A Beginner's Guide to Television

Practical Television

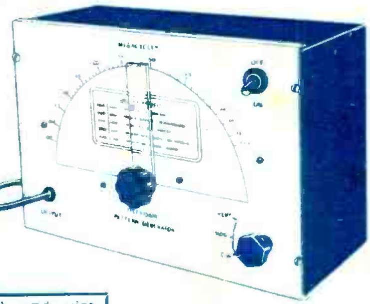
1/-

AND TELEVISION TIMES

FEBRUARY 1956

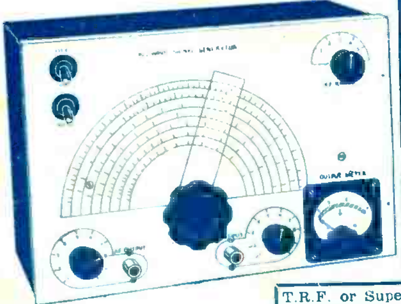
EDITOR: F.J. CAMM

The BBC Colour System



COMPLETELY BUILT T.V. CONVERTER

for the new commercial stations, complete with 2 valves. Frequency can be set to any channel within the 186-196 Mc/s band. I.F. will work into any existing T.V. receiver between 42-68 Mc/s. Input arranged for 80 ohm feeder. EF80 as RF amplifier. ECC81 as local oscillator and mixer. The gain of the first stage, RF amplifier 10DB. Required power supply of 200 D.C. at 25mA. 6.3 v. A.C. at 0.6 amp. Input filter ensuring freedom from unwanted signals. Simple adjustments only, no instruments required for trimming. Will work into any T.R.F. or Superhet incorporating Band switch, and wire-wound gain control. Fully screened in black crackle finished case, size 5¾in. long, 3½in. wide, max. overall height 4½in. **£2.19.6.** P. & P. 2/6. As above with built-in power supply, **£3.19.6.** P. & P. 2/6. A.C. Mains 200/250 v.



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Completely built Signal Generator, coverage 120 Kc/s-320 Kc/s, 300 Kc/s-900 Kc/s, 900 Kc/s-2.75 Mc/s, 2.75 Mc/s-8.5 Mc/s, 8 Mc/s-28 Mc/s, 16 Mc/s-56 Mc/s, 24 Mc/s-84 Mc/s. Metal case 10 x 6¾ x 4½in. Size of scale 6½ x 3½in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F. output continuously variable 100 milli-volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle-finished case and white panel. Accuracy plus or minus 2%. **£4.19.6** or **34**/- deposit and 3 monthly payments 25/-. P. & P. 4/- extra.

3-speed TRANSCRIPTION MOTOR
BY FAMOUS MANUFACTURER

Complete Kit of parts comprising accurately balanced precision made heavy turntable with rubber mat, large constant speed condenser, starting motor, base plate. Can be assembled in half-an-hour. A.C. Mains 200/250 v. Fully guaranteed. **£6.19.6** Post Paid. Parts sold separately.

USED 9in. TUBE. 22/14C with ion burn. 17/6. Post paid. Used Mullard 9in. tube 22/17 and 18 ion burn. **25/-** post paid.

A.C. mains 230/240 Comprising choke, power-factor condenser, 2 tube holders, starter, and starter-holder. P. & P. 3/-. 17/6.

20 watt A.C. or D.C. 200/250 v. Fluorescent kit, comprising trough in white stove enamel, 2 tube holders, starter, starter-holder and barreter. P. & P. 1/6. 12/6.

Three speed automatic changer by **B.S.R. MONARCH** current model. Will take 7in., 10in. or 12in. records mixed. Turnover crystal head. Cream finish. BRAND NEW. VERY LIMITED QUANTITY. A.C. Mains 200/250. **£7.15.0.** P. & P. 3/-

Line and E.H.T. Transformer. 9kV. Ferrocart core. EY51 heater winding, complete with scan coils and frame output transformer and line and width control. **35/-.** P. & P. 3/-.
As above but complete with line and frame blocking transformers, 4 henry 250 mA. choke, 100 mfd. and 150 mfd. 350 wkg., 380 mA. A.C. ripple. **£2.9.6.** P. & P. 3/-.
Standard wave-change Switches. 4-pole 3-way; 5-pole 3-way; 3-pole 3-way, 1/9 each; 9-pole 3-way 3/6; Miniature type, long spindle, 4-pole 3-way and 4-pole 2-way 2/6 each. 2-pole 11-way twin wafer, 5/-; 1-pole 12-way 5/-. P. & P. 3d.
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Combined 12in. Mask and Escutcheon perspex. New aspect, edged in brown. Fits on front of cabinet. 12/6. As above for 15in. tubes, 17/6.
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Wide Angle P.M. Focus Unit, Vernier adj., state tube, **15/-.**
P.M. Focus Unit for Mullard tubes with vernier adjustment. **15/-.**
Ion Traps for Mullard or English Electric tubes. **5/-.** Post paid.
T.V. Coils, moulded former, iron cored, wound for rewinding purposes only. Ali-can 1¾in. x ¾in., **1/-** each; 2 iron-cores Ali-can, 2¾in. x ¾in., 1/6 each. These coil formers are suitable for the Prac. T.V. Converter.
Dubilier .001 10kV working. **3/6.**
Primary, 200-250 v. **P. & P. 2/-.**
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Drop thro' 250-0-250 v. 80 mA. 6 v. 3 amp., 5 v. 2 amp., **14/6.**
280-0-280, drop through, 80 mA. 6 v. 3 amp., 5 v. 2 amp., **14/6.**
Drop thro' 270-0-270 60 mA. 6 v. 3 amp., **11/6.**
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R.F. E.H.T. Oscillator Coil, 6-9 kV with EY51 rectifier winding, and circuit diagram. **15/-.**
As above, but complete with 6V6, EY51 and associated resistors and condensers. Circuit diagram. **37/6.**
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Used A.C. mains 200/250 volts, 4 valve plus metal rectifier, medium wave superhet in polished walnut cabinet, size 14 x 9½ x 7½in., complete with valves 6K8, 6K7m, 6Q7 and 6F6. 6½in. PM speaker. Fully guaranteed. P. & P. 7/6. **£3.15.0.**
1,200 ft. High impedance recording tape on aluminium spool. **12/6** post paid.

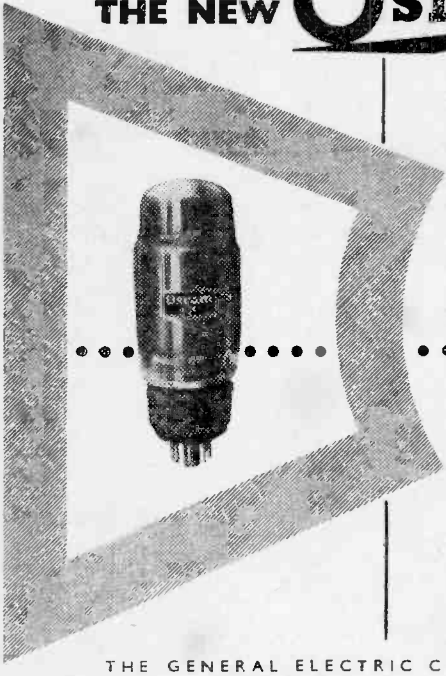
Valve Holders, moulded octal Mazda and loctal, **7d.** each. Paxolin, octal Mazda and loctal, **4d.** each. Moulded B7G, B8A and B9A, **7d.** each. B7G and B9A moulded with screening can, 1/6 each.

32 mfd., 350 wkg.	2/-
16 + 24, 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
40 mfd., 450 wkg.	3/6
16 × 8 mfd., 500 wkg.	4/6
16 × 16 mfd., 500 wkg.	5/9
16 × 16 mfd., 450 wkg.	3/9
32 × 32 mfd., 350 wkg.	4/-
25 mfd., 25 wkg.	11d.
250 mfd., 22 v. wkg.	1/-
16 mfd., 500 wkg.	3/3
8 mfd., 500 v. wkg., wire ends	2/6
8 mfd., 350 v. wkg., tag ends	1/6
100 + 150 mfd., 350 v. wkg., 280 mA., A.C. ripple	4/6
100 + 200 mfd., 275 wkg.	7/6
16 + 16 mfd., 350 wkg.	3/3
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60 + 100 mfd., 280 wkg.	7/6
50 mfd., 12 wkg.	11d.
50 mfd., 50 wkg.	1/9
Miniature wire ends moulded, 100 pf., 500 pf., and .001, ea.	7d.

Where cost and packing charge is not stated, please add 1/6 up to 10/- 2/- up to £1 and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.

R. & T.V. COMPONENTS (ACTON) LTD.
23 HIGH STREET, ACTON, LONDON, W.3

THE NEW Osram KT55 output valve

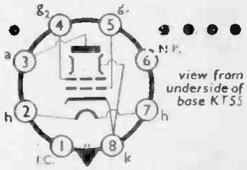


The new Osram KT55 beam tetrode has a heater rating of 0.3A, 52V. It is intended for use in a series heater chain for either DC or AC/DC mains amplifiers.

Outstanding characteristic is its high power output (25 watts per pair) with minimum distortion at comparatively low H.T. voltage (200V).

The Osram KT55 will form a popular companion-type to the well-known KT66. Two valves, type KT55, will supersede the need for four valves, type KT33C, in AC/DC amplifiers required to deliver up to 25 watts at 200 volts.

KT55. List price: 25/- plus P. Tax 9/9



HEATER

I_h	0.3	A
V_h	52	V

TYPICAL OPERATION

Tetrode connection. Push-pull.
Data per pair unless otherwise stated.

	Quiescent	Max signal	
V_a(b)	225	215	V
V_a	200	190	V
V_{g2}	200	190	V
V_{in} (gi—gi) (pk)		28.8	V
V_{g1} (approx.)	—20.5	—23.5	V
I_a	220	225	mA

	Quiescent	Max signal	
I_{g2}	15	45	mA
R_k (per valve)	175	175	Ω
RL (a—a)		2	kΩ
P_{out}		25	W
D		2	%
Z_{out}		9	kΩ

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, W.C.2

CONSTRUCTORS' BARGAINS

BAND III CONVERTER.

Coil kit by TELETRON, with circuit and wiring details, etc. For use with TRF or Superhet TV Receivers. **ONLY 15/-.** Drilled chassis 3/9, or slightly larger to hold power pack components, 6/- (postage on either 6d.). Instruction leaflet only, **6d.**

INDICATOR UNIT TYPE 6.—Contains VCR 97 tube with mu-metal screen, 4 valves EF50 and 2 of EB34, valveholders, CRT holder, condensers, resistors, etc. NEW CONDITION. ONLY **39/6** (carriage, etc., 7/6).

AMPLIFIER TYPE 223A or 208A—As described in July, 1955, issue of *Practical Television*, for making a TV CONVERTER. Complete with 2 valves EF50. ONLY **10/-** (post, etc., 2/-).

PYE 45 MC/S I.F. STRIPS.—Ready-made for London Vision Channel. Complete with 6 valves EF50 and 1 of EA50, and details of very slight mods. required. BRAND NEW. ONLY **49/6** (post, etc., 2/6).

I.F. STRIP 194.—Another easily modified strip for TV. Complete with 6 valves SP61, 1 of EA50, and 1 of EF36; also mod. data. ONLY **29/6** (post, etc., 2/6).

RECEIVER UNIT 159.—Contains 4 valves, 1 each EF50, EA50, SP61, RL37 and 24 v. Selector switch. ONLY **7/6** (post, etc., 2/-).

R.F. UNITS TYPE 26.—Complete with 2 valves EF54 and 1 of EC52, this is the variable tuning unit covering 65-50 mc/s (5-6 metres). BRAND NEW IN MAKER'S CARTONS. ONLY **27/6.**

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AVOMINOR CARRYING CASES.—Size 5in. x 5in. x 2in. with long carrying strap. In high quality leather with press stud fixing flap. Made for UNIVERSAL Avominor. BRAND NEW. ONLY **7/6** (post, etc., 1/-).

"ALL DRY" RECEIVER MAINS UNIT. If your battery portable uses midget 1.4 v. valves of the 1S4, 1T4, 1R5, 3S4 series, then this will save you pounds in batteries. Delivers LT & HT from normal mains. Manufactured by "AVO" for the Ministry of Supply. Fused on mains side, and ready to work. Size 8½in. x 5½in. x 3½in. BRAND NEW. ONLY **39/6.**

E.H.T. TRANSFORMER.—Normal 230 v. Primary, with Secondary of 2,000 v. r.m.s. (approx. 2,800 v. D.C.). A special offer of interest to all using the VCR97 or similar tube. Size 2¾in. W. x 2½in. D. x 3in. H. + ¾in. for tag panel. **AN UNREPEATABLE SNIP**, and well worth buying as an insurance against failure of existing E.H.T. supplies. **ONLY 15/-** (postage, etc., 2/-).

SPEAKERS.—P.M. 6½in. less trans., 19/6; 8in., less trans., **16/6**; 10in. with trans., **27/6** (post 2/-).

CHOKES.—10H 60 mA., 4/-; 5H 200 mA., 7/6 (post 1/-).

BENDIX TRANSMITTER TA-12-C.—A magnificent item of American equipment. Wave ranges are 300/600 kc/s., 3,000/4,800 kc/s., 4,800/7,680 kc/s., 7,680/12,000 kc/s., and 1 spot frequency on each can be selected. Valves employed are 3 of 807 and 4 of 12SK7. A superb buy at ONLY **59/6** (carriage, etc., 10/6).

MODEL MAKERS MOTOR.—Reversible poles. Only 2in. long and 1¼in. diameter, with ¼in. long spindle. Will operate on 4, 6, 12 or 24 volts D.C. ONLY **10/6** (post, etc., 1/-).

TRANSFORMERS.—Manufactured to our specifications and fully guaranteed. Normal Primaries. 425-0-425 v. 200 ma. 6.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a., **ONLY 65/-**; 350 v.-0-350 v. 160 ma., 6.3 v. 5 a., 6.3 v. 3 a., 5 v. 3a., **ONLY 47/6**; 250 v.-0-250 v. 100 ma., 6.3 v. 6 a., 5 v. 3 a., **ONLY 37/6.** 350 v.-0-350 v., 150 ma., 6.3 v. 5 a., 5 v. 3 a., **ONLY 37/6.** 250-0-250 v. 60 ma., 6.3 v. 3 a., 5 v. 2 a., **ONLY 21/-.** The above are fully shrouded, upright mounting. 5.5 kV. E.H.T. with 2 windings of 2 v. 1 a., **ONLY 79/6**; 7 kV. E.H.T. with 4 v. 1 a., **ONLY 89/6.** PLEASE ADD 2/- POSTAGE FOR EACH TRANSFORMER.

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Open until 1 p.m. Saturdays, we are 2 mins. from High Holborn (Chancery Lane Station) 5 mins. by bus from King's Cross.

Cash with order, please, and print name and address clearly. Include postage and carriage on all items.

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Practical Television

& TELEVISION TIMES

Editor : F. J. CAMM

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Televiews

IS ITV FAILING ?

THE news that a large organisation and its associated companies have withdrawn their advertising support from ITA programmes, and the fact that many of the programmes are put out without any supporting advertising at all rather supports the accuracy of our forecast before the ITA service commenced, that advertisers would find that form of publicity unprofitable in view of the high cost in relation to the transient and scant publicity offered in return for the high expenditure. Another factor is that at present ITA has not a nation-wide coverage.

There is a battle going on between the BBC and ITA as to who has captured the greatest proportion of viewing time. The BBC through its research bureau claims the major portion, whilst ITA with their " Metering " system make similar claims.

Judging from the quality of the programmes, there can be little wonder that firms are either withdrawing or failing to support. They are amateurish in extreme and bear the stamp of hasty preparation. No evidence is available as to what results advertisers are getting, but the limited advertising support suggests that this new form of visual advertising has had disappointing results. This is not so much a criticism of ITA as a provider of alternative programmes, as a criticism of the quality of the programmes. The BBC programmes have always had their critics, but viewers have a useful yardstick with which to measure one against the other. If those who have had their sets converted for the alternative programmes are disappointed, they will naturally tell their friends so, and this will deter others from going to the expense of the change-over. Perhaps it would have been wise for the service to have been delayed a few more months so that programme plans could have reached a higher stage of perfection. It is obvious that immediate changes are necessary if the new service is to survive, for we understand that it is losing at present a considerable sum of money each day. Readers will remember our criticism, which was that there was too great a stranglehold on the amount of publicity permitted in each programme and that it could not be expected that advertisers would spend large sums of money just to pay for an alternative programme. Perhaps now that ITA has had a few months' experience they can approach the authorities for a relaxation of the grip they hold over the programmes, some of which leave the impression that they have been not only hastily prepared, but with too lively an eye on the advertisement revenue, and too little consideration to the important fact that, as with newspapers and periodicals, the advertiser must get his money back. Viewers who look in to ITA have a duty to write their criticisms to the Authority for their guidance. We doubt the accuracy of the so-called metering system which at present is the guide of ITA viewing time. We say that it is not possible by this system to obtain any reliable evidence.

A BEGINNER'S GUIDE TO TELEVISION

ELSEWHERE in this issue we commence publication of our new series of articles entitled " A Beginner's Guide to Television," the treatment of which will follow the style of " A Beginner's Guide to Radio," which ran in our companion journal, *Practical Wireless*. Those readers intending to follow this series should place a regular order with their newsagents and avoid the disappointment experienced by many readers of our companion journal due to the greatly increased demand which that series created.

SEPARATE LICENCES

THE Postmaster-General, replying to a question in the House of Commons recently, declined to introduce separate licences for radio and TV so that people who possess only a television set need not pay the full charge of £3. He said that it was unlikely that the £3 television licence fee could be reduced in view of the growing of the TV service. In any case, it would involve separate licensing of sound sets and TV sets even in the same household.—F. J. C.

BBC Experimental Colour System

AN OFFICIAL STATEMENT ON THE SYSTEM AND APPARATUS BEING USED FOR EXPERIMENTS

THE BBC has installed experimental colour television equipment at the London station at Alexandra Palace for a series of experimental tests of colour television transmission systems. These tests started on October 10th, and at the present time a particular type of signal, based on the American N.T.S.C. standard, is being radiated. It is important to understand the nature of these tests and how it has come about that this system is the first to be tested.

In December, 1953, the F.C.C. approved for public service in U.S.A. the colour television standards recommended by the National Television Systems Committee (N.T.S.C.). The principal features of the N.T.S.C. signal which need concern us here are :

1. The colour signal is transmitted in the same radio frequency channel and by the same transmitters as carry the established monochrome service.

2. It is claimed that the system is " compatible " i.e., that existing monochrome receivers can produce a monochrome version of the colour picture which is as good as if the picture had originated from a normal monochrome camera.

3. It is further claimed that the standards are such as to allow for considerable future development in the quality of the colour picture, in the same way as the original specification for the monochrome television service has allowed a continuous improvement in quality over the course of the years.

In this country the BBC has operated since 1936 (except for the war period) a well-established and successful monochrome service employing 405 lines, 50 frames per second interlaced. The advent of the N.T.S.C. colour system naturally aroused interest in the question as to whether this system would show the same advantages here when modified to suit British television standards. Since the scanning and transmission standards of the U.S.A. and this country differ in important ways there was no *a priori* reason to answer this question affirmatively, and work was therefore started on the problem in the BBC research laboratories and in certain industrial organisations.

Work in the laboratories has now reached the stage where practical transmission equipment is available and, with the agreement of the G.P.O. and the co-operation of the radio industry, the investigation will be extended to a wider field. The results of these investigations will be at the disposal of the Television Advisory Committee, which has been asked by the Postmaster-General to report on the whole field of colour television.

The equipment at Alexandra Palace generates a modified N.T.S.C. type of colour signal and its purpose is :

1. To explore the degree of compatibility of the system by making observations on some thousands of black/white receivers.

2. To see whether the system is capable of producing a consistently good quality colour picture.

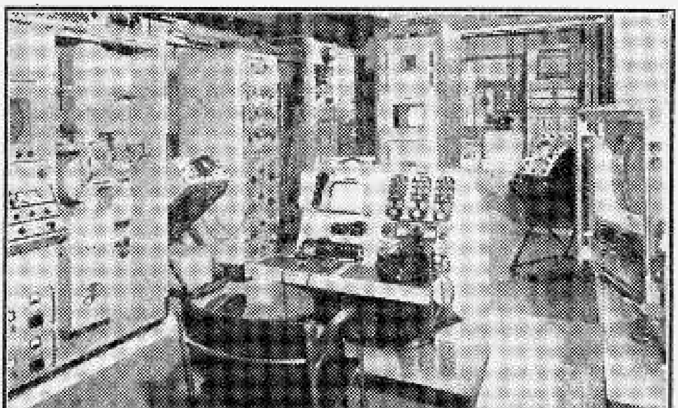
The tests in connection with the first question are already proceeding and it is hoped to provide a statistical answer in due course. Naturally, since colour pictures are being transmitted, some experience and knowledge are being obtained on the second point, but no wide-scale observations are yet taking place because sufficient colour receivers are not yet available.

It cannot be emphasised too strongly that the work is entirely experimental with the sole object of obtaining data which, in due course, will be studied by the Television Advisory Committee, the industry and the BBC.

The test transmissions, which take place outside normal programme hours and have no entertainment value, are in no sense a public service and do not indicate that the start of such a service is imminent. The BBC has no definite plans for the introduction of such a service ; there are many difficult technical problems to be solved before this can be contemplated.

The N.T.S.C. Type of Colour Signal

As the equipment at Alexandra Palace has been designed on the basis of the N.T.S.C. signal, a brief description of the essential features of the latter will be given for the information of those who are not acquainted with the principles on which it is based. For those who are familiar with the N.T.S.C. specification the differences between the signal transmitted



General view of the colour studio control room. On the left is the film scanner, on the right the power supply and pulse generator equipment. In the centre control console and three-tube colour picture monitor, and extreme right the radio check colour receiver.

from Alexandra Palace and the American standard will be apparent.

Because of the physical make-up of the human eye, the sensation produced by practically all the colours encountered in real life can be reproduced by the additive mixture of red, green and blue lights. Therefore, it is a common feature of all colour television systems with any pretensions to accurate colour reproduction that the receiver employs coloured lights of red, green and blue, whose intensities are controlled by three separate signals from the transmitter. The N.T.S.C. signal transmits these three signals as : (a) a luminance (brightness) component ; and (b) a chrominance (colour) component, having two separate parts.

The luminance component is the same as that which would be produced by a panchromatic monochrome television camera looking at the same scene, and this signal therefore produces a normal monochrome representation of the coloured scene on a monochrome receiver.

The chrominance component consists of two colour-difference signals, which in the simplest terms may be said to convey the hue and degree of saturation of the colour information. In the colour receiver these three signals representing brightness, hue and saturation are combined to produce the required intensity from each of the red, green and blue lights. The fact that a monochrome receiver and a colour receiver can simultaneously produce each its own version of the scene from the same signal gives the N.T.S.C. system its valuable feature of " compatibility."

It would be possible to transmit the chrominance signal quite independently of the luminance signal and in this case the compatibility would be virtually perfect. However, the second unique feature of the N.T.S.C. signal is that the two components have been combined in such a way that they occupy the same total bandwidth as that used by the equivalent monochrome signal. Due to the manner in which the human eye perceives colour, the separation of luminance and chrominance enables the bandwidth of the chrominance signal to be reduced to about one-third of that of the luminance. Further saving of bandwidth is achieved by placing this reduced bandwidth information at the upper end of the luminance band in such a way that the inevitable interference (cross-talk) between the two signals has a minimum effect on the compatible picture on the monochrome receiver. The actual mechanism by which this band sharing takes place employs a colour subcarrier (in the British version 2.66 Mc/s) which is simultaneously modulated in amplitude and phase by the two-colour difference signals, the carrier itself being suppressed so that the chrominance signal exists only when colour is present in the scene being transmitted. The colour sub-carrier is an odd multiple of half the line scanning frequency and, under these circumstances the visibility of the best pattern produced between it and the scanning lines is a minimum.

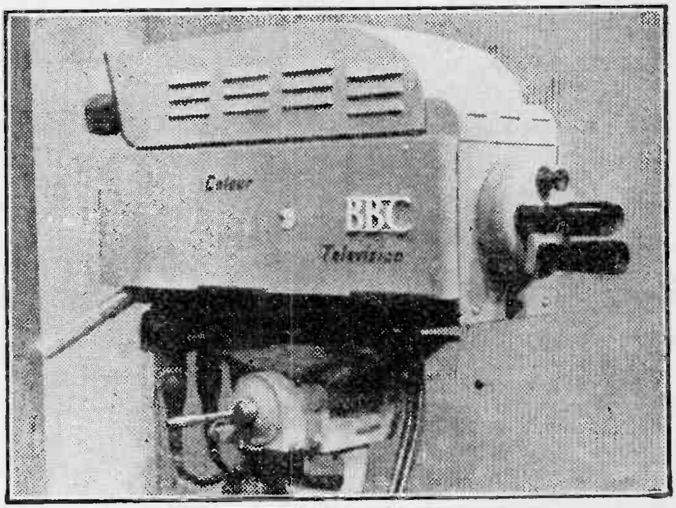
This ingenious combination of band saving, band sharing, suppressed carrier modulation and " frequency interleaving " is claimed in the U.S.A. to produce an adequately compatible signal. Whether or not such is the case in the British version applied to typical domestic receivers in this country is the chief matter under investigation at the present time.

The Equipment Installed at Alexandra Palace

The main items of equipment installed at Alexandra Palace are :

1. Colour slide and film scanner.—Designed and made by Research Department, Engineering Division, BBC.

2. Colour camera. 3. Signal coding equipment. 4. Colour picture monitors. 5. Colour test equipment. —Designed and made by Marconi's Wireless Telegraph Company Limited.



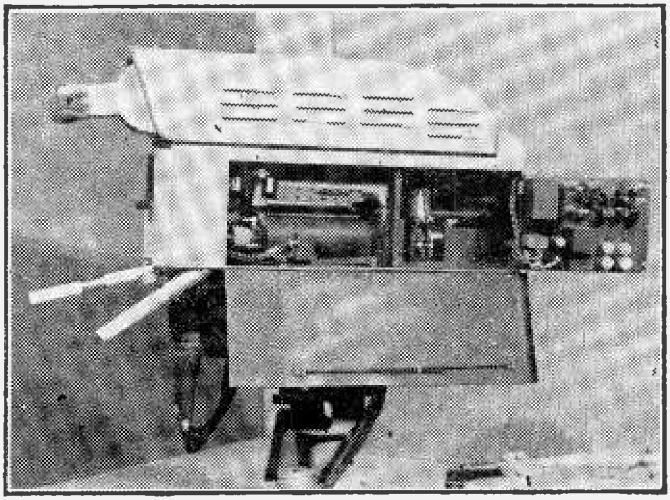
A general view of the three-tube colour camera.

1. Colour Slide and Film Scanner

The colour slide and film scanner is the source of the pictures which are being transmitted for the present series of tests of the compatibility of the N.T.S.C. signal. It produces pictures from slides either $3\frac{1}{4}$in. x $2\frac{1}{4}$in. or 2in. x 2in. or from 16mm. film, by selection of the appropriate optical system.

The scanner employs the flying spot principle and the source of light is, therefore, a cathode-ray tube of which the phosphor emits light as evenly as can be achieved over the whole of the visible spectrum. The light from the raster on the face of the scanning tube is passed either through the slide or the film as desired and the coloured image so produced is then split into three separate parts, which represent respectively the red, green and blue information in the picture. This colour analysis process is performed by a combination of dichroic mirrors, coloured filters, plane mirrors and lenses. The three-colour separation pictures, which emerge from the analyser as three physically separate rays of light, are then focused each on to a photo-multiplier tube which turns the intensity of the light, which is varying in accordance with the scene being scanned, into corresponding electric voltages. The three voltages are then passed through three separate and identical chains of electronic equipment which supply gamma correction, correction for the distortion introduced by the finite decay time of the light from the scanning tube phosphor, and equalisation for aperture loss, exactly as in the case of a monochrome flying spot scanner.

The film transport mechanism is a standard intermittent motion 16 mm. projector with a "pull-down" time of about 4 milliseconds. Since the time available for "pull-down" is only 1.4 milliseconds if all the lines of the television picture are to contain information some picture information is inevitably lost. This loss occurs at the top and bottom of the picture, where about 15 lines are presented as black. In order to preserve the usual aspect ratio of 4 : 3 an equivalent area at the sides of the picture is also black. The picture, therefore, appears as in a black frame, but this disadvantage is accepted because the arrangement permits of a simple and efficient optical system. Synchronism between the film motion and the television picture repetition rate is achieved in a simple way by supplying power to the synchronous motor of the film transport mechanism by amplifying the 50 c/s component of the frame pulses.



Three-tube colour camera, side view, showing one of the camera tubes in its yoke and its associated amplifiers.

2. The Colour Camera

Coloured light entering the lens of the camera is split into three colour separation images by a colour analyser similar in principle to that used in the slide and film scanner. In place of the three photo-multiplier cells are three image orthicon camera tubes of a type developed specifically for colour work. These tubes produce the three colour separation signals in electrical form. Each of the tubes is supplied with the necessary scanning waveforms and electrode potentials just as in the case of the single-tube monochrome camera. It will be realised that the output of each tube is a separate picture of which not only the transfer-characteristic between light input and voltage output must be maintained in a precise manner for the three signals, but the geometry of the three pictures must be the same within very close limits so that any particular detail of the picture occurs at the same point in the scanning cycle of all three.

The signals from the tubes are amplified in the camera and transmitted to the control room over three identical cables. In the control room each signal is gamma corrected and equalised in a manner very similar to that used in monochrome equipments employing the same type of camera tube, and finally emerges as a colour separation signal of the same form as that produced by the slide and film scanner.

We show two general views of the camera. The control desk of the camera is seen in the foreground of the photograph of the control room. The three sets of controls, one for each camera tube, can be clearly seen. The electronic equipment for the camera is mounted in the cubicle nearest to the control desk.

3. Signal Coding Equipment

The signal coding equipment includes the special colour waveform generating equipment and the "encoder" in which the luminance and chrominance signals are formed from the incoming three-colour information.

The "master" frequency, from which all the other scanning and pulse waveforms are derived, is obtained from a temperature controlled crystal oscillator whose frequency is 2.6578125 Mc/s ± 8 c/s. This frequency is multiplied and divided to produce the usual double line frequency of 20,250 cycles/second (i.e., $\frac{4}{525}$ times sub-carrier) from which the standard 405-line interlaced waveform is generated. (It will be noted that the frame repetition rate is asynchronous with respect to mains frequency, in contrast to the existing monochrome service in which synchronous working is almost always employed.) Multiple outputs of line and frame trigger pulses, mixed synchronising pulses and mixed suppression pulses are available.

The input to the encoder consists of the three gamma corrected colour separation signals (red, green and blue) which are produced by either the slide and film scanner or by the camera. The encoder may be considered as performing a single linear transformation of the three incoming signals, red, green and blue, to the other three quantities, Y, I and Q, of which Y is the luminance signal. The colour sub-carrier is then modulated by the I and Q signals in such a way that the amplitude of the resultant signal conveys the saturation information and the phase conveys the hue. In the absence of colour information the sub-carrier is suppressed. The complete chrominance signal is added to the luminance which is, of course, in video form. Finally, the synchronising waveform is added to produce the complete waveform. The synchronising waveform is of the normal type except that a "burst" of nine cycles of the colour sub-carrier is added in the

(*Concluded on page 420*)

Using Metal Rectifiers

A COMPARISON OF VARIOUS METHODS OF H.T. SUPPLY

By W. Cleland

THE H.T. requirements of a television set are often met by using metal rectifiers. Valve rectifiers, because of their heavy emission, fail more often than other valves, while metal rectifiers, if not overloaded, last almost indefinitely.

Some constructors, for convenience, mount the rectifiers vertically, but this is a mistake. Horizontal mounting provides better cooling, and is essential if the rectifier has much heat to dissipate. The final working temperature of rectifier plates must not exceed 65 deg. to 70 deg. C., and determines the maximum output permissible. Thus, with the half-wave rectifier RM4, the maximum D.C. output is fixed by the makers (S.T.C.) as follows :—

Max. ambient temperature	35°C.=95°F	40°C.=104°F	55°C.=131°F
Max. output current (mean)	275 mA	250 mA	125 mA

It is thus desirable to mount the rectifier so that cool air can reach it easily. If one is ever careless enough to overload a selenium rectifier, one finds that it emits a very unpleasant smell which is unmistakable after being once encountered.

One is strongly advised against dismantling rectifiers. A selenium rectifier usually survives being taken to pieces, but with copper oxide rectifiers, the process is almost invariably ruinous.

Transformers

Mains transformers are usually provided with secondary windings for valve rectifiers as in Fig. 1.

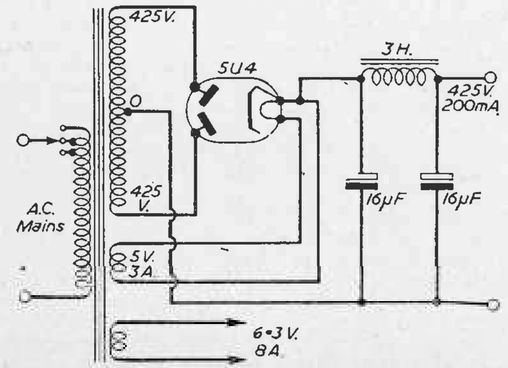


Fig. 1.—Full-wave supply system as used for a VCR97 Receiver. Additional smoothing is not shown.

Such a valve could be replaced by metal rectifiers as shown in Fig. 2. It is interesting to note, however, that the same rectifier could be modified into a bridge system to provide the same output current and voltage (Fig. 3). The transformer secondary winding would then be halved, but the wire thickness would be increased since the single winding now carries all the current.

Since mains transformers for television sets tend to be large, heavy, and expensive, they are often avoided, or else are used merely for heating the valves. The H.T. supply is often provided by a half-wave metal rectifier, which is more suitable for working from the mains than from a transformer, which it tends to magnetise. One disadvantage is that the ripple is 50 c/s and regulation also is poor, unless very large smoothing capacitors are used. These cause a large surge when the receiver is switched on, but suitable rectifiers are designed to withstand this.

Smoothing resistors have no saturation problem and to some extent can take the place of chokes, but they waste power by dropping the output voltage. At 50 c/s a 3-Henry 100-ohm choke has an impedance of 947 ohms and in conjunction with 100 μF will attenuate ripple 29 times, dropping 25 volts at 250 mA. For such a current it would be out of the question to use an equivalent smoothing resistor, but separately smoothed supplies can be used instead.

Bridge Rectifier

A bridge rectifier can be used on the mains, but it must have enough plates to withstand the full peak inverse voltage, since the source impedance is much lower than that provided by a transformer.

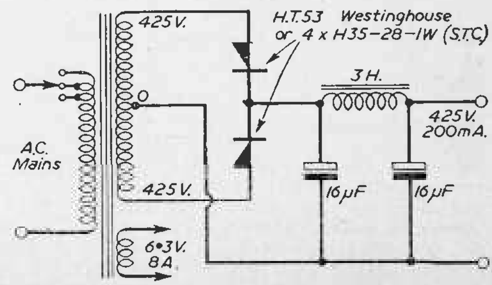


Fig. 2.—Valve replaced by a push-pull metal rectifier.

Half-wave

Returning to the half-wave rectifier, it is interesting to note that when this is centre-tapped, it can be modified into a voltage-doubler for the same output voltage and current. It would, therefore, be practicable to supply a television set by the system of Fig. 6. The number of turns in the secondary winding will be about half of what is required for a half-wave rectifier. A voltage-doubler of this type has a 100 c/s ripple, which doubles the reactance of chokes and capacitors, making a stage of L-C smoothing four times as effective as at 50 c/s.

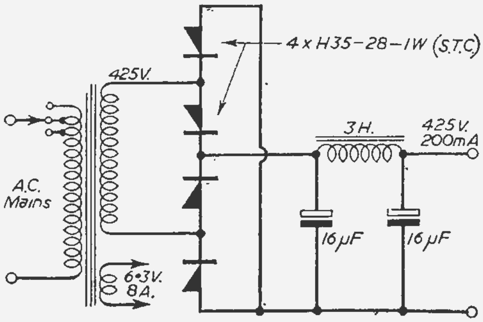


Fig. 3.—Bridge rectifier developed from the push-pull version of Fig. 2.

There is a type of voltage-doubler which gives a 50 c/s ripple and should therefore be avoided, since it offers little advantage over an ordinary half-wave supply, the output capacitor charging only on alternate half-cycles. This type is shown in Fig. 7.

Personally, I work all radio and television apparatus from metal rectifiers (either bridge or voltage-doubler) and wind transformers on a home-made winding machine with a turns-counter. It is not economical to make transformers oneself unless bargains in wire or laminations are to be had, and there are pitfalls as regards insulation and electrostatic screens, but at least one can meet any required specification and provide tappings to adjust the output.

There is some uncertainty as to whether the application of H.T. voltage to valves before they have heated up is deleterious to them. There is probably no serious effect, unless with large output valves. At all events, metal rectifiers are widely used for H.T. supplies. Sometimes thermal delay switches are used to delay the application of H.T. These draw about half an ampere from the heater supply, and often evince contact trouble before long, causing crackling or erratic working. One prefers to avoid such complications, especially as it is usually unnecessary.

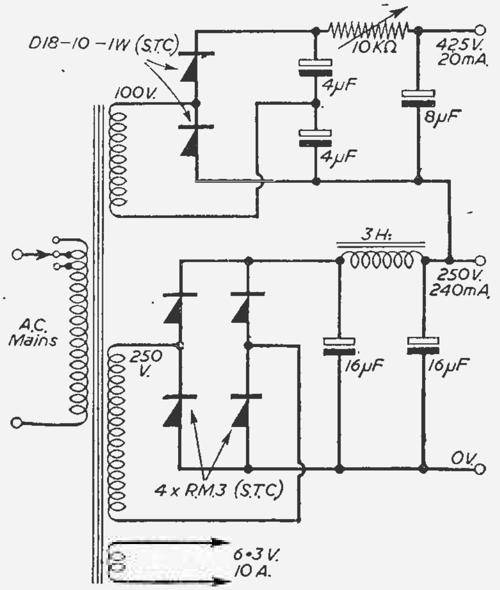


Fig. 4.—A more economical supply for a VCR97 Receiver, which can later be used for a magnetic picture tube if required.

Current Rating

The current carrying capacity of metal rectifiers is decided by the size of the plates, and more especially by the size of the fins from which the heat is carried away. The output voltage is fixed by the number of rectifying sections. Some rectifiers have two rectifying sections between each pair of fins. On alternate cycles, in a half-wave system, the output voltage maintained by the reservoir capacitor adds

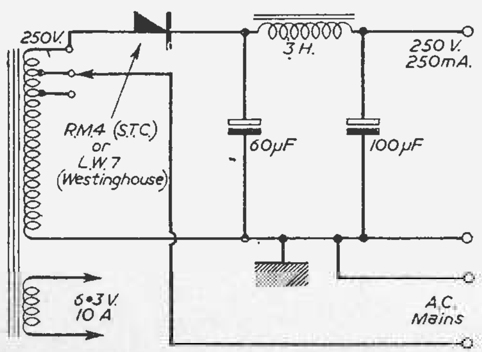


Fig. 5.—Half-wave system directly connected to mains. Boosted if below this voltage. Note the high values of the capacitors.

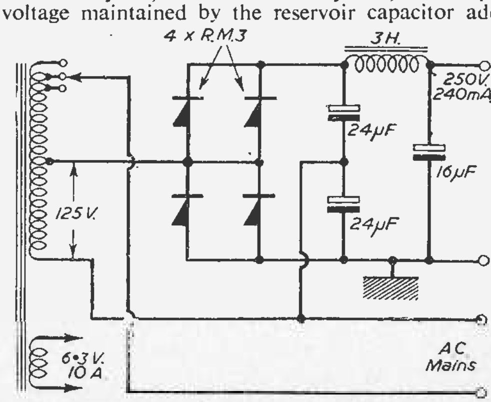


Fig. 6.—Voltage-doubler using equivalent of RM4, with more economical ripple suppression. Neither side of mains directly connected to chassis.

to the peak input to give a peak inverse voltage which the rectifier must be able to withstand.

With a given size of plates, a voltage-doubler provides the same maximum output current as a half-wave rectifier, while a push-pull (valve-replacement) rectifier or a bridge can supply twice as much current as this with the same size of plates.

The following table gives standard voltage ratings for ordinary selenium rectifiers. Some users have exceeded them appreciably for long periods, apparently with little deterioration, but it is best to keep to these figures.

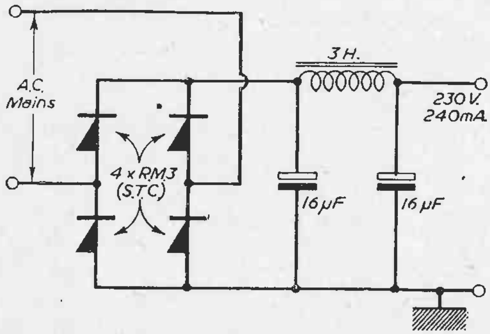


Fig. 8.—Bridge rectifier capable of working from the mains. Neither side of mains directly connected to chassis.

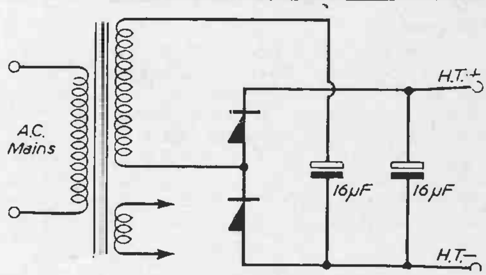


Fig. 7.—A voltage-doubler to be avoided. (50c/s ripple and poor regulation.)

System	Total number of rectifying sections	R.M.S. input current	Typical R.M.S. input voltages
Half-wave ...	V/10	2.5 I	V×0.9 to 1.1
Full-wave :			
Voltage-doubler	V/10	3 I	V×0.5 to 0.6
Push-pull ...	V/4	1	V×0.9 to 1.0 (twice)
Bridge	V/4	1.4 I	V×0.9 to 1.0

Where V and I are the output direct voltage and current respectively.

"Space School"

"SPACE SCHOOL" is the new BBC Children's Television serial in four weekly self-contained episodes. It is written by Gordon Ford; the scientific adviser is S. H. Groom, Lecturer in Physics and Astronomy at the Science Museum, who for the last 25 years has been lecturing to enthusiastic schoolchildren. The producer is Kevin Sheldon who has varied his long association with "The Appleyards," by producing "The Lost Planet," "Return to the Lost Planet" and other serials.

Mr. Sheldon explains that the whole action of "Space School" depicts the type of space adventures that might be expected in the comparatively early days of space travel, which at the time of the first play has become accepted as a matter of course. Landings have been made on Mars and the Moon, and a satellite advance base for observation purposes has been set up within easy range of Venus. Mines have been worked both on the Moon and on Mars, and valuable new metals—such as a pliable metal called Segalium taken from Mars—are being used to revolutionise manufacturing processes of all kinds.

Characters in the play are members of the 500-strong colony on an earth satellite which is established as the H.Q. of space control. The satellite is 320 yards in diameter and 100 yards deep and revolves 1,000 miles off the earth. It has all the modern conveniences including a Space School where the children receive education on space and earthly subjects.

The Colony is headed by Sir Hugh Stirling, Commodore of the Space Fleet and in charge of all operations off the earth; Sir Hugh was one of the pioneers of early space flights who was responsible for plotting the original navigational routes to the Moon and Mars. He is played by John Stewart (Dr. Lachlan McKinnon of the "Lost Planet" serials).

His team consists of Space Captain Michael O'Rorke, an ace pilot and fiery Irishman, played by James O'Connor; his Space Engineer Cedric ("Tubby") Thompson, who is "excellent with a screwdriver, a tube of glue, and a piece of string," played by Donald McCorkindale, son of the South African boxer Don McCorkindale; and the Space Schoolmistress, Miss Osborn who, though a qualified space pilot, is responsible for teaching her pupils the conventional earthly subjects of history and geography, played by Julie Webb, a regular visitor to "The Appleyards."

Three principal child roles are played by Michael Maguire, Ann Cooke and Meurig Jones as Wallace, Winnie and Wilfred Winter.

The BBC Wardrobe Department have designed smart space suits for the children with a school badge on their pockets designed by Gordon Roland who is responsible for the settings. Suitably spatial music is being composed in co-operation with Sound Radio whose background noises for "Journey into Space" are greatly admired by Kevin Sheldon and his team.

The Band III Cascode Circuit

A STRAIGHTFORWARD EXPLANATION OF ITS DEVELOPMENT

By "Alpha"

THE opening of Band III transmissions has brought the cascode circuit to the fore; it is used in many amateur and commercially built converters as a low-noise "front-end."

Cascode operation has developed logically in the search for low-noise input circuits with high stability and ease of adjustment at the very high frequencies used in Band III and is likely to be with us for some time.

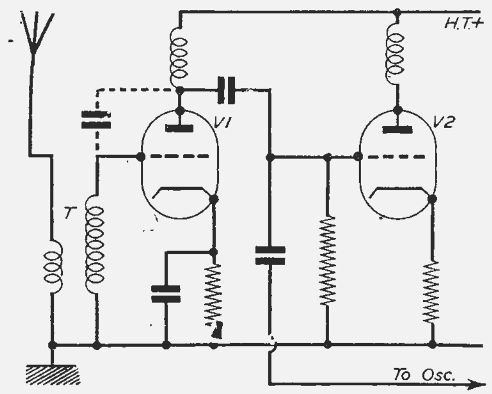


Fig. 1.—Basic circuit showing capacity of valve.

Noise

The successful reception of television pictures depends very largely upon the ratio of the television signal to that of "noise" produced by various sources.

Noise may be classified as random impulses which find their way into the receiver and become amplified along with the signal.

Where high-gain fringe televisors are used it is often possible to obtain the visual equivalent of noise on the screen, simply by turning up the contrast and sensitivity controls to maximum.

In sound broadcasting noise is recognised by the hissing sound which it causes; under severe conditions the hissing noise can be so loud as to make weak signals unintelligible. In the case of vision reception the noise shows itself on the screen as random specks of light. In severe cases it will cover the screen with small specks like a snow-storm and is often referred to as "snow," for this reason.

Normally our picture should be received on the background of a blank screen, but where the background is not blank but is covered with small specks due to noise, the quality of the received picture will be seriously altered, and in severe cases the noise will be so strong as practically to obliterate the picture.

On Band I most of the noise comes from external sources and a great deal of it has its origin in the Milky Way where nuclear disturbances send out electromagnetic signals over a wide band.

On Band I noise from galactic sources is much less evident and a much greater proportion of the noise is to be found due to circuit noise within the early stages of the receiver itself.

Internal Noise

Noise originating within the televisor is classified as internal noise and comes from several different sources.

One quite obvious source is noise due to the random movement of the electrons within a resistance: most constructors must have come across this source in its worst from where a resistance has become "noisy."

Generally, however, the noise is of quite a low degree and of no great importance on Band III. Much more important is the noise caused within the valves themselves.

Within the valve we have several important noise sources. There is *flicker noise* caused by the random emission of electrons from the cathode of the valve; there is *shot noise* due to the fact that the electrons are inclined to reach the anode of the valve in clusters rather than in a steady stream; there is *partition noise* which is the random partition of electrons between the screened grid and the anode.

The latter example is peculiar, of course, to valves which have an auxiliary grid such as the pentode. The triode valve does not suffer from this defect as it has only the one control grid and this has led to the reversion to triodes for R.F. amplification.

(The word "reversion" is deliberate as triodes were used many years ago as R.F. amplifiers, before the screened grid valve and latter the R.F. pentode were developed.)

Prevention of Re-radiation

An important difficulty associated with the use of triodes is the Miller effect which takes place between the anode and grid.

The anode and grid of a triode are separated within

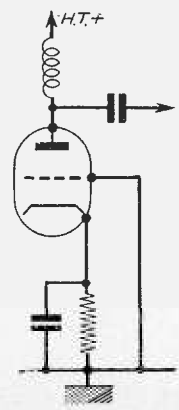


Fig. 2.—Grounding the grid.

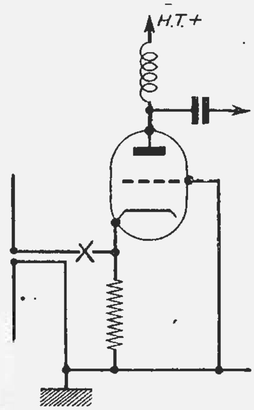


Fig. 3.—Cathode input.

the glass bulb by a very small distance. The two elements, therefore, behave like a small condenser and this condenser can be shown connected as indicated by the dotted lines in V1 circuit, Fig. 1.

It is at once obvious that this capacitance is such that positive feedback will occur between anode and grid. Although the value of the capacitance is quite small, it is appreciably large compared with the frequency and feedback will occur.

The noise generated within the valve which is first in the amplifying chain is of the greatest importance because each successive valve will amplify that noise. It is essential to keep the first valve noise at as low a figure as possible, and if a triode valve is employed then we have the difficulty previously stated due to feedback.

There is yet another factor which must be considered. Most Band III circuits are of the superhet type. Fig. 1 shows the basic outline of the arrangement. The first valve V1 amplifies the signal at its own frequency and the resultant signal is fed to the input of a mixer valve V2. The mixer valve has two inputs; it has that of the amplified signal and also that of the local oscillator.

In Fig. 1 we show the oscillator input connected in parallel with the R.F. input to the mixer, a fairly common arrangement.

Now, it is clear that the oscillator frequency is present at the anode of the triode valve V1 and due to the capacitance between anode and grid of the triode it will appear on the grid of the triode and find its way thence to the aerial.

The net result is that the oscillator signal is re-radiated by the aerial system.

This is obviously most undesirable for several reasons. As a simple example supposing we have a televisor tuned to Channel 8 the I.F. stages being at 10 Mc/s. Now Channel 8 is 189.75 Mc/s vision and to produce an I.F. of 10 Mc/s the oscillator may be at 189.75 + 10 = 199.75 Mc/s. This frequency happens to be that of Channel 10 and so our televisor would radiate a strong interfering signal in Channel 10.

Grounding the Grid

One method of overcoming the problem of feedback and re-radiation is to connect the grid of the valve directly to ground ("earth"). This is shown in Fig. 2. The grid now acts as a shield and prevents re-radiation. The snag is that we must connect our aerial circuit at some point and this cannot be the grid which is now grounded.

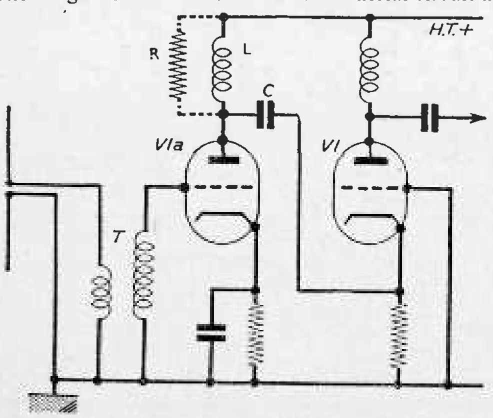


Fig. 4. — The basic cascode circuit.

Fortunately, it is possible to obtain amplification from a valve by injecting the signal either into the control grid, or into the cathode in the same way that it is possible to modulate a cathode ray tube by injecting the signal either into the grid or the cathode.

The circuit arrangement is shown in Fig. 3.

This circuit will work—but we have lost one of the most useful properties of the valve. This is its high input impedance!

The input impedance of the circuit shown in Fig. 3 is very low. Some alleviation may be made by the insertion of a capacitance of suitable value in series with the input circuit at point "X," but in spite of this the input impedance is far from satisfactory and exercises serious damping on the aerial system and mismatch. Further the advantages of the gain of a step-up transformer ("T" in Fig. 1) are lost.

A correctly designed input transformer can give a gain of up to five times.

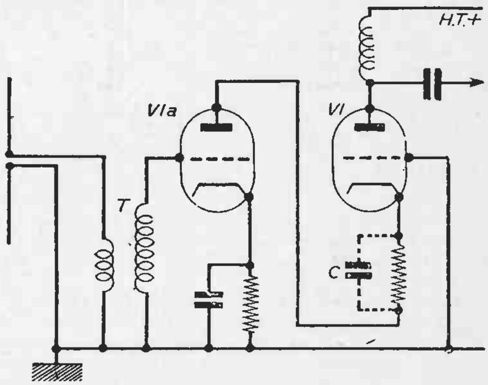


Fig. 5. — A further development.

Using a Second Valve

In an endeavour to obtain the best of both worlds we can use another triode valve in front of the existing one. The circuit arrangement is shown in Fig. 4.

Here we have our input transformer "T" with its step-up ratio and consequent stage gain. The output of the triode V1a is improved by the inclusion of a tuned circuit "L," and is fed to the input of the second valve via a capacitative coupler "C."

Up to this point we were quite happy but, going back to our previous statement, the input impedance of the grounded grid valve V1 is very low and as this impedance is in parallel with the anode load of V1a, i.e., "L" this latter tuned circuit is very heavily damped—so heavily, in fact that it might just as well be replaced with a simple resistance. This is shown in the circuit diagram as "R."

Because of the low value of input impedance "R" would have to be a value of about 150 ohms. It is obvious that with such a low anode load as 150 ohms, the amplification of V1 will be very low indeed—so low, in fact, that the valve might as well not be there.

Now we appear to be in a vicious circle; we add another valve so as to overcome the effect of the low input impedance of the grounded grid valve and now find that the valve is useless!

But wait! Is it really useless? After all we have accomplished our aim of retaining the benefits of the transformer input and also avoided the losses which a low input impedance from the aerial system would involve. Therefore, in spite of the fact that there is little gain from V1a, nevertheless the valve is performing the useful function of acting as a buffer between the aerial and the first amplifying valve.

Simplification

One factor which must not be overlooked in dealing with low-noise circuits, is that the H.T. applied to these stages should not be high; generally speaking a lower H.T. is desirable and voltages in the region of 100 to 180 are sufficient.

If Fig. 4 is studied further it will be seen that we can save a component by connecting the anode of V1a directly to the cathode of V1.

This is shown in Fig. 5. The H.T. supply is now divided between the two valves: the anode load of V1a becomes the bias resistor of V1 and a component has been saved.

However, all is not yet well. First, the cathode connection of V1 is at the wrong end of the R.F. voltage developed on the anode of V1a. This can be quite easily overcome by connecting a bypass circuit for the R.F. and the condenser "C" shown connected by the dotted lines performs the function.

One point still remains to be cleared. The cathode of V1 is now at a high potential with respect to ground. As an example, supposing the circuit was so arranged that a supply H.T. of 250-volt was equally shared by the valves, then about 125-volt would exist between the cathode of V1 and the chassis. If the grid of V1 is earthed this makes the grid 125-volt negative and the valve would not therefore pass current.

To ensure that the grid is not overbiased it must be returned to the far end of the cathode resistor as it was originally when it was grounded, the grounded line forming the common link between the two. This is shown in Fig. 6 which also shows the overcoming of the next problem, that of retaining the grounding of the grid of V1. Cg performs this function.

An Improvement

While the circuit shown in Fig. 6 will perform quite well it can be improved and its gain increased.

First, the cathode bias resistor can be replaced with an inductance tuned to the Band III frequency. This coil (shown as "L" in Fig. 7) should be wound so as to peak to the Band III frequency, its inductance being adjusted so that resonance is reached in conjunction with the capacitances associated with V1a.

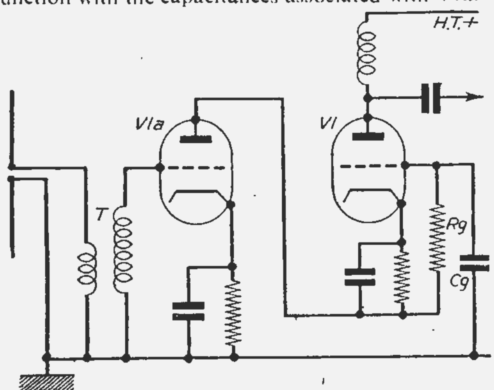


Fig. 6.—A practical circuit.

A useful increase in gain is obtained and the selectivity is increased. (Selectivity of the R.F. section of Band III receivers is a prime necessity.)

A further refinement is the connection of a neutraliser between grid and anode of V1a. In most cases the

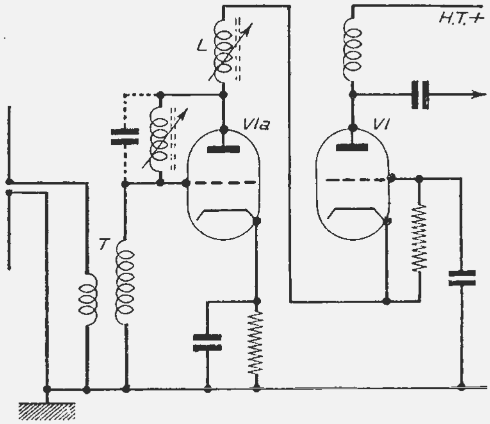


Fig. 7.—Circuit refinements.

valve will be found perfectly stable, but if there is any suspicion of regeneration then either an inductance or small capacitance can be connected as shown by the dotted lines.

V1 and V1a can be conveniently within the same envelope and a valve of the 12AT7 class will be found quite suitable.

A Beginner's Guide to Television

A NEW SERIES

1.—PERSISTENCE OF VISION IN SCANNING—THE CATHODE RAY TUBE—PICTURE SIZE

By F. J. Camm

WHEN you look in to a television programme you are merely watching a tiny spot of light traversing the screen from side to side 405 times in one-fiftieth of a second, at a speed of about 7,000 miles an hour in the case of a 12in. tube, and a correspondingly higher speed in the case of a 15in. tube. This spot of light traces out the rectangular area on which the picture is seen and which is known as the raster. The optical illusion, which the picture undoubtedly is, is due to what might be termed a defect in the human eye which we call persistence of vision. This means in brief that the eye sees as a continuous moving picture any series of pictures each of which is moved at a constant speed and then brought to a stop at a frequency of 16 pictures (frames) per second or more. When you visit the cinema what you see as a continuously moving picture is a series of "stills" which are jerked behind the projector lens at a frequency of 24 frames per second. Each picture is halted in front of the lens for a fraction of a second and then moved on to give place to the next picture in the sequence, thus creating the illusion of moving pictures because the eye will not respond to a frequency in excess of 16 per second.

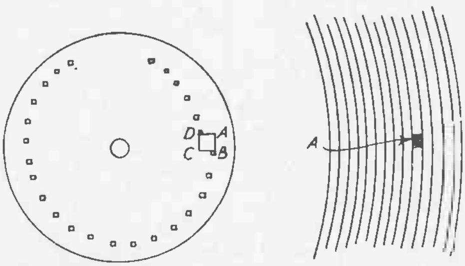


Fig. 1.—How the first type of picture was built up by a rotating scanning (perforated) wheel.

When light rays impinge upon the retina of the eye the impression which they make does not cease immediately the light rays stop. On the contrary, it persists for an appreciable time afterwards, this effect being known as "persistence of vision," or "visual persistence."

It is upon this "lag of retina," as persistence of vision is sometimes called, that we are able to build up a reproduction of motion on the television or cinema screen, in both instances a series of successive pictures (each differing slightly from the preceding one) being formed or thrown on a screen so rapidly that the eye is not able to get rid of the impression made by the one picture or image before the next one arrives.

Persistence of vision lasts for approximately one-twelfth of a second. Hence, if a series of varying images are projected upon a screen at a minimum rate of twelve per second the effect of motion will be obtained.

It should be noted that persistence of vision is a phenomenon which is attached to the actual *retention* of the image on the retina of the eye. The *perception* of the image by the retina in the first place is, so

These two frames of a cinema film illustrate what is meant by persistence of vision. Although the illusion of continuous motion is provided by the film, it is really a series of stills, the film being drawn past the lens in a series of jerks.

far as we can tell, instantaneous.

A television picture is, however, unlike a photograph. In the latter the whole of the picture is visible, and is impressed upon the negative, whereas a television picture depends entirely upon persistence of vision. With a moving picture it is only the illusion of movement which depends upon persistence of vision. With television, both persistence of vision and the building up of a picture are combined.

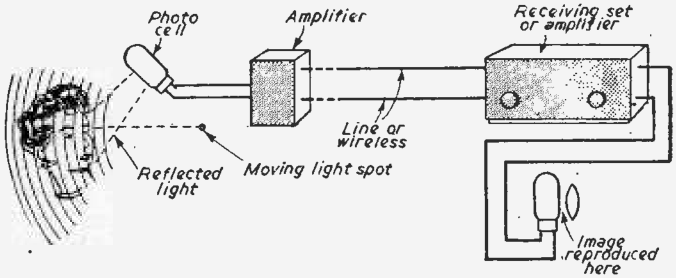


Fig. 2.—How the image was first transmitted and received.

Thus, in the television studio the cameras photograph the scene being portrayed by a scanning process which breaks the picture up into tiny pieces. It was Paul Nipkow, a Polish scientist, who in 1884 first demonstrated the principle of scanning by his crude shadowgraph transmitters. It was with the Nipkow system that Baird experimented, and it is only fair that the credit should be given to Nipkow for this basic invention. It is right, also, at the very start that it should be set on record that the Baird system was proved to be a failure, since it was based on a low definition system which gave very crude and coarse pictures. High definition TV owes nothing to Baird, who is popularly and erroneously supposed to have invented television.

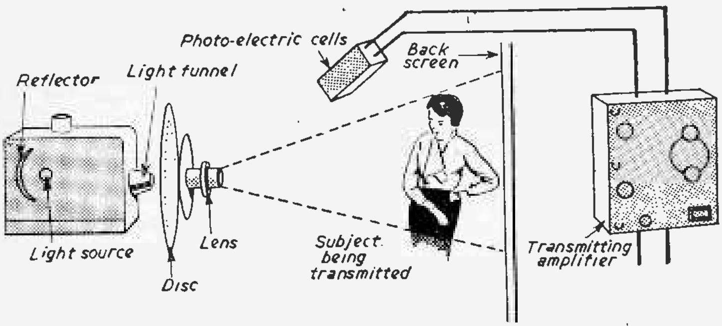


Fig. 3.—Diagram illustrating the manner in which the early television system worked.

The spot of light which traces out the picture is called the scanning spot, and it is made to sweep continuously over every portion of the picture to be televised, thus enabling the picture to be split up into a large number of small areas or picture elements. Other factors being equal, the smaller the scanning spot the finer in detail will be the televised image, for it will enable the light and shade of the picture to be picked up and transmitted with precision, a task which becomes more difficult as the size of the scanning spot is increased.

The television system employed by the BBC and ITA transmits 25 complete pictures per second, each of 202.5 horizontal lines. These lines are interlaced and the frame and flicker frequency is 50 per second. We shall deal with interlacing more fully later on in this series, but it is sufficient here to say that the frame frequency is 50 a second, scanned from top to bottom of the received pictures, and that two frames each of 202.5 lines at a speed of 25 per second are interlaced to produce the 405 lines and a complete picture speed of 50 per second.

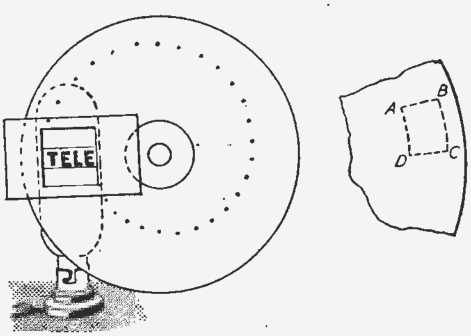
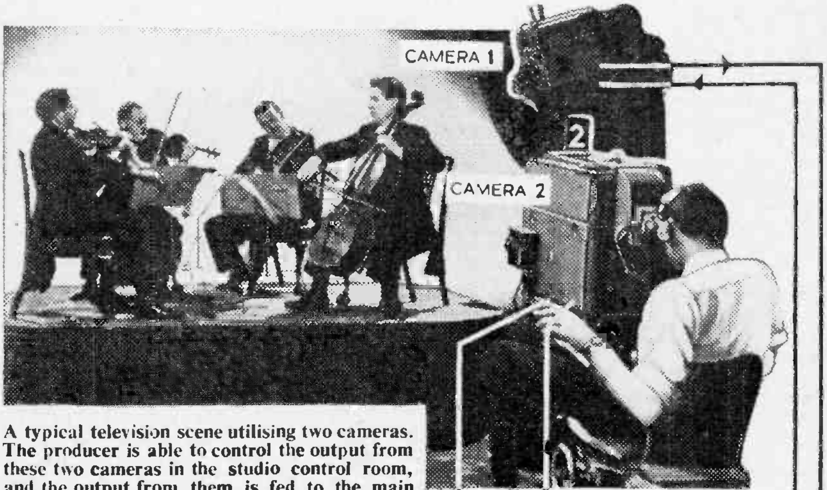


Fig. 4.—Another illustration of the method of building up an image by a mechanical disc.

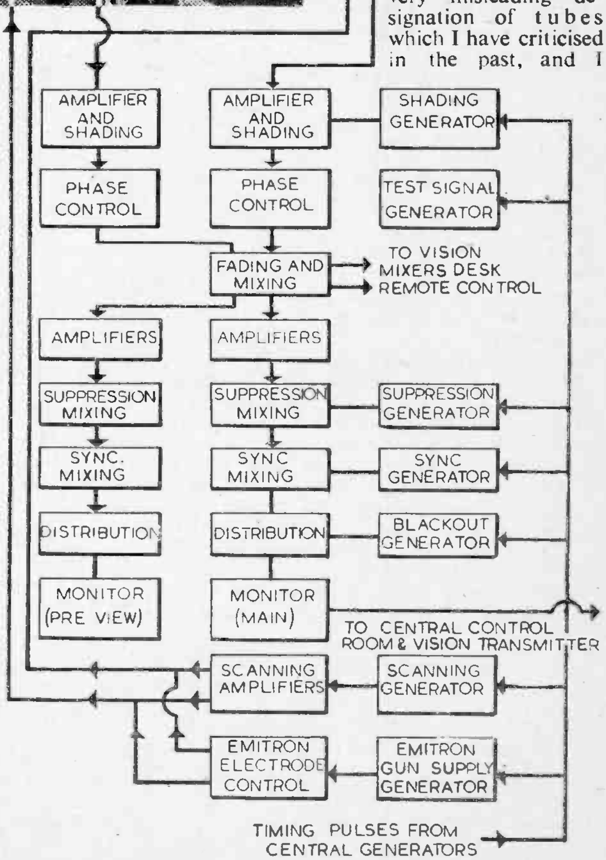
The Cathode-ray Tube

All television receivers, whether designed for direct or projected reception, make use of a cathode-ray

Cathode-ray Tube Diameter	Listed Picture Size	Picture Ratio
12in.	$10\frac{5}{8}$in. x 8in.	1.328
12in.	10in. x 8in.	1.250
12in.	$10\frac{1}{2}$in. x $7\frac{7}{8}$in.	1.333
12in.	$10\frac{5}{8}$in. x 8in.	1.328
12in.	10in. x 8in.	1.250
12in.	11in. x $8\frac{1}{4}$in.	1.333
12in.	10.75in. x 8.6in.	1.250
12in.	$10\frac{3}{4}$in. x 8in.	1.344
14in. rect.	11in. x $8\frac{1}{4}$in.	1.333
14in. rect.	11in. x $8\frac{9}{16}$in.	1.285
14in.	$11\frac{1}{8}$in. x $8\frac{1}{4}$in.	1.348
15in.	$12\frac{1}{2}$in. x 10in.	1.250
16in.	$12\frac{3}{4}$in. x 10in.	1.275
16in.	$13\frac{5}{8}$in. x $10\frac{1}{4}$in.	1.329
17in. rect.	$14\frac{1}{2}$in. x 11in.	1.318
17in. rect.	$14\frac{1}{4}$in. x $11\frac{3}{8}$in.	1.296
17in. rect.	$14\frac{3}{8}$in. x 11in.	1.307



A typical television scene utilising two cameras. The producer is able to control the output from these two cameras in the studio control room, and the output from them is fed to the main transmitter through the network as shown by the block diagram below the picture.



tube, which was developed by Dr. V. K. Zworykin. The front of the tube has a fluorescent screen, on to which is focused the light spot which traces out the raster and the picture which appears upon it. The light spot varies in intensity according to the magnitude of the received signal, thus providing light and shade. This variation takes place, of course, whilst the surface is being scanned in a series of lines and frames. The cathode-ray tube, like a wireless valve, contains a filament, surrounded by a " Gun " ; as soon as voltage is applied to the filament it emits electrons also as in a wireless valve, and these electrons shoot off in a stream towards the end of the cathode-ray tube. Their direction for scanning is controlled either by electrostatic or magnetic means, in conjunction with the impulses received by the aerial.

The magnetic system of controlling the scanning beam is not much used to-day, the electrostatic system being that most generally employed. We shall explain the operation of the cathode-ray tube in greater detail later on, when we come to deal with the working of the television receiver as such. Briefly, however, it can be said that the position of the cathode-ray spot on the front of the tube is always in the same relative position as the picture element being scanned by the transmitting camera. The fluorescent screen has a slight afterglow (light persistence) effect, and this is just less in duration than the time taken to scan one frame and this gives a fair compromise between flicker and blur. Of course, by the incorporation of a spot wobbler to obscure the scanning lines, blur and flicker can be practically eliminated.

The size of a cathode-ray tube, such as 17in., refers to the diameter of a circle in which the rectangular raster is inscribed. Thus, when we refer to a 17in. tube, this does not mean that one side of the rectangle is 17in. That dimension refers to the diagonal of the rectangle. Whatever the size of the tube the aspect ratio of the rectangular picture area is always the same, namely, four to three. So that this point is impressed upon the mind of the reader, let us take the case of a 17in. tube. The overall dimensions are 15.375in. and 10.75in. respectively, the screen diagonal being 15.375in., which means that a 17in. tube has a diagonal of 15.375in., and taking an aspect ratio of four to three the actual size of the screen will be 14.33 by 10.75in. This is a very misleading designation of tubes which I have criticised in the past, and I suggest it would be better to classify tubes by the longer dimension of the rectangle ; in the case of a 17in. this would be 14in. The diagram (Fig. 5) and the table shown on page 398 will illustrate the point.

With a tube diameter of five units, and a square-cornered picture of true ratio (4 : 3), the dimensions

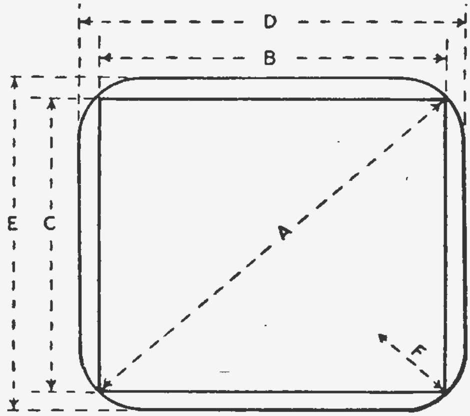


Fig. 5.—Showing how the diagonal measurement could mislead.

give picture width, height, area and tube diameter, and if a diagonal dimension is provided it should be stated whether this is actual or extrapolated.

Projection television receivers employ a very small cathode ray tube. It is only about 2½in. in diameter, and it is used in connection with an optical unit which enlarges and projects the received picture. With a direct vision cathode ray tube, as the size of the tube is increased the brilliance of the picture goes down, since it has not yet been found possible to amplify light as we can amplify sound. Thus, increased picture size can only be effected at the cost of picture brightness. There are advantages as well as disadvantages in both systems of viewing, but the most obvious advantage of a large picture is in the improved angle of view which it permits for people sitting on one side of the axis of view. It is an established fact that if a viewer is far enough away from a television picture to render the line structure invisible, the angle it subtends at his eye level is fixed, and independent of picture size. *(To be continued)*

4 : 3 Picture with Square Corners				4 : 3 Picture with Rounded Corners			
Diagonal "A" in.	Width "B" in.	Height "C" in.	Throw in.	Diagonal "A" in.	Width "D" in.	Height "E" in.	Radius of Rounded Corners "F" in.
15	12	9	25½ ± ⅜	15	14	10½	2⅝
17½	14	10½	30 ± ½	17½	16	12	3
20	16	12	32½ ± ⅝	20	18	13½	3⅜
22½	18	13½	37½ ± ¾	22½	20	15	3¾
50	40	30	86	44	40	30	7½
60	48	36	104	52	48	36	9

are four units width, three units height and five units diagonal. If the practice followed by many American companies was adopted by taking the picture width as expressing the diameter of the tube, the picture shape would be as EFGH (see Fig. 6), as distinct from ABCD. The American system would give five units width, three and three-quarter units height, and a diagonal of six and a quarter units on a five unit diameter picture. This produces an increased picture area of over 30 per cent., with the same diameter tube, and only loses the corners of the picture, which seldom show any part of the programme being televised. For square-cornered pictures, therefore, the diagonal dimension A gives the true picture size, but if advantage is taken of the rounded corners the breadth of the picture on a projection receiver can be increased by 2in. and the height by 1½in. With direct viewing tubes, the fairest description would

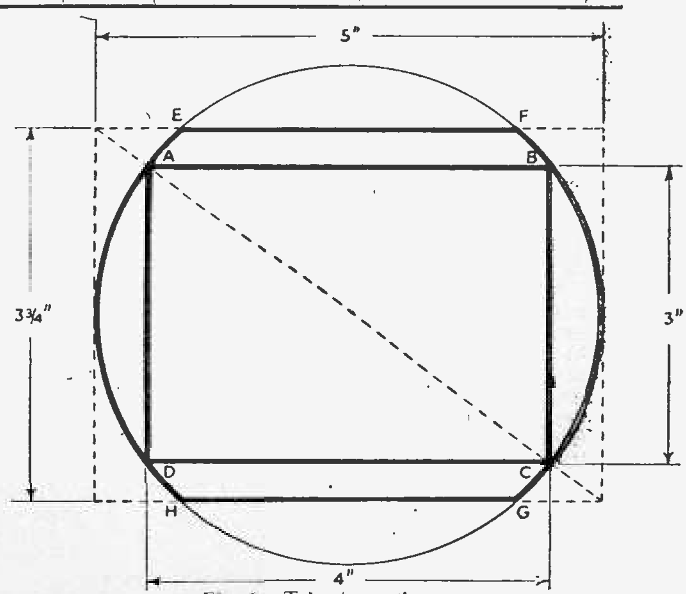
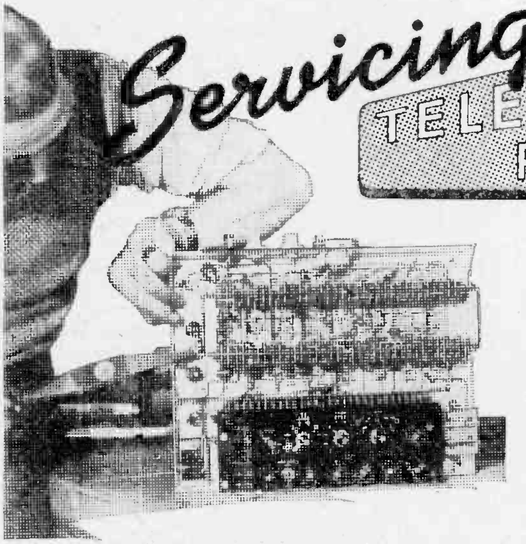


Fig. 6.—Tube proportions.

Servicing Television Receivers



No. 17.—FERGUSON MODEL 991T

By L. Lawry-Johns

THIS is a 22-valve superheterodyne, five-channel receiver. It features flywheel line synchronisation, which enables a picture to be held in areas of low signal strength and of high interference level. The tube is a Mullard MW36-24 and has a grey filter face. The receiver is suitable for A.C./D.C. mains at 200-250 volts, and a separate fuse shunts the rectifier valves when the set is required to work on low-voltage D.C. mains. This is to avoid the voltage drop across the valves. This fuse must never be inserted when the receiver is being worked from A.C. mains.

It is normal for three minutes to elapse between switching the set on and receiving a picture. This is due to the construction of the PY81 efficiency diode which requires this time for the cathode to reach operating temperature. The circuit is conventional except for the flywheel sync circuit which will be described later.

Fig. 1 shows the top chassis layout and the position of the EY51 E.H.T. rectifier is shown by dotted lines to indicate that it is beneath the C.R.T. and inside a plastic box, the cover of which is spring clip secured.

The PL81 line output and PY81 valves are under the focus magnet inside a screening box. The front of this box is secured by a single PK screw. The position and function of each of the five ECL80 valves is worthy of close study and it should be noted that V13 and V14 are concerned with sound A.F. and output only. The output is push-pull and of high quality. V21 and V22 are the PY82 H.T. rectifiers, the anodes being strapped and the cathodes each taken to the unsmoothed H.T. line by a 40-ohm resistor. The receiver chassis is directly connected to one side of the mains and there are no H.T. negative components to consider.

It is not necessary to remove the chassis in order to clean the C.R.T. face or the viewing window. A strip of wood is removable from underneath the speaker fret, and when this and the fret are removed the viewing window may be gently eased down until it clears the guide slots. No trace of moisture must be left upon tube face, surround or viewing window, otherwise a pin-cushion effect will immediately be observed. Inability to fill the corners and sides, with the picture obstinately curling down or up, whichever the case may be, are the usual symptoms of dampness.

The picture shift lever is shown in Fig. 1. Rotation effects horizontal shift, whilst a side-to-side movement moves the picture vertically. A certain amount of horizontal shift is effected by the operation of the horizontal hold control and more will be said of this later, sufficient now to say that this procedure is incorrect and can result in loss of hold some time after the control has been altered.

Band III Conversion

A type B tuner unit is available and requires a certain amount of fitting internally. This is not difficult, however, and the instructions are quite clear. If, after fitting, a certain amount of patterning is experienced on Band I, move the connecting leads to see if this affects it. If not, try the effect of decoupling the converter H.T. line to chassis with various values of capacitor between .1 and .5 μF. It is quite possible that a .1 μF will completely clear the patterning if redisposition of the wiring does not do so.

When switching from Band I to Band III the picture should, of course, remain locked, but it is quite possible that although a locked picture is obtained on Band I, on Band III it is almost impossible to lock using the horizontal hold control. The correct procedure, as detailed later, should in this case be followed and satisfactory operation should then result.

Common Sound/Vision Stages

The R.F. amplifier, frequency changer and first I.F. amplifier are common to both sound and vision. The R.F. tuned circuits respond to the lower sideband of the vision carrier and an image rejector is incorporated in the aerial input circuit. This is factory tuned to 95 Mc/s, but may be adjusted to reduce interference from signals of other frequencies. The adjustment is by the core of L1 which is mounted on the top of the chassis at the extreme rear right-hand corner.

V1 is the R.F. amplifier valve, is an EF80, and the anode of this is coupled to the control grid of V2A which with V2B forms the double triode mixer/oscillator frequency changer ECC81. The oscillator tuning is determined by L5, C11 and C10. V2B cathode is connected to a tapping on L5. The oscillator voltages are coupled to V2A grid by C6 (2 pF) and the anode output of V2A is transformer coupled to the common I.F. amplifier V3 which is another EF80.

A tuned circuit L9 C13 is included in the grid

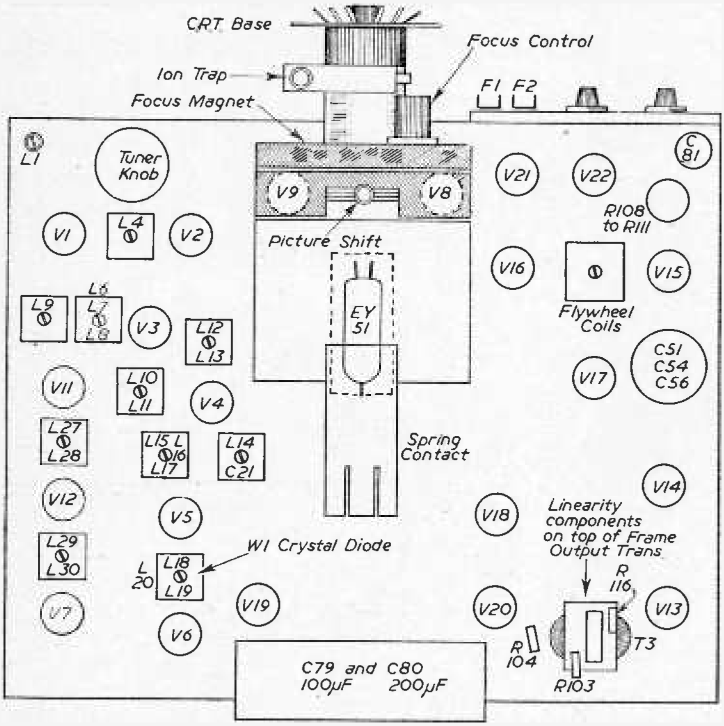


Fig. 1.—Plan view of chassis. Note position of EY51 and W1 crystal-diode

circuit of V3 and is aligned to 14.5 Mc/s to act as an adjacent channel rejector.

The sound and vision signals are split at the V3 anode circuit. L11 is tuned to 19.5 Mc/s which is the sound I.F.

The vision I.F. is coupled to the control grid of V4 by C17 (.001 μF). V4 is an EF80, the control grid circuit of which is tuned to 17.75 Mc/s by L13. Also coupled to L13 is a sound rejector L12, C18.

V5 is the final vision I.F. amplifier coupled to V4 by L15, L16 and L17. The anode circuit of V4 also contains another sound rejector L14, C21. V5 is transformer coupled to the vision detector W1 (crystal diode) by L18, L19 and L20. It should be noted that this crystal diode is contained *inside* the coil can and thus is completely out of sight. The rectifier output of the diode is coupled to the control grid of V6 video amplifier (PL83) by a choke/resistor/capacitor filter. The chokes are L21 and L22 and the vision interference limiter is connected to the junction of these two. The limiter is one section of an EB91 (V7A) the cathode of which has its potential controlled by the limiter variable resistor R37. If the potential applied to the cathode is too low the diode will conduct on peak white and the highlights of the picture will be lost.

V6 video amplifier is cathode biased by a metal rectifier (W2). The advantage of using this type of bias is that the varying currents do not so readily produce a voltage-drop of corresponding magnitude across it. Thus, undesired negative feedback and loss of gain is avoided. A resistor (unbypassed) would, of course, produce an amount of feedback due to the voltage drop across it being in accordance with the variation of current through it.

The anode circuit of V6 contains two resistors in parallel (both 6 K, presenting an effective resistance of 3 K) and two chokes in series. An inspection of Fig. 2 will show the method of coupling the video signal to the C.R.T. cathode. The A.C. signal is directly coupled via the .1μF capacitor, but the D.C. signal is attenuated by the resistors

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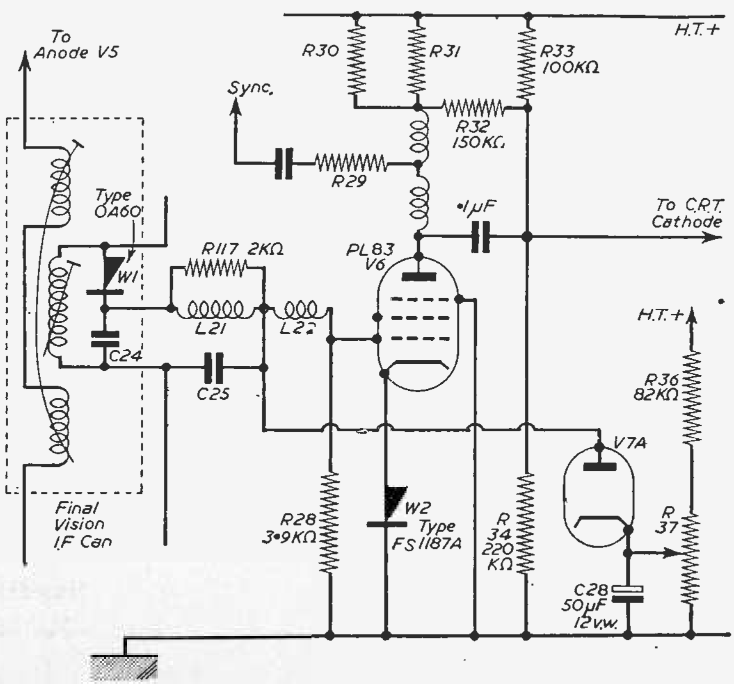


Fig. 2.—The video stage.

so as to effect a reduction of rapid fading such as that caused by aircraft.

The Sound Stages

V11 is the first sound I.F. amplifier and its grid circuit is tuned by L10. The anode circuit is transformer coupled to V12 (EBF80) by L27, L28. V12 is a double-diode-pentode. The pentode section functions as the final sound I.F. amplifier and the diodes are used for detection and A.V.C. purposes. Actually, the signal detector diode also provides the A.V.C. voltage—or A.G.C. to be more correct—and the second diode is positively biased to effect a delay action. Therefore, only signals in excess of a certain magnitude will provoke the A.G.C. circuit into operation.

The rectified signals are fed to the anode of V7B interference limiter via a filter choke and .1 μF capacitor. This diode is normally conductive, but upon the reception of a large pulse of extremely short duration the anode is driven negative with respect to the cathode, and the diode ceases to conduct. The effectiveness of the limiter is determined by the three-position plug which alters the capacity in the cathode circuit. The cathode circuit is coupled to the volume-control via a .01 μF capacitor and the control grid of V13A (triode of ECL80) is fed from the slider. The anode circuit of this triode is resistance/capacity coupled to the control grid of V13B (pentode output section ECL80). From the same point a pair of resistors in series connect to the anode of V14A (triode). From the centre point of these resistors a capacitor couples a percentage of the V13A output to the V14A control grid. Therefore, the output of V14A is in opposite phase to the output of V13A but is of the same magnitude. The two voltages are resistance-capacity-coupled to the output pentode sections V13B and V14B. A feedback circuit is incorporated and consists of capacitors C49 and C50, and tone-control is effected by C52 and R70 which are in series across the primary winding of the output transformer.

Sync Separation

This is carried out over three stages by both sections of V18 (ECL80) and V19 pentode section. The sync signal, and picture signal, at the anode of V6 is taken to the control grid of V19 pentode section via R29 and C26 (12 K and .1 μF), and these signals are positive-going. The negative pulses appearing at the anode of this section are applied to the line timebase circuit through a differentiating circuit which ensures that only line pulses are passed. The components concerned are capacitors C67 and C64 and resistor R82. The pulses at V19 pentode anode are also coupled to V18 triode section control grid, which is returned to the H.T. positive line. The method of biasing and the choice of component values ensure that the signal at the triode anode consists mainly of frame sync pulses. These are coupled to the pentode section control grid which is heavily biased. Therefore, only large pulses cause the section to conduct so that the remaining line pulses do not appear at the anode. The completely separated frame pulses are then fed to the frame timebase by C70 (500 pF). This rather long explanation of the sync separation is included so as to enable the reader to identify the purposes of the various ECL80 sections.

Frame Timebase

The oscillator is of the multivibrator type and consists of the triode sections of V19 and V20. The pentode section of V20 functions as the frame output and is coupled to the frame-scan coils by the T3 transformer. A frame pulse is also applied to the C.R.T. grid to effect frame flyback suppression. A rather complicated circuit is employed to effect frame linearity, and C77 (.05 μF) feeds the fixed and variable feedback arrangements. Two resistors, 27 K and 150 K, are in series with a .01 μF which connects to the control grid-leak (R102, 2.2 MΩ). Shunting these components to chassis is a fixed resistor (100 K) and a variable, which is the frame linearity control. The R116 (27 K) resistor may be found to be shorted out and this is optional to provide for variation in the characteristics of replacement T3 output transformers. The output valve is biased by a 620 ohm resistor bypassed by a 50 μF electrolytic (C74). The frame-scan coils are damped by two 1K resistors, R43 and R44.

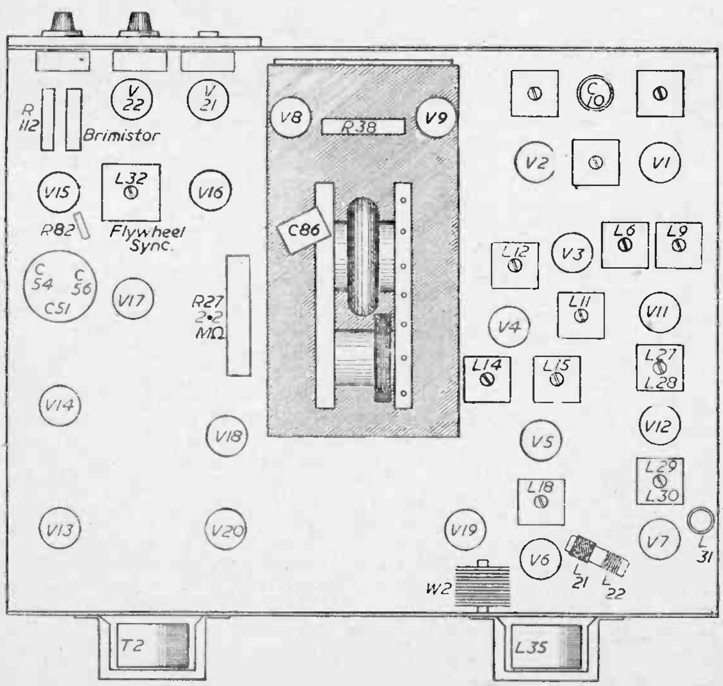


Fig. 3.—Simplified under-chassis view. Note W2 V6 bias metal rectifier, core of L32 and R82. The PL81 grid-leak is R27 2.2 MΩ. R112 may not be fitted.

It is not proposed to describe the flywheel circuit in detail as this would take up too much space and limit the amount of practical servicing information. The broad outline is as follows: V16 is the EF80 line oscillator, the resonant frequency of which is controlled by the "reactance" valve V15 EF80.

This is in effect a variable capacitor forming part of the V16 tuned circuit. This effective capacity is varied by the grid bias of V15 which is derived from the discriminator (EB91) V17 and line-hold control circuit. The line-hold control applies a negative bias to the control grid of V15, and this is obtained from the control grid to chassis circuit of V8 which is the PL81 line output valve. The remaining bias of V15 is obtained from the V17 double diode circuit and this may be positive or negative depending upon whether the time base tends to run too fast or too slow. No bias is applied from V17 when the circuit is perfectly aligned and the sync pulses are arriving properly.

The output of V16 is resistance capacity coupled to the control grid of V8 which is returned to chassis via R27 2.2 MΩ, R26 horizontal hold 100 K. variable and R25 68 K.

The anode H.T. of V8 is supplemented by the usual efficiency diode PY81 (V9) and an over-wind on the line output transformer supplies the EY51 EHT rectifier anode. The PY81 reservoir capacitor is a .25 μF (C29) and the first anode voltage of the C.R.T. is derived from this point via R41 and C30 (220 K. and .01 μF).

The line linearity control is a rotatable magnet which is situated just beneath the rear of the tube neck.

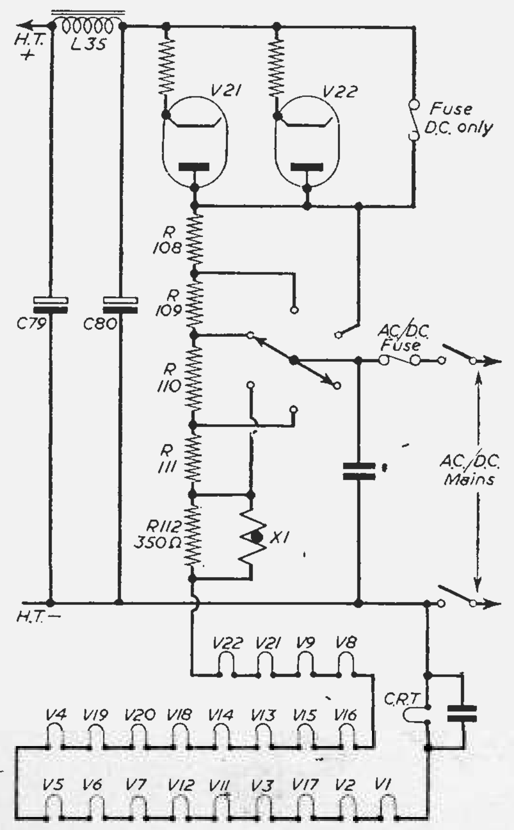


Fig. 4.—Showing power supplies and heater chain. R112 only fitted with Brimistor (X1) or Varite.

Power Supply

The two H.T. rectifiers are of the PY82 type as previously stated and the heaters of all valves and the C.R.T. are wired in a single series chain, the C.R.T. heater being "nearest" chassis.

Possible Faults and the Probable Causes

No results at all.—Check mains input and fuse. If the fuse has blown, replace with one of the same rating (not more than 1.5 amp) and if this too blows, check both PY82 valves for heater/cathode leakage and shorts.

If in order, check H.T. line for shorts. This should also be done if one or both of the PY82 valves are defective.

If the fuse has not blown, suspect heater chain, as one valve is probably defective with an open-circuited heater. If a resistance check proves valve chain has continuity, check Brimistor as this may be cracked or otherwise high resistance.

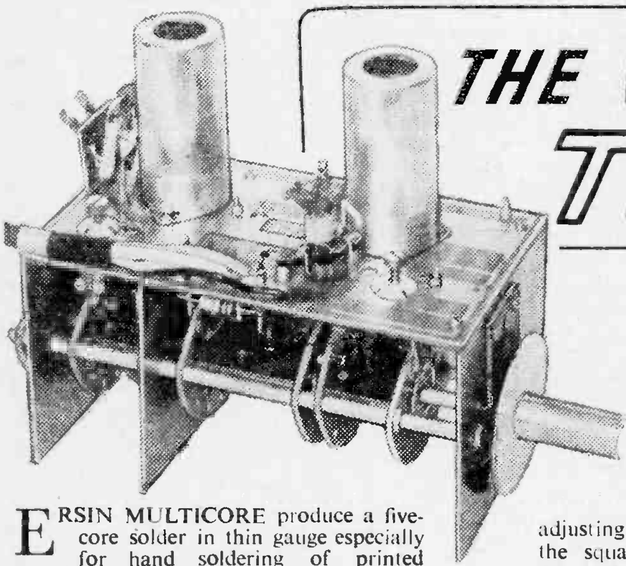
Sound but no picture.—Turn up brilliance. If no raster is available, check EHT by attempting to draw a spark from anode cap of C.R.T. If there is no sign of a spark, remove cap and test again. If a spark is available from the clip when it is off the C.R.T. but not when it is on, replace clip and turn brilliance fully down. If with no beam current still no spark is available, the indications are that the tube is defective. Check grid and cathode volts to ensure that the correct, or approximately correct, voltages are present. This is necessary, as with no bias on the tube a heavy beam current would result which could overload the EY51 EHT rectifier and result in its inability to supply EHT voltage when connected to the anode cap. If no EHT is present with the cap on or off, listen for the line time base whistle. If it can be heard, suspect EY51 valve and check its heater. This involves removing one of the heater leads from the transformer connection. If the whistle is absent, however, check V16, V8 and V9.

If the EHT voltage is present as indicated by a healthy spark at the C.R.T. anode, check V6 PL83 video amplifier (C.R.T. cathode volts high), *ion trap* (if not properly secured) and first anode voltage, pin 10, of C.R.T. Whilst checking these points, observe tube heater. If this is very poorly heated, the fault is probably due to a partial short circuit (internal) of the heater itself.

Check grid volts, pin two of tube base, and if no positive voltage can be recorded with the operation of the brilliance control, check brilliance series H.T. resistor and other grid circuit resistors. If no first anode voltage can be read, check R41 for open circuit or high resistance and C30 for leakage. The values of these components have already been given.

Raster but no picture, no sound.—Check aerial plug, plug connections and V1, 2 and 3, ensuring that the station tuner has not been interfered with. If the aerial circuit cable and plug connections are in order, and the valves are known to be good, check H.T. voltage on anode and screens and if these are not all present test decoupling resistors.

(To be continued)



THE V.M. TV Tuner

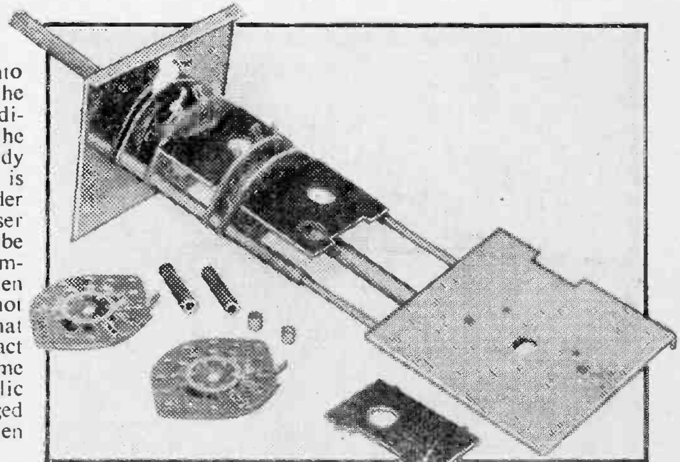
DETAILS OF A 3-STATION TUNER DESIGNED FOR THE VIEW MASTER, BUT WHICH MAY BE USED WITH OTHER RECEIVERS

(*Continued from page 363 January issue*)

ERSIN MULTICORE produce a five-core solder in thin gauge especially for hand soldering of printed circuits. A little practice on the edge of the printed panel will soon indicate the best methods of soldering and so far as soldering of resistors which are mounted directly on the surface of the printed panel is concerned there need be no difficulty at all. Some care, however, must be taken with the coaxial feed-through condensers. These are silvered on the outside of the ceramic tube and if an excessive temperature for an excessive time is applied then it is possible for the silver on the ceramic body to dissolve into the solder, the result being that the capacity of the condenser falls very appreciably. The recommended method of soldering the coaxial feed-through condensers into the printed plate is first to ensure that the hole through which the body of the condenser passes is a reasonably tight fit so that the condenser is held in position firmly with the tinned portion slightly above the copper foil. A small ring of the resin-cored solder should then be made and slipped directly over the body of the condenser so that it rests on the copper surface of the panel. If the soldering iron is then brought into contact with the solder ring and the copper surface, the solder will immediately melt and start to flow around the copper and will then wet on to the body of the condenser. This operation is very rapid and immediately the solder has flowed and wetted the condenser body, the soldering iron should be removed and the operation is complete. Care must, of course, be taken to ensure that solder splashes do not bridge adjacent conductors and that the soldering iron is not kept in contact with the copper for an excessive time since it is then possible for the phenolic base of the tuner plate to be damaged with the result that the copper may then lift.

The trimmer condensers C3 and C18 are mounted by first removing the adjusting screw from the ceramic body, putting the square section of the body into the hole, the body of the condenser being on the underside of the printed panel, then from the top of the panel the screw on which is also mounted the spring nut is screwed into the body. It is only necessary for the screw to enter the ceramic body a short way, after which the spring nut is itself screwed down until it comes into contact with the printed panel ; it is then moved round a little farther so as to hold the screw under tension and thereby prevent it shifting under the effects of vibration. The valve holders used are a special printed circuit type and are normally included with the kit of components which includes the printed panels.

The screens for the valves are mounted directly on to the printed panel, the screen bases being screwed on with the aid of 6 B.A. bolts in the positions indicated, whilst the top part of the screen containing a spring to hold the valve in position locks



Component parts of the switch assembly.

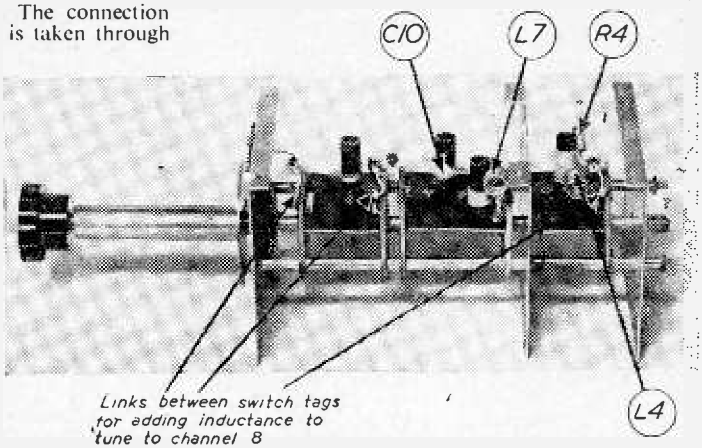
on to the base and need not, of course, be fitted until the valves are in position.

The input and output transformers are mounted on the top of the panel by means of small stand-off spacers. The photographs clearly indicate this method of mounting, but particular care is required with coil L12, as the fixing screws also function as terminations for the transformer. The connection between the anode of V2 and L12 is taken through the panel by one of the screws and the connection between H.T. and the other end of L12 is carried through the panel by the other screw. The damping resistor R14 is also mounted directly across these points. In the photograph will also be seen a small terminal disc mounted at the top of the input and output transformers. These terminal discs are easily made and consist of circles or washers of bakelite board or other insulating material with tags or even wire loops mounted at the periphery. The diameter of the hole in the washer is approximately ¼in. and it should be a tight fit around the moulded coil former. After fitting on to the coil former it should be glued in position.

The connection between L9 and the junction of C9 and C11 will be seen to be a strip of foil. This should be about ⅛in. wide and may be of any suitable metal that can readily be soldered. Copper foil has been found to be easy to work with, but on no account should this strip of metal be too thick or stiff as it might then damage the printed condenser C9 deposited on the panel. A similar copper strip is also used to connect the earthy end of L9 to the panel. The use of copper strip for these connections has been found to be advisable in order to keep the total inductance of the input circuit to V2 low, since otherwise due to the input capacity of this valve the circuit might resonate at too low a frequency. Two last details remain before completing the assembly of the printed plate, these being the small coils L14 and L5. L14 consists of 10 turns on No.28 gauge enamel wire close wound on a 3/16in. diameter former and soldered into position in such a way that it is self-supporting. L5 consists of eight turns of No. 28 gauge enamel wire wound on a 1/8in. former and again soldered into position across the valveholder tags so as to be self-supporting.

One end of the oscillator coil is soldered on to the printed anode tag of V2, the other end of the coil remaining free as it later has to be connected to the SW4 switch wafer. At this stage it is necessary to take any springiness out of the oscillator coil since otherwise it can be the cause of severe microphony. L10 consists of three turns of No. 18 s.w.g. tinned copper wire tightly wound on to a ¼in. diameter former then removed and the turns slightly separated. This method of making the oscillator coil imparts an appreciable degree of springiness to it. Fortunately, the removal of the springy effect is easily carried out and this may be done by heating the coil in a flame.

A lighted match is usually sufficient though occasionally the operation may have to be repeated. These operations complete the assembly of the printed panel and the constructor is now advised carefully to recheck all connections, making certain that there are no errors in either wiring or the quality of the soldering.



View of the switch unit with some components identified.

The Switch Unit

With the printed circuit panel now complete the assembly of the switch unit may be undertaken.

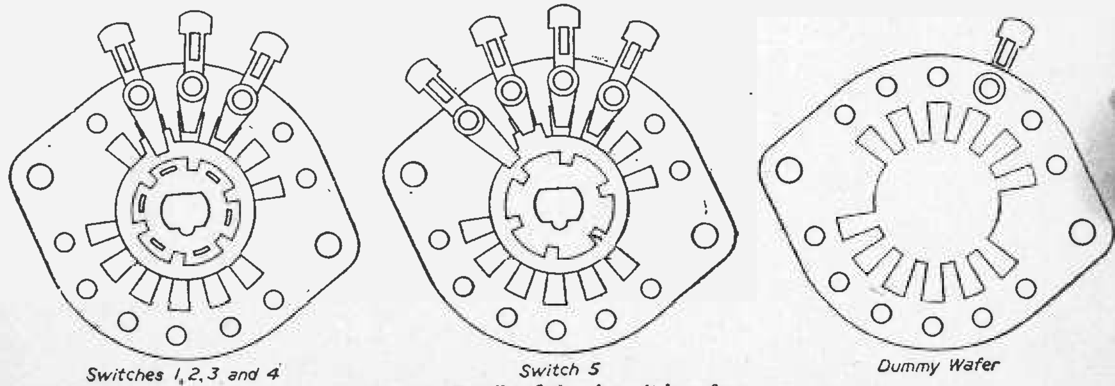
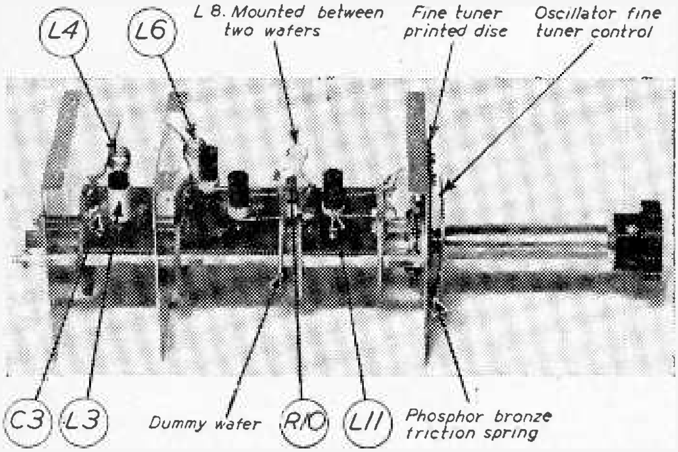


Fig. 3.—Details of the six switch wafers.

Reference to the drawings and the photographs will indicate the method of assembly but before this can be commenced the various component parts have to be prefabricated. The Band I coils should be wound and the turns locked in position by means of a suitable adhesive or even by wrapping with an adhesive tape. The platforms supporting the coils must then be cut to shape and drilled to take the coil formers. These platforms are best made from 1/16in. thick bakelite board or other similar insulating material. It will be seen that the platforms are supported by small extension pieces which fit into holes in the switch wafers so that when all platforms are made the complete switch may be assembled.



Another view of the switch unit for identification purposes.

In the first place the switch is supported on the front panel of the tuner by having two lengths of studding projecting through and held in position with the aid of nuts. The switch click plate must be behind the metal panel and the threaded bush normally used for holding the switch on a panel is now arranged to project through a clearance hole in the front of the metal panel without a nut being fitted to it. This has been done so that the moving plate of the oscillator fine tuner can run on the threaded bush. The spacing between adjacent wafers is shown in Fig. 4 and the appropriate spacers should therefore be available. Commence by sliding the first pair of spacers over the studding, then the SW4 wafer is slid over the studding and rotor spindle. The first platform supporting L11 is then slipped into the appropriate holes, the SW3 switch wafer is put on next and this supports the other end of the L11 platform. Two short spacers are then fitted and a further wafer whose function is only to support the platform

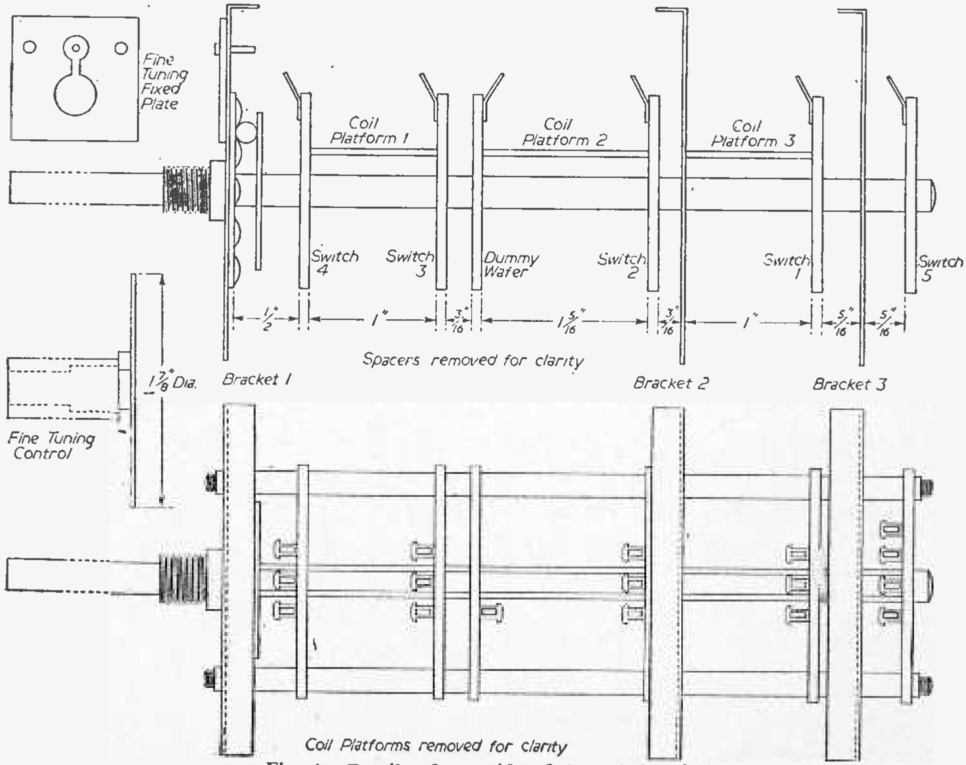


Fig. 4.—Details of assembly of the switch unit.

of L7 and L9 as well as to have on it a single tag is placed in position. The L7 and L9 platform is then fitted, spacers put over the studding and the SW2 wafer fitted. Two more short spacers are slid over the studding, then the screen separating the R.F. and oscillator sections is placed in position and the L3 platform is fitted into the screen. The SW1 wafer is mounted together with the necessary spacers, then the back metal screen of the tuner is placed in position. Finally, two other short spacers are fitted on the outside of the metal screen and the SW5 wafer is slipped over the studding and the complete switch assembly locked tight by means of a pair of nuts.

Though the switch assembly is now complete, one final operation still remains. This is to fit a flexible wire spring between the switch spindle and the wafer supports. This spring, which can easily be made from a thin piece of phosphor bronze wire or other spring material, is fitted adjacent to the screen separating the R.F. section from the mixer and is preferably placed on the R.F. side of the screen. The need for connecting this end of the switch spindle to the metalwork of the tuner arises because R.F. currents can be induced in it from either the output of V1, or from the oscillator, and can then be fed back into the grid of V1, thereby causing instability. Connecting the spindle to the screen effectively prevents this occurring.

The shape of this spring will best be understood from the diagram showing the cross section of the spindle and wafer supports. Thin spring wire may be used so as not to put an unnecessary strain on the spindle itself or on the control knob.

Whilst the complete assembly may sound somewhat involved it is not difficult to carry out since it should be assembled in a straightforward and logical manner. The Band I coils may be fitted to the platforms either before these are assembled into the switch or, if preferred, afterwards.

Assembly

Having now completed the mechanical assembly it only becomes necessary to complete the wiring of the switch and this involves the connection of the Band I coils to the appropriate switch tags as well as putting a short link between the first and second tags of each wafer.

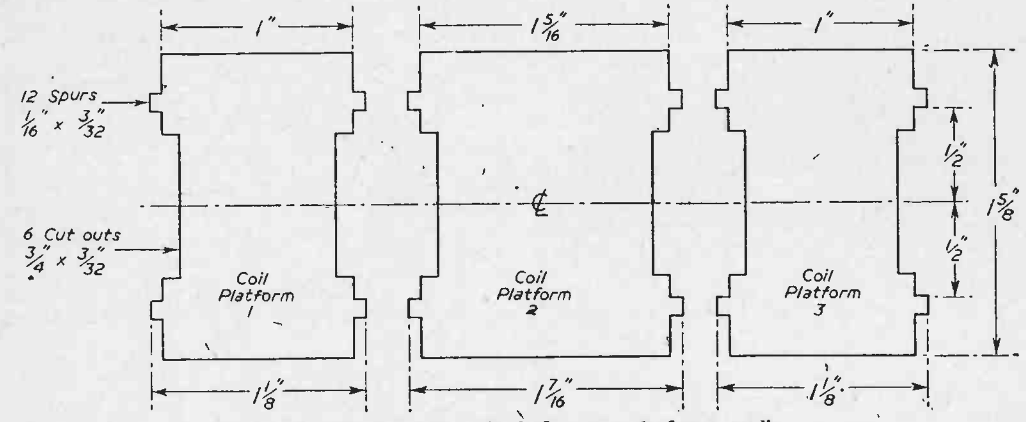
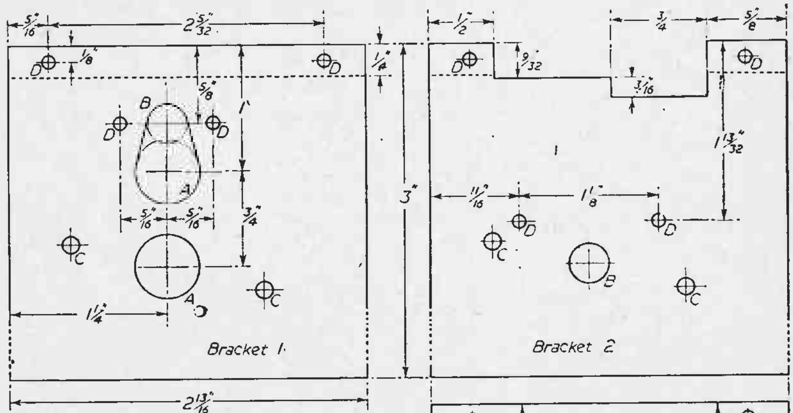
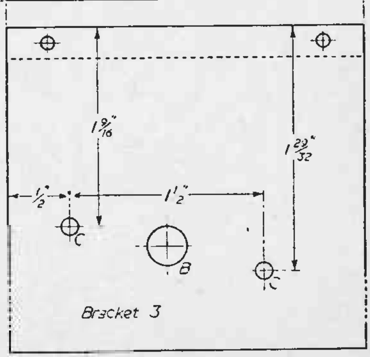


Fig. 5.—Details of the coil platforms—made from paxolin.





A Holes — 1/2" Dia. B Holes — 5/16" Dia.
C Holes — 1/8" Dia. D Holes — 3/32" Dia.

Fig. 6.—Details of the metal brackets supporting the switch and platform assembly.

It will be appreciated that with the switch in a fully clockwise position all the coils connected to the switch are shorted out and the only inductances in circuit are those soldered in position between the printed plate and the switches. These inductances are subsequently adjusted so as to tune to Channel 9 operating at around 194 Mc/s. An anti-clockwise movement of the wavechange switch to the next position then brings into circuit an additional short length of wire connected between the two tags. This additional length of wire together with the two tags is sufficient to increase the inductance of each circuit so as to tune to Channel 8, which is 5 Mc/s lower. In this position the Band I coils are still short circuited, and a further movement of the wave-change switch in an anti-clockwise direction will then remove the short circuit from the Band I coils. The total inductance now in circuit will consist of the Channel 9 inductances, plus a small additional inductance to tune to Channel 8, plus that additional inductance to enable the circuits to tune to any channel on Band I. This will explain the wiring of the switches and they may now be completed, referring for guidance to the photographs. C10 must be mounted across the switch tags terminating L7 and L9, whilst on SW1 is mounted R3, this resistor being connected directly across L3.

The last item to be assembled on the switch sub-assembly is the printed oscillator fine tuner disc which is mounted on the front of the tuner itself. It is important that the metal immediately beneath the copper of the tuner disc is cut away so as to reduce the capacity which would otherwise exist across the oscillator. For this reason two over-lapping holes are shown on the drilling diagram of the front screen.

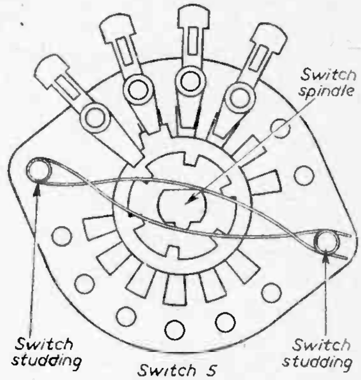
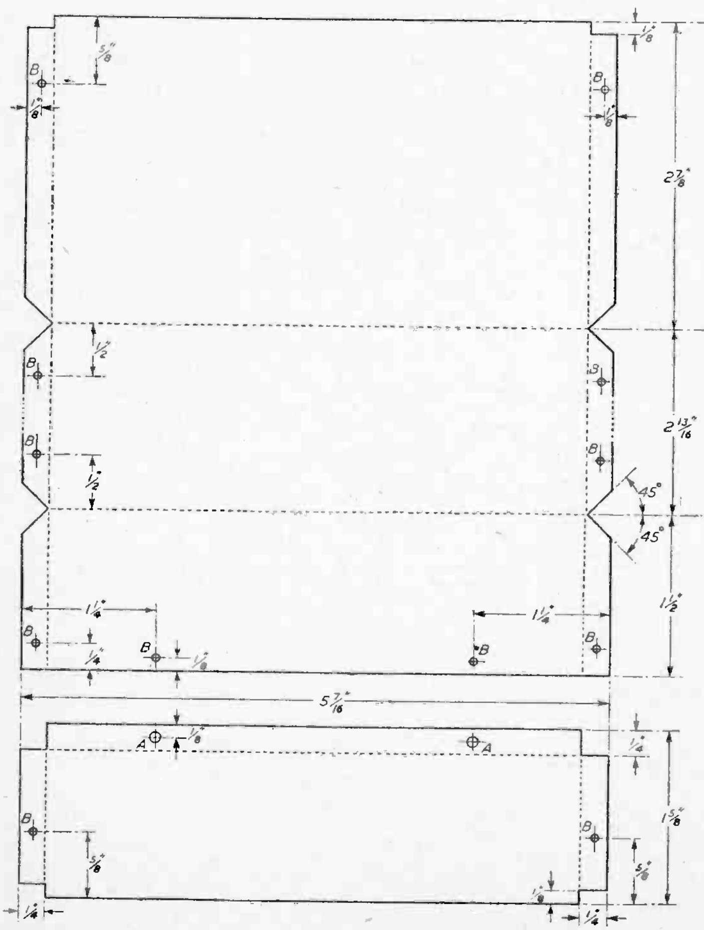


Fig. 8.—Details of the spindle earthing spring.



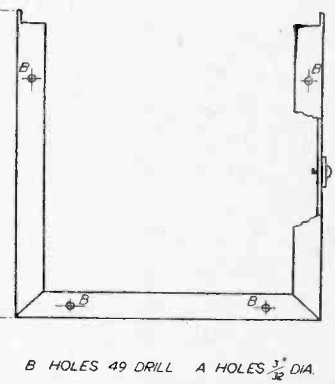


Fig. 7.—Details of the metal cover which totally encloses the tuner.

With the top plate and the switch assemblies complete, the two units may now be connected together to complete the TV tuner. The first step must be to bolt together the two units. At this point it may be mentioned that if preferred the switch wafer, SW5, together with the adjacent screen, may be removed to assist in the wiring of switch SW1, though if this is done it is preferable that the remaining two screens should be fitted on the panel so as not to disturb or otherwise cause further dis-assembly of the switch unit.

(To be continued.)

CORRESPONDENCE

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

FERGUSON 983T AND 988T

SIR,—In the article on "Servicing Television Receivers," in the December issue of PRACTICAL TELEVISION, your contributor, Mr. L. Lawry-Johns, gives a circuit of the line timebase of the Ferguson 983T and 988T receivers.

There are points in this circuit which may be misleading to some of your readers.

The 100 K. resistor should be connected to the H.T.; so also should the lead to the line amplitude tapping selector. Furthermore, although this is not an important point, there are four and not five width tappings on the line transformer secondary.

The circuit, as shown, would not work at all as the PL81 line oscillator's anode is getting no H.T. —CHARLES TANSEY (Chelsea).

[*The 100 K. resistor and the line amplitude tapping should have had their lines continued over the boosted H.T. line to normal H.T. supply as Mr. Tansey says. This was a drawing slip and was certainly not intentional. I regret to have caused any misunderstanding.* —L. L. J.]

COLOUR TV RESULT

SIR,—In reply to your reader G. F. Remmett, whose letter was published in the December issue, the cause of the apparently coloured image was the intermittent stimulation of the retina of the eye by the image on the TV screen. When the eye receives black and white impulses in rapid succession it is possible for these to be registered by the brain as coloured impulses. I have never seen any exact explanation for this, but would venture to suggest that it is a resonance effect. The stimulations resonating with the time of traverse of the impulse along the appropriate circuit to the brain. The fact that the original image on the VCR97 was green does not alter the above as it is the periodicity which causes the phenomenon.

Incidentally, if Mr. Remmett has done an evening's viewing on a VCR97 and then gone for a walk by moonlight he will notice the moon assumes a distinctly pinkish or purplish hue. This is a different effect—the retina has been over exercised as far as green is concerned and when a white moon is presented to it the eye sees the moon minus a little green. The complementary colour to green is magenta, hence the moon appears tinted with this hue.

I have never yet seen a pink elephant by this means, but one never knows . . . !—C. GRANT DIXON (Ross-on-Wye).

VR65 VIDEO STAGE

SIR,—As a reader of your excellent journal for many years and a keen experimenter I would like to express my opinion of the article by J. S. Hopwood, in the April, 1953, issue, entitled "VR65 Video Stage." I have added this parallel VR65 stage to a R1355 receiver in place of the usual single video amplifier and fed into a VCR97 on 2,500 volts it gives the most amazing focus as stated. In fact, I consider it as good focus as a 9in. commercial set I have and I am using a 6in. magnifier on the VCR97, the pictures being about the same size. I have, of course, added another development which helps, viz., the 1355 is fitted with 11 Mc/s I.F. coils not 7.5, the 7.5 Mc/s I.F. in the convertor having been removed and the frequency split with a 7.5 Mc/s I.F. strip to give sound off the same convertor as described in "Inexpensive Television." In fact, my set is a mixture of yours and theirs. I have the Simplex timebase, a voltage doubler rectifier unit to give 2,500 volts from a 1,200 volt transformer and the previously stated improved R1355 for vision and sound. I can assure anyone that this is the only video stage I have ever tried which gives such wonderful results, and if one can line up the vision receiver very carefully to give the maximum bandwidth the resulting picture on even this cheap radar tube is one of crystal clarity. No one need ever be without a set when it is possible, by following your advice and that of similar articles, and using care in construction, they can have such quality. I know it is clumsy but it is cheap and it is also good. I look forward to more of your circuits.—ALAN HARDWICK (Sheffield).

TV INTERFERENCE

SIR,—I would like to pass on a tip for those who may be troubled with interference from a small electric motor. My wife has a sewing machine with attached motor and often finds it necessary to use this during television time. It caused much interference and I had fitted condensers across the brushes without very much improvement. The interference was experienced in the next house. I decided to buy a more elaborate suppressor, and the shop-keeper to whom I went with my trouble suggested that it might be due to badly worn brushes and suggested that I look at them before going to additional expense. I removed them and found that apart from some caked oil, they were very badly "bedded" and I put a thin piece of emery round a wooden roller of the same (more or less) diameter as the commutator and carefully shaped them. When I put them back (with the condensers, of course) the trouble had entirely gone, and I do not even find it bad enough to prevent the use of the TV set in the same room.—G. DAVIES (Stanmore).

PICTURE DETAIL

SIR,—I should like to endorse the criticism of Mr. Bardon in your November issue. On many occasions I have spent time trying to adjust the focus unit and changing the second anode voltage of the tube to try and get a smaller spot, all to no avail. Now, reading Mr. Bardon's letter I have realised that perhaps my set is not at fault, but that the smaller details are probably not there. After all, when I come to think of it, the tube in the camera is much smaller than the receiving tube, and therefore the eyes and similar details on a large chorus at the back of a stage would be almost infinitesimal on the camera tube. It would be interesting to know actually what is the size of the smallest dot which the camera can pick up, and how this compares with small details such as eyes in a face at a given distance. Perhaps BBC or ITA technicians could give us some help here to avoid trying to reproduce something in a set which isn't there.—H. ROWLANDS (Sudbury).

BAND III SIG. GEN.—19/6

1. Will provide the signal for tuning to any Band III station.
2. Can be used as grid-dip meter for checking the frequency of Band III T.V. aerials, Coils, etc.
3. Can be made to give a pattern on T.V. Receiver screen.

This instrument is very easy to correctly calibrate and all necessary to do this is included in the kit. All the parts, including valves, tuning condenser and metal chassis are available as a Kit at 19 6. Constructional data free with Kit or available separately, price 1.6. plus 1.6 post.

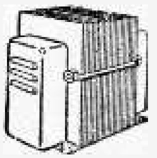
INTERFERENCE FILTER

To eliminate patterning and other interferences, also re-transmitting causing complications with neighbouring televisors. Two models—one high-pass cuts out frequencies above 45 m/c, the other low-pass cuts out frequencies below. Price 27/8 each, postage 2.6.

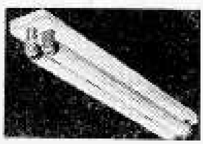
TRANSFORMER SNIP

11/6

Post 2/-

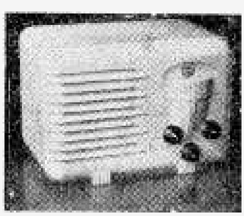


Fully shrouded — standard 200-250 v. primary 280-0-280 at 80 m a. 6.3 v. at 3 amp., 5 v. at 2 amp.



THE TWIN 20

This is a complete fluorescent lighting fitting. It has built-in ballast and starters — stove enamelled white and ready to work. It is an ideal unit for the kitchen, over the work-bench, and in similar location. It uses two 20-watt lamps. Price, complete less tubes, 29 6, or with two tubes, 39/6. Post and insurance 5/-. Extra 20-watt tubes, 7/6 each.

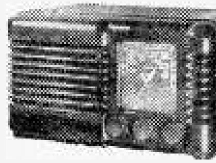


MAINS-MINI

Uses high-efficiency coils, covers long and medium wavebands and fits into the neat white or brown bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, £4 10 0. plus 3 6 post. Constructional data free with the parts, or available separately 1.6.

1956 T.R.F.

32/6



For the benefit of those who already have a loud-speaker and odds and ends, the "1956 T.R.F." is available in basic form. This contains all the essential items, i.e., prepared metal chassis, 3 valves, mains transformer, gang condenser, coil, volume control, valve holders, smoothing condenser, bias condenser, 6 paper and metal condensers, 7 resistors and data. The total list value of all the items is 52 6, but as a Special Offer to publicise the set, we offer all for 32 6, plus 2/6 post and insurance.
Remember, if pleased with results you can add the extra parts to make the "de luxe" set as illustrated.

THE CASCODER

Of the several circuits used for Band III conversion at aerial frequencies, undoubtedly the most popular is the Cascode circuit. We can offer a very good converter suitable for any Band I to any Band III station, in a very neat, polished cabinet with fine tuning, on off mains. Band I-III contrast switches. Price £7.10.0. post and packing 2 6.

INTERCOM—Home or Office

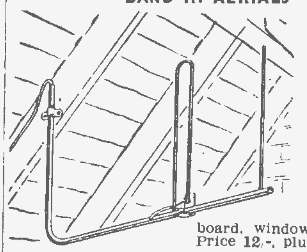
This is a two-station " master " unit comprising an A.C. mains operated push pull amplifier with built-in P.M. speaker which acts as microphone or loud-speaker, depending on whether switch is set to " talk " or " listen." Needs only another P.M. to act as " slave." Complete in polished cabinet ready to work. Price only £4.19.6. plus 3 6 carriage and insurance.

—THIS MONTH'S SNIP—

The "ESTRONIC" Band III Converter

To-day's best value in Band III converters suitable for your T.V. or money refunded. Complete ready to operate, 59 6 non mains or 85/- mains. post and insurance 3 6.

BAND III AERIALS



THE INDOOR

This is a ½ wave, 3 element array. Of all alloy construction, the aerial is completely assembled and ready for instant mounting in loft, bedroom cupboard, window frame, etc. Price 12/-, plus 2/-.

3 element array with swan-neck mast with " U " bolt clamp for fitting to existing masts from ¾in. to 2in. dia.	41/6
3 element array with cranked mast and wall mounting bracket	42/6
3 element array with cranked mast and chimney lashing equipment	65.-
5 element array with swan-neck mast and " U " bolt clamp for fitting existing mast from ¾in. to 2in. dia.	52 6
5 element array with cranked mast and chimney lashing equipment	67/-
8 element array with swan-neck mast and " U " bolt clamp for fitting to ¾in. to 2in. dia. mast	69/-

CAR STARTER/CHARGER KIT

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

Mains transformer	19 6
5-amp. rectifier	17 6
Regulator Stud Switch	3 6
Resistance Wire	2 -
Resistance Former	2/6
Mains on off Switch	1 -
0-5-amp. Moving Coil Meter	9.6
Constructional Data	1/6

or if bought all together price is 52/6, plus 2/- post and packing.

BAND III PRE-AMP

In difficult areas it will be necessary to increase the signal level and this is the ideal unit for this purpose. It is A.C. mains operated and is fitted with input and output coax. plugs. Price £4, post and packing 3/6.

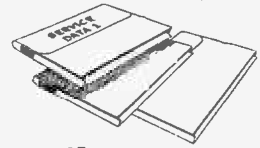
COIL SETS FOR CONVERTERS

Straight Set

Comprises coils for R.F., Oscillator, Rejector, Chokes for the heater line and I.F. coil. Suits many circuits, for instance, Wireless World, Radio Constructor, Teletron, Data Publications, etc., etc. (circuit included). Price 15 -, post 1 -.

Cascode Set

Comprises I.F. coil in square can, oscillation coil, two R.F. coils, heater chokes, etc. Suitable for most Cascode circuits, Practical T.V., Radio Constructor, Teletron, Data Publications, etc. Price 18 - set, post 9d. (circuit included).



SERVICE DATA

100 service sheets, covering British receivers which have been sold in big quantities and which every service engineer is ultimately bound to meet. The following makers are included : Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Philips, Pye, Ultra. Undoubtedly a mine of information, invaluable to all who earn their living from radio servicing. Price £1 for the complete folder.
Our folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers " all dry," etc., which have been imported into this country. Names include Sparton, Emerson, Admiral, Crossley, R.C.A., Victor, etc. Each sheet gives circuit diagrams and component values, alignment procedure, etc., etc. Price for the folder of 100 sheets is £1, post free.

12in. T.V. CABINET—15/-

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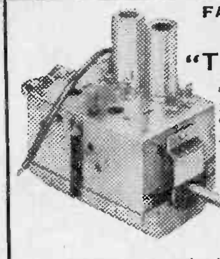

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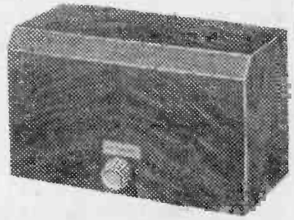

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SELENIUM METAL RECTIFIERS
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BATTERY SET CONVERTER KIT
All parts for converting any normal type of Battery Receiver to A.C. mains 200-250 v 50 c/s. Supplies 120 v 90 v or 60 v at 40 ma. Fully smoothed and fully smoothed L.T. of 2 v at 0.4 a to 1 a. Price including circuit 49/9. Or ready for use 9/9 extra.

ALL DRY RECEIVER BATTERY ELIMINATOR KIT.—All parts for the construction of a unit (metal-case 5½-4½-2in.) to supply Battery Portable receivers requiring 90 v and 1.5 v. Fully smoothed. From 200-250 v 50 c/s mains. Price, inc. point-to-point wiring diagrams, 38/9. Or assembled and tested at 45/9.

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Handsome well constructed with beautiful figured walnut veneer finish. Size 40in. high, 24½in. wide, 20in. deep. For 15in. or 17in. Tube. Limited number at only **9gns** carr. 30/-
Types with full length doors. 10 gns. Above for callers only.
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EX-GOVT. UNIT RDF1.—Brand new, cartoned. Complete with 11 valves, including 5Z4G. Also mains tuned L.F. choke, rectifier, etc., etc. Only 30/-. Carr. 8/6.

TV. PREAMPLIFIER.—For Fringe Areas. Brand New. Complete with 6F13 valve. Only 22/6.

CO-AXIAL CABLE ¼in.
75 ohms 14/36 ... ...9d. yd.
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EX-GOVT. SMOOTHING CHOKES.—
100 ma 10 h 250 ohms Tropicalised 3/11
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150 ma 10 h 150 ohms... ... ... 11/9
250 ma 10 h 50 ohms 14/9

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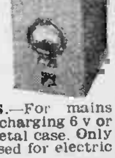
.25 mfd 4,000 v (Block), 4/9 : .5 mfd 3,500 v Can, 3/6.

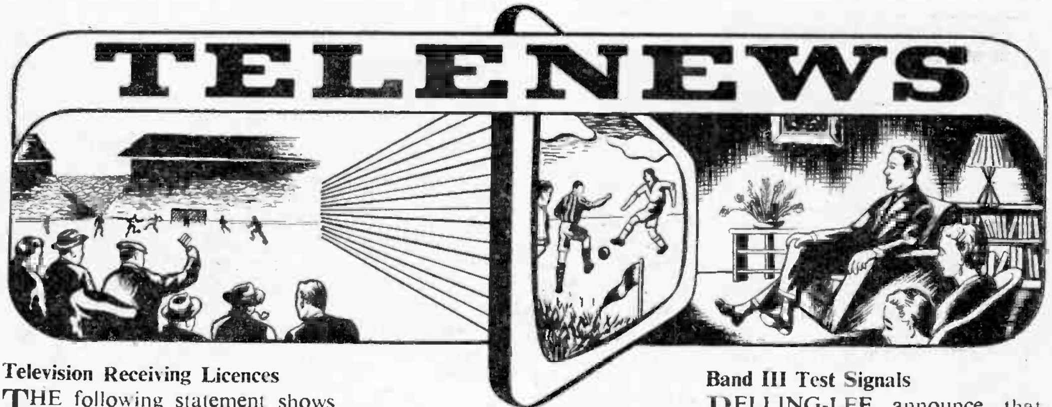
BATTERY CHARGER KITS.—Consisting of attractive Green Crackle Case, Transformer, F.W. Rectifier, Fuse, Fuseholder, Tag strip, Grommets, and Circuit. For mains input 200-230-250 v 50 c/s, 6 v 2 a, 25/9 : 6 v or 12 v, 2 a, 31/6 : 6 v or 12 v, 4 a, 49/9. Any type assembled and tested for 6/9 extra.

R.S.C. 6 v or 12 v BATTERY CHARGER
For normal A.C. mains input 200-230-250 v 50 c/s. Selector panel for 6 v or 12 v charging. Variable charge rate of up to 4 AMPS. Fused, and with meter. Well ventilated case with attractive crackle finish. Guaranteed for 12 months. 69/6. Carr. 2/6.



BATTERY CHARGERS.—For mains 200-250 v 50 c/s. Output for charging 6 v or 12 v at 1 amp. In strong metal case. Only 25/9. Above can also be used for electric train power supply.

R.F. UNIT TYPE 26.—Brand new. Cartoned. 29/6, plus carr. 2/6.



Television Receiving Licences

THE following statement shows the approximate number of television licences in force at the end of November, 1955, in respect of receiving stations situated within the various postal regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London Postal	1,224,594
Home Counties	591,690
Midland	927,483
North Eastern	787,821
North Western	762,562
South Western	334,018
Wales and Border Counties ...	290,683
Total England and Wales ...	4,918,851
Scotland	309,358
Northern Ireland	33,490
Grand Totals	5,261,699

National Research Development Corporation

THE President of the Board of Trade has appointed Mr. C. H. G. Millis, D.S.O., O.B.E., M.C., to be a part-time member of the Corporation. His appointment is for three years.

Mr. Millis is a partner in Baring Bros. & Co., Ltd. He was Vice-Chairman of the BBC from 1937 to 1946.

Mr. Millis succeeds Sir Edward de Stein who recently resigned from the Corporation in view of his business commitments.

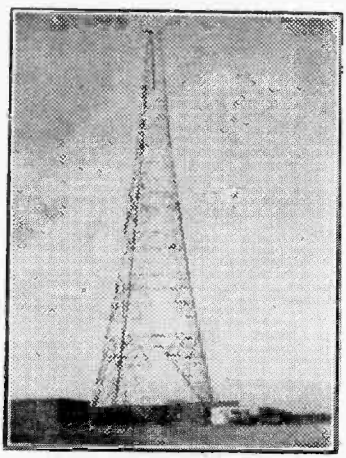
Sir Edward was one of the "foundation" members of the Corporation, having been appointed when the Corporation was set up in June, 1949. His advice and guidance, particularly on financial matters, has contributed in considerable measure to the work and development of the Corporation.

Pontop Pike Station

FOR the BBC's new permanent medium - power television station at Pontop Pike, Marconi's Wireless Telegraph Co., Ltd. have supplied the main vision and sound transmitters as well as the medium power combining unit.

The aerial system, consisting of a three-stack super-turnstile array is also of Marconi manufacture. This, in conjunction with the 5 kW vision and 2 kW sound transmitters, will have an effective radiated power of 12 kW and 3 kW.

Pontop Pike is the fourth of five BBC medium-power stations to be completed with Marconi vision and sound transmitters as the main installations, together with Marconi aerial and feeder systems.



The aerial mast at Lichfield as it appeared when we went to press. The Marconi 16-stack aerial array is the first of its type to be designed and produced in this country.

Our next issue, dated March, 1956, will be on sale on Wednesday, Feb. 22nd.

Band III Test Signals

BELLING-LEE announce that they have raised the G9AED aerial to the 350ft. level on the ITA mast at Lichfield.

Normal transmitting times Mondays to Fridays are :

9.30 a.m.—12.30 p.m.
2.00 p.m.—5.30 p.m.
7.30 p.m.—8.30 p.m.

Saturdays : 10.0 a.m.—1.0 p.m.

Reports of improved reception to Belling & Lee Ltd., Great Cambridge Road, Enfield, would be appreciated.

TV Raising Food Standards Tastes

TV and radio chefs are awakening the palates of hotel and restaurant customers, and they are now demanding a higher standard of catering.

Mr. J. L. Tregoning, Ulster Transport Authority's hotel chief, reminded 12 hotel students of this when they graduated recently from the Antrim County Education Committee's catering training school at Portrush after a three months' residential course of this change in tastes.

Mr. Tregoning said that the public were becoming more discerning about food and consequently the whole standard of catering in Britain and the North of Ireland was undergoing a change.

He added : "In my young days I was not advised by the medium of TV or radio what was the best food to buy, where to get it and how to cook it. All this is affecting the standard of food throughout the country."

Since the Portrush catering school was opened two years ago, 115 girls from various parts of the six counties have received training.

New BBC TV and V.H.F. Stations

THE BBC regrets that, owing to the late delivery of equipment by the manufacturers, the permanent aerials at North Hessary Tor and Rowridge television stations will be delayed. The dates on which the service from these stations will become fully effective will therefore be April, 1956, for North Hessary Tor and May, 1956, for Rowridge. An interim improvement in the service from North Hessary Tor will, it is hoped, be made in February.

For a similar reason the opening of the V.H.F. sound transmitting stations at Meldrum and Divis will be delayed until March, 1956, but the station at Pontop Pike and the transmitter for the Welsh Home Service at Wenvoe was brought into service on December 20th, as already announced.

National Physical Laboratory

THE resignation of Sir Edward C. Bullard, Sc.D., F.R.S., from the directorship of the National Physical Laboratory, took effect on December 31st, 1955.

The appointment of a successor to Sir Edward Bullard will be announced in due course. In the meantime, and pending the taking up of office by a new director, the Lord President of the Council has appointed Dr. R. L. Smith-Rose, C.B.E., D.Sc., M.I.E.E., Director of Radio Research in the Department of Scientific and Industrial Research, to be acting director, with effect from January 1st, 1956.

Child Reaction

A CORRESPONDENT writes: "Do we underestimate the ability of the modern child to take tough entertainment? Before each broadcast of the recent TV horror serial 'Quatermass II' the BBC gave a pre-announcement to the effect that the material contained in it was unfit for children or adults of a nervous disposition. Producer Rudolph Cartier, however, tells me that 'the kiddies loved it.' I am rather inclined to agree with him. Two young girls who happened to be viewing in my home when the feature started were so delighted that they returned every Saturday to follow the adventures of the rocket professor. There were, I am told by their parents, no nightmares or unpleasant reactions. Indeed, on looking through a parcel of children's 'Space Story' books which arrived at my house for Christmas, I found them far more horrific than anything in the much debated 'Quatermass.'"

Audience Figures

IT has been known for some weeks that BBC audience measurement figures and those of the Independent Research Agencies—independent of both the BBC and the ITA—were not in agreement.

The two Independent Agencies have been showing the ITA share of the possible audience at around 55 per cent., while the BBC figures have shown it at around 45 per cent.

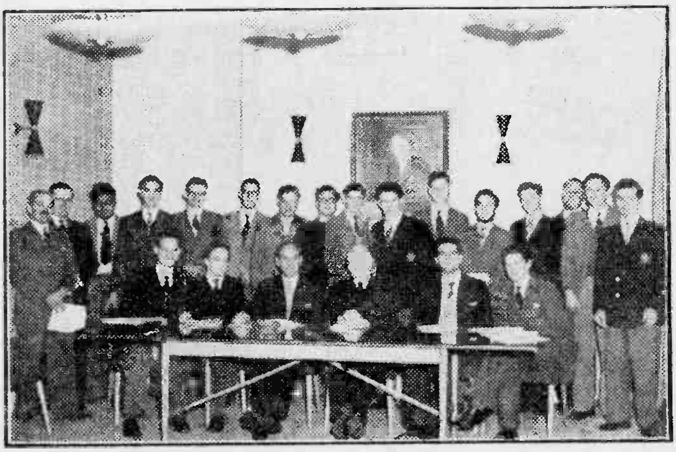
The methods of measurement are, of course, different. The BBC figures are collected in personal interviews, and the interviewers disclose at the outset that they represent the BBC. The Independent Agencies use meters attached to television receivers, which continuously record the programme to which the receiver is switched.

British TV "Worth Imitating"

MR. JACK GOULD, television critic of the *New York Times*, and probably the best-known radio writer in the United States, in a dispatch from London, published under the heading "Worth Imitating," says that there are some lessons for American TV to learn from the British. He refers in glowing terms to the BBC Eurovision and other programmes and chides his countrymen for not capturing some of the "superbly interesting material" on film.

On picture quality, Mr. Gould writes:—

"Finally, there is a technical lesson to be learned from British television, one that has a special and fresh pertinency with this fall's many color 'spectaculars' in the United States. The quality of the British image is infinitely superior to the American picture. This was noticeable here two years ago, but it is apparent that American TV hasn't improved in the interval."



A party of students in their final year at the Ministry of Supply School of Electronics at Malvern recently visited the Mullard Factories and Laboratories. This photograph shows the party in the conference room at the Electronic Display Centre, Gerrard Place, London, W.1, where informal talks and discussions were held as part of a comprehensive programme covering a four-day period.

A BROAD BAND AERIAL

CONSTRUCTIONAL DETAILS OF A NOVEL AERIAL FOR BBC OR ITA SIGNALS

By F. J. Shipgood

THE problem of broadening the frequency response of a TV aerial is usually met by increasing the diameter of rod used for the dipole. The theoretical Q-factor of the dipole, about 7 for a wavelength to diameter ratio of 1,000, falls to

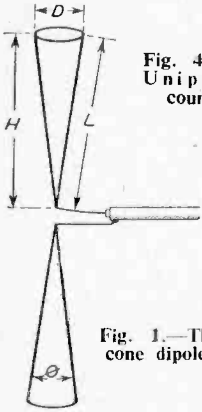


Fig. 1.—The cone dipole.

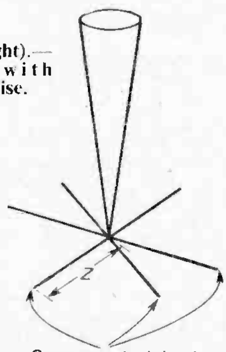


Fig. 4 (right).—Unipole with counterpoise.

about 3 for a ratio of 32. Below this the rapid decrease of the Q-factor does not justify the increase of bandwidth since the received signal is greatly diminished.

An extension of this device is to use, not cylinders, but cones. Dimensions of the cone aerial for channels 1 to 5 in Band I and for G9AED in Band III are given in Table 1 with reference to Fig. 1.

As the angle θ is increased the impedance at the centre of the aerial is decreased, the bandwidth increased and the Q-factor decreased. For the best overall performance the most suitable value of θ is about 20 degrees.

Solid cones need not be used; the surface is effectively solid if about 16 strands of 7.02 tinned copper wire are stretched between the apex and a circular strip of thin copper around the base of the cone, as shown in Fig. 2 (b).

Suggested reflectors are: conventional half-wave rod of length R (see Table 1), a disc of $\frac{1}{2}$in. chicken wire of diameter R or a large sheet of chicken wire with or without a resonant slot. Spacing S between the dipole and the reflector should be a quarter wavelength and the appropriate dimension is also given in Table 1.

Since the cone dipole is not easily constructed for external mounting it is essentially a loft aerial. Fig. 2 suggests a possible form of gantry. Here a tuned disc reflector is used and by way of experiment a Band III dipole has been mounted in front of the Band I dipole. The two dipoles are connected together by twin feeder.

Being well outside the ITA service area it was not possible to check the array efficiency on both bands; however, Band I reception was in no way impaired.

Dimension BC is given in Table 1 under column S, and AC under column X. If the receiver lies between the Band I and the Band III transmitters the two dipoles can be mounted back-to-back sharing the common reflector. In other cases, where the receiver and the two transmitters are not in line, the arrangement in Fig. 3 is suggested. Each dipole is mounted at a distance S from the reflector and is connected to the main feeder by coaxial cable of length nearly twice H. The connection should be made by a matching device such as a diplexer.

Where a vertically polarised aerial is required it may not be possible to erect the array because of space restrictions in the loft In this case use can be made of a counterpoise as illustrated in Figs. 4 and 5. The unipole should be mounted with the apex about 1 cm. above the counterpoise and with the inner conductor of the coaxial cable connected to it. The outer conductor should be connected to the counterpoise immediately below the unipole.

The cone dipole has a low reflection coefficient and does not require matching at the aerial. It is important, however, to check the matching at the receiver end of the line. To do this connect a piece of coaxial cable, a little more than a quarter wavelength long, in parallel with main feeder at the receiver input terminals. With the receiver in operation, snip off small pieces of about a $\frac{1}{4}$in. in length from the free end of the coaxial cable. Continue snipping until

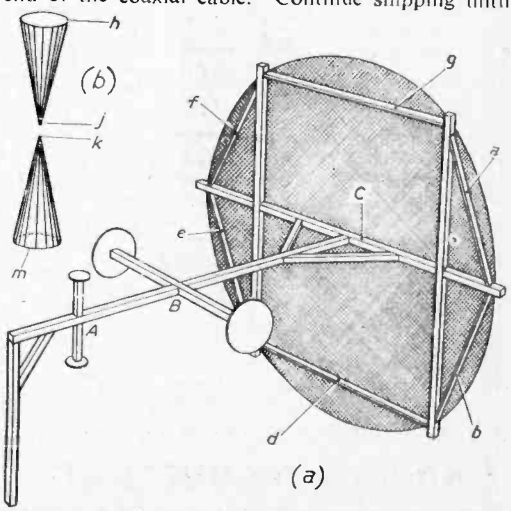


Fig. 2. — For horizontal polarisation dipole may require additional support. (a) All woodwork 1in. square excepting a, b, d, e, f and g, these being 1in. x $\frac{1}{4}$in. All joints half-lapped and screwed excepting at A and B where $\frac{1}{4}$in. holes are drilled and $\frac{1}{4}$in. dowel rod fitted. Bases of cones are plywood discs. (b) Copper strip or bonding wire around h, j, k and m to support wires. Connect coaxial cable to i and k.

the picture disappears. Avoid cutting off too much for if the picture should begin to reappear it will be necessary to try again with another length of cable. When the null point has been reached short-circuit the free end and the picture will now be at its maximum brightness and therefore the maximum signal input is being received. Now remove the matching stub and if the picture does not deteriorate the input is already correctly matched and does not require the stub; otherwise leave it in.

If the aerial is being used for both Band I and Band III reception the matching should be checked for both received signals and a compromise made if necessary.

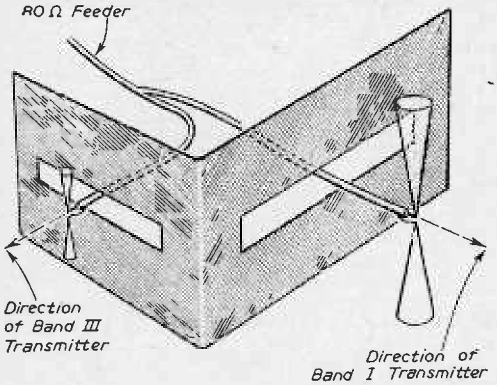


Fig. 3.—Slot length = R. Slot width = $\frac{R}{12}$ Chicken wire extends to a distance at least $\frac{R}{4}$ from slot. Dipoles placed $\frac{\lambda}{4}$ from centre of slot.

Channel	D	L	H	R	S	X	Z
1	15½	44¾	44	127	66	105	63½
2	13¼	38	37½	111	57½	105	55½
3	12¼	34¾	34½	101	52½	75	50½
4	11¼	32	31½	93½	48½	75	47
5	10¼	29¾	29¼	86	44½	75	43
G9AED	3½	10¼	10	29½	15	—	15

Table 1.—Cone dipole measurements

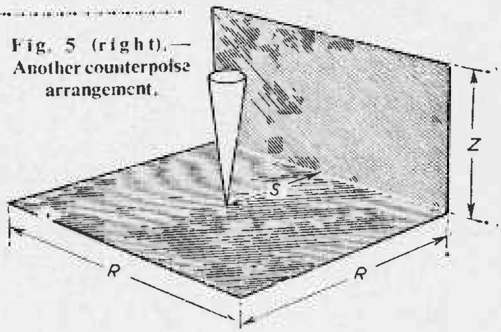
Generally: $H = \frac{1940}{f}$ where f is in Mc/s

$$L = \frac{1970}{f}$$

$$D = \frac{684}{f}$$

All measurements above are in inches.

Fig. 5 (right).—Another counterpoise arrangement.



BBC EXPERIMENTAL COLOUR SYSTEM

(*Continued from page 390*)

suppression period following every line synchronising pulse. This "burst" is used at the receiver to synchronise a sub-carrier generator which is needed for detection of the quadrature modulated chrominance signal.

The waveform generator and the encoder are mounted in the two cubicles adjacent to the camera control equipment. The three other cubicles in the background at the right supply power for the whole of the equipment, with the exception of the slide and film scanner.

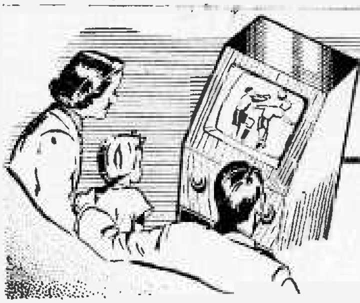
4. Colour Picture Monitors

There are two colour picture monitors. One employs three separate tubes, the phosphors of which emit respectively red, blue and green light. The application of the colour separation signals to the grids of these tubes produces three colour separation images which are combined optically by dichroic mirrors to produce a direct viewed colour picture. This method brings with it the attendant difficulty of superimposing the three separate images accurately, just as in the colour cameras. However, up to the present, this method produces the best pictures and its complication is worthwhile in a monitor intended for technical purposes. This monitor is seen in the centre of the photograph of the control room.

The other monitor uses a 15in. R.C.A. shadow-mask tricolour tube which has been described extensively in the technical literature. Since the monitor incorporates its own decoder the input signal is of the N.T.S.C. type and the unit is, therefore, used for general checking and monitoring of the transmitted signal. It can be seen on the extreme right of the photograph of the control room.

5. Colour Test Equipment

The complicated nature of the N.T.S.C. signal requires special test signals and measuring apparatus to ensure that its specification is met. The main signal for this purpose, "colour bars," is generated electronically and produces on the picture monitor seven vertical strips which, from left to right, are white, yellow, cyan (blue-green), green, magenta (purple), red and blue. These signals represent saturated colours for which the amplitude and phase of the colour sub-carrier are known. The amplitude is measured in the usual way with a waveform monitor; the phase is measured by a special piece of test equipment known as a Colour Signal Analyser. Distortion occurring in the transmission of the signal after it has left the encoder can, of course, be measured similarly.



UNDERNEATH THE DIPOLE

TELEVISION PICK-UPS AND REFLECTIONS

By Iconos

HUMAN STORIES

I MUST say that I never expected the BBC to indulge in the "human document" type of feature which has become so popular on American television and now introduced here first on ITV. Godfrey Wynne's superb handling of this difficult type of feature has been very well received. This has been followed up by the BBC's "Is This Your Problem?" which deals with the types of questions which inspire columns of advice from special correspondents in newspapers and magazines. In the BBC feature the answers came from a group of eminent advisers, headed by Edana Romney and Edgar Lustgarten. The sincerity of all members of the panel and the warm, sympathetic introductions of the characters by Miss Romney instantly captured the interest of viewers. Production values were very carefully handled, with no jarring technical flaws to break the tension. The panel of advisers were dealing with human beings and some of the problems posed were of a serious and touching character. The treatment had to be in good taste, sincere and not sentimental. It succeeded in all these points. I suppose we shall now have a whole succession of problem panels from all the ITV contractors until every possible human problem has been dealt with. The viewer will then have the choice of advice from a large assortment of Uncle Bobs and Auntie Olives in addition to the excellent panels now in operation!

THE NORTHERN TOUCH

THE forthcoming opening of studios and television theatres in Birmingham by A.T.-V. and A.B.C.-T.V. and in Manchester by the Granada T.V. Network and the A.B.C.-T.V., together with hook-ups for relays from these centres to I.T.A.'s London area transmitter will undoubtedly bring a new approach to TV entertainment. Up to now, the style has been dictated by conventions acceptable to the South. The BBC's own relays from Manchester and elsewhere have not carried much weight—with the possible exception of those from Edinburgh. I venture to predict that the amateurishness of provincial TV studio productions will disappear with the launching of ITV in the North. Both A.B.C. and Granada are well acquainted with Lancashire, Yorkshire and Midland audiences, and will give them what they want in a big way. The very name "Granada TV Network" suggests that its horizons are not to be bounded by the sightlines of the I.T.A.'s Lancashire/Yorkshire area transmitter. As for the other I.T.A. contractors—well, they all seem to be fond of the word "Associated" in their titles. Is this an omen?

BRITISH FILMS ON U.S. TV

LARGE sums of money have been paid by American TV companies for the right to televise old British films. Some of these have really been old—pre-war exhibits which qualify as museum pieces. More recently arrangements have been made to transmit comparatively new British films, such as "The Constant Husband," with Rex Harrison and Vivien Leigh, "Captain's Paradise," and "The Man in the White Suit," both with Alec Guinness, and "Great Expectations." The response to the showings of these films has been most favourable, and has created quite a taste for the British product. It seems that the technical quality of film transmission in America has recently been considerably improved at many of the more important TV stations. This has been due to the installation of flying spot scanners, progress on which had been retarded by the difficulties of tying up films shot at 24 frames per second with the 60 cycles per second mains frequency. In England, by shooting and reproducing films at 25 frames per second, it is comparatively easy to arrange a flying spot scanner to produce 50 TV fields per second with 50 cycles per second mains as the basis. However, a solution has now been found which enables the flying spot system to be used in America, with greatly improved results. No longer will it be essential for high contrasts and effect lighting to be avoided when filming for TV in America. It seems that some of these British films reaped the benefit of the new transmitting technique in some areas. Incidentally, I find the American films specially made for TV come over very well on both BBC and ITV. "I Love Lucy" is as popular in America as the Groves and Archer series are here. The excellent photographic quality is the responsibility of one of America's finest cameramen, Karl Freund. By way of comparison, other items on ITV before and after this feature look drab.

TV OSCARS

AT the end of each year it has become customary for many of the newspaper critics of the theatre, films, radio and TV to survey the progress in their own particular fields and to name the more important dramatic presentations of the year. In America, the annual summing-up goes a step further and societies of professional critics get together and vote upon the best acting performance, the best script, the best photography and so forth. The pursuit of the Oscar has long been a cult in the Hollywood film colony and there are now equivalents of Oscars for radio and TV in America, Britain and elsewhere. Our awards range from the laurels of Edinburgh Festival of the Arts to the mascot-like presentations of the "Daily Mail" and the horrific monstrosity prize of the British Film

Academy. This year, no doubt, the annual airing of opinions will be extended by reason of alternative TV, with BBC, A.T.V. and A.R.T.V. competing for the popularity stakes. As I write these notes, the figures from one of the audience research polls puts ITV in the lead. This reflects the viewing public's preference for the lighter types of programme.

THE PALLADIUM SHOW

THE most outstanding success so far on commercial TV has been the London Palladium Show. Not only has its magic name stolen a high proportion of London area viewers from the Sunday night BBC programmes, but it has been a principal argument in the selling talks of radio salesmen. Not that it has been necessary lately for radio salesmen to use very much persuasion in selling converters for Band III. They sell themselves now.

IDEAL TV

THE name "Palladium" is a great attraction, of course, but even this gimmick would not sustain the show week after week if it were not for the following important factors: (a) the slick and highly professional direction of Bill Ward; (b) the excellence of Tommy Trinder as a compère; (c) the first-class orchestra; (d) the high proportion of good variety acts. I regard the crisp presentation, with its introductory film shots outside the Palladium, the close-ups of the theatre programme, and the other initial "build-up" scenes as being an essential preliminary. They create the right atmosphere. Bill Ward handles his cameras superbly. With dancing, balancing or acrobatic acts, he cuts skilfully from camera to camera, often at the rate of nine or ten different view-points a minute. Good tricks look better; hard tricks look more difficult; the pace is terrific. But he does not cut from shot to shot merely through being "trigger-happy" at the vision mixing panel. The ever-changing viewpoint is inappropriate for vocalists or comedians, and Bill Ward holds a single camera angle for minutes at a time on them, occasionally zooming slowly into a head close-up. The great point about his method of presentation is that each camera move or cut is motivated by a movement on the part of the artists or a change in the music. Tommy Trinder makes a very large contribution to the Show, his many "*ad lib.*" remarks registering well with audience and viewers alike. Tommy even succeeds in making something out of the rather silly half-time feature "Beat the Clock," in which members of the audience are required to perform absurd tricks. The technical presentation is good so far as quality is concerned, though the familiar "ageing" process on female artistes and the "blasting" glint of specular reflections from jewellery or sequins betrays the fact that image orthicon cameras are in use.

I.T. NEWS

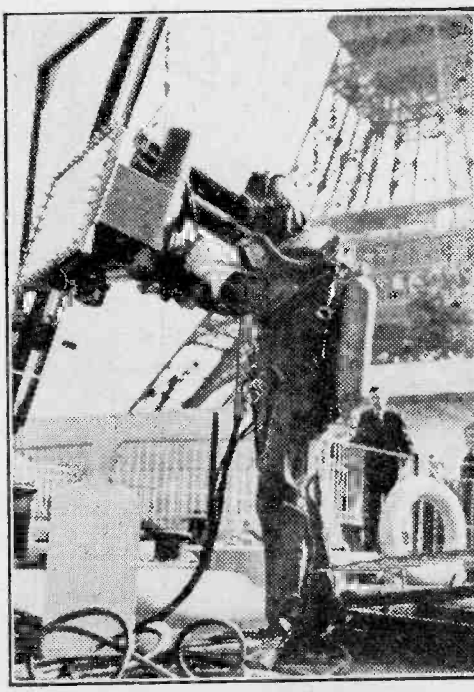
IT is a matter for regret that I.T. News has been reduced in programme time. The building up of this complex organisation has been accomplished quickly and efficiently and there has been a steady improvement in editing and presentation since the first opening newsreel, put over with improvised equipment. The I.T. News readers, particularly Chris Chataway, have suffered from faulty lighting and TV camera distortions which have been far from flattering. These troubles seem to have been overcome. "How? The answer is by the use of make-up.

"THE FIGHTING CHANCE"

AFTER years of ninety-minute TV plays from the BBC (which sometimes have seemed like 120 minutes long!) I had been looking forward to crisp and snappy half-hour playlets from ITV. On the whole, these have been disappointing, frequently turning out to be one-act curtain-raisers of the type beloved of amateur dramatic societies. "The Fighting Chance" played for a full hour, and a fine, gripping, boxing story it turned out to be, with Eleanor Summerfield and Stephen Boyd in the principal parts. This was anything but a one-act playlet, and the wide range of scenes and exciting boxing contests could only have been obtained by pre-filming.

CONTRAST AND TONE RANGE

THE viewing public see their television under all kinds of conditions, from a completely darkened room to one fully lit; with receivers adjusted to different contrast factors and varying brilliance. How is it possible to satisfy all the customers at the receiving end? I believe that the only way is for the transmissions, live or on film, to be restricted to a limited tone range, with avoidance of compression in either the high-light or low-light parts of the picture. It is the compression of the high lights on TV cameras that ruins the features of so many actors and actresses, entirely eliminating the subtle shades of white which register the true skin texture. This problem of reducing contrasts is dealt with in feature cinema films by the use of make-up, by avoiding white collars with black evening dress (the collars are usually dyed a pale yellow or blue), and by avoiding contrasts of black and white in the scenery.



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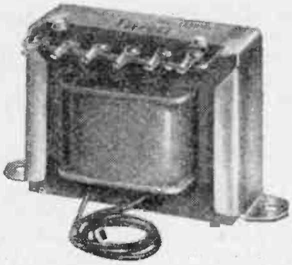

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ALBA 372

My Alba, purchased I believe about 1952, has picture slip. The picture is good, but every now and again, say at change of camera, the picture slips down. Sometimes it is worse than others and after fiddling with picture hold, it may be all-right for a time, then away it goes again, one picture following another from top to bottom of the screen.—T. Bassinder Nr. Rotherham).

We suggest you first change V7 ECL80 which is just to the right of the focus magnet, viewing the receiver from the rear. If this does not effect a cure, replace the .01 μF sync coupling condenser which is mounted just beside the V7 valve base. Also check the associated 330 K and 100 K resistors.

MURPHY V150

My Murphy Model V150 produces a good picture three-quarters the way down the screen But on the bottom I get a reflection and several white lines. When I adjust the vertical hold, the picture rolls, but cannot lock to full picture.

I might mention the slider must be right on the earth end until I can receive the picture as above. If you can indicate a method of removing this it would be most helpful.—F. Hutchins (S.E.23).

Have both frame timebase 20F2 valves tested for emission. If these are in order, check the 25 μF bias electrolytic of the output 20F2. Assuming this is up to capacity, check the 1.2 MΩ and 1.5 MΩ which are in the anode circuit of the frame oscillator. These resistors may have "gone high."

COLUMBIA C501L

My trouble is the picture ; it shows only a small area across the screen. I also lose the sound on turning down the contrast. Hoping you can give me some guidance.—A. T. Harman (S.E.18).

The fault, nearly always, in this model, is caused by the 1.5 MΩ resistor of the frame oscillator going "high." It is mounted beneath the chassis, approximately in the rear centre, and is wired from the oscillator valve base to a tag strip. It is a small carbon resistor coloured brown, green, green.

PYE V4

I have had EF80, PL81, and PY81 tested, and have renewed one valve (PY81) which the test showed L. emission ; also, I have fitted new 250 mA. fuse, and have current passing through it ; but when I switch on the TV set I still can't get the tube face to illuminate.

The controls have no effect on it.—F. Martin (Plymouth).

If the normal line timebase whistle is absent, but upon turning the line hold control a very faint, high-pitched whistle is barely audible, the trouble is no doubt due to the line output transformer, which should be replaced.

However, if the line whistle is audible as normal and E.H.T. is available at the EY51 anode, this valve should be checked.

PHILCO A1707R

The fault is severe vision on sound. Revolution of the core of the sound oscillator coil does not help, neither does tuning of other stages in the vision or sound sections. I've tried to find the "happy medium," but there is still a disturbing amount of vision on sound. I recently replaced the E.H.T. transformer, but I cannot see how that would produce such a fault. The tube appears to be in reasonable condition, and only moderate contrast is required. Have you any helpful suggestions, please ? I am not in possession of a circuit diagram for this model.—H. Morgan (Birmingham).

The vision on sound, if not due to improper alignment, is probably caused by an open-circuited electrolytic capacitor. These should, therefore, be tested for capacity. It is possible that disturbed wiring could cause the fault but we do not think so in this case.

VIEWMASTER AND LINE LINEARITY

Having recently built the Viewmaster, using a 12in. tube, MW16-74, can you please tell me how I may correct the following ? From the viewing position the right-hand side of test card C is cramped and although there is plenty of movement on the left-hand side when shifting the width control only a little and not sufficient width is gained on the right-hand side. Similarly, the bottom of the test card C is a little cramped, but has plenty of movement on picture height. I get a very good picture and suitable sound, but notice that sound, contrast and brilliance controls are at their maximum.

Should this be so, and is there anything amiss that I cannot show a raster when there is no signal?—R. Simmonds (Portsmouth).

The non-linearity of the line scan is usually due to incorrect adjustment of L14 or to MR2 being faulty. To obtain good linearity it is essential that the dust core of L14 should be fully inside the coil former. If, however, the linearity is then improved but the width of the picture is reduced too much we suggest connecting a capacity of approximately 220 pF across the line scanning coils tags L1 and L2.

Non-linearity of the frame scan is probably caused by incorrect adjustment of R65 and R64. Though this can also be aggravated if V12 is faulty or if the H.T. supply in the circuit is low. We suggest deleting R67 readjusting R65 and R64.

To obtain a raster without a signal it should only be necessary to slightly reduce the value of R68.

SOBELL T90

I have a 9in. Sobell Model T90 which uses a Mazda triode C.R.T. CRM92 with grid modulation. The tube is now useless; a friend has presented me with a 9in. Mullard C.R.T. Tetrode MW22-14c, which is 6.3 v. heater as compared with the Mazda. I've tried using it with a separate 6.3 volt transformer for the heater and 200 volts off the H.T. line from the first anode without any satisfactory results; it appears to be biased beyond cut-off.

Is there any way in which I can use this tube ?—V. R. Tracey (S.E.12).

The Mullard tube is not a satisfactory substitute for the Mazda CRM92. Since you have already installed it, however, it would be as well to increase the value of the resistor which is connected from one side of the brightness control to chassis. You will find that this has a value of 10K ohms; if you increase it to 25K ohms a better range of brightness control will be achieved.

SETS ON FIRE

I would like your advice on the causes of fires in TV receivers. I am only a novice to radio and TV, but I am very interested in this work. I had a TV receiver catch fire and will try to explain the symptoms previous to it happening.

The evening previous we were looking at the programme when the picture began to get unstable. This lasted about a quarter-hour until the picture disappeared altogether, but the sound was normal and we could hear a sizzling noise from the set. I took the back cover off the cabinet and the sizzling appeared to come from the E.H.T. section of the set which was enclosed in a metal screening box. When the box was taken off two separate parallel wires had touched together near the top soldering tag and had joined together as one, and was badly arcing; the insulating had melted off each wire for about 1½ inches. I separated the wires with a well insulated screwdriver after the set had been disconnected, and when switched on again the picture appeared normal for the remainder of the evening which was two hours later.

The following evening after the set had been switched on a few minutes it burst into flames and had done considerable damage before it could be put out.

Did a flash-over from one wire to the other cause this, and if new insulated wires had replaced the ones that had the insulation melted off, could the fire have been avoided? Would you please advise me of precautions to take to prevent this happening again? By the way, I forgot to mention that the last time the service man came to replace a valve, the mains input fuses of 1 amp. which were the originals in the set had burnt out, when he was testing for the fault, and he replaced the 1 amp. fuse by a 5 amp.; he said it would make no difference to the safety of the set or components. Is this so ?—H. Lawson (Mansfield, Notts).

Fuses are included in a television receiver to aid in protecting the receiver generally should an internal short-circuit occur. They are purposely only lightly rated so that an internal short would provoke rapid failure and thus prevent the defective component from over-heating to an extent to cause fire. If the manufacturer installed 1 amp. fuses, then 1 amp. fuses should have been used as replacements; consistent failure would indicate an intermittent short within the set, and this cannot be cured simply by increasing the rating of the fuses. It is pointless to fuse a TV set at 5 amps. This affords little or no protection and might well lead to fire should a serious short develop in the H.T. circuits.

EKCO TC185

I have an Ekcovision model TC185 which has developed a fault, though at the moment not serious.

Quite suddenly, a few weeks back, the picture completely blacked out and for several minutes I attributed it to camera failure as sound was still O.K. As no announcement was forthcoming from the B.B.C., I twiddled the brilliance knob and found that advancing it from the usual set position at about 10 o'clock to about 2 o'clock, I again got a satisfactory picture though I had to be continually adjusting up and down slightly as the brilliance would vary considerably during the course of an evening's viewing. However, this unstable condition has now settled down somewhat it seems, but with the brilliance control still set in the advanced position. I would like to add that there has been no trouble from frame slip or horizontal hold, though the picture quality does seem to be impaired slightly.

As I have no circuit or service sheet available, can you please give one or two suggestions as to the cause of the trouble and possible means of correction?—W. J. Richman (Trowbridge).

This fault is often caused by a drop in emission of the video amplifier. This is located toward the front end of the chassis just to the right of the centre line. It is a 10F1 valve..

FERRANTI T1146

This set is fairly old, but I had a new tube fitted last year and the set has been serviced on various occasions. I recently lost the picture and thought I could rectify the trouble. I set about it this way: Realising the age of the set, I thought it would be a good investment to replace all the valves on the vision side which I have done, six valves in all, but the result is still the same. I got a raster, and then what resembles a venetian blind or shuttering effect. Can you suggest what other components, i.e., condensers or resistors would be the cause of this trouble ?—C. W. Chapman (N.17).

The fault is no doubt due to a faulty SP61 line oscillator which is mounted next to the 6L6G line output valve (top right side). The line oscillator may be found to be a VR65 ex-government, and the 6L6G may be found to be a KT66.

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The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64, inclusive, or a woman aged 18-59, inclusive, unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

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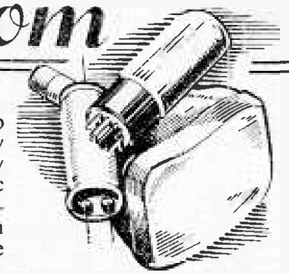
News From the Trade



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BAIRD LINE OUTPUT TRANSFORMERS

DIRECT TV REPLACEMENTS wish to make the position clear to readers concerning the future supply of Baird line output transformers for sets manufactured prior to August, 1954.

With the full co-operation and official approval of the Hartley Baird Company they are manufacturing all the types of transformers used in the above-mentioned sets. The exchange rewind service announced by Hartley Baird is only a temporary measure during the initial change-over period. They should be able to supply new transformers from stock within 24 hours.

Dealers will be pleased to know that the transformers have a redesigned primary winding giving greater reliability. The prices and discounts are the same as when they were supplied by Hartley Baird. —Direct TV Replacements, 134-136, Lewisham Way, New Cross, S.E.14.

NEW MULLARD RECTIFIER

THE Mullard EZ81 is a new all-glass full-wave rectifier valve on the novel base. It has a maximum output current of 150 mA., and is suitable for use with A.C. inputs of up to 350 volts r.m.s. in capacitor input circuits.

The EZ81 has heater ratings of 6.3 volts, 1.0 amps, and the peak heater-to-cathode voltage rating is 500 volts. Filter input capacitors of up to 50 microfarads may be employed.

This new Mullard valve is recommended for use in the Mullard 5 valve 10 watt high quality amplifier circuit.—Mullard, Ltd., Century House, Shaftesbury Avenue, W.C.2.

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Designed primarily as a permanent gift line it will have particular appeal for home electricians and handymen at this time, although due to the prevailing steel shortage, supplies at the moment are limited.—Multicore Solders, Ltd., Maylands Avenue, Hemel Hempstead, Herts.

NEW S.E. PHILIPS REPRESENTATIVE

THE Television and Radio Division of Philips Electrical, Limited, announce the appointment of Mr. S. J. Whitfield as their representative for Kent (excluding the Metropolitan area), East Sussex and part of Surrey.

Mr. Whitfield was formerly employed at head office in the Sales and Distribution Department. Before joining the company in 1953 he served in the Royal Navy as a radio mechanic.

His predecessor, Mr. R. B. Orman, has taken up an appointment with Philips London and Home Counties Regional Office.

BEETHOVEN PRICE CHANGES

THE following are details of the new prices for Beethoven television receivers, taking into account the recent Budget increase :

B.94. 17in. Table Model. £60 11s. 4d., plus £24 9s. 8d. purchase tax, 81 gns.

B.94c. 17in. Console Model. £68 0s. 11d., plus £27 10s. 1d. purchase tax, 91 gns.

B.95. 14in. Table Model. £52 6s. 10d., plus £21 3s, 2d. purchase tax, 70 gns.—Beethoven Electric Equipment, Ltd., 89, Reddish Lane, Gorton, Manchester 18.

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QUERIES COUPON

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PRACTICAL TELEVISION, FEBRUARY, 1956

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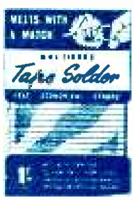

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& TELEVISION TIMES

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Vol. 6 No. 69 EVERY MONTH FEBRUARY, 1956

Televiews

IS ITV FAILING ?

THE news that a large organisation and its associated companies have withdrawn their advertising support from ITA programmes, and the fact that many of the programmes are put out without any supporting advertising at all rather supports the accuracy of our forecast before the ITA service commenced, that advertisers would find that form of publicity unprofitable in view of the high cost in relation to the transient and scant publicity offered in return for the high expenditure. Another factor is that at present ITA has not a nation-wide coverage.

There is a battle going on between the BBC and ITA as to who has captured the greatest proportion of viewing time. The BBC through its research bureau claims the major portion, whilst ITA with their " Metering " system make similar claims.

Judging from the quality of the programmes, there can be little wonder that firms are either withdrawing or failing to support. They are amateurish in extreme and bear the stamp of hasty preparation. No evidence is available as to what results advertisers are getting, but the limited advertising support suggests that this new form of visual advertising has had disappointing results. This is not so much a criticism of ITA as a provider of alternative programmes, as a criticism of the quality of the programmes. The BBC programmes have always had their critics, but viewers have a useful yardstick with which to measure one against the other. If those who have had their sets converted for the alternative programmes are disappointed, they will naturally tell their friends so, and this will deter others from going to the expense of the change-over. Perhaps it would have been wise for the service to have been delayed a few more months so that programme plans could have reached a higher stage of perfection. It is obvious that immediate changes are necessary if the new service is to survive, for we understand that it is losing at present a considerable sum of money each day. Readers will remember our criticism, which was that there was too great a stranglehold on the amount of publicity permitted in each programme and that it could not be expected that advertisers would spend large sums of money just to pay for an alternative programme. Perhaps now that ITA has had a few months' experience they can approach the authorities for a relaxation of the grip they hold over the programmes, some of which leave the impression that they have been not only hastily prepared, but with too lively an eye on the advertisement revenue, and too little consideration to the important fact that, as with newspapers and periodicals, the advertiser must get his money back. Viewers who look in to ITA have a duty to write their criticisms to the Authority for their guidance. We doubt the accuracy of the so-called metering system which at present is the guide of ITA viewing time. We say that it is not possible by this system to obtain any reliable evidence.

A BEGINNER'S GUIDE TO TELEVISION

ELSEWHERE in this issue we commence publication of our new series of articles entitled " A Beginner's Guide to Television," the treatment of which will follow the style of " A Beginner's Guide to Radio," which ran in our companion journal, *Practical Wireless*. Those readers intending to follow this series should place a regular order with their newsagents and avoid the disappointment experienced by many readers of our companion journal due to the greatly increased demand which that series created.

SEPARATE LICENCES

THE Postmaster-General, replying to a question in the House of Commons recently, declined to introduce separate licences for radio and TV so that people who possess only a television set need not pay the full charge of £3. He said that it was unlikely that the £3 television licence fee could be reduced in view of the growing of the TV service. In any case, it would involve separate licensing of sound sets and TV sets even in the same household.—F. J. C.

BBC Experimental Colour System

AN OFFICIAL STATEMENT ON THE SYSTEM AND APPARATUS BEING USED FOR EXPERIMENTS

THE BBC has installed experimental colour television equipment at the London station at Alexandra Palace for a series of experimental tests of colour television transmission systems. These tests started on October 10th, and at the present time a particular type of signal, based on the American N.T.S.C. standard, is being radiated. It is important to understand the nature of these tests and how it has come about that this system is the first to be tested.

In December, 1953, the F.C.C. approved for public service in U.S.A. the colour television standards recommended by the National Television Systems Committee (N.T.S.C.). The principal features of the N.T.S.C. signal which need concern us here are:

1. The colour signal is transmitted in the same radio frequency channel and by the same transmitters as carry the established monochrome service.

2. It is claimed that the system is "compatible" i.e., that existing monochrome receivers can produce a monochrome version of the colour picture which is as good as if the picture had originated from a normal monochrome camera.

3. It is further claimed that the standards are such as to allow for considerable future development in the quality of the colour picture, in the same way as the original specification for the monochrome television service has allowed a continuous improvement in quality over the course of the years.

In this country the BBC has operated since 1936 (except for the war period) a well-established and successful monochrome service employing 405 lines, 50 frames per second interlaced. The advent of the N.T.S.C. colour system naturally aroused interest in the question as to whether this system would show the same advantages here when modified to suit British television standards. Since the scanning and transmission standards of the U.S.A. and this country differ in important ways there was no *a priori* reason to answer this question affirmatively, and work was therefore started on the problem in the BBC research laboratories and in certain industrial organisations.

Work in the laboratories has now reached the stage where practical transmission equipment is available and, with the agreement of the G.P.O. and the co-operation of the radio industry, the investigation will be extended to a wider field. The results of these investigations will be at the disposal of the Television Advisory Committee, which has been asked by the Postmaster-General to report on the whole field of colour television.

The equipment at Alexandra Palace generates a modified N.T.S.C. type of colour signal and its purpose is:

1. To explore the degree of compatibility of the system by making observations on some thousands of black/white receivers.

2. To see whether the system is capable of producing a consistently good quality colour picture.

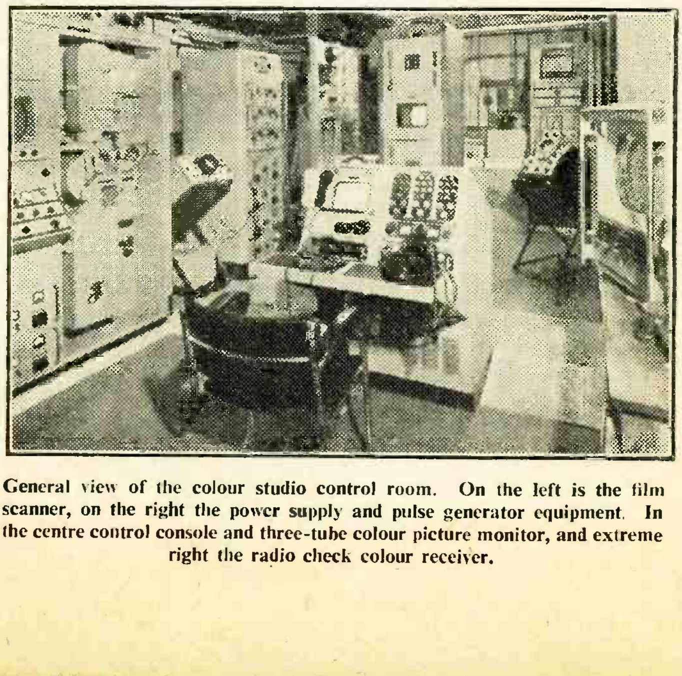
The tests in connection with the first question are already proceeding and it is hoped to provide a statistical answer in due course. Naturally, since colour pictures are being transmitted, some experience and knowledge are being obtained on the second point, but no wide-scale observations are yet taking place because sufficient colour receivers are not yet available.

It cannot be emphasised too strongly that the work is entirely experimental with the sole object of obtaining data which, in due course, will be studied by the Television Advisory Committee, the industry and the BBC.

The test transmissions, which take place outside normal programme hours and have no entertainment value, are in no sense a public service and do not indicate that the start of such a service is imminent. The BBC has no definite plans for the introduction of such a service; there are many difficult technical problems to be solved before this can be contemplated.

The N.T.S.C. Type of Colour Signal

As the equipment at Alexandra Palace has been designed on the basis of the N.T.S.C. signal, a brief description of the essential features of the latter will be given for the information of those who are not acquainted with the principles on which it is based. For those who are familiar with the N.T.S.C. specification the differences between the signal transmitted



General view of the colour studio control room. On the left is the film scanner, on the right the power supply and pulse generator equipment. In the centre control console and three-tube colour picture monitor, and extreme right the radio check colour receiver.

from Alexandra Palace and the American standard will be apparent.

Because of the physical make-up of the human eye, the sensation produced by practically all the colours encountered in real life can be reproduced by the additive mixture of red, green and blue lights. Therefore, it is a common feature of all colour television systems with any pretensions to accurate colour reproduction that the receiver employs coloured lights of red, green and blue, whose intensities are controlled by three separate signals from the transmitter. The N.T.S.C. signal transmits these three signals as : (a) a luminance (brightness) component ; and (b) a chrominance (colour) component, having two separate parts.

The luminance component is the same as that which would be produced by a panchromatic monochrome television camera looking at the same scene, and this signal therefore produces a normal monochrome representation of the coloured scene on a monochrome receiver.

The chrominance component consists of two colour-difference signals, which in the simplest terms may be said to convey the hue and degree of saturation of the colour information. In the colour receiver these three signals representing brightness, hue and saturation are combined to produce the required intensity from each of the red, green and blue lights. The fact that a monochrome receiver and a colour receiver can simultaneously produce each its own version of the scene from the same signal gives the N.T.S.C. system its valuable feature of " compatibility."

It would be possible to transmit the chrominance signal quite independently of the luminance signal and in this case the compatibility would be virtually perfect. However, the second unique feature of the N.T.S.C. signal is that the two components have been combined in such a way that they occupy the same total bandwidth as that used by the equivalent monochrome signal. Due to the manner in which the human eye perceives colour, the separation of luminance and chrominance enables the bandwidth of the chrominance signal to be reduced to about one-third of that of the luminance. Further saving of bandwidth is achieved by placing this reduced bandwidth information at the upper end of the luminance band in such a way that the inevitable interference (cross-talk) between the two signals has a minimum effect on the compatible picture on the monochrome receiver. The actual mechanism by which this band sharing takes place employs a colour sub-carrier (in the British version 2.66 Mc/s) which is simultaneously modulated in amplitude and phase by the two-colour difference signals, the carrier itself being suppressed so that the chrominance signal exists only when colour is present in the scene being transmitted. The colour sub-carrier is an odd multiple of half the line scanning frequency and, under these circumstances the visibility of the best pattern produced between it and the scanning lines is a minimum.

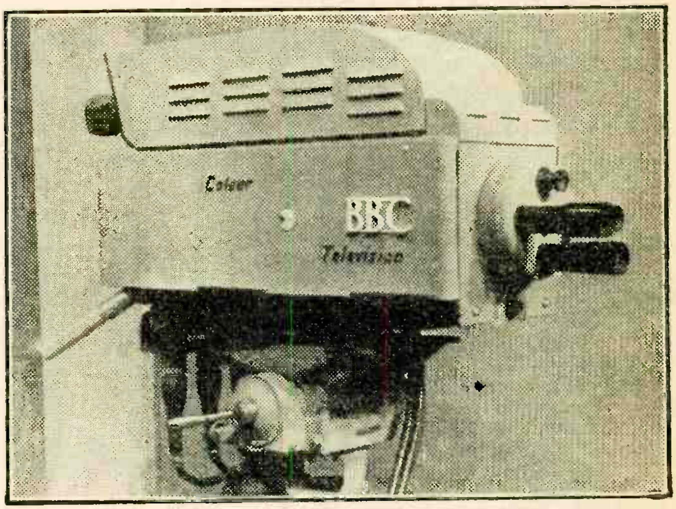
This ingenious combination of band saving, band sharing, suppressed carrier modulation and " frequency interleaving " is claimed in the U.S.A. to produce an adequately compatible signal. Whether or not such is the case in the British version applied to typical domestic receivers in this country is the chief matter under investigation at the present time.

The Equipment Installed at Alexandra Palace

The main items of equipment installed at Alexandra Palace are :

1. Colour slide and film scanner.—Designed and made by Research Department, Engineering Division, BBC.

2. Colour camera. 3. Signal coding equipment. 4. Colour picture monitors. 5. Colour test equipment. —Designed and made by Marconi's Wireless Telegraph Company Limited.



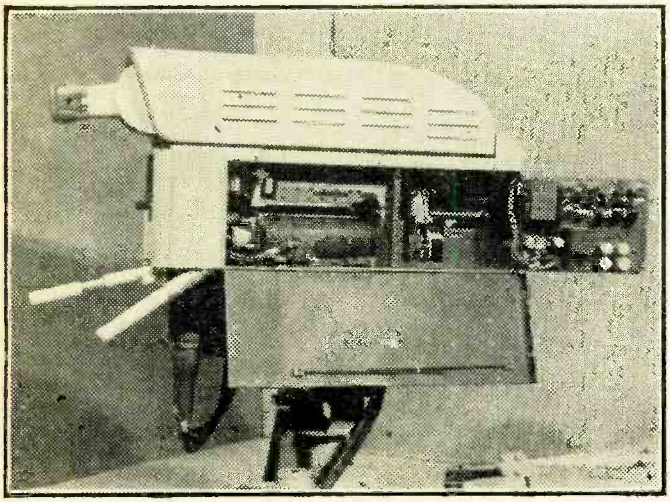
A general view of the three-tube colour camera.

1. Colour Slide and Film Scanner

The colour slide and film scanner is the source of the pictures which are being transmitted for the present series of tests of the compatibility of the N.T.S.C. signal. It produces pictures from slides either 3¼in. x 2¼in. or 2in. x 2in. or from 16mm. film, by selection of the appropriate optical system.

The scanner employs the flying spot principle and the source of light is, therefore, a cathode-ray tube of which the phosphor emits light as evenly as can be achieved over the whole of the visible spectrum. The light from the raster on the face of the scanning tube is passed either through the slide or the film as desired and the coloured image so produced is then split into three separate parts, which represent respectively the red, green and blue information in the picture. This colour analysis process is performed by a combination of dichroic mirrors, coloured filters, plane mirrors and lenses. The three-colour separation pictures, which emerge from the analyser as three physically separate rays of light, are then focused each on to a photo-multiplier tube which turns the intensity of the light, which is varying in accordance with the scene being scanned, into corresponding electric voltages. The three voltages are then passed through three separate and identical chains of electronic equipment which supply gamma correction, correction for the distortion introduced by the finite decay time of the light from the scanning tube phosphor, and equalisation for aperture loss, exactly as in the case of a monochrome flying spot scanner.

The film transport mechanism is a standard intermittent motion 16 mm. projector with a "pull-down" time of about 4 milliseconds. Since the time available for "pull-down" is only 1.4 milliseconds if all the lines of the television picture are to contain information some picture information is inevitably lost. This loss occurs at the top and bottom of the picture, where about 15 lines are presented as black. In order to preserve the usual aspect ratio of 4 : 3 an equivalent area at the sides of the picture is also black. The picture, therefore, appears as in a black frame, but this disadvantage is accepted because the arrangement permits of a simple and efficient optical system. Synchronism between the film motion and the television picture repetition rate is achieved in a simple way by supplying power to the synchronous motor of the film transport mechanism by amplifying the 50 c/s component of the frame pulses.



Three-tube colour camera, side view, showing one of the camera tubes in its yoke and its associated amplifiers.

2. The Colour Camera

Coloured light entering the lens of the camera is split into three colour separation images by a colour analyser similar in principle to that used in the slide and film scanner. In place of the three photo-multiplier cells are three image orthicon camera tubes of a type developed specifically for colour work. These tubes produce the three colour separation signals in electrical form. Each of the tubes is supplied with the necessary scanning waveforms and electrode potentials just as in the case of the single-tube monochrome camera. It will be realised that the output of each tube is a separate picture of which not only the transfer-characteristic between light input and voltage output must be maintained in a precise manner for the three signals, but the geometry of the three pictures must be the same within very close limits so that any particular detail of the picture occurs at the same point in the scanning cycle of all three.

The signals from the tubes are amplified in the camera and transmitted to the control room over three identical cables. In the control room each signal is gamma corrected and equalised in a manner very similar to that used in monochrome equipments employing the same type of camera tube, and finally emerges as a colour separation signal of the same form as that produced by the slide and film scanner.

We show two general views of the camera. The control desk of the camera is seen in the foreground of the photograph of the control room. The three sets of controls, one for each camera tube, can be clearly seen. The electronic equipment for the camera is mounted in the cubicle nearest to the control desk.

3. Signal Coding Equipment

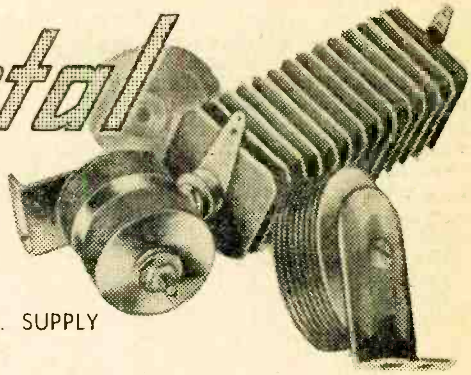
The signal coding equipment includes the special colour waveform generating equipment and the "encoder" in which the luminance and chrominance signals are formed from the incoming three-colour information.

The "master" frequency, from which all the other scanning and pulse waveforms are derived, is obtained from a temperature controlled crystal oscillator whose frequency is 2.6578125 Mc/s $\pm$ 8 c/s. This frequency is multiplied and divided to produce the usual double line frequency of 20,250 cycles/second (i.e., $\frac{4}{525}$ times sub-carrier) from which the standard 405-line interlaced waveform is generated. (It will be noted that the frame repetition rate is asynchronous with respect to mains frequency, in contrast to the existing monochrome service in which synchronous working is almost always employed.) Multiple outputs of line and frame trigger pulses, mixed synchronising pulses and mixed suppression pulses are available.

The input to the encoder consists of the three gamma corrected colour separation signals (red, green and blue) which are produced by either the slide and film scanner or by the camera. The encoder may be considered as performing a single linear transformation of the three incoming signals, red, green and blue, to the other three quantities, Y, I and Q, of which Y is the luminance signal. The colour sub-carrier is then modulated by the I and Q signals in such a way that the amplitude of the resultant signal conveys the saturation information and the phase conveys the hue. In the absence of colour information the sub-carrier is suppressed. The complete chrominance signal is added to the luminance which is, of course, in video form. Finally, the synchronising waveform is added to produce the complete waveform. The synchronising waveform is of the normal type except that a "burst" of nine cycles of the colour sub-carrier is added in the

(Concluded on page 420)

Using Metal Rectifiers



A COMPARISON OF VARIOUS METHODS OF H.T. SUPPLY

By W. Cleland

THE H.T. requirements of a television set are often met by using metal rectifiers. Valve rectifiers, because of their heavy emission, fail more often than other valves, while metal rectifiers, if not overloaded, last almost indefinitely.

Some constructors, for convenience, mount the rectifiers vertically, but this is a mistake. Horizontal mounting provides better cooling, and is essential if the rectifier has much heat to dissipate. The final working temperature of rectifier plates must not exceed 65 deg. to 70 deg. C., and determines the maximum output permissible. Thus, with the half-wave rectifier RM4, the maximum D.C. output is fixed by the makers (S.T.C.) as follows :—

Max. ambient temperature	35°C.=95°F	40°C.=104°F	55°C.=131°F
Max. output current (mean)	275 mA	250 mA	125 mA

It is thus desirable to mount the rectifier so that cool air can reach it easily. If one is ever careless enough to overload a selenium rectifier, one finds that it emits a very unpleasant smell which is unmistakable after being once encountered.

One is strongly advised against dismantling rectifiers. A selenium rectifier usually survives being taken to pieces, but with copper oxide rectifiers, the process is almost invariably ruinous.

Transformers

Mains transformers are usually provided with secondary windings for valve rectifiers as in Fig. 1.

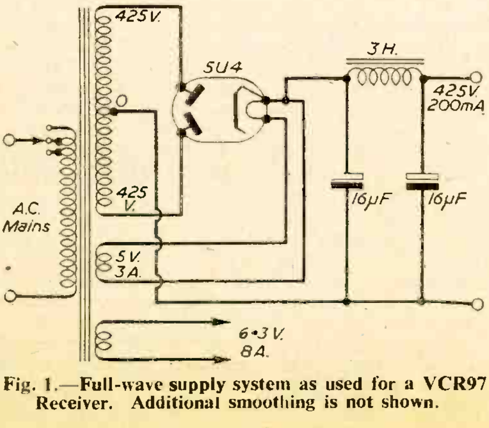


Fig. 1.—Full-wave supply system as used for a VCR97 Receiver. Additional smoothing is not shown.

Such a valve could be replaced by metal rectifiers as shown in Fig. 2. It is interesting to note, however, that the same rectifier could be modified into a bridge system to provide the same output current and voltage (Fig. 3). The transformer secondary winding would then be halved, but the wire thickness would be increased since the single winding now carries all the current.

Since mains transformers for television sets tend to be large, heavy, and expensive, they are often avoided, or else are used merely for heating the valves. The H.T. supply is often provided by a half-wave metal rectifier, which is more suitable for working from the mains than from a transformer, which it tends to magnetise. One disadvantage is that the ripple is 50 c/s and regulation also is poor, unless very large smoothing capacitors are used. These cause a large surge when the receiver is switched on, but suitable rectifiers are designed to withstand this.

Smoothing resistors have no saturation problem and to some extent can take the place of chokes, but they waste power by dropping the output voltage. At 50 c/s a 3-Henry 100-ohm choke has an impedance of 947 ohms and in conjunction with 100 μF will attenuate ripple 29 times, dropping 25 volts at 250 mA. For such a current it would be out of the question to use an equivalent smoothing resistor, but separately smoothed supplies can be used instead.

Bridge Rectifier

A bridge rectifier can be used on the mains, but it must have enough plates to withstand the full peak inverse voltage, since the source impedance is much lower than that provided by a transformer.

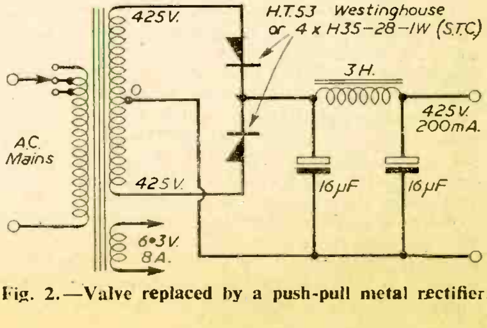


Fig. 2.—Valve replaced by a push-pull metal rectifier.

Half-wave

Returning to the half-wave rectifier, it is interesting to note that when this is centre-tapped, it can be modified into a voltage-doubler for the same output voltage and current. It would, therefore, be practicable to supply a television set by the system of Fig. 6. The number of turns in the secondary winding will be about half of what is required for a half-wave rectifier. A voltage-doubler of this type has a 100 c/s ripple, which doubles the reactance of chokes and

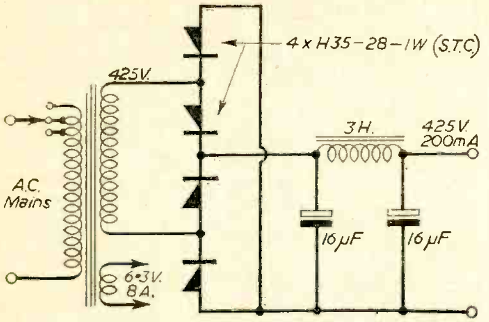


Fig. 3.—Bridge rectifier developed from the push-pull version of Fig. 2.

capacitors, making a stage of L-C smoothing four times as effective as at 50 c/s.

There is a type of voltage-doubler which gives a 50 c/s ripple and should therefore be avoided, since it offers little advantage over an ordinary half-wave supply, the output capacitor charging only on alternate half-cycles. This type is shown in Fig. 7.

Personally, I work all radio and television apparatus from metal rectifiers (either bridge or voltage-doubler) and wind transformers on a home-made winding machine with a turns-counter. It is not economical to make transformers oneself unless bargains in wire or laminations are to be had, and there are pitfalls as regards insulation and electrostatic screens, but at least one can meet any required specification and provide tappings to adjust the output.

There is some uncertainty as to whether the application of H.T. voltage to valves before they have heated up is deleterious to them. There is probably no serious effect, unless with large output valves. At all events, metal rectifiers are widely used for H.T. supplies. Sometimes thermal delay switches are used to delay the application of H.T. These draw about half an ampere from the heater supply, and often evince contact trouble before long, causing crackling or erratic working. One prefers to

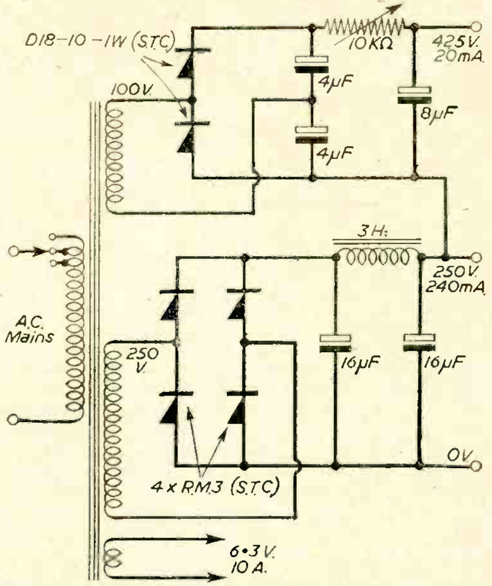


Fig. 4.—A more economical supply for a VCR97 Receiver, which can later be used for a magnetic picture tube if required.

avoid such complications, especially as it is usually unnecessary.

Current Rating

The current carrying capacity of metal rectifiers is decided by the size of the plates, and more especially by the size of the fins from which the heat is carried away. The output voltage is fixed by the number of rectifying sections. Some rectifiers have two rectifying sections between each pair of fins. On alternate cycles, in a half-wave system, the output voltage maintained by the reservoir capacitor adds

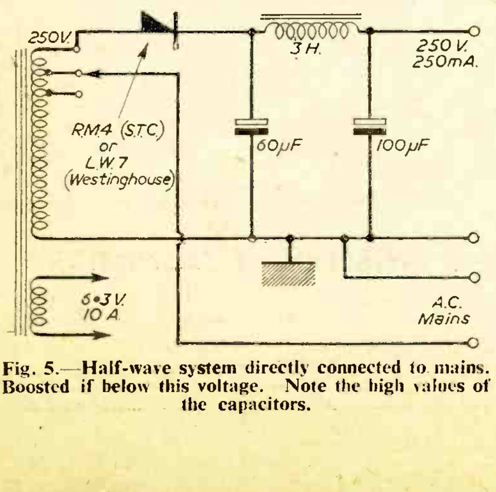


Fig. 5.—Half-wave system directly connected to mains. Boosted if below this voltage. Note the high values of the capacitors.

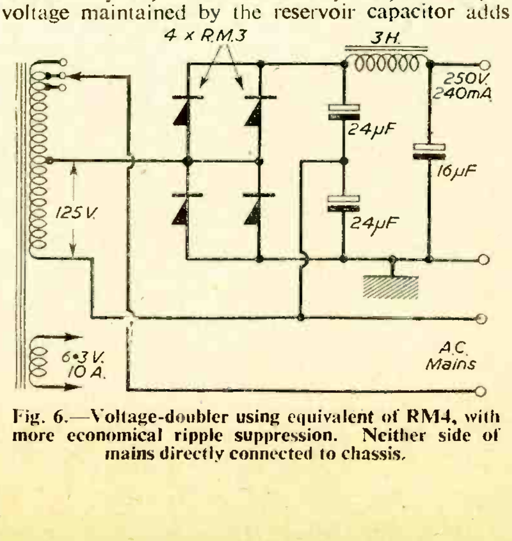


Fig. 6.—Voltage-doubler using equivalent of RM4, with more economical ripple suppression. Neither side of mains directly connected to chassis.

to the peak input to give a peak inverse voltage which the rectifier must be able to withstand.

With a given size of plates, a voltage-doubler provides the same maximum output current as a half-wave rectifier, while a push-pull (valve-replacement) rectifier or a bridge can supply twice as much current as this with the same size of plates.

The following table gives standard voltage ratings for ordinary selenium rectifiers. Some users have exceeded them appreciably for long periods, apparently with little deterioration, but it is best to keep to these figures.

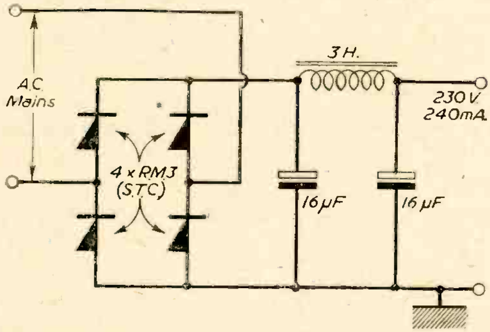


Fig. 8.—Bridge rectifier capable of working from the mains. Neither side of mains directly connected to chassis.

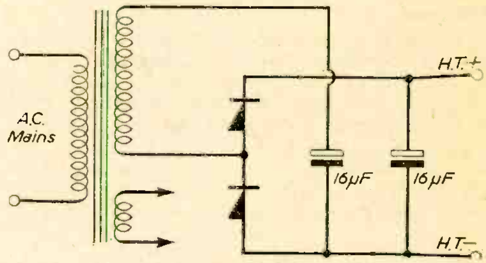


Fig. 7.—A voltage-doubler to be avoided. (50c/s ripple and poor regulation.)

System	Total number of rectifying sections	R.M.S. input current	Typical R.M.S. input voltages
Half-wave ...	V/10	2.5 I	V×0.9 to 1.1
Full-wave :			
Voltage-doubler	V/10	3 I	V×0.5 to 0.6
Push-pull ...	V/4	I	V×0.9 to 1.0 (twice)
Bridge	V/4	1.4 I	V×0.9 to 1.0

Where V and I are the output direct voltage and current respectively.

"Space School"

"SPACE SCHOOL" is the new BBC Children's Television serial in four weekly self-contained episodes. It is written by Gordon Ford; the scientific adviser is S. H. Groom, Lecturer in Physics and Astronomy at the Science Museum, who for the last 25 years has been lecturing to enthusiastic schoolchildren. The producer is Kevin Sheldon who has varied his long association with "The Appleyards," by producing "The Lost Planet," "Return to the Lost Planet" and other serials.

Mr. Sheldon explains that the whole action of "Space School" depicts the type of space adventures that might be expected in the comparatively early days of space travel, which at the time of the first play has become accepted as a matter of course. Landings have been made on Mars and the Moon, and a satellite advance base for observation purposes has been set up within easy range of Venus. Mines have been worked both on the Moon and on Mars, and valuable new metals—such as a pliable metal called Segalium taken from Mars—are being used to revolutionise manufacturing processes of all kinds.

Characters in the play are members of the 500-strong colony on an earth satellite which is established as the H.Q. of space control. The satellite is 320 yards in diameter and 100 yards deep and revolves 1,000 miles off the earth. It has all the modern conveniences including a Space School where the children receive education on space and earthly subjects.

The Colony is headed by Sir Hugh Stirling, Commodore of the Space Fleet and in charge of all operations off the earth; Sir Hugh was one of the pioneers of early space flights who was responsible for plotting the original navigational routes to the Moon and Mars. He is played by John Stewart (Dr. Lachlan McKinnon of the "Lost Planet" serials).

His team consists of Space Captain Michael O'Rorke, an ace pilot and fiery Irishman, played by James O'Connor; his Space Engineer Cedric ("Tubby") Thompson, who is "excellent with a screwdriver, a tube of glue, and a piece of string," played by Donald McCorkindale, son of the South African boxer Don McCorkindale; and the Space Schoolmistress, Miss Osborn who, though a qualified space pilot, is responsible for teaching her pupils the conventional earthly subjects of history and geography, played by Julie Webb, a regular visitor to "The Appleyards."

Three principal child roles are played by Michael Maguire, Ann Cooke and Meurig Jones as Wallace, Winnie and Wilfred Winter.

The BBC Wardrobe Department have designed smart space suits for the children with a school badge on their pockets designed by Gordon Roland who is responsible for the settings. Suitably spatial music is being composed in co-operation with Sound Radio whose background noises for "Journey into Space" are greatly admired by Kevin Sheldon and his team.

The Band III Cascode Circuit

A STRAIGHTFORWARD EXPLANATION OF ITS DEVELOPMENT

By "Alpha"

THE opening of Band III transmissions has brought the cascode circuit to the fore; it is used in many amateur and commercially built converters as a low-noise "front-end."

Cascode operation has developed logically in the search for low-noise input circuits with high stability and ease of adjustment at the very high frequencies used in Band III and is likely to be with us for some time.

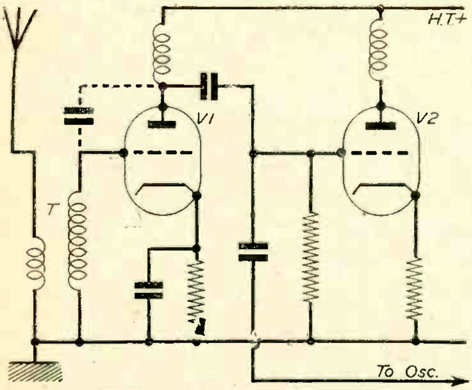


Fig. 1.—Basic circuit showing capacity of valve.

Noise

The successful reception of television pictures depends very largely upon the ratio of the television signal to that of "noise" produced by various sources.

Noise may be classified as random impulses which find their way into the receiver and become amplified along with the signal.

Where high-gain fringe televisors are used it is often possible to obtain the visual equivalent of noise on the screen, simply by turning up the contrast and sensitivity controls to maximum.

In sound broadcasting noise is recognised by the hissing sound which it causes; under severe conditions the hissing noise can be so loud as to make weak signals unintelligible. In the case of vision reception the noise shows itself on the screen as random specks of light. In severe cases it will cover the screen with small specks like a snow-storm and is often referred to as "snow," for this reason.

Normally our picture should be received on the background of a blank screen, but where the background is not blank but is covered with small specks due to noise, the quality of the received picture will be seriously altered, and in severe cases the noise will be so strong as practically to obliterate the picture.

On Band I most of the noise comes from external sources and a great deal of it has its origin in the Milky Way where nuclear disturbances send out electromagnetic signals over a wide band.

On Band I noise from galactic sources is much less evident and a much greater proportion of the noise is to be found due to circuit noise within the early stages of the receiver itself.

Internal Noise

Noise originating within the televisor is classified as internal noise and comes from several different sources.

One quite obvious source is noise due to the random movement of the electrons within a resistance: most constructors must have come across this source in its worst from where a resistance has become "noisy."

Generally, however, the noise is of quite a low degree and of no great importance on Band III. Much more important is the noise caused within the valves themselves.

Within the valve we have several important noise sources. There is *flicker noise* caused by the random emission of electrons from the cathode of the valve; there is *shot noise* due to the fact that the electrons are inclined to reach the anode of the valve in clusters rather than in a steady stream; there is *partition noise* which is the random partition of electrons between the screened grid and the anode.

The latter example is peculiar, of course, to valves which have an auxiliary grid such as the pentode. The triode valve does not suffer from this defect as it has only the one control grid and this has led to the reversion to triodes for R.F. amplification.

(The word "reversion" is deliberate as triodes were used many years ago as R.F. amplifiers, before the screened grid valve and latter the R.F. pentode were developed.)

Prevention of Re-radiation

An important difficulty associated with the use of triodes is the Miller effect which takes place between the anode and grid.

The anode and grid of a triode are separated within

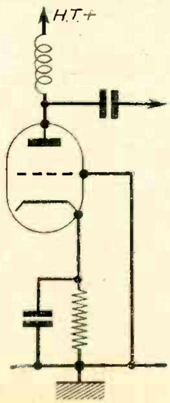


Fig. 2.—Grounding the grid.

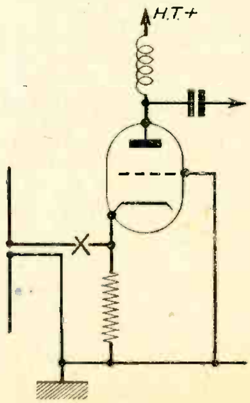


Fig. 3.—Cathode input.

the glass bulb by a very small distance. The two elements, therefore, behave like a small condenser and this condenser can be shown connected as indicated by the dotted lines in V1 circuit, Fig. 1.

It is at once obvious that this capacitance is such that positive feedback will occur between anode and grid. Although the value of the capacitance is quite small, it is appreciably large compared with the frequency and feedback will occur.

The noise generated within the valve which is first in the amplifying chain is of the greatest importance because each successive valve will amplify that noise. It is essential to keep the first valve noise at as low a figure as possible, and if a triode valve is employed then we have the difficulty previously stated due to feedback.

There is yet another factor which must be considered. Most Band III circuits are of the superhet type. Fig. 1 shows the basic outline of the arrangement. The first valve V1 amplifies the signal at its own frequency and the resultant signal is fed to the input of a mixer valve V2. The mixer valve has two inputs ; it has that of the amplified signal and also that of the local oscillator.

In Fig. 1 we show the oscillator input connected in parallel with the R.F. input to the mixer, a fairly common arrangement.

Now, it is clear that the oscillator frequency is present at the anode of the triode valve V1 and due to the capacitance between anode and grid of the triode it will appear on the grid of the triode and find its way thence to the aerial.

The net result is that the oscillator signal is re-radiated by the aerial system.

This is obviously most undesirable for several reasons. As a simple example supposing we have a televisor tuned to Channel 8 the I.F. stages being at 10 Mc/s. Now Channel 8 is 189.75 Mc/s vision and to produce an I.F. of 10 Mc/s the oscillator may be at 189.75 + 10 = 199.75 Mc/s. This frequency happens to be that of Channel 10 and so our televisor would radiate a strong interfering signal in Channel 10.

Grounding the Grid

One method of overcoming the problem of feedback and re-radiation is to connect the grid of the valve directly to ground (" earth "). This is shown in Fig. 2. The grid now acts as a shield and prevents re-radiation. The snag is that we must connect our aerial circuit at some point and this cannot be the grid which is now grounded.

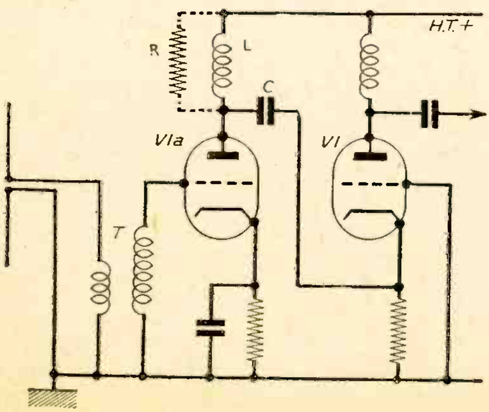


Fig. 4. — The basic cascode circuit.

Fortunately, it is possible to obtain amplification from a valve by injecting the signal either into the control grid, or into the cathode in the same way that it is possible to modulate a cathode ray tube by injecting the signal either into the grid or the cathode.

The circuit arrangement is shown in Fig. 3.

This circuit will work—but we have lost one of the most useful properties of the valve. This is its high input impedance !

The input impedance of the circuit shown in Fig. 3 is very low. Some alleviation may be made by the insertion of a capacitance of suitable value in series with the input circuit at point " X," but in spite of this the input impedance is far from satisfactory and exercises serious damping on the aerial system and mismatch. Further the advantages of the gain of a step-up transformer (" T " in Fig. 1) are lost.

A correctly designed input transformer can give a gain of up to five times.

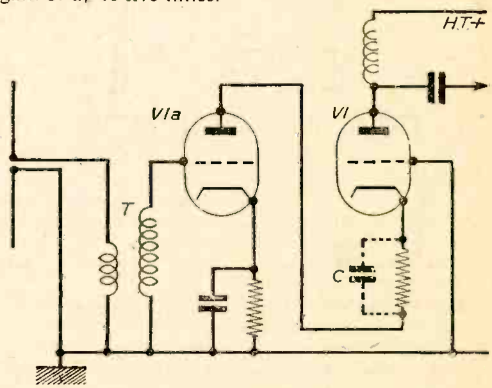


Fig. 5. — A further development.

Using a Second Valve

In an endeavour to obtain the best of both worlds we can use another triode valve in front of the existing one. The circuit arrangement is shown in Fig. 4.

Here we have our input transformer " T " with its step-up ratio and consequent stage gain. The output of the triode V1a is improved by the inclusion of a tuned circuit " L," and is fed to the input of the second valve via a capacitative coupler " C."

Up to this point we were quite happy but, going back to our previous statement, the input impedance of the grounded grid valve V1 is very low and as this impedance is in parallel with the anode load of V1a, i.e., " L " this latter tuned circuit is very heavily damped —so heavily, in fact that it might just as well be replaced with a simple resistance. This is shown in the circuit diagram as " R."

Because of the low value of input impedance " R " would have to be a value of about 150 ohms. It is obvious that with such a low anode load as 150 ohms, the amplification of V1 will be very low indeed—so low, in fact, that the valve might as well not be there.

Now we appear to be in a vicious circle ; we add another valve so as to overcome the effect of the low input impedance of the grounded grid valve and now find that the valve is useless !

But wait ! Is it really useless ? After all we have accomplished our aim of retaining the benefits of the transformer input and also avoided the losses which a low input impedance from the aerial system would involve. Therefore, in spite of the fact that there is little gain from V1a, nevertheless the valve is performing the useful function of acting as a buffer between the aerial and the first amplifying valve.

Simplification

One factor which must not be overlooked in dealing with low-noise circuits, is that the H.T. applied to these stages should not be high; generally speaking a lower H.T. is desirable and voltages in the region of 100 to 180 are sufficient.

If Fig. 4 is studied further it will be seen that we can save a component by connecting the anode of V1a directly to the cathode of V1.

This is shown in Fig. 5. The H.T. supply is now divided between the two valves; the anode load of V1a becomes the bias resistor of V1 and a component has been saved.

However, all is not yet well. First, the cathode connection of V1 is at the wrong end of the R.F. voltage developed on the anode of V1a. This can be quite easily overcome by connecting a bypass circuit for the R.F. and the condenser "C" shown connected by the dotted lines performs the function.

One point still remains to be cleared. The cathode of V1 is now at a high potential with respect to ground. As an example, supposing the circuit was so arranged that a supply H.T. of 250-volt was equally shared by the valves, then about 125-volt would exist between the cathode of V1 and the chassis. If the grid of V1 is earthed this makes the grid 125-volt negative and the valve would not therefore pass current.

To ensure that the grid is not overbiased it must be returned to the far end of the cathode resistor as it was originally when it was grounded, the grounded line forming the common link between the two. This is shown in Fig. 6 which also shows the overcoming of the next problem, that of retaining the grounding of the grid of V1. Cg performs this function.

An Improvement

While the circuit shown in Fig. 6 will perform quite well it can be improved and its gain increased.

First, the cathode bias resistor can be replaced with an inductance tuned to the Band III frequency. This coil (shown as "L" in Fig. 7) should be wound so as to peak to the Band III frequency, its inductance being adjusted so that resonance is reached in conjunction with the capacitances associated with V1a.

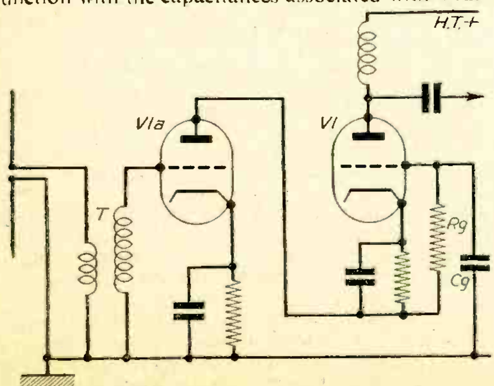


Fig. 6.—A practical circuit.

A useful increase in gain is obtained and the selectivity is increased. (Selectivity of the R.F. section of Band III receivers is a prime necessity.)

A further refinement is the connection of a neutraliser between grid and anode of V1a. In most cases the valve will be found perfectly stable, but if there is any suspicion of regeneration then either an inductance or small capacitance can be connected as shown by the dotted lines.

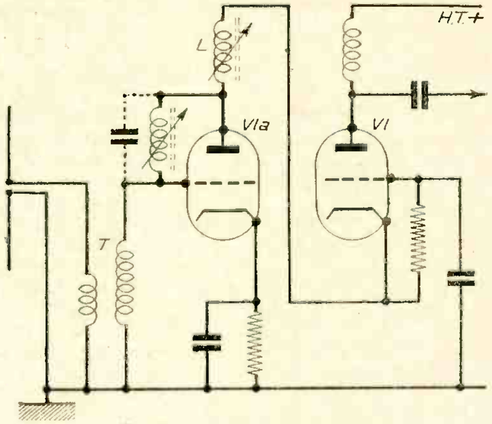


Fig. 7.—Circuit refinements.

V1 and V1a can be conveniently within the same envelope and a valve of the 12AT7 class will be found quite suitable.

A Beginner's Guide to Television

A NEW SERIES

1.—PERSISTENCE OF VISION IN SCANNING—THE CATHODE RAY TUBE—PICTURE SIZE

By F. J. Camm

WHEN you look in to a television programme you are merely watching a tiny spot of light traversing the screen from side to side 405 times in one-fiftieth of a second, at a speed of about 7,000 miles an hour in the case of a 12in. tube, and a correspondingly higher speed in the case of a 15in. tube. This spot of light traces out the rectangular area on which the picture is seen and which is known as the raster. The optical illusion, which the picture undoubtedly is, is due to what might be termed a defect in the human eye which we call persistence of vision. This means in brief that the eye sees as a continuous moving picture any series of pictures each of which is moved at a constant speed and then brought to a stop at a frequency of 16 pictures (frames) per second or more. When you visit the cinema what you see as a continuously moving picture is a series of "stills" which are jerked behind the projector lens at a frequency of 24 frames per second. Each picture is halted in front of the lens for a fraction of a second and then moved on to give place to the next picture in the sequence, thus creating the illusion of moving pictures because the eye will not respond to a frequency in excess of 16 per second.

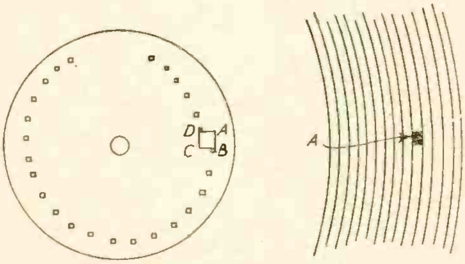


Fig. 1.—How the first type of picture was built up by a rotating scanning (perforated) wheel.

When light rays impinge upon the retina of the eye the impression which they make does not cease immediately the light rays stop. On the contrary, it persists for an appreciable time afterwards, this effect being known as "persistence of vision," or "visual persistence."

It is upon this "lag of retina," as persistence of vision is sometimes called, that we are able to build up a reproduction of motion on the television or cinema screen, in both instances a series of successive pictures (each differing slightly from the preceding one) being formed or thrown on a screen so rapidly that the eye is not able to get rid of the impression made by the one picture or image before the next one arrives.

Persistence of vision lasts for approximately one-twelfth of a second. Hence, if a series of varying images are projected upon a screen at a minimum rate of twelve per second the effect of motion will be obtained.

It should be noted that persistence of vision is a phenomenon which is attached to the actual *retention* of the image on the retina of the eye. The *perception* of the image by the retina in the first place is, so

These two frames of a cinema film illustrate what is meant by persistence of vision. Although the illusion of continuous motion is provided by the film, it is really a series of stills, the film being drawn past the lens in a series of jerks.

far as we can tell, instantaneous.

A television picture is, however, unlike a photograph. In the latter the whole of the picture is visible, and is impressed upon the negative, whereas a television picture depends entirely upon persistence of vision. With a moving picture it is only the illusion of movement which depends upon persistence of vision. With television, both persistence of vision and the building up of a picture are combined.

Thus, in the television studio the cameras photograph the scene being portrayed by a scanning process which breaks the picture up into tiny pieces. It was Paul Nipkow, a Polish scientist, who in 1884 first demonstrated the principle of scanning by his crude shadowgraph transmitters. It was with the Nipkow system that Baird experimented, and it is only fair that the credit should be given to Nipkow for this basic invention. It is right, also, at the very start that it should be set on record that the Baird system was proved to be a failure, since it was based on a low definition system which gave very crude and coarse pictures. High definition TV owes nothing to Baird, who is popularly and erroneously supposed to have invented television.

The spot of light which traces out the picture is called the scanning spot, and it is made to sweep continuously over every portion of the picture to be televised, thus enabling the picture to be split up into a large number of small areas or picture elements. Other factors being equal, the smaller the scanning spot the finer in detail will be the televised image, for it will enable the light and shade of the picture to be picked up and transmitted with precision, a task which becomes more difficult as the size of the scanning spot is increased.

The television system employed by the BBC and ITA transmits 25 complete pictures per second, each of 202.5 horizontal lines. These lines are interlaced and the frame and flicker frequency is 50 per second. We shall deal with interlacing more fully later on in this series, but it is sufficient here to say that the frame frequency is 50 a second, scanned from top to bottom of the received pictures, and that two frames each of 202.5 lines at a speed of 25 per second are interlaced to produce the 405 lines and a complete picture speed of 50 per second.

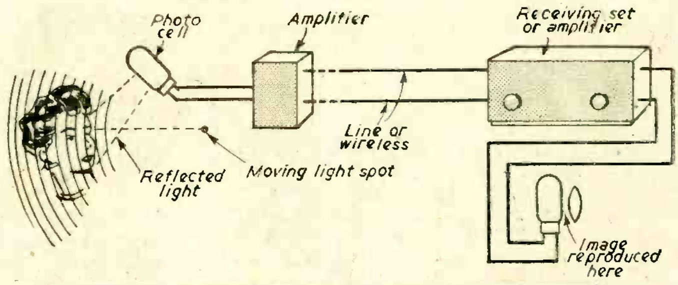


Fig. 2.—How the image was first transmitted and received.

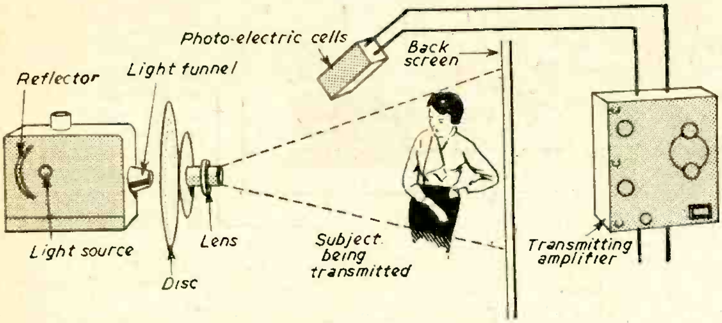


Fig. 3.—Diagram illustrating the manner in which the early television system worked.

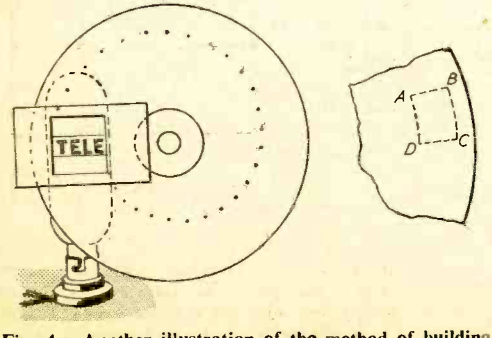
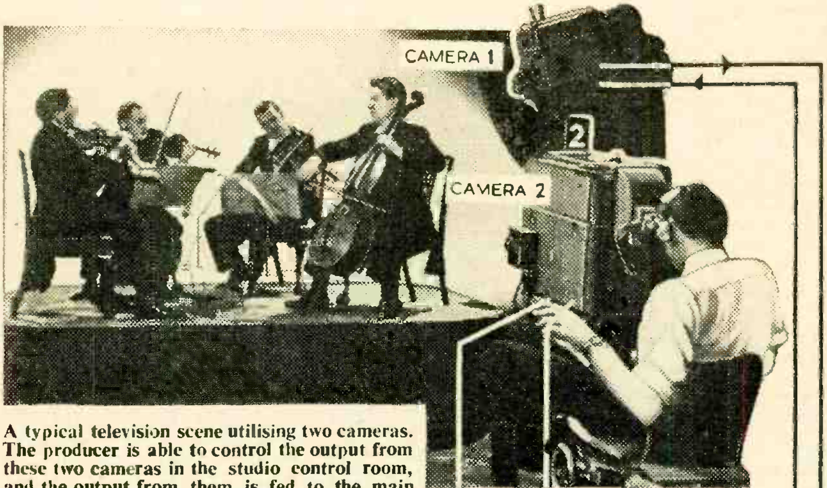


Fig. 4.—Another illustration of the method of building up an image by a mechanical disc.

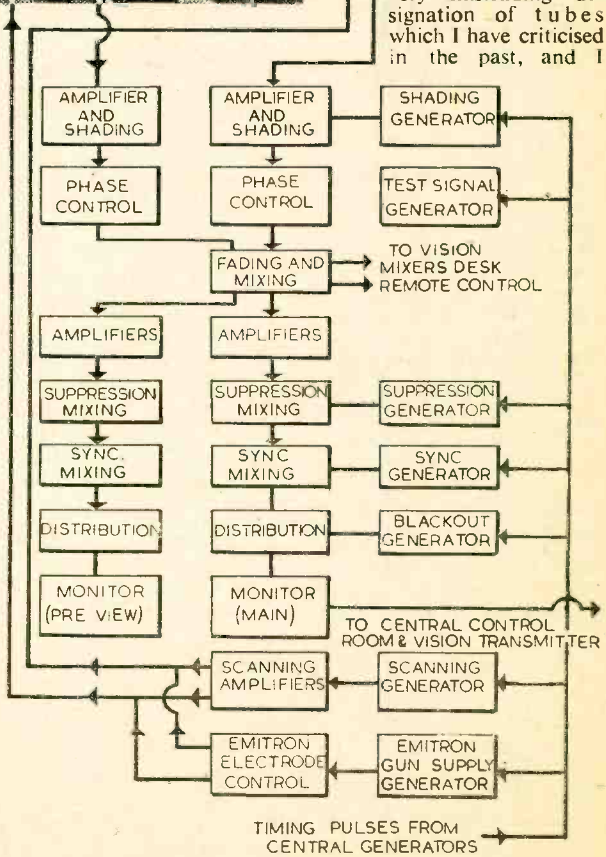
The Cathode-ray Tube

All television receivers, whether designed for direct or projected reception, make use of a cathode-ray

Cathode-ray Tube Diameter	Listed Picture Size	Picture Ratio
12in.	10⅝in. x 8in.	1.328
12in.	10in. x 8in.	1.250
12in.	10½in. x 7⅞in.	1.333
12in.	10⅝in. x 8in.	1.328
12in.	10in. x 8in.	1.250
12in.	11in. x 8¼in.	1.333
12in.	10.75in. x 8.6in.	1.250
12in.	10¾in. x 8in.	1.344
14in. rect.	11in. x 8¼in.	1.333
14in. rect.	11in. x 8 9/16in.	1.285
14in.	11⅛in. x 8¼in.	1.348
15in.	12½in. x 10in.	1.250
16in.	12¾in. x 10in.	1.275
16in.	13⅝in. x 10¼in.	1.329
17in. rect.	14½in. x 11in.	1.318
17in. rect.	14¼in. x 11⅜in.	1.296
17in. rect.	14⅜in. x 11in.	1.307



A typical television scene utilising two cameras. The producer is able to control the output from these two cameras in the studio control room, and the output from them is fed to the main transmitter through the network as shown by the block diagram below the picture.



tube, which was developed by Dr. V. K. Zworykin. The front of the tube has a fluorescent screen, on to which is focused the light spot which traces out the raster and the picture which appears upon it. The light spot varies in intensity according to the magnitude of the received signal, thus providing light and shade. This variation takes place, of course, whilst the surface is being scanned in a series of lines and frames. The cathode-ray tube, like a wireless valve, contains a filament, surrounded by a " Gun " ; as soon as voltage is applied to the filament it emits electrons also as in a wireless valve, and these electrons shoot off in a stream towards the end of the cathode-ray tube. Their direction for scanning is controlled either by electrostatic or magnetic means, in conjunction with the impulses received by the aerial.

The magnetic system of controlling the scanning beam is not much used to-day, the electrostatic system being that most generally employed. We shall explain the operation of the cathode-ray tube in greater detail later on, when we come to deal with the working of the television receiver as such. Briefly, however, it can be said that the position of the cathode-ray spot on the front of the tube is always in the same relative position as the picture element being scanned by the transmitting camera. The fluorescent screen has a slight afterglow (light persistence) effect, and this is just less in duration than the time taken to scan one frame and this gives a fair compromise between flicker and blur. Of course, by the incorporation of a spot wobbler to obscure the scanning lines, blur and flicker can be practically eliminated.

The size of a cathode-ray tube, such as 17in., refers to the diameter of a circle in which the rectangular raster is inscribed. Thus, when we refer to a 17in. tube, this does not mean that one side of the rectangle is 17in. That dimension refers to the diagonal of the rectangle. Whatever the size of the tube the aspect ratio of the rectangular picture area is always the same, namely, four to three. So that this point is impressed upon the mind of the reader, let us take the case of a 17in. tube. The overall dimensions are 15.375in. and 10.75in. respectively, the screen diagonal being 15.375in., which means that a 17in. tube has a diagonal of 15.375in., and taking an aspect ratio of four to three the actual size of the screen will be 14.33 by 10.75in. This is a very misleading designation of tubes which I have criticised in the past, and I suggest it would be better to classify tubes by the longer dimension of the rectangle ; in the case of a 17in. this would be 14in. The diagram (Fig. 5) and the table shown on page 398 will illustrate the point.

With a tube diameter of five units, and a square-cornered picture of true ratio (4 : 3), the dimensions

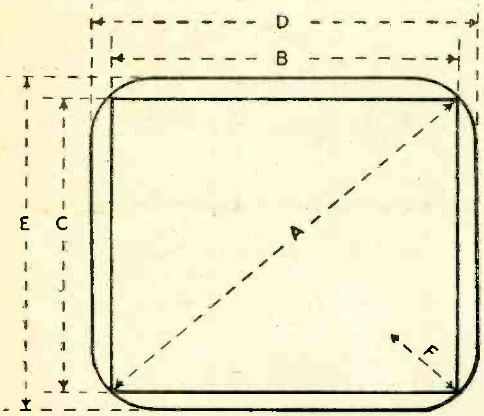


Fig. 5.—Showing how the diagonal measurement could mislead.

4 : 3 Picture with Square Corners				4 : 3 Picture with Rounded Corners			
Diagonal "A" in.	Width "B" in.	Height "C" in.	Throw in.	**Diagonal "A" in.**	**Width "D" in.**	**Height "E" in.**	**Radius of Rounded Corners "F" in.**
15	12	9	25½ ± ⅜	15	14	10½	2⅝
17½	14	10½	30 ± ½	17½	16	12	3
20	16	12	32½ ± ⅝	20	18	13½	3⅜
22½	18	13½	37½ ± ¾	22½	20	15	3¾
50	40	30	86	44	40	30	7½
60	48	36	104	52	48	36	9

are four units width, three units height and five units diagonal. If the practice followed by many American companies was adopted by taking the picture width as expressing the diameter of the tube, the picture shape would be as EFGH (see Fig. 6), as distinct from ABCD. The American system would give five units width, three and three-quarter units height, and a diagonal of six and a quarter units on a five unit diameter picture. This produces an increased picture area of over 30 per cent., with the same diameter tube, and only loses the corners of the picture, which seldom show any part of the programme being televised. For square-cornered pictures, therefore, the diagonal dimension A gives the true picture size, but if advantage is taken of the rounded corners the breadth of the picture on a projection receiver can be increased by 2in. and the height by 1½in. With direct viewing tubes, the fairest description would give picture width, height, area and tube diameter, and if a diagonal dimension is provided it should be stated whether this is actual or extrapolated.

Projection television receivers employ a very small cathode ray tube. It is only about 2½in. in diameter, and it is used in connection with an optical unit which enlarges and projects the received picture. With a direct vision cathode ray tube, as the size of the tube is increased the brilliance of the picture goes down, since it has not yet been found possible to amplify light as we can amplify sound. Thus, increased picture size can only be effected at the cost of picture brightness. There are advantages as well as disadvantages in both systems of viewing, but the most obvious advantage of a large picture is in the improved angle of view which it permits for people sitting on one side of the axis of view. It is an established fact that if a viewer is far enough away from a television picture to render the line structure invisible, the angle it subtends at his eye level is fixed, and independent of picture size. *(To be continued)*

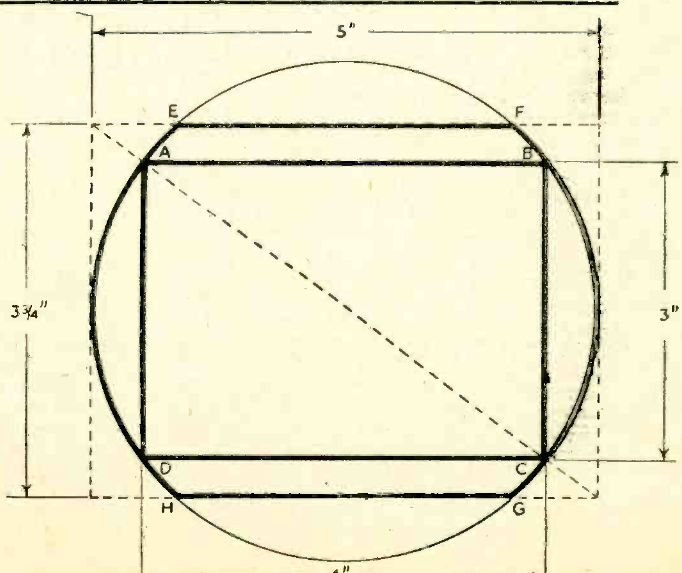
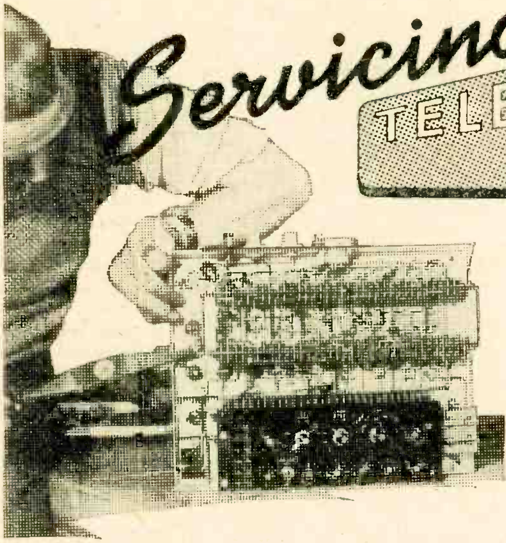


Fig. 6.—Tube proportions.

Servicing TELEVISION RECEIVERS



No. 17.—FERGUSON MODEL 991T

By L. Lawry-Johns

THIS is a 22-valve superheterodyne, five-channel receiver. It features flywheel line synchronisation, which enables a picture to be held in areas of low signal strength and of high interference level. The tube is a Mullard MW36-24 and has a grey filter face. The receiver is suitable for A.C./D.C. mains at 200-250 volts, and a separate fuse shunts the rectifier valves when the set is required to work on low-voltage D.C. mains. This is to avoid the voltage drop across the valves. This fuse must never be inserted when the receiver is being worked from A.C. mains.

It is normal for three minutes to elapse between switching the set on and receiving a picture. This is due to the construction of the PY81 efficiency diode which requires this time for the cathode to reach operating temperature. The circuit is conventional except for the flywheel sync circuit which will be described later.

Fig. 1 shows the top chassis layout and the position of the EY51 E.H.T. rectifier is shown by dotted lines to indicate that it is beneath the C.R.T. and inside a plastic box, the cover of which is spring clip secured.

The PL81 line output and PY81 valves are under the focus magnet inside a screening box. The front of this box is secured by a single PK screw. The position and function of each of the five ECL80 valves is worthy of close study and it should be noted that V13 and V14 are concerned with sound A.F. and output only. The output is push-pull and of high quality. V21 and V22 are the PY82 H.T. rectifiers, the anodes being strapped and the cathodes each taken to the unsmoothed H.T. line by a 40-ohm resistor. The receiver chassis is directly connected to one side of the mains and there are no H.T. negative components to consider.

It is not necessary to remove the chassis in order to clean the C.R.T. face or the viewing window. A strip of wood is removable from underneath the speaker fret, and when this and the fret are removed the viewing window may be gently eased down until it clears the guide slots. No trace of moisture must be left upon tube face, surround or viewing window, otherwise a pin-cushion effect will immediately be observed. Inability to fill the corners and sides, with the picture obstinately curling down or up, whichever the case may be, are the usual symptoms of dampness.

The picture shift lever is shown in Fig. 1. Rotation effects horizontal shift, whilst a side-to-side movement moves the picture vertically. A certain amount of horizontal shift is effected by the operation of the horizontal hold control and more will be said of this later, sufficient now to say that this procedure is incorrect and can result in loss of hold some time after the control has been altered.

Band III Conversion

A type B tuner unit is available and requires a certain amount of fitting internally. This is not difficult, however, and the instructions are quite clear. If, after fitting, a certain amount of patterning is experienced on Band I, move the connecting leads to see if this affects it. If not, try the effect of decoupling the converter H.T. line to chassis with various values of capacitor between .1 and .5 μF. It is quite possible that a .1 μF will completely clear the patterning if redisposition of the wiring does not do so.

When switching from Band I to Band III the picture should, of course, remain locked, but it is quite possible that although a locked picture is obtained on Band I, on Band III it is almost impossible to lock using the horizontal hold control. The correct procedure, as detailed later, should in this case be followed and satisfactory operation should then result.

Common Sound/Vision Stages

The R.F. amplifier, frequency changer and first I.F. amplifier are common to both sound and vision. The R.F. tuned circuits respond to the lower sideband of the vision carrier and an image rejector is incorporated in the aerial input circuit. This is factory tuned to 95 Mc/s, but may be adjusted to reduce interference from signals of other frequencies. The adjustment is by the core of L1 which is mounted on the top of the chassis at the extreme rear right-hand corner.

V1 is the R.F. amplifier valve, is an EF80, and the anode of this is coupled to the control grid of V2A which with V2B forms the double triode mixer/oscillator frequency changer ECC81. The oscillator tuning is determined by L5, C11 and C10. V2B cathode is connected to a tapping on L5. The oscillator voltages are coupled to V2A grid by C6 (2 pF) and the anode output of V2A is transformer coupled to the common I.F. amplifier V3 which is another EF80.

A tuned circuit L9 C13 is included in the grid

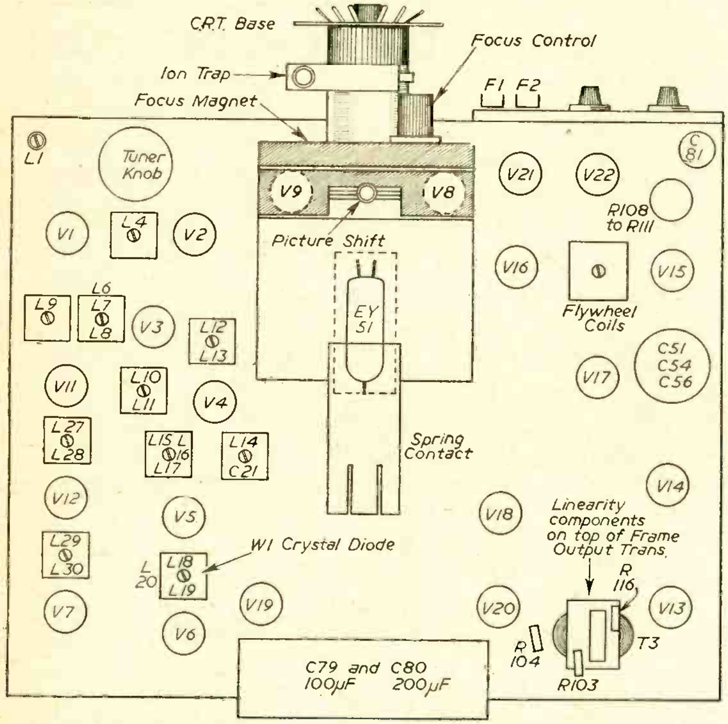


Fig. 1.—Plan view of chassis. Note position of EY51 and W1 crystal-diode

circuit of V3 and is aligned to 14.5 Mc/s to act as an adjacent channel rejector.

The sound and vision signals are split at the V3 anode circuit. L11 is tuned to 19.5 Mc/s which is the sound I.F.

The vision I.F. is coupled to the control grid of V4 by C17 (.001 μF). V4 is an EF80, the control grid circuit of which is tuned to 17.75 Mc/s by L13. Also coupled to L13 is a sound rejector L12, C18.

V5 is the final vision I.F. amplifier coupled to V4 by L15, L16 and L17. The anode circuit of V4 also contains another sound rejector L14, C21. V5 is transformer coupled to the vision detector W1 (crystal diode) by L18, L19 and L20. It should be noted that this crystal diode is contained *inside* the coil can and thus is completely out of sight. The rectifier output of the diode is coupled to the control grid of V6 video amplifier (PL83) by a choke/resistor/capacitor filter. The chokes are L21 and L22 and the vision interference limiter is connected to the junction of these two. The limiter is one section of an EB91 (V7A) the cathode of which has its potential controlled by the limiter variable resistor R37. If the potential applied to the cathode is too low the diode will conduct on peak white and the highlights of the picture will be lost.

V6 video amplifier is cathode biased by a metal rectifier (W2). The advantage of using this type of bias is that the varying currents do not so readily produce a voltage-drop of corresponding magnitude across it. Thus, undesired negative feedback and loss of gain is avoided. A resistor (unbypassed) would, of course, produce an amount of feedback due to the voltage drop across it being in accordance with the variation of current through it.

The anode circuit of V6 contains two resistors in parallel (both 6 K, presenting an effective resistance of 3 K) and two chokes in series. An inspection of Fig. 2 will show the method of coupling the video signal to the C.R.T. cathode. The A.C. signal is directly coupled via the .1μF capacitor, but the D.C. signal is attenuated by the resistors

(*Continued on page* 405)

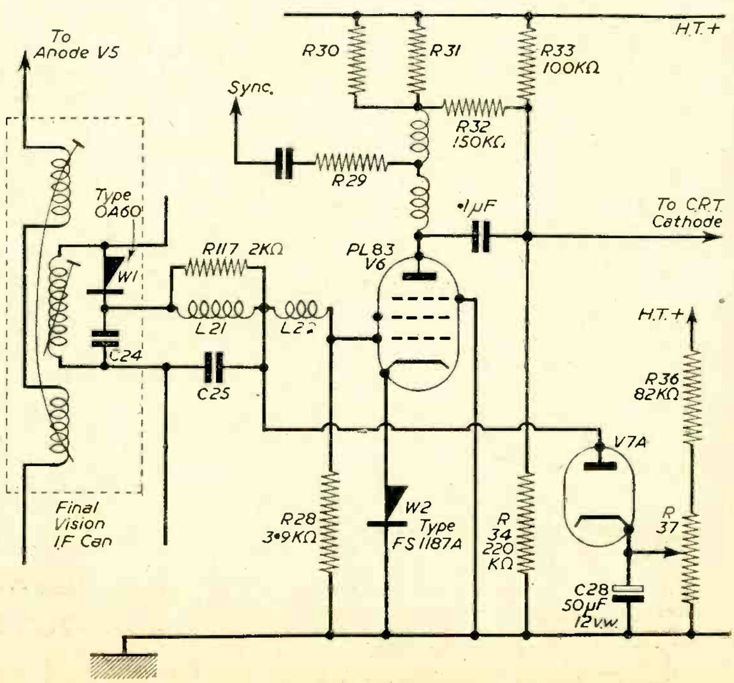


Fig. 2.—The video stage.

so as to effect a reduction of rapid fading such as that caused by aircraft.

The Sound Stages

V11 is the first sound I.F. amplifier and its grid circuit is tuned by L10. The anode circuit is transformer coupled to V12 (EBF80) by L27, L28. V12 is a double-diode-pentode. The pentode section functions as the final sound I.F. amplifier and the diodes are used for detection and A.V.C. purposes. Actually, the signal detector diode also provides the A.V.C. voltage—or A.G.C. to be more correct—and the second diode is positively biased to effect a delay action. Therefore, only signals in excess of a certain magnitude will provoke the A.G.C. circuit into operation.

The rectified signals are fed to the anode of V7B interference limiter via a filter choke and .1 μF capacitor. This diode is normally conductive, but upon the reception of a large pulse of extremely short duration the anode is driven negative with respect to the cathode, and the diode ceases to conduct. The effectiveness of the limiter is determined by the three-position plug which alters the capacity in the cathode circuit. The cathode circuit is coupled to the volume-control via a .01 μF capacitor and the control grid of V13A (triode of ECL80) is fed from the slider. The anode circuit of this triode is resistance/capacity coupled to the control grid of V13B (pentode output section ECL80). From the same point a pair of resistors in series connect to the anode of V14A (triode). From the centre point of these resistors a capacitor couples a percentage of the V13A output to the V14A control grid. Therefore, the output of V14A is in opposite phase to the output of V13A but is of the same magnitude. The two voltages are resistance-capacity-coupled to the output pentode sections V13B and V14B. A feedback circuit is incorporated and consists of capacitors C49 and C50, and tone-control is effected by C52 and R70 which are in series across the primary winding of the output transformer.

Sync Separation

This is carried out over three stages by both sections of V18 (ECL80) and V19 pentode section. The sync signal, and picture signal, at the anode of V6 is taken to the control grid of V19 pentode section via R29 and C26 (12 K and .1 μF), and these signals are positive-going. The negative pulses appearing at the anode of this section are applied to the line timebase circuit through a differentiating circuit which ensures that only line pulses are passed. The components concerned are capacitors C67 and C64 and resistor R82. The pulses at V19 pentode anode are also coupled to V18 triode section control grid, which is returned to the H.T. positive line. The method of biasing and the choice of component values ensure that the signal at the triode anode consists mainly of frame sync pulses. These are coupled to the pentode section control grid which is heavily biased. Therefore, only large pulses cause the section to conduct so that the remaining line pulses do not appear at the anode. The completely separated frame pulses are then fed to the frame timebase by C70 (500 pF). This rather long explanation of the sync separation is included so as to enable the reader to identify the purposes of the various ECL80 sections.

Frame Timebase

The oscillator is of the multivibrator type and consists of the triode sections of V19 and V20. The pentode section of V20 functions as the frame output and is coupled to the frame-scan coils by the T3 transformer. A frame pulse is also applied to the C.R.T. grid to effect frame flyback suppression. A rather complicated circuit is employed to effect frame linearity, and C77 (.05 μF) feeds the fixed and variable feedback arrangements. Two resistors, 27 K and 150 K, are in series with a .01 μF which connects to the control grid-leak (R102, 2.2 MΩ). Shunting these components to chassis is a fixed resistor (100 K) and a variable, which is the frame linearity control. The R116 (27 K) resistor may be found to be shorted out and this is optional to provide for variation in the characteristics of replacement T3 output transformers. The output valve is biased by a 620 ohm resistor bypassed by a 50 μF electrolytic (C74). The frame-scan coils are damped by two 1K resistors, R43 and R44.

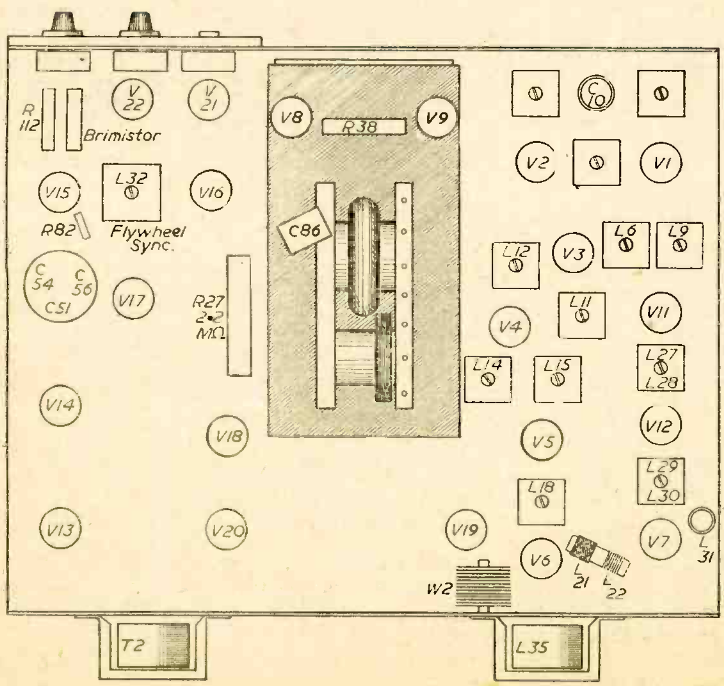


Fig. 3.—Simplified under-chassis view. Note W2 V6 bias metal rectifier, core of L32 and R82. The PL81 grid-leak is R27 2.2 MΩ. R112 may not be fitted.

It is not proposed to describe the flywheel circuit in detail as this would take up too much space and limit the amount of practical servicing information. The broad outline is as follows: V16 is the EF80 line oscillator, the resonant frequency of which is controlled by the "reactance" valve V15 EF80.

This is in effect a variable capacitor forming part of the V16 tuned circuit. This effective capacity is varied by the grid bias of V15 which is derived from the discriminator (EB91) V17 and line-hold control circuit. The line-hold control applies a negative bias to the control grid of V15, and this is obtained from the control grid to chassis circuit of V8 which is the PL81 line output valve. The remaining bias of V15 is obtained from the V17 double diode circuit and this may be positive or negative depending upon whether the time base tends to run too fast or too slow. No bias is applied from V17 when the circuit is perfectly aligned and the sync pulses are arriving properly.

The output of V16 is resistance capacity coupled to the control grid of V8 which is returned to chassis via R27 2.2 MΩ, R26 horizontal hold 100 K. variable and R25 68 K.

The anode H.T. of V8 is supplemented by the usual efficiency diode PY81 (V9) and an over-wind on the line output transformer supplies the EY51 EHT rectifier anode. The PY81 reservoir capacitor is a .25 μF (C29) and the first anode voltage of the C.R.T. is derived from this point via R41 and C30 (220 K. and .01 μF).

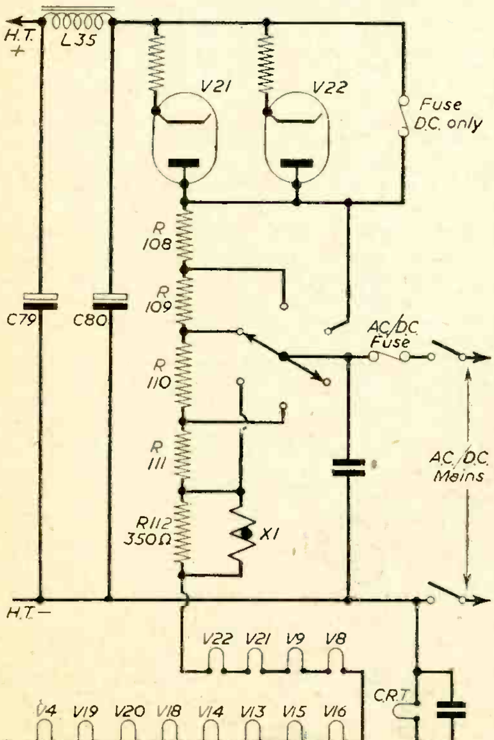


Fig. 4.—Showing power supplies and heater chain. R112 only fitted with Brimistor (X1) or Varite.

The line linearity control is a rotatable magnet which is situated just beneath the rear of the tube neck.

Power Supply

The two H.T. rectifiers are of the PY82 type as previously stated and the heaters of all valves and the C.R.T. are wired in a single series chain, the C.R.T. heater being "nearest" chassis.

Possible Faults and the Probable Causes

No results at all.—Check mains input and fuse. If the fuse has blown, replace with one of the same rating (not more than 1.5 amp) and if this too blows, check both PY82 valves for heater/cathode leakage and shorts.

If in order, check H.T. line for shorts. This should also be done if one or both of the PY82 valves are defective.

If the fuse has not blown, suspect heater chain, as one valve is probably defective with an open-circuited heater. If a resistance check proves valve chain has continuity, check Brimistor as this may be cracked or otherwise high resistance.

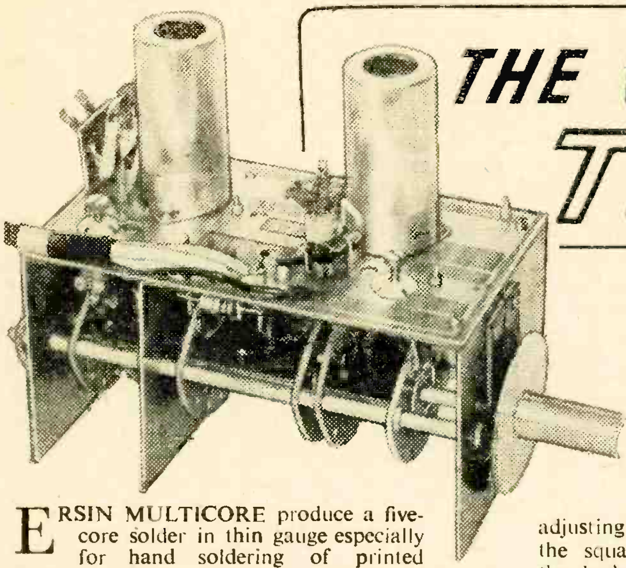
Sound but no picture.—Turn up brilliance. If no raster is available, check EHT by attempting to draw a spark from anode cap of C.R.T. If there is no sign of a spark, remove cap and test again. If a spark is available from the clip when it is off the C.R.T. but not when it is on, replace clip and turn brilliance fully down. If with no beam current still no spark is available, the indications are that the tube is defective. Check grid and cathode volts to ensure that the correct, or approximately correct, voltages are present. This is necessary, as with no bias on the tube a heavy beam current would result which could overload the EY51 EHT rectifier and result in its inability to supply EHT voltage when connected to the anode cap. If no EHT is present with the cap on or off, listen for the line time base whistle. If it can be heard, suspect EY51 valve and check its heater. This involves removing one of the heater leads from the transformer connection. If the whistle is absent, however, check V16, V8 and V9.

If the EHT voltage is present as indicated by a healthy spark at the C.R.T. anode, check V6 PL83 video amplifier (C.R.T. cathode volts high), *ion trap* (if not properly secured) and first anode voltage, pin 10, of C.R.T. Whilst checking these points, observe tube heater. If this is very poorly heated, the fault is probably due to a partial short circuit (internal) of the heater itself.

Check grid volts, pin two of tube base, and if no positive voltage can be recorded with the operation of the brilliance control, check brilliance series H.T. resistor and other grid circuit resistors. If no first anode voltage can be read, check R41 for open circuit or high resistance and C30 for leakage. The values of these components have already been given.

Raster but no picture, no sound.—Check aerial plug, plug connections and V1, 2 and 3, ensuring that the station tuner has not been interfered with. If the aerial circuit cable and plug connections are in order, and the valves are known to be good, check H.T. voltage on anode and screens and if these are not all present test decoupling resistors.

(To be continued)



THE V.M. TV Tuner

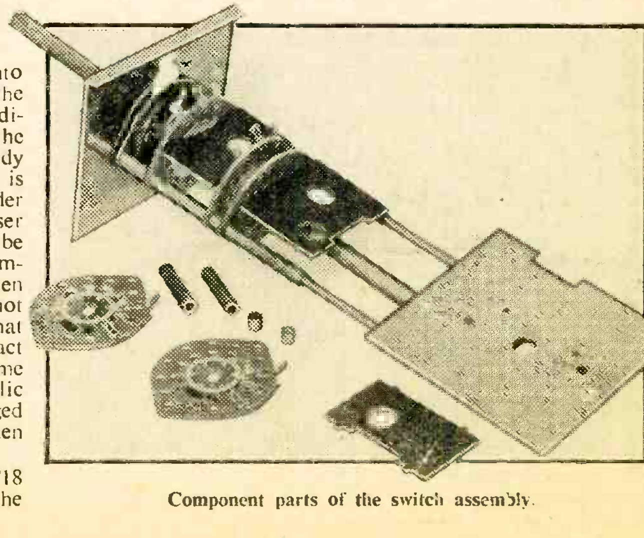
DETAILS OF A 3-STATION TUNER DESIGNED FOR THE VIEW MASTER, BUT WHICH MAY BE USED WITH OTHER RECEIVERS

(*Continued from page 363 January issue*)

ERSIN MULTICORE produce a five-core solder in thin gauge especially for hand soldering of printed circuits. A little practice on the edge of the printed panel will soon indicate the best methods of soldering and so far as soldering of resistors which are mounted directly on the surface of the printed panel is concerned there need be no difficulty at all. Some care, however, must be taken with the coaxial feed-through condensers. These are silvered on the outside of the ceramic tube and if an excessive temperature for an excessive time is applied then it is possible for the silver on the ceramic body to dissolve into the solder, the result being that the capacity of the condenser falls very appreciably. The recommended method of soldering the coaxial feed-through condensers into the printed plate is first to ensure that the hole through which the body of the condenser passes is a reasonably tight fit so that the condenser is held in position firmly with the tinned portion slightly above the copper foil. A small ring of the resin-cored solder should then be made and slipped directly over the body of the condenser so that it rests on the copper surface of the panel. If the soldering iron is then brought into contact with the solder ring and the copper surface, the solder will immediately melt and start to flow around the copper and will then wet on to the body of the condenser. This operation is very rapid and immediately the solder has flowed and wetted the condenser body, the soldering iron should be removed and the operation is complete. Care must, of course, be taken to ensure that solder splashes do not bridge adjacent conductors and that the soldering iron is not kept in contact with the copper for an excessive time since it is then possible for the phenolic base of the tuner plate to be damaged with the result that the copper may then lift.

The trimmer condensers C3 and C18 are mounted by first removing the adjusting screw from the ceramic body, putting the square section of the body into the hole, the body of the condenser being on the underside of the printed panel, then from the top of the panel the screw on which is also mounted the spring nut is screwed into the body. It is only necessary for the screw to enter the ceramic body a short way, after which the spring nut is itself screwed down until it comes into contact with the printed panel ; it is then moved round a little farther so as to hold the screw under tension and thereby prevent it shifting under the effects of vibration. The valve holders used are a special printed circuit type and are normally included with the kit of components which includes the printed panels.

The screens for the valves are mounted directly on to the printed panel, the screen bases being screwed on with the aid of 6 B.A. bolts in the positions indicated, whilst the top part of the screen containing a spring to hold the valve in position locks



Component parts of the switch assembly.

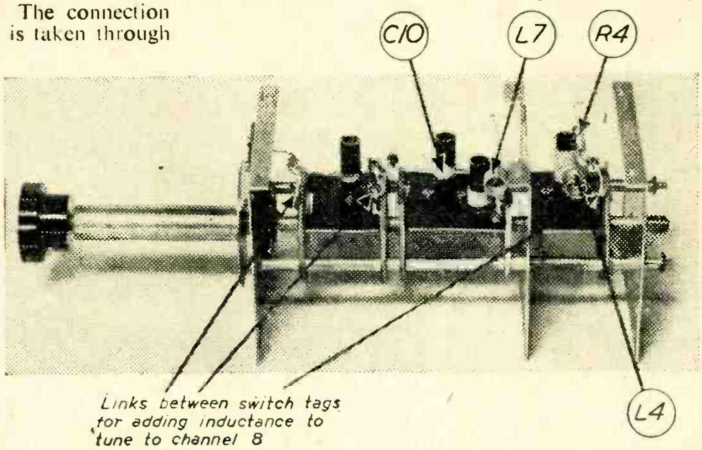
on to the base and need not, of course, be fitted until the valves are in position.

The input and output transformers are mounted on the top of the panel by means of small stand-off spacers. The photographs clearly indicate this method of mounting, but particular care is required with coil L12, as the fixing screws also function as terminations for the transformer. The connection between the anode of V2 and L12 is taken through the panel by one of the screws and the connection between H.T. and the other end of L12 is carried through the panel by the other screw. The damping resistor R14 is also mounted directly across these points. In the photograph will also be seen a small terminal disc mounted at the top of the input and output transformers. These terminal discs are easily made and consist of circles or washers of bakelite board or other insulating material with tags or even wire loops mounted at the periphery. The diameter of the hole in the washer is approximately ¼in. and it should be a tight fit around the moulded coil former. After fitting on to the coil former it should be glued in position.

The connection between L9 and the junction of C9 and C11 will be seen to be a strip of foil. This should be about ⅛in. wide and may be of any suitable metal that can readily be soldered. Copper foil has been found to be easy to work with, but on no account should this strip of metal be too thick or stiff as it might then damage the printed condenser C9 deposited on the panel. A similar copper strip is also used to connect the earthy end of L9 to the panel. The use of copper strip for these connections has been found to be advisable in order to keep the total inductance of the input circuit to V2 low, since otherwise due to the input capacity of this valve the circuit might resonate at too low a frequency. Two last details remain before completing the assembly of the printed plate, these being the small coils L14 and L5. L14 consists of 10 turns on No.28 gauge enamel wire close wound on a 3/16in. diameter former and soldered into position in such a way that it is self-supporting. L5 consists of eight turns of No. 28 gauge enamel wire wound on a 1/8in. former and again soldered into position across the valveholder tags so as to be self-supporting.

One end of the oscillator coil is soldered on to the printed anode tag of V2, the other end of the coil remaining free as it later has to be connected to the SW4 switch wafer. At this stage it is necessary to take any springiness out of the oscillator coil since otherwise it can be the cause of severe microphony. L10 consists of three turns of No. 18 s.w.g. tinned copper wire tightly wound on to a ¼in. diameter former then removed and the turns slightly separated. This method of making the oscillator coil imparts an appreciable degree of springiness to it. Fortunately, the removal of the springy effect is easily carried out and this may be done by heating the coil in a flame.

A lighted match is usually sufficient though occasionally the operation may have to be repeated. These operations complete the assembly of the printed panel and the constructor is now advised carefully to recheck all connections, making certain that there are no errors in either wiring or the quality of the soldering.



View of the switch unit with some components identified.

The Switch Unit

With the printed circuit panel now complete the assembly of the switch unit may be undertaken.

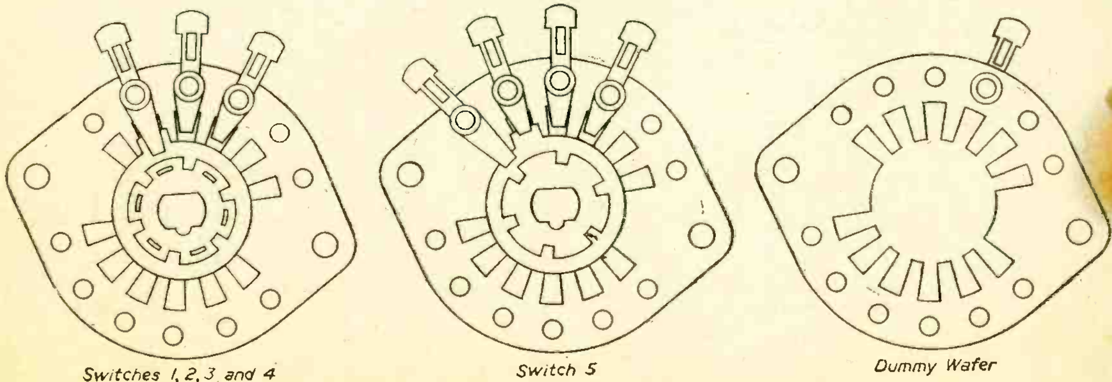


Fig. 3.—Details of the six switch wafers.