MAKE A DOUBLE-TRIODE CONVERTER

Practical Television

1/6

AND TELEVISION TIMES

NOVEMBER 1960

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TELEVISION SERVICING GUIDE

BENTLEY ACOUSTIC CORPORATION LTD.

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IS4	9/-	6F33	7/6		15/11	35L6GT	9/6	DH77	7/-	EF54	5/-	KT61	12/6	PY81	8/6	UCF80	16/7	*and diodes*	
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2A7	10/6	6J5GTG	5/6	12A6	5/-	35Z5GT	9/-	DK32	12/-	EF86	10/6	KT88	22/6	QP21	7/-	UCL82	11/6	OA73	4/-
2P	26/6	6J5GTM	6/-	12AC6	15/3	42	23/3	DK40	21/3	EF89	9/-	KTW61	6/6	QP25	14/6	UCL83	19/3	OA79	4/-
2X2	4/6	6J6	5/6	12AD6	17/3	43	10/-	DK91	6/6	EF91	4/6	KTW62	7/6	QS150/15		UF41	9/-	OA81	4/-
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3A5	10/6	6J7GT	10/6	12AH7	8/-	50CD6G		DK96	8/6	EF97	13/3	KTZ41	8/-	R12	9/-	UF80	10/6	OA91	5/-
3B7	12/6	6K7G	5/-	12AH8	12/6		36/6	DL33	9/6	EF98	13/3	KTZ63	7/6	R18	14/-	UF85	9/-	OA95	5/-
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3Q5GT	9/6	6K8G	6/6	12AU6	23/3	72	4/6	DL82	46/5	EL32	5/-	MHL4	7/6	S130	15/-	UL41	9/-	OC16	54/-
3S4	7/-	6K25	19/11	12AU7	6/6	75	24/7	DL92	7/-	EL33	12/6	MHLD6	12/6	SD6	12/-	UL44	26/6	OC19	54/-
3V4	7/6	6LI	23/3	12AV6	12/8	77	8/-	DL94	7/6	EL34	15/-	ML4	8/6	SP4(7)	14/6	UL46	14/6	OC26	44/-
5R4GY	17/6	6L6G	8/-	12AX7	7/6	78	6/6	DL96	8/6	EL38	26/6	MS4B	23/3	SP41	3/6	UL84	8/6	OC28	60/-
5U4G	6/6	6L6M	9/6	12BA6	8/-	80	9/-	DM70	7/6	EL41	9/-	MU12/14	8/-	SP42	12/6	UM4	17/3	OC35	48/-
5V4G	10/-	6L7GT	7/6	12BE6	9/-	83	15/-	EA50	2/-	EL42	10/6	N37	19/11	SP61	3/6	UM80	15/3	OC44	26/-
5Y3GT	6/6	6L18	13/-	12BH7	21/3	85A2	15/-	EABC80	9/-	EL81	12/6	N78	19/11	SU25	26/6	URIC	9/-	OC45	23/-
5Z3	12/6	6L19	23/3	12E1	30/-	150B2	15/-	EAC91	4/6	EL83	19/11	N108	19/11	SU61	9/-	UU6	19/11	OC65	22/6
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6AC7	4/-	6Q7GT	11/-	12SA7	8/6	956	3/-	EBC41	8/6	EM71	23/3	PCC85	9/6	TP25	15/-	UY85	7/-	OC76	15/-
6AG5	5/6	6R7G	10/-	12SC7	8/6	1821	16/7	EBC81	8/-	EM80	9/-	PCC88	18/-	TP2620	33/2	VMS4B	15/-	OC77	21/-
6AK5	8/-	6SA7GT	8/6	12SG7	7/-	5763	12/6	EBF80	9/-	EM81	9/-	PCC89	11/6	TY86F	13/3	VP4(7)	12/6	OC78	17/-
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6AM6	4/6	6SG7GT	8/-	12SJ7	8/6	9002	5/6	EBF89	9/6	EN31	37/-	PCF82	10/6	U16	10/-	VP2B	14/6	OC81	18/-
6AQ5	7/6	6SH7GT	8/-	12SK7	6/-	AC/PEN		EBL21	23/3	EY51	9/-	PCF86	15/-	U18/20	8/6	VP4B	23/3	OC170	35/-
6AT6	7/-	6SJ7GT	8/-	12SQ7	11/6	5-pin	23/3	EBL31	23/3	EY83	16/7	PCL82	10/-	U22	8/-	VP13C	7/-	OC200	54/-
6AU6	10/-	6SK7GT	6/-	12SR7	8/6	7-pin	15/-	EC52	5/6	EY84	14/-	PCL83	11/6	U24	29/10	VP23	6/6	OC203	58/-
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6B8GT	5/-	6SQ7GT	9/-	18	23/3	AC6PEN	7/6	EC92	13/3	EZ40	7/-	PENA4	12/6	U31	9/6	VR150	7/6	TJ3	50/-
6BA6	7/6	6SS7GT	8/-	19AQ5	10/6	AC/TP	33/2	ECC32	5/6	EZ41	7/-	PENB4	26/6	U33	26/6	VR150	7/6	TP1	40/-
6BE6	6/-	6U4GT	12/6	19BG6G		ATP4	5/-	ECC33	8/6	EZ80	7/-	PEN4DD		U35	26/6	VT61A	5/-	TP2	40/-
6BG6G	23/3	6U5G	7/6		23/3	AZI	18/7	ECC34	24/7	EZ81	7/-		26/6	U37	26/6	VT501	5/-	TS1	10/-
6BH6	8/-	6U7G	8/6	19H1	10/-	AZ31	10/-	ECC35	8/6	FC2A	24/7	PEN25	4/6	U43	9/-	W61M	26/6	TS2	12/6
6BJ6	6/-	6V6G	7/-	20D1	15/3	AZ41	13/11	ECC40	23/3	FC13	26/6	PEN40DD		U45	9/-	W76	5/6	TS3	15/-
6BQ7A	15/-	6V6GTG	8/-	20F2	26/6	B36	15/-	ECC81	6/-	FC13C	26/6		25/-	U50	6/6	W81M	6/-	TS4	24/-
6BR7	15/-	6X4	5/-	20L1	26/6	BL63	7/6	ECC82	6/6	FW4/500		PEN44	26/6	U52	6/6	W107	18/7		
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6BX6	7/-	7B6	21/3	20P5	23/3	CBL31	23/3	ECC88	18/-	GZ30	9/-	PEN46	7/6	U107	16/7	X61(C)	12/6	OC28	25/-
6C4	5/-	7B7	8/6	25A6G	10/6	CCH35	23/3	ECC91	5/6	GZ32	10/-	PEN383	23/3	U191	16/7	X61M	26/6	*each.*	
6C5G	6/6	7C5	8/-	25L6GT	10/-	CK506	6/6	ECF80	10/6	GZ34	14/-	PEN453DD		U201	16/7	X63	9/-	*Limited num-*	
6C6	6/6	7C6	8/-	25U4GT	16/7	CL33	19/3	ECF82	10/6	H63	12/6		33/2	U251	14/-	X65	12/6	*ber only.*	
6C9	13/6	7D6	10/6	25Y5	10/-	CV63	10/6	ECH3	26/6	HABC80		PEN/DD		U281	19/11	X66	12/6	*New surplus*	
6C10	9/-	7D8	23/3	25Y5G	10/-	CY1	18/7	ECH21	23/3		13/6	4020	33/2	U282	22/7	X76M	14/-	*transistors*	
6CD6G	36/6	7H7	8/-	25Z4G	9/6	CY31	16/7	ECH35	6/6	HL2	7/6	PL33	19/3	U301	23/3	X78	21/3	HF & LF	5/-

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32 x 32 mfd., 450 v.	5/9
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100 mfd., 275 v.	3/-	Wire-ended tubular		16 mfd., 450 v.	2/9
				32 mfd., 450 v.	3/9

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ECF80	12/-	PY82	7/-	6Q7G	7/6
ECF82	10/6	PZ30	19/11	6V6G	6/-
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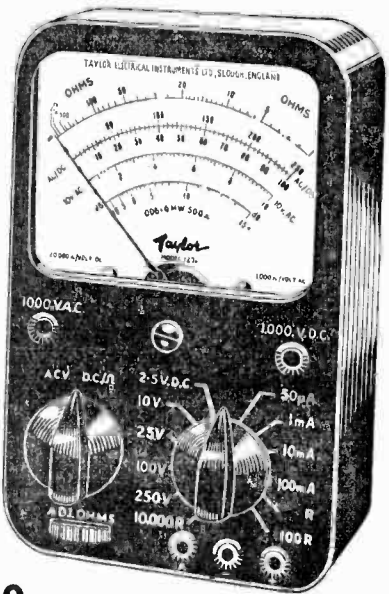

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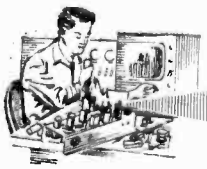
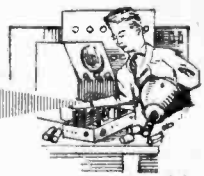


Practical Television



& TELEVISION TIMES

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CONTENTS

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television". Such articles should be written on one side of the paper only, and should contain the name and address of the sender. whilst the Editor does not hold himself responsible for the manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to: The Editor, "Practical Television" George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

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

Our Servicing Guide

WITH this issue, we present a free 24-page pull-out supplement entitled "The Practical Television Servicing Guide" which has been specially prepared by our technical staff. This valuable booklet first deals with the general aspects of television circuitry—how all receivers consist essentially of five independent, but associated units; the tuner, the sound receiver, the vision receiver, the scanner, or timebase sections, and the power supply.

The second section of the booklet deals with 'faults of adjustment' including misadjustment of the ion trap magnet, horizontal hold, vertical hold, contrast and brightness controls.

"Faults in the circuitry" are then analysed and all amateur constructors who service their own receivers will find here an indispensable source of information. The fault symptoms examined include many which appear as various components in the receiver alter with age—the reduction of emission in valves, and especially the cathode-ray tube, is explained thoroughly.

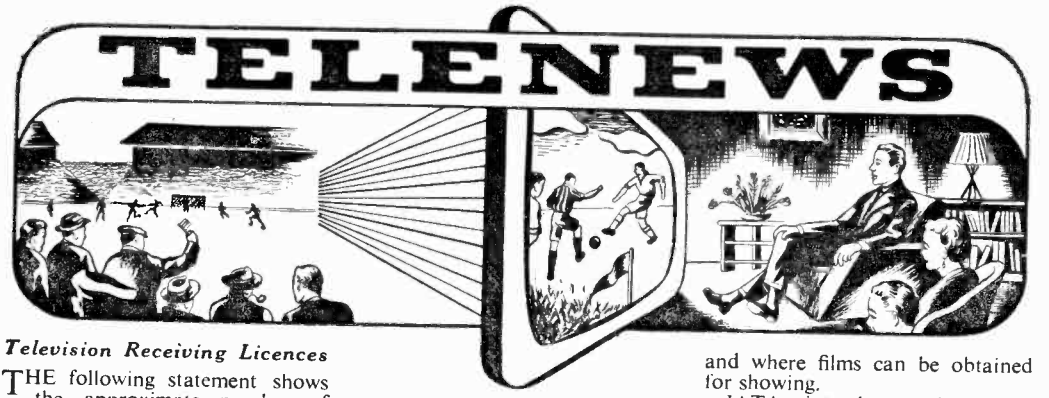
The final part of the supplement describes the use of instruments in television servicing, and care is taken to point out, that while it is commonly imagined that the servicing of television receivers demands a very comprehensive range of expensive equipment, much can be carried out with simple tools. It is true that to diagnose some unusual faults rather specialised instruments are needed, but the information given on the use of the multi-range meter, the neon screwdriver and a pair of headphones will facilitate fault finding.

The booklet is well illustrated with both drawings and photographs of TV components and actual screen pictures. All readers, no matter what their technical skill, will find this Servicing Guide a useful work of reference when carrying out their repairs.

A FILM SHOW

ANOTHER film show has been arranged in collaboration with Mullard Ltd. It will be held at Caxton Hall, Westminster, and readers are invited to send for their free tickets which are now available from these offices. The films will be shown on Friday, January 13th, 1961, and the programme will begin at 7.30 p.m. When applying for tickets, enclose a stamped addressed envelope (at least 3½ in. x 6 in.). Mark your envelope "Caxton Hall" in the top left-hand corner.

Our next issue, dated December, will be published on November 22nd.



Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of August, 1960, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London Postal	1,870,177
Home Counties	1,469,535
Midland	1,636,002
North Eastern	1,749,650
North Western	1,433,932
South Western	905,528
Wales and Border Counties	648,648
Total England and Wales	9,713,472
Scotland	953,447
Northern Ireland	150,129
Grand Total	10,817,048

TV Cameras in U.S.A.

THREE new British television cameras — including an advanced colour system—were shown for the first time in the United States at the National Association of Broadcasters' Exhibition.

Designed and manufactured by E.M.I. Electronics Ltd., these cameras are already proving their worth in the United Kingdom and many overseas countries. The colour camera uses three vidicon tubes and a new optical system — several times more efficient than relay lens systems—which has been designed so that the maximum amount of light falls on the photo-conductive surfaces of the vidicons. This gives an improved colour quality, even under difficult lighting conditions. Negotiations have already begun for the sale of at least ten of these cameras valued at over £200,000 in the U.S.

Air Transport Films

A NEW directory of 223 films on air transport is now being circulated to film distribution agencies and television broadcasters throughout the world on behalf of the international airline industry.

Published by the International Air Transport Association, the revised and expanded second edition of the IATA Directory of Air Transport Films lists full information about 205 films dealing with the travel and tourist attractions of more than 50 countries on all the continents; as well as 18 others which treat specific aspects of airline flying, including cargo transport. Geographical and subject indices are also provided.

Most of the films listed are available in 16mm., colour, and with sound tracks in one or more of 12 languages.

The Directory also indicates how and where films can be obtained for showing.

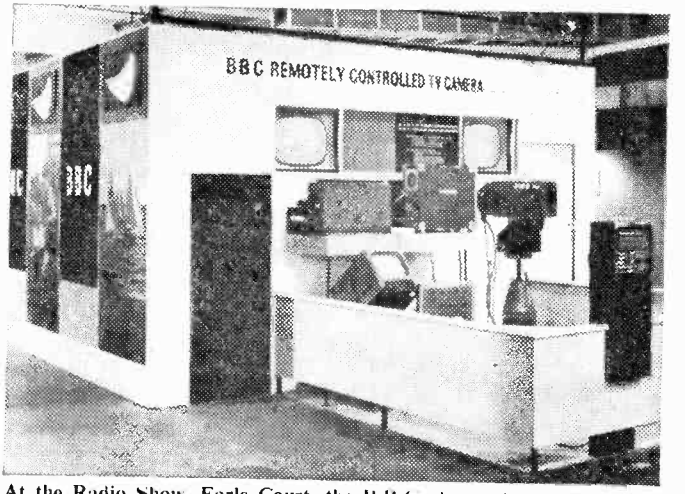
IATA intends to keep the Directory up to date by issuing supplements or revisions as the need arises.

Copies are available to film, TV and other directly interested agencies on application to the Public Relations Office, International Air Transport Association, 1060 University Street, Montreal, Canada, or to the public relations departments of IATA's 89 member airlines.

Ultra Anniversary Lectures

THE first Ultra Anniversary Lecture was held in the Recital Room, Royal Festival Hall on Wednesday, 14th September.

The speaker was Professor Arthur Porter, M.Sc., Ph.D.,



At the Radio Show, Earls Court, the B.B.C. demonstrated their new remotely controlled TV zoom camera fitted with optics and control gear supplied by Taylor, Taylor & Hobson. In the foreground can be seen a remote control panel on which are five push-buttons for the selection of particular camera shots. When the push-button is pressed the camera will automatically adjust tilt, pan, focus, zoom and iris settings.

Dean of Engineering at the University of Saskatchewan and his subject was the Evolution of Instrumentation.

The chairman, Dr. F. S. Stoneman, Chief Engineer and Director of Ultra Electronics Ltd., introduced Dr. W. Cawood, C.B., C.B.E., F.R.Ae.S., Chief Scientist to the War Office, who in turn introduced both the series of Ultra Anniversary Lectures and Dr. Porter.

The audience included many representatives of the electronics industry, service and civil service departments, and the Hon. T. C. Douglas, Premier of Saskatchewan, was among the guests.

New Zealand TV

THE New Zealand Broadcasting Service has placed an order with Marconi's through Amalgamated Wireless (Australasia) Ltd. for the supply of three vision and three sound transmitters, together with studio equipment, for new TV stations at Christchurch, Wellington and Dunedin.

The value of the order is over £100,000 and delivery is expected to be completed by October this year.

The vision transmitters, all 5kW, consist of two Type BD 352 and one Type BD 372. The associated sound transmitters will consist of two type BD 309B (each 1kW FM) and one type BD 324 (1kW FM). The stations will operate in Band I to CCIR-type standards.

Colour TV to Alleviate Animals' Suffering

NEARLY four hundred veterinary surgeons, from all over the United Kingdom, saw 7ft by 5ft television pictures in colour, of curative operations on sick animals, during the British Veterinary Association's Congress, held at the University of Glasgow Veterinary Hospital, from August 28th to September 3rd.

The operations, which were televised by E.M.I. Electronics Ltd. colour TV mobile unit, included the return of a cow's displaced abomasum, or fourth stomach, to the normal side of the body, and the pinning of a dog's fractured femur with Rush pins.

Animals are sent to the Hospital from all parts of Britain when it is necessary to perform major operations. The use of E.M.I. colour television to give veterinarians a close-up view of the leading surgeon's techniques will, it is hoped, enable animals' suffering to be promptly relieved on the spot, and obviate the long journey to Glasgow in all but the most serious cases.

Nigerian Play Contest

WHEN WNTV's contest to discover Nigerian television playwrights ended on August 23rd, more than 100 scripts had been submitted.

First prize in the unique contest is £250 with a television set going to the writer of the "greatest potential future". Rules of the contest called for plays dealing with contemporary African themes written by Nigerians.

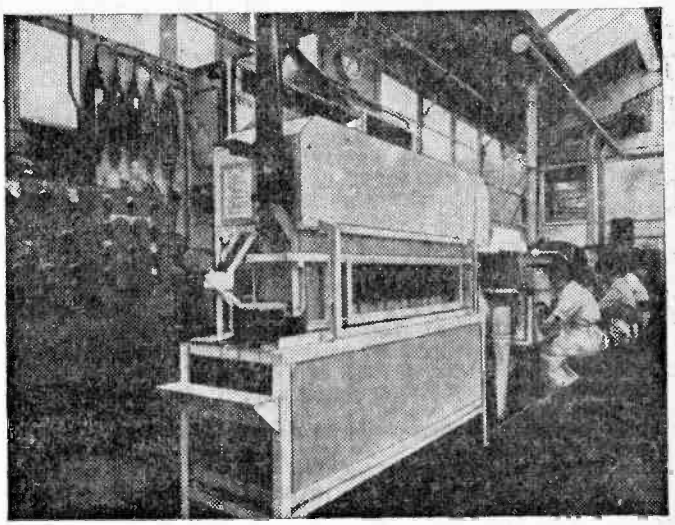
Of the 100 scripts, which came from as far as England and the Cameroons, Douglas Grant, the station's public relations manager, estimated that 25 are "definitely produceable". Announcement of the winners will be made shortly.

As was to be expected, many entries were from students whose command of English was not yet perfect. Entrants were supplied with a guide to the requirements of television playwriting but in many cases the play form was loose, inadequate for the time (45 minutes), not suitable for production, or borrowed from better known writers.

Popular themes were based on Biblical stories, well known legends and in three instances on the Damon and Pythias myth.

Grant pointed out that the contest "has established definitely that there are many Nigerians who can write very well about the life they know and live. The fact that we have received 25 plays that we consider produceable is adequate proof that there are many writers here who can express themselves through this new medium."

WNTV, Africa's first television network, went on the air in October, 1959. It recently produced its first live TV drama, "My Father's Burden", by Wole Soyinka. The station is owned in partnership by the Western Nigerian Government and Overseas Rediffusion Ltd.



The automatic etching plant on the TV silicon rectifier production line at the Rectifier Division of Standard Telephones and Cables Limited at Harlow, Essex. The tiny silicon dice, which look like small tea leaves, are soldered to silver wires and mounted on polythene carriers which are fed into this etching unit.

Ekco in Italy

THE latest move by E. K. Cole Ltd. in the field of international trade is the formation of a new Ekco subsidiary company in Milan under the title Ekcovision Italiana s.P.a. This new company has been established to control and expand the already substantial market for Ekcovision in Italy and it gives the Ekco organisation a strong foothold in the European Common Market.

Semi-conductor Diodes as Variable Capacitors

AUTOMATIC FREQUENCY CONTROL AND WOBBULATORS

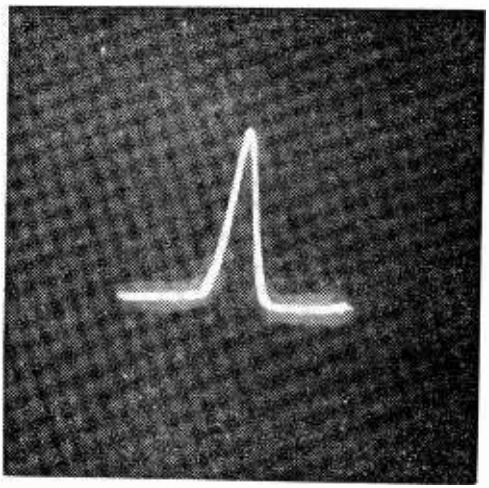
By R. B. Archer

AT the higher frequencies, such as are used in Band III television and VHF on Band II, oscillator stability with temperature change is not always easily obtained. The use of a reactance valve for automatic tuning correction is an old-established and efficient means of reducing the drift of frequency with change of temperature, but it has considerable limitations and these are felt more acutely as the frequency rises.

Automatic Frequency Control

During recent experiments which the writer conducted, the idea of using a germanium diode for the purpose of automatic frequency control was explored. The results were so encouraging that he ventures to put some of them in the way of the amateur, who may find it simple enough to adapt them to his own needs.

Those familiar with semi-conductor devices will be aware that conduction is by way of a very limited number of positive and negative "carriers" which exist in the semi-conductor material near the "p—n" junction. This state of affairs occurs irrespective of whether point-contact or "junction" types are concerned. Normal "forward" bias causes current to flow, but when a D.C. bias is applied in the reverse direction very little or no current flows. Instead a "depletion layer" is formed, where the "carriers" are urged by the voltage applied away from the junction. The thickness of this layer, in which very few carriers exist, either positive or negative, is of course extremely small, and it also varies in thickness with the voltage applied.



I.F. response of an F.M. receiver at the limiter grid.

This insulating layer is capable of acting as the dielectric of a capacitor. Clearly the capacitance will depend on the voltage applied across it. It is only of the order of 1pF or so, but this is quite sufficient to alter the tuning of a high-frequency circuit containing little inherent capacitance of its own.

The first circuit to be described is that of an F.M. receiver, because this circuit necessarily has a phase-sensitive detector which can provide the necessary control voltage. If a ratio detector is used, it must be kept in mind that the stabilising capacitor is not the source of voltage required. The audio take-off point is the correct source of voltage as the "D.C. voltage" at this point is a function of the degree of mistuning, while the stabilising capacitor voltage is a function of signal strength.

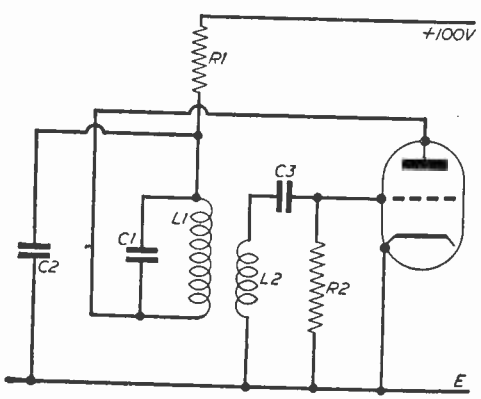


Fig. 1.—Typical H.F. oscillator circuit.

Oscillator Circuit

The oscillator circuit used by the writer in his experiments is shown in Fig. 1. The valve is half an ECC81, R1 about 5·6k for decoupling, and C2 about 2,000pF. C3 is 25pF and R2 the grid leak, 15k. C1 represents all the capacitance in the anode circuit, and includes valve capacitance. This particular circuit was chosen instead of the more usual Colpitts because it avoids using the grid-cathode capacitance—which is quite sensitive to valve temperature changes—as part of the tuning capacitance, and hence tends to have a rather better inherent temperature stability. In practice there is probably little to choose, and the diode can be used very successfully with the Colpitts circuit.

The circuit used is shown in Fig. 2. (The oscillator components are as in Fig. 1). The diode, an OA70, was chosen because it was handy, and works well, but it is possible that a high-back-resistance type, such as the OA81, would give even better results. A "surplus" diode, bought

for a shilling originally also put up a very respectable performance.

Precaution during Experiments

The only special precautions to be taken in carrying out experiments are as follows: first, the connection of the diode, via a 25pF coupling capacitor, adds to the total capacitance of the circuit. This should be corrected for by diminishing any trimming capacitance already in the circuit —the inductance of the anode circuit should not be altered, or two results may occur: the tracking of a F.M. receiver may be impaired or—with a Band III television oscillator—the performance of the oscillator may be altered. In order to obtain the best control the oscillator capacitance should always be as little as possible, for then the small changes in capacitance of the diode that occur when the control voltage is applied have a larger percentage effect. Care must therefore be taken to keep circuit capacitances to the minimum.

Secondly, the control voltage must be in the correct sense. With the capacitance-diode an increased bias in the "reverse" direction increases the thickness of the depletion layer. Hence an extra positive voltage at the "red" end of the diode, or a negative voltage applied at the other end, causes an increase in oscillator frequency. In Fig. 2 therefore to effect frequency correction a drift of frequency "downwards" (the usual case) must cause the D.C. voltage at the audio take-off point to go negative. This should be checked before completing the circuit, and if the voltage is in the wrong sense the ratio detector diode connections to the transformer secondary must be reversed. If this point is not checked and the conditions happen to be wrong it will be impossible to tune in the station correctly.

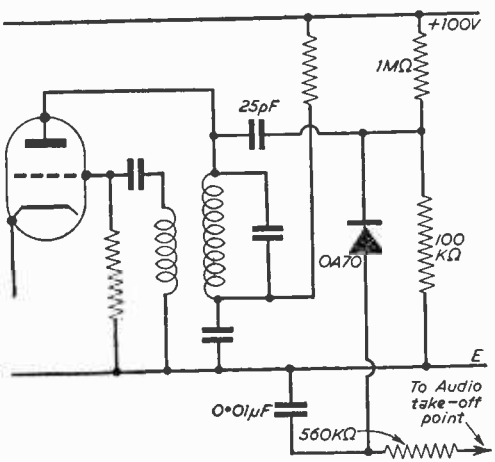
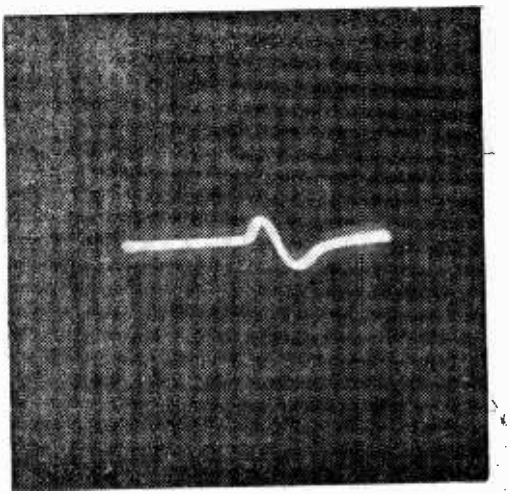


Fig. 2.—The AFC circuit (used with a balanced ratio detector).

The components as given proved the right ones for the particular OA70 used. However, it may be worth while replacing the 100k fixed resistor in the biasing chain by a 250k variable, and connect the diode to the slider, adjusting for best results.



Discriminator response of an F.M. receiver.

Frequency Change

As given in Fig. 2, 1V caused a frequency change of just over 100kc/s, when used with a F.M. receiver of oscillator frequency around 100-105Mc/s. This should be ample for most receivers, and even where complete correction is not obtained a worthwhile improvement in frequency stability should be obtained for the expenditure of a few shillings only.

Care has to be taken not to exceed the rated reverse voltage as specified by the manufacturer, or a most curious effect may be encountered whereby on increasing the positive (reverse) bias a point is reached where the capacitance of the diode begins to increase again instead of decreasing further. The writer is investigating this phenomenon and can offer no explanation for it at the moment.

When a Band III television receiver is to be modified, a source of control voltage has to be found. Good results have been obtained with the detector circuit given in Fig. 4. It will be seen that a Foster-Seeley phase discriminator is used to provide not only the control voltage but also the audio output—by using one diode as an A.M. detector. The same precaution must be taken as with the ratio detector.

Transformer Windings

A transformer, used with an I.F. of 38·15Mc/s, consisted of windings as follows:

Primary—7½ turns No. 24s.w.g. enam.
Secondary—Bi-filar winding, 4+4 turns, No. 24s.w.g. enam., C.T.
Spacing—9mm. between ends.
Former—Aladdin 0·3in. dia. approx.
Slug—Purple-coded dust core.
R.F.C.—60 turns No. 36s.w.g. enam. on 1M. resistor used as former only (approx. ⅛in. diameter).

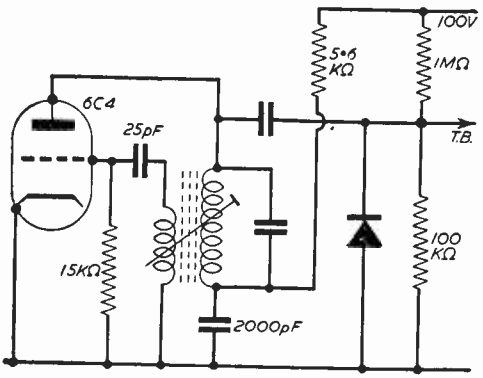


Fig. 3.—Wobbulator circuit.

Another use of the diode as a variable capacitance is that of the variable reactance element in a "wobbulator". The writer has used the circuit in Fig. 3 as a simple and useful device for displaying the response curve of I.F. amplifiers, in conjunction with an oscilloscope.

It will be seen that basically the circuit is very similar to that of Fig. 2. The differences are in the connection of the diode and the supply of a sawtooth voltage from the timebase generator to the biased diode.

The same tuned-anode circuit is employed for the oscillator, but in this case, to obtain sufficient sweep, the oscillator frequency is about 18Mc/s, harmonics being used as the signal to be supplied to the receiver. When the fundamental is frequency-modulated by ±1Mc/s the second harmonic is frequency-modulated to the extent of ±2Mc/s, enough to check the response curve of any British television receiver at the intermediate frequency 34-38Mc/s.

The anode coil consists of 28 turns No. 32s.w.g. enamelled wire, spaced by about half the wire diameter by inter-winding with No. 38s.w.g. enamelled which is later removed. The grid coil consists of 12 turns of 38s.w.g. wire, interlaced at the "cold" end of the anode coil. The former is the usual Aladdin, diameter nearly 0·3in., and an iron dust core is used to trim to the required frequency with no extra circuit capacitance apart from strays and valve capacitances.

Timebase Frequency

The timebase voltage required is about 25V peak-to-peak, and if greater than this should be applied via a potentiometer to reduce it to the required amount. If an OA81 diode is used a much greater timebase voltage can be used, and the 100k resistor in Fig. 3 should be replaced by a 680k resistor. A timebase frequency as low as possible should be used—say 15 sweeps per second. The illustrations were taken using this instrument with an F.M. receiver which happened to be available for experiment. The first shows the I.F. response at the limiter grid, and its rather peaky shape is due to the fact that it is necessarily on a voltage scale rather than a decibel scale; a logarithmic Y-amplifier was not available.

The second illustration shows the characteristic at the phase discriminator—the audio take-off front. The reader with a keen eye will note that some adjustment of the discriminator was called for!

In both cases the timebase voltage supplied was 20V peak-to-peak. The total range of frequency displayed is a band of 2·8Mc/s along the X-axis. The fundamental frequency of the oscillator was 21·25Mc/s, and the fourth harmonic was used, the F.M receiver being tuned to a central frequency of 86Mc/s for the purpose of the experiment.

The above circuits may help experimenters to devise applications of the diode, used as a capacitance, for purposes of their own. Besides A.F.C., electronic tuning over a reasonably wide frequency range becomes a possibility, and the fact that only D.C. connections are needed may enable tuning control placing to be much simplified. The possibilities for fine tuning of Band III receivers are considerable.

Increase in the Capacitance of the Diode

It should be noted that measurements appear to indicate that the capacitance of the diode is inversely proportional to the square root of the voltage applied. Two considerations emerge from this. The first is that for maximum capacitance change with a given change of voltage, the reverse bias should be kept as low as possible. The second is that since the resonant frequency is inversely proportional to the square root of the capacitance, the relationship between voltage change across the diode and the frequency change resulting follows a complex law; it is not linear, but over small ranges of frequency the linearity is quite sufficient for experimental purposes.

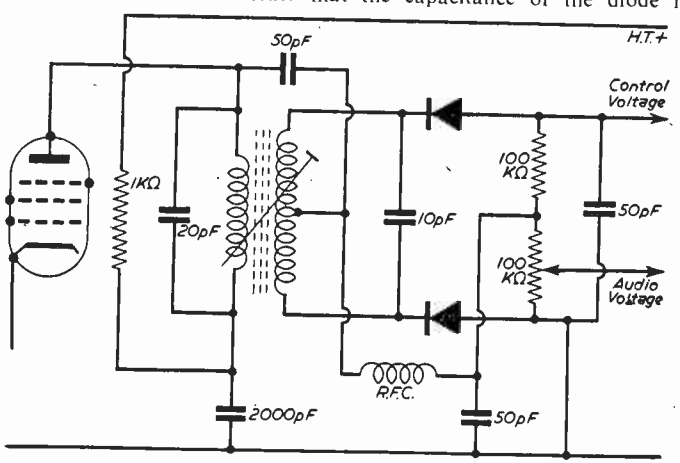
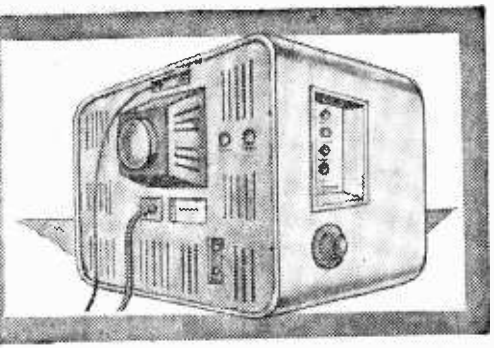


Fig. 4.—Phase discriminator and audio detector.

Servicing Television Receivers



No. 61—COSSOR 948

(Continued from page 17 of October issue)

By L. Lawry-Johns

HAVING discussed some of the more common faults in this receiver including the obvious breakdowns caused by cracks in the printed wiring, we now deal with faults in the timebase sections and controls.

Line Circuits

The symptoms of no picture no raster, but sound normal, should direct attention to panel D. Remove the large screening cover, listen for the whistle, and note whether the EY86 heater is glowing. If the whistle is present but the heater is out, advance a screwdriver (or neon tester) to the insulated top cap of the EY86. If the neon glows brightly or there is a blue glow when the screwdriver touches the insulation, the EY86 may be assumed at fault and should be replaced. If there is no obvious line whistle, check the PL36 and 17Z3 (PY81). If these are in order check the screen dropper resistor R79 to pin 8 of the PL36 and the cathode resistor R80. Check voltages. Capacitor C65 sometimes shorts and this should be checked. The line output transformer is of the plug-in type.

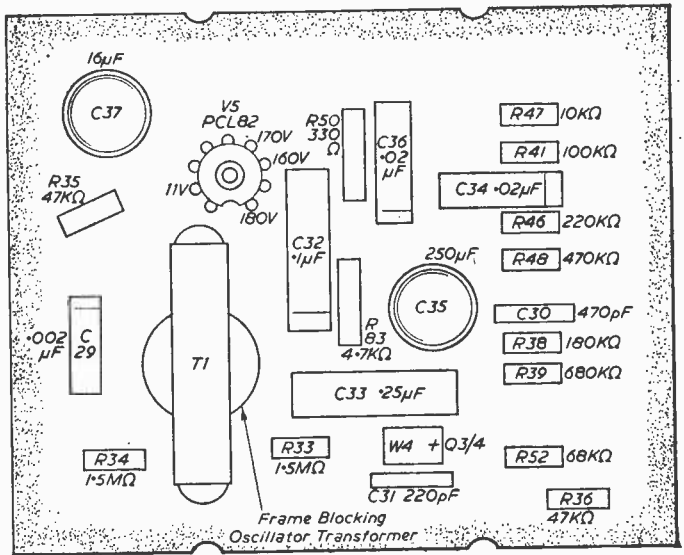


Fig 4.—Frame timebase panel B

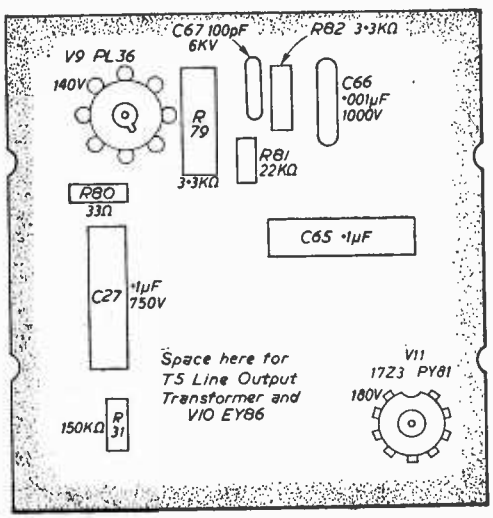


Fig. 5 (left).—Line output and EHT panel D.

Lack of Width

Check PL36, etc., as above.

Frame Collapse

A bright horizontal white line across the centre of the screen denotes a fault in the V5 (PCL82) stage. Check the valve first, then the voltages as indicated.

No voltage at pin 6, although the supply to T2 is present, indicates an open circuit in the winding and T2 should be replaced. Resistance readings should be 300Ω through whole winding, 20Ω to the tap (feed to L13 scan coils).

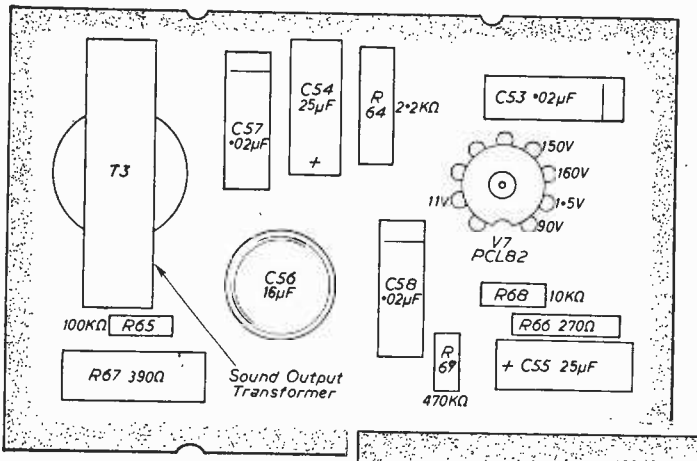


Fig. 6 (above).—Sound output panel A.

If this is in order, check at pin 9 to establish the continuity of T1—blue and red leads. Resistance readings: Primary 450Ω, secondary 750Ω. If all voltages are in order check the height control R40 (500k), which may have an o.c. track.

Distorted Frame Scan

When the picture is elongated at the top or bottom, or has a compressed band across it, sometimes accompanied by difficulty in locking the picture vertically, suspect V5 and replace. Then check R41, C34, C35, linearity control, R42 (1M), R46, C36.

No Picture—Raster in Order

When this symptom appears and the sound is unaffected, check V2 (6BX6), V3 (8A8), the voltages to these bases, W3 (inside L6 can) and L7.

Overheating of R20, R21 should direct attention to R19 (27k), which sometimes falls in value.

W2 is an overload diode which normally conducts only on very strong signals. If in doubt, disconnect it and note the effect. Check for breaks in the printed tracks.

No Sound—Vision in Order

Check V6 and V7, valve base voltages, detector diode W5, and for breaks in the printed circuit. Check also W6 diode.

Intermittent Sound

Check V7 and capacitors C50, C53 and C58. Inspect the panels F and A for hair cracks. Pulling gently on the panels should reveal the presence of such a crack or fracture.

Tube Faults

Where a short in the tube is overloading the EY86 and cannot be cleared by applying a pulse voltage between pins 2 and 11, try the effect of connecting a 150Ω (approximate) resistor across pins 1 and 12 to reduce heater wattage. The

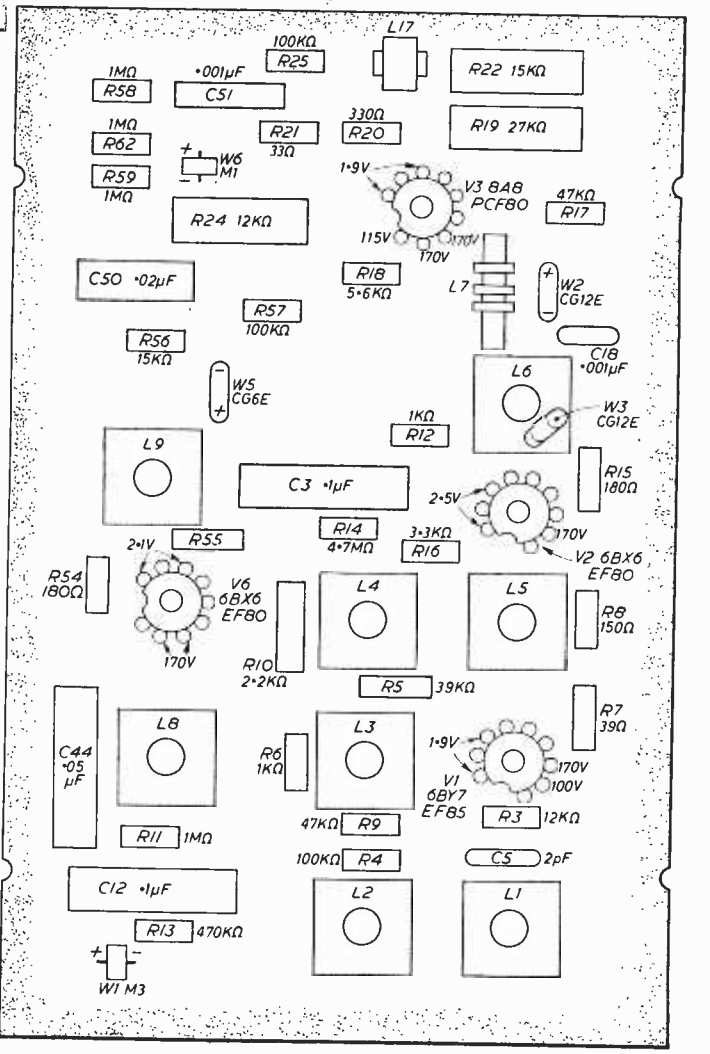


Fig. 7 (right).—The I.F. panel F.

loss in emission is scarcely noticeable and the small drop in operating temperature may prevent the short occurring.

Controls

To remove one of the controls on the top panel, unsolder the leads, remove the clip and remove the whole assembly.

To fit a new control, place the moulding on the panel in the correct position, ensuring that the locating studs (4) engage in the holes. Insert the spindle and turn the knob clockwise as seen from below. Then fit the rotor assembly over the spindle with the wiper arm at the clockwise end of the track. Press on the clip. This can be carried out by pressing firmly on both ends of the clip with the thumbs, the fingers pressing on the knob at the same time.

Control Values

R27—Limiter—250k.
R32—Contrast—1M.
R37—Focus—2M.
R40—Height—500k.
R42—Vert. Lin.—1M.
R44—Vert. Hold—100k.
R51—Brilliance—250k.
R63—Volume—500k.
R60—Sound Limiter—100k. R74—Hor. Hold—250k.

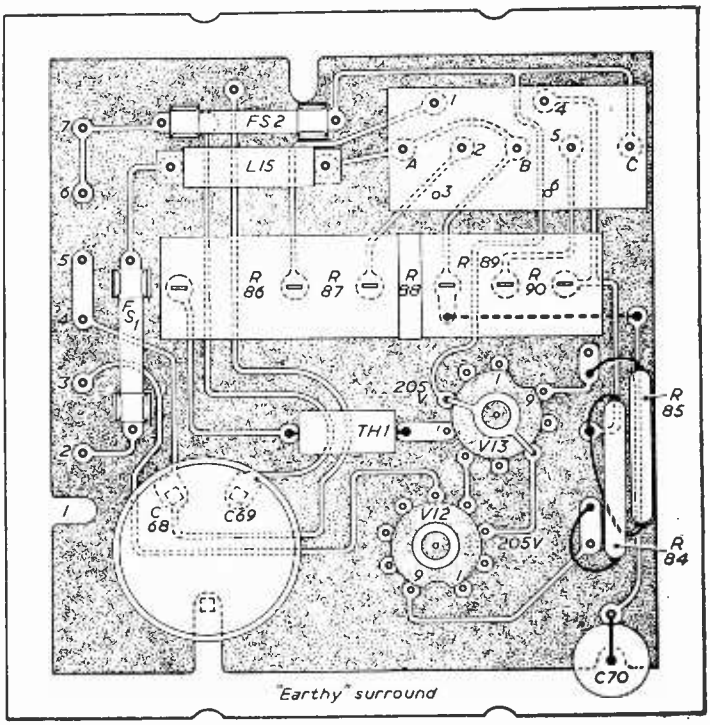


Fig. 8.—Power unit panel E.

V12 and V13 .....19Y3

C68.....200μF
C69 .....100μF
C70.....0·1μF 300V.AC

R84.....50Ω
R85.....50Ω
R86.....88Ω
R87.....55Ω
R88.....55Ω
R89.....24Ω
R90.....24Ω
FS1.....1 Amp.
FS2.....750mA.
TH1.....VA1026 Thermistr

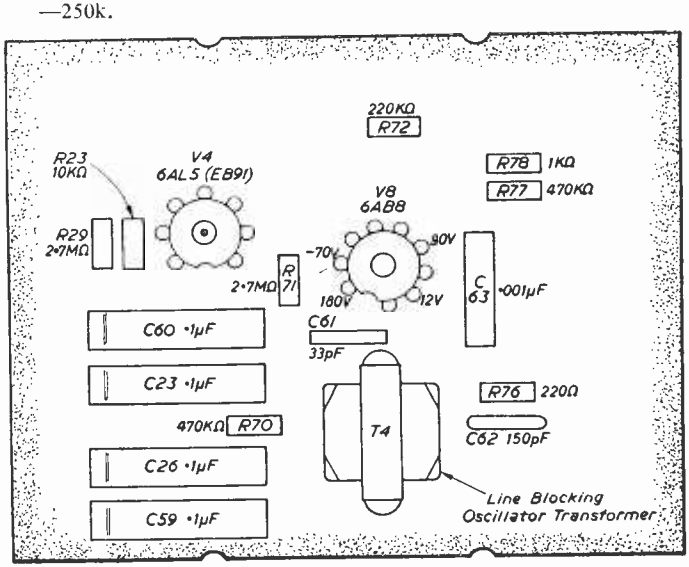


Fig. 9.—Line timebase panel C.

The volume and brilliancy controls are combined with the on-off switch.

New TV Circuitry

LIGHT-OPERATED AND REMOTE CONTROLS

By G. J. King

IT would appear that future design in television is aimed towards automatic control devices that can replace the majority of the "user" control knobs on receivers. It seems that sets in two or three years' time will feature the very minimum of main controls, possibly just an on/off switch and channel selector knob, and these may well not be on the set at all but on a remote control unit which can be operated from any part of the room without being actually connected to the set itself.

Already, this aim to reduce the number of "user" controls is being revealed on the Continent, and in this country this year the trend is very much in the same general direction. There will always be pre-set controls, of course, but these will be out of sight at the rear of the set and will only require adjustment when the set is first installed and after a service operation.

Light-Operated Contrast Control

One of the most useful innovations is the "automatic contrast control". Actually, this is really an incorrect term, since it is already used to describe receivers in which the contrast is regulated automatically in accordance with the signal input (e.g., vision AGC).

The best term would be "light-operated contrast control", and this is available on several of this year's models. It avoids the bother of adjusting the brightness and contrast controls of a receiver to suit changes in the ambient light level within the room. As is well known, if these two controls are adjusted to achieve optimum results under one condition of room lighting, resetting is really necessary when the lighting conditions change.

Light-Sensitive Resistor

The light operated contrast control operates from a light-sensitive resistor (a form of photo-electric cell) the resistance of which is governed to some degree by the amount of light falling on it. The cell is of the cadmium sulphide type and is installed on the front of the receiver cabinet beneath a transparent protection so as to respond to the light level falling on the set. Over a change from a very well illuminated room to a darkened room the cell may change in value by as much as 750k. It is thus highly sensitive to light.

The resistance of the cell decreases as the amount of light falling on it increases, and with this in mind it is possible to realise how the cell operates the contrast in the circuit of Fig. 1. Here V1 is the sync separator valve which is connected to provide vision AGC in the conventional manner. The negative voltage developed across R1 and R2 in series in the control grid circuit is tapped at the junction of R1 and R2 and used as a control bias for the vision I.F. valves. M1 is the usual rectifier for preventing the AGC line from becoming positive in the event of no vision signal.

Contrast Control

The contrast control, R4, is connected in series with the light-sensitive resistor across the receiver's H.T. Thus, since R3 is connected to the slider of the control and to the control grid of V1, the amount of negative voltage at the junction of R1 and R2 can be progressively decreased by operating R4 so that the slider traverses from the "earthy" end to the light-sensitive resistor end. The effect, of course, is that the increasing positive potential applied from the contrast control to the grid circuit progressively neutralises the negative potential produced by the sync separator action of the valve. This is the normal contrast control action. In addition, an automatic control of contrast is provided by the signal itself, for as this decreases, such as during a signal fade, the negative bias from the sync separator also decreases, and this results in an increase in gain of the controlled valves.

Automatic Adjustment

An extra effect, however, is provided by the light-sensitive resistor. If, for example, the contrast control is adjusted in a fairly well illuminated room to provide optimum results, as the illumination of the room falls, so the resistance of the light-sensitive resistor will increase. The effect of this will be to make the vision AGC line become more negative, as there is less positive voltage from the contrast control at the control grid of V1, and as a consequence the picture contrast will fall; which is what is required since the room lighting is less.

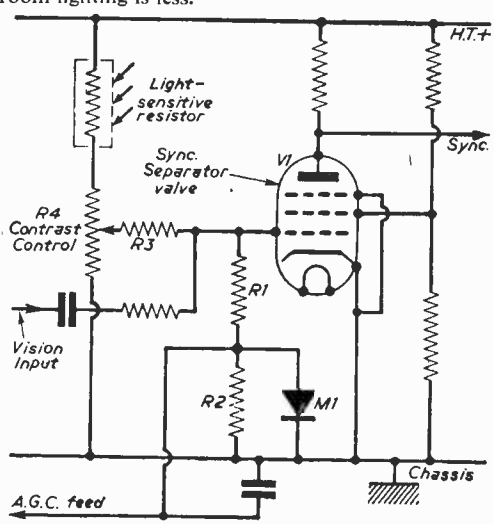


Fig. 1.—Circuit of conventional vision AGC and manual contrast control, to which has been added light-operated contrast control by the action of the light-sensitive resistor in the contrast control circuit.

The converse will also apply, of course, if the set is initially adjusted in a darkened room and then the room lighting is suddenly switched on. The light-sensitive resistor will suddenly decrease in resistance and the vision AGC line will become considerably less negative, thereby resulting in a corresponding increase in picture contrast.

Alternative Arrangement

An alternative arrangement, which serves to vary the video drive to the picture tube over approximately 6dB according to the room lighting, is shown in Fig. 2. Here the light-sensitive resistor is connected

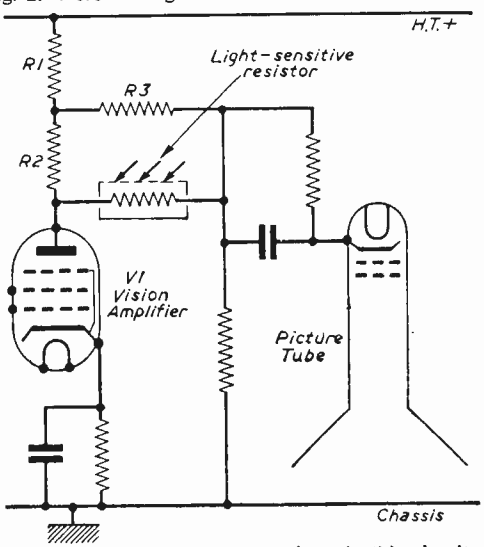


Fig. 2.—The light-sensitive resistor in this circuit is connected in the video amplifier stage and serves to vary the drive to the picture tube in accordance with the level of light falling on the set.

between the video amplifier and the picture tube cathode in a resistive circuit. Under conditions of high ambient lighting, the light cell has a relatively low resistance and so the drive to the tube cathode is virtually from the anode of V1. When the lighting in the room decreases the cell resistance increases and so the majority of the video drive to the tube cathode is from the junction of R1 and R2 in the V1 anode circuit. This, of course, represents a smaller drive than in the former case, but this is what is required as the room lighting is less.

The values of the resistors are chosen so as to provide a maximum/minimum variation of video drive to the tube of about 6dB (two times), but at intermediate light levels the drive will be made up partly from the anode via the light cell and partly from the junction of R1 and R2. In effect, the light cell can be considered as a variable resistor, which is operated by light, and which serves to vary the gain of the video amplifier stage.

Remote Control

Another development of interest is a remote control unit which is now being used by a number of manufacturers and which allows channel changing and control of volume from the comfort of an arm chair. The remote control unit is a small box containing one or more press buttons, and differs from past remote control units in that there is no wire connection between the box and the set..

Operation is not by radio control as may be suspected, but by a supersonic signal with a frequency just above the audible range generated in the control box by the depression of a button. This signal is detected by a specially tuned microphone fitted in the receiver.

There are two methods currently adopted for generating this supersonic signal in the control box. One is by means of a battery-operated transistorised oscillator circuit, and the other uses a tuned reed or rod which is struck by a spring-loaded hammer when the remote control button is pressed. The former method features three remote control buttons providing control of volume and channel changing, while the latter method uses just one button which changes channel and switches the set on or off.

Transistorised Method

There are three supersonic channels of operation corresponding to the three push-buttons. The channel selector button switches the transistorised oscillator on to a frequency of approximately 40kc/s, while the other two buttons, which provide increase and decrease of volume, produce signals approximately 3kc/s either side of 40kc/s. The selected signal is fed to a miniature loudspeaker at the rear of the control unit, this being tuned to the range of frequencies used.

A small microphone at the receiver itself, which is also responsive to the operating frequencies, picks up the signals generated by the control unit and directs them to the appropriate channel, as shown in Fig. 3. For example, the 40kc/s signal produced when the channel selector button is depressed, finds its way only through the tuned 40kc/s channel in the receiver.

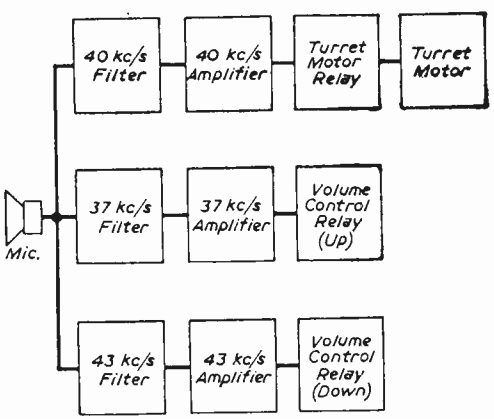


Fig. 3.—A block diagram showing the separate control channels at the receiver end of a remote control system.

It is finally amplified to a level suitable for operating the motor relay. This in turn causes the tuner turret to rotate by means of the electric motor to the next pre-set stop, which can be either a television or V.H.F.-F.M. radio channel.

Similarly, if either of the volume buttons is depressed the corresponding signal is carried through the filter and amplifier and eventually operates the volume control relay. This is coupled to the volume control in such a way that it "kicks" the volume

control spindle round in small steps either to increase or decrease volume, depending upon which button is depressed.

Mechanical Method

With the other method, the control unit frequency produced by the spring-loaded striker is in the region of 45kc/s, and only a single button and control channel are used. A microphone, filter, amplifier and motor relay are used at the receiver, as in the former case, and depression of the control unit button operates the turret motor between pre-set stops, as required, but only on television channels. An extra long stop is used at one position of the motor drive for switching the set off. This stop, at the appropriate position of turret rotation, hits a lever and operates the on/off switch.

On both methods of remote control switching, the fine tuning control is obviated since separate pre-set tuning is arranged on each channel, and tuning is only usually required when the set is first installed and possible later owing to ageing of the tuner valves and components.

NEW ITA STATIONS

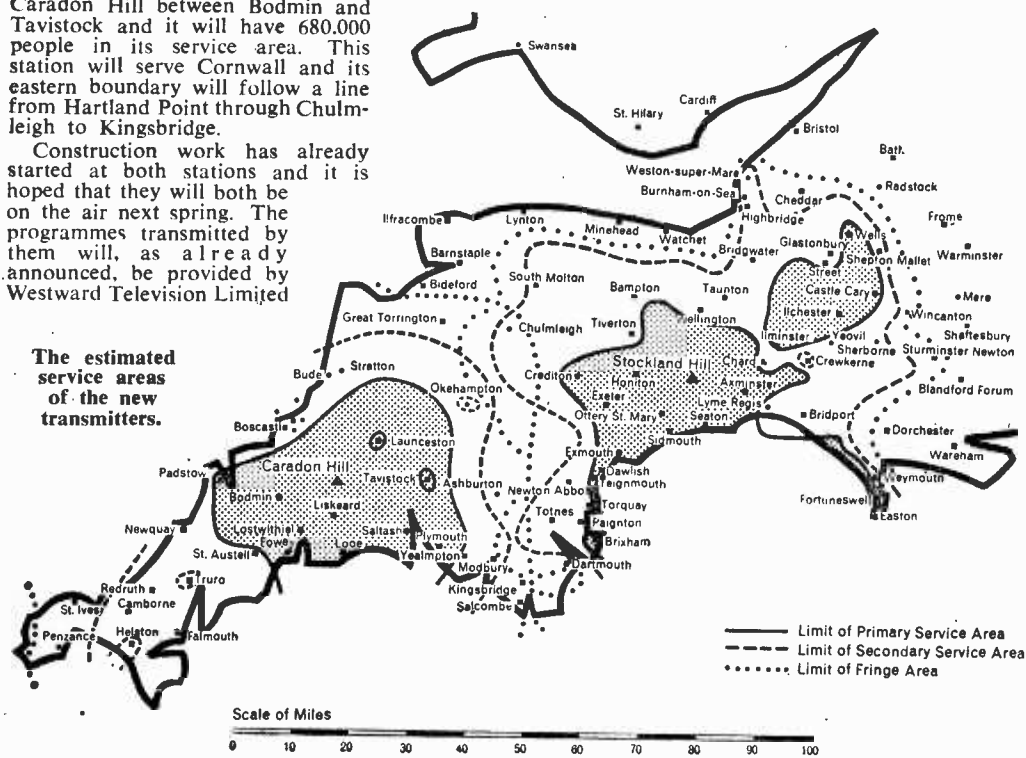
THE map below, issued by the ITA, shows the estimated service areas of the two transmitters which will serve 1½ million people in the south-west of England. The Devon station will be at Stockland Hill between Honiton and Axminster and it will have 861,000 people in its service area. The boundary of this area will extend in the east from Weymouth through Shepton Mallet to Weston-Super-Mare and in the west it will cover South Molton, Chulmleigh and Dartmouth.

The Cornwall station will be at Caradon Hill between Bodmin and Tavistock and it will have 680,000 people in its service area. This station will serve Cornwall and its eastern boundary will follow a line from Hartland Point through Chulmleigh to Kingsbridge.

Construction work has already started at both stations and it is hoped that they will both be on the air next spring. The programmes transmitted by them will, as already announced, be provided by Westward Television Limited with headquarters and studios in Plymouth.

	Stockland Hill	Caradon Hill
Site Height	750ft above sea level	1215ft above sea level
Mean Aerial Height	1460ft above sea level	1925ft above sea level
Channel	9—Vertical Polarisation	12—Vertical Polarisation
Effective Radiated Power	Maximum: 100kW N.W. & S.W.	Maximum: 200kW S.W.
	Minimum: 10kW N.E.	Minimum: 10kW E. & N.W.
Frequencies	Vision 194.74325Mc/s	Vision 209.74325Mc/s
	Sound 191.23Mc/s	Sound 206.23Mc/s

Stockland Hill will operate on Channel 9 and Caradon Hill on Channel 12, both vertically polarised. This will be the first time Channel 12 has been used in this country for television transmissions.



The estimated service areas of the new transmitters.

The Practical Television OLYMPIC

LIST OF COMPONENTS AND COIL WINDING DETAILS

By D. R. Bowman

(Continued from page 51 of the October issue)

Constructional Details

THE best plan is to start with the two I.F. amplifiers, and then proceed to video, sync separator and timebase generators, finishing up with the audio output stages. In this way good progress can be made, and when completed and adjusted the receiver will be ready for the tuner to be added.

The first step is to drill the chassis with the main holes, especially the larger ones which inevitably cause more vibration and swarf than the small ones for 6B.A. bolts. To complete this stage the following tools are necessary:—

Hand drill.
Bits of $\frac{1}{8}$in., $\frac{5}{32}$in., $\frac{1}{4}$in., $\frac{3}{8}$in. diameter (a size between $\frac{1}{4}$in. and $\frac{3}{8}$in. is also useful).
Chassis punches: Octal, B9A and B7G sizes.
9in. half-round file.
6in. rat-tail file.
Instrument-type electric soldering iron.
Supplies of "Ersin" multicore "Savbit" alloy 5-core solder.
Small screwdrivers, round-nosed pliers, tin-snips, and the usual complement of small tools.

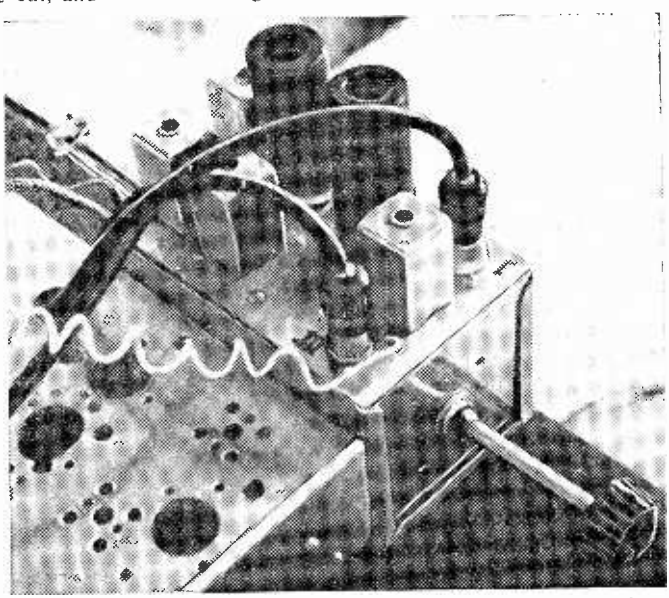
The centre of each hole should be drilled with a small pilot hole $\frac{1}{8}$in. diameter and, where chassis cutters are to be used, it is well to work up to hole size sufficient for the bolt of the punch to pass easily, by way of several drills of intermediate size. The valve-holder holes should then be cut, and where rubber grommets are indicated on the wiring diagram these should be inserted at an early stage.

Holes for the potentiometer spindles should be cleaned carefully of swarf, and the burr on both sides removed with the file or a sharp penknife carefully used. If this is not carried out, the controls will work loose after a number of operations, as the burr wears down.

The holes for the I.F. transformers must be very carefully marked out and accurately cut. Probably the best method is to mark out a template in mild steel or brass, about 1$\frac{1}{4}$in. square. This must be cut accurately. Accuracy can be ensured by centre-punching to a lightly scribed layout. If small inaccuracies occur they can be repaired with the point of the punch before the drilling of the template is undertaken.

The hole sizes given in the figure are the finished sizes on the chassis. The template is drilled with $\frac{1}{8}$in. diameter holes only, and can be placed on the chassis and used for marking out direct. As a good many of these sets of holes are needed, much time can be saved and accuracy improved by using the template. An even better method is to drill out an $\frac{1}{8}$in. hole in the chassis, in the position of the centre hole, and clamp the template to the chassis with a nut and bolt. The chassis can then be drilled direct, through the template.

The paxolin strip carrying the coaxial sockets for connection to the aerial or aerials is mounted behind a suitable hole in the rear vertical of the chassis. This hole is best cut by using two overlapping octal sized holes; but a rather neater finish can be obtained by drilling round a marked-off rectangle and prising out the piece, finally finishing off with the file. Corners are neatened by means of the rat-tailed file. When the paxolin itself is drilled it is best to hold it in a vice, using thin rubber or fabric strips to afford a shock-absorbing mount. This is a useful way of avoiding chipped edges. Perspex is also drilled in this way, with the added precaution of dipping the drill in water beforehand unless it is very sharp.



The tuner unit mounted on the chassis of a prototype receiver.

When the main holes have been cut and the edges smoothed, the valveholders should be fixed with their inter-stage screens where used in the positions indicated. Many valveholder fixing bolts are associated also with soldering tags, and before mounting these they must be treated by the following method.

A small quantity ($\frac{1}{2}$oz. is sufficient) of concentrated nitric acid is obtained from a local chemist

List of Components

Condensers	Quantity	
1pF	3	
2pF	3	
5pF	4	silver-mica
	1	N750K
10pF	3	N750K
20pF	2	Silver-mica 5 per cent
	5	N750K
25pF	2	
47pF	1	
50pF	4	
100pF	1	
220pF	4	
500pF	1	
1000pF	9	disc-ceramic
	2	disc-ceramic 1000VW
2000pF	24	disc-ceramic
	1	disc-ceramic 1000VW
3000pF	3	disc-ceramic (or one 1000pF 2000VW)

The above condensers are Erie components.

Tubular		
0·01μF	7	350VW
0·05μF	4	350VW
0·1μF	10	350VW
0·25μF	1	350VW
0·5μF	3	350VW

Electrolytic Condensers		
16μF	1	275VW
32μF	1	275VW
50μF	2	250VW
100μF	1	300VW } Combined: Type CE37KE
200μF	1	300VW }

The above condensers are T.C.C. components.

500μF	1	25VW (Daly)

Variables		
0·5—5pF	chassis mounting	1 (Erie)
0—10pF	beehive type	1 (Philips)
5—50pF	compression type	2 (Bulgin)
600pF max.	compression type (mica)	1 (Bulgin)

Resistors (Dubilier)		
33Ω		1
68Ω	1W	1
100Ω	½W	3
100Ω		6
150Ω		1
180Ω		4
180Ω	½W	1 (selected to be 170Ω)
330Ω	½W	2 (1 selected to be 370Ω)
470Ω	½W	1
200Ω	2W	1
500Ω	10W	1
1·5k		2
2·2k		2
2·2k	½W	1
2·2k	2W	1
3·3k		2
4·7k		1
5·6k		1
6·8k	2W	1
6·8k		3
8·2k		7
10k		10
12k	1W	2
15k		2
15k	1W	1
15k	2W	2
22k		3
27k	2W	1 (High stability)
33k		1
47k		2
47k	½W	2
68k	½W	1
100k		7
220k		7
330k		2
470k		8
470k	½W	2
560k		1
1M		6
2·2M		3
4·7M		2
10M		1

(All ½W unless otherwise stated)

Variables		
500k	log with DPDT switch (volume control)	1
500k	linear (contrast, linearity 2 and height)	3
250k	linear (brilliance, line speed, frame speed)	3
100k	linear (linearity 1)	1
25k	sync sep. (w.w.)	1
2k	linear (linearity 3)	1

Mains Dropper
20+20+20+20+20+70+70+70Ω—0·3A
(or to suit local mains)

Thermistor
0·3A type (Brimar)

Valves
(All Mullard except 6F33—Cossor)

R.F.	PCC89
F.C., Video	PCF80 x 2
I.F.V.1, I.F.V.2, I.F.V.3, I.F.S.1, I.F.S.2, A.F.	EF80 x 6
Sync separator (1)	6F33
Sync separator (2), audio det.	EB91 x 2
Frame output	PCL82
Sound output	PL82
Frame oscillator, line oscillator	ECC82 x 2
Line output	PL81
Boost diode	PY81
E.H.T. Rectifier	EY86
Cathode ray tube	AW43—80

Crystals
OA81 x 2 AGC
OA70 x 1 Video detector

Silicon Rectifiers
2 x FST 1/4—S.T.C.
or 2 x IS003 —Taxas Instruments

Valveholders (Mc. Murdo)

B9A with skirt	5
B9A. with skirt and can ...	2
B7G. with skirt and can ...	1
B9A. unscreened	8
B7G. unscreened	2
B12A. unscreened	1

(B9A. for EY86 is contained in the line output transformer assembly.)

Transformers, Chokes, etc.

Smoothing choke 5H. 250/300mA (Elstone Type S.C.).
Line output transformer, scan coils—(Gillone Electric Ltd.).
Frame output transformer—(Gillone Electric Ltd.).
Sound output transformar—(Goodmans multi-ratio).
Loudspeaker 9 in. x 6 in. elliptical—(Elac).
Channel selector switch 3 wafers — each 2-pole, 4-way, spacers: ⅛in. x 2; ¼in. x 8; ⅛in. x 2—(J. S. Kendall).
Coil formers, etc.—(Aladdin).
Screening cans and formers (long)—4.
Screening cans and formers (short)—9.
3 tag strips (9in.).
6B.A. nuts, bolts, soldering tags, washers—6 dozen each.
4B.A. nuts, bolts, soldering tags, washers—1 dozen each.
Sleeving in 4 colours—2 yards each.
22 s.w.g. tinned copper wire.
30 s.w.g. enamelled copper wire.
24 s.w.g. enamelled copper wire.
38 s.w.g. enamelled copper wire.
18 s.w.g. tinned copper wire.
Grommets (assorted).
Knobs—4 x 1½in. dia., 3 x ¾in. dia.
Paxolin sheet ⅛in. thick approx. 3in. x 2in.
Chassis—(V. W. Beamish, Shardloes Gerage, Shardloes Road, New Cross, S.E.14).
Aluminium sheet 14 s.w.g. and 20 s.w.g., Duralumin (or aluminium) sheet 20 s.w.g., Tinplate (approx. 24 s.w.g.)—for screening.
Coaxial sockets—4.
Coaxial plugs—4.
Polyvinyl chloride insulated flex 2A type in 4 colours—1 yard each.
Screened lead (single core)—1 yd.
Screened lead (twin core)—1 yd.
Coaxial cable (low loss)—2 yd.
Polystyrene former—¾in. nominal dia—4—(Aladdin).
Polystyrene cement.
Adhesive cellulose tape (Sellotape).
¼in. O.D. copper tubing—1ft.

and is diluted with an equal quantity of tap-water. All the soldering tags to be used are immersed in the liquid, and are then stirred with a glass rod for a few minutes. A chemical reaction begins, and the tin coating is stripped off the tags with the emission of nitrogen peroxide, NO_2. This gas is unpleasant and can be unhealthy so the operation should be carried out in a well-ventilated place, care being taken not to inhale much of the gas.

A tag is hooked out every few minutes, and when the tin coating has been completely removed the brass of the tag will be seen. Soon afterwards the nitric acid should be poured off and disposed of in a safe place, the tags washed with several changes of water or for a few minutes in running water, and dried. The acid used is corrosive, and care must be taken not to splash it on clothes or on the skin. If any accident happens the acid may be neutralised with ammonia or washing soda —the former preferable, as any excess ammonia will evaporate.

Each tag is then completely re-tinned with the soldering iron. This operation may be considered unnecessary, but it is a common experience that for some reason dry joints with soldering tags are

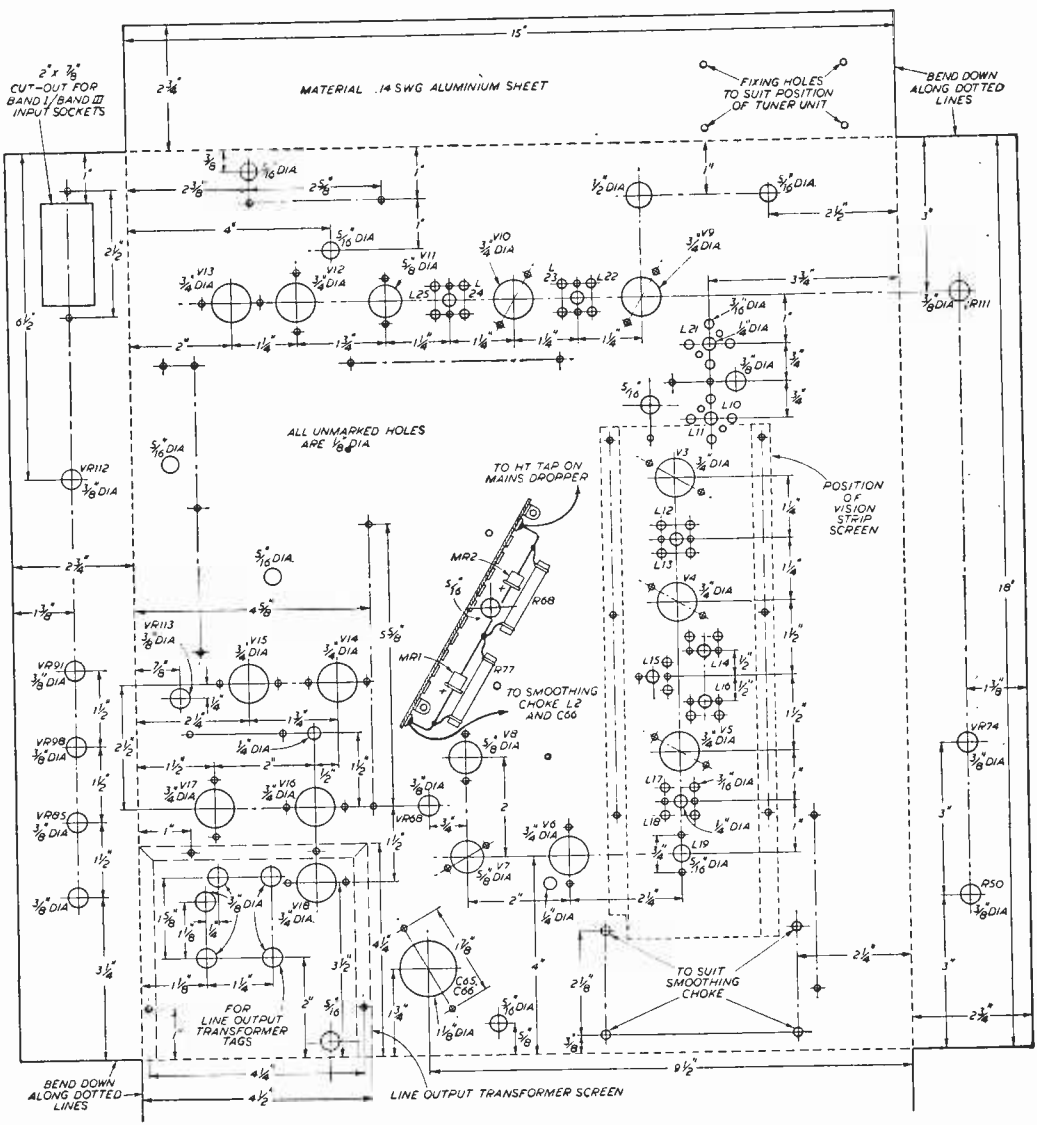


Fig. 3.—Drilling details of the chassis, viewed from above (dimensions of the interstage and vision I.F. screens will be given next month together with hole spacings for the I.F. transformer).

by no means unusual. This method ensures that a perfectly soldered joint is made every time, and in any receiver designed for high-frequency operation this is vital for stability and freedom from feed-back effects. In recent measurements made on a commercial chassis of the resistance of the soldering tags the following figures were obtained:

0—1Ω	16	Over 100Ω	3
1—5Ω	8	All measured at 50Mc/s.	
5—20Ω	8		
20—100Ω	6		

It will be realised that many of these joints could cause unwanted "common impedance" coupling, and resulting instability.

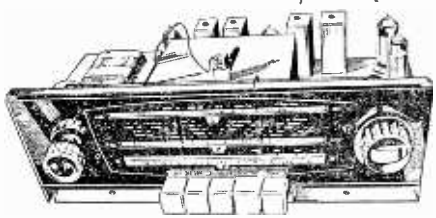
The main components and the remaining nuts and bolts can now be mounted and screwed down carefully. At this stage, the attenuating waveguide screen of the vision I.F. amplifier must be located and its position determined by means of PK screws. When the amplifier is being built up care

(Continued on page 98)

INDUCTANCES: Table of Winding Data

Reference	Description	Wire Gauge	Former Diameter	Primary Turns	Secondary Turns	Remarks
L1	Band III aerial transformer	24 enamel	¼in.	1½ (over L2)		Polystyrene former primary and secondary inter-wound at Earth end of secondary. Primary in thin insulated sleeving spaced ⅛in. long
L2	Band III aerial transformer	18 bare			3½	
L3	Band I aerial transformer	24 enamel	¼in.	2 (over L4)		
L4	Band I aerial transformer	24 enamel			15	Channels 1 and 2
					13	Channels 3, 4 and 5
L5	Inter-stage π coupling	24	No former ¼in.	5	—	Self-supporting close-wound.
L6	Band III f.c. coupling	18	¼in.	2½	—	Polystyrene former spaced to ⅛in. long.
L7	Band I f.c. coupling	30	¼in.	13	—	Enamel, close-wound Channels 1 & 2.
				11		Channels 3, 4 & 5.
L8	f.c. I.F. output	30	¼in.	17	—	Primary and Secondary separated by a layer of Sellotape. Secondary-wound on centre of Primary.
L9	f.c. I.F. output	30	¼in.	—	3	
L.A.	Band III oscillator	¼in. O.D. copper tube	—	—	—	Silver-plated preferably.
L.B.	Band III oscillator	¼in. O.D. copper tube	—	—	—	Silver-plated preferably.
L.C.	Band I oscillator	22	¼in.	5	Channels 1 & 2	Bare tinned wire spaced by wire dia.
				4	Channel 3	Bare tinned wire spaced by wire dia.
				3½	Channels 4 & 5	Bare tinned wire spaced by wire dia.
L10	Vision I.F. amplifier	30 enamel	¼in.	3	—	Primary wound on centre of secondary spaced by a layer of Sellotape
L11	Vision I.F. amplifier	30 enamel	¼in.	—	12	
L12	Vision I.F. amplifier	30 enamel	¼in.	17	—	Close-wound. Primary separated 3·3 mm. from secondary
L13	Vision I.F. amplifier	30 enamel	¼in.	—	12	Close-wound. Primary separated 3·3 mm. from secondary.
L14	Vision I.F. amplifier	30 enamel	¼in.	17	—	Close-wound.
L15	Sound trap	24 enamel	¼in.	14	—	Close-wound.
L16	Vision I.F.	30 enamel	¼in.	—	12	Close-wound.
L17	Vision I.F.	30	¼in.	17	—	Close-wound. NIL separation between primary and secondary (i.e., ends touching).
L18	Vision I.F.	30	¼in.	—	12	
L19	I.F./filter choke	30	¼in.	30	—	close-wound.
L20	I.F./filter choke	38	¼in.	80	—	Close-wound in two layers.
L21	Sound I.F. 1st tuned circuit	24 enamel	¼in.	—	6	Close-wound.
L22	Sound I.F.	24 enamel	¼in.	7½	—	Close-wound; primary and secondary separated by 18 mm.
L23	Sound I.F.	24 enamel	¼in.	—	6	
L24	Sound I.F.	24 enamel	¼in.	7½	—	Close-wound; primary and secondary separated by 18 mm.
L25	Sound I.F.	24 enamel	¼in.	—	6	
L26	Anti-Barkhausen coil	30 enamel	¼in.	30	—	Close-wound.
	(This coil is already part of the line output transformer assembly in the 70 deg version.)					
	Inter-stage heater choke in tuner	24 enamel	¼in.	60	—	Close-wound.

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



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Dial 14½ x 4 in. in gold and black.
Pick-up. Extension Speaker. Ae., E., and Dipole sockets. Five "piano" push buttons—OFF, L.W., M.W., F.M. and Gram. Aligned and tested. With all valves & O.P. Transformer. Tone-control fitted.
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Valves EZ80 rect., ECH81 EF89, EABC80, EL84, ECC85. Speaker & Cabinet to fit chassis, **47 6.** 10 x 6in. ELLIPTICAL SPEAKER. **20 .**
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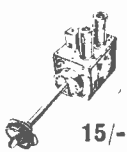

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15/- (2/6 P. & P.) Knobs **2/6** extra. Some tuners less valves **7/6.**

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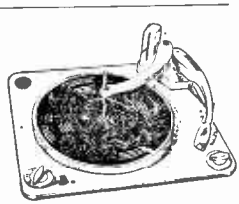

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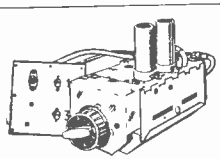
A-10—2K ohms v. on A.C. and D.C. volts (10, 50, 250, 500 and 1000 v.); 10K and 1M ohms; ½ mA, 25 mA and 250 mA. D.C. Size: 5½ x 3½ x 1¼in. Weight 17 ozs.

B-20—10K ohms v. on 0.5 v. and 2.5 v.; 4K ohms v. on 10, 50, 250 500 and 1000 v., A.C. and D.C. Resistance, 2K, 200K, 2M and 20M-ohms; D.C. current, 100 microA, 2.5 mA, 25 mA, 250 mA. Size: 5½ x 3½ x 2½in. Weight 24 ozs.

THE BRAYHEAD TURRET TUNER, £7.7.0 post free. Complete with booklet and fitting instructions. State set and model number when ordering.
Converts your 5-channel BBC only set to receive ITA as well.



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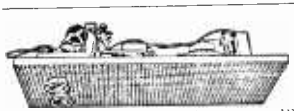
NEW WAXED TUBULARS, 350 v. or above. 3 of each, 0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1 mF. Total 21 for **4 6.** post paid.



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Replacing C R Tubes — 12

R.G.D. AND REGENTONE RECEIVERS

By H. Peters

IT is convenient to deal with the ranges of these two manufacturers together as several of their later chassis are very similar, and the principles involved in replacing tubes in earlier models are the same even though the chassis are physically and electrically different. Due to slight variations between these early models they are not all mentioned individually, but the tube may be changed by using the "Basic Method" outlined below. The following index will provide a key to the section under which any particular model may be found.

BASIC METHOD

(Covering the majority of models).

Unboxing

Remove the front control knobs and the cabinet back. Unplug the loudspeaker where not integral with the chassis and remove it, should it be in a position where it will impede the withdrawal of the chassis and tube. Unbolt the chassis. This is normally held by four large bolts, one at each corner beneath the cardboard bottom and although it is easiest to remove two of them by laying the set on its side it is much safer to remove the final two by having it upright and working from beneath, with the chassis protruding slightly over the edge of the bench. This way the chassis does not fall sideways as soon as the last bolt is withdrawn. The chassis will then withdraw backwards.

Changing the Tube

Discharge the EHT connector and remove it, remove the base connector and ion trap magnet if fitted, slacken the band around the bowl of the tube, and having noted the distance of the front of the face of the tube in relation to the front of the cabinet, remove the tube carefully forward, feeding the scancoils back along the tube neck. The scancoils should be marked for direction so that they are refitted in approximately the same position.

"INDEX" OF MODELS

R.G.D.		Heading	Regentone	
	2351	2351	T15 L+B	B1G12 L, B, H.
1700	1800	1700 Plessey single channel	T15MkIIL T15MkIIH	T15MkIIB
1755 C55 1757	1455 1756 1456	Basic Method	B1G 12/S 17T 17COMB. 143T + C 317T + C	B1G15/5+C 17C 14T. 173T + C 173COMB.
	T14	T14		
THE17 DEEP17C 502 DEEP17CA 600	DEEP17 DEEP17A 502A DEEP17FM THE21	DEEP 17	TT7 T177 T177FM T176	TR177 T21FM T21
590	605	605	Ten 4 Ten 5	Ten 12
610	611	610		

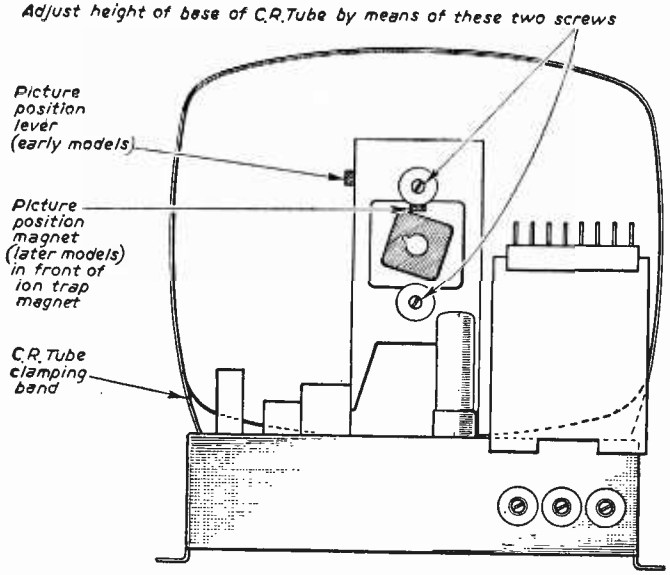


Fig. 1.—Rear view of the R.G.D. "Deep 17" series.

Refitting

Clean all parts before refitting in order to avoid dirty marks appearing on the screen as soon as the chassis is boxed up. Reassemble in reverse order, switch on and apply a signal. Adjust the ion trap magnet (if fitted) for maximum brightness: correct tilt by rotating the scancoils and adjust picture position by means of the shuffle plate on the front of the focus magnet, or by moving the magnet itself. On some receivers, an apparently useless metal strip is to be found hanging from a wingnut on one side of the focus gantry. This is a correction plate which may be moved around by the scancoils and provides correction of small amounts of barrel and pincushion distortion.

Cleaning Screen

It is normally necessary to unbox these sets to clean the screen.

Boosting

The majority of sets use a 2V tube, but whatever the voltage the procedure is the same. Remove the two wires from the tube and in series circuits fit across them a resistor to take the place of the tube heater in the chain. Where the tube heater is parallel fed from a mains transformer the two wires are removed and taped back separately.

Mains for the boost transformer is available at the set side of the on-off switch.

Model 2351

This is one of the earliest of R.G.D. receivers and has the quickest CR tube change that the writer has ever met. Provided that a coin is available to turn the Oddie fasteners which hold the back, no tools are required.

Having removed the back, undo the two thumbscrews which fasten the combined lid and safety glass and hinge it upwards. Remove the tube base and EHT cap and unclip the four springs holding the rubber mask and lift the tube out forwards. Replace in reverse order. Unless the tube has widely different characteristics, no setting up will be needed. Corner shadow can be reduced by turning the tube round in its cradle. (Mind the EHT cap).

Boosting

Use a 2V transformer, but before doing so check that the 2V wires to the tube heater are making good contact at the power unit terminals. Tightening these to restore full heater volts may be all that is needed to bring back a good picture.

Screen Cleaning

Merely lift the lid as outlined above, clean the screen and lower the lid.

Models 1700, 1800

Although the construction of these two models is similar to the 2351, it is necessary to unbox the chassis to replace the tube. Before condemning the tube, check that it is indeed faulty. Symptoms of a failing tube can also be stimulated by low H.T. and the 14A86 H.T. rectifier is a common cause of this trouble and should be replaced if the H.T. line falls below 200V.

Unboxing

Remove the back, unplug the power unit (two leads, one to the mains switch and one carrying the rest of the supplies). Remove the two front knobs and the nuts and bolts holding the upper chassis to the wooden frame. Withdraw the upper chassis, unplug the CRT anode connector and base, unclamp the tube bowl and withdraw the tube forward. Clean and replace in reverse order.

Picture centring and focusing are interdependent and the three screws which surround the focus magnet and centre the picture should be adjusted for a central picture in focus with the focus lever set midway between the limits of adjustment permitted by the slot in the cardboard back.

Boosting

Use a transformer of the correct voltage for the tube fitted, which may have a 2V, 4V or 6·3V heater, depending on its type. Remove the existing heater wires (pins 1 and 8 on Mazda octal holders, and pins 2 and 7 on international octal holders) and tape them back separately and connect the boosted secondary of the transformer to the blank pins, finding mains for the transformer from the set side of the on-off switch.

On many "1700" receivers a 4V Ferranti tube is used, and this can be boosted 50 per cent by increasing the filament supply to 6V. This is carried out on a tagstrip beneath the power unit where a 2·2Ω resistor or a choice of heater voltage tappings is to be found.

Screen Cleaning

Remove the two screws holding the window and frame, and remove the window.

PLESSEY SINGLE CHANNEL CHASSIS

In the models using this chassis the tube is cradled separately from the main chassis, which should be removed first. All the interconnecting leads unplug (scancoils, tube base, and EHT lead) and the chassis is held in by four base screws and the front knobs. In some larger cabinets the tube cradle can be removed without taking out the chassis.

Lay the cabinet face down on a soft cloth and release the focus gantry by removing the four long bolts at the ends of the wooden bar.

Mark and remove the scancoils and release the straps which hold the tube to the front of the cabinet. Remove the tube, clean and replace in

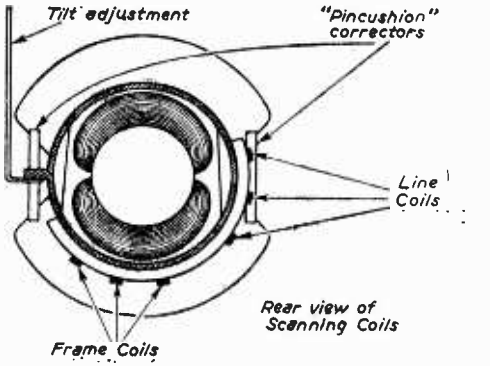


Fig. 2.—" Deep 17 " scancoils.

reverse order. Picture positioning and focus should be obtained with the focus knob set midway between the two ends of its travel, using the adjustment provided by the various slots on the focus gantry.

Ensure that the scancoils are well forward, or corner shadows will appear.

DEEP 17

Unboxing

Remove the back and bottom, detach the coaxial aerial socket by removing the two P.K. screws holding it to the cabinet side. Remove the four front control knobs—the two inner ones are grub-screwed on to the spindle and once these are removed the outer pair will pull off. Pull off the loudspeaker leads. Remove the two 2B.A. screws holding the back of the side flanges to the chassis, noting the angle subtended by their rectangular washers. There may also be two woodscrews to augment them, and these require removing as well. Remove the loudspeaker and baffle by taking out the two screws which pass through the assembly from the front of the cabinet and withdraw the chassis.

On models " The 17 " and " The 21 ", a wooden bar retains three push-on knobs on the front preset controls and these should all be removed at the same time as the other four control knobs. The chassis on these two models is bolted into the cabinet from beneath by four large screws.

Note that the material inside the EHT box is glass fibre, a skin irritant, which normally touches the lower right forearm when the chassis is halfway out, at which stage of the operation it is not convenient to "down tools."

CRT Removal

Discharge the EHT lead to chassis and remove the EHT cap. Remove the CRT base connector ion trap and positioning magnets. Lay these two latter units down away from each other and away from other magnets. Note and unsolder the scancoil leads and remove the tilt adjustment screw. Slacken the screws around the tube clamping band, and remove the tube forward complete with deflector coils. Clean all parts and replace the tube—reassembling in the reverse order. Two dimensions are critical and should be precisely adjusted. One is that the distance from the front of the tube face and the front of the chassis should be $\frac{7}{16}$in. and the other is that the distance between the bottom of the chassis and the centre of the tube base should be $10\frac{9}{16}$in. Failure to check these dimensions may result in the tube touching the safety glass and in time a small patch of opaque glass may develop on the centre of the screen.

Setting Up

With the picture positioning magnet as far forward as possible, the ion trap magnet should be adjusted until maximum brightness is obtained.

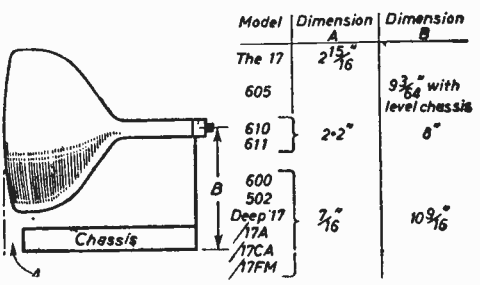


Fig. 4.—Critical dimensions.

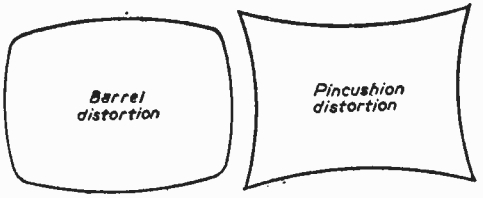


Fig. 3.—Barrel and pin-cushion distortion.

The picture positioning magnet is then adjusted for a central picture, and any tilt corrected by adjusting the deflector coils. The ion trap and positioning magnets should each be adjusted in turn until no improvement results.

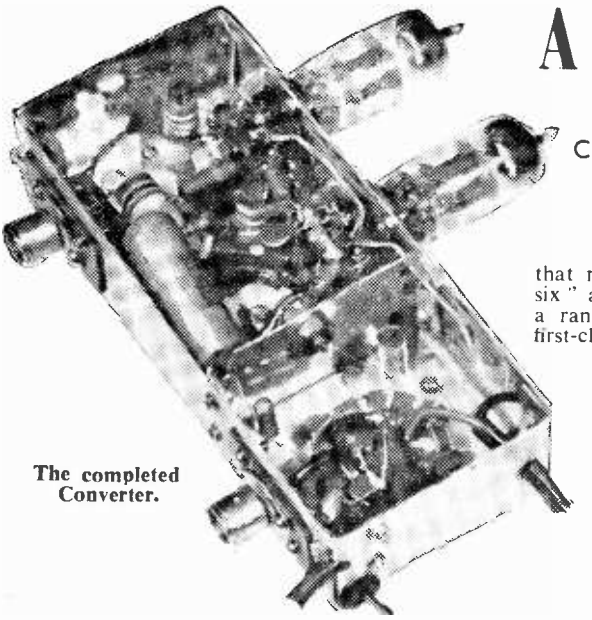
Barrel and pin-cushion distortion may be varied by altering the position of the two small bar magnets clamped to the side of the deflector coils.

(To be continued)

A Triode Convert

A HIGHLY SUCCESSFUL CIRCUIT FOR CONVERSION OF BAND I—ONLY RECEI

By H. G. Underwood



The completed Converter.

THIS converter has proved a very simple, efficient and reliable unit which costs very little to make (around 50s.) and gives excellent results.

Until recently, in the South Suffolk area, the only ITV station which could be received was London. Multi-channel receivers gave poor reception on this programme. However, the converter described here gave good results even at that range in conjunction with a good "double-six" aerial array. Since Mendlesham opened, at a range of approximately 25ml., the results are first-class using only a single 4-element aerial, and all the converters made have been retuned quite easily to the new programme frequency by core adjustments only. The converter as described, therefore, is capable of receiving at least channels 9—11. Other channels may require coil adjustments, but these need be very slight.

The output of the converter is suitable for injection into a London (Band I, channel 1) tuned receiver, but other sets can be accommodated by removing a few turns from the primary of L6, or by using brass cores instead of iron dust.

Basis of the Converter

The basis of the converter is a pair of ECC81 (12AT7) valves, which are very stable, efficient, reliable and easily obtainable from surplus supply firms. The circuit is otherwise quite conventional, and the unit is easily mounted in practically any cabinet.

The use of these triode valves gives a very clean picture quite comparable with that given by a

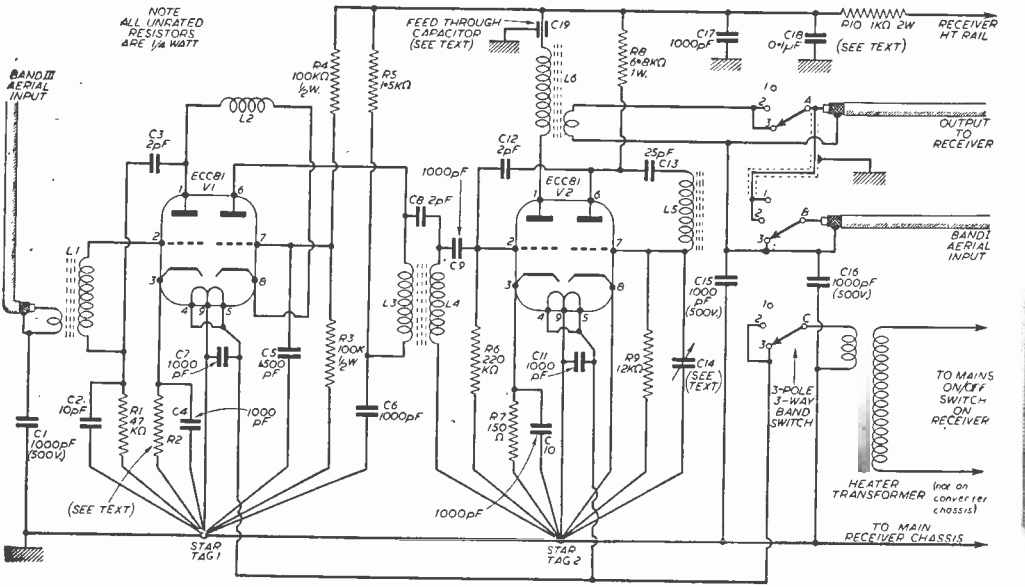


Fig. 1.—The circuit diagram.

A.C./D.C. type, *both* leads should be terminated in capacitors of about 0·1μF, and for work with sensitive receivers a choke should also be used in series with the "live" lead.

The entire A.F. section of the receiver can be tested, also time-base generators and video amplifying stages. It is much simpler to align a receiver with headphones than with an output meter, and very nearly as accurate if care is taken. This is especially true of very sensitive receivers, because the ear can readily distinguish between modulation tone and noise; this the output meter cannot do unless a selective A.F. filter is used in conjunction.

The Signal Generator

This is an instrument which no serious experimenter should lack. There is no difficulty in making one if cost is the objection, but care and patience are needed in calibrating it. Even cheap models are better than none, however, and even if a little inaccurate over some ranges there always exists the possibility of re-calibrating accurately.

The chief points to look for in buying a signal generator are as follows—

(a) negligible stray radiation
(b) controllable output down to a few microvolts.
(c) a "high" or "force" output for rough preliminary alignment of circuits
(d) adequate range covered
(e) A.F. modulation provided internally
(f) known output impedance, preferably 75Ω to match the co-axial cable.

The Oscilloscope

Of all instruments used in television servicing the oscilloscope is perhaps the most versatile. The experimenter with little cash but much skill will make one himself—and good designs have appeared in both *Practical Television* and PRACTICAL WIRELESS in the past. For television servicing a moderately priced instrument is quite sufficient, but of course where design is contemplated a more advanced type will be found much more useful.

The use of the oscilloscope can only be learned by reference to the specifications of the instrument employed. One or two illustrations are given of typical wave-forms in a television receiver, and these illustrate its use better than pages of description.

Other uses of the oscilloscope include the indication of resonance of tuned circuits, phase measurement or comparison, plotting the response of I.F. or R.F. amplifiers, alignment of receivers, and estimation of distortion.

To make up your Servicing Guide, detach the 12 extra pages and fold them along the line to the right of this page. Then, cut along the top of the book so formed to make up your 24-page Guide. If possible, you should staple the pages together at the fold.

PLEASE FOLD ALONG THE DOTTED LINE

Practical Television

SERVICING GUIDE

–TV components and how they work

–Recognising fault symptoms

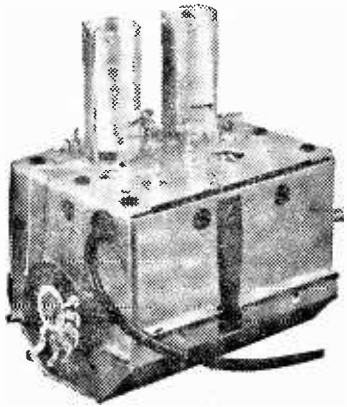
–How to repair your receiver

PRACTICAL TELEVISION
Servicing Guide

THE COMPONENTS OF TV RECEIVERS

A FEW years ago it would have been hard to find an experimenter with television who had not graduated by way of radio. Nowadays there must be quite a handful of young people who have come straight from textbook electricity into the stream of TV circuitry; for these beginners there is always a 'first time' when the apparently complex circuitry of a television receiver must be examined so that a fault may be repaired.

All complete television receivers consist essentially of five independent, but associated units. They are the tuner, the sound receiver, the vision receiver, the scanner, and the power supply.



The Tuner

This is often a separate unit, either built in or bolted on to the main chassis. In older sets it is common to find the tuner as an integral part of the receiver. It is identifiable by one or more of the following characteristics:

(a) Channel selector spindle is located nearby.

(b) The first valve is located near the end of the coaxial socket which takes the lead from the aerial.

(c) The first valve is a double triode, such as PCC84, PCC88 or in more modern sets PCC89. Types in the "E" series corresponding, or valves of similar characteristics, are also found in this position. Sometimes an R.F. pentode of the EF80 or EF91 class is used in this stage, but this is uncommon in sets designed to cover Band III as well as Band I.

(d) The second valve is of the PCF80 type—a triode-pentode valve used for frequency changing. Occasionally a straight R.F. pentode is found instead, or even a double-diode, but these are not usual.

Fig. 1.—A typical turret tuner; these tuners are used in many receivers and may vary slightly from the type shown.

valve cathode resistor all may be well. But if the resistor has burnt out and is open-circuited it will be regretted that the 0–250V range was not selected first.

The Neon-Screwdriver

The neon-screwdriver, which can be found advertised in this magazine nearly every month, is also a most useful device. Because of its very high series resistance only a very small current flows, and thus mains voltages or higher can be tested while holding it in the hand, the human body's resistance being used to complete the circuit. It is mostly used to test whether a chassis is "live"; a glow in the neon tube, in the handle of the screwdriver, indicates that the mains plug has been wired the wrong way round.

Another use is to discover where the field of the line output transformer is. The screwdriver is held by the blade near to, but not touching, the transformer, and when within the 10kc/s field, the neon tube glows. Other oscillators can also be tested in this way, in particular R.F. oscillators. The frameoscillator or output transformer gives no indication however.

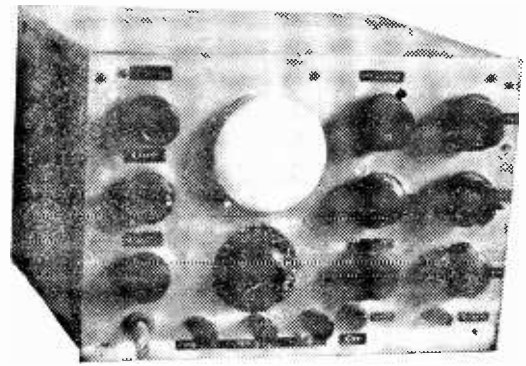


Fig. 21.—A home-constructed oscilloscope—a valuable instrument for tracing many faults.

The R.F. Indicator

R.F. oscillators are readily tested roughly for functioning with the aid of another simple device, which may be quickly assembled in the following way.

Using about 4–6ft of twisted flex, attach one pair of ends to the meter. Across the other pair wire a germanium diode—the "surplus" type sold for a shilling is good enough—and use this as a probe. Set the meter to a low current range, and bring the probe near to the source of oscillation. Unless the radiation is very feeble an indication of current will be shown on the meter. If it reads the wrong way round, reverse the connections to the meter.

This device, placed near a coil carrying R.F., can also be used as a resonance indicator. The degree of coupling should be kept low.

Headphones

A pair of headphones is invaluable to the experimenter. When using them with a receiver of

servicing of television receivers a very comprehensive range of expensive equipment is needed. It is true that to diagnose some unusual faults rather specialised instruments are needed, but much can be done with simple tools. However, the amateur who is concerned chiefly with his own circuits and those of his friends' receivers does need a minimum amount of equipment, and here are described some of the most useful items, with examples of their use.

The Multi-range Meter

This is possibly the most useful of all, and the best that can be afforded should be bought. If money is the main difficulty it is better to purchase a first-rate meter and convert it to a versatile multi-range instrument, than to buy a cheap instrument complete. Switches and resistors are cheap, and shunts can be devised at home with sufficient accuracy. Good designs have appeared in *Practical Television* and in PRACTICAL WIRELESS, from time to time. The ranges most often used in servicing are as follows:—

D.C.	
0–1mA	0–10V
0–10mA	0–300V or 500V
0–100mA	
A.C.	
0–1A	0–10V
	0–300V or 500V

Ohms. The full range from 10Ω to, say, 2 or 3M.

If leakage is suspected in the capacitors, it is very unwise to attempt to measure the leakage current with a meter. Even if the capacitor turns out to be good the charging current may be enough

Fig. 20.—Linearised current through frame scan coils.

to damage the meter, if the capacitance is a microfarad or more. It is always best to make up a neon insulation tester for this purpose and this has the added advantage of giving useful data about the value of high resistances which are usually not easily read off the ohmmeter ranges of the meter.

Care of Instruments

A sensitive instrument should be looked after carefully. When put away, always leave it switched to 0–100mA D.C. range, so that the meter movement is heavily damped. If picked up violently the needle will not swing wildly and so become bent. Always keep the meter in a cool dry place; dampness soon spoils it.

Never attach leads to a circuit without selecting the highest D.C. voltage range first. This will ensure protection, even if there is something wrong with the circuit. If, for example, a 0–5V range is selected to measure the bias voltage across a

The Sound Receiver

This unit is identifiable without much difficulty as a rule, because it ends in the usual output A.F. pentode and a transformer feeding one or more loudspeakers. It consists normally of a one or two-stage I.F. amplifier—valve stages separated by transformer cans—a detector, an A.F. amplifier and an output valve. The I.F. stages are usually straight R.F. pentodes of the EF80 class, but the detector may well be a germanium diode, and the A.F. voltage amplifier is often the triode portion of a multiple output valve of the PCL82 type.

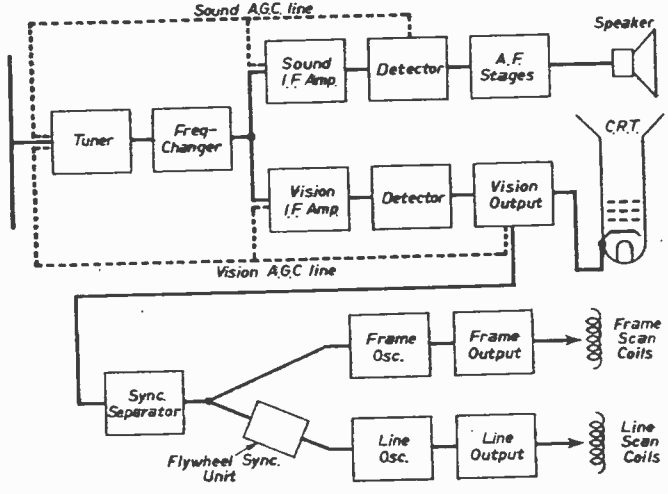


Fig. 2—A block diagram of a typical television receiver. The AGC lines shown are not to be found in all sets and the flywheel sync circuit is generally seen only in fringe area models.

The Vision Receiver

This will normally be similar to the sound receiver, but instead of terminating anywhere in particular will lead to another group of valves, often placed near the rear of the chassis, five, six or seven in number. These constitute the "computer" element of the receiver, which will be mentioned shortly. Normally in the vision amplifier there are two or three I.F. valves, a detector, and a video output valve. A sync. separator circuit is interposed between the video output valve and the time base generators which scan the cathode ray tube. The valves of the vision I.F. amplifier will, like the sound receiver valves, be of the EF80 class. The video detector may be either a thermionic diode or a germanium crystal diode, and

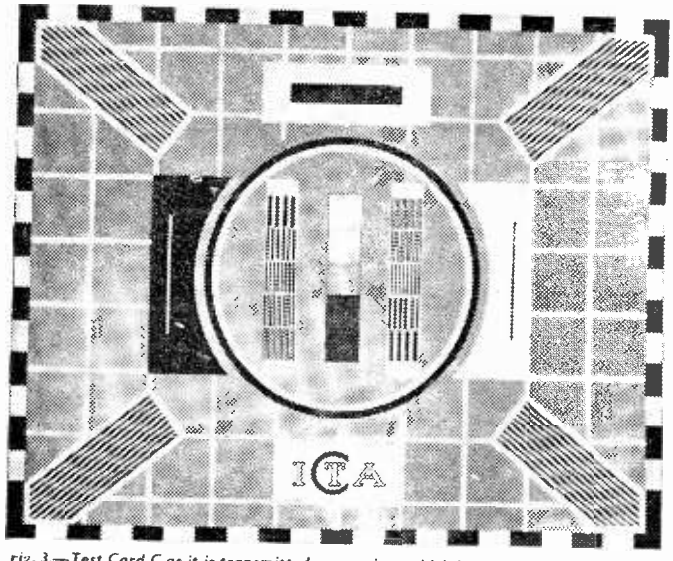


Fig. 3.—Test Card C as it is transmitted—a receiver which is working properly should present a picture similar to that shown above.

the video output valve, which modulates the CRT, may be another straight R.F. pentode, a multiple valve such as PCF80 or even a small output pentode similar to 6CH6.

Timebase Generators and Scanning arrangement.

The scanning section of the receiver is designed to build up an apparent picture on the CRT face. This it does by making a spot of light fly across the tube in a regular pattern at an exceedingly fast rate. The brightness of this spot, at any instant, depends upon the output from the vision receiver, and so—all being well—the details of a picture are built up progressively. There is, of course, no picture on the screen, only a flying spot of light of varying brightness. The phenomenon of "persistence of vision" does the rest. Each "picture" takes about 1/25sec to trace out completely and consists of two interlaced half-pictures of about 200 lines each, the lines of one half being accurately placed between the lines of the other half picture. Accuracy of sweep, as well as accuracy of interlace, is thus vital for the correct presentation of the transmitted signal.

The transmitted signal contains pulses which ensure correct synchronisation of both line and frame scan circuits. These pulses have to

Check all the components associated with the sync separator stage, referring to circuit diagram for correct values.

35. Hum on picture. First suspect breakdown of the smoothing capacitor with H.T. supply currents, especially if there is only one dark bar in the picture. Note also if the sides of picture are bent—this makes above diagnosis certain. If the hum bar is present only when a picture is showing, the possibility exists of A.C. ripple in the R.F. or I.F. amplifier (heater-cathode leak). Suspect also heater-cathode leak in the video stage, or at worst heater-cathode leakage (without actual breakdown) in the CRT. If the latter is the case fit a heater isolating transformer, cathode of the CRT preferably connected to centre-tap of the heater winding.

36. "Ghosts" on Picture—sometimes confused with "ringing". Try another channel but if the ghost disappears or changes materially, the cause is multiple path reception, and re-orienting or re-siting of the aerial may be needed to correct the fault.

37. Ragged verticals—a poor signal will often cause this and so increase contrast to improve the picture. If the ragged appearance does not improve with increased signal, especially if loss of interlace is noted, the probable cause is corona discharge from the line output transformer, the EHT rectifier or the CRT final anode lead, or perhaps poor earthing to the chassis of the outer conductive coating of the tube. If this is so the characteristic smell of ozone may be present, or when the receiver

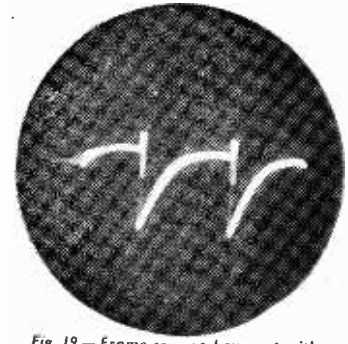


Fig. 19.—Frame scan coil current without linearising—shows severe transformer distortion.

chassis is viewed in the dark the characteristic blue-glow leakage around any high potential parts may be seen. Make sure there are no sharp edges or corners on such parts but if so, cover them thoroughly with cellulose cement (heavy coating) or use silicone grease, especially where dampness is suspected. A ball of Plasticene often helps temporarily and is useful for diagnosis but it should not be left in position permanently as it soon breaks down and the effect may then be worse than before.

THE USE OF INSTRUMENTS IN TELEVISION SERVICING

Many people will, quite understandably, imagine that for the

ing oscillator transformer is used. If a poor whistle is heard, make sure that the boost H.T. storage capacitor is not of open-circuit condition or short-circuit; check the line output transformer again, preferably by substitution. If EHT is present but very low by normal standards, see if a faint raster, much enlarged, is visible in the dark. This may well indicate a short-circuit in the line output transformer. A faint raster not much enlarged probably means that there is a shorted turn in the scan coils, and it would be wise to have them tested.

30. Washed-out picture of normal size. This is usually caused by either a very poor signal, or a failing tube and may be checked by increasing brightness. If this control is satisfactory, look for low amplification in the vision chain. Check the valves for mutual conductance and the detector for breakdown especially if the diode is of the crystal type. If on increasing the brightness the appearance changes little, or if on increasing "contrast" the picture changes to negative, the tube is probably failing. Have it tested, or substitute a good tube. If it is failing, try increasing the heater current by means of a boost transformer or a bleed resistor, to get some extra life out of it.

31. Picture blow-up. If on increasing brightness the picture enlarges greatly and perhaps goes out of focus, the EHT rectifier needs replacing.

32. Ion burn. This defect is seldom seen nowadays, but on older triode tubes without an ion trap or aluminised screen it is of common occurrence. It is characterised by a large spot in or near the centre of the tube, often with sharp edges, where brightness is not up to normal standards or even, in bad cases, an obvious dark patch with the set switched off. The only cure is to replace the tube.

33. Poor resolution (little detail in picture).

(a) When high gain is employed in the receiver, ensure that the anode load resistor in the video output stage has not "gone high". Replace where necessary with a component of adequate power rating (e.g. 6·8k 2W).

(b) With normal or low gain, check the oscillator tuning, the alignment of the vision I.F. amplifier (from manufacturer's data only), and alignment of the R.F. stage.

34. Triggering time-base generators on the picture signal (often confused with "pulling on whites").

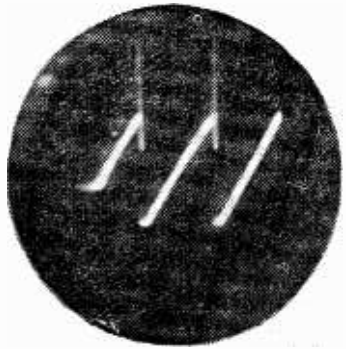


Fig. 18.—Frame oscillator—linear saw-tooth.

be separated from picture intelligence before they can be used, and the circuit which performs this function is commonly known as the "sync separator". The complete schematic diagram of a modern receiver is shown in Fig. 2.

Timebase Generator Components

As far as valves are concerned, the scan generator circuits are characterised by certain arrangements which do not vary greatly in theory, but in practice the scope for variation is quite wide. In scan circuits either the blocking oscillator or a multivibrator is common; both these circuits use triodes as oscillators, but with the multivibrator a double triode of the ECC82 class is popular. The 6SN7, electrically similar though of octal base, is also used especially where space is not at a premium. Sometimes however half a multiple valve may be used as one of the triodes, and identification is not always easy. The blocking oscillator circuit is perhaps easier to recognise since it contains an iron-cored transformer, similar to an inter-valve audio transformer. This similarity could however lead to the impression that the circuit was an A.F. stage.

The frame output valve, feeding the scan coils with a 50 c/s sawtooth current, is usually of PL82 or PCL83 type. An output transformer is used in nearly all cases, but this cannot readily be confused with the audio output transformer because the secondary leads are connected to the scan coils round the C.R.T. neck.

The line scan stage is much more readily recognised, as it essentially contains a characteristic line output transformer. This has nearly always a small valve rectifier arranged very close to it, or wired across a paxolin plate with very large, smooth blobs of solder, often in little brass cups. Several leads come out of the line output transformer: two go to the line scan coils round the tube neck, one goes to the top cap of a valve (usually PL81 or similar type) and another to the top cap of another valve—physically similar though electrically different—of the PY81 class. The line output transformer is usually wound in "open" form on a core of ferrospinel or ferrite; it is normally moulded and clamped between end cheeks, the wiring being well spaced away from anything metallic and often "built up" with a thick tyre of wax or pitch. Associated with the line output transformer is also a very heavily insulated lead going to the side contact of the C.R.T. This carries the extra-high-tension of about 12–16kV needed to operate the

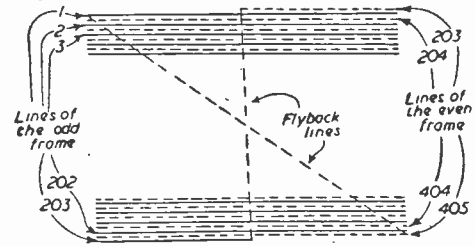


Fig. 4.—This diagram shows how the two scans are interlaced (see page 4).

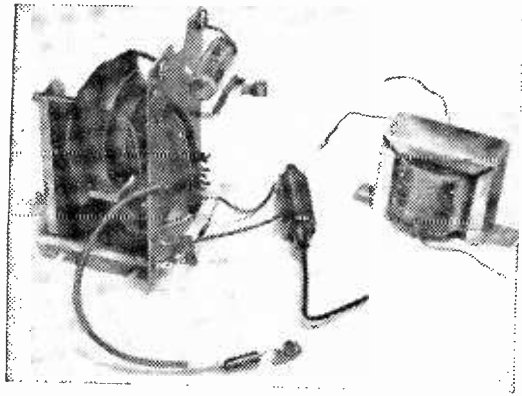


Fig. 5. — Timebase components; on the left, a line output transformer with its soldered-in EHT rectifier; in the centre, a width control; and, on the right, a frame output transformer— which is very similar in appearance to an audio output transformer.

tube. Small inductors, which carry adjustable iron or ferrite cores, are normally included in the line output stage. These afford control of the width of the picture and its linearity. Sometimes only a linearity control is fitted, sometimes only a width control.

Occasionally the whole line output stage is enclosed in a large can of aluminium, which is filled with transformer oil and sealed. This is instantly recognisable by its build, as no other can in the receiver will be half as large.

The Scan Coils

These are always fitted as far "forward" as possible on the neck of the cathode ray tube. Modern types are very different in appearance from older coils, but all have the same function. Within the assembly are two pairs of coils. One pair is fitted so as to produce *across* the neck of the tube a sawtooth magnetic field which gives rise to the frame or vertical deflections; the other pair of coils produces a sawtooth field vertically through the neck of the tube, and this causes the spot of light to be deflected horizontally to form the lines of the picture. These coils are always well insulated, and they have to carry quite heavy currents. Faults in these are not very common as the temperature rise has to be limited or the CRT may be damaged by the heat, and the robust construction needed for this purpose helps to ensure reliability.

Other CRT Components

Apart from the base for the tube, which is always easily recognised, certain other components are found on the neck of the tube. Starting from immediately behind the scan coils, the first unit to be met with will be the focusing magnet; sometimes this is omitted entirely, however, when an electrostatically focused tube is in use. The magnet is always in the form of a ring of large dimensions—sometimes an electromagnet, but more usually a permanent magnet. The magnet is so arranged as to form a strong field lengthwise along the neck of

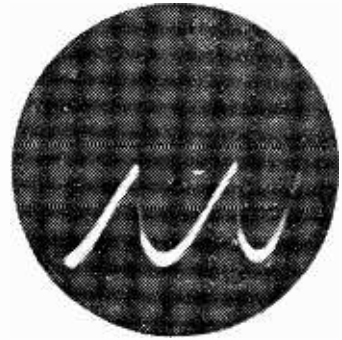


Fig. 17—Approximately parabolic voltage across the linearising capacitor in the correction circuit ta a frame oscillator.

input signal low so that the AGC line, if fitted, does not come into action.

If the I.F. is not known or the signal generator is not very accurately calibrated, proceed as follows: With the aerial lead removed, inject the signal at low level, modulated, to give a pattern on the CRT screen. Alter the input frequency until this pattern is at a minimum. The input signal is now that of the sound trap and is correct. Now adjust all the sound I.F. transformer cores for maximum sound output.

If, after this adjustment, the effect is still in evidence, suspect damping in the sound I.F. amplifier, especially if a tendency towards instability occurs. Check all decoupling circuits, especially the grid and screen circuits, or the cathode decoupling condensers, and see if there are any dry joints in the suppressor grid earth-connections.

28. *Uncontrollable brilliance.* There are two chief causes of this fault, the first being the feed to the video output valve anode has been disconnected; check the anode components for continuity. The brilliance control itself may have too high a setting, if a fault has arisen either in the potentiometer itself or in a resistor between the control and chassis. Replace any component after checking where necessary.

The other possible source of trouble is a heater-cathode short within the CRT. This is best checked by substituting a borrowed CRT where possible, although an ohmmeter may give a fairly reliable check. If this is found to be the defect, fit a low capacity transformer, to isolate the heater from anything else. Series heater connections to the tube, as is usual practice nowadays, necessitate a transformer with mains primary. When fitting, insert a small thermistor in the *mains lead* to the transformer to help limit current surges on switching on from cold.

29. *No EHT* (and therefore no raster). If the EHT rectifier lights, possibly glowing blue inside, remove the EHT cap from the tube and see if the EHT appears. If this is the case, the tube is defective and should be replaced.

On the other hand if the EHT rectifier does not light and a line whistle is present, ensure that the rectifier heater is intact. If the line whistle is not present, check the line oscillator, line output valve and boost diode, preferably by substitution. If these valves are all correct, check the associated components, especially where a block-

should be inspected, especially the anode resistor, replacing if necessary by a component of adequate voltage rating.

25. Picture, no sound signal or distorted sound. First make sure that the oscillator tuning is correct as there may be a position where sound is normal. Starting at the loudspeaker terminals, check back through the sound receiver. I.F. instability may be present if A.F. stages are in order. The corrections applied in the previous fault (24) may prove useful in this case as well.

26. Raster, no sound, no picture (sometimes definite hum in the speaker). This defect is nearly always caused by a fault in the R.F. or frequency changer section of the set. Assuming a signal is being radiated repeat the procedure given in paragraph 8 for adjustment. If a fault is inferred, try changing the channel. If there is still no reception, supply signal from the signal generator at the correct frequency (low level), to the aerial terminal without removing the aerial. Vary the generator setting and any appearance of pattern on the screen now indicates that the oscillator or R.F. circuits are much out of tune. If no signal is received, increase signal level greatly, so as to overload the first valve (use "High" or "Force" output if needed) and an appearance of a picture, even if weak, indicates that the oscillator circuit is defective.

If the oscillator is not oscillating, replace the frequency-changer or other oscillator valve and try to receive a signal. (Checking the presence of oscillations is described later.) If there is still no oscillation, check the circuit components for soundness and replace any where necessary. The most likely cause will be that the anode feed resistor to the oscillator valve has "gone high" and so replace it by a component of adequate power rating. If this component is in order, check the coupling capacitor to the oscillator grid as it may be open-circuited or short-circuited.

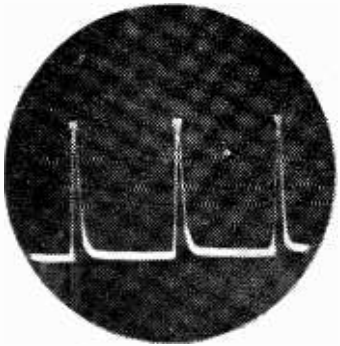


Fig. 15.—Line sync pulses from the sync-separator.

27. Picture signal on sound. This fault is sometimes mistaken for mains hum. To distinguish, detune the oscillator, and if the hum disappears, the fault is present. The cure is either accurate setting of the oscillator tuning or re-alignment of the sound I.F. amplifier. If the sound I.F. is known, and a generator, modulated at audio frequency is available, feed in the signal at the aerial terminal (after first removing aerial lead) and adjust all sound I.F. transformer cores for maximum output at the loudspeaker. Keep the level of the

the tube. The electron beam interacts with this field and is brought to focus on the screen of the CRT. Adjustment to this magnet alters the air gap in the magnet, and provision is made for this to be done by means of either a screwdriver or an arm which extends from one side. With electromagnetic focusing the current through the wire coil is varied by means of a suitable control; either a by-pass of current through a variable resistor or a restriction of current by altering the bias on one of the output pentodes—usually the audio output pentode—whose anode is fed via the focusing coil.

Associated with the focus magnet is often the picture-centring device. This frequently consists of a "shuffle plate" on the "forward" face of the magnet and can be adjusted by means of an arm. Sometimes the focus magnet is tilted to obtain alignment of the picture, and sometimes the screw adjustment of the focus magnet itself is the only control of centring.

With electrostatically focused tubes a small (and weak) magnet is clamped round the tube neck behind the scan coils. This can be adjusted readily by hand to centre the picture.

In order to reduce the incidence of the fault known as "ion burn", the "electron gun" of the CRT is usually arranged asymmetrically in the tube neck. A small magnet round the neck near the base of the tube is arranged to deflect the electron beam—but not the ion beam—towards the screen; the ions strike the neck of the tube and cause no harm while the electrons are deflected towards the focusing and scanning devices and are used to produce the picture. The adjustment of this device is highly critical, and will be dealt with later.

Power Supplies

Apart from the fact that power

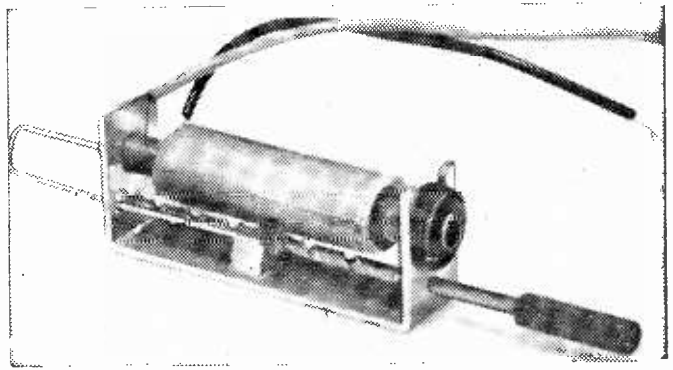


Fig. 6.—A line linearity control; these controls are usually mounted near to the line output transformer and consist of an inductance wound on a former, inside which a permanent magnet is moved for best results.

supplies are very similar indeed to those of any other electronic device, they are almost invariably found towards the rear of the chassis, where ventilation is easier. It may be expected however, that, as silicon rectifiers become more widely used for H.T. rectification, the power supplies may be found anywhere that space permits. If thermionic valves are used it is common practice to use two in parallel since the current supply to the receiver may be anything up to 400mA. Selenium rectifiers are often employed, and cooling by contact with the chassis is used on a number of receivers.

The smoothing capacitors are usually much larger in capacity than those used in radio receivers. Values of 60, 100 or even 200μF are usual; large capacitance has to be used because the smoothing choke—which has to carry a heavy current and therefore requires to be wound with heavy gauge wire—cannot be of very high inductance—5 to 10H is about the largest value found in practice.

In some older receivers a large A.C. mains transformer not only provides the valve heater and H.T. requirements, but also 4–6kV for the CRT high-tension. It should be noted carefully that this is potentially a very dangerous component, and the utmost care is needed in inspecting the receiver with current flowing. Mis-handling of this transformer can be fatal.

Fig. 7.—The scan coils in position on the neck of the tube; the picture-positioning magnet and the ion-trap magnet may also be seen. If the scan coils are not as far along the neck of the tube as possible, the corners of the picture may be cut off (see Fig. 14, on page 16).

FAULTS AND THEIR CURES

Faults in television receivers usually occur as a result of either incorrect adjustment of the various controls—often owing to ageing of components—or due to the partial or complete failure of one or more components. If a receiver displays an apparent fault it is always necessary to try re-adjustment of the controls first. If the fault symptom still prevails, it may be inferred that some failure has occurred, although the failure may be no more than the normal "wearing-out" of a valve. In the ensuing paragraphs, therefore, faults are classified accordingly as incorfect adjustment and failure of components.

23. Sound, no picture, no raster. Assuming that the A.C./D.C. technique rules out the possibility of this fault being caused by a defective CRT heater, the following procedure should be taken.

First check for adjustments as in paragraph 1 above. If EHT is present suspect CRT supply to the first anode. The voltage present should be about 350–450V. but it may be fed through a high-value resistor, giving a low indication. Check the voltage between the CRT cathode and the chassis and if there is full H.T. voltage, not varying with contrast control setting, suspect the video amplifier cathode components open-circuit. Test and replace as necessary, using a resistor of adequate wattage. Check the H.T. feed to the brilliance control; commonly the grid of the CRT will maintain a little positive but will be below H.T. potential. When at the chassis potential, replace the defective feed resistor or control potentiometer as needed.

24. Sound, raster and no picture. Repeat the adjustments given in the above paragraph. Ensure that the oscillator is in tune as this defect is easily obtained by de-tuning of this component. Inspect the vision amplifier I.F. valves: if one or more screen or anode is overheating (red hot, or glass envelope hotter than the others) it indicates I.F. instability. Inspect video output valve: if overheating, this also is a sign of I.F. instability or peak-white picture. Ensure that all decoupling capacitors in the I.F. amplifiers are not defective by bridging with a good one (2000pF,

Fig. 15. A multi-range signal generator.

short leads). Check that screening is well secured to chassis, and for any dry joints—soldering tags are especially suspect. Check the valves by tapping with a rubber mallet (a pencil thrust through an eraser)—temporary clearance of the fault may mean an internally disconnected screen connection. If there is evidence of instability, make sure that the voltages at each vision I.F. amplifier anode and screen is about equal to H.T. or a little less, depending upon decoupling. Inspect decoupling resistors for burning; burning may indicate short-circuited decoupling capacitor.

Inspect the video detector components, including the germanium diode if one is used, and ensure that its forward and backward resistances are normal by temporary unsoldering at one end (care is needed not to overheat this component and so a "thermal shunt" should be used).

The video output components

If the valves are not alight, suspect that one heater has failed if the receiver is A.C./D.C. (as is usual). On older sets, with mains transformer, all valves "dead", indicates transformer or supply disconnection. Note, in this case, whether the rectifier valve or valves light up. Suspect a switch fault, primary open-circuit, and take remedial action accordingly. If the receiver is A.C./D.C., check the valve heaters in turn until an unserviceable valve is found. When valves are hard to remove from their sockets, or when the chassis is easily accessible from below, proceed in the following manner.

Switch the set on, connect one A.C. voltmeter terminal to the chassis and, using a well-insulated prod, check the valve-holder heater pins in turn, starting at the "earthing" end of the valve heater chain. When the mains voltage is finally shown, the last heater tested is that of the defective valve and must be replaced accordingly.

If some, but not all valves, light up there is a double heater chain and, in this case, the quickest method is to remove all unlit valves in turn until the offender is detected.

When replacing a defective valve, on switching on, note whether its heater glows much brighter than the rest, or whether a number of valve heaters light up too brightly. If this is so, the reason for the fault is probably a short-circuit from that valve heater pin to the chassis. A defective valve-holder may be the cause of this. Remove the mains plug and follow through the heater chain with an ohmmeter, and at the same time looking for stray blobs of solder, pins, nuts or small bolts which may be lodged between live wires and the chassis.

If the valve heater tests reveal no defective valve, the surge-limiting thermistor or mains dropping resistor has failed. When this is accessible from above the chassis, it should of course be checked first of all before any valves are removed or otherwise tested.

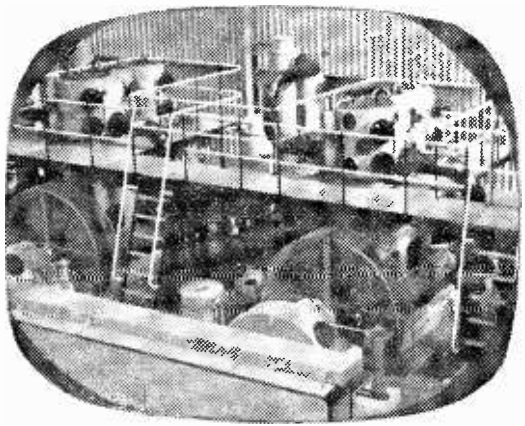


Fig. 14.—"Corner-cutting" may be caused by misadjustment of the ion-trap magnet or by the scan coils not being positioned sufficiently far along the neck of the tube (see paragraph 19 on page 14).

FAULTS OF ADJUSTMENT

1. Sound, no picture, no raster, on adjustment of brilliance control. First ensure that CRT heater is all right. If so, test the tube anode by bringing a well-insulated screwdriver near: a series of clicking noises indicates that EHT is present. If EHT is present, the characteristic line-output whistle at approximately 10,000c/s will be heard. Inference: ion trap requires adjustment. Unclamp the ion trap slightly, rotate and move along the neck of the tube until a raster is obtained. Reduce brightness control and re-adjust ion trap, until maximum brilliance is achieved. Re-clamp ion trap in place. If no raster is obtainable the fault is not one of adjustment.

2. "Wicker-work" appearance of screen. This probably means that the line-hold (line speed, horizontal hold) is out of adjustment. Rotate the line-hold control until the picture locks. Continue rotating until the picture is lost again. Return control to best intermediate position. Or, better still, reduce the contrast control until the picture only locks over a small range of the hold control. The contrast control may now be returned to its former position. (See Fig. 10).

3. A vertical sync bar in the picture. This is caused by loss of line sync but not to such a great degree as in the previous case and so the same correction may be applied.

4. Multiple images. This type of distortion is always associated with loss of width if the horizontal hold control is set for too high a frequency for the line time-base

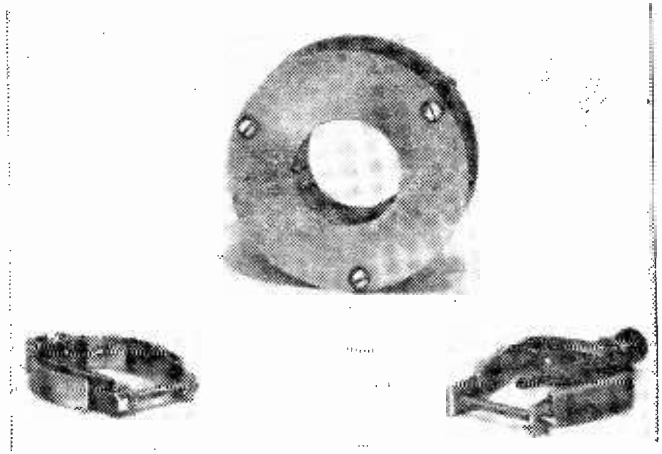


Fig. 8.—A closer look at the various magnets used in television on the neck of the tube; on the left, an ion-trap magnet; on the right, a picture-positioning magnet; and in the centre, a focusing magnet.

generators. The cure is the same as for the previous two cases. If multiple images appear with normal width or with heavily fluctuating picture, aircraft are overhead and giving rise to multiple path reception. Nothing can be done except to wait for conditions to improve.

5. Insufficient scan. This will cause black borders to appear at the sides of the picture, and sometimes at the top and bottom as well and indicates that the width and height controls need re-setting. If no further adjustment is possible, see that the mains adjustment panel is set to the correct voltage. If this causes no improvement, the H.T. rectifier may need replacement.

6. Picture rolls upward or downward. Re-setting the frame-hold (vertical hold) control should cure this and lock the picture. Inspect the interlace of lines with a small hand lens, or through the aperture of a match-box with the tray removed. Adjust the vertical hold control for best interlace consistent with the correct lock.

7. Flyback lines showing on picture. Reduce the brightness and if lines persist, the vertical hold is not operating, even if the picture is stationary (usually it will be jittering or "bouncing"). Re-adjust the frame hold control. An excessively powerful signal may also cause this effect and therefore try reducing the contrast. (See Fig. 11).

8. No picture, no sound, good raster. Make sure that the aerial is plugged in; but if the fault persists, change channels, and listen for the characteristic line whistle. If this is present, wait until the transmitter fault is cleared. The line whistle may be ragged, and edges of the raster also unsteady, and so ensure that the aerial has not blown down.

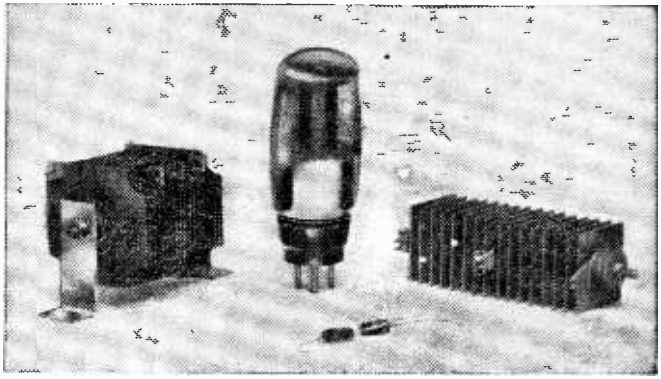


Fig. 9.—Rectifiers used in television sets; a typical valve rectifier, two large, metal rectifiers, and two of the latest, midget, silicon rectifiers (as used in our "Olympic" receiver).

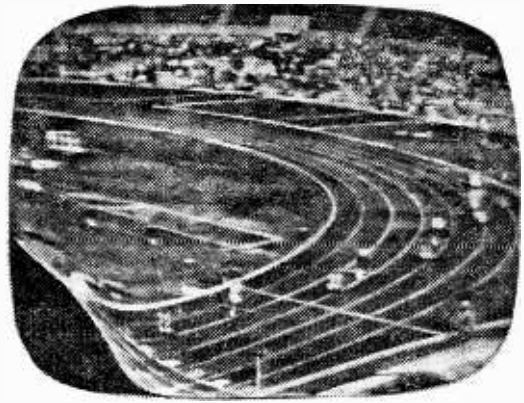


Fig. 13.—Exessive distortion which may have appeared suddenly may be due to the presence of a magnetised object near the tube (see paragraph 18 on page 14).

horizontal and vertical form, unless a fault has developed in the time-base generators. Always adjust with the horizontal width and vertical height a little short of the full extent. Correct if possible on Test Card C. When satisfactory width and height can be advanced so that the picture fills the screen. If Test Card C cannot be used, a pattern generator may be employed instead or a plain signal generator set a little above or below the frequency being received so as to cause patterning. When linearity is correct the patterning will be regular, with uniform spacing. This patterning however tends to drift about on the tube, as a rule, and does not remain stationary; however, in the absence of the test card, it can be used satisfactorily, so long as the signal does not cause interference with the synchronisation.

21. Bowing of Verticals. In receivers having over 70deg deflection, correction magnets of small size are normally fitted on the scan coils: usually in small pockets in the polythene insulation or at the end of aluminium "arms" sticking out from the assembly. If the verticals are much bowed, suspect that the magnets need adjustment or one has fallen out of its "pocket". Reduce the width until a ½in. border appears at each side and referring to Test Card C adjust the position of the magnets by slightly bending the aluminium arms so that the first vertical line on the card (not the border of the picture) is correct. Now the width can be increased to fill the screen.

Sometimes bowing of verticals occurs when flywheel sync is fitted to the receiver. No adjustment is possible in this case as a component fault is to be inferred, but slight re-adjustment of the line-hold control may alleviate the trouble enough for normal reception.

RECEIVER FAULTS

22. No picture, no sound, no raster. Ensure the set is switched on: check mains and fuses of the domestic supply, if necessary, and those of the set.

annoying at normal viewing distance, the oscillator should be re-aligned. Sometimes a rejector circuit is included in the video amplifier to reduce this effect, and this may be in need of re-alignment if accessible.

17. Sound-on-vision. This may be caused by two separate effects, and is characterised by the appearance of bands (usually horizontal) across the picture which vary in position and intensity with the modulation of the sound signal received.

The first effect is caused by anode modulation of the video amplifier by the changing currents in the sound output stage. This can be cleared by turning down the volume control: if the "sound-on-vision" disappears, this effect is present, and a fault is to be inferred, usually the main smoothing condenser having become low in value owing to drying out, or a poor contact with the chassis having arisen.

The second effect is caused by inadequate selectivity in the vision I.F. amplifier. Sound traps are fitted to reject the sound I.F. frequency, and these may need re-alignment. However, the first attempt at curing the fault should be to try slight re-alignment of the oscillator, either by the rotation of the oscillator coil iron-dust core or, in cases where a tuner is used, adjustment of the fine-tuning control.

18. Picture distortion. If the picture is irregular in nature, make sure that nobody has left a magnet on, alongside or under the receiver (or any magnetised object). Even an enamelled-steel ash tray may cause this effect if close to the CRT. If a loudspeaker has been replaced by a new one, its strong field may be the source of distortion. (See Fig. 13).

19. "Corner-cutting". Incorrect adjustment of the ion trap, or picture-centring device, may give rise to this fault. If the scan coils are loose, and have slipped backwards on the tube neck, corner cutting will certainly occur. The remedy is clear in each case. It must be noted that the ion trap magnet must not be altered in adjustment so that any decrease in brightness occurs, otherwise the tube will be damaged. If the fault persists even after the above procedure has been followed carefully, try turning the tube upside down: slight manufacturing inaccuracies can sometimes give rise to the effect, and this alteration may clear the trouble. If the scan coils are loose, pack underneath them with strips of folded polythene sheet.

20. Non-linearity. Careful adjustment of the various linearity controls should clear up any noticeable non-linearity of both

Do not forget that in Practical Television each month there are valuable articles on servicing television receivers—all the information needed for you to service your own receiver is given. We are prepared to help you by post in your servicing problems but you must comply with the rules of our query service and send a stamped addressed envelope and a query coupon from the current issue.

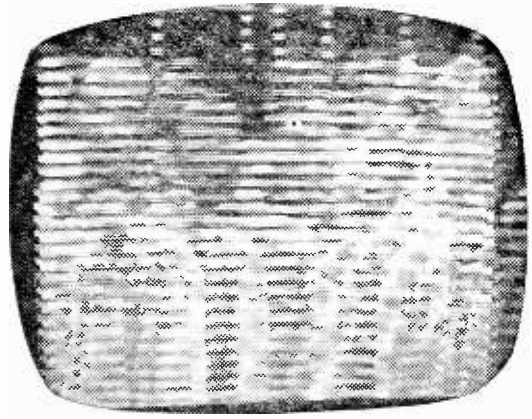


Fig. 10.—The appearance of the screen when the line hold control is out of adjustment (see paragraph 2 on page 9).

If this is not the case, infer a fault in the receiver (this is probably no more than a poor connection in the aerial plug).

9. Poor contrast. A washed-out picture with fly-back lines showing indicates poor contrast and re-adjustment of the contrast control may be the simple solution. If this has no effect, check the aerial plug to make sure that it is correctly inserted. In fringe areas wait to see if the signal returns. Also make sure that the correct channel is selected. (See Fig. 11).

10. Dark picture (with good detail and high lights). Too much contrast is probably the cause, and therefore reduce this control and increase the brightness control until the correct balance is achieved.

11. Good sound, good raster, no picture. If line whistle is not present, wait for the transmitter fault to be cleared, or infer a fault in the receiver. When a whistle is present, reduce the contrast control—a negative picture may appear faintly; if so, reduce contrast still further when the picture will appear. This particular fault can be due to an excessive signal causing a peak-white picture even under no-modulation conditions. Also it may possibly be self oscillation in the vision I.F. amplifier. If no picture appears on reducing the contrast ensure that the mains adjustment panel is set to the mains voltage actually prevailing. A receiver adjusted for 220V may become unstable if used without any re-adjustment on mains of 250V. Sync pulses often "pass through" under such conditions and the line whistle gives no reliable indication.

12. Noise on picture

(a) A general "snowstorm" effect or, in milder cases, a "crawling" background is common in areas where much amplification is needed of a weak signal. Ensure that the aerial plug is properly inserted, and that the correct channel is selected. If width and height appear to be reduced, check that the mains

Fig. 11.—Excessive brightness results in the flyback lines showing on the picture (see paragraph 7 on page 10).

voltage is correctly selected. When the above points are correct, and the area is within the normal service area for the transmitter, infer a fault in the receiver if the fault persists.

(b) Interference due to electrical machines is usually associated with some noise in the sound receiver also, though this need not be great. There is little that can be done about it.

13. "Ringing." This is nearly always caused by phase distortion of the signal at some point or other. This may in turn be caused by multiple-path reception; a large reflecting object located near by (a gasometer or steel-framed building), is a common source of reflection. Nothing can be done to eliminate it, but the effect can be reduced by accurate re-positioning of the aerial, a swing of 5–20deg is usually enough to make the "ghosts" tolerable in a good proportion of cases. Before this is undertaken however it will be as well to see that the oscillator is accurately tuned by means of the "fine tuning" control, if fitted. The oscillator tuning inductance may have to be adjusted in bad cases.

Another cause of "ringing" is the mis-alignment of "sound traps" in the vision I.F. amplifier, but this is not a likely cause in a receiver which has been functioning correctly.

14. Poor focus

(a) at the edges of the picture only. This is quite normal, and does not necessarily indicate a mis-alignment. Slight readjustment of the focus control should enable an optimum, over most of the tube face, to be obtained. With electrostatically focused tubes, a control for focus is not always provided, and if the edges out of focus are unpleasant, at the normal viewing distance, a fault must be inferred, but first ensure that the mains voltage adjustment is correctly set.

(b) focus poor overall. Adjust focus control for optimum results. If this control is ineffective or not fully effective, check the mains voltage adjustment. Make sure that the brilliance control is not too far advanced, and that the outer conductive coating of the CRT is properly "earthed" to the chassis.

15. "Patterning". Signals entering the receiver alongside the required signals and "beating" with the local oscillator, signal frequency, vision intermediate frequency, or the higher video (picture) frequencies, cause the interfering signal. It corresponds to a heterodyne whistle on sound radio. Check the fine tuning control, if one is fitted, and that the aerial plug is properly inserted (loose or high-resistance contacts can cause the whole lead-in cable to act as an aerial picking-up short-wave or even medium-wave signals which can interfere). The mains plug must be correctly wired (the chassis of the receiver should not be "live" when tested with a neon-lamp screwdriver). If this does not clear the patterning, the correct connection should be made if it is discovered that an error has occurred in installing.

Slight I.F. instability can also cause patterning of a random nature, or "streaking" after peak-white objects on the screen. The mains voltage should be readjusted if incorrect as too much H.T. can give rise to this symptom. Patterning may also be caused by Band I "break-through" on to Band III. Aerial down leads being inserted in the wrong coaxial sockets may be the faults here. If persistent patterning occurs at all times of the day, break-through is a likely cause, and there are probably faulty components in the receiver.

16. 3.5 Mc/s "dotting". When a receiver is capable of 3Mc/s resolution or better, this fault may occur if the oscillator is a little off-time. If the distortion is only slight, no correction is necessary because it is hardly noticeable. When it proves

Fig. 12.—The effect of R.F. interference on the picture; the lines over the picture may change their position at random and may not be so prominent as those illustrated.

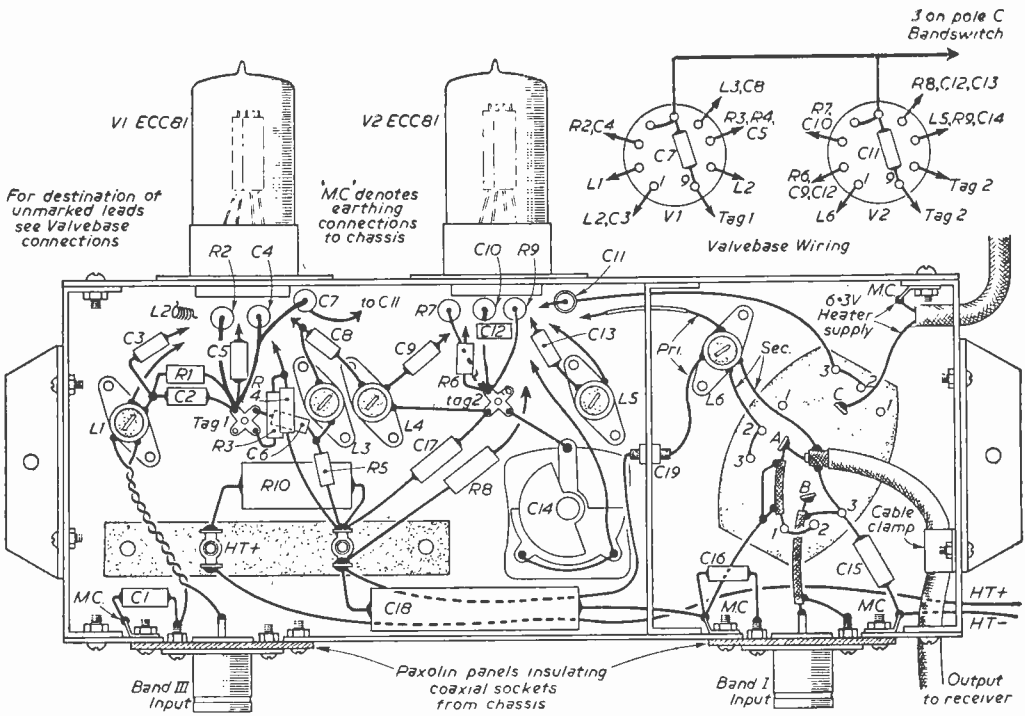
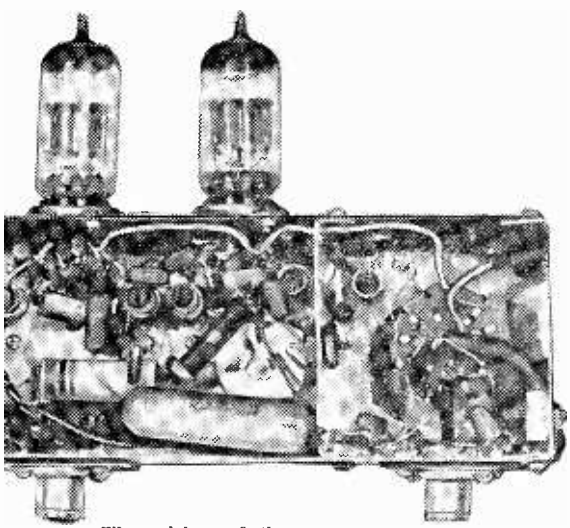


Fig. 2.—The underchassis layout and wiring of the converter.

multi-channel receiver. In addition, the use of triodes throughout reduces the demands of H.T. to approximately 18mA, which is easily supplied by the main receiver. Heater supplies are obtained from a small independent transformer mounted in a convenient position inside the cabinet, or on the main receiver chassis, and fed from the "set" side of the main on/off switch. Switching includes breaking the heater supply; thus the converter valves are only in use when required, and the switch contacts have only to deal with 6·3V.



The wiring of the converter.

Control Switches

Two control knobs are used: one for switching from BBC to ITV, and one for fine tuning which, once set, normally needs very little subsequent adjustment. The channel switch has three positions, BBC, BBC plus ITV warming up, ITV. In the second position indication that ITV is ready to be switched is given by breakthrough of that signal on the screen. I have found this much more useful than direct switching; the valves take only a few seconds to heat up and a great deal of screening is avoided. Switching back to BBC is, of course, instantaneous.

The strength of the ITV signal is matched to that of the BBC by the value of the cathode bias resistor in the first stage. This resistor is mounted in an easily accessible position for replacement. Several values are tried—varying from about 75Ω for maximum gain to 1·5k or so where the ITV signal is particularly strong. A value of 150Ω is a good starting point for preliminary tuning.

The circuit is given in Fig. 1, and the practical layout in Fig. 2. Coils are wound on standard ¼in formers of the flat base type. If the only type available have the spigotted base, this can either be cut off or filed. The only screening needed is round the output stage to prevent feedback, although R3 and R4 are deliberately specified ½W to provide a measure of screening between L1 and L3 by their extra bulk compared with ¼W components.

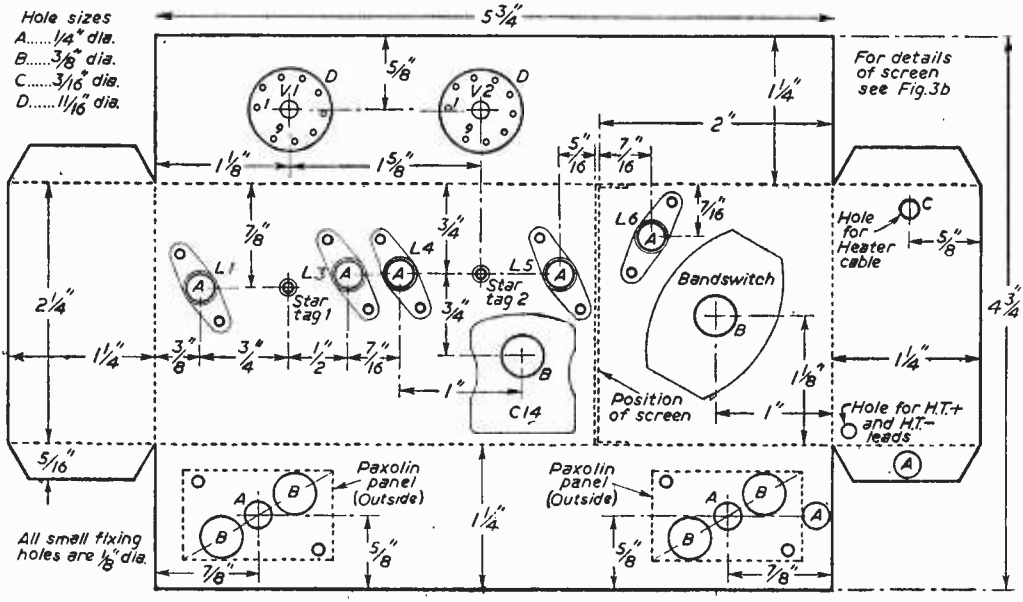


Fig. 3(a).—Drilling details of the chassis.

Winding the Coils

Details of the coils are given in Fig. 4. The coils, L3 and L4, are inductively coupled by mounting close together—at about ¼in. between the former centres. These two coils must be wound in the same direction. Coil L2 is self-supporting and wound on an ⅛in. drill shank for forming. It is not necessary to drill holes in the chassis for the adjustment of the coil cores, as all tuning is carried out from the top.

It is of utmost importance that the aerial sockets and output lead are isolated from the chassis as shown. This is applicable to all A.C./D.C. apparatus. It is highly dangerous to omit these precautions. The aerial sockets themselves are mounted on pieces of paxolin isolated from the chassis. Holes are drilled in the chassis to clear the fixing bolts and centre contact.

No base cover has ever been used on the chassis and this helps to prevent oscillator drift through excessive heat. The unit is usually mounted inside, on the left (looking at the back) of the cabinet, just behind the back cover, with appropriate holes cut in this for the aerial sockets and output lead. For mounting on the right-hand side, the converter is either constructed "mirror-wise" (laterally reversed), to the layout shown, or turned upside down (with the switch at the top). Thus the control knobs spindles will protrude through drillings provided in the cabinet side in a very convenient position.

Tuning

Tuning is straightforward and easy. On several of the converters made, in fact, the ITV signal was received immediately on switching on! Normally, tuning takes about 60sec. and if the layout is carefully followed results are guaranteed.

Various types of switch have been tried, but the best so far used is a 3-pole, 3-way component. This is wired as shown in the layout diagram. Complete screening of the BBC input wires is necessary, even though that signal is earthed when in the ITV receiving position. Microphone screened cable is the most satisfactory as it is easily handled in very short lengths, is thin and insulated externally. The screening braid should be taken right up to the very tips and well earthed. The output lead should be kept as short as possible when the unit is finally installed, and securely clamped inside the chassis to prevent movement. This output lead, of course, will be standard coaxial aerial cable.

On many older sets it will be found that the aerial input sockets are designed for twin feeder—although invariably the lead-in is unbalanced coaxial. This may be modified by fitting a coaxial

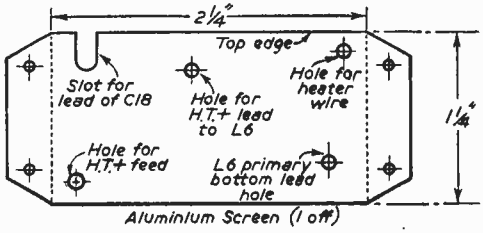


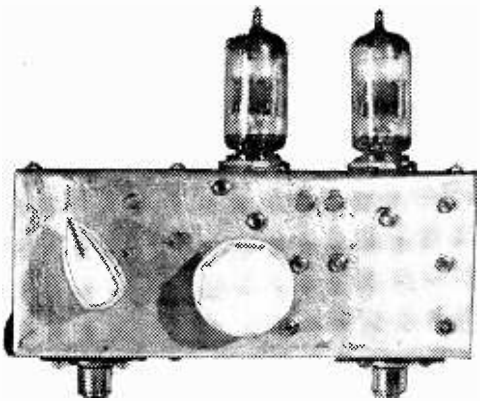
Fig. 3(b).—The interstage screen.

socket in place of the twin sockets. This modification is, in most cases, quite simple. Where maximum efficiency is required the input coil of the receiver may be rewound, but this is rarely justified.

The fine tuner, usually obtainable as a 0-50pF airspaced type with ceramic base is modified by carefully pulling off the vanes until only two are left—one moving and one fixed—spaced one vane apart. This gives a very fine control.

Wiring

Wiring, of course, must be kept short and direct and all soldered joints very firmly made. All "earthy" joints, in particular, must be very



Front view of the converter.

efficient, and long earthing wires avoided. For Band III work, besides the usual soldering iron, drill, screwdriver and thin-nosed pliers, a pair of long tweezers is necessary.

Construction is commenced by cutting and drilling the small aluminium chassis and screen to the recommended dimensions shown in Fig. 3. The chassis is assembled complete with the screen, valveholders, coaxial sockets and tags, and the output coil (L6) is next wound and bolted in position. A piece of sleeving is passed over the bottom lead of the primary winding, passing through the hole in the screen, and the end of the lead soldered to pin 1 of V2. Keep the wire close to the chassis side round the valveholder base.

Tag Strip

Now bolt in the long tag strip, install a 2-3ft length of red p.v.c. covered wire for the H.T. supply, passing it out through the screen and base holes provided, and solder R10, C17 and C18 in place. Take a red p.v.c. covered lead from the junction of R10 and C18 and pass it through a hole in the screen to a small insulated tag inside the switch compartment for the H.T. supply to the output coil primary. This arrangement could very conveniently take the form of a lead-through capacitor, if one is available. Solder the top lead of the primary of the output coil to this.

Now wire the heaters, positioning C7 and C11 round the bases of the valveholders close to the chassis. Make all necessary earth connections from the valveholders and take to the star-shaped tags mounted as shown (one for each section). It is important to group all "earth" connections as shown. Now solder all the remaining components with the exception of C2, C3, R1, R5, C8, C9, C13, C14 and C15.

(To be continued)

LIST OF BASIC COMPONENTS

5in. x 9in. and 3in. x 1½in. of sheet aluminium.
Two B9A valveholders (ceramic or moulded).
Two coaxial chassis sockets.
Five ¼in. coil formers (flat base type) and iron dust cores.
One tag strip (two wide-spaced tags).
One single insulated tag — or feed-through capacitor.
One 50pF single gang air-spaced ceramic tuning condenser.
One 3-pole, 3-way switch.
One heater transformer (6·3V, 1A).
Two valves, ECC81 or 12AT7.
Capacitors:
- **Three 2pF tubular ceramic condensers.**
- **One 10pF tubular ceramic condenser.**
- **One 25pF tubular ceramic condenser (preferably with a negative temperature coefficient).**
- **Ten 1,000pF tubular ceramic condensers (500VW).**
- **One 1,500pF tubular ceramic condenser.**
- **One 0·1μF waxed tubular condenser (500VW).**

Resistors:
- **Two 150Ω ¼W.**
- **One 1·5k.**
- **One 12k.**
- **One 47k.**
- **One 220k.**
- **Two 100k ¼W.**
- **One 6·8k 1W.**
- **One 1k or 6k 2W resistor (R10).**

One coaxial plug.

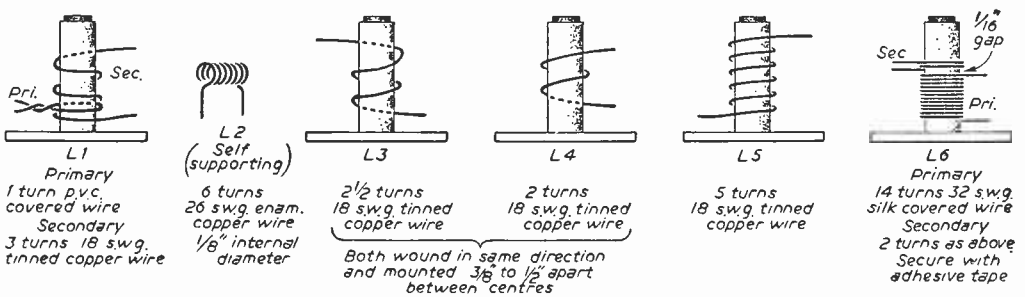


Fig. 4.—Coil winding details.

Line Oscillator and Sync Circuits

No. 1—FIRST CONSIDERATIONS

By A. G. Priestley

A CIRCUIT diagram of a television receiver can easily be divided into several groups of circuits, each having a well defined job to do. On further examination of any of these groups, it is found that they have a carefully chosen balance of quite a large number of characteristics and compromises, and this is one of the main responsibilities of the development engineer. However good the basic circuit may be, it is of little use to the receiver, as a whole, until it has been engineered to suit the particular circumstances, and this is especially true of line oscillator and line sync circuits.

The purpose of these articles is not to describe individual types of circuit in detail, as such circuits may easily be obtained from the many books on the subject, but rather to discuss the characteristics which need to be built into them, and some of the practical means of obtaining the right sort of behaviour.

The Line Oscillator

The basic function of the line oscillator is to produce a series of large negative going pulses, at the correct time intervals, to drive the line output valve. This sounds fairly straightforward, but examination of the full list of requirements will show which practical techniques are needed to deal with the situation. The author has attempted to look at these matters from the points of view of both the professional engineer and the home constructor, because they are not always the same. Below is the list of requirements considered necessary for the correct functioning of the line oscillator:

- a satisfactory output pulse;
- an adequate hold range and free running range;
- a low oscillator frequency drift;
- a good self-starting characteristic;
- a small change of oscillator frequency with picture brightness;
- satisfactory circuit tolerances and component ratings.

The Output Pulse

One of the first things needed to be known is the size of pulse required in order to switch the line output valve on and off completely during each cycle. During flyback, when the valve is not conducting, the anode voltage may be anything up to 6kV, and so it will clearly need quite a large negative grid voltage to ensure that it is safely cut off. This information can be found in the manufacturers' published data, and is commonly 100–130V.

Most of the common oscillator circuits will give an output of this size with the anode taken to the H.T. line, but if any difficulty is experienced it may be possible to take the anode to boost H.T. instead, providing that the current drain is not more than about 1mA. The boost H.T. is often 400-500V, and so a much larger pulse can be obtained. In some cases it is also helpful to use the highest value of grid leak resistor for the line output valve that the makers will permit.

To make sure that the pulse is large enough, try reducing the H.T. supply to the line oscillator only by about 20 per cent, and note whether any change of picture brightness occurs. If there is none, then the drive is adequate for that particular output valve.

The next thing to do is to make sure that the leading edge of the pulse is steep enough to cut off the grid before a significant amount of the flyback energy in the transformer has had a chance to escape through the valve. To avoid this, the negative pulse fed to the grid should reach the cut-off voltage in under 1μ sec (1/1,000,000th of a second). If you know that the pulse is large enough, from previous experience of the circuit, then the reduced H.T. test of the oscillator will tell you whether it is steep enough.

Blocking oscillators and ordinary multivibrators are usually satisfactory, but some sine-wave types, often used in flywheel circuits, and a special multivibrator which uses the line output stage as one half of it, may give trouble. The cure here is to make the output time constant shorter, or else to apply some more high frequency positive feedback. One useful way of doing this is to connect a small capacitor of about 39pF between the screen of the line output valve and the grid of the oscillator. Any improvement will be shown by an increase in EHT, and therefore of picture brightness, at any particular setting of the brilliance control. A typical example of this technique is shown in Fig. 1.

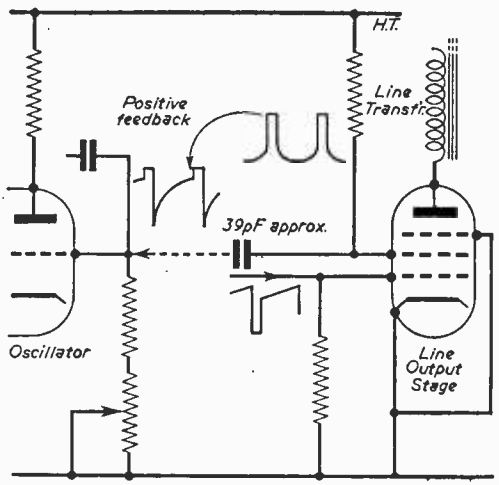
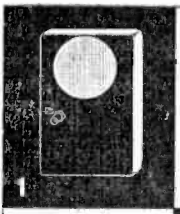
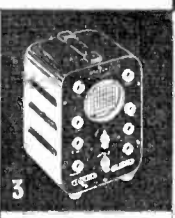
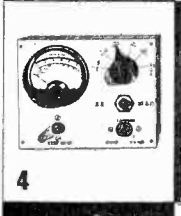


Fig. 1.—Improving the steepness of the oscillator output pulse by adding a positive-going pulse on to the grid from the line output stage.

CHECK with these BARGAINS







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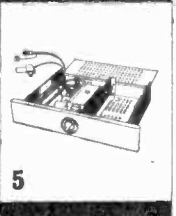

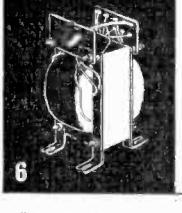

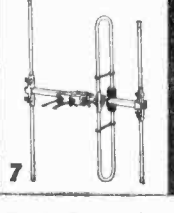

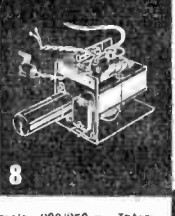

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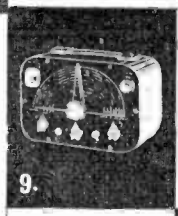

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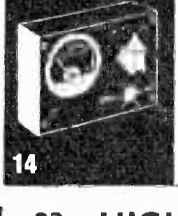

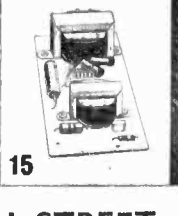

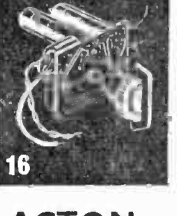

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The extra positive feedback to the oscillator makes it trigger more quickly, and so the output pulse is consequently steeper. Too much capacity will upset the oscillator and cause the opposite effect, so a compromise must be reached.

The last important item to consider is the duration, or width, of the pulse. If this is less than the width of the flyback pulse, the output valve will start to conduct again too soon and some of the energy stored up in the line transformer will be wasted. This means that there will be less available for the first half of the next cycle, and the picture will be narrower in the line direction, with a lower EHT (see curve (a) Fig. 2).

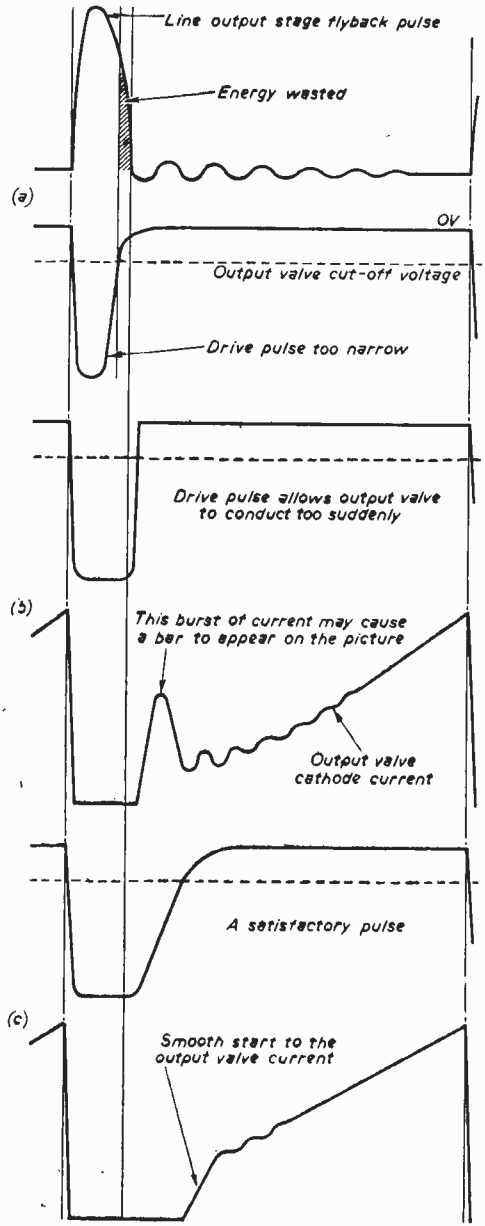

Fig. 2 (a, b and c).—Relation between the drive pulse and the line output stage flyback pulse.

If the pulse is only slightly longer than the flyback cycle and finishes abruptly, as it probably will (Fig. 2b), the output valve cathode current will start too suddenly and a vertical bar will appear near the start of the raster. A satisfactory shape of drive pulse, and the resulting cathode current, is shown in Fig 2c, and this is often obtained by means of a simple shaping circuit (Fig. 3). This is for the case of a sawtooth output from a normal multivibrator circuit.

The basic requirements of a line oscillator pulse have now been covered, and these will be the same for both amateur and professional equipment, but the circuit could still be most unsatisfactory if the other characteristics are left to look after themselves.

Hold and Free Running Ranges

In an ideal receiver the hold control would never be needed because the frequency would never vary. In practice, however, component values change with age and temperature, and the H.T. voltage depends on the mains output. Also the difference in actual component values between receivers of the same type have to be taken into account by the commercial set-maker. Consequently a potentiometer needs to be designed into the circuit and made accessible to the user.

The possible combination of all the adverse tolerances means that the setmaker has to provide a large free-running range in order to ensure that the hold range, say from 8·8–10·125kc/s, will always lie within the range of the control. This free-running range in a typical case will be about 7–12kc/s, and if the hold range happens to be small, the knob adjustment will be rather critical.

For reasons which will be described later, when discussing line sync problems, the home constructor will want to provide just such a short hold range, and since he has no component tolerances to worry about he can use a small free-running range of say 8·5–11kc/s and thus have ease of adjustment. The range is normally reduced by increasing the value of the series resistor and decreasing the potentiometer, where this applies.

Oscillator Drift

If the component values change as the receiver warms up, the oscillator frequency will vary, and the hold range has to be correspondingly increased, and this is undesirable. Most components have negative temperature coefficients, i.e. the resistance or capacity falls with increase of temperature, and the oscillator speeds up.

The easiest way of finding out which components are causing the oscillator to drift is to disconnect the line sync feed, adjust the frequency so that the picture just tries to hold, and then place a warm soldering iron near (but not too near!) each of the likely resistors and capacitors in turn for a few seconds. Any change of frequency is immediately noticeable on the picture.

Having found which components are causing the trouble, the cure is to move them to a cooler part of the chassis, or to protect them with a small heat baffle, where appropriate. If this is not successful, then the frequency-controlling capacitors should be changed for types with positive temperature coefficients, although these are sometimes hard to obtain in certain ranges of valves.

In other cases, the trouble may be due to the valve base material having a large temperature coefficient, and here ceramic tends to be poor and it is better to use a plastic type with only a small amount of material surrounding the tags.

The base material of printed panels has a positive coefficient, which is a good thing, but this is offset by the low thermal conductivity which causes it to take up a higher temperature, and the net result may be to make matters worse.

If the line sync is fed direct to the oscillator, or through a clipper, the frequency stability is not quite so important as it is when a flywheel type of oscillator is used, where the pull-in range may be only 200c/s. Great care should be taken to keep the drift as low as possible because otherwise the pull-in range will have to be increased and the quality of synchronisation will suffer proportionately.

Oscillator Self-starting Ability

It is clearly of great importance in both amateur and professional equipment that the oscillator should start oscillating as soon as the circuit warms up, on each and every occasion, and that it should never fail to do so. If it does fail to start, the output valve will be damaged, or its life will be reduced, by the excessive mean anode current that will flow if there is no bias on the grid.

Before coupling a new oscillator circuit to the output valve it is a wise precaution for the home constructor to connect a resistor in the cathode, chosen so that the current will never rise above its limiting mean value. The resistor is calculated by looking up the published curves and lists of all valve limits and noting the value of grid bias for which the anode current reaches its permissible limit.

The cathode resistor R_K is given by the bias required divided by the limit of the anode current I_k plus the screen current (i.e. cathode current I_K plus the screen current (i.e. cathode current I_K), and the wattage $P = I_K R_K$. A typical value might be 82Ω and 3W.

The reason why a commercial setmaker often does not use such a resistor is that it is a bulky and expensive item and the efficiency of the live output circuit is reduced by the power dissipated in a purely precautionary device. Nevertheless its absence often leads to the unpleasant sight of the electrodes glowing red hot when the oscillator stops!

When testing a circuit for its self-starting ability it is most important to do so when the components are completely cold—especially the valves—and with no signal applied to the receiver. Almost any circuit will start up when it is hot and has large sync pulses fed to it, but some are strangely reluctant to do so when left to their own devices. It is also a good plan to test it with a reduced H.T. voltage and with old valves, if you have any available.

When reducing the H.T. for these, or similar tests, by fitting a resistor in the H.T. line, do not forget to decouple it with a fairly large electrolytic capacitor connected to chassis, or results will be unreliable.

The cure for an unsatisfactory circuit depends on understanding how it works. Basically an oscillator functions because it has positive feedback between anode and grid, i.e. a change of voltage on the grid is amplified and appears at the anode as a larger voltage in the opposite phase. This is then inverted in a coil, another valve or a phase-change network, and fed to the grid again so that it is larger than it was before. This larger voltage travels round the loop again and excites the grid still more. It is said that the loop gain is greater than unity, and this enables a sustained oscillation to occur.

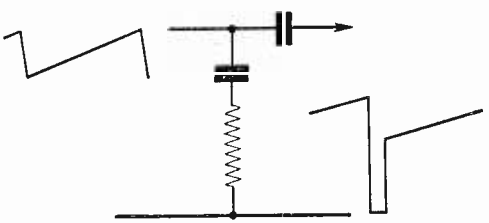

Fig. 3.—Drive pulse shaping circuit.

The initial change of grid voltage which allows the circuit to build up an oscillation is normally a minute noise impulse, which is present in every electrical circuit, but a sync pulse is far more effective because it is larger. Touching the grid of the oscillator with a screwdriver, or switching the mains input off and on again, is quite enough to trigger it off.

In improving the starting ability of an oscillator the aim must be to increase the positive feedback. This can be done either by increasing the gain of the valve, or by taking a larger proportion of the inverted anode voltage back to the grid or by applying more feedback from a different part of the circuit.

In the first case it may be possible to increase the gain of the valve by choosing the operating conditions more carefully, and possibly by using the boost H.T. instead of the ordinary H.T. line if the current drain is small.

The next possibility is to check the circuit impedances and make sure that no unnecessary attenuation occurs between anode and grid.

There is, in the second alternative method, often quite a lot of scope for using ingenuity in applying more feedback from other parts of the circuit, mostly from the line transformer. Positive pulses are available for feeding back to the appropriate electrode of the oscillator, and these can often be applied direct through a capacitor of a few pF, depending on circumstances. If the oscillator operates off boost H.T., try unsmoothed boost H.T. instead. If the line frequency ripple is in the right phase, it may help.

In the case of an oscillator which uses the line output stage as one half of it, a resistor of about 33Ω in the output valve cathode circuit is sometimes effective in biasing it so that its grid exerts more control over the anode current under starting conditions: i.e. more gain. It will also give some protection against overload, as mentioned earlier.

(To be continued)

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

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COMPLETE KIT—now ONLY 79/6, Carr. 2/6. 7in. x 4in. matching speakers 18/6. Circuit and instruction leaflet for complete Portable Record Player 2/6, post free.

Driver Trans. 10/6	Special price
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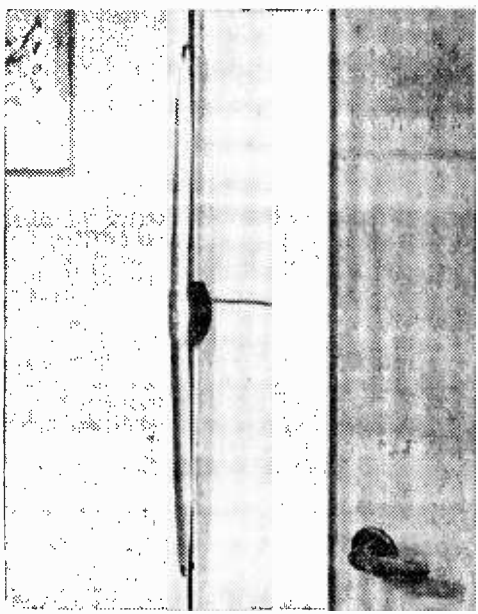
Trade News

NEW PROSPECTS AND DEVELOPMENTS

"Cresta" Indoor Aerial

THIS aerial is for Band I and Band III reception and is suitable for mounting almost anywhere in a room. It employs a centre-fed full-wave dipole for Band III, which is impedance-corrected by a special resonator in close proximity to the dipole. The Cresta is supplied complete with fixing screws and ready to plug in (15ft of cable and coaxial plug fitted). It is styled in black and gold and retails at 25s. *(Antiference Ltd., Bicester Road, Aylesbury, Bucks).*



The "Cresta" indoor aerial which is suitable for Band I and Band III reception.

Two Aerialite Cables

TWO new cables have been developed by Aerialite Ltd. for the distribution of television programmes. The cables are available in a range of conductor sizes and have good high frequency characteristics. The single screened television relay cable incorporates the already widely used Aeraxial polythene insulation to provide an attenuation characteristic lower than that obtainable in any other form of continuously extruded semi-air-spaced coaxial cable. The primary screen on this insulation consists of folded copper tape with overlapping edges covered by copper wire braid applied at the same time and in such a manner that it locks the edges of the tape and provides mechanical flexibility. The double screened version of the new copper taped Aeraxial television relay cable has an inner screen of close mesh copper braid applied to an Aeraxial insulated conductor and separated by an insulating inter-sheath from the secondary screen, which is a copper tape.

Both of these cables are available in five conductor sizes, up to 0·104in. in diameter. These cables are manufactured by *Aerialite Ltd., Castle Works, Stalybridge, Cheshire.*

New Valve Tester

A NEW valve tester, model 45C, has just been released by Taylor Electrical Instruments Ltd. This instrument is capable of testing over 5,000 different types of valves—British, American, and Continental. Two ranges of mutual conductance are provided 0-3mA/V and 0-15mA/V and tests are also incorporated for element shorts, cathode leakage and emission. A separate TV tube adaptor Model 445 is available which now incorporates a special base for the latest wide angle 110deg. tubes. The 45C incorporates 21 valve holders and is supplied complete with instruction book and valve characteristic manual. Model 45C is manufactured by *Taylor Electrical Instruments Ltd., Montrose Avenue, Slough,* and is illustrated overleaf.

Two New Oscilloscopes

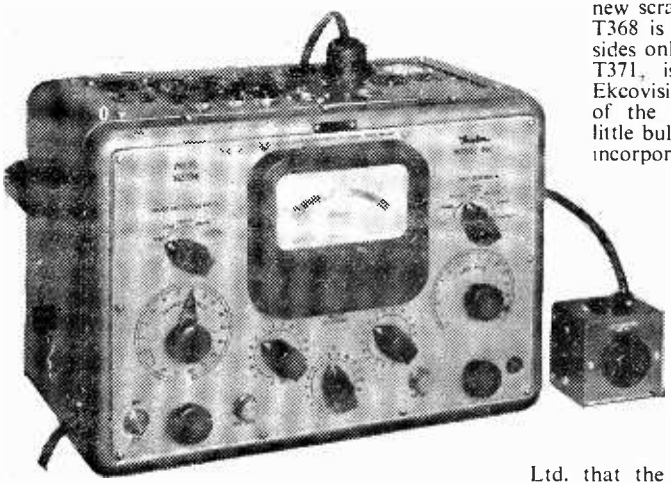
THE U.K. distributors for Philips, Holland—Research and Control Instruments Ltd.—have recently announced two new oscilloscopes. Both are general purpose instruments suitable for routine measurement on production lines and in laboratories and service workshops. The difference between them lies in the vertical amplifiers. Type GM5606 is designed for measurements between 0-200kc/s (−3dB) with 10mV/cm sensitivity. Type GM5601 covers the frequency range 0-5Mc/s (rise time 75μs) with 100mV/cm sensitivity. Both types have a flat-faced 10cm cathode ray tube, stable triggering at frequencies up to 1Mc/s with adjustable trigger levels and timebase magnification up to a maximum of five times with 3per cent accuracy. The sole distributors are *Research and Control Instruments Ltd., Instrument House, 207, King's Cross Road, London, W.C.1.*

C.W.S. Television Receiver

THE latest C.W.S. Defiant television receiver is a 21in. table model—No. 2A22. The set is styled in light sapele mahogany veneer with sycamore mask and surround, and has a heat resisting Polyestre finish. Three push buttons give on/off, tone and picture control, and the set also incorporates matched twin speakers to ensure good sound reproduction. Further information may be obtained from the *Co-operative Wholesale Society Ltd., 1, Balloon Street, Manchester, 4.*

Ekcovision Receivers

SEVERAL new Ekcovision receivers have recently been placed on the market by E. K. Cole Ltd. These receivers have extra-slim cabinets which have a



The new Taylor valve tester, model 45C.

new scratch-resistant polyester finish. Model T368 is a 17in. table model and has cabinet sides only 8½in. deep. The 21in. table model, T371, is only a few inches deeper. The Ekcovision "carry-about" 17in. receiver is one of the slimmest receivers available and is little bulkier than a brief case. Model TP373 incorporates V.H.F. radio and has provision for a clip-on telescopic aerial which serves for both radio and television reception. Two other models, T370 17in., and T372 21in., incorporate V.H.F. radio and a dual-speaker sound system. Further details of these receivers may be obtained from *E. K. Cole Ltd., Southend-on-Sea, Essex.*

Price Reduction

IT is announced by the Stella Radio and Television Co. Ltd. that the tax-paid price of their 21in. table television receiver, model ST 1011U, has been reduced from 76 guineas to 72 guineas.

THE "OLYMPIC"

(Continued from page 80)

must be taken that no leads will be trapped by the screen when it is finally fixed.

Heater leads are the first to be attached. These have to be tucked well down on to the chassis, out of the way. In the sound I.F. amplifier these leads are carried in metal braiding, and the heater wire should be covered with high-temperature resisting insulation; a suitable kind can be bought from your local store, and consists of a copper wire inner with a very tough covering of insulation. The reason for this precaution is that the braid has to be soldered to the tags at the valve-holders and with some insulating materials the extra heat produced may cause failure.

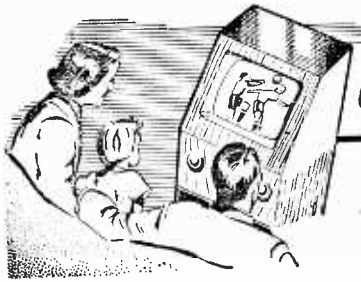
Wiring Order

The correct order of wiring to the valves must be observed if hum effects are to be minimised, and care should be taken that the cathode ray tube heater is connected at one side to the chassis; it is the last in the chain. When the heater leads have been attached the necessary heater decoupling capacitors should then be added. Note that the leads of these disc-type capacitors must be cut as short as possible if the best decoupling is to be obtained. A certain amount of latitude may be allowed in the vision I.F. amplifier, but none in the tuner.

Flexible leads are taken to the tube holder, and these should be made sufficiently long at the start. They can easily be shortened later when the tube is mounted. Where the leads are soldered to the 12-pin holder they may be stiffened a little for an inch or so with insulating tape, the tape being bound round the holder to minimise movement.

In building up the vision and sound I.F. amplifiers, two-dimensional construction is the aim. Good clearance between "hot" leads and the chassis must be given to avoid circuit capacitances, but the layout is simple. In the timebase generators three-dimensional layout is necessary, partly because of the number of controls involved and partly because the space must be utilised to the best advantage. The wiring diagram should therefore be checked frequently against the theoretical circuit diagram to ensure that the correct valve pin is always located and to avoid any chance of crossed wires being mistaken for joined connections.

(To be continued)



UNDERNEATH THE DIPOLE

TELEVISION PICK-UPS AND REFLECTIONS

By Iconos

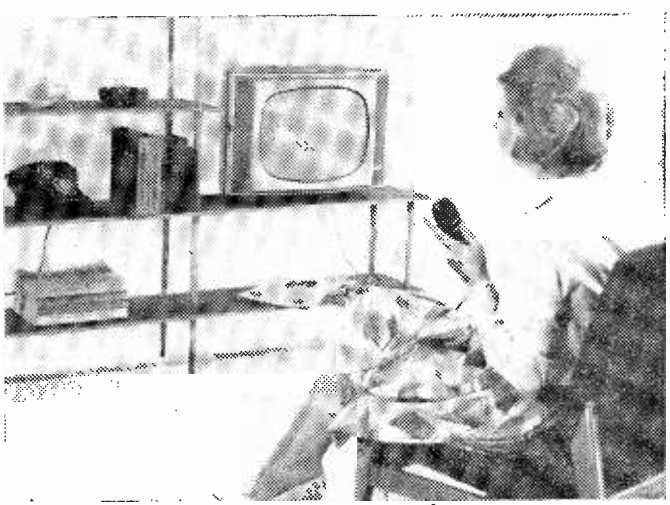
ONE of the essential preliminaries to the opening of a commercial television station is the enlistment of the largest possible number of viewers for the very first sight of local and ITV network programmes. Without some kind of assurance on this point, advertisers will not be interested in buying space in the "natural breaks".

Conversion Campaigns

This "softening up" process applies all over the world, and as the number of station openings is increasing month by month, it can be assumed that each opening has been preceded by its own particular conversion campaign. "Conversion" is the name applied in Britain to this type of sales drive, originally devised to persuade viewers to buy converters for switching over their TV sets from BBC to ITA, but latterly extended to a general campaign for achieving a high set-count for the opening night, for co-operation with manufacturers of sets and aerials and for the enlightenment of the public on the coming attractions of the star features of ITV. As practically all sets sold since 1956 have built-in turret tuners or other means of selecting the different channels—therefore not requiring a separate converter—the title "conversion campaign" is now something of a misnomer in its original definition. It is used in the wider sense of persuading viewers to add ITA aerials to their existing BBC ones, to fit appropriate coils, to twist existing high-gain aerials around towards the new and nearer ITA transmitters (and possibly to add an attenuator!). Even if the ITA signal is so strong that it can be picked up on the BBC aerial, to advise viewers to spend money on fitting even the simplest types of ITA aerials is in the interests of better quality pictures. Television dealers naturally welcome these campaigns as being good for business and often take a prominent part in conversion campaign activities.

Increasing the Set Count

Tyne Tees Television was one of the first of the British regional ITV stations to indulge in what appeared to be a most extravagant expenditure on a campaign to tell the public to "get ready for the day"—that was. the opening "on air" date of the station. It was a well co-ordinated publicity campaign using posters. press, exhibitions, lectures and demonstrations, and it was a colossal success. Tyne Tees had a fine large set-count from the start, and set the fashion for these campaigns. Southern Television copied the idea before their Southampton studio opened, adding a few stunts of their own, including elaborate exhibitions in six towns, with live shows and closed-circuit facilities to TV sets on retailers or manufacturers stands, backed by a barrage of posters and "throw-aways". Anglia followed suit before opening at Norwich, their extra gimmick being visits to various towns of Anglia by helicopter, supported on the ground by an outside broadcast van, closed-circuit pictures on monitors, personal appearances of TV stars and so forth. Westward Television, opening at Plymouth next spring, are now planning their own conversion campaign with an exhibition train calling at twenty-three towns in their area. The train, headed by the record-breaking "City of Truro" locomotive, will have a miniature television studio and telecine in one of the coaches, a cinema coach,



This Sobell receiver incorporates a remote control unit which enables the viewer to operate brightness and volume controls from a distance—an example of the latest trends in TV design.

and three exhibition coaches containing exhibitors' stands. The Westward Express will start at Truro and call at Penzance, Taunton, Exeter, Torquay and many other towns in the area, for periods of one to three days, ending with six days at Plymouth. Smaller towns will have a one-day "whistle stop"; larger towns will have a two or three day visit. It should be a most effective gimmick.

The Theatre and TV

Everyone connected with television, whether as a viewer or as professional in the TV business seems to have their own very individual and positive view of the medium as an "art form". ITV viewers mainly look upon it as a pleasant form of light entertainment, in which their evening doses of Westerns and who-done-it mysteries are as essential to their diet as their bacon and eggs for breakfast. BBC-TV viewers take a somewhat different view, stressing the dynamic journalistic appeal of "Face to Face" and "Panorama" but acknowledging the craftsmanship of BBC's handling of TV plays, ballets and sports events. I would imagine that ATV's executives pin their faith to spectaculars, revue and variety presentation, while ABC-TV obviously plunge heavily on specially written plays for Armchair Theatre, which are presented more in film continuity form than in the format of the theatre. Personally, I think that Howard Thomas, Head of ABC-TV, has evolved a consistently successful policy which pleases both ITA and BBC groups of viewers. His plays are pleasantly varied from week to week, their style and type is varied—never overloaded with dialogue or underloaded with lack of settings—and there is little risk of repeating the same old routine, week after week, as in the everlasting (but ever-popular) "Wagon Train". For example, a recent Armchair Theatre play, "The Dummy", was a fast moving comedy thriller about a henpecked husband, longing to break out in adventure, who sees his opportunity for achieving this objective when his wife inherits a legacy. He will murder his wife, collect the money and tour the world. The perfect alibi for the perfect murder will rest upon his unusual hobby of making masks, faces and other ornamental oddities in his garden shed. He makes a perfect reproduction of his own head, which he places in a prominent position near the window where he normally sits every night. Improbable and unconvincing as the story was, the production by Alan Cooke and the excellent acting and strong personality of Cyril Cusack in the principal part held the interest throughout. It was a pity that the actual fake dummy's head was so poor, as this "prop" was the mainspring of the whole plot and should therefore have been a superb likeness.

Audience Shows

One of the most successful television theatres has been the BBC's conversion of Sir Oswald Stoll's old Empire Theatre, Shepherd's Bush. Recently modernised and overhauled, it is one of the best conversions of this type, highly suitable for spectacular shows requiring an audience. ATV copied the idea when they bought the Empire music halls at Wood Green and Hackney, and ABC did the same with an old music hall at Aston, Birmingham, Associated Rediffusion in London used the Granville Theatre for a time, and Granada converted the Chelsea Palace. There are other examples in Britain of this kind of television theatre conversion, highly suitable for certain kinds of audience participation programmes, but in almost every other way inconvenient to operate and maintain. The craze for converting theatres was at its height four or five years ago. Then came a period when Companies built new larger studio stages, like TWW's at Cardiff, AR's first studios at Wembley and Southern's at Southampton. This meant that when an audience participation programme was being put out, a large proportion of expensive studio space was taken up with portable chairs for them to sit on. So now there is a slight move once more towards the use of live theatres; but in a different way. The London Palladium is now wired to enable it to be rigged for television in a couple of hours. No trailing of cables all around the place, cameras and light are simply plugged into permanent outlets, thus speeding up the preparation work. A similar plan is to be followed out at Plymouth, in the new Athenaeum Theatre Auditorium, a gem of modern "little theatre" construction. This will be connected with its neighbour, Westward Television, by an underground passage! All Westward's audience participation shows will originate at the Athenaeum, which will be fitted up with camera, microphone and the lighting sockets to reduce rigging time. Video tape will be used to enable additional programmes to be recorded on one day's use of the Auditorium. Back in London, the Granville Theatre, Fulham Broadway, has once more been opened for television.

Letters to the Editor

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

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

FRAME BOUNCE

SIR,—I think my experience with a fault might be worth relating in case the cause and cure would be of help to others. The trouble was a jittery picture, called in technical circles, I believe "frame bounce". All sorts of things had been tried without success, but when going to remove the sync valve one day (with the set still switched on, I am ashamed to say), I noted that when I grasped the valve the jumping stopped. After a little experimenting I found that the cause of the trouble was microphony in the particular valve, owing to some fault in the electrode assembly as it did not occur with other valves of the same type and make. Only this one valve causes the trouble, and vibration from the loudspeaker was the cause. —H. DICK (Harringay).

ADVERTISEMENTS

SIR, — While fully realising the Independent Television Authority's need to present their advertisements in such a way as to increase the sales of their clients, so impelling them to go on using TV as a advertising medium, it would, in my opinion, make programmes more acceptable if the advertisements were shown every half-hour instead of every quarter of an hour. Of course the time allotted to the advertisements would have to be increased correspondingly, but I feel this would not reduce the sales of the various products. Indeed if the programmes are more pleasing to the viewer, as I believe they would be, surely the sales would increase.—M NICHOLLS (Bradford).

ODD INTERFERENCE

SIR,—I have noticed a distortion on my receiver which seems to be peculiar to my set. It occurs whenever my wife uses a vacuum cleaner while the television is on. The picture looks as though it is formed along a sine curve. Experiments with neighbours' television receivers show that only my set is affected by the use of the vacuum cleaner. This does not worry me particularly as it is seldom that both the set and the cleaner are in use together, but as I cannot furnish a suitable explanation I wonder if any reader knows the reason for this distortion. —R FAULKNER (Glasgow).

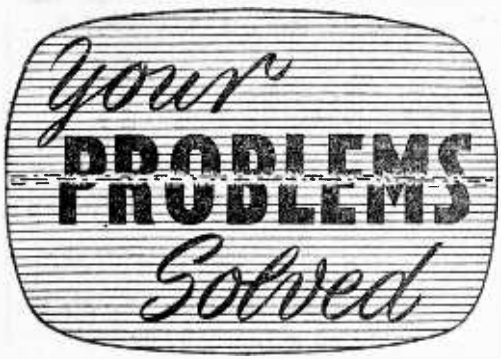
NOVEL AERIAL

SIR,—During a recent gale my TV aerial was completely wrecked. I ordered a new one but was told it would be some weeks before I would receive it. therefore I began to hunt for some suitable substitute, and subsequently connected a disused aluminium weather cock to my set. This "aerial" gave reasonable reception but the addition of some aluminium framework, taken from an abandoned lorry, fixed to the weathercock, gave a perfect picture.

Although everyone passing my house looks with astonishment at this construction I have since cancelled the order for the commercial aerial and have saved a good deal of money.—A. ROWE (Wandsworth).

SOUND PROBLEM

SIR,—The small size of my living room necessitates that my TV receiver is situated in one small corner. As my set is fitted with the loud speaker at the side, much of the sound is muffled by the close proximity of the walls. I overcame this problem by fitting a home constructed megaphone to the side of the set. This assembly, although looking rather out of place, enables the sound to be directed at the viewer and the sound reproduction is also increased and improved. J. BLACKMAN (Pershore).



Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 110 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

MURPHY V240

The tube on this set, a CRM141, was boosted 50 per cent six months ago and gave a good picture until recently when the heater burnt out. I fitted a CRM142 rebuilt tube, but cannot obtain a picture or raster and the sound volume has slightly decreased. When the brilliance control is turned up a flash appears on the tube face but there is still no raster. I suspect a fault in the EHT rectifier.—J. Shelley (Chester-le-Street).

Check the setting of the ion trap magnet carefully and if this does not help, suspect a faulty EHT rectifier. This is inside the line output transformer.

EKCO TS88

I wish to replace the existing tube—CRM92—with a 10in. EMI 3-16. I can overcome the heater problem by fitting a 13·3V isolating transformer. However, I find that while the original tube takes 7kV on the final anode, the replacement will only take 5·5kV according to the maker's data. What is the best way to reduce the EHT voltage in the TS88 to suit the replacement tube?—S. A. Franklin (Basildon).

We suggest you risk the EHT as it is. We doubt if the TS88 gives much more than 6kV and we know of several 3-16's working in Cossor 916's where the EHT is a certain 7·5kV.

PORTADYNE 17392

What is the best type of converter to suit my set? The I.F. is 16Mc/s vision and 19·5Mc/s. I should like to use a tuner which does not require too much alteration to the set.—H. Dartnell (London E.9).

For the minimum of alteration we would suggest you use a Cyldon P16H turret tuner. The method of fitting is simply to remove the V1 EF80 R.F. amplifier and insert the R.F. plug of the tuner, remove the V2 EF80 mixer and insert the I.F. or mixer plug.

H.M.V. 2811

I have recently replaced a burnt out tube with a Mullard MW 31-74, taking a first anode supply from the maximum H.T. available, fitting a new focus magnet and ion trap magnet. To obtain adequate EHT I fitted a voltage doubler. I now have a brighter and sharper picture than ever before, but there is insufficient width and I have to reduce the height to match. I have tried putting a condenser across the line scan coil but lose definition. Can you suggest any means of increasing width?—E. R. Barker (King's Norton).

A large increase of EHT is always attended by the problem of providing extra scanning power. For this reason we normally advise doubling the A1 voltage, leaving the EHT little changed. Wire a 0·1μF condenser from pin 8 of the KT36 to chassis and a 500pF across the scanning coils.

STELLA 148OU/15

This set is fitted with a Brayhead turret tuner, and has now developed a fault. The set was removed from its cabinet for a change of channel coils in fitted Brayhead turret. The set was replaced in its cabinet, readjusted and at first worked excellently. After about three hours the picture brightness decreased and the picture size changed. I increased the brightness and contrast to maximum. The line hold could only produce a picture with left half to right of the screen and right half to left of the screen. Other positions of line hold caused flutter and very bright thin, vertical, zig-zag lines. UL44 (V15) was replaced by a "reclaimed" valve and the picture was reset, apparently in order. When the set was replaced in the cabinet the fault appeared again. V15 was replaced but the fault was still evident. No burnt resistors or broken leads were apparent but the anode of UL44 (V15) carried very high voltage. The top cap lead voltage is about 300V if removed from anode. The sound is perfect.—R. Taylor (Windsor).

Check the value of resistor from the line hold control to the 33,000pF capacitor from the line output transformer. If in doubt change to 8·2k. The line output transformer itself may well be responsible for the condition.

DEFIANT 947

I am unable to remove a broad black band across the centre of the screen. I have changed over T415 and interchanged all the other valves possible. The sound is perfect but the tube is low.—W. Fetters (Edinburgh 9).

The frame time base appears to be locking on a mains ripple rather than on a clean sync pulse. We would therefore advise you to check the 16μF electrolytic capacitors generally, by shunting each with a test 16μF 450W capacitor (wire ends). The capacitor associated with pin 5 of the rear centre (right side chassis) 6F14 is the principal suspect. Check the setting of the pre-set sync control.

VIEWMASTER

The sound on this set is fine but there is no raster or picture. When the trouble started, the picture collapsed to a narrow horizontal line about 1in. wide. I have fitted a new line transformer and also EY51. The EY51 lights up and there is a spark from the cap on CRT. The line amplifier valve has been tested and found to be in order and the frame line thyratron valves 6K25 are in order because I can hear the whistle from the timebases. All the valves in the vision circuit have

been checked, EF50 from V1-V5.—A. Barton (Dagenham).

From your description it is evident that a fault has developed in the frame timebase whilst you have been looking for a fault in the line timebase. We suggest that you check the components and wiring around V11 and V12, particularly R59, R65, R64. R56 and C48, frame transformer and scan coils.

PETO SCOTT 1412T

The general picture is good but the fault is that I cannot reduce the width, which is too great and white and black lines smear faintly to the right. The left hand edge of the test card is very extended. I have changed valves and various condensers without success. The picture seems to take too long to reach full brightness, about 2—5 minutes. Is this in order or are resistors too high?—P. Twist (Luton).

Check the 2·5k resistor to pin 8 of the PL81. Then check the 27k resistors across the width and linearity coils and the 100pF capacitors (in series with a resistor) across each of the scanning coils connections.

INVICTA T111

This set has low EHT resulting in a dull picture. The EY51 has been replaced by another with no improvement. The line scan amplifier valve and "booster" diode have been tested and have been found to be in order. There is only about 1V across the cathode resistor (10k brilliance control) of the PL38 line output valve, but removing the booster diode causes this to increase to about 60V. The line amplitude plunger, when fully withdrawn, causes the picture to become paler. A momentary shorting of the line scan coils alters the note of the line whistle and increases the brightness of the picture temporarily. I suspect that the scan coils are at fault, or else the line output transformer. The CRT works satisfactorily in another set. Can the Cossor 121K tube be used in the T111? —J. Ramsey (Hemel Hempstead).

The cathode circuit of the PL38 is not completed by the brilliance control. The circuit is through the 33Ω resistor and then through the line amplitude coil and PY31 booster diode. You should check the 25μF capacitor which is wired positive to chassis, negative to the 33Ω resistor at the junction of the brilliance control. The cathode of the PL38 should record 38V negative. The Cossor 121K tube can be used with a B12A base and an ion trap magnet.

ACE

What type of turret tuner and what I.F.'s can I use with this set? This has a 14in. rectangular tube and parallel heaters. Two 2-pin plugs and sockets are fitted for H.T. and heaters. Would there be any wiring alterations apart from removing the first two valves?—H. Richard (Wigan).

We are inclined to think that your receiver is an Ace Astra. If so, the left side 2-pin socket is for a pre-amplifier (160V HT·6·3V L.T.). and the centre sockets are the aerial input. The I.F.'s are 9·8-13Mc/s and a suitable tuner would be a Cyldon E10L or a Brayhead 10P. No alterations apart from removing V1 and V2 and replacing these with the plug, or adaptor is necessary.

KB HV20L

There is a rasping on the sound which, when the sound is turned up, causes rippling on the picture.—S. Wells (Surrey).

It would appear that the volume control is in need of replacement, or at least of thorough cleaning. Since the focus coil is associated with the sound output valve, some vision interference will result if the volume control is noisy. It has a value of 0·5M (500k).

MARCONI VT150

This set has interference on channel 9. The picture becomes watery at top and middle and bottom in turn and sometimes gives the effect of a torn picture. We have a dipole indoor aerial for both channels but channel 1 is received free from interference.—F. Merker (London S.W.4).

The ragged and irregular picture is no doubt caused by the reception of reflected or ghost signals on the Band III aerial. A more sensitive or directional aerial (say of the slot type) would help.

PLESSEY MARK 11

I have obtained two TV chassis of the above type. One works perfectly except for the following fault. When the raster is on the screen, a patterning appears and when vision is on, it turns to a smear. Apart from this the picture is good. This receiver will not give a better picture with the normal aerial plug, I have to remove the metal surround first. The other chassis has low sound, good raster but no picture. The patterning is also on this raster. The video valve heaters seem to light up brighter and become hotter than usual. —G. Hughes (Sale).

You must first ensure that both chassis are properly tuned to the channel required. The brass core protuding through the front centre of the right side chassis must be correctly tuned and the coil cores in the can on either side of the front and 6F1. If some valves seem to glow excessively, suspect instability and check the decoupling capacitors.

PHILIPS 21680

The horizontal hold is at the end of its range, fully anticlockwise. At any slight drift the picture breaks up at the top. I have checked ECL80 and PL36.—C. Smith (Lancaster).

Check the two resistors associated with pin 2 of the ECL80. The resistor to the H.T. is a 220k, and that to the hold control is a 330k. The associated 120pF capacitor could be at fault but this is less likely.

DYNATRON TV41F

What means of trimming are employed on this set to ensure that the main trimming control (concentric with the channel switch) is roughly in the middle of its travel when stations are tuned? This is a fringe model, no V.H.F. being fitted.—W.M.S. (Dundee).

The oscillator coil core is adjusted from below the tuner. It is the front adjustment below the 30C1 valve. A very firm, non-metallic screwdriver is required for this operation. A large tool may damage the core or coil.

ALBA

I am unable to give the model number of this set but according to the instruction book it is one of three, T321, T324 and T524. When the fault first developed I had difficulty in locking the picture to prevent it from rolling. I replaced valves PL81 and PY81 which stopped the rolling but after the set had been on about half an hour the picture became darker and distorted across the centre of the screen. I can only obtain a broken picture on Band III.—H. Atkinson (Saltburn).

If the picture starts rolling vertically again check the ECC83 frame oscillators and the 820k resistor from the frame (vertical) hold control to pin 2 of one of the ECC83 valves. To correct the horizontal hold, replace the PCF80 line oscillator valve. For weak Band III we suggest you check the PCC84 valve on the tuner unit.

AMBASSADOR

The sound is perfect but the vision is at fault. There is no raster at all. I have changed the EY51 without success. All the valves seem to be working but have not been tested.—J. Grant (Mansfield).

You should concentrate on the 20P1, U281 circuits. If these valves are in order, check the 4k wire wound resistor to pin 4 of the 20P1, the 33Ω cathode resistor (pin 8) and the timebase capacitors.

STELLA ST86170

The trouble is lack of height, leaving a gap of about 1in. top and bottom. This sometimes tries to right itself. The frame output valve was down in emission so I put in a new valve PCL82. When this valve had been put in it would not light but worked after I cleaned the valve pins. Now I cannot obtain a raster. I checked PY81, PL36 and anode of EY86 for spark and this I can obtain. I cannot obtain a proper spark on the EHT connector to the tube. The other valves have been tried in three stages, PY81, PL36, ECL86 and EY86 and the transformers have been checked. When I remove the line hold, the slight E.H.T. seems to stop altogether.—P. Norcott (Birkenhead).

Although you may well find that the line output transformer is at fault you should first check the ECL80 resistors and those associated with the PL36 screen (4) and cathode (8). Then check the boosted H.T. voltage and components, as a capacitor often shorts in this section thus presenting the effects described. This is the 0·018μF or 0·039μF. Both are on the tag strip near the PY81 valve base.

RAYMOND ELECTRIC

The picture on this set is very dim and there is no brightness. When I turn the brightness or horizontal controls right down the screen goes blank.—P. Price (Liverpool 14).

First adjust the ion trap magnet on the rear of the tube neck for maximum brilliance. Then check the PL81 and U37 valves before suspecting the tube itself. You may find that both the tube and the U37 are in need of replacement. (We assume the set is an F60.)

COSSOR 937

The screen of this set is black and needs cleaning. What is the correct procedure?—J. McFarlan (Glasgow).

You will need to remove the chassis and tube cradle. The chassis disconnects from the tube cradle and can be slid out on its board after four screws have been removed from the bottom. The four front control knobs and side panel have first to be freed, as have the loudspeaker leads. Next lay the cabinet on its face and remove the two long bolts holding the focus gantry to the woodwork, at the back, and the four holding the tube cradle to the cabinet, at the front. The tube cradle will then lift out to permit cleaning.

EKCO T161N

This receiver is modified to TU169 which is tuned to BBC at Holme Moss. It is my intention to convert this set for use on BBC and ITV transmissions in the Cambridge area. Can you tell me what tuner would be suitable for this set and at what I.F. it operates.—Mrs. H. Miller (Cambridge).

The Brayhead 16S or Cyldon U16H are the two commonly used tuners for this model. Both will only just fit inside the available space in the cabinet and at Cambridge, where maximum gain is required we suggest that the Brayhead be used and wired in so as to convert the present mixer 10F1 to an I.F. amplifier. Ask for the tuner to be fitted with "U" series valves and coils for channels 1, 9 and 11.

MURPHY V178C

I inspected the set after the picture had suddenly disappeared from the screen and replaced line output EL83 and found that the horizontal form control was broken and shorted out. Now, when the set is switched on, horizontal lines start to come down from the top of the screen and ruin the picture. This rights itself and the picture is all right for a minute or two then becomes bright until the picture area is white. Reducing brightness brings back the picture to normal for about half an hour when it then goes black. I have had the tube tested and it was reported to be in order.—T. Holmes (Colne).

The horizontal form control is a variable bias resistor in the EL38 cathode circuit and should be replaced (value 200Ω). Its correct setting is for maximum width which is usually at 1/3 of its travel. Also examine the 47Ω resistor on the EL38 valveholder and replace it if charred. Both of these components, if incorrect will cause a bright line down the left of the screen and give a short life to the EL38's.

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