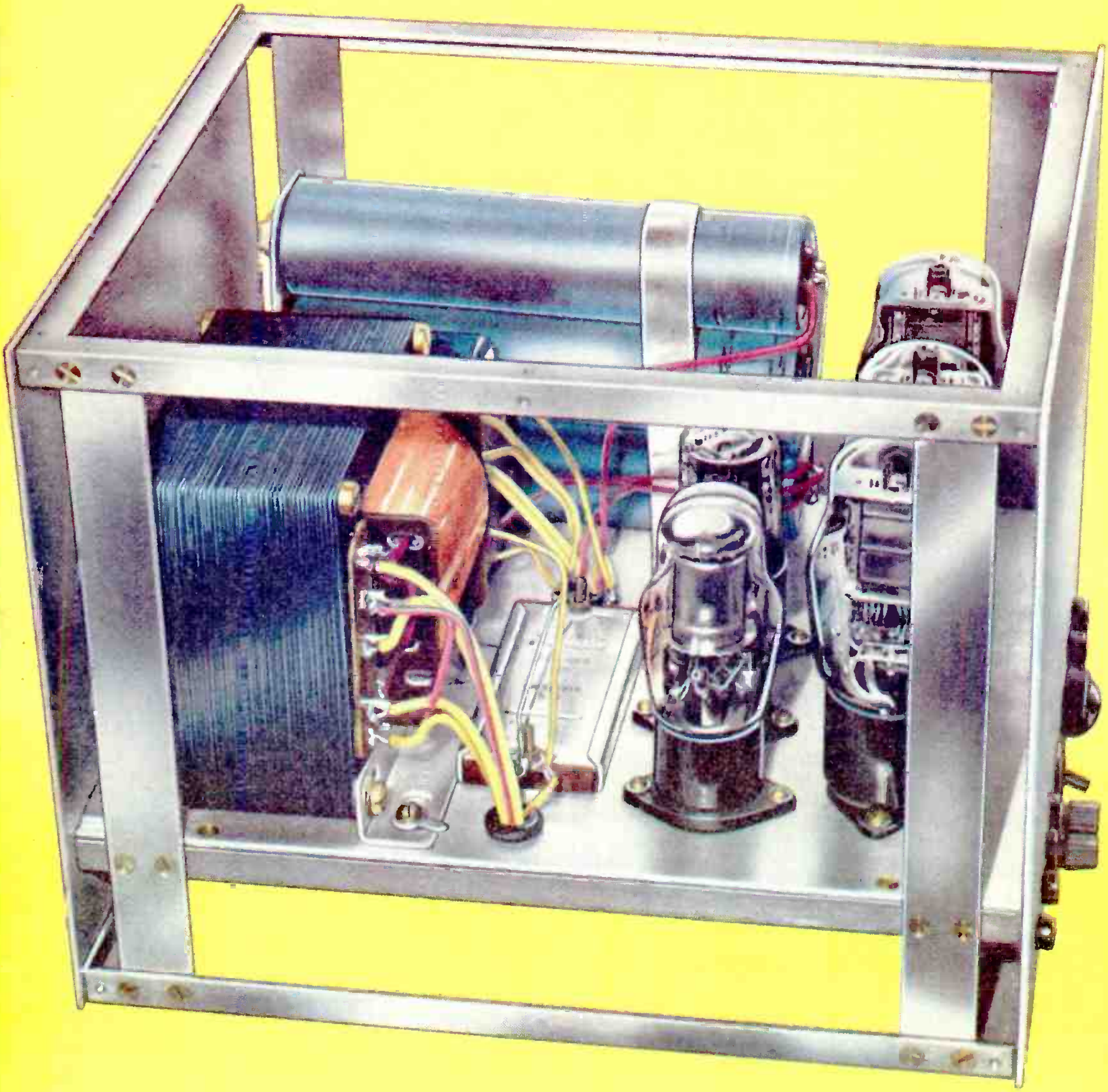
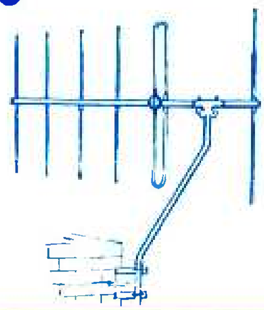
Practical TELEVISION

AUGUST 1962

1/9



ULTRA-STABILISED H.T. SUPPLY for TV experiments



Tubes

HIGHEST QUALITY—
COMPARE OUR PRICES

Carr. & Ins. 12/6.

		GUARANTEED		NEW TYPES
		Months	12 Months	MW 31/74
MOST MULLARD, MAZDA, COSSOR, EMITRON, EMI-SCOPE, BRIMAR, FERRANTI TYPES. PROCESSED IN OUR OWN FACTORY	12in.	£2. 0.0	£3. 5.0	£4-0-0
	14in.	£2.10.0	£3.15.0	MW 36/24 £5-0-0
	15/17in.	£3. 5.0	£4.10.0	CRM 172 MW 43/64
	21in.	£3.15.0	£5.15.0	£6-0-0

★ NEW MAIL ORDER WAREHOUSE ★

In order to facilitate expansion our mail order dept. now operates entirely from a larger premises at Brighton. We would like to thank our many customers for their patience in any unavoidable delays occasioned by this move.

IVORY/GOLD KNOBS 1" Diameter, half price 1/2, 5 for 4/6: 1¼" 1/3. 5 for 5/-.

VALVE HOLDERS. B7G, 6d., with Screen 9d, B9A, 6d. with Screen 10d.

TRANSISTOR INTERCOM. High sensitivity, complete with batteries, usually £9. DISCOUNT PRICE £5.10.0.

B.B.C./I.T.A. TUNERS
Famous makes complete with PCF80, PCC84 valves. 38 M/c I.F. Fantastic value **19/-**

CONDENSERS. 25 Mixed, Electrolytic. Many popular sizes. List Value £5. Our Price 10/-.

21in. T.V. CHASSIS
Unused famous make, complete with valves, only requiring MW43/80. To complete 13 channel. Worth £30. FEW ONLY. £16.0.0

13 CHANNEL TV's. Table Models—Famous Makes Absolutely complete. These sets are unequalled in value due to huge purchase direct from source. They are untested and are not guaranteed to be in working order. CARR., ETC., 15/-.

12"—£2.19.0
14"—£4.19.0

ALSO 12in. 5 CHANNEL TV'S 39/-. 14in. 5 CHANNEL TV'S 59/-.

NEW SPEAKER CABINETS. Covered in attractive Rexine. Gold metal front, 11/-. Or complete with Speaker, 19/-.

CO-AX, standard and low loss, 25 yds., 12/6; 50 yds., 22/6; 100 yds., 42/6. Co-ax Plugs 1/3. Wall outlet boxes 3/6.

4-SPEED RECORD PLAYERS. Latest Turntable, together with lightweight Staar Galaxy dual sapphire crystal turnover pick-up head. Amazing value (pick-up only 19/-). £3.10.0. Carr. 3/-.

THE BARGAIN OF THE MONTH

4½ watt AMPLIFIERS

Further delivery of these excellent units to hand complete with 6F3 amplifier, 20P3 output, and UU9 rectifier. Easily converted into high gain unit, complete with good quality, 8in. speaker in attractive two tone bakelite case easily converted for guitars, record players. baby alarms, mic. amplifiers, (Carr. Packing, etc. 7/6. 19/-

RECORDERS. "Verdik" 4 Track Deck, Collaro 3 Speed Transcription, Superior reproduction, Streamlined Portable Case, with Mike. Market value £45. OUR SPECIAL PRICE 29 gns.

RECTIFIERS. Silicon Diodes 125 v. 500 mA, 2 in series make superior replacement for R.M.4 and R.M.5, etc., 8/- each. 250 v., 80 mA, 5/-; RM1, 5/3; RM2, 6/9; RM3, 7/6; RM4, 19/6; RM5, 19/6; 14A86, 17/-; 14A97, 19/6; 14A100, 19/6; 16RC1-1-16-1, 7/9; 18RA1-1-1-16-1, 6/-; 18RD2-2-8-1, 14/-; 14RA1-2-8-2, 17/-; 14RA1-2-8-3, 20/-.

GERMANIUM DIODES, general purpose, 9d. each, 8/- dozen.

LINE TRANSFORMERS. Most types available from stock from 19/-. Also frame and blocking oscillator transformers. S.A.E. enquiries.

100 RESISTORS 6/6

100 CONDENSERS 10/-
Miniature Ceramic and Silver Mica Condensers 3 pF to 5,000 pF. LIST VALUE OVER £5.

UA20 Autochangers. Latest B.S.R. 10 mixed records. Brand New. Unrepeatable, £6.19.0. Also UA14. A Proven Choice £7.10.0. P.P. 4/-.

EXTERNAL I.T.V. Converters, with Power Pack. Very compact, 39/-.

PERSPEX fronts for 17in. T.V. Sets. Brand new, 7/6. P.P. 1/6.

TAG STRIPS from 3 way to 12 way. Mixed parcel of 25, 3/9. This is the cheapest way to buy!

RESISTORS, your selection, 4/6 doz. Condensers, Silver Mica and Ceramic, 6/- doz. Most values in stock.

ALADDIN Type Slugged Formers with Screen. Small 5/- doz. Tall 6/- doz.

SPECIAL TEMPORARY OFFER. Due to huge Bulk Special Purchase we are offering **MW 31/74** Tubes at the unrepeatable price of 29/-. MW 36/24 ditto, 39/-. P.P. 12/6. The above are guaranteed for 6 months.

P.M. SPEAKERS. 3 ohm, top makes. Performance guaranteed. 6½in., 8in., 8/-, 5in. 7 x 4in., 11/-.

P.V.C. CONNECTING WIRE. 100 yds., 30 mil: Special Price 7/6. 200 yds. 30 mil: special price, 12/6. 25ft. Coil, 1/-, 5 Coils different colours. 4/-. Connecting flex. Prices as above.

★ VALVES ★

BY RETURN OF POST

10% DISCOUNT SPECIAL OFFER TO PURCHASERS of any SIX VALVES marked in black type (15% in dozen). Post: 1 valve, 6d., 2-11, 1/-.

NEW LOW PRICES GUARANTEED 3 MONTHS

FREE TRANSIT INSURANCE. All valves are new or of fully guaranteed ex-Government or ex-equipment origin. Satisfaction or Money back Guarantee on Goods if returned unused within 14 days.

OZ4	5/-	6J5GT	4/-	12K8GT	9/6	DET19	2/9	EL91	4/-	R19	11/-
1A5GT	5/-	6J6	4/-	12Q7GT	5/-	DF35	9/9	EM80	7/9	SP41	2/6
1A7GT	11/-	6J7	8/6	12SA7	7/-	DF91	3/6	EM81	8/6	SP61	2/6
1C5GT	9/-	6J7G	4/9	12SG7	5/-	DF96	7/3	EM84	9/-	SU25	16/-
1D5	8/-	6J7GT	7/6	12SH7	3/6	DF97	8/6	EM85	10/-	SU2150	4/6
1D6	9/9	6J8	9/6	12SJ7	5/6	DH63	6/-	EN31	16/-	T41	7/6
1H5GT	9/9	6K6GT	6/6	12SK7	4/9	DH76	5/-	EY51		TDD4	7/6
1L4	3/3	6K7	5/9	12SN7GT	7/9	DK32	11/-	Small	7/9	U14	8/-
1LD5	3/6	6K7G	2/3	13D3	9/-	DK91	5/6	EZ86	7/6	U18	8/-
1LN5	4/9	6K7GT	4/6	14S7	14/9	DK92	7/-	EY86	5/6	U22	6/9
1N5GT	9/9	6K8GT	8/9	19AQ5	7/6	DK96	7/3	EZ35	6/6	U24	16/-
1R5	5/6	6K25	7/6	19BG6	19/-	DL33	8/-	EZ41	7/-	U25	11/6
1S4	8/-	6L1	12/6	20D1	9/6	DL35	9/-	EZ80	6/-	U26	9/9
1S5	4/6	6L6G	6/6	20F2	9/6	DL65	6/-	EZ81	6/6	U31	7/-
1T4	3/6	6L18	9/-	20L1	16/-	DL73	6/-	FW4/500	8/-	U33	14/-
2A3	6/6	6L19	11/-	20P1	8/9	DL82	9/-	FW4/800	8/-	U35	12/6
2A7	9/6	6LD3	8/-	20P3	12/6	DL91	8/-	GT1C	7/-	U37	26/-
3A4	4/9	6LD12	6/9	20P4	18/-	DL92	6/-	GZ32	8/9	U50	5/9
3A5	9/-	6LD20	7/9	20P5	15/-	DL94	6/9	GZ34	12/6	U52	4/9
3D6	4/6	6N7	7/6	25A6G	8/-	DL96	7/3	HL41DD		U76	5/6
3Q4	7/-	6P1	7/6	25L6G	6/9	EABC80	6/9		3/3	U78	5/-
3Q5GT	8/-	6P25	8/6	25L6GT	7/9	EAC91	4/6	HN309	19/-	U191	12/6
3S4	6/-	6P28	12/6	25Y5G	8/-	EAF42	8/-	HVR2	10/6	U281	9/6
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5U4G	4/9	6SA7	5/6	30C1	7/-	EBC41	8/-	KT32	6/9	U329	6/9
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5Y3G	5/9	6SH7	3/-	30F5	6/-	EBF80	7/9	KT36	12/6	U801	19/-
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5Y4G	11/-	6SL7GT	5/9	30L1	6/9	EBF89	8/6	KT45	8/6	UAF42	7/9
5Z4	11/-	6SN7GT	4/6	30L15	9/6	EBL21	12/6	KT61	8/6	UB41	7/9
5Z4G	7/6	6SQ7	5/9	30P4	9/6	EBL31	17/6	KT63	5/9	UBC41	7/9
5Z4GT	11/-	6SS7	3/6	30P12	7/6	EC91	4/6	KT76	8/6	UBC81	9/6
6/30L2	9/-	6U4GT	10/6	30P16	6/6	ECC31	7/6	KTW61	5/9	UBF80	8/-
6A6	4/9	6V6G	5/-	30P19	17/6	ECC32	4/-	KTW62	5/9	UBF89	7/6
6A7	10/-	6V6GT	6/-	30PL1	9/6	ECC33	4/6	KTW63	5/9	UBL21	14/6
6A8G	8/6	6X2	7/9	30PL13	13/-	ECC34	9/-	KTZ63	5/6	UCC84	14/6
6A8GT	13/6	6X4	5/-	35L6GT	8/6	ECC35	6/-	L63	2/9	UCC85	7/-
6AB8	7/-	6X5G	5/-	35T	25/-	ECC40	14/-	LN152	7/-	UCF80	15/-
6AC7	3/3	6X5GT	5/6	35W4	6/9	ECC81	5/6	MU14	7/6	UCH21	12/-
6AG5	3/-	6Y6G	7/6	35Z4GT	5/6	ECC82	6/-	N37	11/-	UCH42	7/3
6AG7	7/6	7A7	8/6	35Z5GT	8/-	ECC83	6/6	N78	13/-	UCH81	8/-
6AK5	5/-	7B6	9/-	41	7/6	ECC84	8/-	N108	16/-	UCL82	9/9
6AL5	3/-	7B7	7/9	42	7/6	ECC85	7/9	N152	8/6	UCL83	13/6
6AM6	3/-	7C5	7/3	50C5	9/-	ECC89	16/-	P41	4/6	UF41	7/6
6AQ5	6/-	7C6	7/6	50CD6	19/-	ECC91	4/-	P61	2/9	UF42	5/6
6AT6	5/9	7H7	7/3	50L6GT	8/6	ECF80	8/6	PABC80		UF80	7/-
6AU6	7/6	7K7	9/6	52KU	10/6	ECF82	8/6		11/6	UF85	7/6
6B7	8/6	7Q7	8/6	53KU	10/6	ECH21	12/6	PCC84	6/9	UF86	14/6
6B8G	3/-	7R7	1/6	61SPT	11/-	ECH35	7/6	PCC85	8/9	UF89	7/-
6BA6	5/9	7S7	9/-	62BT	13/6	ECH42	3/6	PCC88	14/-	UL41	7/-
6BE8	5/9	7V7	7/9	75	6/6	ECH81	7/9	PCC89	9/-	UL44	11/-
6BG6G	15/-	7Y4	6/9	78	6/6	ECH83	8/3	PCC189	13/6	UL46	9/9
6BH6	6/-	7Z4	7/-	80	5/9	ECL80	6/-	PCF80	7/-	UL84	7/-
6BJ6	6/-	8D3	3/-	83	9/6	ECL82	9/6	PCF82	7/6	UM80	9/6
6BR7	9/6	10C1	11/6	185BT	19/6	ECL83	11/7	PCF84	16/-	URIC	8/-
6BW6	7/6	10C2	14/6	803	19/-	ECL86	10/6	PCF86	12/6	UU6	12/6
6BW7	5/6	10C14	8/-	807(A)	5/6	EF22	7/-	PCL82	7/3	UU7	9/6
6BX6	4/9	10F1	5/9	808	7/6	EF36	3/3	PCL83	10/6	UU8	17/-
6C4	3/6	10F9	10/6	813	55/-	EF39	4/6	PCL84	7/6	UY1N	11/-
6C5	5/6	10F18	10/-	832	14/-	EF40	12/-	PCL85	11/6	UY21	11/-
6C6	3/9	10L14	7/-	866A	11/6	EF41	8/-	PCL86	12/6	UY41	6/-
6C9	11/-	10LD3	7/9	954	2/-	EF42	7/6	PEN45	8/6	UY85	6/6
6CD6G	19/6	10LD11	14/6	956	2/6	EF50-BR	2/-	PEN46	5/-	VP41	5/6
6CH6	7/6	10LD12	8/-	9001	4/-	USA	3/-	PL33	8/3	VR105	6/9
6D2	3/-	10P13	11/-	9002	4/9	EF54	3/3	PL36	9/6	VR150	6/9
6D3	9/6	10P14	9/-	9003	5/6	EF80	4/9	PL38	16/6	W61M	11/-
6D6	4/3	10P18	7/-	ATP4	2/9	EF85	6/6	PL81	8/6	W76	4/9
6F1	4/9	12A6	1/9	AZ31	8/-	EF86	9/-	PL82	6/6	W81	7/3
6F6G	5/9	12AH8	9/-	AZ41	11/-	EF89	6/9	PL83	6/6	X61M	11/-
6F12	3/-	12AT6	7/6	B36	7/9	EF91	3/-	PL84	8/-	X63	8/6
6F13	6/9	12AT7	5/6	C1C	9/6	EF92	4/6	PL820	8/6	X65	11/-
6F14	9/6	12AU6	9/6	CBL1	26/6	EF96	3/-	PX4	12/6	X66	11/-
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6F16	8/-	12AX7	6/6	CCH35	14/-	EF184	12/-	PY31	9/-	X78	21/-
6F19	6/6	12BA6	7/6	CL33	9/6	EL32	4/6	PY32	10/-	X79	16/6
6F23	6/6	12BE6	7/6	CY31	9/-	EL33	7/9	PY80	6/9	X81M	9/-
6F24	12/-	12BH7	9/9	D77	3/6	EL35	7/-	PY81	6/6	Y63	6/3
6F25	13/-	12C8	6/6	D152	5/9	EL41	8/-	PY82	6/-	Z63	4/9
6F32	6/6	12E1	17/6	DA30	12/6	EL42	8/9	PY83	7/-	Z66	9/6
6F33	6/6	12J7GT	9/-	DAC32	9/9	EL81	11/-	PY88	9/9	Z152	4/9
6J5	4/3	12K7GT	4/9	DAF91	4/6	EL83	11/-	PZ30	9/6	Z719	4/9
6J5G	3/-	12K8	11/-	DAF96	7/3	EL84	7/-	R18	11/-	ZD152	7/9

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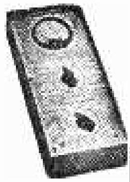
A.C./D.C. Multimeter Kit



Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000 A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000 D.C. milliamps 0-5, 0-100, 0-500, Ohms 0-50,000 with internal batteries. 0-500,000 with external batteries. Measures A.C./D.C. volts. D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions. Price 24/6, plus 2/6 post and insurance.

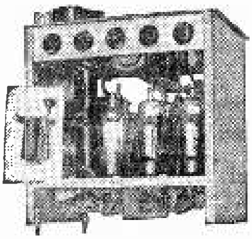
Portable Tape Recorder for only £6.19.6.

You'll be really thrilled at its performance. Superior to many selling at £12 to £15. Supplied as sub-assemblies which go together in about an hour. Three transistor amplifier with centre switch-forward-stop-rewind with microphone input record play-volume control, etc. Complete in most modern carrying case in two-tone and with microphone reel of tape and spare reel. Nothing else to buy. Do not miss this bargain! **Only £6.19s. 6d.,** plus Post & Ins. 5/-.

Lens System for Closed Circuit T.V.

Contemplating building a T.V. camera? We have just heard from a reader that the lenses contained in the infra red binoculars (and there are two complete systems) are ideal for T.V. cameras. We are able to offer the binoculars at the give away price of **£2.17.6.** plus 10/- carriage and insurance.

Building An Amplifier?



Here is a buy for you! Modulator Unit Type 20. Contains parts, ideal for building a large output amplifier and already set out in metal case. To name a few:—Four high output valves Type KT44. Driver valve Type MH41. Iron cored choke for up to 200 milli-amps. Dozens of wire wound and carbon resistors, paper and mica condensers. Terminals and tag panels, etc., etc.

Three other items of interest to everybody and well worth the price asked for the unit are:—

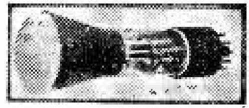
1. **Transformer Reference 10K/143.** This can act as autotransformer to convert 230 to 110 or 230 to 460, and also as a filament transformer 230 to 6.3 or 230 to 12.6 volts.
2. **Miniature Circuit Breaker.** For breaking 10 amps A.C. reset by pushing knob.
3. **Steel Case.** With heavy gauge chassis, already cut out and fitted valve holders etc.

Price for complete unit is 19s. 6d., carriage 5/-.

What! A TV in a Tent?

To operate your razor from car battery or suitable for many other uses, we offer Motor Generator 12v. input, 200 v. output, which must have cost at least £10 to make, for only **17/6,** plus 4/6 post and insurance.

Building A 'Scope?



3in. oscilloscope tube. American made type No. 3FP7, 6.3 v. 0.6 amp, heater, electrostatic deflection, brand new and guaranteed with circuit diagram of scope. **15/-** each, plus **2/6** post and insurance.

Power Unit

A useful source of D.C. for experimenting energising instruments, electro plating, reactivating batteries etc. This power unit can be made in a few hours and due to the availability of the rectifier valve at a very low price, we can supply the complete kit of parts with ABC instructions, fits into any box for **9s. 6d.** plus **1s.** post and insurance.

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● Orders received by post are despatched from our warehouse. **Dept. 5, 66 Grove Road, Eastbourne,** and to save time, please post your order to this address. Please include enough for postage. Callers, however, should use one of the following addresses:

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Wonderfully improve definition and brilliance.

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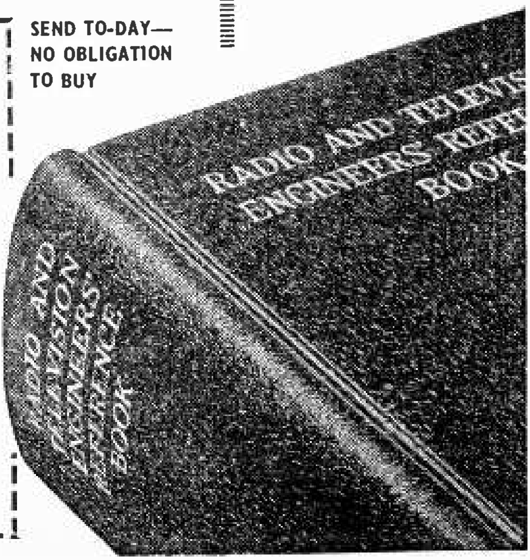

Practical Television

AND TELEVISION TIMES

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Contents

The Pilkington Report

THE Committee on Broadcasting was set up in July 1960 "to consider the future of the broadcasting services in the United Kingdom", and the Committee—now better known as the Pilkington Committee, from the name of its chairman—submitted its report in June. The Report has already received much publicity, but some of its aspects are of particular interest to readers of this magazine.

Our main interest is in the technical recommendations of the Committee, but some of those dealing with what might be termed aesthetic considerations, also merit discussion. The following paragraph, which speaks for itself, is a case in point.

"We conclude that the dissatisfaction with television can largely be ascribed to the independent television service. Its concept of balance does not satisfy the varied and many-sided tastes and interests of the public. In the field of entertainment—and not least in light entertainment—there is much that lacks quality. It is these facts which largely account for the widespread opinion that much on television is trivial."

The Committee recommended the reconstitution of independent television and in particular that the Independent Television Authority should plan the programmes and sell advertising time. The programme companies would produce and sell to the Authority programme items for inclusion in the programme planned by the Authority.

So far as technical considerations are concerned, there was a recommendation that one of the first objectives must be to extend the coverage of television to areas which at present have no service. The Committee made the point that these areas are often remote, sparsely populated, and away from most sources of entertainment, and therefore particularly in need of television.

Another recommendation in the Report was that the definition standard should be changed from 405 lines to 625 lines and that colour television should be introduced using a compatible system on 625 lines. This would mean that by the time this service could be introduced, colour techniques would probably be on a better footing and receivers might be simpler and less expensive.

It was also stated that any extensions to the television services should be made in the UHF Bands IV and V. The UHF stations of the BBC and the ITA should be co-sited and the Postmaster General should be empowered to direct the broadcasting authorities to co-site stations. This latter recommendation is of particular importance; on Bands IV and V, directional effects are likely to be more noticeable than in the lower-frequency bands. If stations are to be co-sited, there will be much less variation in signal strength between stations.

When alterations are made to the television services in this country, there will be much to occupy the time of the amateur enthusiast—in tuner construction, receiver modifications and aerial construction. We shall keep readers abreast of the latest technical developments and present new designs regularly in the months to come.

Our next issue dated September, will be published on August 22nd.

MODERN SILICON POWER RECTIFIERS by K. Royal

ALL solid-state rectifiers can be considered as semi-conductors and these include the early copper oxide units and the more recent selenium stacks. Copper oxide rectifiers are not very suitable for power applications because they are only able to supply relatively small currents. They also have a poor inverse characteristic and become hot in operation, therefore requiring bulky cooling fins. This type of rectifier, however, has certain attributes for instrument work and is often used in a bridge assembly in A.C. voltmeters and multimeters.

Selenium Rectifiers

With the coming of television and other equipment demanding 200mA or so of H.T. current the selenium rectifier was developed to the most efficient state possible. These rectifiers really appeared several years after the copper oxide types and even in the early days they could withstand much greater inverse voltages than the copper oxide types. Their ability to stand up to severe switch-on surges made them popular for television sets, but their major shortcoming is that the forward resistance tends to increase gradually with age. This causes the units to heat up more than normal and the loss of voltage across the forward resistance causes a reduction in H.T. voltage.

There are two basic types: the stacked variety which are made up of a series of selenium cells clamped between fins or plates for heat conduction and the contact-cooled specimens in which the selenium cells are arranged in a series of small stacks in the case. These cells are in thermal contact with the base-plate and, as the latter is clamped firmly to the chassis of the receiver, the heat developed in the cells is rapidly dissipated to the large metal of the chassis.

The next move up the rectifier ladder is to the very recent silicon power diode. These are made in various sizes, but one of dimensions a little larger than a pea is almost three times as efficient as a television-type selenium rectifier.

What is a Silicon Rectifier?

A silicon rectifier or power diode is really a crystal diode which uses silicon as the crystal base rather than germanium, which is used in the smaller type of crystal diode. Pure silicon is an almost perfect insulator. It thus has an extremely high resistance and in its pure state is no good at all for the conduction of electricity. It is made conductive, however, in a particular kind of way so as to have a high resistance to current in one direction and a very low resistance to current in the other direction. This, of course, is the normal requirement of a rectifier.

To be efficient, the forward resistance must be extremely low to avoid power loss across the resistance and excessive heating, while the reverse resistance must be very high to prevent the rectifier itself from shorting out the voltage charged by the reservoir capacitor during the forward flow of current. A perfect rectifier, therefore, would be one with zero forward resistance and infinite reverse resistance. But, since the perfect is impossible, we have to make do with the next best and there is little doubt that in the field of rectifiers this is the silicon power diode.

How Does the Silicon Rectifier Work?

Basically a pure crystal of silicon has no free or mobile electrons which are able to serve as current carriers, so in order to secure conduction through the crystal, impurities must be added. There are various impurities and various ways of introducing them to the crystal to achieve the desired results. For example, during the manufacture of the BY100 power diode, Mullard introduce phosphorus on to one face of a thin slice of silicon and boron on to the opposite face. These impurities do two things. On the phosphorus side the silicon is caused to have an excess of mobile electrons, while on the boron side the silicon is caused to have an excess of what are called positive "holes". These holes are really produced by an electron deficiency in that side of the silicon, but in semi-conductor parlance they are called holes because they are carriers of positive electricity just as electrons are carriers of negative electricity. Thus the phosphorus side of the silicon is termed *n*-type material (*n* for negative) and the boron side is termed *p*-type material (*p* for positive).

The impurities are introduced by a process of diffusion. The coated slices of silicon are heated at a carefully controlled temperature for a considerable time and this causes the impurities to be diffused into the crystal. When the diffusion process is completed the treated crystals are thoroughly cleaned and their faces coated with a metal to facilitate the connection of termination wires. Finally, the slices are cut up into small squares and hermetically sealed in metal envelopes. The *n*-side of the crystal is soldered to the bottom of the metal envelope, which thus acts as a heat sink, while the *p*-side is connected to a lead-out wire.

During the diffusion process there is initially a migration of holes and electrons across the *p-n* junction towards each other. On impact the negative charge of the electron is neutralised by the positive charge of the hole. This means, then, that the *p*-material in the region of the junction has a hole deficiency, while the *n*-material has an electron deficiency. These deficiencies cause the interface of the *p*-material to take up a negative charge and the *n*-material to take up a positive charge.

In effect a potential barrier is formed at the junction, as shown in Fig. 1(a), and this prevents the further movement of holes or electrons. The diode thus settles down to a state of equilibrium until, of course, it is connected to an external source of voltage.

Now when the diode is connected to an external voltage in the direction shown in Fig. 1(b) the potential across the barrier is, in effect, counteracted. The barrier thus disappears and electrons and holes are once more able to move freely across the junction and cause a normal flow of electricity with very little resistance.

However, when the external potential is reversed, as shown in Fig. 1(c), the potential of the barrier is, in effect, reinforced by the external voltage, making it totally impossible for electrons or holes to cross the junction. Unfortunately there is always a little flow of current in the reverse direction and this is due to conduction by minority carriers and is called leakage current. Its value depends to a large extent on the concentration of minority carriers in the two regions of the diode. It should be noted, however. that minority carriers are caused to multiply by an increase in the operating temperature of the diode, just as the collector leakage current of a transistor increases with increase in temperature.

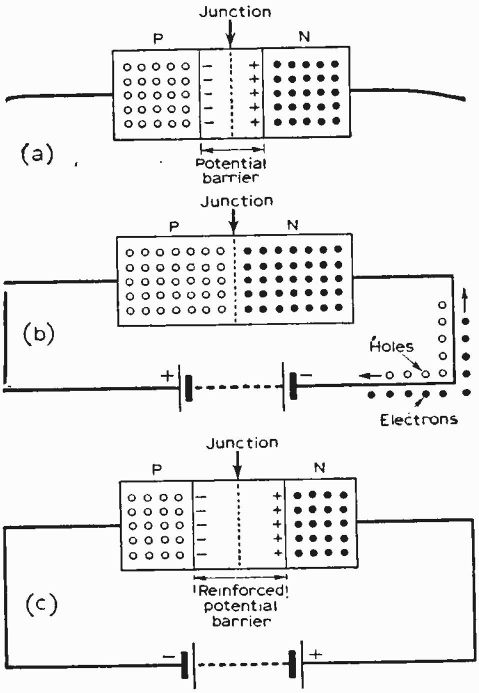


Fig. 1—The conduction conditions of a silicon power diode. In (a), a condition of equilibrium occurs initially due to a potential barrier forming at the junction. This is rather like a small battery which prevents further movement of holes or electrons across the junction. In (b), the diode is based for forward conduction, which takes place since the external voltage effectively removes the potential barrier and thus permits the free interchange of holes and electrons across the junction. In (c), the diode is biased for reverse conduction. Here, the external voltage effectively reinforces the potential barrier and thus makes normal conduction impossible. A small conduction occurs, however, as the result of minority carriers in the junction regions.

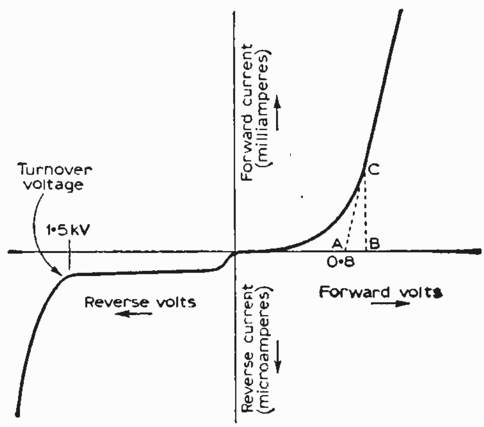


Fig. 2—The characteristics of a typical silicon power diode.

Power Diode Characteristics

In Fig. 2 is shown a typical characteristic curve of a silicon power diode. Here it will be seen that the forward current does not commence until the diode is biased to a specific value in the forward direction. In fact conduction occurs when the applied voltage overcomes the potential of the barrier. This is often called the "threshold voltage" and is the value given on the forward voltage datum by extending the curve as a straight line as shown by the broken-line C-A. For the Mullard BY100 the value is in the order of 0·8V.

Another rather important characteristic is the "slope resistance". This, in fact, gives the resistance of the diode in forward conduction and on the curve is obtained by dividing the voltage between A-B by the current in amperes between B-C. For most silicon units the slope resistance is less than one-tenth of an ohm, while for a television-type selenium unit in new condition the value could well be 100 times greater (e.g., 10Ω).

From the curve it will be seen that the reverse current is of the order of a few microamperes and that this is virtually independent of the applied inverse voltage up to about 1·5 kV. At that point, known as the "turn-over voltage", the current rises very rapidly with further increase in voltage. This is due to the great velocity of the minority carriers in proximity to the junction, which in turn release other carriers and give rise to a "flood" of carriers, giving the breakdown or "avalanche" condition.

The inverse characteristic, of course, determines the maximum recurrent peak-inverse voltage rating of the diode, which for the Mullard BY100 is 800V, at a temperature of 50° C. At the same temperature the diode is able to deliver an average forward current of 550mA, but its maximum ambient temperature rating of 70° C allows it to be used inside television receivers without any difficulty at all.

Using a Silicon Power Diode to Replace a Selenium Rectifier

There are one or two things to note when using a silicon rectifier in place of the selenium unit for which the circuit is designed. In the first place the far greater efficiency of the silicon diode will almost certainly give a considerable step-up in D.C. output voltage.

To some extent it is unfortunately necessary to reduce the efficiency of the diode by including in series with it and the mains input a surge limiting resistor (see Fig. 3). Most selenium rectifiers incorporate such a resistor and the minimum value given for some silicon units is 25Ω. With the

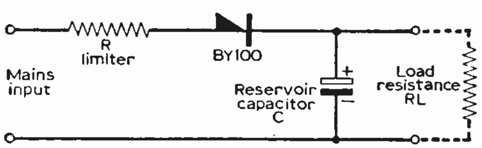


Fig. 3—The surge limiting resistor R lim is essential at the input (anode) of a silicon diode. The actual value is usually about 30Ω, but may be greater or smaller, depending on the value of the reservoir electrolytic.

Mullard unit it is possible to go down to 6Ω (but no less) if ever such a small value is necessary—which is unlikely.

The minimum value for the limiting resistor is somewhat related to the value of the reservoir electrolytic capacitor at the D.C. output (cathode) of the rectifier. It is not desirable to alter the reservoir value in any given design, it always being best to adjust the surge limiting resistor for the required D.C. output voltage, that is to say, to the voltage which would be present with a new selenium unit. This value is usually given on the service sheet of the receiver.

With those rectifiers with a metal envelope, such as the Mullard BY100, care should be taken to avoid contact with any other part of the circuit or the receiver chassis. Care should also be taken over soldering, it being best to employ a heat shunt

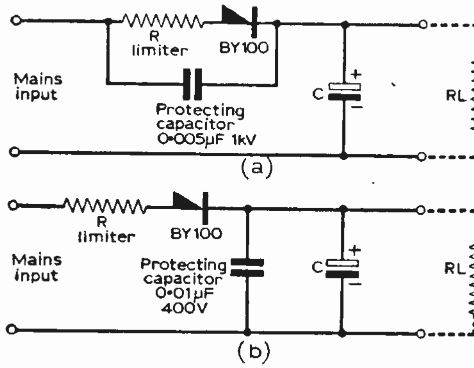


Fig. 4 (a) and (b)—Two ways of suppressing transient surges across the rectifier circuit.

of some kind or other to reduce the flow of heat from the soldering iron to the junction. Further, it is best to avoid bending the connecting leads closer than about ⅛in. from the diode, since this action may be likely to fracture the glass seals through which the connecting wires are directed.

Prevention of Surges

Although silicon diodes are extremely robust and will withstand normal operation for a considerable length of time they can be damaged by surge voltages as may be generated in television circuits due to the random discharging of the EHT system, for example.

There are two basic methods of protecting the rectifier under such conditions and these are illustrated in Fig. 4; in (a) the rectifier and surge limiting resistor are simply by-passed by a 0·005μF 1kV capacitor, while in (b) a capacitor of 0·01μF (400V) is connected across the reservoir electrolytic capacitor. ■

Colour Television for Visual Flight Simulator

The world's first colour visual flight simulator—it gives the trainee pilot on the ground a mid-air view in full colour of the runway and surrounding scene—has recently been demonstrated by a British company to international airlines and military air forces.

Equipped with a colour television camera supplied by EMI Electronics Ltd., a large screen projector and a three-dimensional coloured model of an airport and adjacent countryside, the visual flight simulator covers the critical stages of take-off and landing approach in a way which previously could not be synthesised when training flight crews on the ground.

As the pilot flies the simulator, the television camera is automatically controlled so that the correct aspect of the scene is viewed. The resultant picture is either projected on to an 8ft. by 6ft. screen or shown on a 21in. colour television receiver, mounted in front of the flight deck windows.

Telenews

Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of May, 1962, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London	1,993,985
Home Counties	1,684,687
Midland	1,769,664
North Eastern	1,899,381
North Western	1,573,587
South Western	1,025,582
Wales and Border Counties	718,104
Total England and Wales	10,664,990
Scotland	1,085,737
Northern Ireland	178,182
Grand Total	11,928,909

Surgical Operation Televised in Colour

A NEURO-SURGICAL operation at one of the biggest hospitals in Sweden—the Soders-jukhuset Hospital, Stockholm—was televised in colour on Thursday, June 7 by an EMI Electronics colour TV camera.

During the operation—carried out by Dr. Ragnar Frykholm, Head of the neuro-surgical Unit—the EMI camera in the operating theatre was manned by one of the hospital staff, but an engineer was attending the camera control unit.

The colour television picture was projected in a nearby room to give a very large picture for the audience of some 200.

TV in the Steel Industry

AT the Instruments, Electronics and Automation Exhibition, which was held at Olympia, London from 28th May to 2nd June, Marconi's Wireless Telegraph Co. Ltd. exhibited a selection from their range of specialised components. Also featured on the Marconi stand was the application of closed-circuit television in the steel industry. The operator's pulpit of the Cargo Fleet Works' mill—part of the South Durham Steel and Iron Co. Ltd. — houses a typical closed-circuit TV system to enable the operator to supervise the entry of the steel; which would be impossible without the use of television.

The Most Modern Boat on the Rhine

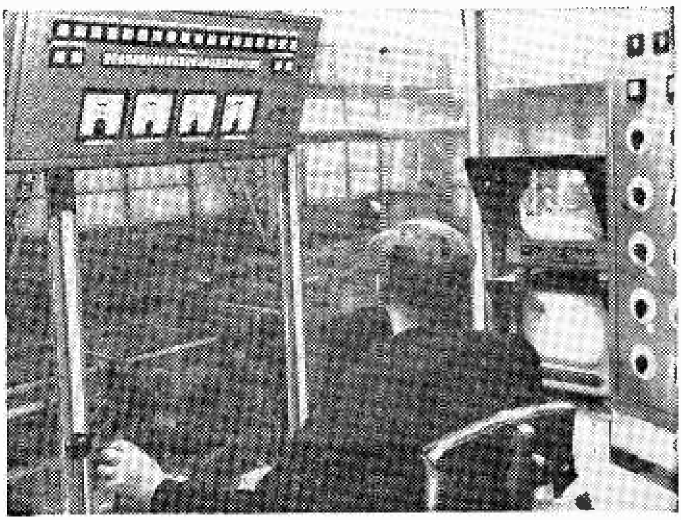
FITTED with the most modern technical equipment and furnished like a luxury cruiser, Damco 21—which went into service last year — is the most modern tug on the Rhine.

Built in Holland and owned by a Dutch shipping interest, Damco 21 can pull eight fully loaded boats with its two 1,000 h.p. engines, and can develop a speed of about 38 m.p.h. down-river or about 10 m.p.h. up-river. The low draught, the hydraulic steering and the small radius of turning are other important features of the boat.

But the most-up-to-date feature of the Damco 21 is the television camera on top of the wheel house. It watches the movements of craft around the ship, and relays the picture down to a television screen below, so that the captain can control from his cabin. The set can be switched to the normal programmes so that the crew can watch in the evening.

Start of Television Transmissions from the Transmitting Station at Llanddona, Anglesey

THE BBC's new television transmitter for North Wales, which has been installed at the existing VHF sound broadcasting station at Llanddona, Anglesey,



Part of the Marconi TV installation at a steel works, which enables the operator to supervise the entry of the steel which would otherwise be out of sight.

was brought into service on 15th May.

This new television station gives improved reception for more than 80,000 people in the northern part of Caernarvonshire, including the towns of Conway, Bangor, Caernarvon and Nevin, and in Anglesey, excepting Holyhead where a separate television station is to be built.

The television programmes are fed to Llanddona over a radio link from Bwlch Mawr, near Clynnog Fawr, Caernarvonshire, where they are received direct by radio from the BBC's television station at Blaen-plwyf, Cardiganshire. Llanddona retransmits the programmes on Channel 1 (vision 45Mc/s, sound 41·5Mc/s), using vertical polarisation, which means that viewers' receiving aerials should be mounted vertically.

TV Traffic Control for Essex Show

THE Essex County Constabulary installed a closed-circuit television control between Braintree and Chelmsford to assist them with traffic control during the Essex County Agricultural Show, which took place on 13th and 14th June. The TV camera was mounted on a 50ft telescopic mast and used to survey the approach roads and check on the density of cars in the three official parks. Monitor screens were installed in two police control locations and information was passed on to personnel on traffic regulation duties by radio telephone.

International Telefilm Show

THE International Telefilm Show Berlin took place from 25th to 30th June this year, within the frame-work of the XII International Film Festival Berlin 1962.

In technical co-operation with the broadcasting and television station "Sender Freies Berlin" particularly noteworthy productions of international television were transmitted daily.

Admitted under the regulations of the International Telefilm Show Berlin 1962 were only films that were telecast for the first time in their country of origin after 1st April, 1961 and which, in the opinion of the spectators and of the press of the respective country, are to be considered as last year's most successful TV films. The final selection among the entered telefilms was made by a Selection Committee in Berlin, composed of public personalities, the press, television, film industry and of the Academy of Arts.

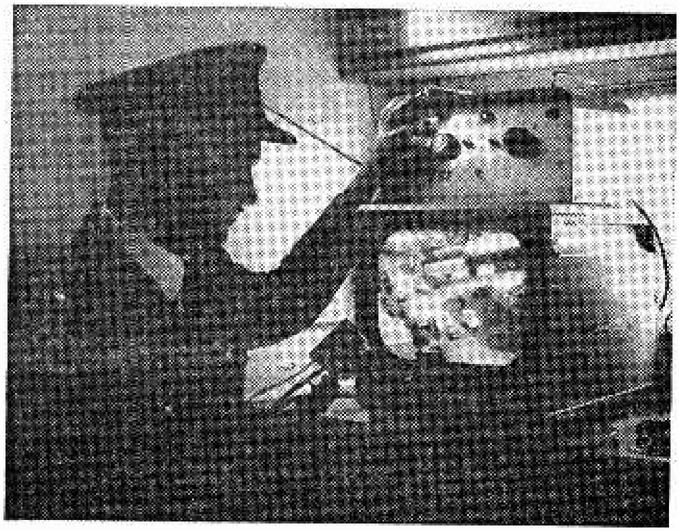
New ITV Aerial for London

LONDON is to have a new Independent Television transmitting aerial. This will increase the strength of signals received in north and northwest London, Middlesex, Hertfordshire and Buckinghamshire.

The existing installation at Croydon is being replaced by a 500ft. tower which the Independent Television Authority ordered from EMI Electronics Ltd. This contract includes the supply and installation of the tower, aerials and feeder systems. EMI commissioned British Insulated Callender's Construction Ltd. to supply and erect the tower. EMI will equip the tower initially with one aerial array, of 80ft aperture, to transmit in Band III the existing Associated-Rediffusion and associated Television programmes on Channel 9. The special aerial array will use vertical polarisation.

In addition, the tower will have provision for the fitting of a second Band III 80ft aperture array, and will be capable of supporting two UHF aerials for transmitting in Bands IV and V.

It is expected that the new aerial will take over transmission towards the end of this year.



One of the monitor screens of the closed circuit television system used to help in traffic control at the Essex County Agricultural Show.

Welsh Independent Television

A LARGE amount of equipment for the new independent television service for West and North Wales, which is scheduled to begin later this year, is being supplied and installed by Marconi's Wireless Telegraph Co. Ltd.

For the Independent Television Authority the company are providing two transmitting stations, one at Bryn-y-chain, in Caernarvonshire, and the other in Flintshire.

The installation at Bryn-y-chain consists of two 500W (peak vision) Band III translators in parallel, with two further translators, also in parallel, to act as standby equipment. This installation is designed for fully remote control and will be operated unattended.

The station in Flintshire will use two 500W (peak vision) Band III transmitters in parallel to carry the programme service, with a second pair as standby. The signals will be radiated from a Marconi 16-stack (twin 8) aerial array supported on a 750ft mast.

Wales (West and North) Television Ltd., who will be providing the programmes, have ordered a substantial quantity of studio equipment from Marconi's.

SERVICING DATA AND MODIFICATIONS

By D. Elliot

LINE AND FRAME DEFECTS

(*Continued from page 486 of the July issue*)

A FAULT which has been reported on numerous occasions in the Ferguson 406 series is worth bringing to light. The symptom is that, although the sound and raster remain perfectly normal—with the brightness control working as it should—the vision modulation fades out leaving an unmodulated and unsynchronised raster. The fade out may be sudden or gradual and there may occur a total collapse of picture signal or a trace of picture may remain on the screen when the trouble appears.

In almost all cases, the trouble is caused by a dry joint on the video coupling coil from the detector to the control grid of the video amplifier valve (see Fig. 25). The trouble can often be proved very quickly by gently prodding around the terminations of the coil with a plastic probe, such as a plastic knitting needle, thereby revealing the poorly soldered connection. Resoldering after cleaning the coil wire and its connections thoroughly—clears the trouble. It is wise to check the other two chokes (L1 and L2 in Fig. 25) while the chassis is under examination.

Beware of Electric Shock

During the course of tracing a fault in any A.C./D.C. television receiver, it is invariably necessary to remove the aerial plug from the socket. On many sets the plug is a tight fit in the socket, and its removal demands holding the socket in one hand and the plug in the other and pulling hard. To do this a tight grip is essential which, under certain conditions, can be dangerous. As soon as the connection is broken, continuity continues to exist between the plug and socket through the body of the operator. This is of little consequence if the aerial isolation components are in order, and the mains is connected to the set so that the neutral is connected to chassis. However, if the isolation capacitor is short circuited (see Fig. 26), then the full mains voltage will exist between the aerial socket and earth. Owing to the good (and possibly moist) connections between the plug, the socket and the body of the person removing the plug, such a shock is liable to prove fatal, depending upon how well the aerial system is earthed.

Even if the isolating capacitor is without fault, a shock may still be obtained if the "live" side of the mains supply is connected to chassis. This is because the isolating capacitor has a certain capacitive reactance to 50c/s (which is rather like resistance from the D.C. point of view), and although the reactance will be fairly high—since capacitors above 0·005μF should never be used for isolation—the resulting shock can be extremely unpleasant to say the least!

A severe leakage—due to a short in the isolating component—would eventually blow either the set fuse or the house fuse provided the aerial was adequately earthed—as it should be anyway. One case has been reported where the set could be switched on and off by inserting and removing the aerial plug.

Negative Picture on Ferguson 725

If this symptom is accompanied by failure of the contrast control; that is, the control has no effect on the contrast, which remains at maximum irrespective of the setting of the control, then a fault in the vision AGC system should be suspected.

Vision AGC for this model is obtained from the negative voltage developed across the grid resistor of the sync separator valve, and the contrast control functions by reflecting a positive voltage on to the AGC line to neutralise the negative voltage to a degree dependent upon the setting of the control.

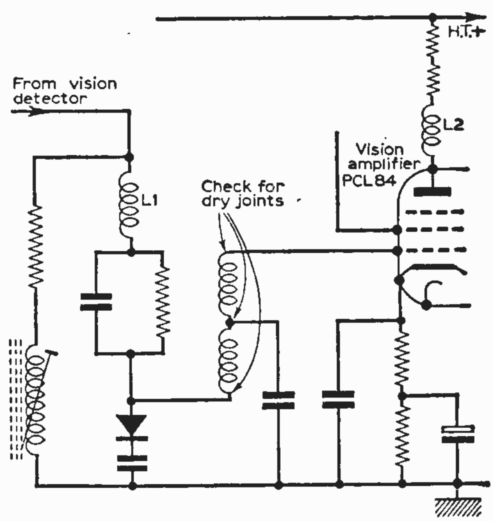


Fig. 25—Check for dry joints where indicated in the event of vision fade-out on the Ferguson 406 series.

The first thing to check is that the positive voltage at the slider of the control, relative to chassis, can be swung from zero up to a positive maximum by rotating the control. If it cannot, then both the control and the H.T. feed resistors should be investigated. If the voltage varies correctly, however, the fault must lie on the AGC line proper, and the most likely cause is either a short or leak in the AGC line by-pass capacitor or a fault in one of the controlled valves. In the latter case, a valve may develop a defect which results in its control grid going slightly positive, thereby permanently neutralising the negative voltage of the AGC line and making the contrast control wholly or partly ineffective.

Poor Sound Quality on Ferguson 438T

There are two chief causes of this fault, one being a leak in the A.F. coupling capacitor (0·1μF) connected to the control grid of the sound output valve. The other cause is an open-circuiting or increase in value of the 2·2M resistor connected in the sound interference limiter circuit.

The symptom from both causes may gradually develop as the set warms up, the quality being reasonable to start with but becoming very bad with time.

Striations on Ferguson 996T

If the vertical shading effects spread right across the screen and can be altered slightly by adjusting the line linearity magnet at the rear of the chassis, the trouble is almost certainly caused by open-circuiting or increase in value of the 910Ω resistor across the line linearity inductor. It should also be mentioned that a fault in the line output transformer can also cause striations, but in this case they are not altered by adjustment of the linearity magnet. Here a fracture in the core of the transformer should be suspected, which may also give low width.

Line Stabilising Defect in Ferguson 506T Series

These models feature a line stabilising control connected in the control grid circuit of the line output valve. The circuit is to reduce amplitude variations due to ageing valves or mains voltage fluctuations (see Fig. 27). Use is made of a voltage dependent resistor (VDR) which, in effect, rectifies some of the line pulse voltage at a tap on the line output transformer and then uses this as a bias for the line output valve. If the pulse decreases, then there is less bias and more effective drive at the valve grid and, conversely, less drive if the pulses increase. This is rather like a kind of AGC system in the line output stage.

The control should be set after letting the set warm up properly by first turning the control fully clockwise and then setting the width control for a slight overscan. At this stage a meter (with 20,000Ω/V sensitivity) should be connected between the boosted H.T. line and chassis (at point "X" on Fig. 27) and the voltage noted. Finally, the line stabilising control should be adjusted slowly anticlockwise until the boosted H.T. voltage drops by 30V.

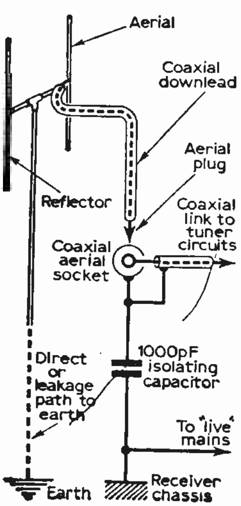


Fig. 26—A short in the isolating capacitor can cause the mains voltage to exist between the aerial socket and plug, as shown. The normal reactance of the capacitor may also cause a nasty shock if the chassis is connected to the "live" side of the mains supply.

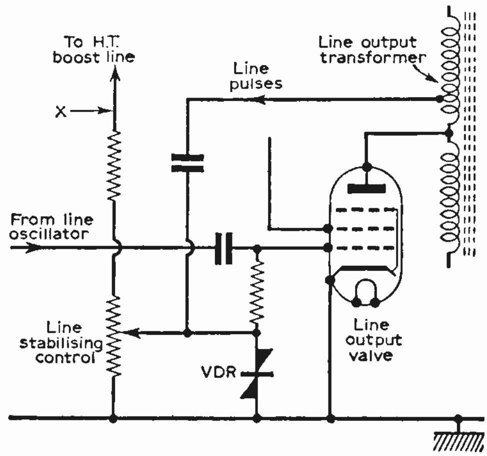


Fig. 27—The basic circuit of the line stabilising system used in the Ferguson 506T series.

If this cannot be done, then there is a defect somewhere in the circuit, and the VDR should be checked by substitution. However, the control itself sometimes goes wrong. This may cause the width to decrease badly so as to leave a gap of an inch or so either side of the picture. If now a rapid movement of the stabilising control restores the width for a while, the control itself should be examined, for in several cases a minute crack appeared in the top end of the track, which causes an alteration in resistance — hence in the amplitude of the line scan—with temperature increase.

Frame Stabilising Defect in Cossor 950 Series

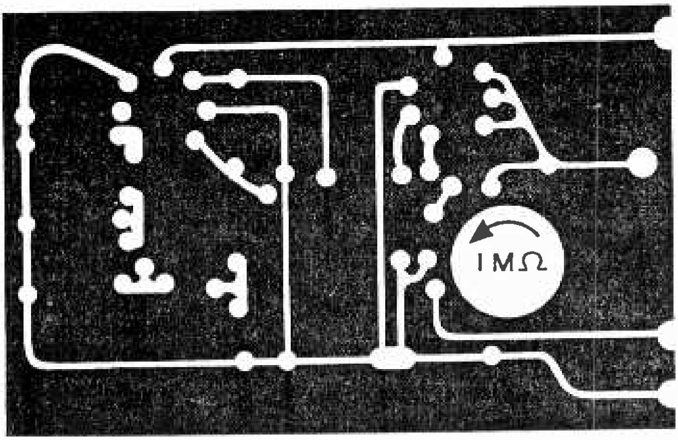
It is a well known fact that the resistance of copper wire (and other metal conductors) increases with increase in temperature. This gives rise to problems in the frame timebase, for as the windings of the frame scanning coils warm up, so their resistance increases and causes a reduction in frame scan.

The Cossor model 950 overcomes this effect by the use of a thermistor connected between the earthy end of the frame output transformer and chassis. The thermistor is located above the mains dropper where it is able to sample the ambient temperature within the chassis and change its resistance accordingly. A thermistor, it will be recalled, has characteristics opposite to those of metal conductors, in that its resisance *decreases* with increase in temperature. Connected as explained, therefore, it serves to neutralise the increase of the resistance of the frame coils and

(Continued on page 527)

MAKING PRINTED CIRCUITS

A PHOTOGRAPHIC METHOD



A PHOTO-RESIST PROCESS SUITABLE FOR THE AMATEUR CONSTRUCTOR

By N. Mears

(Continued from page 474 of the July issue)

LAST month's article ended with a list of materials required for the process, and now the complete operation is described step by step.

First, from the circuit drawing, a good tracing should be made using drawing instruments and Indian ink. This should be as accurate as possible. Then all the parts *which are to be etched away* are blacked in with Indian ink, leaving conductors clear. The drawing prepared is thus similar to a photographic negative. Care is needed so that all conductors are continuous as required; if a line of ink interrupts one it will have to be pared away with a sharp knife very carefully. The finished drawing must be inspected against a light to make sure that all areas intended to be covered are in fact sufficiently opaque, and that no pinholes exist in the ink coating. The drawing is then put to dry.

Preparation of the Resist

While the ink is drying, the circuit board is prepared. If "Glitseal" is to be used as the resist, a little is poured into a glass tube and thinned with about a quarter its volume of methylated spirit. To the mixture is added a few crystals of the violet dye and the tube shaken until complete solution has taken place. The colour should be a deep violet through which a 60W bulb can barely be seen. The dye is merely to render the resist easily visible on the copper foil. At the same time a gelatine solution is made up by dissolving a bare teaspoonful of powdered gelatine in a fluid ounce of warm water, and a sensitising solution made by dissolving a piece of ammonium bichromate about the size of a pea, or a little bigger, in half a fluid ounce of warm water. When both gelatine and bichromate are thoroughly dissolved, the two solutions are mixed together. The mixture will keep for a few days provided it is kept in a dark-coloured bottle away from heat. After some hours it will gel, but for use this can be overcome by gentle warming in a bowl of warm water. The mixture is best kept still because air bubbles trapped in it are a long time in disappearing, and air bubbles are a great nuisance.

The copper-clad laminate is now scoured carefully with a piece of cotton wool and household scouring powder to which a little detergent has been added. When the laminate is clean enough for use, the water used for rinsing it should form a complete film; no "water-break" must occur. The surface is now dried by means of clean blotting paper or a current of air, and when quite dry is coated *thinly* with a layer of the violet solution, using a brush. The coating will take about an hour to dry, but it is preferable to leave it for a longer period. When quite dry, a little of the warmed gelatine solution is poured on to the surface and spread out evenly with the finger so that a very flat and even layer is obtained. Any excess should be poured off one corner of the board and the whole put in a dust-free place to dry. It is essential to use artificial light—not fluorescent light—during the gelatine-coating process, but ordinary room lighting will not fog the plate in any practical time.

If plain shellac solution is to be used instead of the "Glitseal" polish it should be made up by dissolving a little shellac in some warm methylated spirit. The mixture should be easily poured; a thick mixture is no good. It should be filtered through a loose plug of cotton wool and crystal voilet added to colour it.

Exposure

When the gelatine layer is quite dry—not merely gelled—the laminate is placed copper side upwards on a firm but not hard surface, such as a magazine.

The ink drawing is next put on top of it, and a sheet of fairly thick Perspex or glass placed on top to secure a good pressure contact between the drawing and the gelatine. The next process is the exposure to actinic light.

If an ultra-violet " sun " lamp is available, an exposure of about four minutes is sufficient at a distance of a foot. If one has to rely on sunshine it is best to do the exposure in the morning when dust in the atmosphere is less and the content of ultra-violet light is higher. At 10.30 a.m. in the winter an exposure of about an hour—the plate lying flat on the ground—is about right; on a summer morning half this would be sufficient. However, a few trials will doubtless be needed since all readers do not live in the country where the air is clear and exposures may well have to be lengthened in some places. If on development, it is found that exposure has been insufficient, the laminate may be cleaned off with a small scrubbing brush and hot water, re-scoured to clean up and re-coated with lacquer and gelatine for a further effort. As an alternative, a step-wise test exposure, in the manner of a test strip in photography, can settle the exposure question quite quickly.

Development

Development consists first of washing off the gelatine which has not been hardened by light. This is done in water at 40°C—this temperature feels hot but not uncomfortably so to the hand. Two to three minutes will be sufficient. The plate is now allowed to dry thoroughly once more. When completely dry, the second stage is carried out by pouring on to the surface a small pool of methylated spirit and spreading it out until it covers the plate. Gentle rubbing with a small plug of cotton wool will now remove the lacquer from the places not protected by the hardened gelatine. A second and third wash will be needed, using clean methylated spirit, to remove all traces from the copper foil. At this stage the pattern of the printed circuit will be easily visible.

It is probable that at the first attempt there will be some imperfections in the pattern. If not too bad or too many the plate may be used after re-touching with some of the lacquer on a fine brush. If however the blemishes are too extensive or too many, re-touching can be a tedious business, and it will probably be found quicker to clean off the laminate and start again.

Faults Encountered

With only a little practice excellent results can be achieved. Principal faults include the following:

(a) After water-development, the circuit pattern is visible but spirit-development fails easily to reveal the bare copper pattern. This is due to over-exposure.

(b) The lacquer film comes off in places when water-developing the gelatine. This is due to insufficient cleaning before coating.

(c) The image is much more readily developed in some parts of the plate than in others. This is due to too thick a layer either of gelatine or lacquer.

(d) Water development reveals the image but subsequent spirit development takes off all the lacquer coating. This may be due either to under-exposure to light or to the use of too old a gelatine solution.

(e) Water-development reveals the image but when spirit is applied, the image is marred by blotches where the film should have been but has washed off. This is due to uneven coating with gelatine or to under-exposure, or to too hard rubbing with the cotton wool.

When a good image has been obtained, the etching process is undertaken. Experiments show that the fastest etch in ferric chloride solution is obtained when the solution contains 30 per cent ferric chloride. As bought, the ferric chloride is in its hydrated form which increases the weight required to make a solution of a given strength. If four ounces of ferric chloride is obtained—a quite convenient amount—it will need to be made up to a solution of volume 16oz. and the water should be adjusted after adding one tablespoonful of concentrated spirit of salt—hydrochloric acid. In this solution a complete etch of foil 0·003in. thick is accomplished in 12 minutes if the dish containing the fluid is rocked continuously once per second. If stirring is violent the etch will be speeded up. It is not advisable to leave the dish to stand or else the etch may well take an hour or more; clearly the less time taken, the less chance there is of the lacquer coating failing.

After the etching process is complete, the board is removed from the solution and washed thoroughly under running water for a few minutes, after which the lacquer may be removed by scrubbing under hot water in case some gelatine has survived the etch bath, followed by a spirit wash and final cleaning up with some scouring powder and water. When dry, assembly of the circuit can commence.

Alternative Procedure

When large areas of copper are to be etched away, correspondingly large areas need to be blacked out in the drawing. The application of a sufficiently dense and even coating of Indian ink over large areas is a difficult matter and, if ordinary tracing paper is used, the problem of cockling arises. In such cases it will probably be best to use such a paper as Permatrace and to use poster-paint instead of Indian ink. Poster-paint however tends to crack if the paper is flexed too much, so care will have to be taken to keep it reasonably flat. As an alternative, some success has been had by depositing dyed gelatine direct on the foil and, after exposure under a " positive " drawing (conductors in black) and water-development in the usual way, lacquering in the conductors direct—using the gelatine as a stencil. Hot washing-soda solution will remove the hardened gelatine leaving the resist-covered conductors behind. However, plastic laminates do not stand up too well to alkaline solutions, and a trial run with some pieces of scrap laminate is advised as a preliminary.

The illustration (page 517) shows a simple circuit board produced by the two-layer method described in previous paragraphs. Little re-touching of plate or finished circuit has been done; most defects seen are due to imperfections in the drawing—the writer makes no claim to be an expert draughtsman! That there are imperfections is clear, but it should be noted that this was a deliberately-chosen difficult circuit because of the large areas to be etched away. More normal circuits would present an even better appearance with much less difficulty. ■

The ABC of TV Circuits

AN ANALYSIS OF THE DEVELOPMENT OF TELEVISION CIRCUITS

By T. L. May

THIS new series will deal with TV circuits old and new. It will discuss the various circuit refinements which have found their way into TV sets during the last five or six years and describe the operation and the merits of circuits and show how they may be incorporated to bring old models into line with current practice.

Bright Spot Suppression

The bright spot or pool of light which lingers in the centre of the screen after the set has been switched off has always been a matter of some concern to both the viewer and the manufacturer. Before the days of the ion trap assembly and aluminised screens, the repeated occurrence of this effect resulted in the centre of the screen becoming progressively less sensitive, and ultimately a dark patch appeared which was said to be an ion burn.

Ion-trap and aluminising techniques minimised the trouble, but, even so, the energy retained in the electron beam after switch-off could still be sufficient to impair the efficiency of the screen at the centre or cause a pin-point burn mark.

When a TV set is switched off, the timebases cease working almost immediately, since they take quite a lot of H.T. current. However, the tube cathode continues emitting electrons for a while because it takes a little time for the cathode to cool down. EHT voltage also remains on the tube owing to the charge stored in the EHT reservoir capacitor, which may be a high-voltage capacitor or the capacitance given by the inner and outer conductive coatings on the tube with the glass as the dielectric. These factors, of course, are responsible for the undeflected illumination.

Several manufacturers have solved the problem very cleverly, as shown in Fig. 1. Here the ordinary on/off switch is coupled to the brightness control, and so far as the mains power is concerned the double-pole switch works in the ordinary manner. However, instead of the bottom of the brightness control being returned direct to chassis, it is connected to the neutral side of the mains supply. Thus, when the set is switched on, the brightness control and power supply circuits work as they would do in any set.

Rapid Discharge

However, when the receiver is switched off, the picture tube grid rises immediately to the potential of the H.T. line (there is no current in R1, R2, R3 and R4—because the bottom end of R2 is now not connected—and, therefore, no voltage is

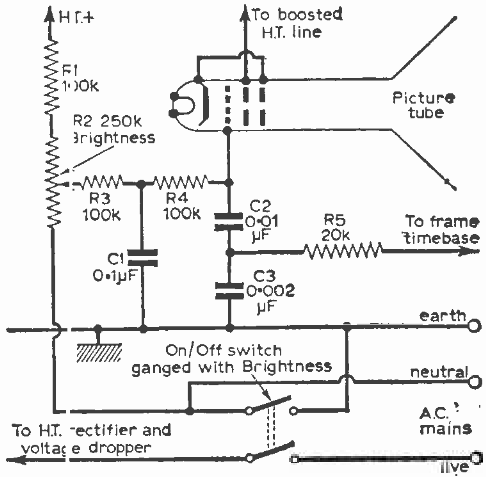


Fig. 1—This circuit was designed to eliminate the bright spot or pool of illumination which sometimes lingers on the screen after the set has been switched off.

dropped across the network and the grid voltage rises to that of the H.T. line). This results in a high beam current (or a relatively low impedance across the EHT circuit) which discharges the EHT capacitor quickly, and by the time the timebase deflections cease there is no EHT left to cause a stationary spot on the screen.

R1 is the ordinary brightness control resistor which is found in almost all sets, while R3, R4,

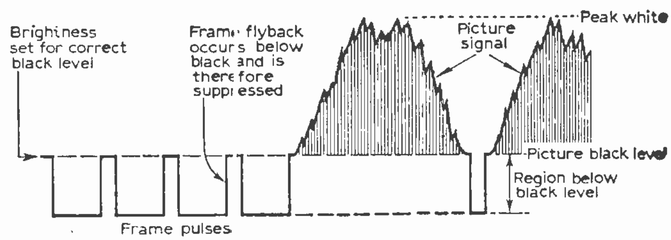


Fig. 2—If the brightness control is adjusted to coincide with the black level of the picture, the frame flyback will occur below black, as shown, and flyback lines will not be displayed on the picture.

R5, C1, C2 and C3 are concerned with line flyback suppression and, although not directly concerned with the circuit under discussion, were included for the sake of completeness.

This arrangement can be fitted to almost any model which suffers from a prolonged bright spot with very little trouble. It does not matter much whether the on/off switch is on the brightness control or the volume control. The same results will occur in either case. On switching off, the whole picture will momentarily become extra bright and then quickly collapse to zero illumination.

Line Flyback Suppression

Almost all recent receivers contain a circuit designed to eliminate the extra white lines of the frame flyback. Under normal conditions of operation, the brightness control should be adjusted until, with the contrast turned right down and the aerial removed, the illumination (raster) *just* disappears from the screen. This provides the correct setting for the picture black level. The idea is then to plug the aerial back into the set and slowly turn up the contrast until the best picture is obtained.

On sets which have no D.C. attenuation between the video amplifier and picture tube cathode, and provided the tube is in good condition, this method of adjustment works very well indeed. However, it is now in vogue to attenuate the D.C. component as a means of reducing fading and flutter caused by passing aircraft and to keep the tube cathode at the lowest possible potential relative to the heater. This means that it is often necessary to advance the brightness control beyond the theoretical ideal. This causes the display of flyback lines, and the effect is further aggravated by a worn picture tube, for then it becomes necessary to step-up the brightness simply as a means of countering the worn tube to obtain a picture bright enough to be viewed.

The flyback of the frame timebase occurs towards the end of the frame pulses sent out by the transmitter, so assuming that a receiver is adjusted for the correct black level, as described above, the flyback just cannot be recorded by the tube since it is held at beam cut-off by the "black" signal (see Fig. 2).

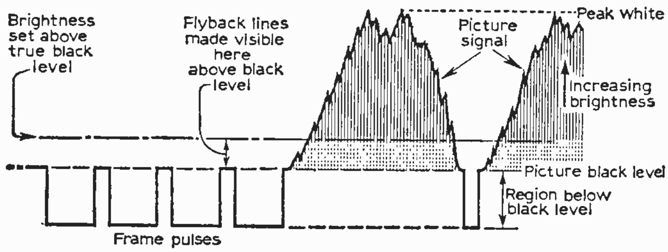


Fig. 3—This diagram shows how the flyback lines are rendered visible when the brightness circuit is set above true black.

Appearance

However, if the brightness control is set above true signal black, the tube will show a little brightness even when the video signal itself is at black level, and so the frame flyback — which occurs during the black level of the frame pulses—will be displayed (see Fig. 3). The flyback lines appear on the picture or raster as shown in Fig. 4, but it should be remembered that the raster must be under the influence of the transmitter sync pulses. A free-running timebase will, of course, give rise to random lines, but these are *not* true flyback lines.

Because very few viewers adjust the brightness control correctly, coupled with the reasons given in the foregoing, manufacturers have now designed the brightness control circuit in a way that it

(Continued on page 539)

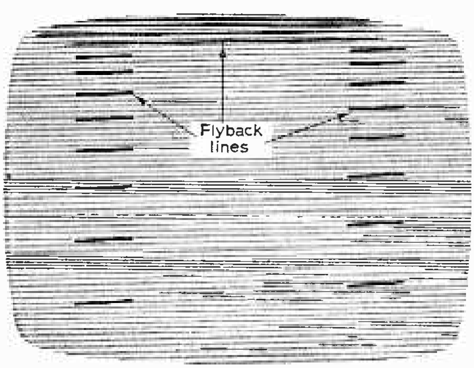


Fig. 4—Frame flyback lines are often displayed in this manner on a picture or locked raster.

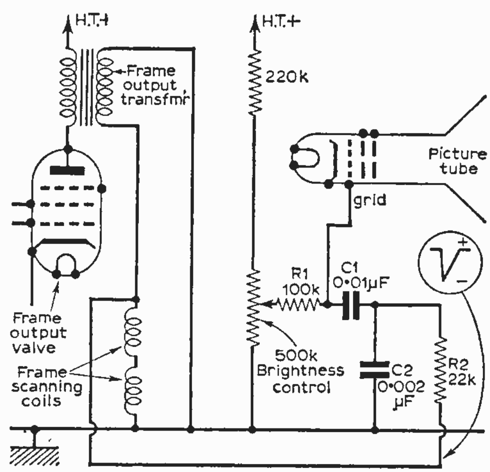


Fig. 5—The negative-going pulses from the frame timebase are fed to the brightness control circuit to cut-off screen illumination during the flyback period.

UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

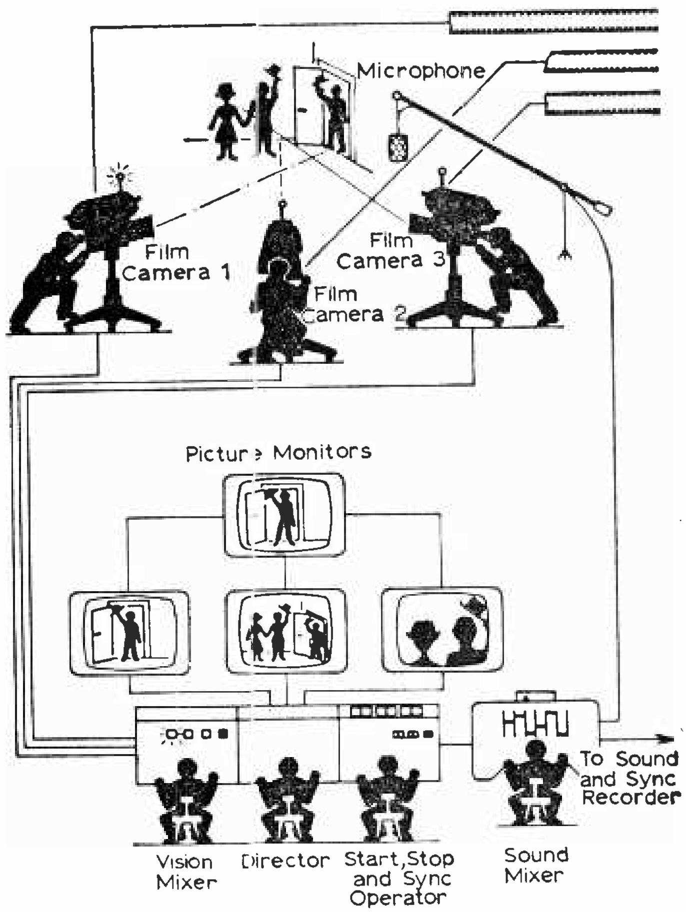
BY ICONOS

THE editing of TV tape is not an easy matter, as compared with editing the visible pictures on a film or a film recording. First, the position where a cut is to be made has to be located and marked, then a section of the tape subjected to a special development process to find the sync pulses. The same procedure is carried out on the other section of tape to be joined. Then the delicate operation of splicing has to be carried out, which is no quick operation. There is always the risk that the joint may come adrift—and later on, when the pictures are erased, nobody likes using it again for other programme recordings. Video tape, too, is expensive. There has been a trend towards the use of several tape machines for the patching together of taped sequences by a re-recording process.

This means that the editing can be done by placing reel A on one machine, reel B on a second machine, and using the third machine to record the composite output of the first two. On the RCA television tape recorders, any residual jitter can be reduced by a special Automatic Timing Control device. This is the method of tape editing which has been proposed for the elaborate new television tape recording suite at ABC-TV's studios at Teddington. This suite provides space in separate rooms for no less than six RCA tape machines, with an elaborate sound and vision console in the centre. Four machines are being installed initially. Each machine and operator will be visible through windows from the console position, thus avoiding the claustrophobic effect induced from parking machines and technicians in windowless cells. The console will be very flexible in the effects it can achieve, since the programme can be assembled with wipes, dissolves, fades, inlays and overlays in addition to cuts. Inserts from films on telecine or from slides or captions can be introduced with the greatest of ease. This is indeed a step forward.

Telerecordings

The BBC have been tackling the editing of recorded television programmes from another angle. They have made telerecordings from live TV cameras on to film of those programmes which have a world appeal and can be sold to such places as the USA, Australia,



The operation of Arriflex film cameras with electronic aids, for the production of films for television (see page 522).

Canada or any other English speaking country which has a television service. The standard of quality of 35mm telerecording has improved to an enormous degree, as may be judged by the quality achieved on such popular programmes as "The Rag Trade", "Ask me Another", "Brothers in Law", "Maigret" and "Discovering Science". The recorded 35mm film negative can easily be edited and prints made on 35mm or 16mm film for use anywhere in the world, without any restrictions due to line standards. Telerecordings are not easy to make and there are a great many links between the TV cameras and the final picture negative, a fault in any one of which could render the quality unacceptable. Neverthless, the BBC have steadily improved the reliability and consistency of telerecordings, and I have no doubt that they back it up with a TV tape recording, as a safety precaution.

625-Lines

We shall be reading and hearing a lot about 625-line transmissions during the coming months and years. Opinions differ upon the improvement in picture quality compared with 405 lines, and Sidney Bernstein, head of Granada, has put on record his opinion that we should stay put on 405. He envisages even greater advances in the years to come and would prefer to wait rather than make two changes. Those who have seen closed-circuit demonstrations on 625-lines will have noted the improvement in picture quality and the less obvious raster. But it was not until quite recently I had the opportunity of seeing 625-line transmissions on ordinary TV receivers. I was in Munich and watched the transmissions of Bayerischer Rundfunk on Channel 10 on a typical German mass-produced receiver, which included D.C. restoration and frequency modulated sound! Picture-wise and sound-wise the results were superb technically, though the programme content seemed to be of a lower standard than either BBC or ITV. Later, I went along to the studios in the suburbs of Munich, where they are situated in beautifully laid out grounds covering an area of several acres. There are five stages of various sizes, and Fernseh 3in. image orthicon cameras and associated equipment are used throughout.

Electronic-cam

A fair proportion of the programmes on Munich television are video-taped on Ampex machines, and some are photographed direct on to 35mm film with the ingenious Electronic-Cam system, used at the Bavaria Film Studios at Munich. This system uses electronic aids for multiple camera filming on 35mm film, with switching from camera to camera along the lines of normal television control room techniques, with the director viewing monitor screens and selecting his camera angle (see page 521). There are three or four film cameras, each of which has attached to it a small Fernseh vidicon camera which picks up the scene being photographed via the mirror-backed rotating shutter on the camera. The resultant negative is naturally superior to telerecorded film. The cameras are not yet quite so mobile as television cameras and the focusing is more critical. However, there are obvious advantages in this system, and with remote control focus and improved mobility, the system will have a great appeal for many types of programme. Filming with electronic aids is not a new development in itself and several such systems have been used in the USA and England, but the Electronic-Cam method had a unique cueing device which indicates and synchronises each camera as it is switched on and off. The cue-tracks are sound tones, recorded simultaneously with separate dialogue tracks on a sound tape. When all the separate sections of film are joined together in accordance with the cue-tracks, the programme is complete and in its correct order. The economy of film stock is obvious, as only the required sections are photographed. It would seem to me to have special advantages for colour television. By merely substituting colour film for black and white (and increasing the amount of artificial light) a studio could turn over to make colour television programmes on film with little extra expense.

The Derby

Who won the Derby? ITV or BBC? I saw both—the first one at the time of the race, and the second one a few minutes later, when the BBC reproduced their tape recording. On the whole, it seemed to me to be a dead heat; both failed to catch the disastrous falls of horses and jockeys, but both reproduced a fine selection of angles on the race and carried first-rate commentaries. Only one or two amateurs with 8mm cine cameras secured shots of the accident which led to a surprise result.

How TV Remote Control Works

THE VARIOUS ARRANGEMENTS USED BY MANUFACTURERS IN PROVIDING THIS LATEST FACILITY ON THEIR SETS

By J. Jones

(Continued from page 488 of the July issue)

LAST month, remote control systems connected by cable to the receiver were considered.

Cable-less Remote Control

Several receivers now feature remote control systems which are *not* connected to the receiver through cables. There are two kinds. One, the so-called "supersonic" arrangement where the remote unit generates a signal a little above audibility, while the second uses light dependent resistors (LDR) to produce the required control.

Both are very interesting and well worth consideration. In the supersonic remote unit either a supersonic oscillator or mechanical reed is contained which emits a supersonic note at about 45kc/s when the remote press button is operated.

The signals at the output of the microphone are amplified by valves and then used to operate a relay. The relay in turn switches power to the tuner motor, which continues to operate to the stop correspondingly to the channel previously set—rather like the Pye system previously described.

The Dynatron also features two more remote buttons, in addition to that for channel selection. One button increases the setting of the volume control in small increments, while the other button does exactly the reverse.

A block diagram of the overall system is given in Fig. 6, and the three functions are achieved by the use of three separate supersonic channels. The "channel-change" operation uses a frequency of about 40kc/s, "volume down" about 37kc/s, and "volume up" about 43kc/s. These frequencies are

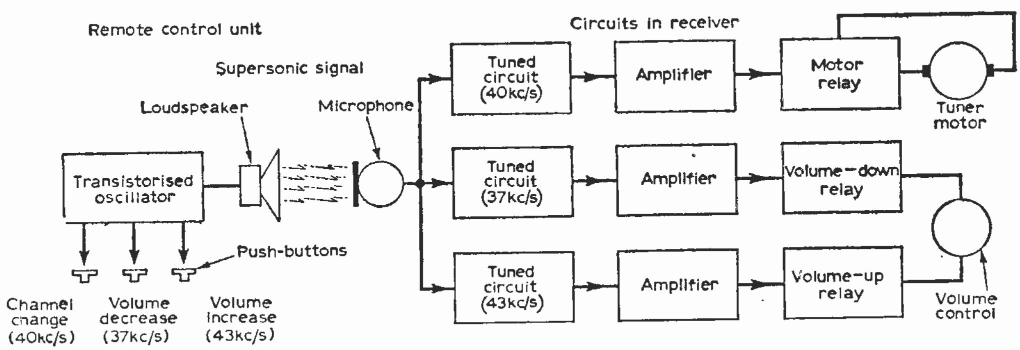


Fig. 6—The operation of a three-channel "supersonic" remote control system.

With the oscillator system, used by Dynatron and others, a self-contained battery-operated transistor circuit in the remote control unit produces the supersonic signals, and these are fed to a small, integral tuned loudspeaker. The signals are then picked up by a tuned microphone at the receiver.

produced at the loudspeaker of the remote control unit as required by the depression of the appropriate button.

At the receiver, three separate channels are again employed, and each one is preceded by a tuned circuit and followed by an amplifier and relay. Now, if, say, the channel-change button is pressed, the microphone will pick up the 40kc/s signal and pass it only by way of the 40kc/s tuned-circuit and corresponding amplifier. This causes the motor relay to operate and the channel on the receiver to change. The motor will stop, of course, at the pre-set position. If either the "volume up" or "volume down" button is pressed the microphone will again pick up the signal and only pass it on to that channel concerned. The volume control relay moves the volume control up or down in small steps as required.

Mechanical Arrangement

Auto-models in the British Radio Corporation series use a similar supersonic idea, but here the control signal is produced by a spring-loaded hammer striking a reed which is mechanically tuned to about 45kc/s. There is only one button which when pressed operates the hammer.

Light-operated Remote Control

The light-operated remote control unit consists of nothing more than a hand torch with a closed beam. On the Ekco models with this type of remote control, channel-changing is effected by directing the beam of the torch at a light-dependent resistor which is sited beneath an ambient light shield on the front of the receiver cabinet. When the beam is waved across the LDR about four times the channel is automatically changed.

In areas with a choice of three channels the torch is used a second time, and this, of course, applies when an unwanted channel lies between the channel in use and that required.

In Fig. 7 is given the full circuit of the arrangement. An LDR decreases in value when illuminated, and the flashing of a torch produces pulses which are amplified by V10A. The pulses are fed, via C1, to a pulse counting circuit comprising V14A

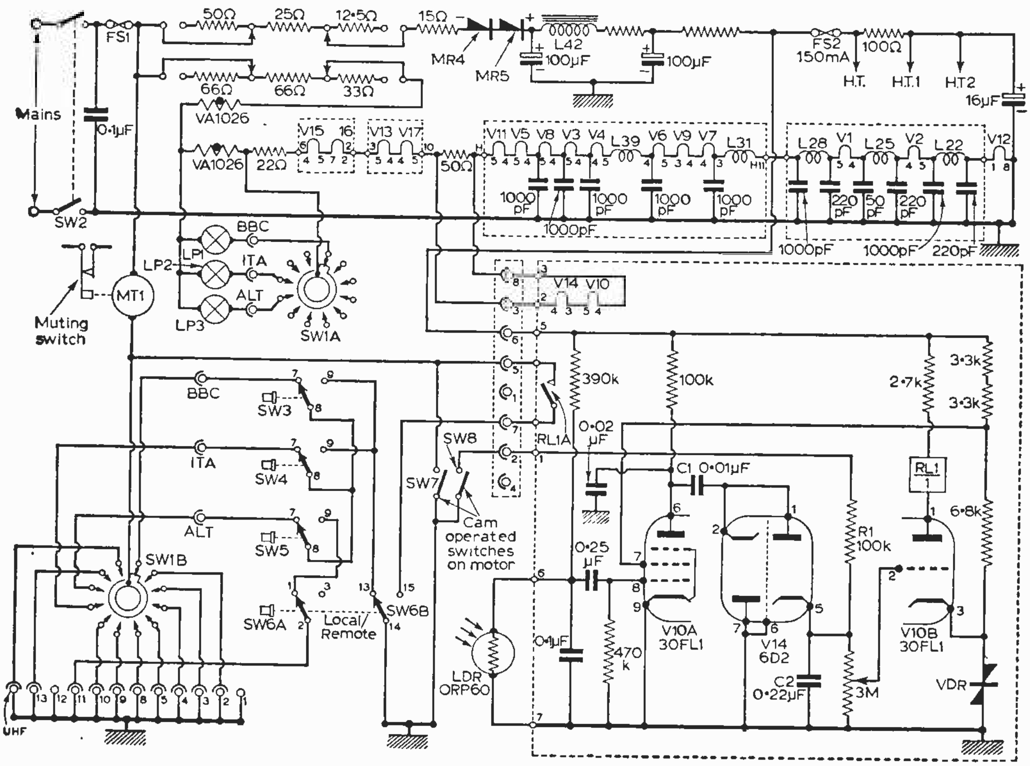


Fig. 7—The light-operated channel changing circuit of the Ekco series.

At the receiver is a microphone as before, but just a single channel amplifying system. Each time a signal from the remote control unit impinges on the microphone the motor relay is activated and the tuner rotates to the pre-selected stop. The set can also be switched off remotely, and this is achieved by pre-set studs in the motor drive. These are longer than the channel studs and thus engage in a toggle switch arrangement when the drive arrives at the position pre-selected.

and V14B. The pulses thus cause C2 to charge, and when the charge reaches a pre-determined value V10B is caused to conduct. This conduction energises the relay RLI/1 in the anode which in turn switches power to the tuner motor.

The motor and drive mechanism is shown in Fig. 8, and as soon as wheel C of the drive operates, switch SW8 (Fig. 7) closes and discharges C2 through R1, which causes the motor relay to de-energise. This causes the motor to continue running until SW1B (which is coupled to the motor drive) comes to the first vacant channel position.

Switch SW7 is also operated by wheel C (Fig. 8), and it is the function of this to determine the stopping position of the tuner motor when one of two adjacent channels has been selected.

On this range of receivers the remote control receiver unit is supplied in kit form and consists of the LDR (type ORP60), a small printed circuit sub-assembly and a closed-beam torch.

Philco models have a second LDR for muting sound, and the circuit is basically as given in Fig. 9. When the LDR is illuminated from a torch its resistance falls and ripple current from the unsmoothed H.T. line flows through C1 and energises the relay winding R/L. This causes the relay contacts RL/1 to adopt the position shown on the circuit, and since a small current flows from the H.T. line through R1, R2, the neon, D1 and R3, the neon is caused to glow. This current flow means that the diode D1 is biased for forward conduction, and due to this the audio across the volume control is by-passed through the diode and C2. The sound is thus muted.

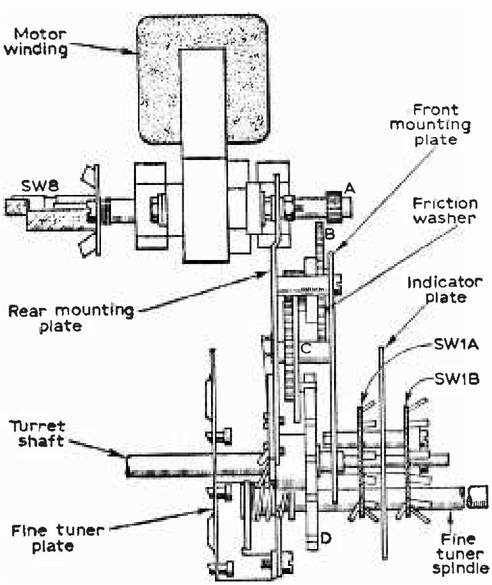


Fig. 8—The motor drive, gearing and switching of the Ekco sets.

If the torch is now given a further flash, a negative pulse occurs across the LDR when the light is cut off. This negative pulse speedily decreases the ripple current in C1 and the relay and it de-energises. Contacts RL/1 change over, the bias is removed from D1 and there is no longer an audio by-pass. Sound is thus restored.

The channel changing operation on the Philco is slightly different from that of the Ekco series. The motor relay is normally energised from the H.T. line and a network containing the LDR. When a

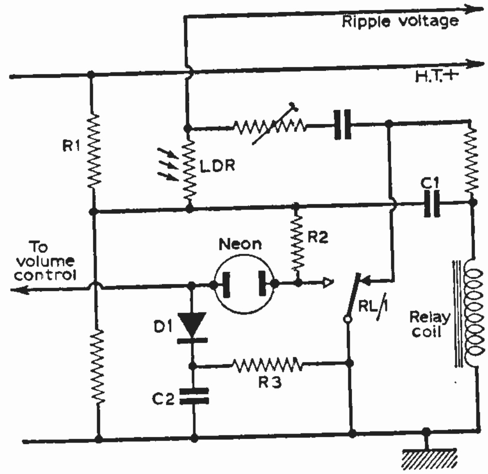


Fig. 9—The basic circuit of the sound muting light-operated remote control used in Philco models.

flash causes a fall of LDR resistance, the relay winding is de-energised, the relay changes over and the motor starts. ■

Servicing data & modifications

(Continued from page 516)

holds the total resistance of the circuit constant over a wide temperature range, thereby stabilising the frame scan.

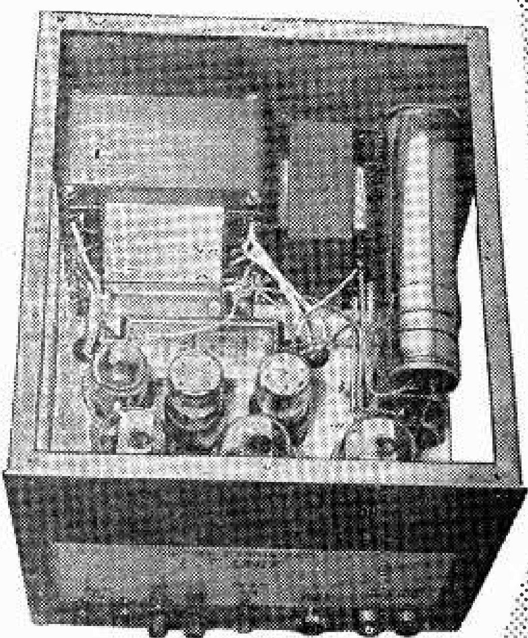
It can cause trouble, however, usually by cracking, and when this happens the frame either collapses to a thin wavy line or is reduced in amplitude. The state of the thermistor can be quickly determined simply by shorting it out. If this measure restores the scan, then the component should be replaced, but it does not do any harm if it is left shorted out while a replacement is being sought. Receivers other than the Cossor series incorporate the idea.

Frame Troubles in the Stella 6821 Series

A critical frame lock on this series can often be traced to an increase in value of the coupling capacitor connected to the grid of the sync separator valve. This does not affect the line lock by anywhere the same amount, and for this reason can be misleading. The component may also develop a leak which upsets the operation of the sync separator and puts it out of balance. Replacement and test should be made after first removing the suspect from circuit.

The 3.3M resistor connected in the frame hold circuit of this series is another vulnerable component. This sometimes increases in value and puts the frame hold control outside the locking range of the frame oscillator.

(To be continued)



An Ultra-

THIS unit is designed to give high output current at a voltage so highly stabilised that fluctuations are less than a fifth of a volt from no-load to full-load. The internal resistance is probably less than the domestic mains supply itself.

Introduction

The author has already described a comprehensive universal stabilised power unit, the "Experimenter's Power Pack", in PRACTICAL WIRELESS in recent months—January 1962 to July 1962 inclusive.* That unit involved stabilisation of the H.T. supply giving some 50Ω remaining internal resistance, as compared to the one or two thousand ohms internal resistance of normal unstabilised H.T. units. The value of 50Ω was considered adequate for the wireless experimenter dealing with the normal range of audio frequencies, and moderate current drains demanded by most domestic radio and audio-amplifier apparatus.

For the ambitious television experimenter, especially for the enthusiast interested in experimenting with closed-circuit TV-transmission equipment—or possibly in developing colour-television equipment—the "Experimenter's Power Pack" is likely to be inadequate, however. This is because such experimental television apparatus will embody dozens of valves, giving high total current demands, and also operation will be largely with high-current pulses containing video-frequencies. Thus a much higher degree of stabilisation will be required in the H.T. power supplies if many circuits are to be fed from the one supply instead of each having to receive its own power pack.

* *All of these issues are now out of print.—ED.*

The Present Unit

This unit is intended to meet these demands. It is ultra-stabilised, having a remaining internal resistance well under 1Ω, i.e. stabilisation at least 50 times better still than the "Experimenter's Power Pack". It uses a two-stage balanced D.C. error-amplifier, with the usual neon-tube as voltage reference, controlling three series-pentodes in parallel. The only serious disadvantage of this circuit is that no easy method of continuous variation of output voltage is possible. The whole circuit has to be balanced for optimum performance at one particular output voltage, as will become apparent in the course of this article. Thus, the "Experimenters' Power Pack" scored on this point, which was considered more important for wireless work than the extreme stabilisation possible with the present circuit.

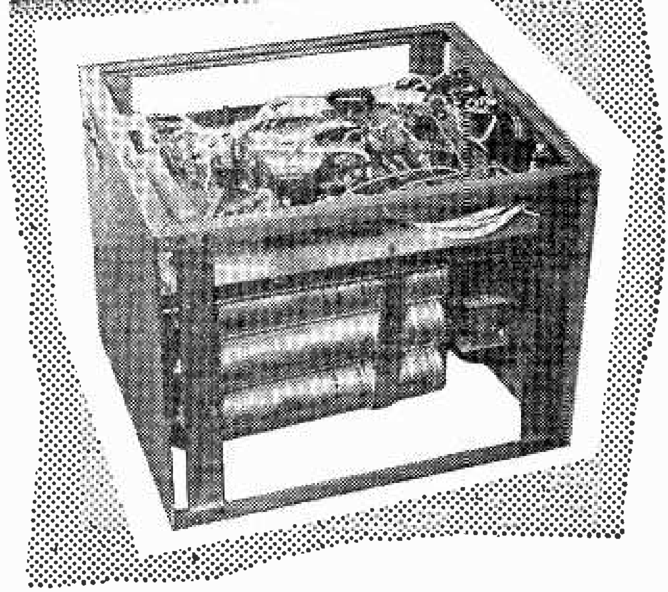
Variation of Output Voltage

The output voltage is, in the steady state, certainly variable by adjusting the setting of VR1 (see Fig. 1), but it will be found that a range of only ±50V at the most is possible, either side of the optimum voltage, before the stabilisation rapidly deteriorates. This applies to the stabilisation against *slow* drifts of load or input mains voltage. For fast changes of load, matters are even worse; stabilisation deteriorates appreciably already at a setting only some 10 to 20V above or below the optimum output voltage. This is the reason why VR1 is left as an internal pre-set, and not brought out to the front panel. It has to be carefully adjusted for optimum performance, as will be explained later.

The only really successful way to change the (optimum) output voltage is to choose a different type of neon for V1. The optimum output voltage will be roughly three times the running-voltage of the neon used for V1. Thus if a 90C1 is used instead of the specified OC3, the optimum output voltage would lie at about 250V instead of at 300V as in the prototype with the OC3. In that case, to avoid unnecessarily high dissipation in the three 6Y6's, the transformer voltage should be reduced to 350V. The values of R9 and R12 may then

[S]tabilised H.T. Supply

By M. L. Michaelis



have to be modified somewhat for optimum performance. Experiment showed such modifications to be well possible, but requiring careful individual trimming for each desired voltage.

Description of Fixed-Voltage Prototype

The circuit is based on an American publication, and has been modified in some respects after careful study of an experimental rig-up of the original circuit—which incidentally, appeared only as a theoretical circuit. The modifications finally made to produce the circuit given here were firstly a conversion to selenium rectifier operation, avoiding thereby the considerable extra heat from rectifier valves, and saving space and secondly an adaptation to enable preferred-value resistors to be used. A number of close-tolerance items specified in the original circuit were eliminated by means of introducing VR1 and the network around it, this enabling accurate trimming to optimum conditions to be carried out with the help of a sensitive multimeter and a variable stabilised H.T. supply as "backing-unit", or else with an oscilloscope capable of withstanding the full D.C. component at the Y-amplifier input. Trimming is thereby possible to exact optimum conditions, even if slight

COMPONENTS LIST

Resistors (All 1W carbons unless otherwise stated)

R1	*100Ω*	*R9*	*470k*
R2	*100Ω*	*R10*	*10k 10W*
R3	*100Ω*	*R11*	*10k 10W*
R4	*1k*	*R12*	*220k*
R5	*1k*	*R13*	*1M*
R6	*1k*	*R14*	*100k*
R7	*1M*	*R15*	*270k*
R8	*1M*	*R16*	*100k*

VR1 500k linear Pre-set

Select samples with actual values as close as possible to nominal values. Better still, use ±5% components.

Capacitors

- *C1 4μF 750V*
- *C2 4μF 750V*
- *C3 0·1μF 500V*
- *C4 0·15μF 500V*
- *C5 0·15μF 500V*
- *C6 4μF 500V*

Electrolytics are undesirable; use metallised paper components. 5μF types would also be suitable for C1, C2 and C6.

Valves, etc.:

- *V1 Neon OC3 (100-105V)*
- *V2 6SL7*
- *V3 6SL7*
- *V4 6Y6*
- *V5 6Y6*
- *V6 6Y6*
- *D1, D2 Selenium bridge rectifiers 400V A.C., 125mA. D.C.*
- *LP1 Pilot Lamp and Holder for 6·3V operation.*

Six good quality international octal valveholders.

Sundries:

Mains Transformer: 400V 200mA / 3 x 6·3V 4A, one centre-tapped. (or a suitable pair of smaller transformers).
Smoothing Choke: 15H 200mA.
2 Panel fuses, (insulated).
6 Insulated Sockets (3 black, 2 blue, 1 Red).

Mains Connector:

Single pole mains switch
Brass, aluminium, bolts for chassis and cabinet.
Wire, solder, sleeving, solder tags, etc.

inaccuracy of resistors exists, and the prototype was built successfully using normal ±20% carbon resistors. If possible, it is of advantage to choose resistors with values as close to the nominal values specified as is achievable.

Furthermore, a suitable layout in the smallest possible cabinet was designed, and a form of all-metal chassis and cabinet devised which should prove neat and robust, and not beyond the skill of anybody capable of brazing neatly, and of working accurately with simple hand-tools. It is not advisable to use a wooden cabinet for this unit, as it will become very hot during normal operation. If constructors do not wish to use the advanced metal cabinet design to be described. Any commercial metal housing and chassis of similar dimensions, or a home-made one of simpler construction, will be suitable.

Consequently the two anodes will be sharing the total cathode current equally. But it is easy to see then, that the voltage drops across R9 and R12 will be approximately equal, because R9 has about twice the value of R12, but is receiving only half the current. But the voltage drop across R12 is, by cathode-follower action from the grid (pin 4), just about equal to the neon voltage, 100V. Thus 100V is dropped across R9 too, and the grids and cathodes of V3 rest at almost equal voltages, as they should in the balanced condition. In fact, a tiny difference between grid and cathode voltages will be set automatically for V3. so that this valve draws sufficient anode current through R7 and R8 to give the main 6Y6 valves the correct bias. Careful study will show that slight displacements are self-correcting, i.e. the circuit is fundamentally stable, in that the resting point is one of true equilibrium.

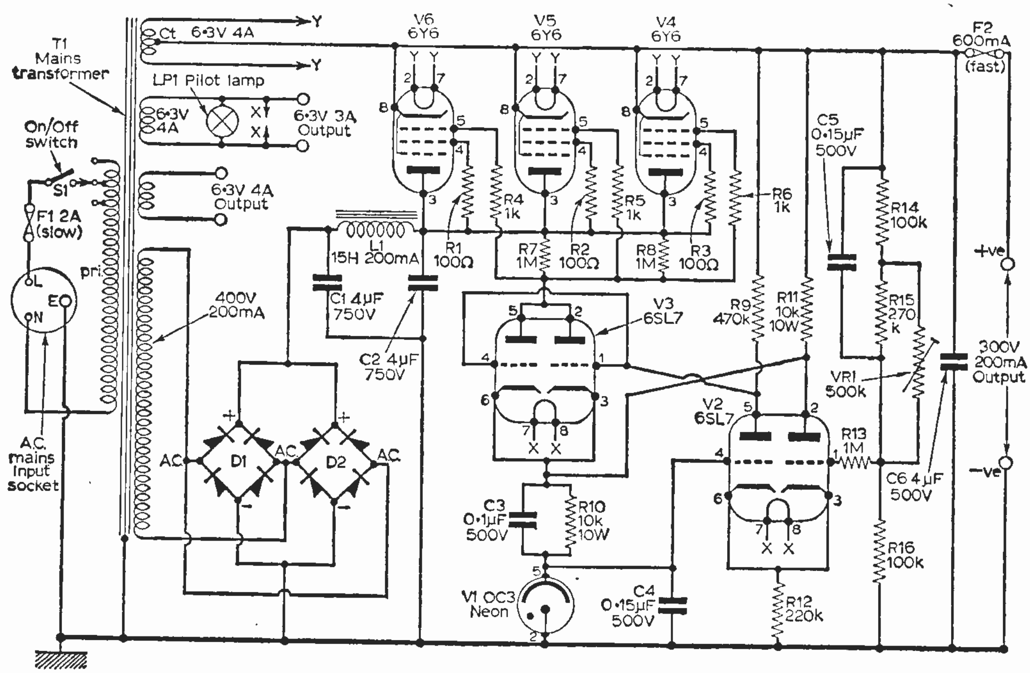


Fig. 1—The circuit diagram.

Circuit Principles

Fundamental to the circuit is the bleeder R11, R10 and V1 across the output voltage, dividing this output voltage into three virtually equal portions. The bottom third, which remains constant even if the output voltage should attempt to change, is the operating voltage of the neon, V1, and is applied to the grid (pin 4) of V2. The bottom two-thirds form the cathode voltage of V3 and the anode (pin 2) voltage of V2. The grid voltage for the other grid of V2 is obtained from another 3:1 voltage bleeder across the output voltage, one third appearing across R16. Now, since R16 is a resistor, and not a neon, any fluctuations in output voltage will be felt in full, which will throw V2 out of balance.

But suppose, for the present, all is well. The two grids of V2 are at virtually the same voltage. Nevertheless, the possibilities of "hunting" must be examined, i.e. repeated overshooting of the mark in alternate directions before coming to rest. The circuit was found never, under any circumstances, to "hunt" free, yet it shows strong over-critically damped hunting if VR1 is much displaced from the optimum position, in an attempt to obtain an output voltage differing much from the optimum one. This involves sharp transient kicks, of anything up to 50V in the output, if the load is changed suddenly, restabilisation taking place in a fraction of a second.

Transients

Such transient kicks upon rapid variation of the load simply mean that the A.C. internal resistance is appreciably higher than the D.C. value, and also produces phase-shift—all *very undesirable* features for a high-quality stabilised power supply. Furthermore, the extra A.C. internal impedance represented was found to rectify completely. In other words, if VR1 is set to give an output voltage well above the optimum, the output voltage gives a sharp transient kick downwards when a heavy load is switched on, but shows no reaction when this load is switched off again. The opposite takes place if the output voltage is set too low: no reaction takes place on switching a heavy load on to the output, but a sharp transient kick upwards takes place when this load is switched off again. These effects are connected with the asymmetric current sharing in V2, and hence the total asymmetry of the whole circuit, if the network R14, 15, 16 and VR1 does not divide truly 3:1—this rapidly leads to V1 and V2 running on to a non-linear part of the characteristics, as only a limited range of correction is possible over V4 to V6 in changing the output voltage. Hence, the loss of stabilisation after, at the most, a misadjustment of ·50V on VR1. The fact that transient kicks already start at a far smaller mis-adjustment of VR1 is explained by considering surges in C6; these cause temporary excursions of V2 or V3 even sooner into the non-linear field if the circuit is unbalanced.

Circuit Adjustment

The transient kicks are used to trim VR1 to the optimum setting. It will be found that these are absent only for a range some 5 to 10V either side of the optimum voltage output, and any setting in this range is suitable. A load taking at least 150mA should be wired in series with an insulated morse-tapper across the output, and VR1 adjusted for zero-kicks in the output voltage upon making and breaking contact with the key in rapid succession. If 300V does not lie within the zero-kick range, or is too near one end of it, check the actual values of R10 and R11 (equality is more important than precise values). Also check R9 and R12 (the ratio 2:1 is more important than precise values).

Two methods are available for observing the "kicks". Measuring the full output voltage on the appropriate range of a multimeter is not sensitive enough when VR1 is almost but not quite at the correct setting. This could leave appreciable internal A.C. resistance inadvertently. Thus, it is necessary to connect another (unloaded) H.T. supply of approximately equal (variable) voltage in series-opposition, to cancel most of the net voltage. The multimeter may then be operated on a far lower range, but the *greatest care indeed* is needed to avoid destruction of the meter. The following procedure should be adopted (see Fig. 2).

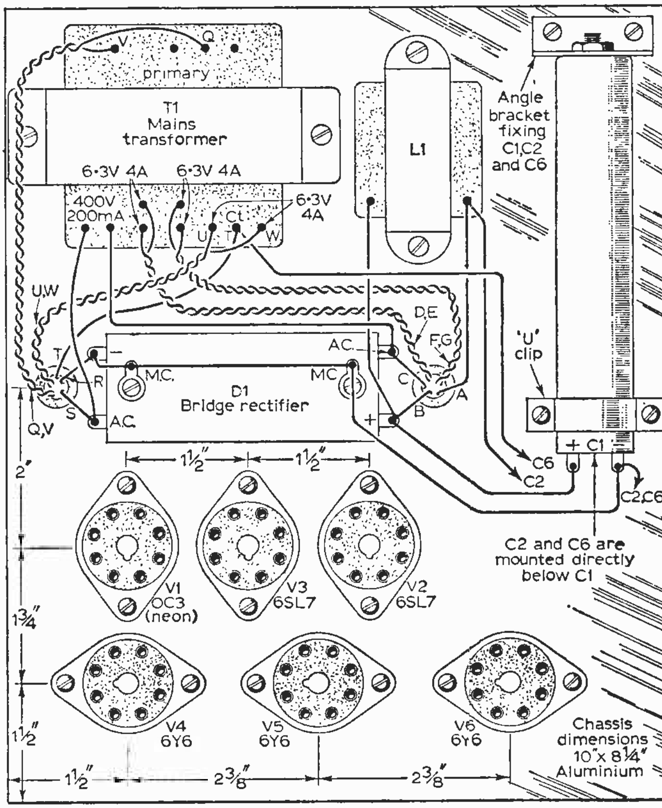


Fig. 3—The above-chassis layout of components.

(a) Connect the negatives of the two supplies together (common earth), and connect the multimeter between the two positives. The "negative" of the multimeter should go to the positive of the additional "backing-H.T." supply, and the "positive" to the positive of the unit described in this article. The meter will then show correctly any excess voltage which the present unit has above that of the backing supply.

(b) The multimeter must be on the 500V range, at least, at the time of making the above connection. The voltage of the backing-H.T. is then adjusted until no noticeable meter deflection remains.

(c) The meter is then switched down to the next lower range, and any deflection again removed by careful adjustment of the backing-H.T.

(*Continued on page 543*)

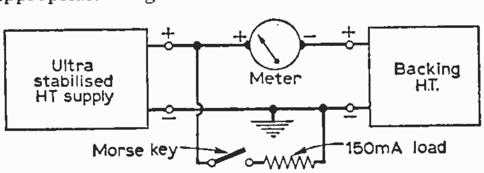


Fig. 2—Using a multimeter to adjust the power pack for minimum internal A.C. resistance.

SERVICING TELEVISION RECEIVERS

No 81—SOBELL TPS180 and series

By L. Lawry-Johns

THE series includes the Sobell TPS180 and McMichael MP18 which are portable 17in. receivers; the Sobell T278 and McMichael M74T table models; the Sobell T24 21in. table model; the Sobell SC270 and McMichael M74HFC 17in. consoles and the Sobell SC24 and McMichael M247HFC 21in. console receivers.

All models feature a fourteen position, three Band tuner unit which includes VHF/F.M. radio reception on Band II. This tuner was described in the August 1961 issue of *Practical Television*, the circuit being shown in Fig. 5 on page 566.

No Picture, Sound OK but No Raster when Brilliance Advanced. Receiver switched to TV

Listen for the line timebase whistle. If it is absent, check V12, V14, V15. If the whistle is audible, check for a spark at EY51 (V16) anode—single wire end. If a healthy spark is available, but V16 does not light up, or has an internal blue glow, change this valve, taking particular care with the soldered connections which must not have any sharp edges or wires protruding.

If, however, the EY51 is lighting normally, the EHT is probably in order and the fault elsewhere. Attention should then be directed to the voltage at the tube base socket. The cathode of the tube is pin 7 and the voltage to be expected here is very approximately 120, this being the anode (pin 6) voltage of the V6 video amplifier (PCL84). If this voltage is high, say 190, the indicators are that V6 is inoperative. Check V6, and if this valve is in order, check the V6 cathode (pin 7) voltage. If this is also high, it is probable that L7 is o.c. and this can be proved shorting it out. This is done by connecting the pin 7 end of L7 to the "hot" end of R37. The correct cathode voltage of V6A is 2·5.

Assuming the CRT cathode voltage is correct at about 120, pin 2 (or 6) should next be checked. This voltage should be dependent upon the setting of the brilliance control and should vary according to its setting from almost zero to something like 130. If the voltage remains low, check the voltage at the brilliance control itself. If this is correct, check C124 (0·005μF) which is the flyback suppression capacitor as this may be shorted. If the voltage at the control is low overall, check R115 (68k). If the voltage at the R115 end of the control

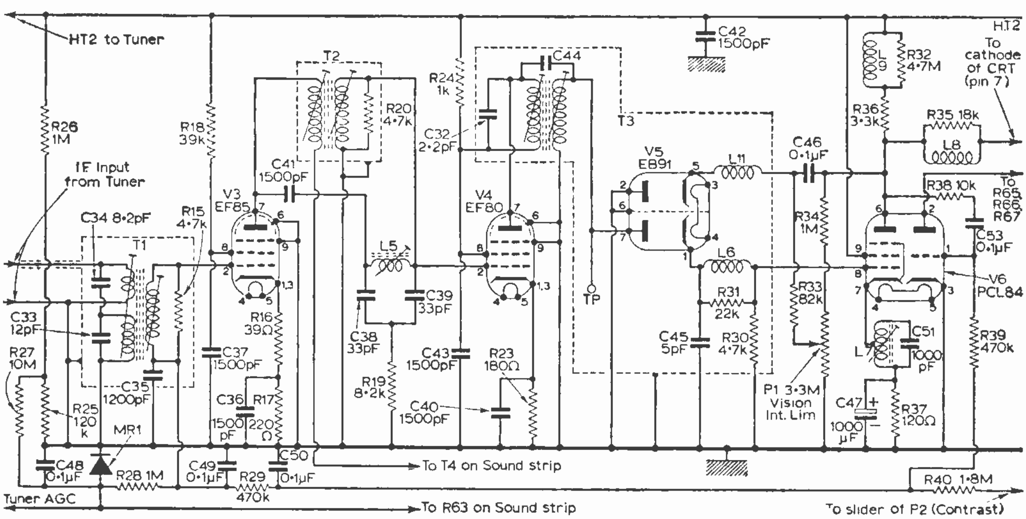


Fig. 1—The vision I.F. stage of the circuit.

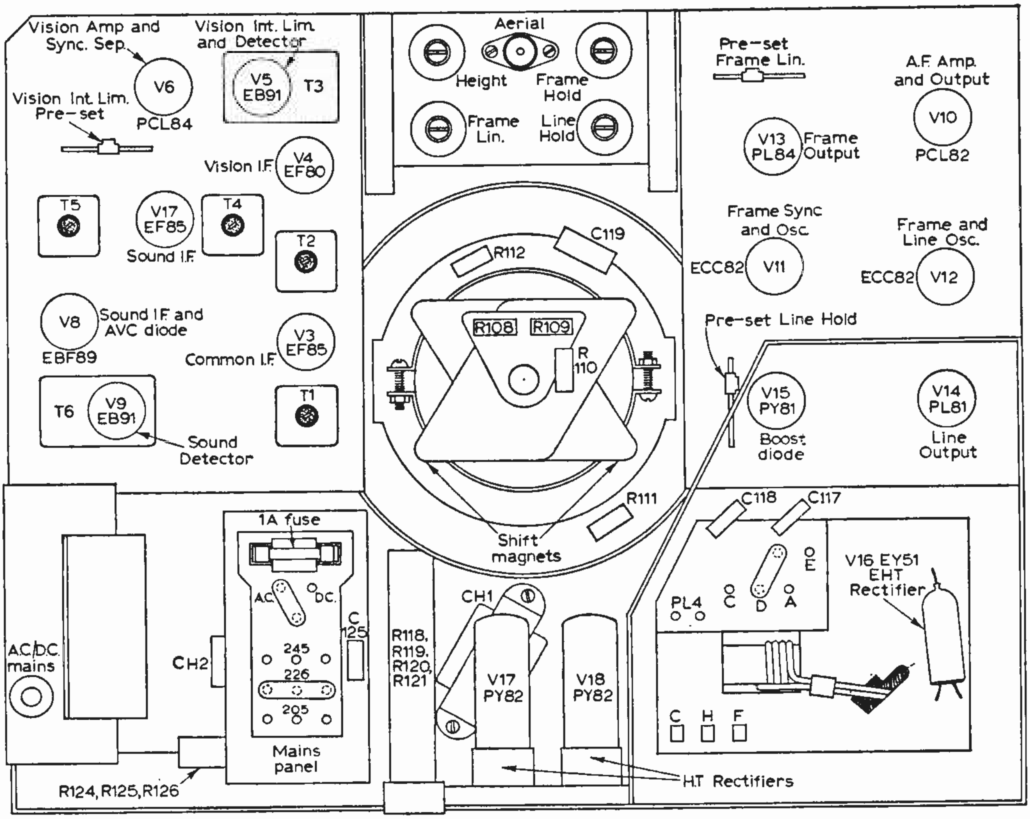


Fig. 2—The receiver viewed from the rear showing the position of the larger components.

is high, but the slider voltage remains low whatever the setting, replace the control itself which is o.c. at the H.T. end of the track.

The first anode pin of the CRT base is 3 and if a good quality meter is used, a voltage reading of about 400 can be expected with about 300V at pin 4 (focus electrode). If these voltages are low, despite the use of a sensitive meter, check C120 (0·1μF) which may be leaky or shorted to the H.T.2 line. As far as the tube base voltages are concerned, this leaves only the heater to be considered. The heater pins are 1 and 8, and an A.C. reading (assuming the set is operated from A.C. mains, of course) of 6·3V is to be expected. A reading of 3-4V with all the other valve heaters normal will denote a partially shorted heater which may or may not be sufficient to give some sort of weak response on the screen. A sharp tap on the tube neck may temporarily clear this condition as evidenced by the upward swing of the meter needle and the corresponding increased glow of the heater.

If the CRT base voltages and the EHT are in order, a raster must be displayed on the screen when the brilliance is advanced unless the tube itself is defective.

There is no ion trap magnet. If a clamping band and magnet is found on the tube neck, this is the alternative type of picture shift control and the rotary plates depicted in (Fig. 2) will not then be found fitted.

No Picture, Sound in Order, Raster Present

This condition, provided the brilliance of the raster is fully controllable, signifies that the vision signal is being lost between V3 and the CRT. V3 must be working to an extent since the sound is in order and therefore the V4, V5, and V6 stages should receive attention. A fault in the V6 stage will usually cause an alteration in the effect of the brillance control since the CRT cathode is tightly coupled to the anode of V6 and therefore the V4 and V5 stages are likely to be at fault. Check V4 and its anode and screen (pins 7 and 8) voltages (about 180). If absent, check C43 (0·0015μF) and R24 (1k).

Check the cathode voltages of V4 (pins 1 and 3) which should be roughly 2V. Check the EB91 (V5) ensuring that both heaters are glowing. Check also the continuity of the panel connections to and from pins 1 and 7.

Check (by bridging with a known good capacitor) C40. C42, C43 (all 0·0015μF).

Brilliance Control will not Fade out Raster

It is under these conditions that V6 is to be suspected. The high level of brilliance denotes (probably) low V6 anode voltage. This may be due to oscillation in the V4 stage (check C42 and C43), an o.c. in the video anode choke L9 (wound over R32), high resistance anode resistor R36 (3·3k), or a short across the bias components. C47 (1,000μF) may have shorted or R37 (120Ω) may have changed value to a low figure. The C.R. tube could have developed a heater-to-cathode short in which case the V6 anode voltage will return to normal when the lead to pin 7 of the CRT base is removed.

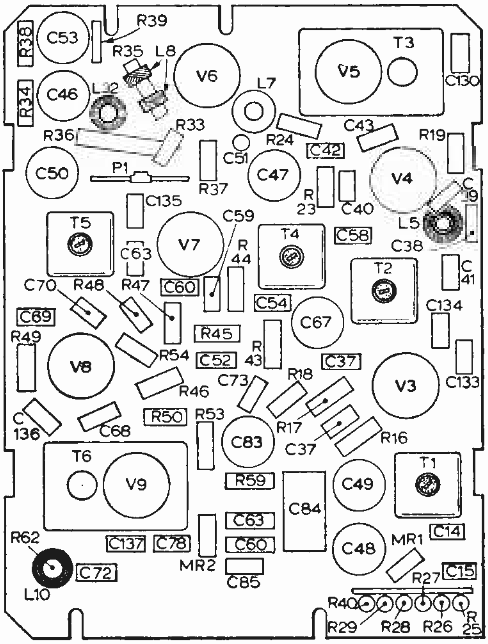


Fig. 3 (above)—The layout of the I.F. panel with all the components.

Fig. 4 (right)—Details of the timebase panel.

Raster Normal, No Sound or Picture

Check the tuner unit valves, particularly the PCF80, and then check V3 EF85 and its supply voltages—pin 7 180V, pin 8 about 100V, pins 1 and 3 between 2 and 3V.

Weak or Grainy Picture

Check as above, particularly the PCC84.

Picture in Order, No Sound, TV or F.M.

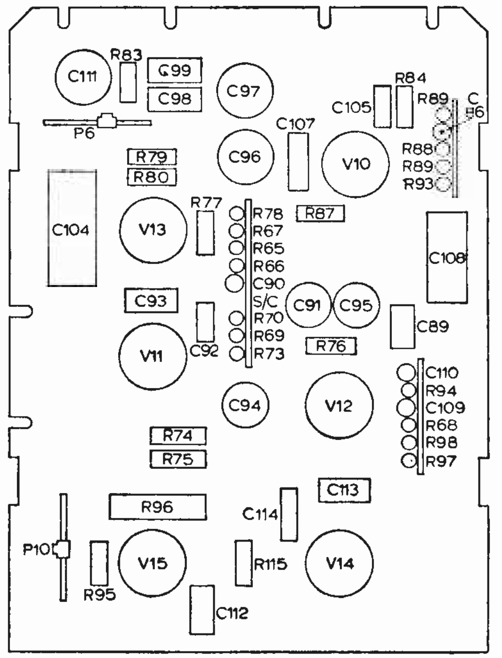
Check V10 and if there is no response from the loudspeaker at all, the H.T. at V10 pin 6 as primary of the TX2 (sound output) transformer may be o.c. If there is a response from the loudspeaker, and V10 is in order, check V9, V8 and V7 in that order. Check the base voltages: V7 pin 7 185V, pin 8 120V and pin 1 or 3 2V; V8 pin 6 185V, pin 1 100V, pin 3 1·5V. These figures are only approximate. If the anode voltage of V8 is very low, check the continuity of L10 (wound on R62). Where other voltages are absent, check the decoupling capacitors and feed resistors.

Alignment of Stations on Tuning Dial

See August 1961 issue, but if this is not available, oscillator alignment is carried out as follows. Switch to the desired station, set the fine tuner midway, remove the side panel to expose the front of the tuner where the core holes will be visible. If only one core is presented, adjust this for maximum sound. If more than one core is visible, adjust that nearer to the fine tuner spindle for maximum sound.

Unboxing

The chassis may be withdrawn leaving the tube and scanning assembly in the cabinet. The leads are long enough for this to be done.



TPS180, MP18, M74T, and T278

Remove the cabinet back cover, remove side panel by rotating the two quick release clips inside the cabinet; remove the channel selector and the fine tuner knobs.

Pull the top of the chassis away from the tube assembly, and then withdraw by lifting at an angle over the lower studs. To separate the chassis from the tube assembly, remove the scanning coil plugs from the line and frame output transformers and the pair of leads from the loudspeaker, noting that one is used as the chassis connection of the tube assembly.

T24

A separate lead is used for earthing the tube assembly and the side panel is secured by the screw holding the channel indicator, otherwise the above instructions apply.

(To be continued)

INTERMITTENT FAULTS

By G. J. King

HINTS FOR THE SERVICE MAN

TELEVISION faults reveal themselves in three ways; one is when the whole or just part of the receiver fails completely. Such faults are relatively easy to locate, since the fault condition usually remains until the component responsible has been replaced. The second is when there is a progressive deterioration in some part of the set, such as frame or line shrinkage, sound distortion and so on. This is more difficult to diagnose since an ordinary test may not show up the faulty part, which probably only alters in characteristics or becomes impaired when hot and under full load. In this case substitution tests are nearly always required, followed by prolonged running of the receiver in its cabinet. The third way in which faults are revealed is the intermittent failure of the whole or just a section of the receiver. This article is concerned essentially with faults of the intermittent variety.

For various reasons, the component responsible for intermittent operation of either the sound or vision sections can often prove rather difficult to locate and to avoid wasting a lot of time, a definite plan of action is essential, depending upon the section affected. A big problem with many intermittents is that as soon as a meter or other instrument is connected the fault clears and the set goes on working correctly for hours afterwards. Indeed, it is often thought that the fault has cleared for ever. The set is then put back into its cabinet, but the next day the same trouble starts again.

Also, it often happens that a set does not reveal its intermittent fault when operated out of its cabinet, or it may only develop the fault when working in a certain position in the room. These things can really make fault-finding very tedious.

What to do First

It is unwise to remove the set from its existing environment before carrying out a series of preliminary tests. The person who is actually going to undertake the repair should make the preliminary tests on-site, and he should also be in a position to question the owner on the fault condition first hand.

Let us suppose that the complaint is "intermittent vision". Make notes and head them "intermittent vision". Next check as many other factors as possible. These can only be obtained by asking questions of the owner and making tests on the set when the trouble occurs.

It may be discovered that the vision fails after the set has been working normally for fifteen minutes. Find out from the owner whether this happens consistently or only at certain times. If only at certain times, the trouble may be connected with a drop in mains voltage. Find out what happens to the sound when the vision fault occurs, whether or not the screen goes completely dark, whether or not the trouble clears by itself if the set is left running. Obtain as much information of this kind and make notes.

While such questions are being asked, the set should be left running in its normal position with the back in position. When the fault eventually occurs be careful to avoid disturbing the set too much as that may cause the fault to disappear, and the whole process will have to be repeated.

Considering still the hypothetical fault of intermittent vision, next turn up the brightness if the screen is black to see if a raster or illumination can be obtained. If it can, turn up the contrast in an endeavour to secure a little modulation. Note whether the sound was affected in any way when the vision fault occurred. Try the set on other channels. Listen for the line whistle and note whether this decreased in strength, altered in frequency or disappeared when the vision failed.

Remove the Back Cover and Look Inside

When as much information as possible has been obtained by making adjustments to the main and pre-set controls with the set operating under the fault condition, the set should preferably be left switched on and the rear cover removed while the fault actually exists.

As an example, let us suppose that the sound is unaffected, that it is impossible to obtain a raster by turning up the brightness control and that the line whistle disappeared when the fault occurred. This in itself is a major clue as to the wherabouts of the trouble, for almost certainly it will be observed that the heater of the EHT rectifier is out. One can be sure then that there is no EHT and that the intermittent fault has caused either the line oscillator or line amplifier to cease operating.

More information could possibly be obtained by looking at the line output valve. If the valve is glowing blue and is very hot (possibly with the anode and screen red hot), the line drive is probably missing due to an oscillator fault, but shorting turns in the line output transformer may give similar symptoms, depending on the design of the circuit, and normal servicing procedures would be adopted to prove these possibilities.

A short-circuit occurring in the line output valve itself is another likely cause, and since the trouble is not present until the set has been on for a while associated valves should first come under suspicion.

The action in this case, therefore, would be to check the line output and line oscillator valves and, possibly, the booster valve by substitution, after *each* change, switching the set on and letting it run to see whether or not the replacement has cured the trouble. Valves are prone to intermittent faults when they are hot, more than when they are only just warm.

In certain cases of intermittency, it may be impossible to make many basic tests before the set with equal suddenness loses the symptom and behaves perfectly normal again. When this happens before sufficient data has been recorded, it may be desirable to switch the set off, let it cool down and start the process all over again. On the other hand, it may be considered best to take the set into the workshop and examine it in the light of the various factors that have been recorded.

The basic on-site tests, coupled with the information given by the viewer should, at least, point towards the stage which is defective, as illustrated in the above example.

Intermittent Vision, Sound and Raster Normal

Let us take another typical intermittent example through the whole process of testing, diagnosing and repairing. Here suppose it is discovered that the picture suddenly cuts off leaving both the sound and raster unaffected. It is also discovered from the viewer that the time that it takes for this to happen after switching on may vary widely, but that it never occurs when the set is first switched on. Basic tests made on-site when the fault occurred showed (a) all channels affected (b) normal brightness control action on raster (c) no trace whatsoever of the sound being affected and (d) not the slightest indication of modulation with increase of contrast setting.

We would now reason as follows: (i) that the raster is present indicates normal operation of the line timebase and EHT circuits (ii) the time lag effect would probably indicate that something has to warm up before it goes faulty (iii) normal sound on all channels clears the tuner, aerials and the whole of the sound channel (iv) normal brightness control action shows that the tube bias is correct and that, because the bias is associated with the video amplifier stage, the latter is almost certainly working correctly from the D.C. aspect and (v) lack of vision modulation at a high contrast setting indicates that there is a complete and total open-circuit in the vision channel.

From that information we can say conclusively that the trouble lies somewhere between the sound take-off point and the input to the video amplifier valve. Looking at the circuit we may well see something like Fig. 1. Here V3 is the common I.F. valve (common to both sound and vision), V4 the vision I.F. amplifier valve, W1 the vision crystal diode detector, V5 the video amplifier valve and V6A the vision interference limiter diode.

Now, since the sound signal is extracted from the anode circuit of the common I.F. valve, via C14, it follows that this stage must be working correctly otherwise the sound would fail as well as the vision. What all this means is that somewhere between points A and B (marked on the circuit) something becomes open-circuited when it becomes hot. The interesting thing about this is that we have discovered the approximate whereabouts of the suspect simply by making a few tests. So far we have not connected an instrument to the circuits.

This is the best thing to do with all intermittent faults. Reduce the area of suspicion by basic tests, asking questions of the viewer, and logical reasoning, and finally concentrate on the suspect area. There is no point in taking voltage and current readings when the set is working normally, and if

(*Continued on page 539*)

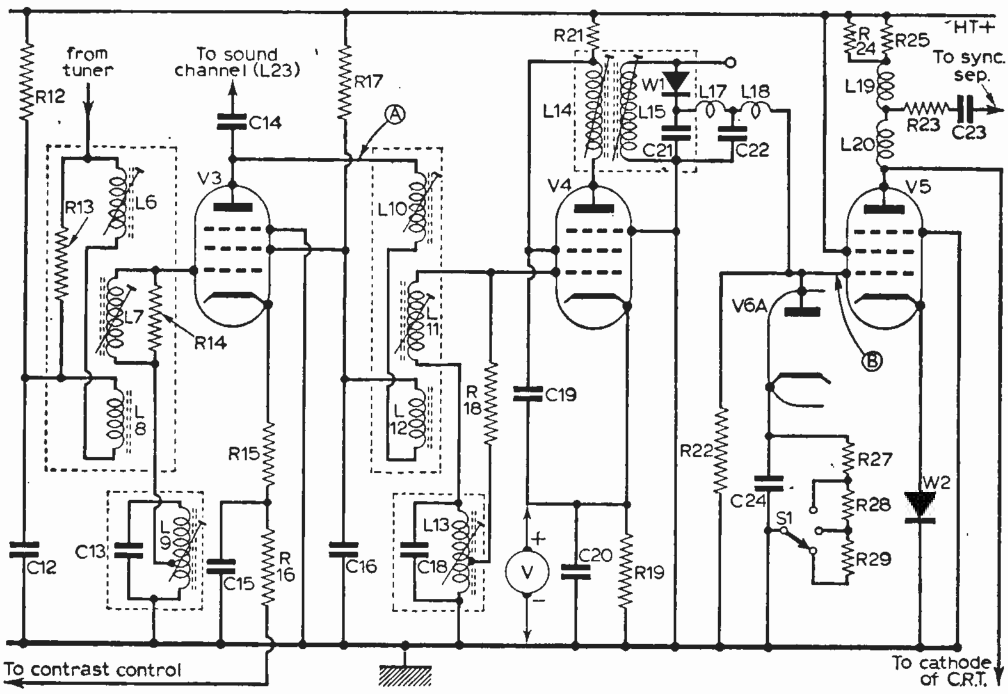


Fig. 1—The vision stages of the TV receiver which is examined in the text for intermittent operation.

(*Continued from page 536*)

such tests are attempted with the receiver in the fault condition, the fault is likely to clear, as already explained.

With the example under examination, it would probably be best to check V4 by substitution before doing anything else. The set should then be left to run to see whether or not the replacement has cleared the trouble. If it has not, the cathode voltage of V4 should be metered, as shown in Fig. 1. The set should be allowed to become hot quickly by covering it with a blanket and a note should be made of the cathode voltage under normal operation conditions. When the fault occurs, the meter reading should again be noted. If it is the same as that recorded originally, one can be pretty sure that the anode, screen and cathode resistors and capacitors are not to blame for the trouble.

However, if the voltage rises greatly, the cathode resistor R19 would be an immediate suspect, as such an increase could be caused only by this component going open-circuit or very high in value. If the voltage collapses, an open-circuit in R21 or a short in C19 would be most probable, but an open-circuit in L14 would cut off H.T. from the anode and give the same symptoms. Anyway, a constant voltage at the cathode would indicate that the D.C. conditions of V4 are unaffected by the fault.

This, now, leaves W1 and the associated components. Crystal diodes have been known to go intermittent, and a sharp tap with the eraser-end of a pencil may reveal such trouble without more ado. If such action clears the fault, the diode should be replaced immediately.

Video filter chokes, such as L17 and L18 have been known to give intermittent trouble on vision. These are usually wound on a small diameter former with thick pieces of wire inserted through each end to terminate the winding. It often happens that a dry joint (poor soldered connection) develops between the terminal wire and the winding wire, and that the effect of this only shows up when the component is hot. If there is any doubt about these components they can be shorted out as a test.

If the faulty part has still not been located (which would be extremely unlikely), there could be an intermittent connection on the grid coil of V4 (i.e., L11), which would cut off the signal without affecting the D.C. conditions of the valve, or the vision interference limiter may be shorting all the video signal to chassis due to a short in the diode or biasing circuits at the cathode. However, this is not very likely in the type of limiter circuit used in Fig. 1, but as conclusive proof it is usually a simple matter to disconnect the diode circuit in most sets. In Fig. 1, for example, this could be accomplished by removing the connection between the anode of V6A and the control grid of V5.

In Conclusion

It is obviously impossible to detail a large number of specific cases of TV intermittents in a short article, but it is hoped that the foregoing will, at least, give the experimenter an idea of the best way to tackle these often difficult faults.

There are five main points to remember. One, obtain as much information as possible from the owner and by operating the set on-site under the fault condition while disturbing as little as possible; two, use this information carefully to establish the fault area; three, set up an instrument (or instruments) in the fault area and carefully note any differences in readings when the fault occurs; four, use this information to pin-point the part responsible and, five, heat up a suspect section with a hair dryer or a suspect component with the heat from a soldering iron or, even the whole of the set by covering it with a blanket, should it appear that the fault occurs only when the set is really warm. ■

The ABC of TV Circuits

(*Continued from page 520*)

automatically turns off the brightness during the frame flyback period. The switching is so rapid, of course, that it cannot be observed, and the picture is in no way affected, apart from the total removal of the flyback lines.

The way that this is accomplished is shown in Fig. 5. Instead of the grid of the picture tube being connected directly to the slider of the brightness control, as is usually the case with the older models, it is connected in series with a resistor (R1 in the circuit). This acts after the style of a grid load, and allows a signal to be developed across it for application to the grid.

The signal is in the form of a negative-going pulse, and this is picked up from the "live" side of the frame scanning coils (e.g., the side remote from chassis) and fed across R1, and thus to the grid, through R2 and C1. Capacitor C2 gives the circuit a time-constant, shapes the pulse and removes any spurious higher frequency signal from the grid.

As the negative-going pulse occurs on each frame flyback, the display of the flyback line on the screen is totally suppressed since the effect is exactly the same as turning down the brightness control. The heavy negative pulse completely removes tube illumination on each flyback, as would be expected.

Adding Flyback Suppression

The arrangement is fairly easy to fit in almost any receiver, and the circuit shown in Fig. 5 is probably the most effective and easily installed. Care should be taken to ensure that one side of the frame scanning coils is earthed (connected to chassis). Most sets will already have this connection, but if not, make sure that such a connection will not short the H.T. supply or the frame linearity correcting circuits.

If it is found that the flyback lines are made even more prominent, the earth and pulse connections on the scanning coils should be transposed, for the effect would be caused by a positive-going pulse being fed to the grid. If such reversal is necessary, do not reverse the scanning coils connections to the secondary of the frame output transformer, as this would reverse the picture laterally and a mirror would be needed to view it.

(To be continued)

Trade News

New Twin Panel Television Tube

THE AW47-10 is a new 19in. 'twin-panel' television tube, made by Mullard, which has a safety guard bonded direct to the tube face, eliminating the need for a separate glass or plastic window mounted within the cabinet.

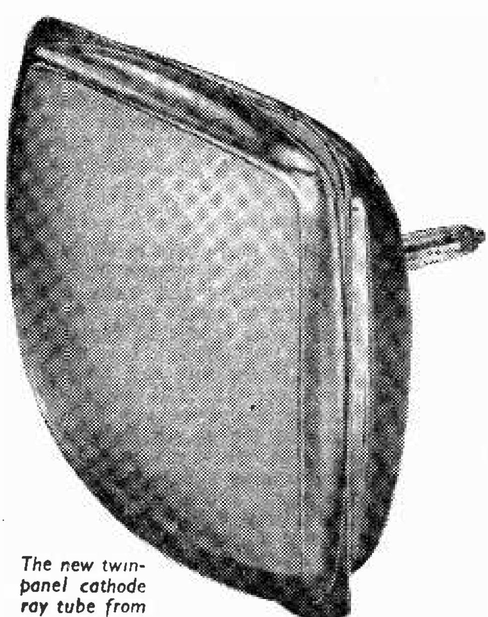
The twin-panel tube gives the same complete protection against possible implosion as the conventional safety window, and at the same time offers several new advantages. One important advantage is that dust cannot collect between the guard and the tube face.

The tube is a new 110° short-necked type with an overall length of only 302mm—an inch shorter than standard 19in. 110° tubes. The saving in length is given by a new, shorter electron gun and by reducing the size of the base sealing pip.

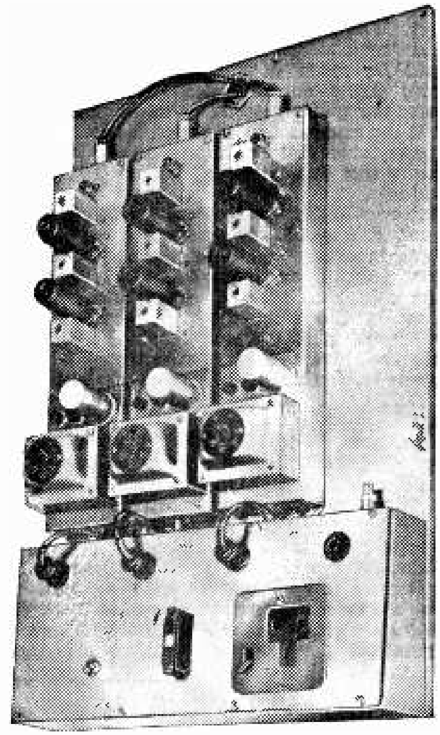
An additional feature is the near-flat screen, which permits a wider viewing angle without any increase in picture distortion.

Focusing is electrostatic, the focusing lens being of the unipotential type, which prevents deflection defocusing and thus ensure good spot quality.

Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.



The new twin-panel cathode ray tube from Mullard Ltd.



The TD 106 distribution equipment made by Aerialite Ltd.

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THE "TD" series of television distribution equipment, recently introduced by Aerialite Ltd., has been designed specifically for use in flats, schools, hotels, hospitals and housing estates, and consists of a range of amplifiers having gains of 25, 40 and 55 dB over Band II (F.M.), or over any one channel in Bands I (BBC) and III (ITV). Using a new cascode coupled double triode, bandwidths of $4\frac{1}{2}$-5Mc/s are obtained over each TV channel and 7Mc/s in the F.M. range with a very low noise level and with a high degree of stability. These amplifiers are equally suitable for the present 405-line transmissions and for any CCIR 625-line systems.

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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.

STRANGE RECEPTION

SIR,—During recent months the BBC and ITV have warned us, on some evenings, not to adjust our sets as conditions were such that interference was being experienced in certain parts of the country from Continental transmitters. On one of these occasions I turned the knob of my turret tuner and at Channel 4 I received a very muddled picture with distorted sound. The latter was such that I could not tell what language it was, and no amount of adjustment of the controls (I have a 405/625-line switch on the set) would resolve a picture. It appeared as though there were three images superimposed. I can only get this effect when conditions are such that the warning already mentioned is transmitted. Have any other viewers, I wonder, tried to find other stations, and with what success, when these strange conditions exist?—J. GAUNT (Leicester).

VALVE SCREENS

SIR,—As an experimenter I have built successfully several receivers but have now come across a point which I do not seem ever to have seen explained, and I wonder if any other experimenter has found the problem of interest. I refer to the small cans which are intended to screen the valves. These, as most readers will know, are available in two types,—one clean aluminium and the other blackened. During one experiment, I was trying the effect of screening a local oscillator in a form of F.M. receiver (anticipating the change which might be introduced later), and I found that when the black can was used, the set was stable and performed as expected. When I used the clean can, the valve gave a very feeble oscillation. I cleaned the can and made sure that it completed the screening, and even isolated it, in case the black can had insulating properties and did not contact the valveholder skirt. But I could not obtain identical results with the two types of can. I wonder why this was, and is there some other property in the black type of can?—G. HAWES (Maidstone).

MAINS LOCKING FREQUENCY

SIR,—I should like to thank the many readers who have supplied information on the above subject. I certainly found that poor smoothing was the trouble but not from the point of view of design—but as a result of a fault. The usual choke and two condensers were fitted, but what I think was a most unusual thing, both condensers had become open-circuited. Naturally my simple meter tests had not revealed this, and I assume that as there was no reading they had not broken down. A simple test by holding a known good condenser across the receiver side of the choke and earth made an appreciable difference, and replacement of the defective condenser (a block type) by a new one restored the set to normal working.—G. MARSHELL (Leeds).

CONTINENTAL TV RECEPTION

SIR,—I recently converted my second-hand receiver for Continental reception.

On the first day of operation (June 9th) I received no less than 8 different stations on Channels 2 and 3 at good strength. By far the strongest stations are both Spanish—Navacerrada on Channel 2 and Zaragoza on Channel 3. Recently I decided to make some tests, and at present I am receiving both of these stations with 10in. of single flex in the aerial socket, with the gain and contrast at minimum, and under these conditions the set is overloading.

This in itself may seem surprising, but I am screened all round by high hills!—G. J. POWELL (Marden, Hereford).

AN ULTRA-STABILISED H.T. SUPPLY

(Continued from page 531)

(d) This procedure is repeated until the meter is operating on the 10V f.s.d. range. Very careful adjustment of the backing-H.T. voltage is then made until half-scale deflection results.

(e) Switch back to the 50V range, and start tapping the morse-key whilst adjusting VR1 with a screwdriver. As soon as the kicks are less than about 5V, switch back to the 10V range and make the final adjustment. Note that, as VR1 is adjusted, the backing-H.T. voltage will need to be altered to follow-up.

(f) When the correct setting has been reached, the voltage should fall smoothly by somewhat less than a tenth of a volt per hundred mA of load switched in, and rise again smoothly by the same amount when the load is switched off again, without kicks in either case. If larger smooth variations are found, although not in the nature of kicks, note the remarks on fuses made below.

(g) Return the meter to the 500V range *before* switching off either H.T. supply.

(To be continued)

CORRECTION

It is regretted that in the advertisement on page 501 of the July issue under the heading 'Sets and Components', the telephone number of DIRECT TV REPLACEMENTS was given as TID 6686 instead of the correct number **TID 6666.**

DIRECT TV REPLACEMENTS have also asked us to state that they issue free Data Charts of Replacement components to bona fide Service Engineers and Dealers.

Direct TV Replacement Ltd., 138 Lewisham Way, London S.E. 14.

Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 548 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

BUSH TV36

The fault on this set is a fold over on the frame scan at the bottom of picture. This is approximately 1¼in. deep. There is also a series of horizontal white lines, which appear as a vertical bar, about 2in. deep, and approximately three-quarters of the way across the picture. This, when appearing, is accompanied by noise on the speaker. A new ECL80 and two new PY82s have been fitted. Operating VR5 reduces the top of the raster and then opens it out again whilst still turning the control in the same direction. Adjustment of the height control has a limited effect, as does adjustment of the interlace control, but the picture does lock vertically and horizontally. When on BBC, the contrast control is at zero and during loud passages of music the picture shows signs of sound on vision and is rather jumpy.—W. J. Walke (Peterborough).

You should check the 50μF electrolytic capacitor from pin 3 of the ECL80 valve base to chassis, also the 8μF decoupling pin 8. Check the 0.02μF coupling capacitor for leakage if necessary. The horizontal disturbance may be caused by an ill-fitting screen over the line output section; remove the screw and note the effect of moving it about. A slight discharge in the line output transformer itself may be responsible. Fit a BBC signal attenuator to the aerial input to reduce the Band I input.

K.B. NV40

I have recently fitted a new tube to my television set, and although this has improved the picture, two faults have developed since doing this on which I should appreciate your advice. The first is that the picture needs moving about 1in. to the left. There are two levers at the back, one marked focus, and the other unmarked, but I assume it is for centering the picture. I have moved this lever but still cannot properly centre the picture.

The second fault, which is intermittent but at times fairly frequent, is a bending of the picture at the top which distorts it to the right. Sometimes the whole picture breaks up and flicks quickly across the screen to the right. This can be cured by adjusting the horizontal hold control. —F. D. Osman (Ipswich).

If the shuffle plate lever (centering) will not centre the picture correctly it would appear that the tube has been mounted out of square. The tube should be remounted ensuring that the neck passes squarely through the focus aperture.

With reference to the second fault, you should check the line oscillator 12AU7 (V15) and line sync valve 12AT7 (V14). These are both situated in the centre of the chassis under the tube.

FERGUSON 992T

I have been given this set which I am trying to repair. At the moment no valves light up at all. I notice that there are two valveholders close together, both with wired caps above them but one valve is missing. On the bases of these holders there is a resistor wired across which has burnt out.

I should be very grateful if you could advise me on the kind of valve I need to replace the missing one and the values of the resistor.—S. A. Ling (Colchester, Essex).

Of the two valves under the tube neck and focus assembly, the left hand one as viewed from the rear is a PL81. The right hand valve is a PY81. The resistor from pin 9 of the PY81 (H.T.) to pin 8 of the PL81 is 4·7k. This value is not extremely critical but we prefer to see a wire wound type fitted with a value of between 3 to 5k.

McMICHAEL MP17

This set is connected to a communal aerial (BBC, ITV, F.M.). When on BBC only, every so often the picture will flick as if it had been switched off and on quickly. The tuner oscillator core (BBC), although correctly adjusted, is not a very tight fit in the threads, so might not this be the cause? If this is so, is there any way of rectifying the fault?

There is also a dark outline to the right of images on BBC only. The contrast between stations is also unequal: on switching from BBC to ITV it is necessary to reduce the brightness.

On VHF/F.M. radio, with volume fully advanced, all the stations are very faint, although on TV the volume is perfect.—M. F. Smith (Abingdon).

The faults you describe could all be quite easily attributed to the communal aerial system. The BBC oscillator coil core can be sealed with wax or a dab of varnish. Incorrect oscillator tuning could give rise to the outline on BBC but this could be due to mismatching in the aerial feeder system. It also appears that the ITV signal is boosted to a higher degree (perhaps necessarily) than the BBC or V.H.F. The performance of the MP17 on V.H.F. can sometimes be improved by slight trimming to the left side sound I.F. coil cores. Perhaps you should try a separate horizontal dipole for V.H.F.

MURPHY V410

Would you be kind enough to give me some advice on the above-mentioned receiver?

For a year now, there has been intermittent

(Continued on page 547)

(*Continued from page 544*)

sound interference on both Channels 1 and 9 in the form of hissing and occasionally a varying whistle. Adjustment of the contrast control for a higher gain eliminates the interference to a certain extent but speech is mildly distorted. This fault persists when V1 and V2 are substituted.

Three months ago I replaced R82 (150Ω) with a higher valve component and the fault disappeared for about two months, but recently it has reappeared again and I am wondering whether any modification exists to correct this fault.—G. W. Luckhurst (Enfield).

This fault is usually due to an unsuitable V9 30F5 sound I.F. amplifier or disturbed wiring in the immediate vicinity of it.

Try interchanging V9 with V4 and also try the effect of bridging C62 and C67 with a known good 0.001μF capacitor with short connections.

MARCONIPHONE V.T.59DA

The sound is perfect, but there is no picture. There is no EHT at the tube, and only a low EHT at the anode of the U151. The U151 does not glow, but the filament is intact. I tried applying a separate LT supply to the U151 which gave a very dim picture concentrated into a vertical strip. I also tried replacing the adjacent PL81 (the line timebase output valve) with no results. I now suspect the line oscillator, but at times it can be heard working. I would be very grateful for your interpretation of the fault.—I. Thomas (Cardiff).

The trouble is either in the line amplifier or booster circuit. If the associated valves and components check normal, shorting turns in the line output transformer is a likely cause of the trouble. Unfortunately, there is no simple test for this component, it generally being necessary to prove the suspect by substitution.

COSSOR 938F

The picture has insufficient width and when turned to full brilliance the picture goes very dull and begins to fade out if the control is not turned back again. I would be obliged if you could tell me how to remedy these faults.—D. Mulley (Woodbridge, Suffolk).

Low H.T. voltage could cause this trouble, and in the first place, therefore, we would suggest that you check the condition of the two 19Y3 H.T. rectifiers and the 97Ω resistors connected to their cathodes—pin 3. If the H.T. voltage is correct, however (180V on the H.T. line), check the 21A6 and 17Z3 valves for emission and replace if necessary.

FERGUSON 454T

This is a portable set with controls and aerial on the top. The cabinet appears to consist of two halves and I would appreciate it if you could give me details for the correct way in which to remove the chassis from the cabinet. I have already removed the four metal bands on the sides of the cabinet but still the top half refuses to budge.—P. Murphy (Glasgow).

The cabinet may be removed as follows: Slacken off the four screws at each side, then turn cabinet over on its side and withdraw the two 2BA screws underneath. Turn the cabinet upright and lift the top half with chassis attached out of the bottom by means of the carrying handle. The speaker is clipped between the two cabinet sections and should be lifted simultaneously to avoid straining the connecting leads. Remove the two 2B.A. screws in the carrying handle. The top half of the case may then be lifted off the chassis and the mains socket connections withdrawn from the input panel at the side of the chassis. Due to the mains interlock on the cabinet, a separate mains lead is necessary to enable the set to be operated outside the cabinet.

DECCA DM22/C

I have just acquired this second-hand receiver which has a small amount of mains hum on sound. The electrolytic condensers in the H.T. supply (100 and 200μF and 32 + 16 + 16 + 16μF) have been replaced as these showed some evidence of leakage; but this substitution made no improvement. The valves have been changed with no improvement.

The addition of a 32μF condenser to the sound output H.T. gives some improvement. The hum decreases considerably, in fact to a reasonable level when the receiver is switched to the VHF radio position.—H. J. Greensmith (Dundee).

Misplaced wiring on the volume control often causes this trouble, and is sometimes due to pickup of the frame signal, as distinct from mains hum. If the hum varies as the frame hold control is turned, then frame pickup is the cause. Make sure that the "live" wires on the volume control are screened and try moving them about to minimise the effect.

SOBELL SC270

When the set is switched on the sound comes up as normal, but it takes the vision five minutes to appear. When the set has been on for about 30 minutes a black band appears at the bottom of the screen about ½in. wide. I have changed the PL81 but the fault remains. Also, could you tell me for what purpose the slider control is used (the one close to the base of the PY81)?—L. Hopkinson (Mansfield).

A slow PY81 could be responsible for the delayed vision. The frame cramping should lead to a check of the PL84 frame amplifier—the valve but one from the PY81.

The control mentioned is the horizontal hold preset. This should be adjusted for line lock with the main line hold at the centre of its range.

BUSH TV24C

The set takes about three minutes for the sound to come on and about a further minute for the picture to follow. As the set warms up the picture becomes stable and both sound and vision remain correct for the rest of the evening.

The sound is very clear and varies with the volume control, but when first switched on, the brilliance control has to be turned to full-on and then brought back about five degrees. At this setting the picture will come in and remain in all evening. It is too white and somewhat hazy in outline and both faults can be partially improved by operation of the contrast.

If any attempt is made to reduce the brilliance by turning the brilliance control the screen goes blank but the sound remains unaffected. The picture can be brought on again by turning the

control clockwise to the five degree setting but turning it slightly further clockwise the picture goes excessively white both in object and background and shows acute signs of loss of vertical control. The setting of the brilliance control is therefore very critical, five degrees from full on; anything less results in a blank screen, anything more the picture is almost white. Once this critical setting is obtained the set can be switched off and on, day after day, and the picture will come in and remain stable but I think that this critical setting indicates that something is wrong. —A. Richards (Stockport).

The track of the brilliance control is fractured at the point where the screen goes blank. The 30k wire wound control should be replaced or a small piece of metal or wire inserted behind the track to bridge the fracture.

INVICTA 237

On BBC the brightness keeps varying and on ITA there is a picture for about five minutes then it and the raster disappears and on turning to BBC the same thing happens.

When it is working without any signal input on any channel there is a raster for about five to ten minutes and then it disappears. The voltage at the tube grid drops to about 50 volts with brightness full on. When the voltage drops, current starts to flow in the grid circuit and current stops flowing in the cathode circuit. The cathode voltage remains normal at 130V.— M. Vicker (Larne, Co. Antrim).

It would appear that the brilliance control itself is at fault being open circuited at the H.T. end, but the effect of disconnecting C26 (0·1μF) should be noted.

Most versions of this set did not use a flyback suppression circuit, but on some a 0·05μF capacitor connects from the CRT.

MARCONIPHONE VT69DA

The trouble with this set is a black band at the top of the picture, about one inch in depth and a band of about two inches at the bottom. Also the picture rolls upwards or downwards and will only lock for a short time.—J. Patterson (Lowestoft).

Check by substitution the LN125 frame timebase valve. This should clear the creeping effect. Connected to pin 1 of that valve is an 0·047μF capacitor. This goes to a 2·2M resistor across which is a small metal rectifier. Check all these components by substitution as a fault in one could cause the weak frame lock effect.

BUSH TUG34

This receiver is fitted with a Bush Converter, Type 184. It has previously been used on Sutton Coldfield and Lichfield frequencies.

Would you please give me the necessary information for modifying the set to receive Wenvoe and St. Hillary transmissions? Are new coils needed or can the existing ones be retuned satisfactorily?—E. Curtis (Somerton, Somerset).

Channel changing is extremely simple. As far as Band III is concerned (ITV) it is only necessary to tune the knob on the side, i.e. it is pulled out for ITV and turned for the channel required. As far as Band I (BBC) is concerned it is only necessary to push in the tuner knob and retune the oscillator knob to the right of the BBC aerial input for maximum sound. It is then necessary to retune the recessed cores between the knob and the aerial input panel. There are two recessed cores, one R.F. tuning and the other aerial coil tuning.

COSSOR 938

The above set gives a good picture on switching on, but if the brilliance control is advanced the picture shrinks in sideways until it is only about 6in. wide and then it fades.

As the set warms up the same process takes place automatically; however if the brilliance control is retarded slightly the picture can be restored perfectly for a while.

This can be repeated for about half-an-hour, gradually reducing the brilliance by means of the control, until it is fully retarded, after which the picture finally shrinks so much that it is impossible to view.

I suspected the line output valve and changed it and the efficiency diode, without any effect.— G. E. Walton (Doncaster).

Check the SU61 EHT rectifier valve. If this is in order, check the 17Z3 and 19Y3 valves. With the brightness control set to the point just before picture fade, adjust the ion trap magnet on the neck of the 141K picture tube for maximum raster brightness.

PHILIPS 1100U

I wonder if you can help me to to correct the fault which is affecting my receiver?

Whilst viewing the other night the picture suddenly closed from both sides to the centre leaving a vertical white line which lasted a short time until the screen went completely blank.— C. W. Petterson (Hayes, Middlesex).

This is the symptom of failure of the line timebase. Firstly, have the PL81 and PY80 valves checked for emission and replace if low. If the valves are in order, a careful check should be made of the associated components. If the smaller ones are in order and the line whistle can be heard faintly when the line hold control is rotated, shorting turns in the line output transformer could be responsible.

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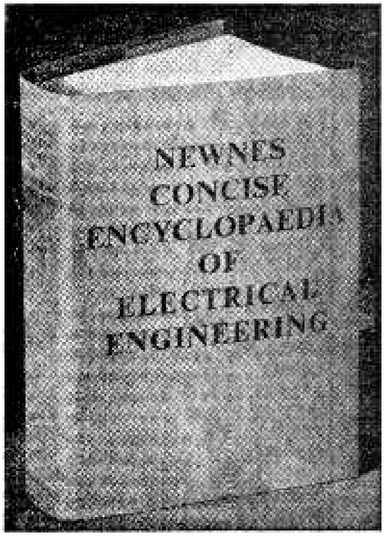

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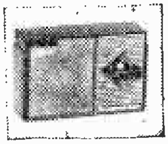

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	5in. reel.	600ft	16/-	7 in. 2/6

"Instant" Bulk Tape Eraser and Head Defluxer. 200/250 v. A.C., 27/6. Leaflet, S.A.E.

O.P. TRANSFORMERS. Heavy Duty 50 mA. 4/6. Multiratio, push-pull. 7/6. Ditto, 10w, 15/6. Miniature. 3S4. etc., 5/9. **L.F. CHOKES** 15/10 H. 60/65 mA. 5/-; 10 H. 85 mA. 10/6; 10 H. 150 mA. 14/-.

MAINS TRANSFORMERS 200/250 v. A.C.
Postage 2/- each transformer.

STANDARD, 250-0-250, 80 mA. 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. 5 v. 2 a. or 4 v. 2 a. 22/6 ditto. 350-0-350	29/6
MINIATURE 200 v. 20 mA. 6.3 v. 1 a.	10/6
MIDGET, 220 v. 45 mA. 6.3 v. 2 a.	15/6
SMALL, 220-0-220. 50 mA. 6.3 v. 2 a.	17/6
STD., 250-0-250. 65 mA. 6.3 v. 3.5 a.	17/6
HEATER TRANS. 6.3 v. 1½ amp.	7/6
Ditto, tapped sec. 2, 4, 6.3 v., 1½ amp.	8/6
Ditto. sec. 6.3 v. 3 amp.	10/6
GENERAL PURPOSE LOW VOLTAGE, 2a. 3. 4. 5. 6. 8. 9. 10. 12. 15. 18. 24. 30 v.	22/6
AUTO TRANSFORMERS. 150 w.	22/6
0, 120, 200, 230, 250 v., 500 w.	82/6

ALADDIN FORMERS and core, ¼in.. 8d.; ⅜in., 10d.
0.3in. **FORMERS 5937/8** and Cans **TV1/2.** ⅜in. sq. x 2⅛in. and ⅜in. sq. x 1⅜in., 2/- ea., with cores.
SOLON Soldering Iron, 200 or 240 v. 25 w. 24/-.
MAINS DROPPERS. Midget. Adj. Sliders. 0.3 amp., 1,000 ohms, 5/-. 0.2 amp., 1,200 ohms, 5/-.
LINE CORD. 0.3 amp., 60 ohms per ft., 0.2 amp., 100 ohms per ft., 2-way. 1/- per ft., 3-way. 1/- per ft.
LOUDSPEAKER P.M. 3 OHM. 2¼in., 3in., 4in., 19/6. 5in. 17/6. 8in. Plessey, 19/6. 7in. x 4in. Rola, 18/6 6½in. Rola, 18/6. 10 x 6in., 27/6. 10in. 30/-. 4in. Hi-Fi Tweeter, 25/-. 12 in. R.A., 30/-. 13¼ x 8in. E.M.I., 45/-.
STENTORIAN HF1012, 10in. 3 to 15 ohms, 10w., 95/-
CRYSTAL DIODE G.E.C., 2/-. **GEX34.** 4/-. **OA81**, 3/-.
HIGH RESISTANCE PHONES. 4,000 ohms, 15/- pr.
MIKE TRANSF. 50 : 1, 3/9 each.
SWITCH CLEANER. Fluid squirt spout. 4/3 tin.
TWIN GANG TUNING CONDENSERS. 365 pF miniature 1in. x 1½in. x 1⅜in., 10/-. 500pF Standard with trimmers, 9/-; midget, 7/6 with trimmers, 9/-.
SINGLE, 10 pF, 25 pF, 50 pF, 75 pF, 100 pF, 160 pF, 5/6. Solid dielectric 100. 300. 500 pF, 3/6.

COMPLETE RADIO
£4.19.6 post free

4 Mullard valves, 5in. speaker, frame aerial. 4 pre-set stations. 1 long, 3 med. wave. **Superhet Circuit.** Size 9 x 6 x 5½in. high. Tested ready for use. 200/250 v. A.C.—D.C. Mains.

DE-LUXE MODEL. With illuminated dial and slow-motion tuning drive. Medium and long-wave, brand new, tested. **£5.19.6.**

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New and Boxed. **VALVES** 90-day Guarantee.

0Z4	5/-	6K7G	5/-	EABC80	8/-	PCL82	10/-
1R5	6/-	6K8G	5/-	EB91	4/-	PCL84	10/-
1S5	6/-	6L6G	8/-	EBC41	8/-	PL81	10/-
1T4	3/-	6N7M	5/-	EBC81	8/-	PL83	8/-
2X2	2/-	6Q7G	6/-	EBF80	9/-	PY80	7/-
3S4	7/-	6SN7	5/-	ECH42	9/-	PY81	8/-
3V4	7/-	6V6G	5/-	ECH81	9/-	PY82	7/-
3Q5	7/-	6X4	5/-	EF85	6/-	PY83	8/-
5U4	6/-	6X5	6/-	EF89	8/-	QP25	7/-
5Y3	6/-	12AT7	6/-	EL32	5/-	SP41	3/-
5Z4	9/-	12AU7	6/-	EL84	7/-	SP61	3/-
6AC7	4/-	12AX7	7/-	EY51	9/-	U22	7/-
6AM6	4/-	12BH7	7/-	EY86	9/-	UBC41	8/-
6AT6	6/-	12K7	5/-	EZ40	7/-	UBC81	9/-
6BA6	7/-	12K8	14/-	EZ80	7/-	UBF89	9/-
6BE6	5/-	12Q7	5/-	EZ81	7/-	UCH81	9/-
6BW6	7/-	25Y5G	9/-	E1148	1/-	UCL82	10/-
6C4	5/-	35L6	9/-	HABC80	10/-	UCL83	12/-
6D6	5/-	35Z4	5/-	HVR2A	5/-	UF89	9/-
6G6	4/-	807	5/-	KT33C	8/-	UL41	9/-
6H6	3/-	954	2/	KT76	8/-	UY41	7/-
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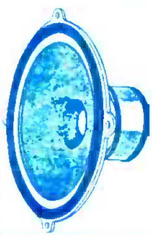
6J6	5/-	DF96	8/-	PCC84	8/-	UU9	7/-
6J7G	6/-	DK96	8/-	PCF80	8/-	VR150	7/-
6K6	5/-	DL96	8/-	PCF82	8/-	W81	6/-

BAKER SELHURST LOUDSPEAKERS



12in. Baker 15w. Stalwart 3 or 15 ohms, 45–13,000 c.p.s. .. 90/-

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12in. Baker Ultra Twelve, 20 c.p.s. to 25 kc/s. £17.10

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Audio OC71 6/- RF OC44 8/9 OA70 3/-
OC72 7/6 OC45 8/6 OA81 3/-
Sub Miniature Condensers. 0.1mFd, 30 v. 1/3. 1, 2, 4. 5, 8, 25, 50, 100 mfd. 15 volt, 2/6 each. **Weyrad Printed Circuit Components in Stock.** Book 2/-. 7 x 4in. Speaker 35 Ω 25/-.

CRYSTAL MIKE INSERT precision engineered. Size only 1⅜in. by ¼in., 6/6.

ALUMINIUM CHASSIS. 18 s.w.g. undrilled. With 4 sides, riveted corners and lattice fixing holes, 2½in. sides, 7 x 4in., 4/6; 9 x 7in., 5/9; 11 x 7in., 6/9; 13 x 9in., 8/6; 14 x 11in., 10/6; 15 x 14in.. 12/6; 18 x 16 x 3in., 16/6.
ALUMINIUM PANELS. 18 s.w.g. 12in. x 12in., 4/6; 14 x 9in., 4/-; 12 x 8in., 3/-; 10 x 7in., 2/3.

JASON F.M. TUNER COIL SET. 29/-. **H.F.** coil, aerial coil. Oscillator coil. Two I.F. trans. 10.7 Mc/s Ratio Detector and heater choke. Circuit book using four 6AM6. 2/6.
COMPLETE JASON F.M. KIT, FMTI. with 4 valves, components and chassis. £6.5.0.

BBC TRANSISTOR RADIO. Med. and Long Wave. Two transistors and diode. Complete kit, 22/6. Earphone, 7/6, battery. 2/3.

465 Kc/s. SIGNAL GENERATOR. Price 15/-. Uses B.F.O. Unit ZA 30038 ready made, with valve. **POCKET SIZE** 2½ x 4½ x 1in. Slight modifications required, full instructions supplied. Battery 8/6 extra, 69 v. + 1½ v.

I.F. TRANSFORMERS 7/6 pair
465 Kc/s Slug Tuning Miniature Can, 2 x 1 x 1 in. High Q and good bandwidth. Data sheets.

TV REPLACEMENT LINE OUTPUT TRANSFORMERS

FROM **45/-** ea. Most makes available. S.A.E. with all enquiries.

LINE BLOCKING TRANSFORMERS, from 10/-.
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HIGH GAIN TV PRE-AMP KITS
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Tunable channels 1 to 5. Gain 18dB. ECC84 valve. Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred.)
BAND III ITA—Same prices.
Tunable channels 8 to 13. Gain 17dB. ECC84 valve. (PCC84 valves if preferred.)

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Complete with ready built amplifier, speaker & cabinet. **£12.10.0**
carr. & ins. **5/-**

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B.S.R., U.A.12 Stereo/Mono	£8.5.0
Garrard Model Autoslim	£7.19.6
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Garrard Model 4SP GC8	£6.17.6
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Amplifier player cabinets (except 4 H.F.)	70/-
2-valve amplifier and 6½in. speaker	95/-
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Wired and tested ready for use with above.
All sapphire styli available from 6/-.

Volume Controls
Linear or Log Tracks.
Long spindles. Guaranteed 1 year. Midget 5K ohms to 2 Meg. L/S, 3/-. D/P, 4/6. Stereo, 10/6. D/P, 14/-.

80 ohm CABLE COAX
Semi-air spaced. ¼in. Losses cut 50%.
40 yds. 17/6, 60 yds. 25/-. **6d.** yd.
Fringe Quality Air Spaced. **1/-** yd.

TRIPLEXERS Bands I, II, III	12/6
COAX PLUGS .. 1/- **LEAD SOCKETS**	2/-
PANEL SOCKETS 1/- **OUTLET BOXES**	4/6

BALANCED TWIN FEEDER yd. 6d. 80 or 300 ohms.
DITTO SCREENED per yd. 1/6. 80 ohms only.
WIRE-WOUND POTS, 3 WATT. Pre-set Min. TV Type. All value 25 ohms to 25 K., 3/- ea. 30 K., 50 K., 4/-. (Carbon 30 K., to 2 meg., 3/-).
WIRE-WOUND 4 WATT. Pots Long Spindle Values, 50 ohms to 50 K., 6/6; 100 K., 7/6.
CONDENSERS. New Stock. 0.001 mfd. 7 kV. T.C.C., 5/6; Ditto, 20 kV., 9/6; 0.1 mfd., 7 kV., 9/6; Tubular 500 v. 0.001 to 0.05 mfd., 9d., 0.1, 1/-; 0.25, 1/6; 0.5/500 v., 1/9; 0.1/350 v., 9d.; 0.01/2,000 v. 0.1/1,000 v., 1/9; 0.1 mfd., 2,000 volts, 3/6.
CERAMIC CONDS. 500 v., 0.3 pF to 0.01 mfd., 9d.
SILVER MICA CONDENSERS. 10% 5 pF to 500 pF, 1/-; 600 pF to 3,000 pF, 1/3. Close tolerance (±1 pF) 1.5 pF to 47 pF, 1/6. Ditto 1% 50 pF to 815 pF, 1/9; 1,000 pF to 5,000 pF, 2/-.

New Electrolytics. Famous Makes

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				16/450v.	5/-
1/350v.	2/-	50/350v.	5/6	32/350v.	4/-
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8/450v.	2/3	500/12v.	3/-	5,000/6v.	5/-
16/450v.	3/-	8+8/450v.	3/6	32+34/450v.	6/-
32/450v.	4/9	8+16/450v.	3/9	32+32+32/350v	7/-
				50+50/350v.	7/-
25/25v.	1/9	16+16/450v.	4/3	64+120/350v.	11/6
50/50v.	2/-	32+32/350v.	4/6	100+200/275v.	12/6

RECTIFIERS SELENIUM 300 v. 85 mA. 5/-.
CONTACT COOLED 250 v. 50 mA. 7/6; 60 mA. 8/6; 85 mA. 9/6; 200 mA. 21/-; 300 mA. 27/6.
COILS Wearite "P" type, 3/- each. Osmor Midget "Q" type adj. dust core from 4/-. All ranges.
TELETRON. L. & Med. T.R.F., with reaction, 4/-.
FERRITE ROD AERIALS. M.W., 8/9; M. & L. 12/6.
T.R.F. COILS A/HF, 7/- pair. H.F. CHOKES, 2/6.
FERRITE ROD, 8in. x $^5/_{16}$ in. dia. 3/-. 6 x ⅜ in., 3/-. 8 x ⅜ in., 3/-.
FULL WAVE BRIDGE SELENIUM RECTIFIER; 2, 6 or 12 v. 1½ amp.. 8/9; 2 a., 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ amps., 15/6. 2 amps.. 17/6; 4 amps., 22/6. Circuit included.
VALVE and TV TUBE equivalent books, 9/6.
TOGGLE SWITCHES. S.P. 2/-. D.P. 3/6. D.P.D.T. 4/-
WAVECHANGE SWITCHES

8 p. 4-way 2 wafer long spindle	6/6
2 p. 2-way, or 2 p. 6-way long spindle or 4 p. 2-way or 4 p. 3-way long spindle	3/6
3 p. 4-way. or 1 p. 12-way long spindle	3/6

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SPEAKER FRET. GOLD CLOTH. 17in., 25in., 5/-. 25in. x 35in., 10/-. Tygan 52in. wide, from 10/- ft.; 26in. wide from 5/-. Various colours. Samples S.A.E. Expanded Metal, Gold, 12 x 12 in., 6/-.

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