Practical TELEVISION

FEBRUARY 1965

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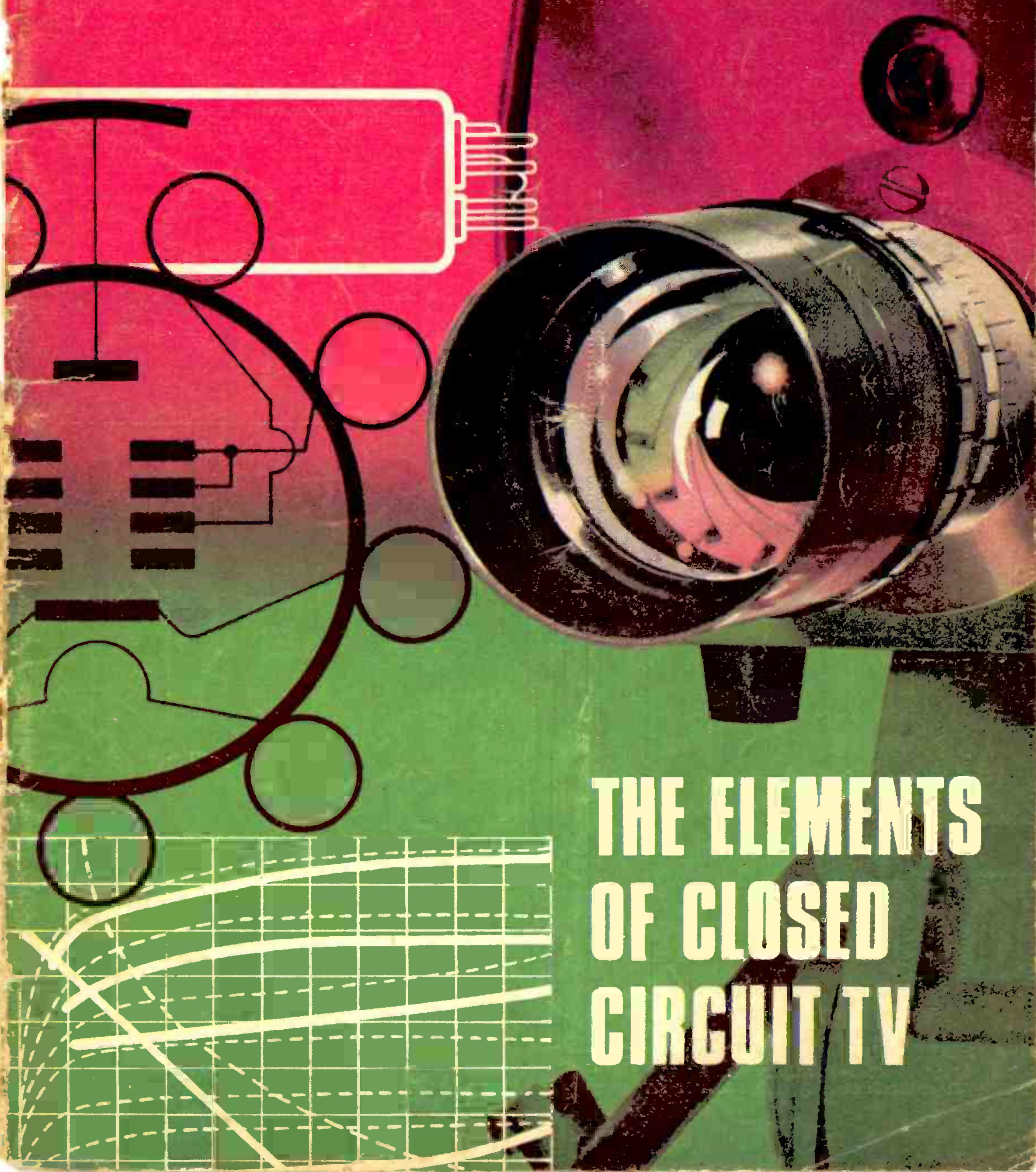

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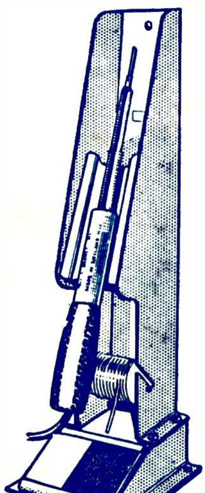

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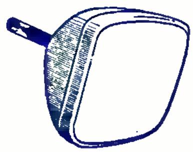

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ID6	9/6	6D3	9/6	12AC6	8/6	35W4	4/9	DM71	9/9	ECH84	9/6	EL820	16/4	MHD4	7/6	PL83	6/-	U33	13/6
1R5	4/-	6F1	9/6	12AD6	8/6	35Z3	16/2	DY86	6/9	ECL80	6/-	EL822	18/6	MHLD6	18/6	PL84	6/6	U35	16/6
1S5	3/6	6F13	3/9	12AE6	8/-	35Z4GT	4/6	DY87	8/-	ECL82	6/6	ELL80	18/6	MU12/14	4/6	PL300	15/6	U37	29/-
1T4	2/3	6F23	6/3	12AH7	5/-	35Z5GT	5/9	E80F	24/-	ECL83	9/6	EM34	11/6	N37	28/3	PM84	9/6	U45	15/6
2D21	5/6	6F24	9/6	12AH8	10/9	50B5	6/6	E83F	24/-	ECL86	8/9	EM71	18/6	N78	26/-	PX4	6/-	U76	4/6
2X2	3/-	6J7G	4/6	12AT6	4/6	50C5	6/6	E88CC	10/-	EF22	6/6	EM80	6/3	N108	26/3	PY31	7/-	U191	9/6
3A4	3/9	6K7G	1/3	12AU6	5/9	50L6GT	6/3	E180F	18/6	EF36	3/6	EM81	7/-	P2	10/-	PY32	8/9	U251	9/-
3A5	6/9	6K8G	3/3	12AV6	6/6	72	6/6	EA50	1/6	EF37A	6/-	EM84	6/9	PABC80	6/9	PY33	8/9	U282	12/3
3Q5GT	7/-	6K25	24/-	12BA6	5/9	85A2	6/6	EABC80	5/9	EF39	3/9	EM85	8/9	P61	2/6	PY80	5/-	U301	11/3
3S4	4/6	6L1	10/-	12BE6	4/9	90AG	67/6	EAF42	7/6	EF40	8/9	EM87	7/6	PC86	10/3	PY81	5/-	U404	6/-
3V4	5/3	6L6G	6/6	12BH7	6/-	90AV	67/6	EB34	1/-	EF41	6/9	EN31	10/-	PC88	9/6	PY82	5/-	U801	16/3
5R4GY	8/6	6L7GT	4/6	12K5	10/-	90C1	16/-	EB41	4/9	EF42	3/9	EY51	6/9	PC95	11/3	PY83	5/9	U4020	6/6
5U4G	4/6	6L18	10/-	19AQ5	7/3	90CG	42/-	EB91	2/3	EF50	2/6	EY81	7/3	PC97	7/3	PY88	7/3	UABC80	5/-
5V4G	8/-	6LD20	5/6	19H1	6/-	90CV	42/-	EBC33	6/-	EF80	4/-	EY83	9/3	PCC84	5/6	PY800	6/-	UAF42	7/-
5Y3GT	4/9	6P28	11/6	20D1	10/-	150B2	16/6	EBC41	6/6	EF83	9/9	EY84	9/6	PCC85	6/9	PY801	6/3	UB41	10/6
5Z3	7/-	6Q7G	4/-	20F2	11/6	185BT	34/11	EBC81	5/9	EF85	4/6	EY86	5/6	PCC88	10/6	PZ30	9/6	UBC41	6/3
5Z4G	7/6	6R7G	5/3	20L1	12/6	866A	12/6	EBF80	5/9	EF86	6/9	EY88	8/9	PCC89	8/6	R10	15/-	UBC81	6/3
6A8	5/9	6SL7	5/3	20P1	12/6	5763	7/6	EBF83	7/3	EF89	4/-	EY91	3/-	PCC189	10/6	R17	17/6	UBF80	5/9
6AC7	3/-	6SN7	4/-	20P3	12/-	7475	2/9	EBF89	6/3	EF91	3/-	EZ40	5/3	PCF80	6/6	R18	8/6	UBF89	6/9
6AG7	5/9	6U4GT	8/6	20P4	13/6	AC6PEN	4/9	EBL21	10/6	EF92	2/6	EZ41	6/-	PCF82	6/3	R19	6/6	UBL21	10/9
6AQ5	5/9	6V6G	3/9	20P5	12/3	AZ31	6/6	EC53	12/6	EF95	4/9	EZ80	3/9	PCF84	8/6	SP41	3/-	UC92	6/3
6AT6	3/9	6X4	3/9	25L6	4/9	AZ41	6/6	EC70	4/9	EF97	10/0	EZ81	4/-	PCF86	7/9	SP61	3/-	UCC84	8/9
6AU6	5/3	6X5	4/6	25Z4G	7/-	B36	4/9	EC92	6/6	EF98	10/-	GZ33	17/6	PCF801	10/-	SU25	27/6	UCC85	6/6
6AV6	5/6	6/30L2	9/-	25Z6	8/-	CL33	11/6	ECC31	7/3	EF183	7/-	GZ34	10/-	PCF802	10/-	T41	9/-	UCF80	8/9
6BA6	4/6	7B6	12/6	27SU	23/3	CY31	5/9	ECC40	7/-	EF184	7/-	GZ37	14/6	PCF805	10/6	TH41	13/-	UCH21	8/-
6BE6	4/9	7B7	9/6	30C15	9/-	DAF96	6/-	ECC81	3/6	EF804	20/5	HABC80	9/3	PCF806	17/6	TH233	6/-	UCH42	8/-
6BG6G	13/6	7C5	8/-	30C18	10/6	DD41	10/6	ECC82	4/6	EH90	7/-	HL42DD	8/6	PCL82	6/6	TY86F	11/9	UCH81	6/6
6BH6	5/3	7C6	6/9	30F5	5/9	DF66	15/-	ECC83	4/6	EK32	5/9	HN309	25/-	PCL83	7/9	U10	9/-	UCL82	7/9
6BJ6	5/6	7H7	5/9	30FL1	9/3	DF96	6/-	ECC84	5/6	EL33	6/9	HVR2	8/3	PCL84	7/6	U12/14	7/6	UCL83	8/-
6BQ7A	7/6	7R7	12/6	30L15	9/3	DF97	10/-	ECC85	5/9	EL34	8/6	HVR2A	8/9	PCL85	7/6	U16	15/-	UF41	6/9
6BR7	8/3	7Y4	5/-	30P4	12/3	DH101	25/-	ECC88	8/9	EL36	8/9	KT33C	4/-	PCL86	8/3	U18/20	8/6	UF42	4/9
6BR8	8/-	9BW6	9/6	30P12	7/6	DH107	16/11	ECC91	3/-	EL41	7/3	KT36	29/1	PEN45	7/-	U22	6/6	UF80	6/3
6BW6	8/9	10C1	8/9	30P19	12/3	DK92	8/-	ECC189	11/6	EL42	7/6	KT41	7/9	PEN45DD					
6BW7	5/-	10C2	12/3	30PL1	8/6	DK96	6/6	ECF80	6/6	EL81	8/3	KT44	5/-		12/-				
								ECF82	6/3	EL83	6/9	KT61	6/9	PEN46	4/-				
								ECF86	11/6	EL84	4/6	KT63	3/6	PEN383	10/3				
								ECH21	9/-	EL85	7/6	KT66	12/3	PL33	9/-				

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UL84	6/6	OC28	25/-
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UM34	16/9	OC35	18/-
UM80	8/-	OC38	[illegible]
UU6	9/-	OC41	[illegible]
UU8	11/-	OC44	8/-
UY1N	10/3	OC45	[illegible]
UY21	7/9	OC65	22/6
UY41	5/-	OC66	[illegible]
UY85	5/-	OC70	6/6
VP4	15/-	OC71	6/6
VR105	5/-	OC72	[illegible]
VR150	5/-	OC73	16/-
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Practical Television

AND TELEVISION TIMES

VOL. 15, No. 173, FEBRUARY, 1965

Editorial and Advertisement Offices

PRACTICAL TELEVISION

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Contents

The Videophone

FOR very many years, all sorts of people have been predicting a video telephone. It is one of those obvious developments which must, ultimately, become a feasible technical and commercial proposition. From time to time, the idea has taken a practical form and even in the 20's and 30's engineers were staging practical demonstrations.

So it will come as no great surprise to know that 37 years after the first public demonstration of a TV-telephone, the American electronics industry has come up with a modern, workable, system. Using micro-miniaturisation and other new techniques, it is a far cry from the crude and cumbersome equipment of the past. Called the Picturephone, it is now installed in New York, Washington and Chicago, where it provides an experimental inter-city service.

Each Picturephone terminal installation consists of a telephone headset on a control unit, a picture tube unit containing camera and c.r.t., and a small power supply unit. The user sees a picture (about $4\frac{1}{2}$ x $5\frac{1}{4}$ inches) of the caller, showing head and shoulders.

To make a call, the user presses an 'On' button, then a 'Viewing' button, and finally calls the required number, not by dialling but by pressing touch buttons. Clear pictures are possible using normal room lighting and there is automatic adjustment for a wide range of ambient lighting.

The future of the see-as-you-talk telephones is, however, still a matter of conjecture. The present three-city public installation will be used to evaluate thoroughly performance and reliability. But the electronic side is perhaps the least important—for the system is obviously a practical proposition and any snags which arise should not prove to be insuperable.

The reaction of the general public is less easy to predict. The initial installations have aroused enormous interest, but much of this may be due to natural curiosity. What happens when the novelty wears off?

Bell Telephone representatives are interviewing users to find the answer to this and other unknown factors, the key question being, of course, how much does the visual facility contribute to a telephone service?

It seems inevitable that see-as-you-talk telephones will gain universal acceptance, for other countries (Germany and U.S.S.R. for instance) are working along similar lines. Presumably the main use for such a service will be for business purposes although some of the drawbacks (often used in frivolous context, but none the less real) would apply equally to commercial and private use.

In the American system, however, there is a button on the control unit which enables the user to disconnect the camera circuit. This "commercial killer" is, we feel, one of the brightest facilities of the system and does a lot to dispel the Big Brother feeling that video telephones engender!

One thing is certain: we shall still get wrong numbers for inexplicable reasons. The one consolation is that they *could* possibly be more interesting!

Our next issue dated March will be published on February 18th

TELETOPICS

PMG's Approval for More Relay Stations

THE fourth stage of the BBC's plan for a network of relay stations across the country which will bring BBC-1 television and v.h.f. sound programmes to over 90% of the population, has received in principle, the approval of the Postmaster General.

In welcoming this announcement, the BBC has named the following places for these new stations, subject to suitable sites being found: combined television and v.h.f. sound stations at the Scilly Isles, Campbeltown, Kingussie, Lochgilphead, Dolgellau, Llanidloes, Ballycastle and Kilkeel; television only at Aldeburgh, Bodmin, Bude, Whitby, Ayr, Ballater, Girvan, Cardigan, Llangollen and Portrush and sound only at Weardale.

At the completion of this stage of the plans, the BBC will have built a total of 66 television and 48 v.h.f. sound relay stations. So far 27 television and 16 sound stations have been brought into service.

These additions to the Corporation's network of relay stations will eventually result in the extension of BBC-1 television programmes to a further 24,000 people and improved reception for 100,000.

Operation of the stations in general depends upon the use of translator equipment which receives programmes from an existing station and relays them on another channel over the local area.

Under the existing programme for relay stations, one of the latest additions to be opened is at Pitlochry in Perthshire. Transmissions of the television BBC-1 programme will be on channel 1 with horizontal polarisation. The station, which also provides the three v.h.f. sound programmes, serves an area including Pitlochry and Aberfeldy in which some 4,000 people live.

DUTCH CLOSE NORTH SEA TV PIRATE

OPERATIONS from the Dutch radio and television "pirate" station which had been erected in the North Sea, came to an abrupt end recently when Dutch police and officials boarded the artificial island from helicopter and boat to put into effect a new law passed by the Dutch government banning television transmissions from the Continental shelf sea region off Holland.

Our illustration (left) of the station was first published in the November issue of PRACTICAL TELEVISION when little was known of its activities. Now it is known that the steel platform, its equipment and 360ft. mast cost £3,000,000 to build and was believed to be insured for £530,000.

The Dutch TV "pirate" station which was until recently operating from its site in the North Sea, just off Holland.

BRITISH 625-LINE EQUIPMENT GOES ABROAD

TELEVISION equipment for overseas has been the object of two contracts recently undertaken by Pye T.V.T. Limited of Cambridge. Both contracts involved 625-line equipment; transmitters for the Syrian Arab Republic and studio equipment for Barbados.

The equipment for Syria—two 5kW transmitters—is to be installed on the summit of a mountain in the northern part of the country, where it is expected to begin operations in the summer of this year.

The 4½in. image orthicon cameras and telecine units making up the equipment supplied to Barbados, is being used in the new television station at Bridgetown where the Caribbean Broadcasting Coporation inaugurated its first television service in December last year.

TELEVISION TECHNIQUE FOR ELECTRON MICROSCOPE

A NEW technique involving the use of television described by Radio Corporation of America at Princeton, New Jersey, will increase the magnification of an electron microscope by ten times (that is, up to times 2,000,000).

The conventional electron microscope is focused on a special phosphor screen at the normal viewing position. In the new system, however, the image is passed through a high speed optical system with an image intensifier which increases the intensity of the image by a factor of 2,500. The image is then focused on the c.r.t. of an image orthicon camera and passing through a low noise video amplifier and video signal processor, is projected on the screen of a TV monitor.

NEW TV BOOKLET FOR STUDENTS

A NEW Mazda booklet which deals in a simple way with the evolution of television cathode ray tubes, the reasons for each major stage of development and the associated electron-optics involved, has just been published.

The booklet is entitled "Electrons in Picture Tubes" and was written by B. Eastwood, B.Sc., Chief Engineer of the Thorn-AEI Applications Laboratory. In 24 pages, Mr. Eastwood's approach to the vast subject has been kept on a non-mathematical plane for the apprentice technicians and other students interested in television, for whom the booklet is intended.

"Electrons in Picture Tubes" joins a series of Mazda "Electron" booklets any of which are available free of charge to electronics students and television service technicians, on application to Thorn-AEI Radio Valves and Tubes Ltd., 155 Charing Cross Road, London, W.C.2.

C.C.TV LINKS FOUR CITIES

DURING December a private preview of new products to be marketed by Slumberland Limited in 1965 was presented simultaneously in four cities by the use of colour closed-circuit television. This was one of the most extensive set-ups of its kind ever attempted in Great Britain and permitted over 1,300 Slumberland retailers throughout the country to follow Mr. J. L. Seccombe's introduction of the new products on television, as he made it in the London Hilton Hotel.

At the Hilton Hotel where Mr Seccombe (Slumberland's Managing Director) made his address, two Marconi 3in. image orthicon colour TV cameras, ancilliary and lighting equipment, televised pictures which were relayed from London to Manchester, Birmingham and Glasgow by G.P.O. land-lines and micro-wave links. At the Hilton and the hotels in the other three cities where the retailers had gathered, Rank-Bush Murphy colour monitors were used to show the pictures from London and further screening of the television signals was provided at Manchester, Birmingham and Glasgow by Rank Cintel TV projectors with pictures up to 9ft. x 6ft. 9in. in size.

This hook-up represented the first commercial use of a colour c.c.TV link on the 625-line N.T.S.C. colour coding system.

New TV Award

THE institution of Electronic and Radio Engineers recently established a new Institution award—the "P. Perring-Thoms Premium"—to be presented to the contributor of the most outstanding paper published on improved methods of television reception.

The late Mr. P. Perring-Thoms, whom the award commemorates, was the founder of Radio Rentals Limited, who have endowed the Premium.

WIRED TELEVISION RELAY SYSTEMS AND BBC-2 FROM BIRMINGHAM

IN his address at the annual luncheon of the Relav Services Association held recently, Sir Ronald German, director general of the G.P.O. said that 750,000 homes in the United Kingdom were already equipped to receive television by wire-relayed signals. 80,000 of these were installed last year.

Speaking as chairman of the Association, Mr. A. M. Lowe made the prediction that wired programmes for sound and television in cities would be the rule rather than the exception in ten years' time.

As evidence of the increasing demand for wired TV networks, it has been announced that 10,000 homes in Worcester have been wired to receive BBC-2 programmes, following the inauguration of the new channel in Birmingham. Although outside the primary service area of the new transmitter the network of homes wired by Rediffusion is already enjoying the new programme.

The transmitted BBC-2 signal is received from Birmingham by an aerial at the top of an 100ft. tower erected on Tunnel Hill.

FOUR TUBE COLOUR CAMERA SYSTEM PATENTED BY RCA

THE Radio Corporation of America has recently taken out a patent on an unusual colour television camera system.

In this system, four vidicon camera tubes are used instead of the more usual three. Three of the tubes supply the red, green and blue signals and the fourth is a high resolution tube which supplies the luminance signal.

Several advantages are claimed for this system, one being that its output can be reproduced as a high resolution picture in a black and white receiver. This is because the luminance signal is not derived from the three colour signals which may be in poor registration.

PART I — A NEW SERIES

The Elements of Closed Circuit TV

BY G. J. KING

IN the early days before television, experimenters used to entertain themselves and their families by connecting a microphone to the pick-up sockets of the domestic radio set, setting up the microphone in an adjacent room or even in an outside shed and using this improvised studio for "putting on" a quiz, drama or musical show.

The next development was the tape recorder. This allows such programmes as the above to be taped and replayed to the party as a whole with all participating and listening to themselves. This is indeed still a very popular form of electronic entertainment.

These things are all beginning to happen again—but this time with vision as well as sound. Closed-circuit television systems are now within the means of most experimenters, since relatively good quality experimental camera tubes can be obtained for about £10 and several firms are now marketing TV lens systems at remarkably low prices. The rest of the material—or at least a lot of it—is generally already available in the experimenter's den.

This article does not set out specifically to detail ways and means of making closed-circuit television equipment—future articles, it is hoped, will do this. What it does set out to do, however, is to bring to the notice of the television enthusiast the basic features of closed-circuit television. What can be done and what is required to do it.

Also, most important, how it works and how it can be used in conjunction with the standard domestic television receiver.

Sound to Signal

We all know that a microphone responds to sound. That is it translates the sound waves into corresponding electrical waves. The absolute character of the sound waves is retained in electrical form and after the small signal produced by the microphone is amplified it can be fed to a loudspeaker which does the opposite to the microphone —it translates the electrical signals back to sound again.

This is a relatively simple exercise since sound is composed of one or a multiplicity of waveforms happening together to give the sound its character. We thus hear sound as a whole and not as individual component parts. It is then possible to process sound as a whole and amplify it in that way as well.

Vision to Signal

A television camera system does for vision what a microphone does for sound. That is it translates the scene which it sees into electrical signals. The television receiver does the converse and translates the signals back to vision again.

In this process, however, we have many more problems than with sound. Firstly the camera tube itself is *not* the visual equivalent of the microphone. It is the complete camera *system* which has this equivalent.

If it were attempted to use just the camera tube to provide our visual signal translation the output would be simply proportional to the amount of light reaching the tube. There would be no picture.

This is the effect that one gets by lightly closing the eyes and turning the head about. As the closed eyes pass over a scene or look towards the sun one has the impression of varying brightness as the average brightness of the scene is recorded by the light filtering through the closed lids of the inhibited eyes.

In fact the eyes break down the scene into diminutive component parts and send the relevant messages to the brain. This organ then proceeds to reassemble the information and form a "brain picture" of the scene that the eyes are viewing. If the defining ability of the eyes is destroyed by closing the lids to act as filters then, of course, the scene just cannot be translated by the brain.

To secure a television picture we attempt to copy the functions of the eyes and the brain. Thus we have our second problem and that is in breaking down the scene as seen by the camera tube into component parts. The third problem is in the reassembly of these components at the receiver.

Camera System

Let us see first how the camera system produces electrical signals corresponding to individual breakdown elements of the scene. To do this we must look inside a camera tube. A cross-section of the vidicon camera tube with its basic controlling elements is shown in Fig. 1.

An evacuated cylindrical tube contains the electrodes forming the "electron gun". This features a heater, cathode and accelerating and focusing electrodes, the same as the gun assembly in the receiving picture tube.

External voltages are applied to these electrodes to produce an electron beam and this is brought to a fine focus by the focusing electrode and controlled by the focusing coil. But instead of impinging in

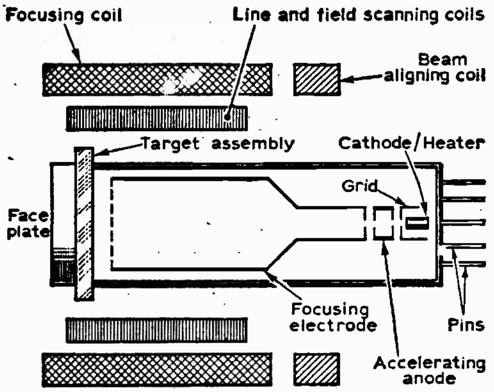


Fig. 1—Cross-section of the vidicon camera tube and its associated control elements.

focus at a fluorescent screen, as in the picture tube, the beam is focused on the "target" electrode which closes the far end of the tube.

Scanning

Further, the beam is caused to "scan" the target area from left to right (horizontal scan) and from top to bottom (vertical scan). These scanning functions are accomplished by line and field scanning coils of a type similar to those used on a receiving picture tube.

The line scan is either 10,125c/s or 15,625c/s and the field (frame) scan 50c/s to give "standard" interlaced pictures of 405 lines or 625 lines respectively. Any other number of lines can be produced, of course, by altering the line or field frequency (or both). The whole of the target area is scanned first with half the number of total lines and then a second time with the same number of lines but this time with the lines interleaving those of the first scan. This is the interlacing technique.

Not all closed-circuit television systems, however, adopt the interlaced scanning technique. Some use what is called "sequential scanning", where the total number of lines are traced on one scan, or "random interlacing", where the lines of the second scan may not always and exactly interleave the lines of the first scan.

Photo-conductive Target

So far so good. But what is the purpose of scanning the target area with an electron beam? Well, to discover this we shall have to look at the target in greater detail. In Fig. 2 is shown the target end of the vidicon camera tube.

Here it will be seen that the target is composed of an optically flat faceplate and a photo-conductive material, such as cadmium sulphide, deposited on a transparent conductive film connected to the target electrode.

The photo-conductive material has the property of being of high resistance when unexposed to light and of a much lower resistance when light is caused to fall upon it. The resistance when dark may be as high as 10MΩ (called the "dark resistance"), while when exposed to a bright light it may drop to below 100Ω. The resistance of the material when exposed to light is called the "light resistance".

The target area thus has through conductivity or resistance from the surface of the photo-conductive material to the target connection of a value governed by the amount of light falling upon it. It also has capacitance between the photo-conductive material to the conductive film.

Now in front of the tube is a lens system as shown in the diagram. This causes an image of the scene upon which the camera is focused to fall upon the target area. The *overall* resistance of the photo-conductive material then assumes a value proportional to the average light of the focused image.

Combinations of R and C

If a pin-point cross-section of the target is considered this will be found to possess both resistance (as governed by the intensity of light falling upon that particular pin-point) and capacitance in parallel with the resistance. In fact the whole of the target area can be broken down into pin-point cross-sections each having resistance as above and capacitance.

In effect then the whole of the target can be looked upon as being composed of a large number of RC parallel combinations with all the combinations themselves in parallel between the surface of the photo-conductive material and the target connection.

Clearly then when an image is focused upon the target area the resistive elements of all the combinations will assume values corresponding to the light intensity of every minute part of the image. In other words, the light and shade of the image will be translated into a pattern of resistance values.

The value of resistance where the image is dark

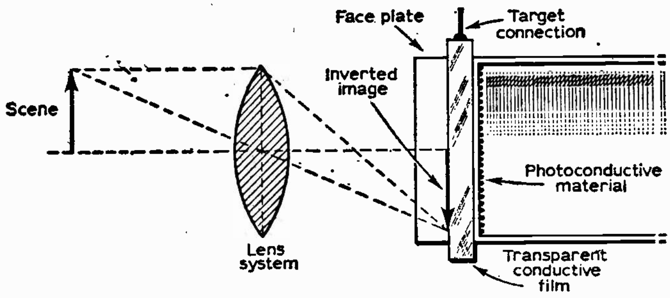


Fig. 2—A detailed view of the target assembly of the vidicon camera tube.

will be high, while at those pin-points where the image is light the resistance of the corresponding cross-sections of the target will be low. Intermediate values of illumination between white and black will give intermediate values of resistance corresponding to the grey parts of the image.

To derive any use from this pattern of varying resistive values we must obtain from the output of the target information which is related directly and individually to *all* the pin-point (or " element ", as they are usually called) values of illumination of the image falling on the target.

It is impossible to collect this information all at one time for, as we have seen, an attempt to do that would simply resolve in information corresponding to the overall brightness of the image on the target. The information must thus be collected an element at a time by the scanning process and this is where the scanned electron beam comes in.

Charging Effect

Fig. 3 shows a few of the RC combinations which can be considered as forming a part of the photoconductive material on the target. As the electron beam scans the target area and makes contact with each effective RC combination in turn it causes the C element to charge from the target potential which is applied through the load resistor as shown in the diagram.

This charging effect occurs because the electron beam, being composed of current carriers (electrons), can be considered as a conductor of electricity. In fact it does the same thing as a wire would do in connecting the negative side of the target potential, via the electron gun, to each RC combination in turn.

The positive side of the target potential is connected to the transparent conductive film, which is the common connection for all the RC combinations.

Now the charges acquired by the C elements will dissipate through the parallel R elements but—and this is the secret of the whole process—the *rate* at which each C discharges will depend upon the value of R.

Suppose that the beam is in connection with an RC combination which is " seeing " a dark picture element. R will be high, so the charge in C will not be very quickly exhausted, which means that the next time the beam makes contact with the same RC combination only a little current will need to flow through the load resistor from the target potential to restore the charge to its original value.

However, when the beam is in connection with an RC combination which is " seeing " a light picture element will be low, so the charge in the associated C will soon drain away. Thus when the electron beam next makes contact with that combination a greater current will need to flow through the load resistor to restore the original value of charge.

Video Signal

The process is such then that for each picture element, as determined by its brightness, a value of current flows through the load resistor. The current pulses in the load produce voltage pulses across it and these form the picture or video signal

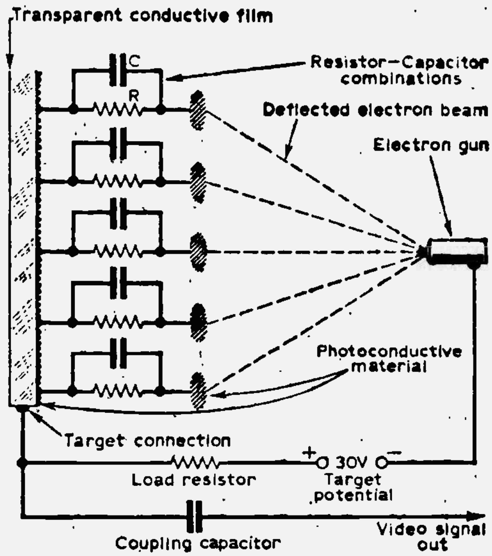


Fig. 3—This diagram shows the basic electronics of the vidicon operation, as detailed in the text.

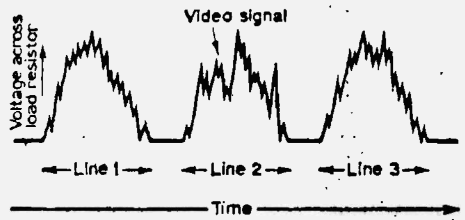


Fig. 4—Three lines of video signal. The spaces between the lines are due to the flyback time of the line timebase.

which are conveyed to the camera amplifier through the coupling capacitor.

As the beam is scanned from left to right across the target area a line of signal corresponding to the light values of the picture along that line is produced. This is followed by the signals of subsequent lines as shown in Fig. 4.

When the picture image on the target has been scanned linewise from top to bottom the beam quickly returns to the top of the target again to commence a sequential or interlaced repeat.

Note that Fig. 4 shows a sequential scan where line 1 is followed by line 2 and line 2 by line 3 and so on. With an interlaced scan line 1 would be followed by line 3 and line 3 by line 5, etc. In this case lines 2, 4, 6, etc., would occur on the subsequent field scan and interlace with lines 1, 3, 5, etc.

The short time period between the line scans where there is no video signal is the time that it takes the beam to " fly back " from the right to the left of the target area to commence the next line scan.

Adding Sync

At the end of each field scan there is zero video signal space over a longer period of time to allow for the field flyback.

Now, since it is necessary for the electron beam in the receiver picture tube to follow exactly the scanning movements of the beam in the camera tube, some means must be made available to hold the two beams in step or synchronise them.

This is done by the insertion of synchronising pulses on the picture signal and advantage is taken of the picture-less spaces between the line and field scans. Here the sync pulses are inserted as shown linewise in Fig. 5. After a field scan a series of field sync pulses are similarly added.

We are now ready to look at a block diagram representative of a basic camera *system*. Such is shown in Fig. 6. Here we see that the lens system focuses the image of the scene upon the target of the camera tube, that the resulting video signal output is amplified in the video amplifier and then applied to an " adder " which, from the appropriate line and field sync pulse generators, adds the sync pulses to the video signal.

At the output of the camera system we have a signal which should be suitable for direct application to the input of the video amplifier of any television receiver provided the line standards and video signal polarity match.

It is at this stage where we have the video equivalent of the sound signal. But while a relatively simple microphone provides a signal suitable for connecting direct to the input of the audio amplifier in any radio set a complete camera system—and not just the camera tube alone—is needed to produce a signal acceptable by the video amplifier of a television set and from which good pictures can be obtained.

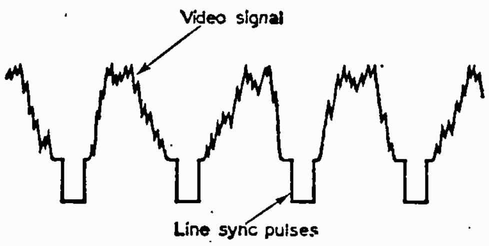


Fig. 5—Here is shown how the sync pulses are added between the lines of picture signal.

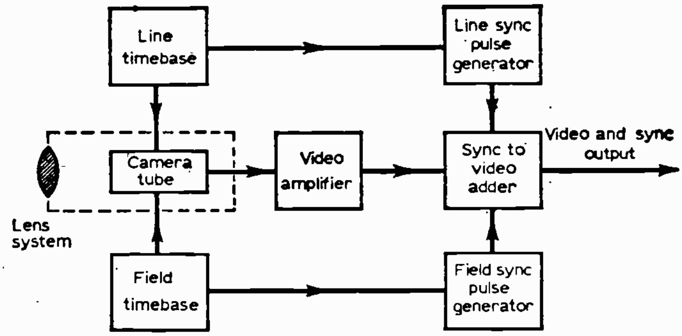


Fig. 6—Block diagram showing the basic elements of the camera system.

The camera and receiver electron beams are synchronised by the line and field sync pulses instigating the line and field flybacks in the receiver timebases. The camera system thus puts the receiver timebases under the control of its own timebases by way of the sync pulses.

In that way the position of the focused beam on the camera target is arranged always to correspond to that of the focused beam on the fluorescent screen of the receiver picture tube. This is absolutely necessary, for the amount of illumination at any point on the picture tube screen is directly proportional to that of the image element on the corresponding point on the camera target.

A camera system giving a video output provides a signal voltage which can be coupled direct to the video amplifier of any TV set. This means that home television pictures can be coupled into the domestic set with not a great deal of trouble.

Video Tape

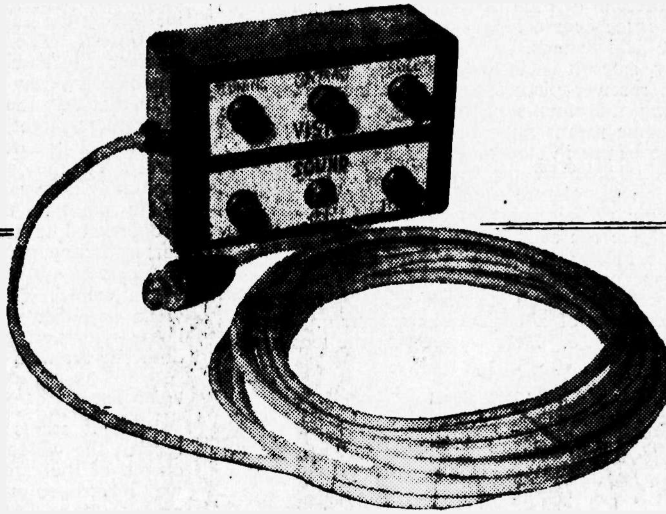
Soon it seems likely that we shall be able to record the video signal as appearing from the output of the camera system on magnetic tape—as we record sound—and then replay the visual recordings at leisure by connecting the recorder output to the input of the receiver's video amplifier.

A useful development of the camera system is an arrangement whereby the video signal is modulated on to a v.h.f. carrier corresponding to an unused vision channel. Thus the camera system produces what amounts to the equivalent of a television signal as picked up from an aerial, thereby making it possible simply to plug the camera system output into the aerial socket of any television set, turn the channel selector knob on the set to suit and immediately to commence a home-derived television programme.

Contrary to expectations such systems are not unduly expensive, far less for the television experimenter who is able to make much of his own equipment from old television sets and from spares always found in the junk box.

About the only expensive items are the camera tube and the lens system, but then, when television first started, the picture tube was a costly item, and equally as much enjoyment, if not more, can be had by making one's own closed-circuit television system as in the early days of TV Reception.

PART 2 NEXT MONTH



REMOTE CONTROL OF TV RECEIVERS

By

M. L. Michaelis

CONTINUED FROM PAGE 155 OF THE JANUARY ISSUE

FIG. 4, in conjunction with Fig. 1 (last month), shows typical details of the sound channel controls in compliance with the general principles already discussed, and the various points of interest in this circuit will now be discussed.

The remote volume control (VR5) in Fig. 1 is simply a 250kΩ log. potentiometer wired as a variable resistor to chassis, with a parallel shorting switch for sound muting. Referring to Fig. 4 first of all for CCIR f.m. sound, for which the full limiter and ratio detector circuit has been drawn in, the remote control VR5 is switched through to the screen grid of V3 and constitutes the bottom section of a screen grid voltage potentiometer for the f.m. limiter V3 in conjunction with R40. When VR5 is reduced to zero resistance, or the muting switch S1 (Fig. 1) is closed, the f.m. limiter stage V3 receives zero screen grid voltage and can consequently give no output. When VR5 is at maximum resistance, V3 receives normal screen grid voltage as a limiter stage, and gives normal full output.

In passing, note the feedback of the rectified carrier voltage from the ratio detector to the suppressor grid of the f.m. limiter V3, in combination with judicious cathode bias for this stage via R36. This arrangement serves three important functions. Firstly, it neutralises tuning changes due to input capacitance changes with signal level. Secondly, it cancels residual distortion due to the screen-grid volume control at low levels. Thirdly, the suppressor grid feedback of the rectified carrier voltage developed across C32 greatly increases the a.m. rejection of this f.m. detector circuit, when correctly adjusted with the preset control VR9. A.M. rejection of the f.m. sound channel in CCIR standard television receivers is much more important than in f.m. sound broadcast receivers, because the "local oscillator" for generation of the sound d.f. at the video detector is the vision carrier, which is amplitude modulated. The sound d.f. signal is therefore necessarily amplitude modulated with the picture content, in addition to being frequency modulated with the sound signal. Good limiting and a.m. rejection are thus essential. Poor a.m. rejection leads principally to frame buzz varying with picture content. The same symptoms can also be produced by ghosting on poor aerial installations or under difficult reception conditions (valley locations), even if signal strength is ample, e.g. with a local repeater transmitter on a nearby mountain fringing the valley location. These effects arise if negative, i.e. antiphase ghosts arise, such that the white ghost of a black point coincides with a peak white point. This can give "whiter than white" on the CCIR signal, i.e. total momentary absence of the vision carrier at that point on each frame. The trouble is most prominent on white captions or designs on a dark background, and can take the form of a crackling buzz similar to arcing within the receiver, easily confused therewith. If the ghosts cannot be removed completely, try reversing the two antenna leads, to convert negative ghosts to positive ones, with which the effect cannot arise, since vision carrier cancellation is then impossible. As long as the vision carrier never becomes less than the normal peak white level, sufficient d.f. signal is generated at all times to hold the f.m. limiter saturated and the sound channel clear of vision a.m. interference.

Remote Volume Control for BBC—405-line

When the switch S2 in Fig. 4 is thrown over to the BBC-405 a.m. position, V3 screen grid voltage is no longer reduced, and assumes the full value, generally higher on a.m., to avoid limiter action, if V3 is used as a switched a.m./f.m. final sound i.f. stage in a dual standard receiver. The control line from the remote volume control is now connected to the junction of VR10 and R43 in Fig. 4. D4 and D5 establish rectified voltages of equal magnitudes but opposite polarities across C34 and C36 respectively. They are fed from a suitable tap on the a.c. heater chain, i.e. their input is connected to the lead joining the heaters of a suitable pair of valves in the TV receiver such that an a.c. input voltage of 10 to 30 volts w.r.t. chassis is obtained. The positive voltage across C34 is used to back the negative voltage across C36, such that a net negative voltage is obtained across D6 for use in variable-mu gain control, applied to the bottom ends of the sound i.f. grid circuits on a.m. sound reception. D6 is present to prevent positive control voltages from arising. If the remote volume control is turned to zero resistance, or the remote muting switch closed, the junction of VR10 and R43 is shorted to chassis. The positive backing voltage cannot then get through at all to D6, so that maximum negative output voltage exists across D6. The tapping on the heater chain from which the rectifiers D4, D5 are fed should be selected, so that sound volume is *just* reduced to zero or a minimum, under these conditions. If sound volume is zero long before the minimum resistance setting of the remote volume control is reached, move the tapping nearer to the chassis end of the heater chain; if sound volume cannot be reduced sufficiently, move the tapping further away from the chassis end of the heater chain. The optimum tapping point will vary according to the number of controlled sound i.f. stages and their grid base characteristics, i.e. it will depend upon the particular television receiver in question.

After having found the optimum tapping point on the heater chain to enable the sound volume just to be reduced to zero, connect a high-impedance VTVM or multimeter across D6 and gradually turn the remote volume control to maximum. During this procedure, the negative voltage across D6 will get less and less, as more and more positive backing voltage can get through via VR10. Adjust VR10 such that the negative voltage across D6 *just* reaches zero when the remote volume control is at maximum.

Tone Control

Referring to Fig. 4, it can be seen that two tone controls are present in the author's television receiver from which the circuit example has been taken. The switch S3 selects two alternative values of coupling capacitance from the sound detectors to the a.f. amplifier section. When S3 is closed, C31 is switched in, giving bass boost for music reproduction. S3 should be closed for all mixed speech/music programmes, and, especially for musical concerts, and opened only for "speech-only" programmes, such as TV plays, news bulletins, political broadcasts, etc. The second tone control in the receiver is continuously variable and

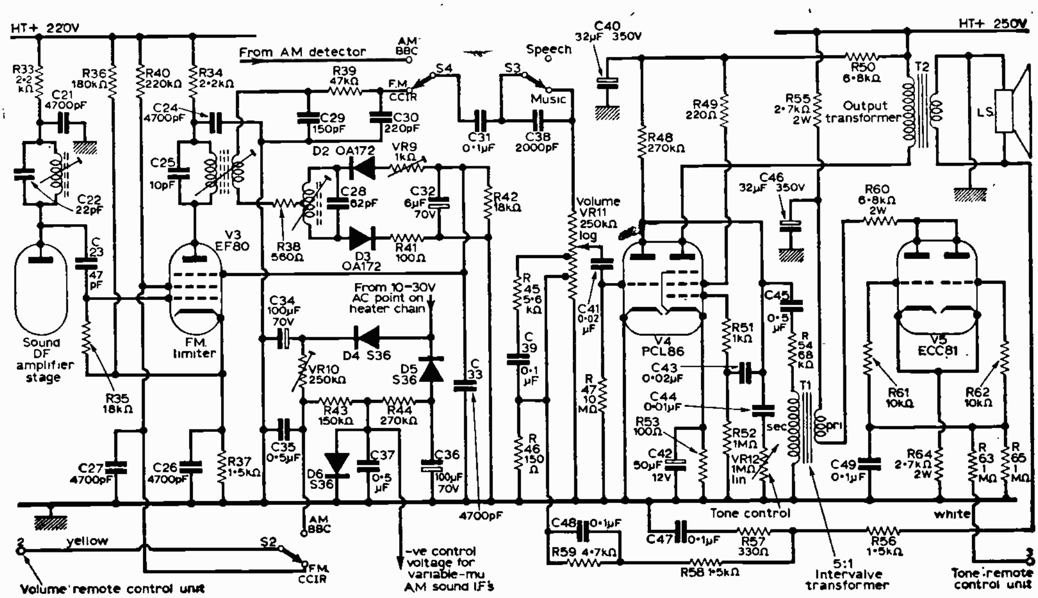


Fig. 4—The audio circuitry of the author's receiver. The f.m. limiter and ratio detector sections for 625-line f.m. sound are included, since these are used for remote volume control on f.m. sound reception.

takes the form of a conventional treble-cut arrangement at the grid of the sound output valve (C44 and VR12). Note that the correct position for such a tone control is at the grid of the output valve, *not* at the anode. The treble-cut volume control is most frequently found wired between the output valve anode and chassis, in both TV and sound radio receivers. It certainly *works* in either position (given correct respective component values), but it shunts power when connected in the anode circuit, considerably reducing the available power output in the "bass" setting—just where good "punch" is required! This disadvantage is absent when the treble-cut control is connected at the grid of the output valve.

Aurally Compensated Volume Control

It is seen that the main volume control at the input to the a.f. amplifier section of the TV receiver in Fig. 4 is of an unusual kind, as far as current and past British design is concerned. This type of volume control has, however, been universally adopted in most other European countries for at least the last six years, both for sound and television receivers. The volume control, VR11, is a normal potentiometer apart from the fact that its track has two *fixed* tappings at a quarter and one half the total track resistance from the chassis end. Ingenious constructors can easily add taps themselves to a normal volume control, and those wishing to buy a suitable component ready-made and finding difficulty in obtaining it, may write privately to Messrs. Arlt Radio-Electronics, 4 Düsseldorf 1, Friedrichstrasse 61a, West Germany. This company is prepared to send goods by C.O.D. to any private address in the U.K.

It is a fact that the human ear is predominantly sensitive to middle frequencies around 800c/s when the overall sound volume is low, whereas the sensitivity of the ear—in particular to low bass frequencies—rises strongly as the overall sound intensity is increased. It is therefore of advantage to *gang* the tone and volume controls in some suitable manner if the *impression* is to be one of pure volume change without change of tonal balance as the sound intensity is varied. The ideal arrangement must automatically boost bass as volume is decreased. This is the purpose of the aurally compensated volume control exemplified by VR11 in Fig. 4, which represents the cheapest practical method of realising the desired effect. Tandem potentiometers, such as are found in stereophonic amplifiers, could certainly be used, but are more expensive, and give no improvement over the method described here.

The standard method of wiring a double-tapped aurally compensated volume control is to inject treble boosted negative feedback from the output stage into the lower tap on the volume control track, connect a standard treble-cut c.r.-combination to the upper tap, at the same time adding a small differentiating resistor to the bottom end of this treble cut path (R46) to inject slight treble-boost into the bottom tap in addition to the negative feedback. With properly chosen component values, as shown in Fig. 4 for a typical arrangement, this circuit smoothly cuts treble and boosts bass as volume is reduced, and finally at low volume levels accentuating the bass boost even more and re-introducing a slight amount of treble boost.

Reference Levels

Once we make use of an aurally compensated volume control, it is clear that we must forfeit the facility of using the volume control as a compensator for arbitrary signal *carrier* input amplitudes. The compensation circuit is necessarily designed so as to give "the right impression" at all output volume levels for a *particular input* signal level. In other words, assuming that the radio or TV broadcasting authorities modulate properly at the transmitter, which we may assume that they do on f.m. transmissions, an aurally compensated volume control at the receiver is only of avail in conjunction with an excellent a.g.c. circuit in the r.f. and i.f. sections. As far as f.m. reception is concerned, this condition is largely met if a good limiter stage is used and a.m. rejection thereof is very good. We thus see yet another advantage in this respect of the rectified carrier feedback to the suppressor grid of the limiter stage V3 in Fig. 4. In passing, it is also clear from the above remarks why an aurally compensated volume control is seldom, if ever found on an amplifier unit by itself, since it would there be rather pointless—the input signal levels which a general-purpose amplifier has to handle, vary over too great a range.

Points on Remote Control

We have seen that a radio or television receiver incorporating an aurally compensated volume control, also has highly efficient a.g.c. to deliver the required constant mean signal input to the audio section. On the other hand, we saw earlier in this article that remote sound volume control must be via the i.f. section, which contradicts the condition of constant detector output required by an aurally compensated volume control.

It is therefore essential to bear two points in mind for a successful remote volume control. Firstly, it should not be used to an excessive degree. Thus, do not turn the volume control on the receiver to maximum and then reduce to normal listening intensity at the remote control, since this will necessarily give exceedingly weak bass and very "tinny" reproduction. The correct method is to turn the *remote* volume control (VR5 in Fig. 1) to half-track position and *thereafter* to advance the aurally compensated volume control on the TV receiver to a position which gives normal listening volume on an average programme. The second important point is then concerned with the *small* residual tone corrections required in conjunction with operation of the remote volume control if really critical programmes, such as symphony concerts, are involved. Without the remote tone control VR12 (Fig. 4, treble cut at receiver) is normally operated at mid-track position. With the remote tone control via V5 (Fig. 4) connected this takes over control, i.e. VR12 at the receiver should then be set to maximum resistance, i.e. maximum treble. Correct tone on a normal programme at normal listening volume set as described above is then obtained with the remote tone control (VR4 in Fig. 1) at mid-track position. If this condition is not satisfied modify the values of C45 and R54 in Fig. 4 accordingly, since results will be somewhat dependent upon the particular intervalve transformer used for T1.

Function of the Remote Tone Control

The control range of the remote tone control is only moderate. It is a correction control for the connoisseur listener and *not* a wide-coverage main control. Satisfactory control over the limited range available can be achieved without magnetic distortion using the saturable reactor principle as outlined earlier in this article.

The inductance of the high-impedance secondary of an intervalve transformer T1 is adjusted by varying the d.c. anode current of V5 that passes through the primary. This current is controlled by varying the grid bias for V5 via a line from the remote control unit. In order to be able to use the h.t.+ line as a voltage source at the remote control unit once again V5 has a large cathode resistor so that correct grid control is obtained with equally large positive grid voltages-w.r.t. chassis. V5 should be mounted on a small bracket at some suitable point near the audio section of the TV receiver being modified and the heater should be connected near the chassis end of the heater chain, e.g. above the c.r.t. heater. Check that the heater current is correct for either the series or parallel connection of the ECC81 heater or use an alternative heater rating valve as appropriate in a given case. Alternatively a small heater transformer may be fitted if the supply is a.c.

High Fidelity Sound

Some very exacting statements and practical pointers have been made in the above discussion regarding TV sound reproduction. Readers should not be tempted to think that these are in any way pedantic unless they are satisfied with the rather inferior sound reproduction unfortunately so prevalent in TV receivers of the past. Enough lamentation of this point has been presented elsewhere in the pages of this journal to bear out the truth thereof! In striving for high-fidelity TV sound one is concerned with even more incentives than in the case of sound radio or sound recordings alone. It is a psychological fact that a really brilliant and impressive sound channel amounts, so as to speak, virtually to "several inches more screen diameter". In other words, a lifelike sound channel greatly increases the "presence" and "dimension" of the picture on many programme types.

The author wishes to point out at this stage that two requirements must be satisfied. The first is to assure low distortion and correct tonal balance, which we have already dealt with at various stages in this article. The second requirement is to assure adequate audio power output. The reason why some otherwise ingenious suggestions made from time to time by our readers have seldom led to complete success is that they failed to satisfy this second point. For instance, the pentode section of the PCL86 shown as an audio output stage in Fig. 4 does not give anywhere near sufficient power for real high fidelity sound. This stage is, however, present in the author's TV receiver and is used to a medium-sized loudspeaker within the TV receiver cabinet. In addition, and not shown in Fig. 4, a low-impedance isolating transformer takes a signal from T2 secondarv to a separate 15W high fidelity power amplifier housed in a large bass reflex cabinet fitted with the latest model WB Stentorian loudspeaker and used as a table for the television receiver.

The main power amplifier is a permanent fixture within the bass reflex cabinet and its controls have been set and sealed once and for all for optimum results. The mains input to the power amplifier is so connected to the TV receiver that the main power amplifier is switched automatically, together with the TV receiver, at the mains switch of the latter.

This combination of equipment, together with proper attention to all the points regarding the sound channel discussed elsewhere in this article, has led to a performance which a television broadcasting engineer visiting the author's home has pronounced as being hardly distinguishable from studio quality.

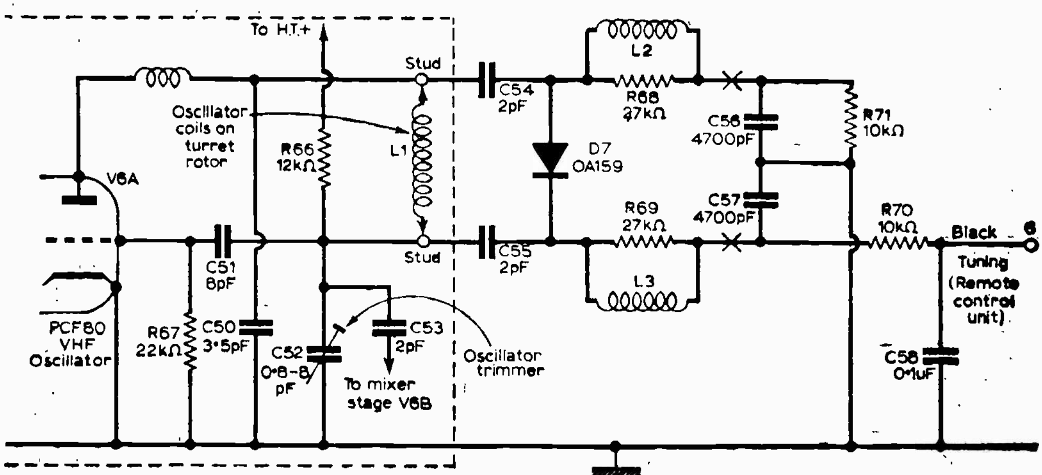


Fig. 5—This circuit shows how a variable capacitance diode D7 may be added to virtually any TV turret tuner, as a simple means of remote fine tuning.

Remote Fine Tuning

There are two methods of achieving fine tuning on a television receiver channel selector. The first method is analogous to the familiar bandspread control on short wave receivers, making use of a low-capacity variable capacitor in parallel with the main tuning capacitor or of a mechanical coil-slug adjustment (variometer tuning). All such devices are inconvenient for remote control, since they would then require some form of servo-motor drive. The second, more modern, method employs no form of mechanical device but rather a variable capacitance diode connected across the local oscillator coil and itself controlled by a positive d.c. voltage of variable magnitude applied to its cathode (i.e. in the cut-off direction of the diode). Almost any semiconductor diode manifests the phenomenon of decreasing barrier layer capacitance with increasing inverse voltage applied and this is all that is being made use of here. Some diodes are specially sold as variable capacitance diodes because in them the effect is most stable and most pronounced, but readers can try any r.f. diode which happens to be to hand.

Fig. 5 shows the relevant local oscillator components of the channel tuner within the dotted line; the arrangement is typical of current design in turret tuners. To the right are shown the d.c. blocking capacitors C54, C55, the variable capacitance diode D7 and a decoupling network suitable for feeding in the diode control voltage from VR1 in the remote control unit, Fig. 1.

Optimum stability is achieved if C54, C55, D7, R68, R69, L2, L3 are small components and wired in a tight bunch within the turret tuner around the oscillator coil studs of the turret stator connections. The two leads marked "X" pass out through the metal casing of the turret tuner and R70, R71, C58 are situated very close thereto on the exterior of the tuner. C56 and C57 must be either ceramic lead-through capacitors or otherwise be situated on the exterior of the tuner. In the latter case it may be necessary to duplicate each of them by a similar capacitor in parallel connected immediately at the point of entry of the control leads inside the tuner casing. The windings L2, L3 are not critical. A few dozen turns of very fine enamelled copper wire wound on the resistors R68, R69 are satisfactory. In some cases R68 and R69 alone are sufficient without requiring L2, L3 at all.

Automatic Fine Tuning

The latest TV receivers frequently employ an arrangement such as shown in Fig. 5 with the control input at "6", not from a remote control unit but from an a.f.c. (automatic frequency control) circuit. This consists of a frequency discriminator sensing the vision i.f. and developing a d.c. output voltage proportional to the magnitude and sense of the i.f. frequency error. The d.c. voltage is amplified and applied as control voltage for the diode D7 in Fig. 5 in such a sense as to correct the oscillator tuning.

The author's receiver in fact contains such an a.f.c. circuit, too, which was already connected to L1 via its own pair of isolating capacitors. The manual remote control circuit shown in Fig. 5 was added in parallel so that in fact two such variable capacitance diode circuits operate independently on the local oscillator coil. There is no objection to such an arrangement and the a.f.c. circuit continues to operate when switched on without mutual interference. The slight increase of stray capacitances due to the double control circuit was easily counteracted by readjustment of the oscillator trimmer C52 and slight realignment of the individual coil slugs on the turret rotor for the higher frequency channels. In some receivers already fitted with a.f.c. it may be convenient to feed the remote tuning control voltage from the remote control unit to the a.f.c. discriminator d.c. amplifier grid so as to operate into the existing a.f.c. diode. This is not possible without complications in a number of receivers, as was the case in the author's model, which is also fitted with a.f.c. for the u.h.f. tuner assembly, using a rather complicated common switched a.f.c. network. Indeed, receivers already fitted with a highly efficient a.f.c. circuit, such as the author's model, normally do not need a fine tuning control and such can be dispensed with entirely in the remote control unit. The real need for such remote fine tuning arises only in the large number of slightly older receivers fitted with only manual fine tuning, usually in the form of an externally adjustable oscillator trimmer capacitor C52. The remote control fine tuning circuit can be added as shown in Fig. 5 to virtually all such receivers. Trouble is rarely encountered whatever the precise details of the particular tuner may be.

The author added the remote fine tuning in parallel with the existing a.f.c circuit because it was sometimes found necessary to operate his CCTV transmitting equipment off channel, i.e. at a non-standard carrier frequency beyond the pull-in range of the channel a.f.c. to avoid heterodyne patterns from TV stations. In such applications it was not found to be necessary to mute the a.f.c. On the contrary the manual fine tuning extends the effective range of the a.f.c. and the fact that a.f.c. remains operative and pulls in the oscillator as soon as the manual control has been tuned sufficiently makes the operation of the latter very smooth and efficient. It should be pointed out that similar conditions and requirements can arise for DX-TV broadcast reception. Should it be desired to mute the a.f.c. circuit where such is present, i.e. to have optional manual or automatic fine tuning, the spare line 7 (blue in Fig. 1) from the remote control unit can be used to switch a muting bias to the a.f.c. d.c. amplifier. It is then possible to remove a.f.c. and take over manual fine tuning at the remote control unit when required, e.g. under conditions of poor reception or variable reception.

Conclusion

It is hoped that this article has clarified important aspects of simple remote control circuits for the major functions of a television receiver. Whilst specific circuit examples have been given, the discussion is intended to be quite general and logical application of the principles explained for a particular television receiver to be fitted with remote control is far more important than blind copying of the circuit illustrations given. The latter apply *as they stand* only to a limited number of receiver models but with slight modification to almost any model. ■

Servicing TELEVISION Receivers

No. 110: Emerson E700 and E701

by L. Lawry-Johns

THE E700 is a 14in. model with transportable facilities and the E701 is a 17in. version. These a.c./d.c. models have a metal shell cabinet which should not and must not have any direct connection to the receiver chassis. As one side of the mains connects directly to chassis any omission of the insulating pieces resulting in connection of the chassis to the cabinet will result in the possibility of a live cabinet and dangerous, perhaps lethal, shock potential. The mains plug must be non-reversible and wired so that the chassis is never live.

Chassis Removal

The side control knobs should be removed by releasing the tension on the spring clip by depressing the clip with a screwdriver blade inserted behind the knob. The knob and/or clip can be broken by directly pulling without easing

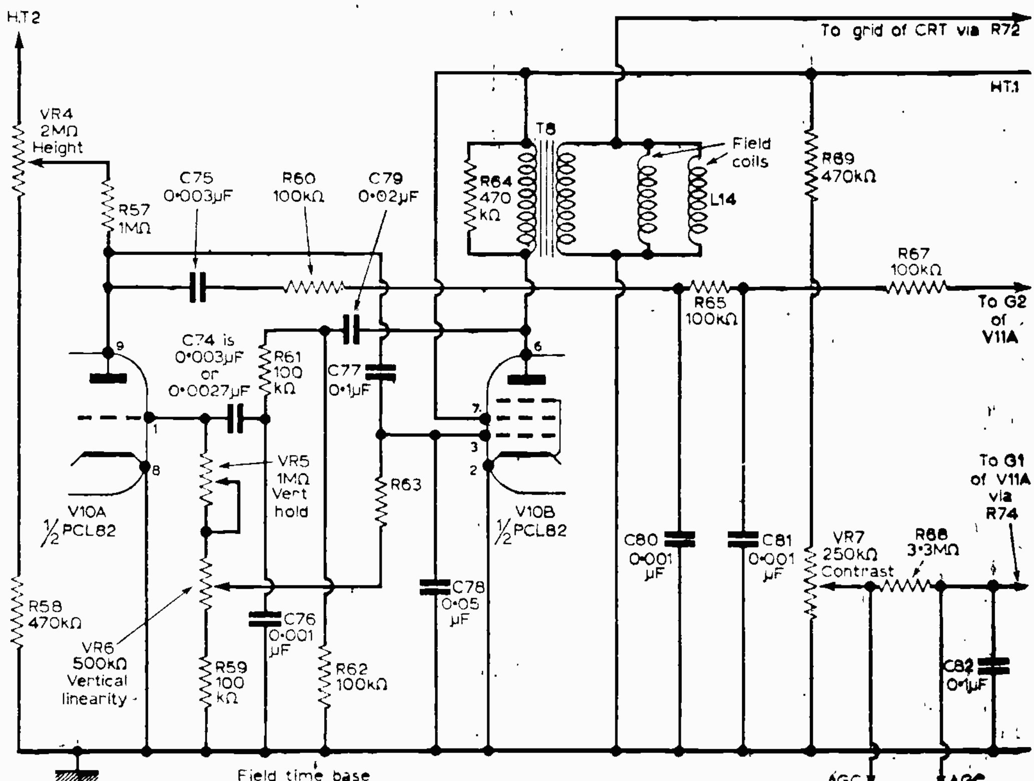


Fig. 1—The field timebase stage of the circuit.

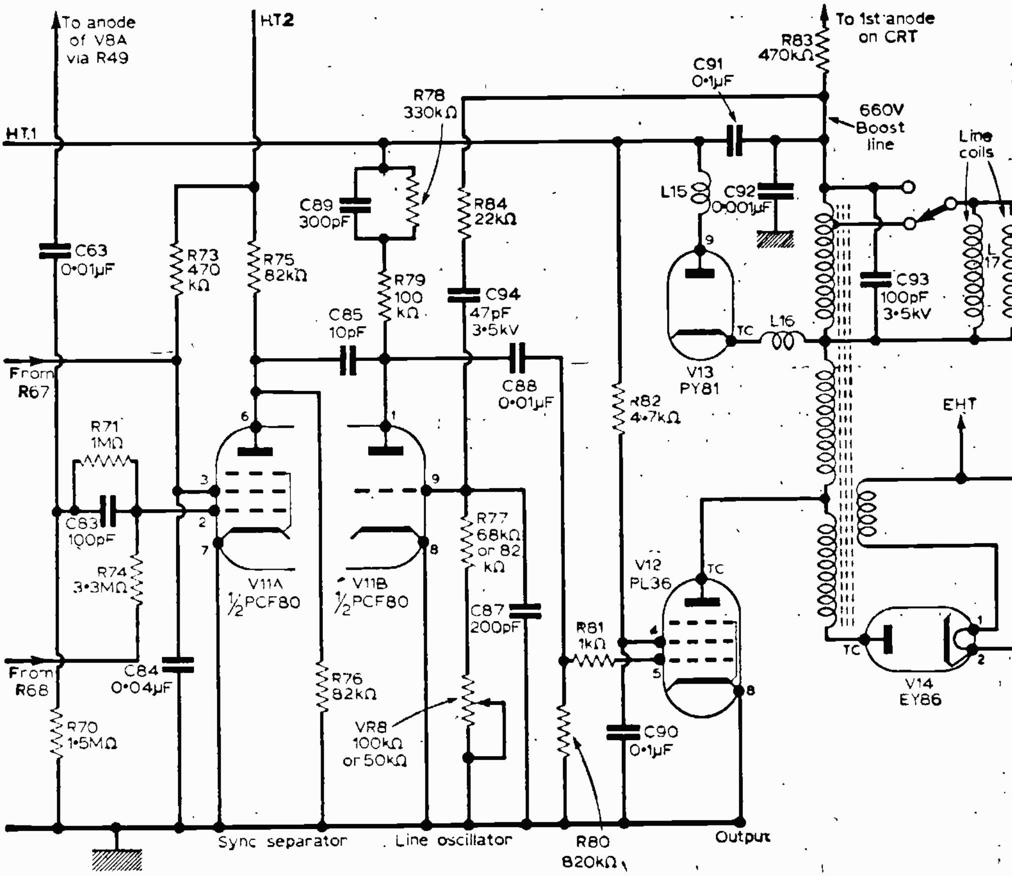


Fig. 2—The line timebase and amplifier and sync separator sections.

the clip. There is no such spindle clip on the volume/contrast knobs and these are directly pulled off. The channel selector knob has a grub screw. Turn the channel selector to channel 7, rotate the fine tuner so that the hole allows access to the grub screw.

Remove the four screws from the bottom and the top left screw at the rear which secures the control bracket and the cabinet bonding lead. Unplug the scanning coil leads, noting carefully their positions, also the loudspeaker plugs, e.h.t. lead to the side of the tube and the tube base socket. The chassis can now be eased from the cabinet, leaving the tube in position.

Replacing Chassis

Make sure the cabinet lining and insulating pieces are in position. Insert chassis and connect leads, including the top left bracket bonding lead. Ensure that cabinet is insulated from chassis. When replacing the line deflection coil leads it will be noted that there are three sockets on the transformer panel. The clear lead goes to the right side socket and the blue lead goes to one of the other two, minimum width in the centre, maximum on the left. The fine width control is the closed loop sleeve on the neck of the tube which slides under the deflection coils to decrease width, being withdrawn to increase width. This sleeve must not be rotated.

Tuner Unit

A "Fireball" tuner unit is used. For cleaning, stripping and adjustment notes see previous articles in this series. With the tuner inverted, as it is in these models, the oscillator tuning coil core is presented to the rear, thus making adjustment a comparatively simple matter.

Common Faults

The PY32 h.t. rectifier is probably one of the most common causes of failure. The sound is usually slow in coming through and the picture may not appear at all or may take a long time, then appearing small. A blue glow can usually be seen in the PY32 envelope, but not always, and it is always as well to have a spare PY32 at hand for a conclusive test. A voltmeter check would show a very slowly rising h.t. voltage, the rate of rise depending upon the condition of the valve as the getter slowly copes with the impaired vacuum.

Persistent fuse failure can be due to intermittent arcing in the PY32, but if the fuse holds until the sound comes through, only to fail as the line timebase warms up, the PY32 heater then glowing brightly for a moment before the fuse fails, check the PY81 efficiency diode as a breakdown of insulation between the heater and cathode sometimes occurs only when the line timebase

When the PL36 is not at fault it will be necessary to make further checks and the order of these will depend upon the evidence of one's ears, eyes and meter (I was going to say smell). For example, if the line whistle is very ragged and a discharging noise can be heard the source of the sound will often reveal the cause immediately. If heavy interference is visible on the screen and a noise can be heard from the deflection coils this is not a signal to replace the coils. Nearly always the trouble is due to a discharge from the line coils to the fine

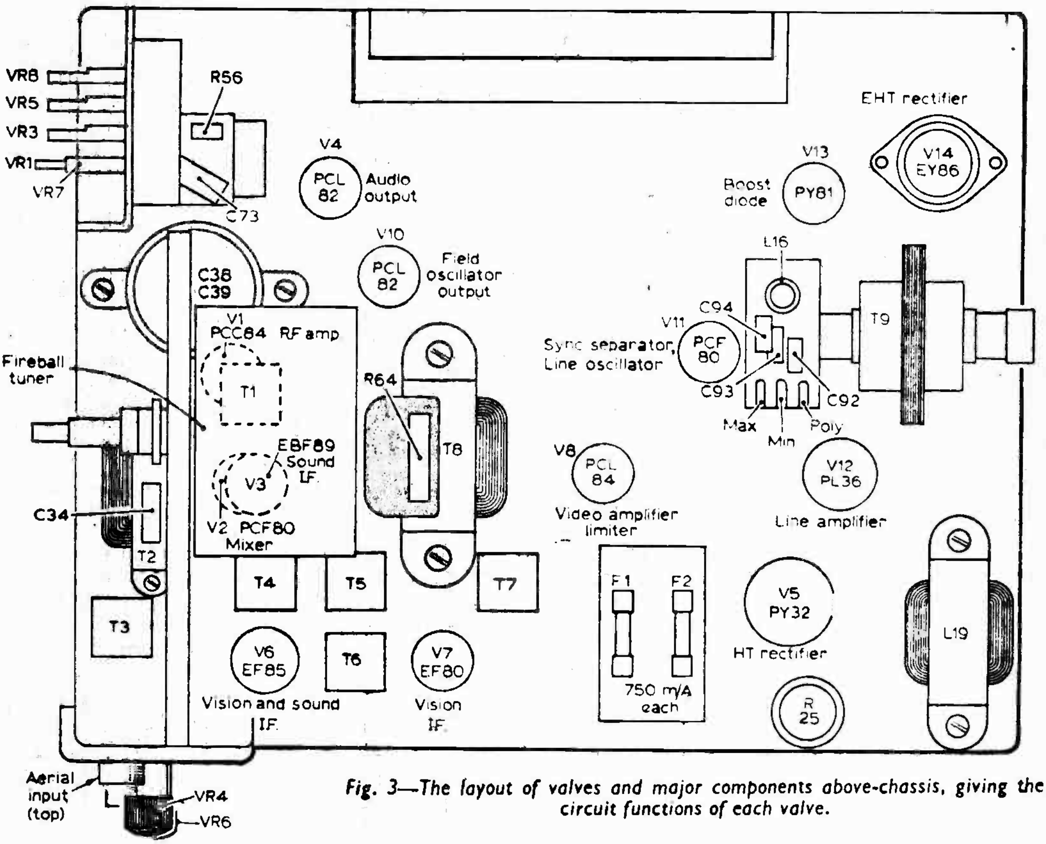


Fig. 3—The layout of valves and major components above-chassis, giving the circuit functions of each valve.

commences to produce its high-peak voltages.

Another quite common fault is normal sound with no picture or raster, no whistle and thus no e.h.t. Examination may show that all valves are lighting except the PL36. This indicates that the vacuum has been destroyed and it is not uncommon to find that the whole glass envelope is neatly cracked and will lift off the plastic base. Whilst this can happen with no contributory causes it is as well to check for causes of overheating. A frequent cause is a change in value of R82, the 4·7kΩ screen dropping resistor wired to pin 4. A change in value also causes lack of width and variation of line hold. A wire-wound resistor, 5W, should be used for replacement but note that the chassis is rather shallow and the resistor must not be pressed against any other components.

width sleeve on the neck of the tube, which can be removed altogether, adjusting the coarse width to compensate, or replaced with a new sleeve (available from most dealers). C93 is a 100pF 3·5kΩ ceramic which sometimes shorts. The obvious test for this is to disconnect one end to note the effect. A replacement must have adequate voltage rating, minimum 3·5kΩ. This capacitor is fairly accessible, being mounted on the line transformer panel. A shorted C92 0·001μF high-voltage rating as C93 produces more obvious effects, PY81 red hot, fuses blown, etc., with perhaps complications due to the PY81 or/and PY32 breaking down under the strain. C91 0·1μF is the boost line capacitor which is sometimes the responsible component when the e.h.t. fails.

CONTINUED NEXT MONTH

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

AS I write this month's article, the poor Sporadic E conditions continue, but we must not be despondent as it is quite normal for this time of the year.

I am glad to note, however, that Tropospheric reception conditions are continuing to be quite good, but of course this is not of any great assistance to those DX'ers who live well inland and to the north and west of the country, and who are too far from Continental TV stations to be able to receive many of them by this method. All that I can say to them is: be patient, Sporadic E will return again next year, and you, too, will be able to receive those Continental transmitters.

If you do fall into the above category then I suggest that you concentrate on more local DX and see what can be received in the way of more distant BBC/ITA stations, not forgetting Telefis Eireann, Eire.

During the present period of relative DX inactivity, the Editor has suggested that it might be useful if we gave fuller details of Continental TV channels and frequencies, and I fully agree with this. We are therefore this month publishing an analysis of the Band I channels and how they lie in relation to the English "B" channels used by BBC/ITA stations. This will be of particular use to beginners, as it will help them in searching for DX stations.

Later we will deal with Band III channels in the same manner, but for the moment we will concentrate on Band I, and a list of all channels in this band is given below, covering all European frequencies for the 405, 625 and 819 line systems in use.

Frequency (Mc/s.)	Channel		Frequency (Mc/s.)	Channel	
	Vision	Sound		Vision	Sound
41·25	—	F2	56·75	B3	—
41·50	—	B1	58·25	—	B4
45·00	B1	—	59·25	R2	Ia
48·25	E2	B2	59·75	—	b
49·75	E2a, R1	—	60·75	—	E3
51·75	B2	—	61·75	B4	—
52·40	F2	—	62·25	E4, Ib	—
53·25	—	B3	63·25	—	B5
53·75	Ia, b	E2	65·55	F4	—
54·40	—	F4	65·75	—	R2
55·25	E3	E2a	66·75	B5	—
56·25	—	R1	67·75	—	E4, Ib

Vision Channel Tuner Positions:

E2. Vision lies between B1, and B2 vision and is approximately ⅔ of the way between them, it is in fact where the B2 sound appears as a pattern on the screen.

E2a and R1 Vision lies to the h.f. side of E2, and between B1 and B2 vision.

F2. Vision lies just to the h.f. side of B2 vision.

Ia. Vision lies approximately half way between B2 and B3 vision.

E2. Vision lies just l.f. of B3 vision.

R2. Vision lies approximately half way between B2 and B3 vision.

E4 and Ib. Vision lies just h.f. of B4 vision.

F4. Vision lies just l.f. of B5 vision.

Sound Channel Tuner Positions:

F2. Sound lies just l.f. of B1 sound.

E2. Sound lies just h.f. of B3 sound.

F4. Sound lies approximately half way between B3 and B4 sound.

E2a. Sound lies approximately half way between B3 and B4 sound, and just h.f. of F4 sound.

R1. Sound lies just l.f. of B4 sound.

Ia. Sound lies just h.f. of B4 sound.

E3. Sound lies approximately half way between B4 and B5 sound.

R2. Sound lies h.f. of B5 sound.

E4 and Ib. Sound lies a little further h.f. of B5 sound than R2.

In addition to the above *Telefis Eireann*, Eire, operates on channel "b" in Band I, outside the normal European channels, and its relative position for the Gort Maghera station on the tuner is as follows:—

"b". Vision lies approximately half way between B2 and B3 vision and is in fact the same frequency as channel E3 vision.

"b". Sound lies approximately half way between B4 and B5 sound, and just h.f. of Ia sound.

—*continued on page 226*

SIGNAL PREAMPS FOR BANDS I AND III FROM OLD CONVERTERS

A simple conversion to an old ITA "converter" provides an efficient signal booster for fringe area receivers.

BY T. D. WILLIAMS

WITH the arrival on the market of old, and often brand new, converters of the "turret" variety at practically give away prices, my thoughts turned to what possible use could be made of these other than their original purpose.

A friend who lived in a really bad signal area in Wales where BBC on channel 5 Band I was just about viewable, and ITV on channel 10 Band III was merely a whisper of sound, even with high gain aerials and low loss down lead, led my thoughts to preamps which could be made cheaply and were switchable from channel to channel.

The possibility of using half a converter as a preamplifier occurred to me, since the cascode PCC84 r.f. amplified stage was clearly well suited to such a purpose and the best type of device the TV industry could produce.

In order to produce the very best results it is essential to obtain coils for the actual channels which it is required to tune. Also, if possible, a converter having coil biscuits similar to those shown in Fig. 2 should be obtained rather than those in Fig. 1, as they can be given a final trim, whereas those in Fig. 1 cannot. However, providing coils for the proper channels are obtained, there should be no difficulty with either type of coil.

IMPORTANT! When carrying out a conversion such as described in this article, you will be working with a.c./d.c. circuitry. Ensure that the mains connections are made correctly to avoid the metal parts being "live" to earth and therefore dangerous.

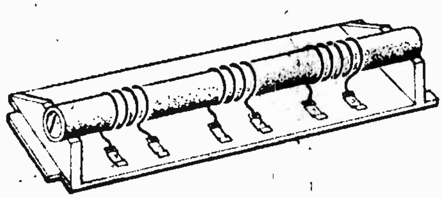


Fig. 1—Converters having this type of coil biscuits are suitable but have the disadvantage that they cannot be trimmed.

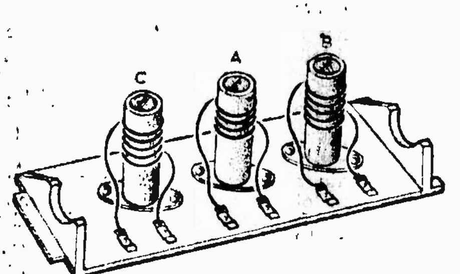


Fig. 2—A final trim to this type of coil biscuit is possible and is therefore preferable.

THE PROCESS OF CONVERSION

The process of converting the converter was reasonably simple. The existing aerial connections were not interfered with in any way, but in

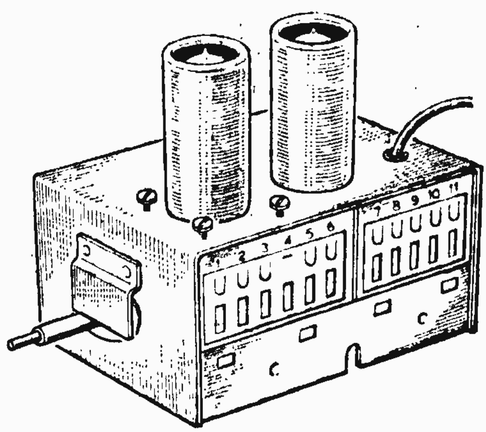


Fig. 3—A typical converter with its side plate removed to show the contacts to the switch banks.

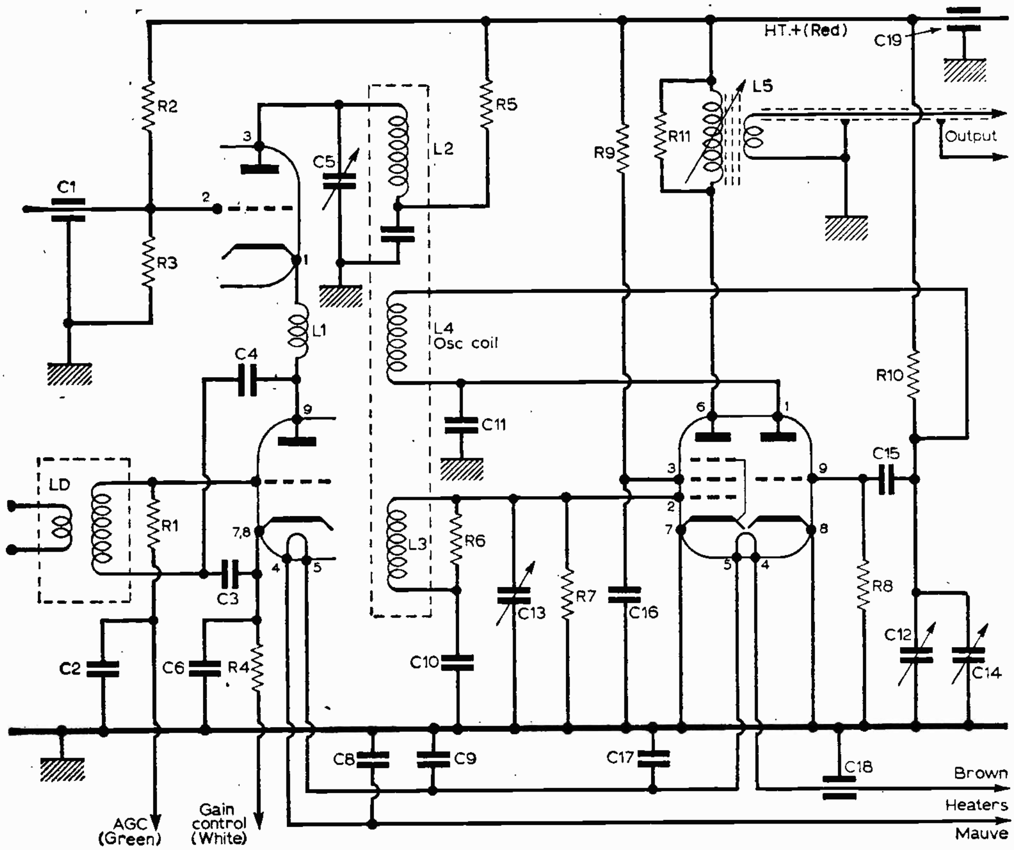


Fig 4.—The circuit of a typical turret tuner.

turrets having separate inputs for Band I and Band III it is usual on the aerial coils for tags 9 and 10 to be used to contact one aerial and tags 10 and 11 the other aerial (see Fig. 3) to the coil biscuits. Therefore if it is intended to use one type of converter with coil biscuits from another, it is as well to bear this point in mind.

The question of taking the amplified output from the converter to the aerial socket of the receiver was the only one which called for thought.

A look at the circuit of a typical turret tuner (Fig. 4) will show the output from the second triode of the PCC84 is coupled via coil L2 to the grid of the pentode section of the PCF80 via coil L3. Coil L4 is the oscillator coil and can be ignored.

It was necessary to take the output from coil L3, and to get at the connections to this, firstly remove the clip-on base of the converter and then the side panel, which is usually secured by two self-tapping screws. When this has been done the connections to the two banks of contacts with which the coil biscuits connect are revealed.

CONTACT CONNECTIONS

The aerial, or shorter of the two banks, was left untouched, while a short length of coax cable was soldered to the two centre contacts numbered 3 and 4 on the longer of the coil banks, as shown in Fig. 3.

It will be found in most turrets that contact number 4 is not brought out, as are the others, but is turned to the inside of the turret and is soldered to a test point. This test point varies in location from turret to turret, but an inspection of the inside of the tuner with the coil biscuits removed will quickly show to what point it is connected.

The two main alternative positions are shown in the top view of the turret in Fig. 5. Contact number 4 should have the coax outer soldered to it and should also be bonded to tuner chassis. It is in order to make these connections at the "Test Point" on the top of the tuner if this is found easier.

This cable should be terminated at the other end with a coax plug. There does not appear to be a critical length for the cable and the writer used a piece about 18 inches long. This gave plenty of free movement while the preamp was being adjusted and allowed it to be tucked neatly in the receiver on completion.

H.T. AND L.T.

Since no valves were removed from the receiver, as would be the case in a normal conversion, it was necessary to wire the converter into the circuit so far as its h.t. and l.t. supplies were concerned.

Bear in mind that some very old receivers have 0·1 Amp heater chains and if the preamp is intended for use with one of these the valve required will need to be a UCC84 which has a 0·1 Amp heater. Incidentally, the i.f. output of the turret is of no consequence whatsoever in this modification.

In view of the vast variety of receivers in use it is impossible to give specific notes on obtaining power for the preamp, except to say that the heaters are best wired in as near the low voltage end of the heater chain as possible. Since only one valve is being inserted into the circuit it is rarely necessary to adjust the mains tappings of the receiver. H.T. can be picked up at any suitable point in the circuit.

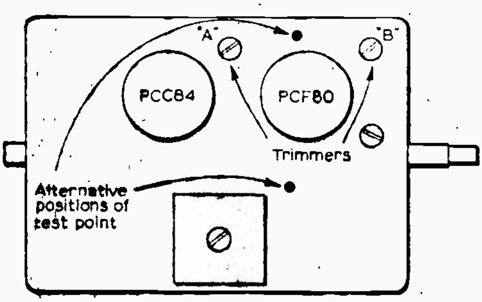


Fig. 5—Top view of the converter showing the alternative positions for the test point.

WIRING CONNECTIONS

It is necessary to solder a jumper lead across pins 4 and 5 of the PCF80 valve base. Do not, under any circumstances, operate the preamp with the PCF80 left in circuit otherwise its local oscillator will produce the most weird effects and possibly not only on your receiver, but also on those of your neighbours, who are likely to bring the GPO breathing fire and smoke down your neck.

If difficulty is found in getting at pins 4 and 5 of the PCF80 valve base, which is quite likely since they are rather tucked away, it is in order to form a piece of fairly heavy gauge wire into a small hairpin loop and insert this between pin-holes 4 and 5 from the top of the base.

Make certain the set is not plugged in or switched on when this link is inserted, for if it is, mains potential will exist between pins 4 and 5 until the link is in place.

FIRST TESTS

When these modifications have been completed, plug in and switch on the parent receiver and allow to warm up. *AT THIS POINT TEST THE CHASSIS AND METAL WORK WITH A NEON SCREWDRIVER TO MAKE SURE THE MAINS POLARITY IS CORRECT AND THAT YOU DO NOT HAVE A "LIVE" CHASSIS. IF THE NEON GLOWS, REVERSE THE MAINS PLUG AND TEST AGAIN.*

If any sort of results are being obtained from the aerials make sure these are being received as well as possible. Then unplug the aerial and insert into the receiver socket the coax plug leading from the preamp, plug the aerial down lead into the preamp aerial socket and switch the preamp so the coil biscuits therein are connected to the same channel as the receiver.

If the coils in the preamp are accurately aligned it will be found that a vastly improved picture appears on the tube and that there will be no need to make any further adjustments. If there is little or no improvement the coils will need to be adjusted.

ADJUSTMENTS

The two coils marked "A" and "B" in Fig. 2 should be adjusted for maximum picture brightness. The coil on the aerial biscuit should be adjusted last of all. It has been found this coil needs adjustment even from aerial system to aerial system.

If the preamp has coil biscuits as in Fig. 1, the only means by which coils "A" and "B" can be adjusted is by moving the coil turns nearer or further apart. The aerial coil, of course, has the usual tuning slug which can be adjusted through a hole in the rear of the tuner.

It is unusual to have any need to adjust coils "A" and "B" as they are very accurately aligned by the manufacturer.

When one channel has been safely aligned for best results the receiver should be switched to the second channel and the preamp similarly switched to have its coil set for that channel switched into circuit. It may sound silly, but always remember to do this. The writer nearly went mad on the occasion when he switched the set tuner over but forgot to switch the preamp; there is nothing more frustrating than trying to preamplify a feeble ITV signal through BBC coils.

PCC89 SUBSTITUTION

Further gain can be achieved by replacing the PCC84 with a PCC89 valve. So far as base connections are concerned they are a plug-in replacement, but to obtain optimum results from the PCC89 it is necessary to alter the cathode bias resistor R4 in Fig. 4 from the existing value of 100Ω to 82Ω.

To do this it is necessary to remove the revolv-

—continued on page 227

RESONANT LIN

A N electrical circuit is tuned by a combination of inductance L and capacitance C and resonance occurs at the frequency at which the reactances of L and C are equal. There is a simple little formula which expresses this condition and it is:

$$\text{Frequency at Resonance } f = \frac{159}{\sqrt{LC}}$$

where f is in Mc/s, L is in μH and C is in pF.

Thus it can be seen that by reducing either L or C (or both) the tuned frequency is increased. In many cases of radio and television practice L is the ordinary tuning coil and C is the tuning capacitor, and either may be variable to tune the circuit over a range of frequencies. This shown in Fig. 1.

Strays of L and C

At broadcast frequencies (medium frequency radio) both L and C are relatively large. At 500kc/s (0·5Mc/s), for example, the inductance is about 300μH and the capacitance about 340pF. These relatively large values of L and C mean that strays of L and C in the circuit and valves themselves have virtually no effect on the tuned frequency. An extra two or three "puffs" or μH of inductance would barely give a recordable change in frequency.

At such frequencies therefore one does not need to bother too much about how much extra C or L the circuit is introducing. As the tuned frequency is increased, however, strays of L and C become more important. At 200Mc/s (Band III television frequencies) it only needs an inductance of 0·2μH and a little over 3pF to obtain resonance. Thus here only a fraction of a pF or μH would cause a substantial change in tuned frequency.

Between the windings and turns of coils there exists a capacitance and the circuit connecting leads possess inductance. These capacitances and inductances have to be taken very much into account at Band III frequencies, as we are probably well aware.

In addition, the internal capacitances of the valves and the capacitances formed between the wiring and components and the chassis are also very important at very high frequencies (v.h.f.).

It is for this reason that the performance of a v.h.f. tuner or amplifier may very much deteriorate after a servicing exercise if the wiring or components have suffered misplacement. It is also the reason why some home-constructed equipment fails to work if the layout has been altered from that specified by the designer.

The very small inductance requirement for tuning Band III channels is made up of very few turns of heavy gauge wire on a small diameter former, while a substantial part of the capacitance is formed by strays (under controlled conditions) and the internal capacitances of a valve. This, then, is why considerable mistuning can occur in a v.h.f. tuner if a wire is misplaced, a screen left off or a different size component used as a replacement.

Fixed capacitors are used to partially "swamp"

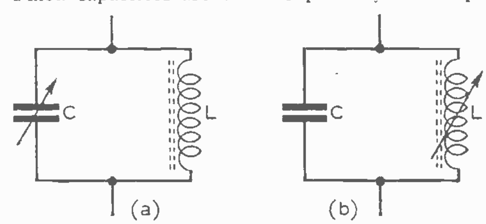


Fig. 1—The resonant frequency of a circuit in which capacitance is connected in parallel with inductance can be altered either by varying capacitance, C (a) or inductance, L (b). Increasing either decreases the tuned frequency.

the strays, for if this were not done there would be substantial frequency drift during warming up and on changing a valve. Even so, when a valve is replaced retuning is often necessary.

Turns Spacing

The tuned frequency is also originally established by the spacing between the few turns on a coil, for varying the spacing changes the self-capacitance of the coil, increasing the spacing reduces the capacitance and increases the frequency.

It is seen, therefore, that at Band III frequencies a v.h.f. tuner must be in a high state of L and C balance for optimum results. Early tuners were easily prone to misadjustment but modern versions are relatively stable devices, though, of course, they can simply be put off tune and out of balance by internal fiddling.

At Band I frequencies (around the 50Mc/s mark) things are not quite so critical and changes in strays of L and C have less of an effect on the tuning. At medium frequencies (radio broadcasting) great liberties can be taken over the layout of the components and wiring, for small changes in L or C are insignificant in comparison with the large L and C necessary to tune over the broadcast bands.

ES

GORDON J. KING

U.H.F. Bands

Now, suddenly we have jumped from about 200Mc/s in Band III to towards 600Mc/s at the top end of Band IV (channel 33—the London BBC-2 Channel—has a vision frequency of 567·25Mc/s). As most of us will know, the new BBC-2 transmissions are taking place in the ultra-high-frequency bands, so now we are concerned with tuning these far higher frequencies as compared with those that we have been used to in the past.

Indeed before we have finished we will be dealing with frequencies up to about 850Mc/s (Channel 68) and this is really going some from the domestic front!

These ultra-high frequencies make it virtually impossible to employ standard inductors in television tuners designed for Bands IV and V, for great difficulty is experienced in keeping the stray Ls at a sufficiently low value to secure the tuning point! That is to say, the value of the stray Ls is *greater* than required to tune the u.h.f. channels in conjunction with the stray Cs of the circuit.

It is interesting to note that a 4in. length of ordinary 18s.w.g. copper connecting wire has itself an inductance of about 0·1μH. Even valves designed for u.h.f. service have appreciable inter-electrode capacitances, so all in all problems are certainly involved in attaining the LC combination needed to get up to 600Mc/s or so. The chassis and metal parts of the tuner or amplifier also assume a great importance at such high frequencies.

The author has experimented with many designs of chassis for u.h.f. service and has never failed to be surprised at the "new look" that these take on at such frequencies. In many cases a virtual "open circuit" has been measured, for instance, between two perfect electrically connected chassis points at the working frequency. This is because the inductance of the chassis in conjunction with capacitance effects has caused the combination to act as a rejector at the tuned frequency!

Chassis points for the connection of decoupling capacitors, tuned circuits and so on thus need often to be chosen with great care and after much experimentation. Anyway, now to revert to the main theme.

Transmission Line Tuning

Since it is not easily possible to secure resonance on the u.h.f. channels by the conventional LC combination, other methods have been adopted. In u.h.f. tuners and some amplifiers the normal LC method of tuning is totally abandoned and in place is employed a carefully designed transmission line.

The transmission line usually takes the form of a "coaxial" arrangement. Here the inner conductor is supported in an enclosed trough which forms the outer conductor. The system is sometimes called "trough-line" tuning and "lecher wire tuning", according to the fancy of the designer or author!

A transmission line which is adjusted in length in relation to the frequency it is required to tune, can be made the equivalent of a parallel resonant circuit (as shown in Fig. 1). The line is so resonant at 1/4, 3/4, 5/4 and etc. wavelength when it is shorted at one end and 1/2, 3/2, 5/2 and etc. when it is open.

An ordinary length of coaxial cable or other transmission line will exhibit this characteristic, and there are circuits which use coaxial cable for tuning instead of the more conventional inductance and capacitance.

For u.h.f. tuners and amplifiers, however, ordinary coaxial cable has too much of a spread and is insufficiently stable for serious work. A transmission line is thus created after the style of that shown in Fig. 2. Here we have a metal box in which

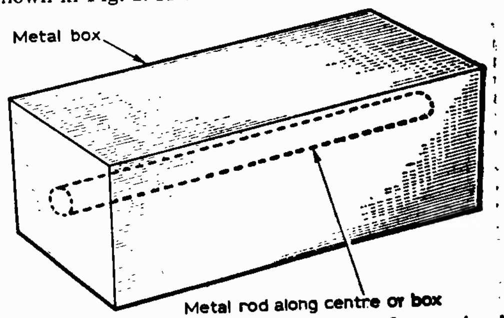


Fig. 2—A simple transmission line consists of a metal rod enclosed by a metal box. It has a characteristic impedance Z_o equal to: $138 \log_{10} \frac{D}{d}$, where D is the internal diameter of the outer conductor and d the diameter of the inner conductor.

is a metal rod, the whole often being silver-plated to reduce the losses, having in mind that u.h.f. signal currents travel within the first few microns of surface, this being known as the "skin effect".

Let us suppose that we wish to make up such a transmission line for half-wave tuning, the line being open-circuit. The metal rod (inner conductor) is then supported on insulators so that it is free from connection with the metal box (outer conductor) at each end.

Half-wave Line

Now, a half-wave at Channel 33 is 28cm (about 11 inches), so on the face of it, it would seem that we should need a remarkably clumsy device to take the place of a very small LC combination. Moreover, since a tuner would be required to tune over the u.h.f. channels (from Channel 22 at 470Mc/s to Channel 68 at about 860Mc/s) it would also seem that some mechanical means would be required to allow the physical length of the line to be adjusted. This would be from 32cm at 470Mc/s to 17·4cm at 860Mc/s.

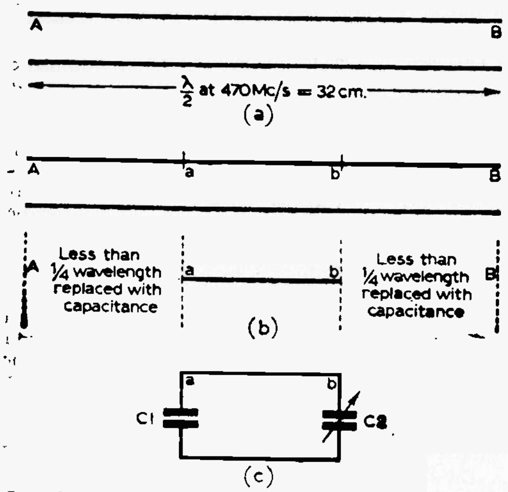


Fig. 3—The length of a half-wave transmission line unloaded is 32cm at 470Mc/s (a). By cutting off a slice of the line at each end and replacing the pieces cut off by capacitance, the line A-B can be reduced in length to a-b (b). The finished configuration is shown at (c) and the line a-b is 5cm.

In Fig. 3 (a) is represented a half-wave transmission line A-B, and at 470Mc/s, as we have seen, its physical length is 32cm. Fortunately, however, it is possible to reduce this length considerably by cutting off a length of line at each side and replacing the pieces cut off with capacitance.

Line Shortening Artifice

This line shortening artifice is possible because a length of open-circuit line which is less than one-quarter wavelength is equivalent to a capacitor. That is, it represents a capacitive reactance.

Thus, provided the end bits that are severed are less than one-quarter wavelength (which they must be, anyway, since the whole line is only a half wavelength), then capacitance can be used as a substitute without impairing the overall efficiency.

Fig. 3(b) shows how the length of the line is reduced in the manner described (the electrical length still being a half-wavelength, but the physical length being reduced to something like 5cm!), the physical length now being a-b instead of A-B, while Fig. 3(c) shows the final arrangement.

Not only is the line physically reduced in length, but its effective electrical length can easily be adjusted, and this is achieved by making C2 variable. Thus, we have line section A-a being replaced by C1, much of which can be the anode capacitance of a valve, and line section b-B being replaced by a variable capacitor.

If the length of the line is arranged so that at maximum capacitance of C2 resonance occurs at 470Mc/s, at minimum capacitance the frequency swing could be such as to embrace 860Mc/s.

In that way, therefore, continuously variable tuning over all the u.h.f. channels is possible without switching. It is upon this principle that the u.h.f. tuner is based.

U.H.F. Amplifier

Fig. 4 shows the cross-section of a transmission line system which is designed as a tuneable u.h.f. amplifier. The inner conductor is supported in the

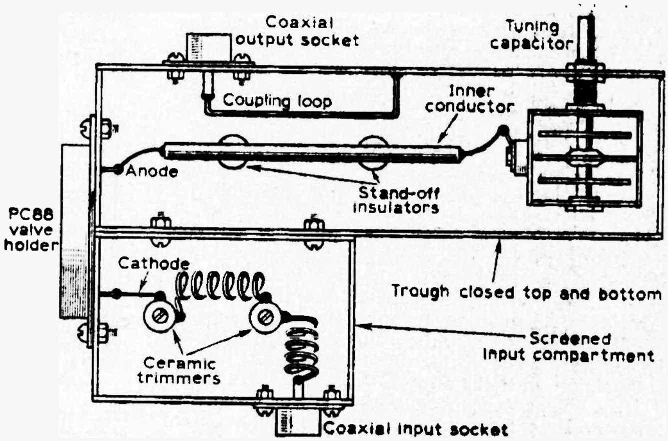


Fig. 4—Here is shown the cross-section of a valve u.h.f. amplifier featuring a transmission line of the nature described in the text.

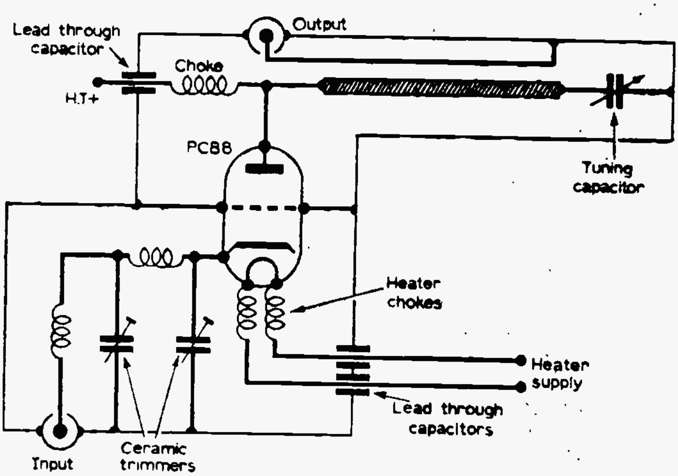


Fig. 5—This is the circuit of the amplifier depicted in Fig. 4.

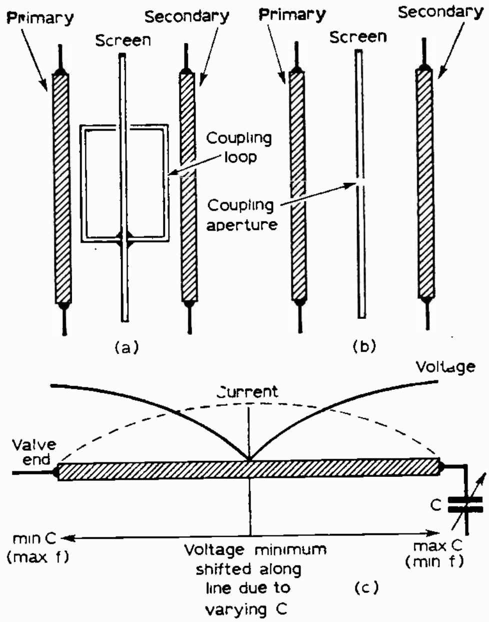


Fig. 6—(a) and (b) show link and aperture coupling between two lines respectively. At (c) it is shown how the minimum voltage point is caused to move along the line by adjusting C. As shown, the circuit is at the centre of its tuning range.

trough on stand-off insulators. One end is loaded by the variable tuning capacitor while the other end is loaded by the anode capacitance of the valve.

Signal energy is extracted from the transmission line by a small take-off loop which at one end is soldered to the inside of the trough and at the other end soldered to the inner connector of a co-axial socket or similar termination.

The input signal is applied to the cathode circuit of the valve through a pi-coupling, as shown in the circuit of the amplifier at Fig. 5. It will be seen that the valve is arranged in the earthed-grid configuration, as is conventional in u.h.f. circuits.

When the transmission line is tuned to a signal, a standing wave is set up on the line, the characteristics of which are rather like that set up on a half-wave aerial. A voltage minimum occurs near the valve end of the line at the highest frequency tuneable by the capacitor, and this moves along the line as the tuning capacitance is increased and the frequency decreased.

The signal energy due to the standing wave effect can be coupled by a loop, as mentioned above, or by an aperture in a screen between the primary line and the secondary to which it is required to couple. The two methods of coupling are shown in Fig. 6, at (a) and (b) respectively. The diagram at (c) shows the standing wave conditions on the line at the centre frequency.

U.H.F. Tuner

In Fig. 7 is shown the complete circuit of a u.h.f. valve tuner using the transmission line tuning principle on all the tuned circuits. There are four variable tuning capacitor elements, and these are ganged to the common spindle on which the channel selector knob is fixed.

In this circuit, V16 is the earthed-grid r.f. amplifier, with the signal from the aerial loop coupled to the first line and then link coupled from that same line to the valve cathode, with VC1 as the tuning capacitor. The circuit is developed amplified across the second line on the anode, with VC2 as the tuning capacitor.

From here the signal is bandpass coupled to the

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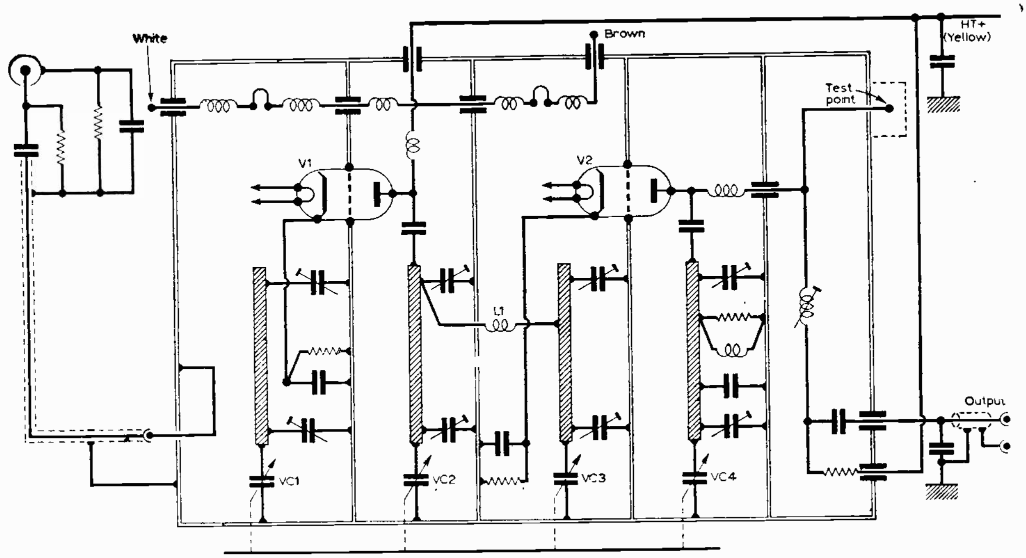


Fig. 7—The complete circuit of a u.h.f. tuner using transmission lines for tuning. This is described in the text.

UNDERNEATH

THE DIPOLE

CRAZES *come* and crazes *go*. In the entertainment business they mostly *go*, to be replaced by some new and fresh method of passing the time or, alternatively, providing the re-creation (hyphened, please) which restores the jaded nerve tension of modern living.

Shock Treatment

Television, the theatre, roller skating, the music hall, diabolo, the cinema and bingo are just a few of the diversions which, strictly in non - chronological order, help to make life worth living, just as important to the mind as eating and drinking are to the tummy. But you can't have fish and chips with everything, and tastes change as time goes on. Public executions, cock-fighting, jousting, bear - baiting and other horrifics of life 200 years ago have their modern shock treatment equivalents, certified by the film censors' "X" certificate.

More sophisticated entertainments are now presented, but sometimes they reappear and the full circle is accomplished. Music hall, said to have died out years ago, has reappeared in the North of England in pubs and clubs, particularly in Lancashire, and a new craze has started. The "Stage" newspaper recently devoted ten pages to the spectacular increase in the activities of these places of entertainment, their professional artistes and their agents. The stages, lighting and technical presentation in the saloon bars or club rooms have improved equally rapidly. A new source of talent for television has arrived. The contagious effect of audience participation has communicated itself on television via "The Good Old Days" on BBC, "Stars and Garters" on Rediffusion and "Cider Cellar" on Westward Television, each with their own stylised method of presenting music hall. Hundreds—if not thousands—of would-be members of the TV audiences have applied for tickets to these shows, arriving in immaculate Edwardian (or Victorian) dress, word-perfect in the lyrics and chorus. A good time is had by all.

"Cider Cellar"

Regional television efforts are, of course, on a scale different from that achieved on national networks, but have the advantage of using local jokes, as well as local faces and names of places. "Cider Cellar", down at Plymouth Studios, carries with it the tang of the famous Devon and Somerset brews, with their draughts of "rough" or "smooth". There is an interlude in which the ladies and gentlemen of the audience are entertained, "*at great expense*", with demonstrations of "*the new-fangled Kinematograph, the magic lantern and the cylinder phonograph*", as well as being "*enthralled by the performances of talented artistes*". Viewers have sent in hundreds of postcards, guessing the names of stars of years ago, which the attractive hostess, Penny Bowles, projects on to the screen, or plays on an Edison Bell phonograph.

Crazes

Nothing succeeds like success, and some of the TV programmes, such as "Coronation Street", "Take Your Pick" and "Z Cars" seem to stay the course with continued vigour. "*Kitchen sink*" *plays* have become "*kitchen stinks*", and even the BBC seem to have become aware of this fact. The craze for satire has declined and this type of programme, though it may be a way of life for the BBC, continues to be the preoccupation of some of the BBC's producers who persist in providing entertainment of the "varsity rag" type. Even the best comedians seem unable to survive the self-consciously egghead forum in "Not So Much a Programme, More a Way of Life".

There are times when I have the feeling that the TV side of the BBC should be taken over by the much more professional steam radio programme producers. However, in spite of the poor TAM ratings BBC-TV has been achieving as compared with ITV, the BBC have revived new hopes by allocating a special programme to a professional comedian who is not restricted—Frankie Howerd! Here is a comic with a streamline up-to-date interpretation of the techniques of George Robey, who used to take the music hall audiences into his confidence and whose timing of "gags" had precision accuracy, with every "um" and "er-er" carefully planned and rehearsed. Frankie Howerd wields the sword for the BBC, as he told us, and we viewers look forward to the uproarious duel with programmes "from the other people".

"Steam" Films

The cinema continues to exist and even, on occasions, to draw large and enthusiastic audiences to films with big stars, spectacular scenes and real entertainment values. There has to be some special incentive to draw people into cold wintry air away from their firesides and their television sets. Dramatic films are hand-made products of craftsmen, laboriously made with great care and cost compared with the production of plays for television. After watching the streamlined video tape recorded production techniques of television, a visit to a film studio carries with it the atmosphere of the age of steam, wood-cuts and Honiton lace in an age of super-markets and automation.

The best examples of feature films are the joint work of a collection of individualists which creates its own special stylisation. It is a hand-made product which often costs as much as a hundred times as much as a good VTR'd television play. In a film studio, the technicians are dealing with huge screen areas, which necessitate tight tolerances in focus, picture composition and scenery construction. Almost every camera set-up is dealt with individually, several takes being required for most shots. The film is edited from shot to shot with precision that is not possible to attain on video-taped TV production.

The July Plot

Take, for instance, the BBC's play. "The July Plot", which was adapted by Roger Manvell from his book which was jointly written with Heinrich Fraenkel. Here was a dramatic mixture of fact and fiction, the story of the unsuccessful plot by a number of German army officers to assassinate Hitler. With many exciting filmed exterior scenes and VTR'd interior sequences, the latter had flaws which rather let down the whole production. Here and there were actors' 'fluffs', mistimed cuts and camera angles which revealed to everyone (excepting the actors present at Hitler's conference) the obvious planting of a bomb by Count von Stauffenberg, one of the plotters. There was nothing in these scenes which could not have been put right if it could only have been edited and adjusted by cutting in the traditional film manner. But you can't do that on videotape. And you can't afford to make a television play with traditional film studio techniques. "The July Plot" was a classic example of the need to evolve production techniques which make use of the best of both worlds—filming and television—now beginning to be known as "*telecam*".

Culloden

Telecine has always been regarded by the BBC as being of vital importance. The technical problems have been tackled with energy for years, which has led to quality reproduction of films made on both 35mm and 16mm. The BBC's Films Division at Ealing has carried on the quality traditions of that old-established film studio in no uncertain manner. From the editing and directing side, too, films have been created which have attained classic importance. "Culloden" was a splendid example of documentary film production, shot entirely on exteriors near Inverness and photographed—to my surprise—on 16mm film. It was "A" and "B" roll process printed from the negative. That is to say that each sequence up to the next fade or dissolve was optically printed from, say, "A" roll from which a mixing changeover was made to a "B" roll, from which it was printed until the next dissolve. This avoided the jumps and contrast changes which often occur when straightforward single negative rolls are printed in the laboratory by contact printing.

The photographic quality on 16mm was equal to best on 35mm and was worthy of the directorial talent, scripting and acting in this historical subject.

Iconos

A COLOUR BAR GENERATOR *and* FIELD SEQUENTIAL ENCODER

BY J. THORNTON LAWRENCE, GW3JGA/T

ONE of the difficulties facing the enthusiast who contemplates the construction of amateur colour TV equipment is the cost. In domestic colour TV receivers a shadow mask tube is used to display the colour picture. The cost of such a tube and associated components is £60 or more and is usually outside the "amateur" budget.

A field sequential display system has the advantage of low initial cost and can produce very encouraging results. A sequential colour TV system was first used by Baird in 1928 and a much more sophisticated field sequential system was officially adopted in America for a short period from 1950 to 1951 before the shadow mask tube became available.

In the field sequential system one field scan contains all the red picture information, the next all the green and the next the blue. This sequence is continuously repeated. The display consists of a standard "black and white" picture tube in front of which is mounted a rotating disc having red, green and blue gelatine filters. The disc is driven by an electric motor and is synchronised with the field scan so that when the video signal containing the red picture information is being displayed by the picture tube the red gelatine is covering the screen. Thus all the picture seen during this field scan appears red. As the colour disc is arranged to rotate in the same direction as the field scan the green gelatine will be in front of the screen during the display of green picture information and so now all the picture appears green. Similar conditions pertain for the blue. If this process is repeated rapidly the persistence of vision in the viewer's eye will cause the red, green and blue pictures to superimpose, giving the impression of a steady colour picture.

The first type of colour monitor built by the author consisted of an MW6-2 projection tube viewed directly through a 7½in. diameter colour disc. The method of synchronising the colour disc has been described elsewhere.[1] The present colour monitor employs a 14in. MW36-24 tube. The colour filters form the curved sides of a drum inside which the tube is mounted. The drum is open at one end to allow for supporting the tube; the other end is closed and contains the bearing on which the drum revolves. The tube is viewed through the rotating gelatine filters and the whole provides a very compact arrangement.

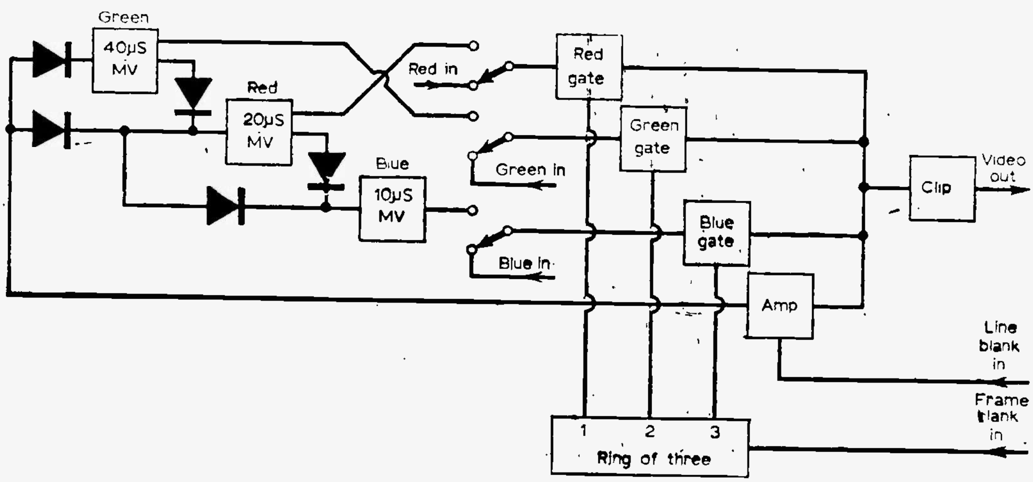


Fig. 1—A block diagram of the equipment described in this article.

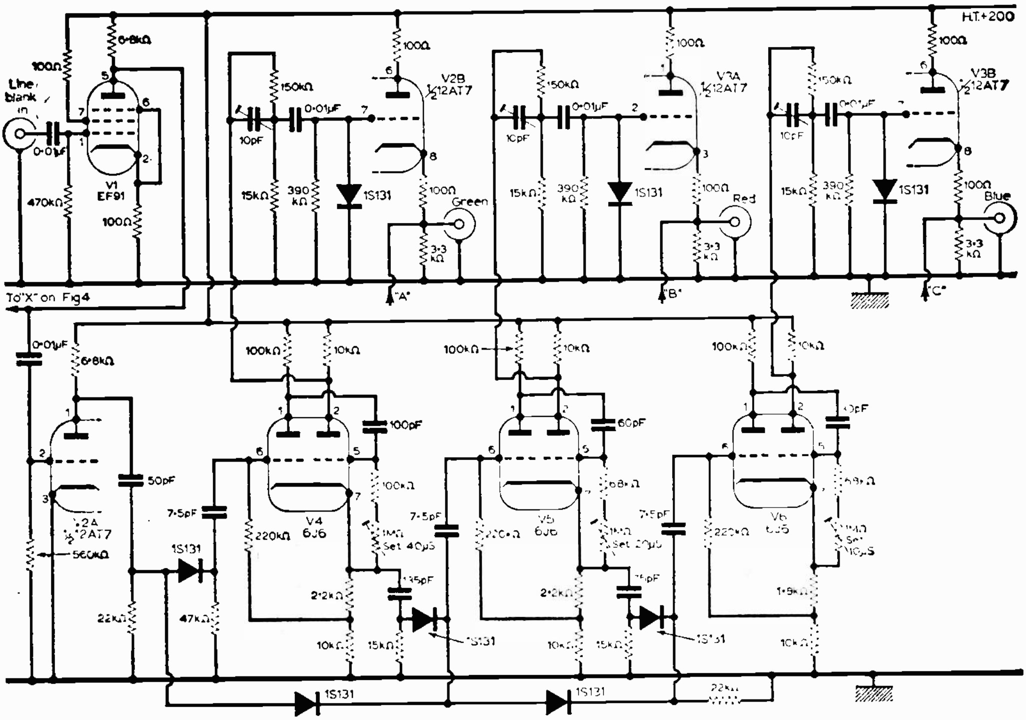


Fig. 2—The circuit of the colour bar generator.

In a field sequential system it is, of course, necessary to encode the separate colour signals in the red, green, blue sequence. In principle this could be done by feeding the three separate colour signals into a single pole, three-way rotating switch and switching these in turn to a common output.

A normal mechanical switch would be unsuitable, so in practice an electronic switch or "gate" employing valves is used.

In experimenting with any colour TV display it is desirable to have a colour signal source. A colour pattern produced by valve circuits is very useful and can conveniently be made to give a range of six colours plus black and white.

The equipment to be described has been designed to operate from any normal TV waveform generator which provides 1V p-p of line blanking and field blanking and with any normal vision-sync mixing unit which will accept a non-composite video signal of 1V p-p.

The equipment can be conveniently divided into two parts, the colour bar generator and the field sequential encoder (see Fig. 1). The colour bar generator can be used separately to provide red, green and blue signals suitable for feeding into other systems. The encoder can also be used separately to generate a field sequential signal from the red, green and blue signal inputs. By internal switching the colour bar signals can be encoded directly.

Colour Bar Generator Circuit. Fig. 2.

This circuit consists basically of three monostable multivibrators each generating a different pulse width. These are triggered by the trailing edge of the line blanking pulse and also by each other in the sequence shown in Fig. 3. The resultant waveforms when applied to the red, green and blue inputs of a colour monitor would produce a pattern consisting of eight vertical bands—white, yellow, cyan, green, magenta, red, blue and black.

Line blanking is fed into an amplifier V1 and the waveform reinverted in V2a. The line blanking pulse is then differentiated and a positive spike is formed coincident with the trailing edge.

This positive spike is used to trigger all three vertical bar multivibrators V4, V5 and V6. After 10µS the "blue" multivibrator V6 resets and when, after 20µS the "red" multivibrator V5 resets, a positive spark is passed from V5 cathode to retrigger the "blue" multivibrator V6.

A similar set of conditions pertains when the "green" multivibrator V4 resets after 40µS. The waveforms generated are shown in Fig. 3 (for further information see Reference 2). The outputs from V4, V5 and V6 are fed to three cathode followers V2b, V3a and V3b respectively.

Components included in the coupling circuits give good, square, flat-topped waveforms. The 10pF trimmers are adjusted for best waveform shape.

The outputs of the cathode followers can be used to drive external equipment and the internal encoder simultaneously if required. The outputs should always be terminated by 75Ω resistors to keep the signal at approximately 1V p-p.

Field Sequential Encoder. Fig. 4.

The encoder consists of three "gates" only one of which is open at a time, thus allowing the particular video signal to pass through. The gates are opened in sequence

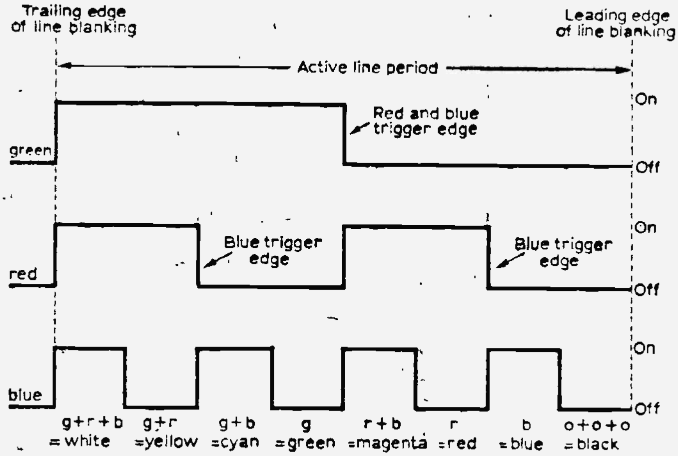
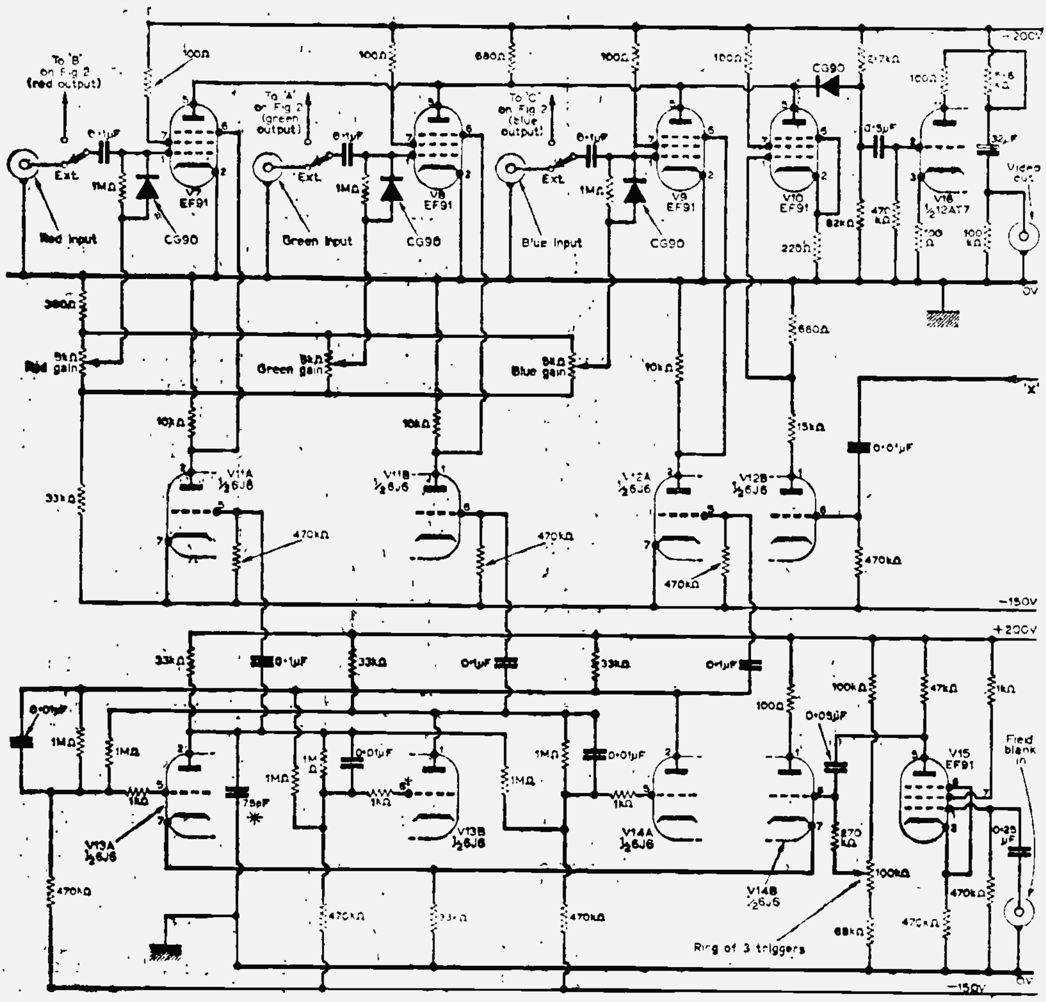


Fig. 3 (right)—The sequence of pulses occurring in the three monostable multivibrators of the colour bar generator.

Fig. 4 (below)—Circuit of the field sequential encoder.



when driven from a ring-of-three counter; this counter is triggered from the field blanking pulses. The combined output from the gates forms the field sequential signal.

Field blanking is amplified by V15 and fed to a cathode follower V14b. The output of this triggers the ring-of-three counter comprising V13a, V13b and V14a by feeding a positive pulse into the common cathode line. The three valves in the ring are d.c. coupled and biased so that only one valve can be conducting at any one time, the other two being cut off. A 0·01μF capacitor is included across one of the d.c. couplings in each stage to ensure that the state of conduction is changed from one valve to the next in the same direction each time the circuit is triggered.[3] A potentiometer is included in V14b grid circuit to set the d.c. and trigger conditions. This is adjusted for the correct operation of the circuit shown in Fig. 5. In the particular layout adopted it was found necessary to fit a 75pF capacitor (marked *) from the anode of V13a to earth to prevent parasitic oscillation.

The three outputs from the ring-of-three counter are a.c. coupled to V11a, V11b and V12a and the anodes of these valves are d.c. coupled to the suppressor grids of V7, V8 and V9 respectively.

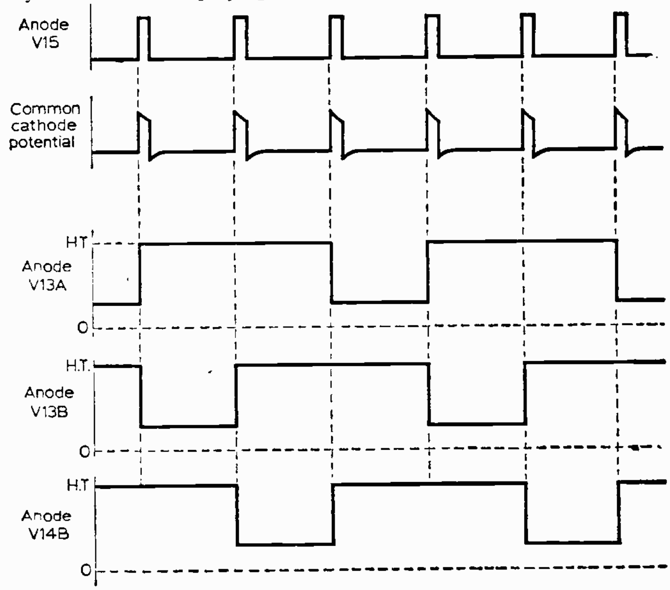


Fig. 5—The ring-of-three counter waveforms.

Red, green and blue inputs are fed into the control grids of V7, V8 and V9 and as each valve is turned on in sequence the respective output signal appears in the common 680Ω anode load resistor.

Black level set is provided for each signal by varying the d.c. bias on the control grids of V7, V8 and V9. The controls providing this bias can be conveniently used as gain controls when displaying the colour bar pattern. Diodes are used

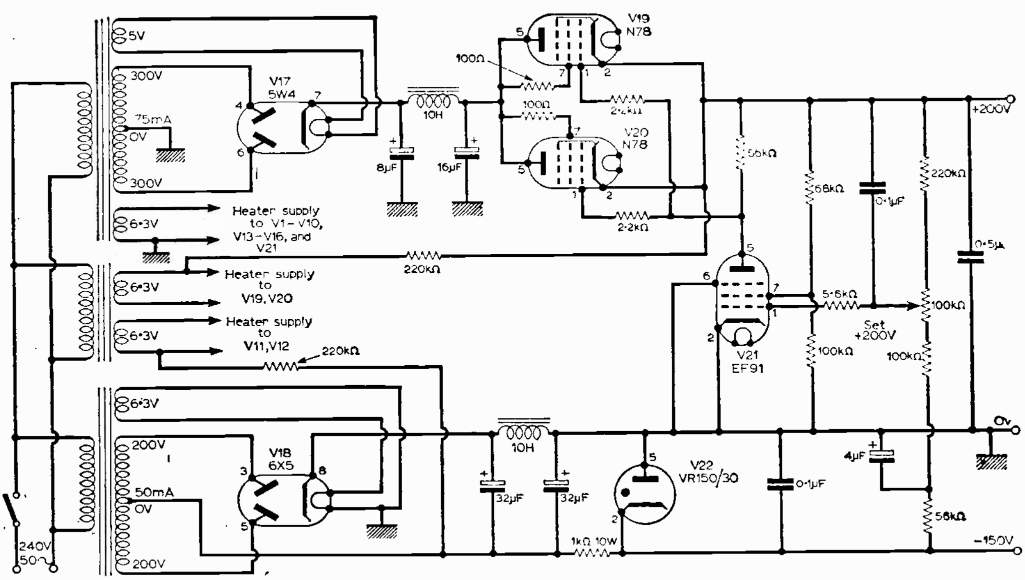


Fig. 6—The power supply circuit, which is entirely conventional.

as d.c. restorers for each input signal.

Because of the individual bias controls the black level is uneven during the blanking periods. To overcome this a further valve V10 is connected in parallel with V7, V8 and V9. V10 conducts during the line period and turns off during the line blanking period.

The positive pulse appearing in the common anode load causes the CG90 diode feeding V16 to open during the blanking period, giving a constant blanking level suitable for d.c. restoring or clamping in subsequent equipment.

The anode follower stage V16 provides a positive going video signal of about 1V p-p into 75Ω.

Power Supply. Fig. 6.

The power supply is conventional and provides a negative output of 150V and a positive output of 200V.

Conclusion

The unit has been in use now for about 12 months feeding the 14in. frame sequential monitor using a colour drum and this compares very favourably with the results obtained from a borrowed shadow mask monitor connected to the R.G.B. output. Colour "fiddle" systems using positive and negative signals from a monochrome F.S.S. have been used with good effect.

The equipment would be very suitable for use with a receiver containing an NTSC or SECAM decoder to recode these R.G.B. signals for viewing on a field sequential display. ■

1. Lawrence, J. T. "Colour Wheel Drive Circuit." CQTV No. 49, p. 3.
2. Carnt and Townsend. "Colour Television," p. 178.
3. Amos and Birkenshaw. "Television Engineering," Vol. 4 p. 27.

RESONANT LINES

—continued from page 219

cathode circuit of the frequency changer valve V2 via L1 on the one hand and an aperture in the screening between the second and third lines on the other hand. The signal arrives at the frequency changer cathode (as this valve is also in the earthed-grid mode) via a loop coupling from the third line, this latter being tuned by capacitor section VC3.

The fourth line is the tuning for the local oscillator in conjunction with capacitor section VC4.

Tracking Adjustments

On all the lines it will be noticed that trimmers are connected at each end. These facilitate the tracking of the tuned circuits over the entire frequency range, and they work rather like the padders and trimmers in an ordinary radio tuned and ganged circuit. The trimmers are placed at the voltage nodes corresponding to the band limits.

The low-frequency padding is performed by the trimmer at the valve end of the line, while the trimmer at the other end of the line is concerned with high-frequency trimming.

Quarter-wave Lines

It is possible to employ quarter-wave lines for tuning, but these differ from half-wave lines in that when they are shortened and short-circuited at one end they exhibit the property of inductive reactance. Thus, by adding capacitance at the open end the inductive reactance can be tuned out, thereby causing the combination to act as a resonant circuit.

The quarter-wave system is not usually employed with valve amplifier, though it is sometimes used with valve oscillators and transistor amplifiers. ■

DX-TV

—continued from page 210

It should be noted that the following sound channels are f.m.: Channels E2, E2a, R1, Ia, E3, E4, Ib, and R2, also "b", the "F", and "B" channels are a.m.

You will find that when searching for DX stations it will be easier to separate them from local TV station interference if the station that you are trying to receive lies on the l.f. side of the frequency of the more local TV station. This is due to the shape of the frequency response curve of the receiver and the nature of the band-width transmitted.

I would suggest for beginners that they make themselves fully conversant with the exact tuner positions of all the BBC/ITA stations that they can receive, this will be of considerable help in tuning other channels.

READERS' REPORTS

As previously noted, DX conditions have not been very good recently and this has again been reflected in the volume of readers correspondence. Despite this we have once again had some good reports of readers' successes.

There is, for example, the excellent log of DX reception from George Le Couteur of Torteval, Guernsey, C.I., covering the period Mid-June to early October, and including the following:—

Norway E2 (Melhus) and E3; Sweden E2 (Horby) and E4; Denmark E3 (Fyn); Finland E2 (Helsinki); Poland, Bydgoszcz; Austria E2a (Jauerling); U.S.S.R. R1; West Germany E2 (Grünten); East Germany E3 (Helpterberg); Portugal E3 (Coimbra); Hungary R1 (Budapest); Czecho-Slovakia R1 (Ostrava) and R2 (Bratislava); Switzerland E2 (Bantiger); Italy Ia (Mt. Cammarata) and Ib; Spain E2 (Madrid); France F2 (Caen) and F4 (Nantes); Belgium E2 (Ruiselede—now confirmed).

All the above are in Band I. In Band III he reports reception of Lille F8a, Rouen F10, and Brest F8, and in addition to these Eire Republic B7 (Mt. Kippure). On u.h.f. he has already logged BBC London on Channel 33, so he has produced an excellent log indeed, and we wish him continued success in the future.

J. Potts, of Thanington, Canterbury, has already had a success with his newly converted Bush TV receiver, and following examination of his sketch of a test card and opening caption we confirm that he has received Belgium via Ruiselede on Channel E2.

LETTERS TO THE EDITOR

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.

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

PUZZLING POLICIES

SIR,—I am glad that I am not the only viewer puzzled by the policies behind the BBC-2 programmes (your leading article, January issue). It would be interesting to know what goes on in the corporate mind of the organisation.

While still bemoaning lack of support among the viewing public for the BBC-2 programmes they decided to begin re-running the Great War series on BBC-1 while it was still being shown on BBC-2. In other words, they made their "best seller" available to people without u.h.f. receivers, thus destroying an incentive strong enough for many viewers to become "converted".

Another wonderful piece of planning took place recently when BBC-2 showed a repeat of the well-known "*Alberts*" programme. What was BBC-1 showing *at the same time?* No less than "*It's a Square World*"!

Whether one likes or dislikes either of these programmes it is surely obvious to the simplest mind that both programmes are intended for the same type of viewer and that anyone interested in seeing one would want to see the other. Consequently I presume that most people watched "*Square World*", then switched over to BBC-2 for the last few minutes of the "*Alberts*". Or stayed with BBC-1. Or switched off.

So much for audience ratings! Vive la confusion!—L. LEGGATT (Godalming, Surrey).

SERVICING TELEVISION RECEIVERS

SIR,—With reference to your article on "Servicing Television Receivers" contained in the December issue of *Practical Television*, we are a little perplexed by the opening paragraph which infers that readers have been unable to obtain service information on our Model 340 series.

As pioneers in the field of television development we have always been ready to give the most complete service instructions regarding any of our models and these can be obtained readily on application to: *Technical Publications Department, Works Centre, Radio Rentals Ltd., Beresford Avenue, Wembley, Middlesex.*—R. A. SMITH, Publicity and Public Relations Manager, Radio Rentals Ltd.

SIGNAL PREAMPS FOR BANDS I AND III

—continued from page 215

ing portion of the turret, when the 100Ω resistor will be easy of access. To remove this, snip it out rather than unsolder it as the less heat introduced to the components in the tuner the better. The 82Ω resistor must, of course, be soldered in, and when doing this do not disturb the wiring of the tuner more than is needed.

On the subject of bias, it is as well to note that if tuners recovered from 13 channel receivers are used it will sometimes be found, as the circuitry in Fig. 4 shows, that the "earthy" end of the cathode bias resistor is brought out either to a white lead or sometimes to a tag for attaching to a gain control in the parent receiver.

If this is the case solder the lead, or connect the tag, as the case may be, to the tuner chassis to complete the cathode circuit, otherwise the preamp gain will be non-existent.

When the PCC89 is in circuit, it will be necessary to make considerable adjustment to the aerial coil and trimmers marked "A" and "B" (in Fig. 5). If these adjustments are done carefully it will be found the signal level will be considerably better even than that obtained from the PCC84.

Using this preamp with either a PCC84 or a PCC89 will give vastly improved reception on both channels, and after trying such units on a number of makes and models of TV sets it has been found they do not increase the "graininess" of the picture to any extent.

HOUSING THE UNIT

When adjustments are complete it is necessary to fit the unit into the cabinet of the receiver. It can be fitted in a similar manner to that of a converter, except there is no call to cut a large hole in the cabinet side to accommodate the fine tuner knob as this is not required. The hole need only be of sufficient size to allow the inner switch spindle to be fitted with a knob.

Whatever method of final fitting is decided, remember the unit is now part and parcel of an a.c./d.c. circuit and should be fitted to ensure the metal work is not exposed to the user's touch.

Finally, remember that a preamp, no matter how efficient, will not do anything to improve the non-existent. Such devices will only be needed in areas of poor signal and it is vital in such circumstances to have well erected and sited aerial systems. This design of preamp, if given any sort of signal to work on, will produce a viewable picture from extremely small signals. ■

PART 2 MEANS AND ENDS

VIDEO A.G.C. SYSTEMS

BY H. W. HELLYER

IN the first article last month, oscillograms, waveform shapes and other such frightening apparitions were deliberately excluded. Although the professional engineer takes them in his stride and, indeed, finds the use of a 'scope a very decided short cut, the average chap who does not have 'scoping facilities tends to be deterred by the article which glibly throws off waveforms and the tests to obtain them.

SHAPING AND CONTROL CIRCUITS

All of which is by way of apology! Fig. 6 includes waveforms. Not to complicate matters and lay down a rigorous schedule of tests but to indicate in the easiest way I can find what is happening in the a.g.c. shaping and control circuits.

The reason for this is the choice of the Philips circuit, eight years old but still going strong in

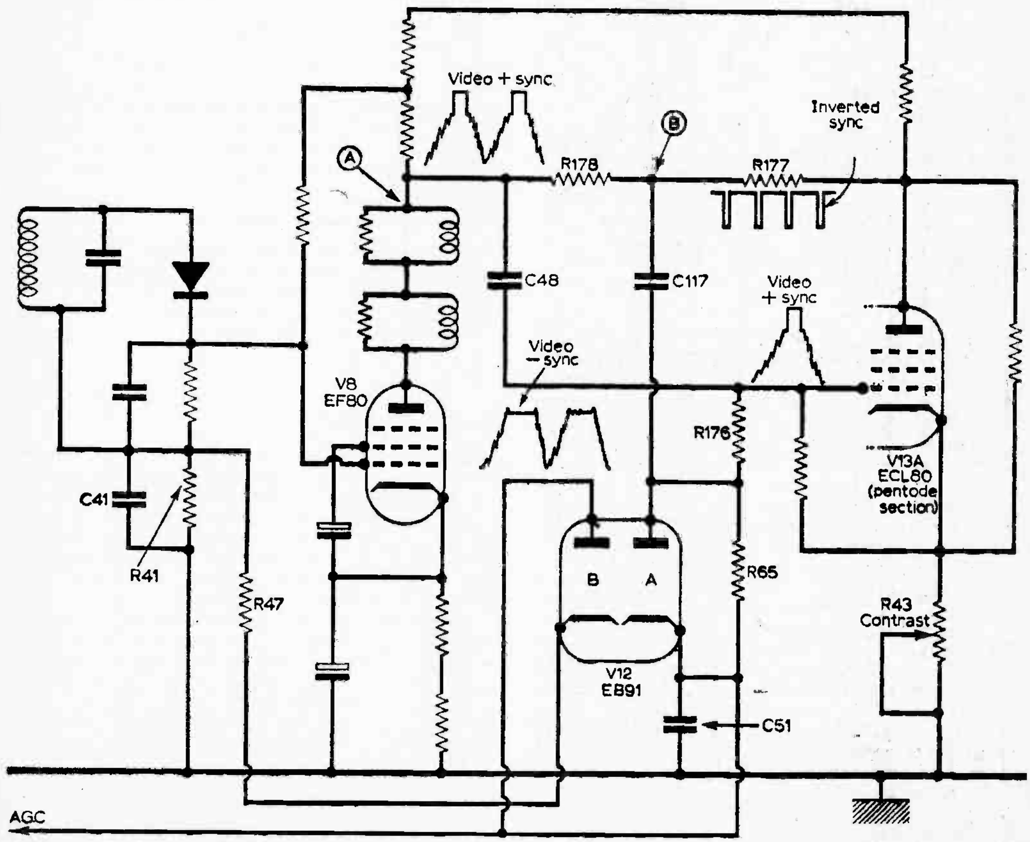


Fig. 6—Earlier Philips type of a.g.c. circuit, with waveforms included. Sync-cancelling system is employed, the resultant of three voltages producing the necessary control.

various forms. The circuit of Fig. 6, for example, is that of the Stella 8514 and 8517 models, all part numbers being retained from the maker's data sheet.

The video amplifier is V8 and complete signal waveforms as indicated, video and sync, appear at the point A, which is the junction of the split anode load. These pulses are applied via C48 to the grid of the sync separator V13A (the pentode section of an ECL80 valve). A negative voltage which depends on the mean value of the video signal appears between grid and cathode of this valve. At the same time negative-going sync pulses appear at the anode.

These negative-going pulses are combined with the complete video information at the point B and fed via C117 to the anode of V12a. The exact values of R177 and R178 are chosen so that these two waveforms add in the correct proportions.

The result is that the sync pulses cancel out and the anode of V12a receives only the picture information from this path. This tends to produce a positive voltage across C51.

But C51 is also connected back to the grid of the sync separator via R65 and R176 and thus

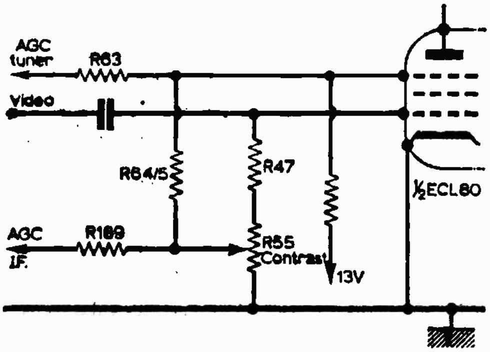


Fig. 7—Simple suppressor-regulated a.g.c. circuit used on later Philips models, with variations. A.G.C. is derived from the sync separator, and delay by supressor grid biasing.

receives a larger negative voltage, the balance of the two voltages appearing across R65 and being applied to the a.g.c. line.

The reference voltage, at which the a.g.c. is intended to come into operation, is determined by the cathode voltage of V13a, which is controlled by the variable resistor R43 acting as the contrast control. Thus the a.g.c. is the resultant of three voltages.

In this type of circuit at maximum gain, i.e. with a very weak incoming signal, the contrast control will have little effect. Similarly the circuit does not allow for the contrast to be turned fully to minimum. If the picture were, theoretically, to be reduced to zero the three controlling voltages outlined above would disappear.

OVERLOAD PROTECTION

It is therefore necessary to provide an overload protection. V12b prevents the a.g.c. line from going positive in the following manner:

When V8 is driven hard by a temporary strong signal, grid current flows. R41 and C41 are raised to a negative potential, V12b becomes conductive and the negative burst of current is fed, via R47 and V12b, to the a.g.c. line.

C51 charges and normal conditions are restored, after which V12b ceases to conduct. The protection is thus seen to be rather different from the simple diode clamps we have previously discussed.

But later models in the Philips range revert to the less complicated a.g.c. systems as evidenced in Fig. 7. This circuit is used in the Stella 1007U and 1001U and similar Philips models.

"SUPPRESSOR REGULATED" CIRCUIT

The principle is somewhat similar to the "suppressor regulated" circuit described in Part 6 of the previous series, *Stock Faults* (pp. 33-37, October, 1964, *Practical Television*). It works by using the grid clamping action of the sync separator valve (pentode section of an ECL80).

A negative potential developed across the grid leak R47, R55 is fed to the controlled stages via two separate paths.

The voltage is tapped off from the contrast control R55 and fed via R189 to the i.f. amplifier. This same control voltage is taken via R64/65 to the suppressor grid of the sync separator.

A positive bias voltage is applied to this grid and it thus acts, in combination with the cathode, as a diode, remaining conductive until the a.g.c. voltage (negative) is sufficient to cancel it. As the a.g.c. to the tuner unit is fed via R63 from the suppressor a delay of approximately 4V is obtained.

The purpose is to let the "front end" operate at maximum gain until the received signal is strong enough to overcome the delay, thus giving the best possible signal-to-noise ratio on weak signals.

DUAL-STANDARD SETS

The dual-standard receiver does not offer the complications with a.g.c. systems that some people had feared. Whereas it is now obvious that mean-level systems are quite sufficient for domestic receivers, and the added cost of "gated" circuitry can only be justified in the special sets constructed for monitoring, etc., the dual-standard set can operate quite happily with mean-level conditions.

This is because with negative video modulation the transmitter is modulated 100% on the tips of the sync pulses. Black level corresponds to 70% modulation, so the tips of the sync pulses can be sampled for a reference voltage and the resultant a.g.c. is independent of picture information.

An example of this can be seen in the Thorn 850 chassis, used in a great number of different receivers very successfully. Fig. 8 shows the rudiments of the a.g.c. circuit and from this it can

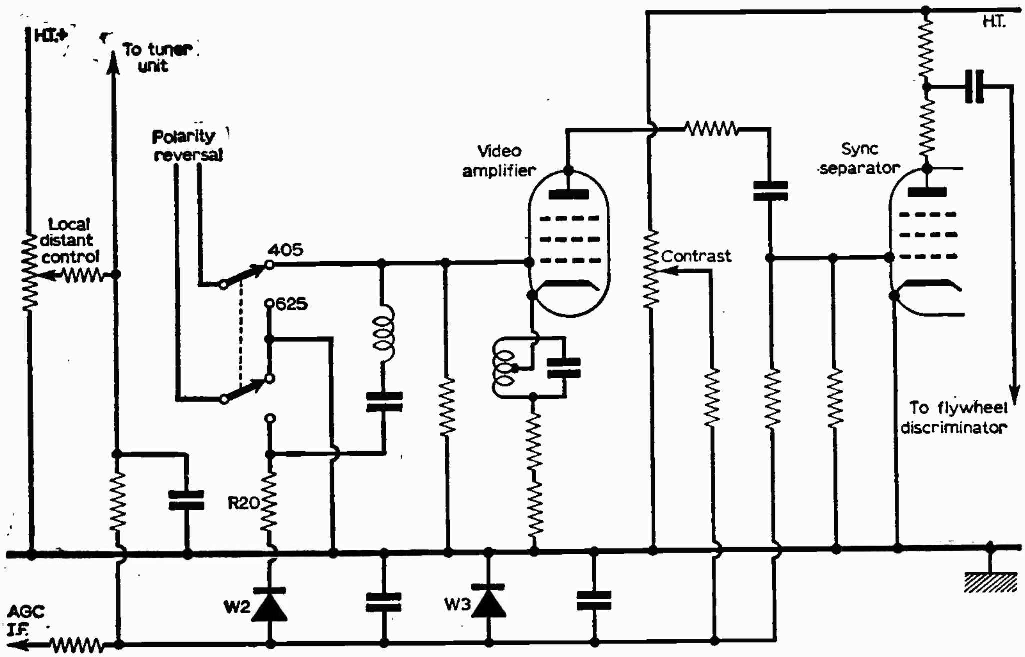
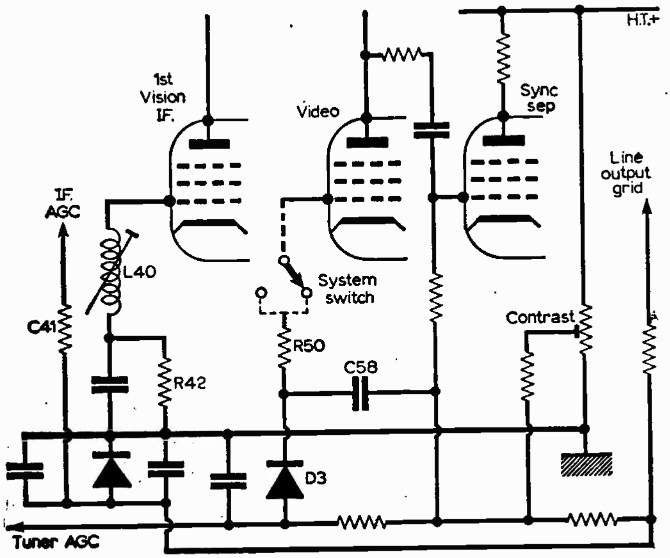


Fig. 8—Thorn 850 a.g.c. circuit, showing additional control necessary when switching to 625-line operation.

be seen that the controlling voltage is again derived from the sync separator grid with the contrast control setting the reference level.

The main a.g.c. line is clamped by the diode W3 and controls both the first i.f. stage and the tuner unit. A variable delay is afforded by the local/distant control, giving a cancelling positive voltage —again to preserve good signal-to-noise ratio on weak signals. This a.g.c. is, of course, only applied to the v.h.f. tuner unit.

When the set operates on 625 lines there is only one small change. Diode W2 with R20 in series is switched in to provide overload protection. If the d.c. component of the rectified signal (negative modulation, the sense is reversed by the switching) becomes greater than the a.g.c. line voltage, as it could during channel switching and with sudden surges, W2 conducts and the a.g.c. voltage is temporarily augmented.



A somewhat similar arrangement is used for the later Thorn 900 chassis. But there is one important difference. In this unit the v.h.f. tuner is arranged to assist the u.h.f. amplification by using the pentode section of the PCF805 as a first i.f. amplifier and thus some a.g.c. control is needed.

The switching is arranged to apply a delayed a.g.c. to the grid

Fig. 9—Kolster-Brandes a.g.c. circuit, as used in the VV series. Protection circuits are incorporated, and delay effected by separate a.g.c. feed lines.

circuit. As before, an additional overload protection is fitted for 625-line operation by the switching in of W3.

The reason for this extra protection on 625-line operation is entirely due to the features of negative modulation. A signal overload would cause sync pulses to be cut off at the grid of the video amplifier, in turn producing an unchanging d.c. at the sync separator grid, leading to a blocking action which would prevent a.g.c. action and aggravate the overload.

So it should be remembered that the diode W2 of Fig. 8 is used to feed a portion of the video drive to the a.g.c. line to supplement a.g.c. voltage, not as a bias feed to the video amplifier grid.

A small point but with circuits becoming so overgrown with complexity there may be a tendency to take small points for granted.

Although this series of chassis has been used in Ferguson, Marconi, HMV and Ultra receivers there are some earlier Ultra receivers—the *Bermuda* range—with an a.g.c. circuit worthy of attention.

The predecessor to the circuit of Fig. 9 was actually discussed in Part 6 of *Stock Faults*, but this circuit demonstrates yet another means of achieving the common end.

A conventional sync separator is used, the pentode section of the 30FL1, with the triode section strapped as a diode, acting as a video restoring stage and providing a mean-level a.g.c.

The contrast control sets the cathode voltage of this valve and provides a variable delay. There are two feed paths for the a.g.c. voltage to the common i.f. valve and to the tuner, but in the feed to the latter a 10MΩ resistor is fitted with a link across it.

This link should be opened only in areas of high signal strength, thus reducing the delay to the r.f. amplifier.

Another circuit which uses circuit changes to improve a.g.c. action is that of the Kolster-Brandes VV series (see Fig. 9). Again this is a dual-standard circuit and has the small complications noted previously.

To obtain an a.g.c. voltage in this case the negative potential at the grid of the line output valve is used and a fairly complex delay system is used.

But the same method of augmenting the a.g.c. line to prevent overload may be noted comprising a diode, D3, from the detector/video drive circuit on 625-line operation.

To improve the a.g.c. action on u.h.f. this diode can be disconnected from the junction of R50/C58 and its cathode returned to chassis. Then this free junction is connected to the junction of R42/L40/C51, i.e. the lower end of the grid tuning circuit of the first vision i.f. valve. R42 should be increased from 100kΩ to 1MΩ.

The d.c. anode load of this valve should also be increased from 1kΩ to 2·7kΩ to reduce the possibility of instability.

The choice of the tapping point for the a.g.c. voltage may be determined by other factors. In the Pye V700 range an OC71 transistor is employed as a sync separator.

The control voltage is therefore extracted from a tapping of the video anode load and applied to a diode whose cathode voltage is controlled by the variable contrast control.

A.G.C. (or A.P.C., as Pye prefer) is fed to the common i.f. amplifier from the anode of the diode and to the tuner unit after a delay circuit.

This comprises a clamp diode and fixed potentiometer feed plus a backing-off positive voltage from a variable resistor as part of a potentiometer across the h.t. and designated local/distant control.

VALVE CIRCUITRY

Later versions of the Pye range, such as the 11U, 12L and 20U, revert to valve circuitry and employ the additional complication of separate 405 and 625 line preset contrast. These are merely potentiometers across the h.t., applying a cancelling positive voltage to the a.g.c. line.

In these circuits as in the switchable versions, 11F, 21F and 22F, with flywheel sync, the sync separator is a triode valve and the contrast control is in the video output circuit, a tapped potentiometer selecting the tube drive.

A.G.C. is taken via a 1MΩ resistor from the grid of the sync separator and applied through further delay circuitry to both the common i.f. stage and the v.h.f. tuner unit.

TRANSISTORISED RECEIVERS

Mention of a transistorised stage in a previous description leads to a discussion of the completely transistorised receiver and the problem of applying a.g.c. which this particular style of circuitry causes.

A practical example is that of the Perdio *Portarama* Mark 2. Despite all the recent publicity for transistorised receivers this circuit was first brought on the market in 1962 and the design is typical of modern trends. Fig. 10 shows the video

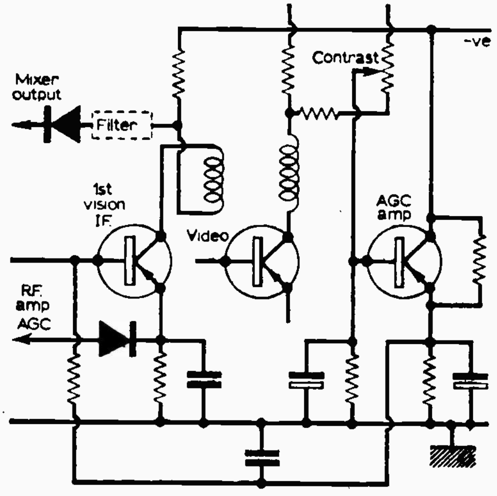


Fig. 10—'Damping' method of a.g.c. control used in the Perdio Portarama transistorised television receiver.

amplifier, the a.g.c. amplifier and the first common i.f. amplifier.

From the collector of the video output transistor the contrast control couples a pulse to the base of the a.g.c. amplifier. Increased output from the video causes negative d.c. voltage across the base resistor of the a.g.c. amplifier to increase.

This in turn causes the voltage at the emitter junction to grow more negative. This negative voltage is fed back to the base of the first common i.f. transistor.

An increase in emitter/collector current results and an increase in the voltages across R1 and R2. This increase is passed to the diodes in series with both input of the r.f. stage and output of the mixer stage, damping the circuits, reducing the gain.

To obtain good signal-to-noise ratio, as we have seen, it is necessary to delay the a.g.c. voltage to he r.f. stage and this is effected by the difference of the emitter and collector voltages of the common i.f. stage. Clamping is thus automatic and no additional protection is required.

PRECAUTIONS WHEN TESTING

When testing around the a.g.c. circuits special precautions have to be taken. Because of the high impedance of the a.g.c. feed lines the presence of even a 20,000Ω/volt meter will load the circuit to some extent and modify results.

The intelligent tester will interpret the results of his meter application as well as take note of any reading obtained. In other words, treat the meter application as a "disturbance test".

It must be remembered that although the control voltage derived from the sync separator or other source is negative with respect to chassis, the cancelling voltage from contrast or preset gain controls will probably be positive with respect to the same point.

The overall a.g.c. potential is the resultant of opposing voltages. Thus if the meter is placed across the a.g.c. line and set to a high voltage tapping to obtain the best ohms/volt characteristic, then the contrast turned to minimum, there should be a fairly strong negative voltage present.

It is better to read, say, 13V in the lower 30° of the scale than to reduce the meter tapping and attempt to obtain a more accurate reading from mid-scale upwards.

It is unlikely in any case that the reading would be more accurate and doubtful whether such accuracy would be necessary. Often an indication is all that is sought. Experience tells what interpretation one must place upon results.

This question of interpretation can often lead to short cuts in tracing suspected open-circuited decoupling capacitors in i.f. stages. If the application of the meter produces a definite lift in gain, even where the impedance of the meter is high, an a.g.c. decoupling capacitor may well have open-circuited.

Similarly a reduction of overload symptoms when the meter is applied may indicate that the clamp diode is not functioning as it should.

A typical example of this fault tracing by disturbance methods can be found when making an a.g.c. test at the sync separator when the symptoms of the receiver include weak line lock. (In some circuits, particularly on the older Emerson, Beethoven, some Sobell and HMV circuits, weak frame hold may be apparently improved by this connection.)

The interpretation is that addition of the meter has altered the sync input conditions and should lead one to investigate not the a.g.c. circuit but either the h.t. carrying resistors of the sync separator or the video output stage.

An incorrectly biased video valve will fail to amplify the sync pulses properly or poor cathode decoupling could distort the response of the stage and give the same effect.

Except in the case of the set with a complicated feedback a.g.c. circuit, nowadays very rare, it can help to disconnect the a.g.c. line and insert a variable voltage by a battery and potentiometer.

This should prove whether the fault in fact lies in the a.g.c. control circuits or, as is more likely, in the i.f. stages themselves.

Most multirange meters with an ohms range will provide sufficient voltage from their self-contained battery for this test. As the internal battery polarity is generally in opposition to the test leads, connection of the negative lead to chassis and the positive lead to the a.g.c. line with the meter switched to the "ohms" range will generally decrease the contrast.

If it does not, the trouble lies not in the control-producing stages, i.e. the sync separator, etc., but in the a.g.c. feed line.

A common fault producing symptoms which these tests will fail to alter is the internal G1/G2 short-circuit of a controlled stage. This applies a fixed potential to the a.g.c. line and causes the operation of the contrast control to be ineffective.

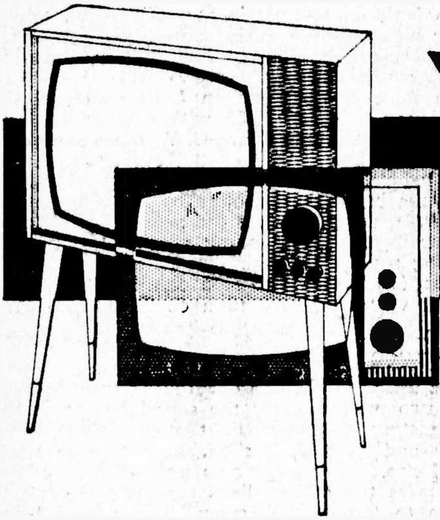
It can also inject hum to the a.g.c. line, giving a bent vertical effect.

In general, testing the a.g.c. line is a matter of careful observation of results and it is hoped that the foregoing notes may have helped in an understanding of these observations. ■

Yours for the price of a stamped addressed envelope

a ticket to the "Practical Wireless" and "Practical Television" Film Show

There is still time to write to the "Practical Television" offices, enclosing an S.A.E., for your free ticket to this annual event, held in collaboration with Mullard Limited. Date and place are February 5th and Caxton Hall, Westminster, London, and the films to be shown are "Electromagnetic Waves" and "The New Panorama Tubes". There are refreshments in the intermission too.



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 236 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

SOBELL T194

On BBC-2 there is good vision but there is no sound. Channels 9 and 12 are perfect.—W. Mathie (Lytham, St. Annes).

Assuming that the u.h.f. aerial signal is strong enough in your area to work the set correctly, the symptom that you mention could be caused by trouble in the vision i.f. channel (misalignment on the 625-line standard) in the intercarrier 6Mc/s sound channel or in the f.m. detector circuit. A fault somewhere in the switching could be responsible, but tests will have to be undertaken first to establish the location of the fault, as above.

PERDIO PORTORAMA

Fuse F3 keeps blowing. The picture, if normal, would suddenly have no linear control, then a vertical line would appear on the lower half of the screen. After a few seconds this line used to fade. I have applied the test described in the manual for detecting a faulty line output transistor, and this appears to be in good order.—K. Caswell (Merthyr Tydfil, Glamorgan).

The trouble almost certainly lies somewhere in the line circuits. The symptom indicates complete failure of the line section. The line oscillator, of course, may fail. This would be noticed by lack of line whistle when the fault occurs. Check the oscillator and the efficiency diode circuit and bear in mind that a transistor or transformer could break down, although indicating "good" on a test procedure.

STELLA ST8617U

The picture has reduced to a half inch strip across the centre of the tube and the height control has no effect. The anode voltage on the PCL82 triode section is very low, and the voltage on the anode of the ECL80 is not as high as it should be. These valves have been tested and were found to be OK. The voltage on the height control is about 450V.—H. Bond (Bradford 3, Yorkshire).

The low voltage on the anode of the frame amplifier valve means either that the valve is passing a very high anode current or that the primary of the frame output transformer is open-circuit or high resistance. This would, of course, considerably affect the frame scan amplitude. If the valve is passing excessive current both the transformer and the valve would be extremely hot. In the first place, we suggest that you check the frame output transformer.

INVICTA 137

The vertical hold on this receiver is unstable and can be adjusted only with great difficulty. V14, V15, V16 and V21 have been tested and replaced where necessary without improvement.—M. Thornton, (Sutton Coldfield).

There is a small type M3 metal rectifier between the sync separator valve anode and the frame oscillator. This has probably failed. Check by replacement.

SOBELL T25

There is acute picture break, more so on ITV than BBC although it is not continuous.—C. Griffiths (Ebbw Vale, Monmouthshire).

The usual cause of picture tear which is more pronounced on the ITV channel is a weakness in the first stages, causing noise on the signal plus weak sync pulses.

You should first try a new 30L15 r.f. amplifier valve. Next, check that the trouble is not caused by ghosting, usually obvious from a close inspection of the picture. A slight improvement of the aerial will often cure this kind of fault.

MARCONIPHONE VT151

The 500mA h.t. fuse keeps blowing. The ordinary tests have been carried out without success.—R. Baggelaar (Wells, Somerset).

Persistent fuse failure, of course, signifies a short somewhere on the h.t. line. However, if the set is working normally the trouble could be due to a flashover in the line output valve.

FERGUSON 203T

There is no frame or line sync which makes me think that the fault is something to do with the a.g.c. I have checked the valves associated with this circuit, but they all seem in order.—J. Eveleigh (Salisbury, Wiltshire).

It seems from your remarks that the trouble lies somewhere in the sync separator, as distinct from the a.g.c. system. The sync separator receives signals from the video amplifier anode circuit and removes the picture signals, leaving only the frame and line sync pulses. These are then fed to the respective timebases via valves and resistor/capacitor networks. Since both timebases are affected, the sync separator stage and/or its coupling to the video amplifier should come under attention.

PYE V14C

On renewing V21 (PCF80 sync sep. amp.) a much poorer picture appeared with the contrast control turned fully clockwise. There are prominent flyback lines especially on ATV. Normally the contrast control was fullv anticlockwise for BBC and fully clockwise for ATV.

I have renewed valves in the tuner unit (PCC84 and PCF80) and interchanged both EF80's with the sound section and tried PCF80 for V21 (sync sep.) I am not sure how to replace V3 (CG12E det.).

Sound and all other controls seem normal except the channel selection switch, which on rotation momentarily produces a better picture.—R. A. Duffett (St Albans, Hertfordshire).

We have met a number of these receivers which need a PCF82 in the sync separator stage. An alternative cause of your symptoms is a faulty c.r.t. The detector diodes are inside the i.f. transformers, and it is usually simpler to replace the entire transformer complete with diodes.

MURPHY V659

When this set has been on for about an hour, the screen suddenly becomes covered with a mass of horizontal thick black lines about ¾in. wide. The sound then disappears and the raster shrinks away from all sides. On looking in the back some of the valves do not appear to be lit up.

If the set is switched off and left for a while, it is perfect when switched on again, but after a few minutes, the fault occurs again.—H. Parr (Stoke-on-Trent, Staffordshire).

The symptoms that you describe suggest a heater-cathode leakage on either the 30FL1 or the 6F23 valve.

FERGUSON 408T

On switching on there is a 2in. gap at the bottom of the picture, and there is a shrinking of the picture on each sound peak. When the set has fully "warmed up" about 15 minutes later, the picture becomes full size and the sound-on-vision symptoms disappear.—B. Williams (Norwich, Norfolk).

We would advise you to change the PCL82 frame (field) timebase valve which may be failing, thus causing bottom compression. The sound-on-vision could be due to a faulty PCL82 output valve, a defective electrolytic capacitor, or incorrect (or drifting) tuning.

SOBELL T174

The fault on this set is ragged verticals which appear intermittently during an evening's viewing. The effect can be slightly reduced by increasing the brightness control.

The fault is apparent on both channels, the tuner being a Cyldon P16H with a 30L15 in place of the PCC84 r.f. amplifier.—C. Williams (Swansea, Glamorgan).

Ragged verticals are caused by random triggering of the line timebase often by noise pulses. It is possible, therefore, that the signal-to-noise ratio of your installation is below standard due to (a) reducing sensitivity of the set or (b) weak aerial signals: (a) should lead to a check of the vision channel valves and (b) to a check of the aerial system.

BUSH TV 53

When first switched on, the picture appears some two minutes after the sound has come up. The picture is rather light with flyback lines visible and its area is then about three-quarters its full size. This condition persists for about five minutes as the flyback lines gradually clear from bottom to top of the screen, this process being accompanied by some flashing.

The picture then settles down and remains steady for the remainder of the time it is on without need for any other adjustment than resetting the fine tuning control after about ten minutes.

The c.r.t. was boosted some time ago and I now intend to replace it.—J. E. Smith (Melton Mowbrav, Leicestershire).

The light, flashing picture can be attributed to an internal short in the tube which will of course, be rectified when the c.r.t. is replaced.

The small picture is probably due to a "lazy" PL81 or PY81 on the right-hand side.

FERGUSON XX 3602

This set has been converted to 625-lines. On 405-lines only, the timebase whistle suddenly becomes very loud after the set has been switched on for about 30 minutes. This continues for about an hour and then the whistle drops down to its normal level. During the time that the whistle is there, the picture is quite normal. The PL36 line output, PCL85 frame output and PY801 boost diode were replaced recently, and this fault has occurred since then.—P. Sparks (Reigate, Surrey).

The trouble described is caused by a characteristic in the line output transformer and can only be modified by changing the transformer. Note, however that even a replacement transformer will whistle to some extent on 405-lines.

BUSH TV 24

Sound and vision were restored to this set when the PL38 valve was replaced after it had been found to be defective. However the replacement brought with it considerable hum which renders the set unusable. This hum is occasionally interrupted bv a "ripping" sound.

The PZ80 valve was passed o.k. at the same time as the PL38 was shown to be faulty.—A. B. Clark (Brighton, 6, Sussex).

Check the lower deck valves—EF91 in early models, EF80 in some later versions—for heater-cathode leaks and then check the electrolytic capacitors generally.

SOBELL T278

The picture has gradually deteriorated. Firstly, a black band started to appear at the bottom of the screen and gradually increased until it was about 2in. deep. At the same time there was a turnover at the bottom which increased until it was halfway up the screen. The top of the picture has become extremely elongated, making a circle on the screen appear like a very tall egg. Adjustment to the controls only seems to worsen the picture. Also the frame hold does not seem very stable. Both the brightness and contrast seem quite normal.—J. McVicar (Carmarthen, South Wales).

On the face of it, it seems likely that the frame trouble is due to a worn frame output valve. It may be as well to check this by substituting with a new valve, after which carefully adjusting the height and frame linearity controls for the best linearity. Note however, that failure of the electrolytic capacitor on the cathode of the frame amplifier could aggravate the symptom.

PETO SCOTT 733

The frame and line hold will not stop and the picture is continuously rolling. If either the frame or line hold controls are adjusted, the fault stops for a moment and then starts rolling again.

I have tried substituting most of the valves without much success.—D. Sykes (Pudsey, Yorkshire).

As you say you have substituted the valves, we presume you have checked the sync separator, the PCF80 which is second from the left at the top.

If this is in order, check the common return tag of the 100 + 250μF electrolytic capacitor. Earlier runs of this model had the possibility of a loose rivet here—a subsidiary symptom being hum. Later runs had this riveted connection soldered over. If this is not done, try soldering first. If this does not cure it, the electrolytics may need replacement.

All this presupposes a good signal.

FERGUSON 505T

This set takes a long time to warm-up, and replacement of the PY82's has had little effect on this. The line oscillator does not work, but if the line hold is pushed in, it does, the tube lights up but fades out when it is released.

I have replaced the line multivibrator, V8, ECC82, V6, a.g.c. rectifier and pulse amplifier ECC82, and several other valves. All the valve voltages are within a few volts of those shown on the circuit.—F. Brown (Leamington Spa, Warwickshire).

Although you say that all voltages are normal, you do not mention whether this includes the boost voltage, and from your description of the symptoms, it would seem that the PY81 boost diode is the cause of the trouble. This should be your first test.

If the boost voltage is normal, you may have to look more closely at the line oscillator circuit. We would mention that on this model it is sometimes necessary to try two or three ECC82 line oscillators before a suitable valve is found.

EMERSON E700

When this set is switched on, all the valves and the tube light up except the EY86. The PY32 is low, and the sound is perfect.—W. Murray (Scotland).

If the PY32 is low, you will certainly get no glow from the EY86, as this valve only lights when the line circuits are in full operation. Replace with a PY33.

When the h.t. is again normal, if the EY86 still remains unlit—listen for the line whistle. If absent, check the ECC82 line oscillator, and then the 0·5μF boost capacitor beneath the line output transformer.

KB MV50

The focus is poor and the focus control is at the end of its travel. There is poor balance of light and dark tones. Advancing the brightness and contrast controls causes the picture to blow up and disappear. I have fitted a new EY51 e.h.t. rectifier. A faint spark can be drawn from the single wire end and a thin spark can be obtained from the d.c. end with a screwdriver held fairly close to the wire. A new RM4 was fitted quite recently, and no raster is obtainable with the aerial removed. There are a number of bright horizontal lines instead.—H. Ward (Cumbernauld, nr Glasgow).

It sound very much as if the cathode ray tube is low from the symptoms you describe.

The "blowing-up" could be lack of h.t., lack of line drive or boost voltage, but you appear to have checked these faults.

Remove the final anode cap to the c.r.t. and test again for d.c. spark at the EY51. If a good spark can now be obtained, the c.r.t. is drawing excess current to produce the raster, and should be replaced

SOBELL T280

There is instability on both the sound and the vision. After switching on, the fault seems to develop for about a quarter of an hour, then there is a sharp click and everything is normal for the time that the set is switched on.

Can you also tell me the correct method of unboxing this set.—G. Smith (Orpington, Kent).

There could be many causes of the fault you describe, but the root is heat. As the set warms up, fault conditions change. Most often, a dry joint can be blamed when the fault disappears when hot, but finding such a tricky one demands a lot of patience. Try the effect of switching on. and immediately going along the small decoupling capacitors with a hot soldering iron held near them (but not touching). If one is faulty, the trouble will temporarily clear itself.

The most common culprit is an a.g.c. decoupling capacitor, especially the 0·1μF capacitor decoupling the a.g.c. feed to the tuner.

The next most likely cause is a partial inter-electrode leak in the 30L15. Check also that the a.g.c. link has a tight connection.

This set is unboxed in sections, and the most difficult part is the removal of the knobs. This requires the insertion of a long, narrow-bladed screwdriver to push the lower end of the spring retainers towards the knob, while a withdrawing pull is made. The control panel can then be slackened by turning two swivel clips.

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PRACTICAL TELEVISION, FEBRUARY, 1965

TEST CASE -27

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions, but are based on actual practical faults.

While on holiday at a coastal resort an experimenter was asked to advise on some television trouble that his host was experiencing. A quick check revealed that the BBC picture was badly marred by dark horizontal lines which had a tendency to vary in intensity. At some moments the effect was so severe that the holds were destroyed. Close examination of the picture showed that between the lines a form of herring-bone pattern interference was present as shown in the accompanying illustration.

The sound was mostly clear but it was discovered that by detuning the fine tuning control a loud buzz could be produced which, so the experimenter was informed, was not present before the picture trouble started.

Tuning to the local ITA channel in Band III the picture was perfect and completely free from any interference effects.

What was the most likely cause of this state of affairs and what steps, if any, could the experimenter have taken to cure or alleviate the trouble?

See next month's PRACTICAL TELEVISION for the solution to this problem and for another Test Case in this series.

SOLUTION TO TEST CASE 26

(Page 188, last month)

Since the h.t. line voltage increased slightly as the fault developed the clue given was that something happened which reduced the total h.t. current. Failure of the line timebase is the connection but because it was found that the associated valves were in good order a current check should have been made in the line output valve (in the cathode circuit or by measuring the voltage across the cathode resistor, if used) during the period that the trouble developed.

This technique was, in fact, adopted by the engineer and it was discovered that the current in this amplifier fell when the timebase cut out.

H.T. checks on the screen and at the dead end of the anode circuit again showed a slight rise in voltage, thereby proving that the h.t. feed circuits were in order. Eventually a check was made of the negative voltage on the control grid of the line output valve and this was found to rise (go more negative) as the fault occurred. The valve was thus being back-biased and eventually cut off. A quick check of the grid components brought to light a 1MΩ preset which was open-circuit. Replacement cured the trouble.

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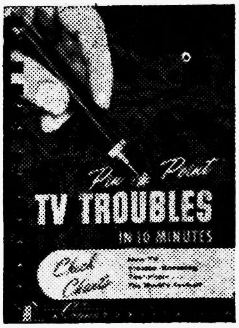

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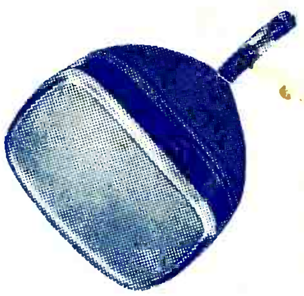

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