Practical TELEVISION

DECEMBER 1962

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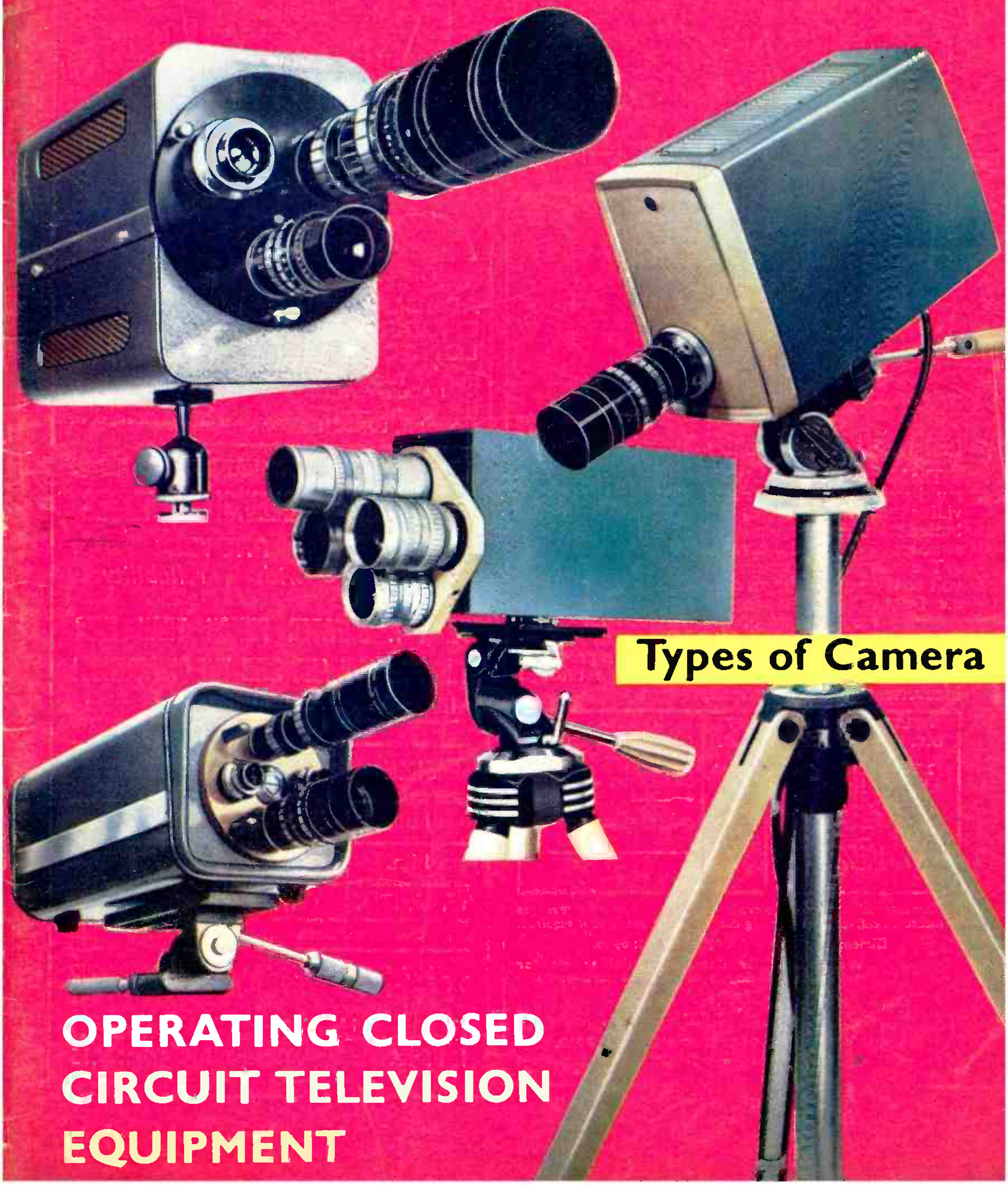

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				Maximum indication 20MΩ	
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10V	10V	250μA	1A	0—200,000Ω	
25V	25V	1mA	2.5A	0—20mΩ	
100V	100V	10mA	10A		using external batteries
250V	250V	100mA	—	0—200MΩ	
500V	—	1A	—		
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Practical Television

AND TELEVISION TIMES

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Contents

Fortieth Birthday

DURING the past year, the British Broadcasting Corporation has passed two significant and praiseworthy milestones in its history. It celebrated the 25th anniversary of its Television Service, the first public service of its kind in the world, and has now completed its fourth decade as a broadcasting organisation.

Judged by any standards, this is no mean achievement and we, of the Practical Group, join in the many congratulations which have been extended to the B.B.C. on this occasion.

In the just published Annual Report, the B.B.C. welcomes the recent Government White Paper and states that immediate steps were taken to bring into operation at the earliest possible dates the proposals for a second TV programme, a start to colour TV, more Welsh and Scottish TV and more educational programmes on the present television service.

The B.B.C. reports unspectacular but steady developments on the engineering side—with a few major steps forward such as video tape recording, cablefilm and the radio camera. The gradual bringing into functional operation of the Television Centre with its up-to-date equipment and facilities marks further continuous progress.

One of the most important aims for years has been the expanding of the distribution network and the B.B.C. has now reached the stage where some 99% of the population are within range of the television service. The final 1% is proving stubborn but new TV stations were opened during the year and others planned.

Of importance is the fact that Stage III of the relay station programme has been approved and this means no fewer than 23 new low power relay stations which are scheduled for completion in 1964. These together with the 22 stations of Stages I and II will overcome some of the remaining blind spots and will increase the coverage by another 0.7%.

The past year has also seen a further stride forward with the linking of the *Eurovision* network with that of the Eastern European *Intervision* and following that the foretaste of global television made possible by the epoch making *Telstar* experiments.

All this goes to show that although it is 25 years old, television is still a young and exciting medium of entertainment and communication. It continues to develop on both the engineering and production fronts. Today we are on the brink of a change in line standards, more channels and—dare we hope?—colour.

We wonder what the next 25 years will bring!

Our next issue dated January, will be published on December 21st

Telenews

Television Receiving Licences

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

Region	*Total*
London	2,019,492
Home Counties	1,714,780
Midland	1,796,317
North Eastern	1,924,971
North Western	1,589,793
South Western	1,044,012
Wales and Border Counties	726,575
Total England and Wales	10,815,940
Scotland	1,105,000
Northern Ireland	189,056
Grand Total	12,109,996

Colour Television in Roumania

COLOUR television cameras were the highlight of EMI Electronics Ltd.'s display at the British Industrial Exhibition, staged in the Herastrau Park, Bucharest, Roumania, in October this year.

Also on show was monochrome industrial closed-circuit television equipment. Other exhibits included oscilloscopes, stroboscopes, nuclear health instruments and special electronic valves and tubes.

Manchester's New Landmark

STREETS around Granada's TV centre, just off Deansgate, Manchester, were closed for 12 hours recently, when a 200ft jib hoisted a plastic radome to the top of the aerial mast at the centre.

The plastic dome is 10ft in diameter and weighs a ton. The aerials inside are used for picking up pictures from outside-broadcast locations and feeding them into the central control room on their way to the Winter Hill ITA transmitter. The aerials also transmit and receive Short-wave radio messages between the TV centre and outside crews and pick up "off-air" TV pictures for the station's own TV system.

At night the radome and mast are floodlit.

A Mobile Sound Control Room

A UNIQUE mobile sound control room, designed and constructed by ATV's engineering staff, went into operation recently when "Val Parnell's Sunday Night at the London Palladium" programme returned to the screens.

The control room provides 32 separate sound channels, contains two tape machines, a grams desk and talk-back facilities. And it is completely mobile—built into a scenery van which now takes it place beside the vision control van outside the Palladium Theatre every Sunday. Previously the sound engineers had to work in the same van as the producer and in various strategic spots inside the theatre.

The new control room will be used at important outside broadcasts which call for elaborate sound facilities.

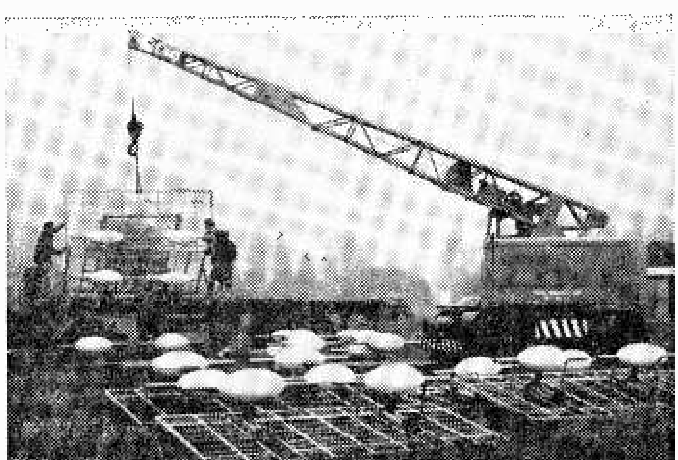
The control room was designed and manufactured in ATV's Development and Maintenance Department at Elstree.

Studio Equipment for Vera Cruz

IN the face of strong competition, EMI Electronics Ltd. has secured a contract to provide studio equipment for a new small private commercial television station in Vera Cruz, on the Gulf of Mexico.

The units comprise two studio vidicon television camera channels, a vidicon telecine channel and ancillary equipment. The studio vidicon cameras will be equipped with "joystick" control, which enables one operator to control studio cameras as well as telecine equipment.

EMI already has television equipment in the shape of three



Sections of the aerial array for the new Croydon ITA transmitter being loaded on to a lorry at EMI's in Hayes, Middlesex.

$4\frac{1}{2}$in. image orthicon television cameras working in Mexico City.

Closed-circuit Television at opening of New School

THE new Ambrose Fleming Technical Grammar School at Ponders End, named after Sir Ambrose Fleming whose historic pioneer work on the thermionic diode valve took place not far away, was officially opened by his widow, Lady Olive Fleming, on Thursday evening, 11th October. The number of guests attending was so great that arrangements had to be made for an overflow gathering in the School Dining Hall, and a closed-circuit television system was installed and operated by Belling-Lee to link this to the main Assembly Hall where the actual ceremony took place.

Using two Thorn cameras and four standard 19in. Ferguson television receivers, the 405-line vision signals were "piped" by v.h.f. relay equipment. The sound, picked up by multiple microphones, was relayed via a public address amplifier.

Advertising Agency installs Closed-circuit TV

ONE of the largest advertising agencies in Britain, Lintas Limited, has incorporated a comprehensive Marconi/RCA closed-circuit television system in their new premises in Fetter Lane.

The new film and television system will provide extensive facilities for auditioning, pre-viewing "commercials" and for general experimental work.

The heart of the installation is a central control room, which houses two telecine channels and embodies full control facilities similar to those of a broadcasting studio. A television studio adjoins the central control room, with a small sound dubbing studio beyond. From the control room, the programme outputs from the two telecine channels and the output from the studio camera are fed, after amplification and processing, to standard television receivers in offices throughout the building.

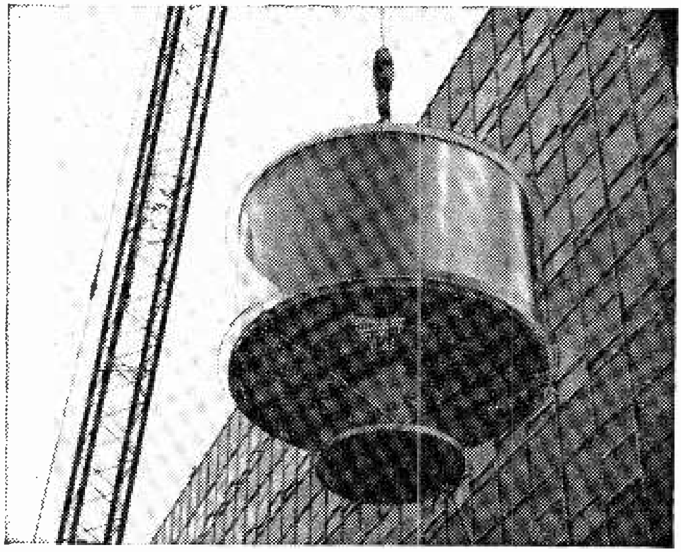
Croydon Transmitting Aerial

THE new Independent Television transmitting aerial, being erected at Croydon, will increase the strength of signals received in north and north-west London, Middlesex, Hertfordshire and Buckinghamshire.

The existing installation is being replaced by a 500ft tower, which the Independent Television Authority ordered from EMI Electronics Ltd. This contract includes the supply and installation of the tower, aerial and feeder systems. EMI commissioned British Insulated Callender's Construction Ltd. to supply and erect the tower.

The sections of the aerial array were loaded on to lorries at EMI's test area at Hayes and transported to the new aerial site at Croydon.

This aerial array, of 80ft aperture, will transmit in Band III the existing Associated-Rediffusion and Associated Television programmes on channel 9. The special aerial array uses vertical polarisation.



A one ton, plastic radome being hoisted to its position atop of the aerial mast at Granada's Manchester TV centre.

Colour Tests at Elstree

COLOUR television experiments have recently started at ATV's studio centre at Elstree. They will continue at regular intervals throughout the winter, providing members of the staff with valuable experience for the future when colour transmissions become a practical and economical possibility for viewers at home.

The experiments are being controlled by a committee and following each set of experiments the committee meets to assess the results, distribute the information gained and plan the next experiments.

Studio D, with an area of 9,280sq ft was taken over for the first experiments. Viewing took place on a monitor on the floor and in a scanner van outside.

One of the main lessons learned was that red is the "devil" so far as colour on the screen is concerned. Lipstick, it was discovered, has to be very, very light.

Britain Lagging in Educational Television?

LORD Bessborough, chairman of the organising committee of the Institute for Educational Television, challenged those concerned with future television policy in this country to provide a comprehensive system of educational programmes transmitted not only to schools but into homes, when he spoke at the first Prize Day of Havant Grammar School on Friday, 11th October.

Lord Bessborough went on to remind his audience of teachers, pupils and parents, that television is the newest tool in the hands of the teacher—it cannot replace the teacher himself, but the teacher must learn how to use it.

Closed Circuit Television

Types of CAMERA

By H. Peters

(Continued from page 76 of the November issue)

THE Vidicon tube is the most compact pick-up tube available, measuring about 6½in. by 1in., about the size of a PY33 rectifier valve. By comparison with other pick-up tubes it is cheap, costing about £50 to replace.

From a glance at Fig. 6 the electron gun assembly resembles a domestic cathode ray tube, with a target and signal plate in place of the fluorescent screen. The action is similar too. Electrons liberated from the cathode are attracted to the far end of the tube by a positive voltage. Their number, and thus the beam current, can be varied by the charge upon G1.

This is negative with respect to cathode by an amount determined by the setting of the "Beam Current" control, which is analogous to the "Brightness" control on TV receivers. The current is much less, about 1/5mA for a white signal by comparison with 50mA in a c.r.t.

Being a low velocity beam no e.h.t. is required, the highest potential (300V) existing at accelerator anode G2. The target is held just above cathode potential by the setting of the target bias control which normally gives a reading of approximately +30V at the target electrode.

The beam is deflected in the usual way by deflector coils around the tube and scans a portion of the target surface about the same size as a frame of 16mm film, which incidentally simplifies the optical system, since standard 16mm cine lenses can be used.

Electronic focusing is accomplished by an electromagnetic coil which extends nearly the length of the tube, and also by varying the cylinder and mesh (G3 and G4) potential by means of the "beam focus" control. There is also an optical focusing device to project sharp pictures on to the starage plate, and this is commonly done either by a coarse thread on the lens itself, or by moving the whole camera tube and scanning assembly back and forth inside the case.

For remote control applications the moving platform is coupled to a motor driven worm reduction gear, At the back of the tube is a third coil assembly marked "Beam Alignment Coil", and the function of this is similar to the picture postioning magnet on a domestic receiver.

Scanning Principles

The storage plate may be regarded as a large number of small capacitors, each with a variable

UNIT	Beulah	Elect. Units	Murphy	Nashton	Nev. Eye	Nev. Minnie	Pye & Ekco
Line System (*625 to order) ...	405*	405*	405	405*	405*	405*	625
Sync. System	Random	Interlaced	Interlaced	Random	Random		
R.F. Output tunable over Band I	100mV	Extra	10 mV	100mV	10mV	10mV	2mV
Video Output (in 80 ohms) ...	To order	1·4V	1V	To order	To order		1V
Resolution (300 lines=2·7 Mc/s)...	300 lines	600 + lines	300 + lines	300 lines	300 + lines		
Power Consumption (watts) ...	50W	250W	110W	50W	50W	12W	
Units per Channel	1	2	2	1	1	1	
Weight	14 lb	68 lb	15 lb	16 lb	12 lb	4 lb	
Usable with Flywheel Sync. Sets ...	Yes	Yes	Yes	No	No	No	
Basic price (inc. 1in. lens) ...	£236	£440	£225	£175	£145	£155	Approx. £200
Turret extra without lenses ...	£22	£18	£17	£20	£21	£21	
Spare Vidicon Tube	£45	£60		£50			

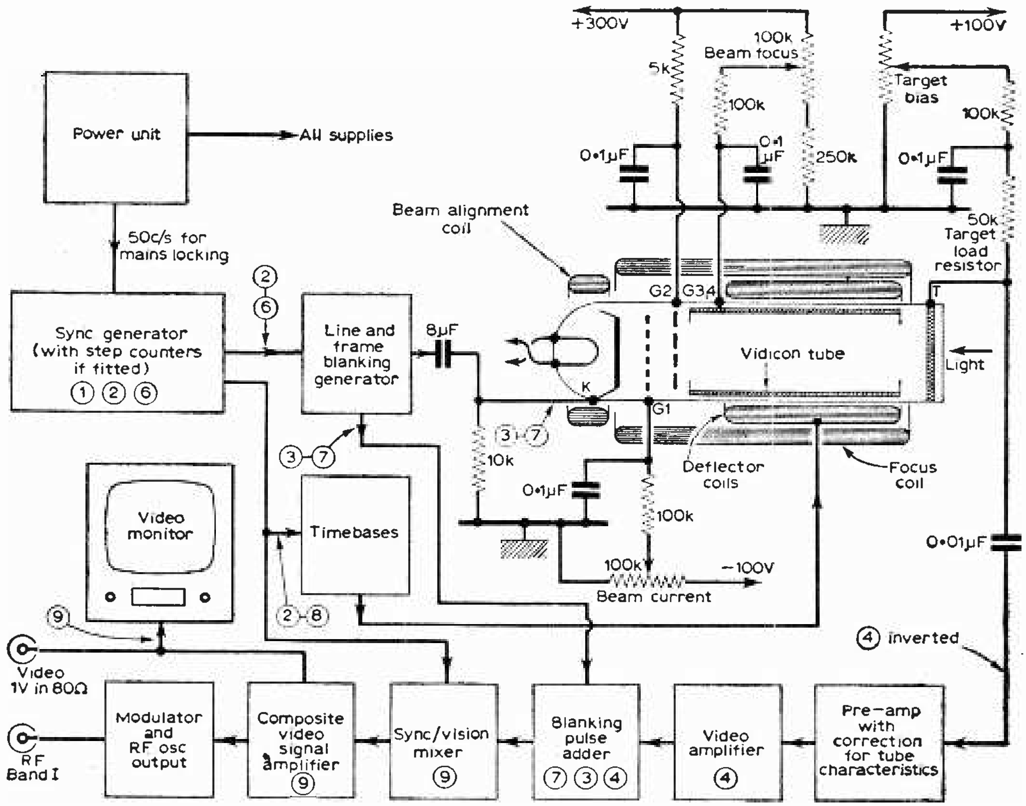


Fig. 6—Block diagram of a more ambitious closed circuit TV set-up showing typical tube supplies in detail. The circled numbers relate to the waveforms shown in Fig. 7.

leakage. It is in fact a layer of semi-conducting material, the transverse resistance of which varies with light, being low in bright light, and high in total darkness. The effect is as if the individual small capacitors have good insulation in the dark, but become leaky when exposed to light.

The right-hand plates of all these capacitors are joined together by the transparent signal plate and are thus all connected electronically to the target load resistor and must therefore all be at the same potential, that is to say 20-30V positive to cathode as set by the "target bias" control.

The left-hand plates of the little capacitors face into the tube and are scanned by the electron beam, which can be regarded as a wire attached to the cathode which passes across the target face, touching each of the left-hand plates in turn and discharging them.

As the electron beam does this once in every complete frame, and there about 200,000 separate "picture points" in a frame* it dwells upon each separate capacitor plate for $\frac{1}{200{,}000}$ of the total time.

(**A picture with 405 lines and a 4:3 aspect ratio can be said to 405×4/3 (or 540) picture elements per line, that is to say 405×540 or 219,700 picture elements per complete frame).*

This period is known as the "examination time", and the remainder as the "storage time". The sensitivity of the tube is therefore quite remarkable since the current drawn from one capacitor during the brief examination time is the total charge is has accumulated during the storage time. (It follows from this that a given camera will be more sensitive on 625 lines than on 405 lines.)

In the dark all the capacitor elements have good insulation and the electron beam scans all the left-hand plates, reducing them to cathode potential. The right-hand plates are all at ±20V due to the target bias. If light is allowed to fall on one element its insulation will fall and the left-hand plate will tend to rise to assume the same voltage as the right-hand plate.

How rapidly this happens depends upon the amount of incident light. The next time the scanning beam examines the left-hand plate it finds it positively charged (deficient of electrons) and deposits sufficient electrons on it to neutralise the charge.

Current therefore flows and the left-hand plate is discharged back to cathode potential. The

ACKNOWLEDGEMENTS

Cover photographs show Murphy, Nashton, Electronic Units and Nev Eye cameras.

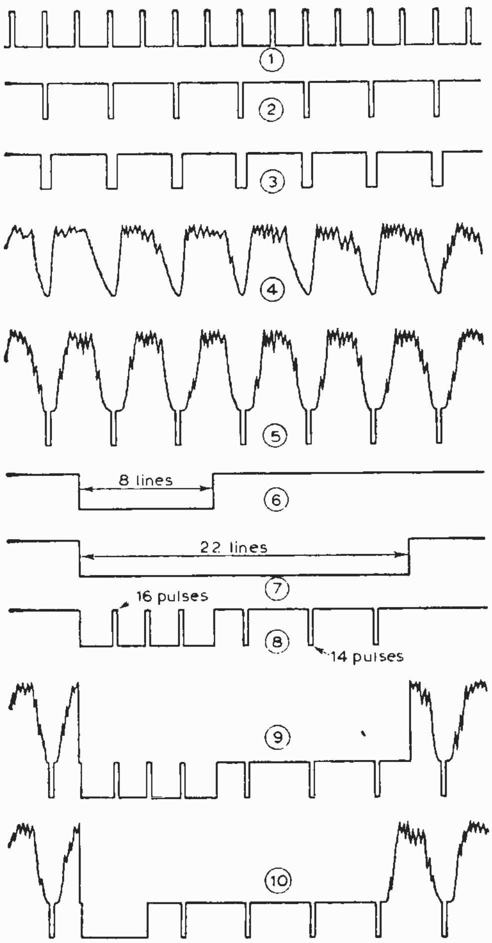


Fig. 7—The waveforms which made up the composite interlaced picture. For key see table on opposite page.

charge builds up again during the storage time and the process is repeated each time the scanning beam comes along.

The instantaneous beam current is therefore proportional to the light falling on the target and as it flows through the 50kΩ target load resistor the voltage at T will be varied accordingly. The signal at this point will be negative going for peak white.

With a beam current of 0·1μA the signal developed across the load resistor is in the order of 5mV for low-frequency signals but less for the finer details of the picture due to the shunting effect of circuit capacities.

To correct this a pre-amplifier is normally fitted between the target and the video amplifier and incorporates a differentiating circuit of approximately the same time constant as the integrating network formed by the target load and shunt capacities. The signal-to-noise ratio of the system is determined by the noise threshold of the pre-amplifier.

The "target bias" and "beam current" controls can therefore be compared to the contrast and brightness control for a cathode ray tube. They are interdependent and for a given setting of target bias the beam current must be sufficient to completely discharge the white parts of the picture.

Insufficient beam current will produce pictures flat in highlight detail which on the screen of a receiver gives the same effect as a low-emission tube or excessive interference limiting.

The Control Unit

Apart from the conventional power supply the heart of the control unit is the sync generator. This supplies the line and frame sync pulses, which are the foundations upon which the picture is built. In the more elaborate units the master oscillator runs at 20,250c/s, giving two pulses to every line.

Its output is taken to a ÷2 stage which produces the line sync pulse at line repetition frequency 10,125c/s. It is also taken to frequency dividing stages relating it to the frame frequency.

In the Electronic Units system binary counters are employed which have the advantage of either working right or not at all. Other units use less

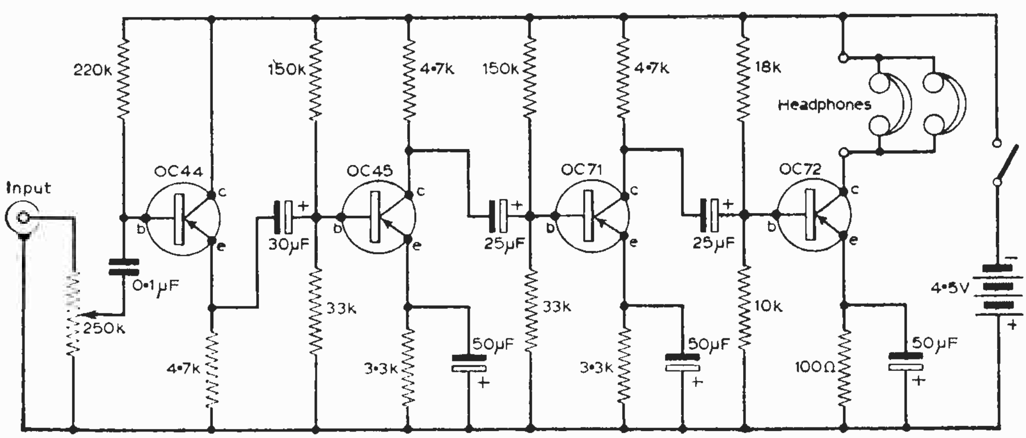


Fig. 8: Circuit of the transistor amplifier used for talkback. (Mentioned in Part I).

The 10 waveforms which make up the composite interlaced picture.

1. Master oscillator at 20,250 c/s.
2. Line sync. generator at 10,125 c/s.
3. Line blanking pulse at 10,125 c/s (wider than the line sync. pulse).
4. Picture signal at tube target (shown inverted for clarity).
5. The sum of 2+3+4.
6. Frame sync. pulse (8 lines long).
7. Frame blanking pulse (22 lines long).
8. The sum of 6+7+1+2. The combined frame sync. pulse.
9. Complete waveform, 8 added to 5. The end of the odd pulse and beginning of even pulse are shown to illustrate the interlace waveforms starting and ending at half a line.
10. Economy waveform to reduce circuitry, used by Murphy. A broad pulse one line long is used in place of the 16 half line M/Osc. pulses gated into the frame sync. period.

expensive step counters with multivibrators or "staircase" blocking oscillators usually in stages of $\div 3 \div 3 \div 3 \div 3 \div 5$ to produce the 50c/s frame sync pulse.

This is compared with the 50c/s mains supply in a bridge of four diodes which produce a positive or negative d.c. voltage according to the difference between the phase and frequency of the frame sync pulse and the mains.

This d.c. voltage is smoothed and appropriately applied to the master oscillator as a bias which alters its frequency to one which, when taken through the frequency dividing network will produce a frame sync pulse that is the same frequency and phase as the mains.

The unit is thus locked to the mains and strobing effects due to hum are reduced. On low-priced units the master oscillator and step counter are omitted, the 10,125c/s line sync generator is free running but stable and the 50c/s frame sync generator is locked to the mains by a simple diode circuit.

The frame and line speeds are thus unrelated and no interlace is possible. On the screen of the monitors the scanning lines appear to twinkle in and out of interlace and units incorporating this simple sync generator are said to have "random interlace".

Blanking Pulses

Line and frame sync pulses are taken to the blanking generators which produce the wider line and frame blanking pulses. These black out the picture during the sync pulse period and the flyback time which follows it. They are normally added to the vision waveform after the video amplifier.

As an economy the vidicon tube is sometimes used as the blanking pulse mixer. The pulses appear, positive going, at the cathode and cut off the beam current during the sync and flyback period.

Timebases and Sync Mixing

Sync pulses trigger the timebases supplying the conventional currents to the deflector coils. They are also added to the vision plus blanking pulse signal, completing the composite video signal, which is amplified and, if necessary, inverted.

From here the 1V in 80Ω positive video signal is taken to the monitor receivers and a larger signal (d.c. restored) to the modulator of the r.f. stage. An output of 10 to 100mV can be easily obtained from a single r.f. pentode, grid modulated on any Band I channel.

The output is naturally double sideband, which may produce excessive l.f. on the resulting picture unless the set or the unit is slightly detuned.

Resolution

The resolution of a vidicon unit is good, the limit being set by the video amplifier and pre-amplifier. For units with r.f. output there is little point in attempting to better the 2·7Mc/s bandwidth of the receiver used as a monitor. This in effect would enable 300 fine vertical lines to be resolved across the width of the tube (i.e., 300 lines in the specification tables).

With a video output into a special receiver and careful design the resolution can be increased to 600 lines, which corresponds to a 5Mc/s bandwidth at 405 lines or "better than broadcast" quality. Such units benefit from a 625-line system if practical.

UNITS AVAILABLE

Beulah

An early entrant into the low-priced group was the Beulah D800. Features are its ability to work in normal room light, to give steady pictures on flywheel sync receivers and the complete absence of printed panel from the component layout. One of the first Beulah cameras is installed in a technical college where it can be used to televise the output of high-speed 3in. oscilloscope tube for the benefit of students.

Illustrated in last month's issue was a D800 coupled to a film camera. This enables the director to see the appearance of the resultant picture without waiting for the negative to be processed and is also useful in commercial work where a sponsor is anxious to watch the filming.

A new addition to the Beulah range is a motor projection unit which automatically televises a 6-minute closed loop film. This equipment can run unattended. Other Beulah specialities are TV microscopy for instructional purposes or where infection risks are present, a remote control system to which all later units are convertible. Westward Television use a D800 in a tele-prompter system.

Electronic Units

The culmination of 2½ years' work has produced the PV104 vidicon camera channel. This is a high-grade unit giving true interlaced pictures with transistorised binary counters in the sync generator. Resolution on video monitors is 600 lines and up to 1,000ft of cable can separate the camera from the control unit.

An 8in. monitor can be provided as an electronic viewfinder and a special trolley carries the camera, control unit and monitor on a unipole mount. This is ideally suited for the purposes described in last month's article and the equipment, and if necessary an operator, can be hired for special occasions from the makers.

The Telecine adaptation of this camera can operate either from a projector with a low-wattage lamp or else by the insertion of a special glass plate in the projector beam. By this means it is possible to televise the projected film to a number of monitor receivers at the same time as it is being screened in the cinema.

Other features of the PV104 are reversible scans and reversible video. The former facility enables the camera to "peep round corners" using a mirror, and the latter is extremely useful in photographic work. A wet negative can be hung up in front of the camera and a positive image obtained directly on a monitor screen.

Photographers will hasten to say that an experienced eye can accurately assess the quality of a wet negative without reversal, but where a customer has to choose between a number of negatives such a system is invaluable.

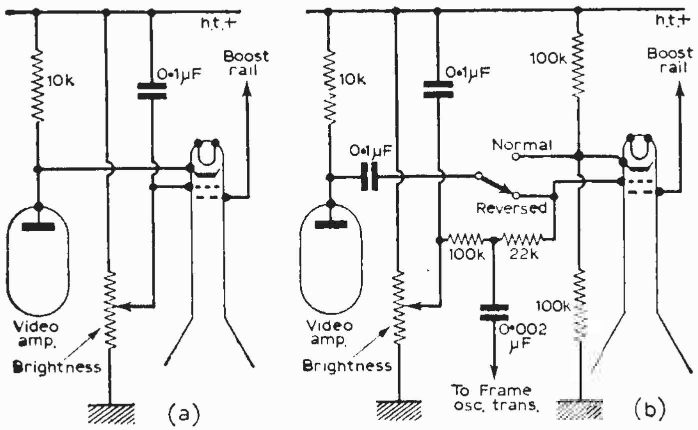


Fig. 9: A circuit to produce positive images from photographic negatives held in front of the camera. Few C.C. TV units have this facility inbuilt, but it is easily incorporated in the monitor TV. (A) shows the c.r.t. supplies as they normally are. The conversion at (B) comprises the removal of d.c. clamping on the tube cathode by fitting 0.1μF in series with the video feed and d.c. stabilising the cathode by a pair of 100kΩ resistors from h.t. to chassis. To reverse the picture, video is simply switched from cathode to grid. Frame flyback suppression is essential and has been added into the lead from the brightness control to c.r.t. grid.

Murphy

The electronics division of Murphy Radio have recently introduced the TVC761. This is also a 2-unit arrangement giving true interlaced pictures, the only departure from the BBC waveform being a single broad frame sync pulse.

Both line and frame are locked to the mains and an automatic sensitivity control maintains full picture quality over brightness changes up to a 50 to 1 range. Both r.f. and video outputs are available.

As with all Murphy products the unit is well styled and easy to service. The video monitors are similar in style to the *Astra* range of domestic receivers but have a bandwidth of 5Mc/s and a choice of three channels selected by press buttons.

Nash and Thompson

The Nashton camera is a compact lightweight instrument at a very low price. Designed by the Ferguson Radio Corporation, the camera uses standard non-fringe television receivers as monitors and thus purchasers can use the facilities of their local Ferguson dealer for economical maintenance of their channel.

Cameras can drive a monitor receiver over half a mile of standard coaxial without boosting and four cameras can be fed into the monitor by tuning each to a different channel on Band I. Pictures are simply selected by rotating the channel selector knob of the monitor receiver. The fifth Band I channel will be the one taken by the local BBC station.

Nottingham Electronic Valve Co.

The Nottingham Electronic Valve Co. make three cameras: The *Nev Eye*, which is claimed to be the cheapest camera in the world, will work with standard receivers and uses only two valves, a transistor and several diodes. The focus current for the tube is stabilised and the circuits are designed to protect the tube if the scans fail.

A lightweight version, the *Minnie Eye*, is in an all-transistor camera operating from mains or battery and weighing only 4lb. The *Nev Colour*, just released, is a simple colour camera chain FS701. The camera is about the same size as the *Nev Eye* and the monitor incorporates an optical magnification system giving a picture about the size of a 14in. screen. FS301 works on the 405-line system with vertical scan of 100 fields per second giving 33⅓ frames per second.

Pye Group

Pye Ltd. have produced industrial camera units of the senior type with full interlace for a number of years. Two models are generally available, the earlier one with a single lens and the later one with a two-lens turret and a small control box interspersed between the camera head and the scanning generators and timebases. Short-term hiring facilities are available on the above units.

In conjunction with the associated E. K. Cole Co. a new competitive camera is about to be introduced. Using only transistors, this mains operated camera is self contained and will operate on 625 lines. This is advantageous for good definition and, as all future receivers of the two companies will operate on 625 lines, monitors present no problem.

E.M.I. and Marconi

Mention must be made of the E.M.I. and Marconi units, which are high-grade specialist units of broadcast quality. These are normally too expensive for the applications mentioned in this article but have outstanding mechanical and electronic standards. ■

SERVICING DATA AND MODIFICATIONS

By D. Elliot

(Continued from page 71 of the November issue)

A RATHER interesting modification was introduced to the GEC BT5246 series some years ago to reduce the effects of picture flutter due to passing aircraft. In receivers where the picture tube signal feed circuit is designed to be responsive to very low video signal components (right down to d.c.), relatively fast periodic changes in signal strength can cause disconcerting flutter or flicker effects on the picture—this being typified by passing aircraft.

What really happens, of course, is that the change in signal strength alters the picture black level, since the d.c. component and low video frequencies are most affected by the signal fade. The way that this can be eliminated without detracting too much from the average presentation of a picture is shown in Fig. 42. All that is required for the modification is a resistor-capacitor parallel combination to be connected in series with the cathode lead to the picture tube.

The resistor attenuates the d.c. component of the video signal, while the capacitor ensures that the high and medium-frequency components get through without attenuation. Fig. 42b shows how the extra components are connected to the picture tube base socket.

Drift in Turret Tuners

Although there are several "electrical" reasons for excessive frequency drift in turret tuners, there are often also "mechanical" reasons which are probably less well-known, particularly when such a tuner has been fitted to a Band I-only receiver for multi-channel operation.

The electrical faults are frequently caused by drift in the frequency changer triode-pentode valve, alteration in value of a small capacitor associated with triode local oscillator section, fracture or distortion of the fine tuning dielectric (e.g., that eccentric insulating material which is coupled to the fine tuning control) and poor or weak contacts between the oscillator biscuit studs and the spring contactors.

A few years ago Pilot Radio Limited undertook a series of tests in an endeavour to trace the cause of excessive frequency drift when turret conversion kits were installed in certain Pilot receivers. In the majority of cases, the tuners which were returned to the factory with the complaint of drift were, in fact, found to be in perfect order electrically.

The tests involved fitting the tuners returned into the cabinets of Band I receivers, running them on soak tests and measuring the short- and long-term drift. In order to incite drift, the complete receivers were covered to raise the temperature inside the cabinets, but even then there appeared to be no justification for the complaint of drift.

After the examination of a number of modified receivers in which drift was occurring, it was ultimately discovered that the trouble was caused by incorrect fitting of the turret tuner.

One big factor was that the holes which were drilled in the sides and backs of the cabinets for fixing the tuners had been inaccurately drilled. This resulted in the tuners going into the cabinets under strain. In some cases, it was found that the top of the tuner was pressing against the top of the cabinet, so that when the fixing screws were tightened the tuner chassis was pulled out of shape.

It was also found that the hole drilled in the cabinet to accommodate the tuner spindle was also out of balance, thereby causing the spindle to press on the side of the hole.

Extra trouble occurred when the channel selector and control knobs were forced on to the spindles—as they have to be since they are spring-loaded. Due to the badly fitted tuner, there is undue pres-

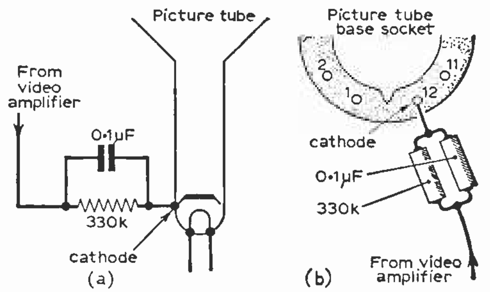


Fig. 42—Showing how the resistor capacitor combination is connected on GEC BT5246 series receivers for reducing the effects of picture flicker caused by passing aircraft.

sure on the spindle when the knobs are pushed on. This causes poor contacts on the coil biscuit studs against their spring contactors and also alters the capacitance of the fine tuning control, one plate of which is formed by the metal bracket on the front end of the tuner assembly.

As the set warms up there is a slight expansion of the cabinet, which is very much geared-up in terms of strain on the tuner assembly, thereby resulting in variations of contact resistance and capacitance of the tuner during the time that the set is operating, this, of course, being directly responsible for the excessive frequency drift.

It has been proved that if the fine tuning capacitance is varied by the slightest degree due to the plate bracket being off-set or bent, then a very severe drift will occur, and in many cases this will be of a very quick nature.

Where experimenters and service technicians experience such trouble after the installation of a turret tuner, therefore, the first check should be one of ensuring that the tuner is correctly fitted and that there is no undue strain on the tuner chassis or spindle due to inaccurate drilling. Most tuner manufacturers supply a template for drilling the holes in the cabinet, so trouble should not normally be experienced in this respect.

To prove whether or not drift is being caused by the mechanics of fitting or by some electrical component within the tuner, the tuner should be removed from the cabinet with its connections remaining. If there is no drift under this condition, then the fitting is almost certainly at fault.

Radio Interference

This trouble still crops up extensively and is not always easy to eliminate. All television receivers radiate from their line timebases to a certain extent, and on nearby radio receivers this is heard as a whistle (or hum) modulated on the station to

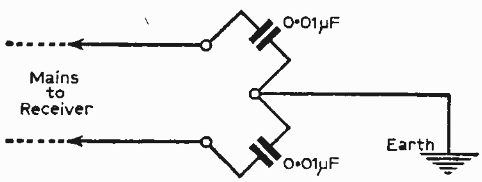


Fig. 43—Mains-borne interference from the line timebase circuits of television receivers can be considerably minimised by two a.c. capacitors connected to the power plug as shown. Capacitors may be required at both the television receiver and the affected radio set.

which the radio is tuned. The interference is not normally heard when the radio is tuned off a station, and the trouble is worse on the Long-wave Light Programme.

Radiation from the line timebase can be either electromagnetic or electrostatic (or both) and, although the line timebase frequency of 405-line receivers is only 10,125c/s (which is within the audio spectrum), it is picked up by radio receivers due to the production of many harmonic components of the basic frequency—these being created by the sawtooth nature of the line timebase waveform.

The Long-wave Light Programme is badly affected because the 20th harmonic of the line timebase falls only about 2·5kc/s away from the Light Programme carrier frequency (200kc/s). It will be understood, of course, that the whistle which is heard is really the line timebase modulation of the interfering harmonic. There may also be a beat effect due to the difference between the frequency of the harmonic and the tuned carrier.

The interference can get out of the television receiver either by direct radiation or through the mains lead and circuits, and resulting from the latter the effect is often aggravated when the radio receiver is being operated on the same power line as the television.

Usually, however, the interference is caused both by direct radiation and mains conveyance, and in this case the direct radiation contribution can often be greatly minimised by repositioning or increasing the distance between the two receivers.

On battery operated receivers the effect is often considerably less since then only the directly radiated interference is responsible. Portables with ferrite rod aerials are even less troubled by the disturbance because the set can usually be orientated for maximum interference *rejection* while still maintaining sufficient signal pick-up of the required station.

In severe cases, the metal screws and shields of the line timebase should be carefully examined to ensure that they are, in fact, present and securely clamped to chassis. The "earthing" surround of the scanning coils on the tube neck should also be examined to make sure that this is earthing to chassis adequately and that all the clamping screws are in position and tight.

Early models often featured a metallic lining inside the cabinet and on the cabinet back as one way of attenuating the line timebase radiation. Ensure that this lining is fully intact and that it is connected to the chassis of the receiver where provision is made for this. The same applies to the back cover and inspection cover at the bottom of the cabinet. If such a receiver is operated either without the back or base cover, then the radiation will be far greater than it need be.

Warning

The chassis on a.c.-d.c. receivers is connected directly to one side of the mains supply, so it is imperative that the conductive coating inside the cabinet and on the back and base covers is so arranged that it can *never* be touched from the outside of the cabinet. There have been several serious accidents due to the coating flaking off and protruding through a ventilation hole.

The coating is, of course, at full mains potential with respect to earth when the power supply to the receiver is connected "live" to chassis, and if this is touched while also being in contact with an earthed object, like an electric radiator, fire or even a stone or tiled floor, a fatal electric shock could well occur—more so with a child or elderly person.

A tin-foil is often used for cabinet screening and this is held on the wood by staples. The radiation from receivers which are so endowed can be reduced by fitting a screening inside the cabinet, and for this purpose a liberal coating of a conductive paint is ideal. This is akin to that used on the outside of picture tubes. The paint should be applied so that it makes good contact with the earthed members of the chassis, but extreme caution must be taken to avoid it spilling on to the outside of the cabinet or through the ventilation holes or slots in the cabinet back or base cover, since here it would represent a potential danger, as detailed above.

If interference is still troublesome after it has been ensured that the line timebase is fully and effectively screened (as per the original design) and after the inside of the cabinet has been treated with a conductive paint, attention should be directed to the aerial and earth system on the radio receiver which is being affected.

(Continued on page 126)

The PRINCIPLES and PRACTICE of TELEVISION

By G. J. King

REFER TO THE FREE DATA CHART, GIVEN AWAY WITH THE OCTOBER ISSUE, WHEN READING THIS ARTICLE

(Continued from page 58 of the November issue)

LAST month we saw that the greater the number of scanning lines, the better the *vertical* definition of the picture. We also discovered that both pictures of 405 lines and 625 lines are produced by a system of interlaced scanning, and that although there are 50 frames or fields each second there are only 25 complete pictures, since each frame is composed of half the number of lines of a complete picture and that the lines of each frame interlace with their partners to produce a picture with the full number of lines.

It was also revealed that the number of scanning lines is a function of the line timebase frequency, and that with a fixed frame or field frequency of 50c/s a line timebase frequency of 10,125c/s is required for 405 lines and 15,625c/s for 625 lines.

Horizontal Definition

Before we can understand this, we shall have to get some idea as to how a picture is actually built up on the raster. When the scanning spot on the screen of the receiver starts its journey from the top left-hand corner of the screen to trace out first one frame and then the next in the way already described, so a similar spot on the screen of the camera tube does likewise.

Indeed, the two spots are held in perfect synchronism throughout the whole transmission; this is, provided the vertical and horizontal hold controls of the receiver are adjusted correctly.

This is accomplished by synchronising pulses which are geared to the camera tube scanning spot being sent out by the transmitter along with the picture signals. The receiver "sees" these pulses as electrical signals at the frame and line timebases and, in effect, they initiate the scanning stroke of each timebase. Thus, there occurs a line sync pulse at the finish of each line and a frame pulse at the finish of each frame. In that way, therefore, the scanning spot on the receiver screen is forever in the same position as the scanning spot on the camera tube screen.

Scanning Spot

The scanning spot at the receiver is produced by a very fine beam of electrons generated by the "electron gun" in the picture tube. The beam is brought to a very sharp focus at the inside of the screen either by a permanent magnet round the neck of the tube (e.g., focusing magnet) or by electrostatic focusing electrodes within the tube proper.

The inside of the screen is coated with a special fluorescent material which glows brightly when bombarded by electrons. Thus, a scanning spot is produced. This is deflected both vertically and horizontally by two electromagnetic fields applied at the tube neck. The vertical field is produced by the "frame scanning coils" and the horizontal field by the "line scanning coils", and these coils are energised by the frame and line timebases respectively.

The beam, being a movement of electrons, is rather the same as a flow of electric current in a conductor, and is thus influenced by a magnetic

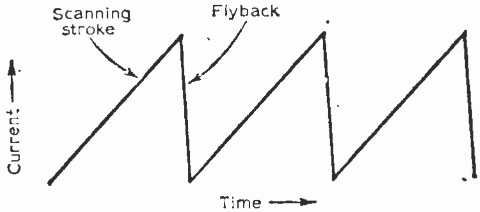


Fig. 11 (above)—A sawtooth current passes through the line and frame scanning coils to deflect the spot across the screen. During the scanning stroke the spot is deflected linearly during which time the picture is reproduced by changes in brightness of the spot. At the finish of the scanning stroke, the waveform causes the spot to "flyback" to start a subsequent scan.

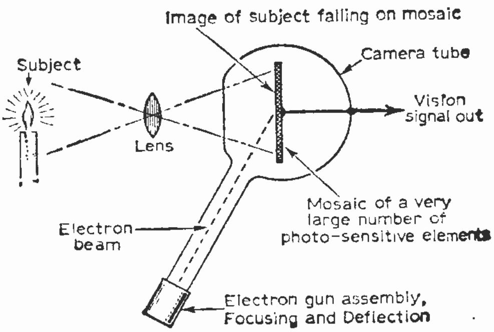


Fig. 12 (right)—The basic parts of a television camera tube.

field so as to be deflected which, of course, gives the spot deflection. The same thing happens in electric motors and moving-coil instruments. Here we have a magnetic field and a flow of current through the windings of the coil, thereby causing the coil to move or deflect.

The timebases cause a sawtooth change of current in the scanning coils, as shown in Fig. 11. During the scanning stroke the current in the coils rises linearly with time and causes the spot to move from left to right across the screen (line) and from the top to the bottom of the screen (frame). At the end of the scanning stroke the current swiftly falls to zero again and causes the spot to revert to its starting point, which gives the flyback.

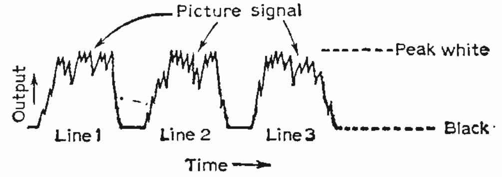


Fig. 13 (right)—Showing how the vision signal may appear over three lines.

More or less the same things happen at the camera, but instead of the electron beam causing illumination on a fluorescent screen, the beam impinges upon a "mosaic" consisting of a very large number of minute photo-sensitive elements. This part of the camera tube is rather like the

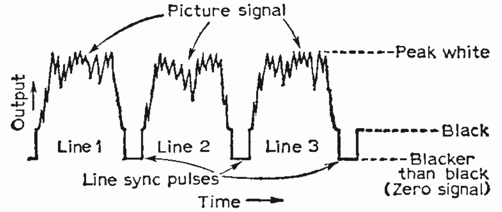


Fig. 14 (right)—Sync pulses are added to the picture signal at the end of each line, as this diagram shows.

retina of the eye, for upon it is focused the image of the subject to be televised (Fig. 12).

Each photo-sensitive element on the mosaic acquires an electric charge of a value depending upon the intensity of the light of that part of the image falling upon it. Thus, over the entire mosaic is produced a pattern of electric charge matching the lights and shades of the image. In that way, the image is converted into an electrical equivalent, but in this form it is no good for television as the total charge simply represents the average brightness of the image.

This is where the electron beam comes in. This, as we have already seen, is deflected in exactly the same way as the beam in the picture tube and the deflections are synchronised. As the beam scans the mosaic so it discharges each photo-sensitive element in turn and the discharge current flows from the output of the camera tube. In this way, then, the image is broken down into elements, and the output consists of pulses which correspond to the light and shade values of the image.

For example, when the beam passes a photo-sensitive element which corresponds to a bright part of the picture, then the pulse is stronger than that which is produced when the beam passes a photo-sensitive element which corresponds to a dull part of the image or picture.

In Fig. 13 is shown the output from the camera tube which occur over three scanning lines. This output is known as the picture signal or "video", and is processed and amplified so that the zero-signal datum corresponds to black and the full signal amplitude corresponds to peak white (that is, in the 405-line system). The intermediate amplitudes, of course, correspond to various degrees of grey.

Sync Pulses

It will be recalled that the beam in the picture tube is synchronised to the beam in the camera tube by sync pulses at the finish of each line scan. The line sync pulses, therefore, are added to the picture signal at the transmitter.

This is done by causing the signal to drop about 30% below the black level at the end of each line scan, as shown in Fig. 14. The regions below the black level are called "blacker than black" and the base line of the sync pulses correspond to zero modulation, bearing in mind that this composite signal is modulated on the vision carrier wave.

Thus, black corresponds to 30% modulation and peak white to 100% modulation. This is on the 405-line system. On the 625-line CCIR system, which we are changing to, the reverse is true. That is, the sync pulses correspond to 100% modulation and the peak white signal to zero modulation.

When all the lines of one frame have been traced out, a series of slightly longer duration sync pulses is produced for frame synchronisation. But just before this takes place several lines carry no vision signal, which is the reason why the full number of lines is never used (Fig. 15).

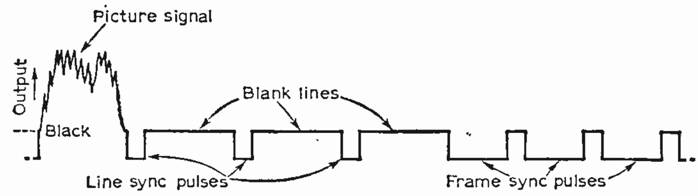


Fig. 15—At the finish of the lines of each frame a number of lines appear without vision signal, and these are followed by a series of frame sync pulses.

How the Picture is Built

To understand this we must now go back to the receiver. The vision modulation signal is extracted from the carrier wave by the vision detector, at the output of which occurs a signal like that in Fig. 14. This is amplified by the "video amplifier" stage and fed to the picture tube in such a way that it modulates the electron beam.

A picture tube in some respects is rather like an ordinary thermionic valve. It has a control grid just like a valve, and when this is fed with a negative bias the density of the electron beam is decreased. If there is sufficient negative bias, then the electron beam is cut off altogether. This means that the scanning spot can be reduced progressively from its normally very bright value to complete cut-off by turning up the negative bias on the tube grid.

Its brightness can, in fact, be adjusted, and one way that this can be accomplished is by adjusting the brightness control, since the brightness control is nothing more than a bias control. This is normally adjusted so that when there is no vision signal (e.g., with the aerial removed) the screen is just on the threshold of illumination—this corresponding to the black level of the picture signal.

Now, the vision signal from the output of the video amplifier is also fed to the tube as a counteracting bias, and as the signal rises from black level towards peak white so the scanning spot brightens up and corresponds to the brightness value of that of the image which at that instant is being scanned by the electron beam in the camera tube.

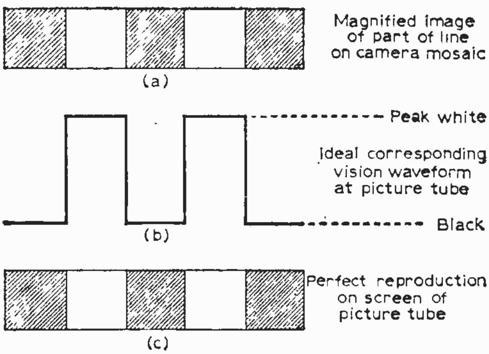


Fig. 16—Showing the ideal—though impossible—reconstruction of the image at the camera at the screen of the picture tube.

In that way the picture is recomposed on the picture tube screen, with the scanning spot of the picture tube changing brightness as it scans the fluorescent screen to correspond with the brightness value of the image on the mosaic of the camera tube.

Horizontal Definition

We have now got back almost to where we started from, and should now be able to understand the factors governing the horizontal definition of the picture. Let us consider the scanning spot on the picture tube tracing out one line of pictures. As the spot moves very fast from left to right across the screen, so its intensity changes, as already described.

If the image has an absolute change from, say, black to white along the line which is being scanned, then in order to reproduce this 100% it is required for the brightness of the picture tube scanning spot to change from zero illumination to peak white instantaneously. A brightness change in zero time is, of course, impossible, as it takes time for the various circuits between the camera tube and the picture tube to respond.

What happens, then, is the spot changes from black to white in finite time (although in practice this is remarkably small), and since the spot is moving rapidly across the screen, the effect on the picture is not a clear-cut transition from black to white, but a progressive change as the spot gradually brightens. This gives a slight smearing effect at the vertical edges of the picture where there is a distinct change in brightness.

Thus, the horizontal definition of the picture is related directly to the speed at which the scanning spot can change brightness. The faster it can

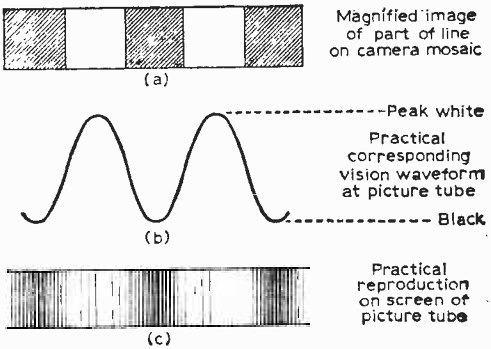


Fig. 17—Owing to the finite time taken for the brightness of the scanning spot to change, this diagram shows the practical reconstruction of the image at the picture tube.

change, the better will be the resolution of, say, a thin vertical line on a white or black background, depending upon whetther the vertical line is black or white.

The effect is illustrated diagramatically in Fig. 16. At (a) is shown a highly magnified part of a scanning line which would represent the image of a subject consisting of alternate black and white squares. At (b) is shown the ideal vision signal waveform which would be created by such a subject, and at (c) the reproduction on the screen of the picture tube. This would also be a perfect replica of the original, since the vision waveform assumes that there are instantaneous changes from black to white and from white to black. But this is the impossible.

The practical situation is given in Fig. 17. Here we have the same pattern, but the resulting waveform, instead of having perfectly vertical edges and flat tops and bottoms, is rather like a sine wave. This reveals that time is necessary for the waveform change from black to white, and vice versa.

Due to this, the reproduction of the picture tube screen is somewhat poorly defined owing to the finite time taken for the scanning spot to change brightness.

The narrower the vertical black or white element

(Continued on page 117)

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 84: ULTRA V17-70 Series

THE models covered are V17-70, V17-71. VP17-72, VR17-71, 17-73 with f.m. radio and the 21in. versions, e.g. 2171 etc.

The diagrams presented are of the models with f.m. radio and where radio is not fitted the switching S1-S2 etc. is omitted. The 17in. models use a CME 1703 110deg. deflection electrostatically focused tube whilst a CME 2101 is fitted in the 21in. versions.

The separate f.m. unit functions as an i.f. amplifier operating at 10·7Mc/s with ratio detector. The heater supply for the three valves of this unit is taken from the main h.t. line via a suitable dropping resistor.

As the timebases are switched out on f.m. the h.t. supply is not called upon to supply extra current for these heaters, the 100mA representing less loading than the normal timebase current. Therefore the h.t. is slightly higher on f.m. than on TV although there is only a difference of about 3V.

The heater circuit is also modified as far as the main chain is concerned since in the f.m. position the CRT heater (V12) is shorted to chassis by S4 and the 30PH (V7) is open circuited by S3, a 125Ω resistor being brought into the circuit to compensate for the two heaters.

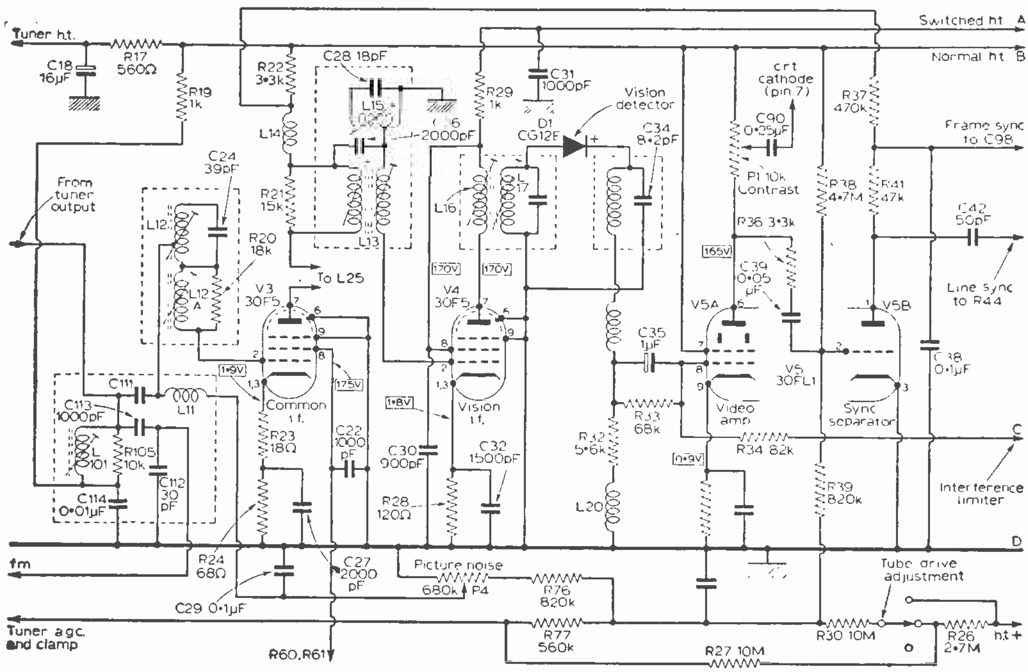


Fig. 1—The vision signal stages of the V17-70.

No F.M.

This point is mentioned since our query service is often asked why all valves should go out except the f.m. valves when switched to f.m. and no f.m. signals are received. This happens when R121 (125Ω) becomes open-circuited. As the f.m. *i.f. and detector* valves are fed from the h.t. line these continue to function but as the main chain are out, the tuner and audio stages cannot function.

It also sometimes happens that although the main chain remains alight the f.m. unit heaters do not function when the switch is in the f.m. position. This indicates that one of the unit valves has an o/c heater or that R120 (1,530Ω) is open.

No TV

If the f.m. side functions but all main chain heaters go out when switched to TV the unfortunate indication is either V7 (30P4) heater is o/c or the tube heater. The tube heater is quite easily checked by shorting pins 1 and 8. If the valves all light up, all that is required then is a new tube!

Common Faults

Probably the most frequently met fault condition which does not stop the receiver operating is bottom compression. While this could (and often does) indicate a failing 30PL13 (V13) valve, the most frequent offender is C93 (100μF) which becomes open-circuited.

It is as well when checking this to also check R97 (270Ω) which sometimes changes in value. Attention to the valve, capacitor and resistor will nearly always clear a bottom compression fault.

White Horizontal Line

This denotes that the frame timebase is totally inoperative and a voltage check at P9 (Height) will often show an absence of voltage at this point (270V is normal). This is nearly always due to C40 (0·5μF) shorting to chassis.

While this also cuts off the supply to the tube first anode and focus the concentration of beam current into a single line is sufficient to show this on the tube face when the brilliance is advanced.

Lack of Height

If an equal gap is shown top and bottom when the height control is fully extended note the effect of disconnecting the *live* (270V) end of the *focus* control. The 2·2MΩ element sometimes changes value down to a figure which drops the voltage available at the height control.

If full height is restored by disconnecting P5, leave this disconnected until a new element is

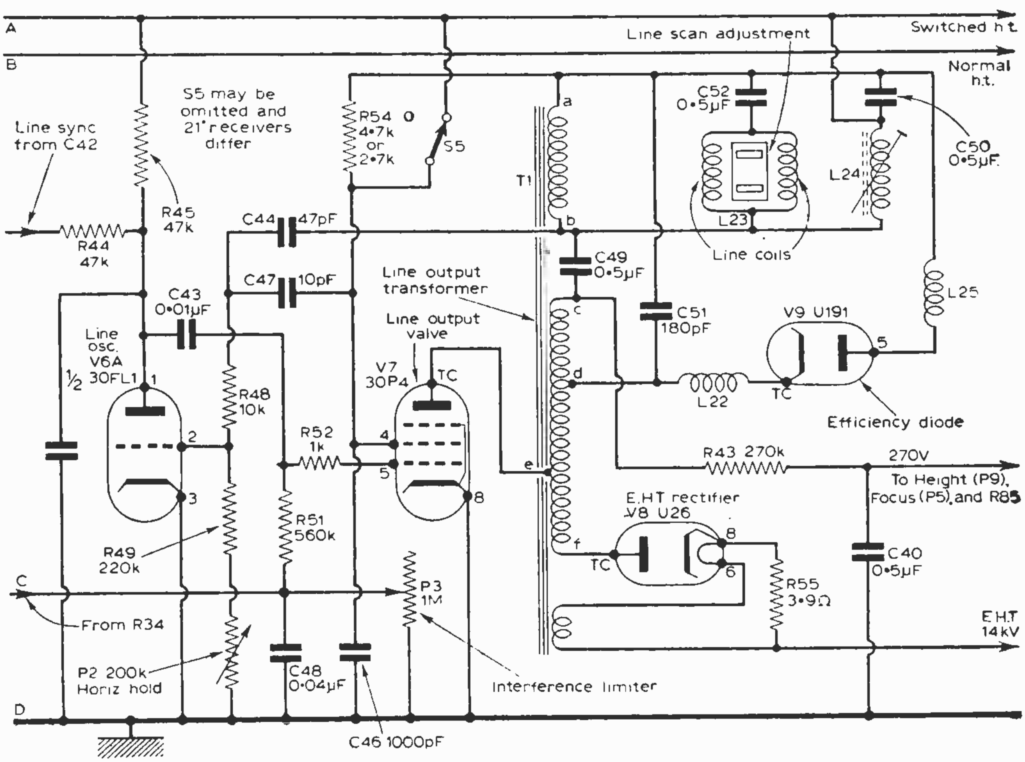


Fig. 2—The line timebase circuitry of the V17-70.

available and operate with pin 4 of the c.r.t. base connected to 3, 2 or 7 whichever gives the best focus.

If there is little or no improvement in height when the focus control is checked, attention should be directed to R87 (270kΩ) which may have gone high.

Excessive Height with Shaded Raster

Check C92 (0·001μF) which may be leaky or s/c. This should not be confused with varying height and focus when the brilliance is operated or on changing scenes. This is normally due to a low emission U26 e.h.t. rectifier unless accompanied by lack of width which should direct attention to V7 (30P4) V9 (U181) and V6 (30FL1) in that order. Check R54 if necessary.

No Picture, No EHT

Check the above three valves and then check C49 (0·5μF) which appears to become o/c quite frequently. If the line timebase is obviously working and the presence of high voltage is obvious at the U26 top cap, it is likely that this valve is at fault with an o/c heater. C51 often shorts resulting in complete loss of e.h.t. (140pF or 180pF 12kV).

Lack of Contrast

When the picture resolved is pale and lacking in "attack" although the contrast (P1) and picture noise (P4) controls are set to maximum the trouble is usually to be found in the vision detector or video amplifier stages. The 30FL1 (V5) should be checked first.

If this is not at fault check C35 (1μF) and the crystal diode detector D1 (CG12E). The setting of the interference limiter control should also be checked since this controls the bias applied to the video amplifier control grid. Check capacity of C90 if necessary.

Tube Drive Adjustment

This is actually a pre-set a.g.c. control and should not be altered unless peak whites are being clipped with the limiter in the minimum position. It is normally set with R30 connected to the junction of R26, R27. When the input signal is strong enough to cause overloading R30 should be disconnected (*minimum position).*

Picture Noise

P4 also controls the a.g.c. voltage but whereas the tube drive adjustment cancels the negative control voltage by applying a small positive potential the noise control varies the a.g.c. applied to V3. It should be set for the best possible picture consistent with absence of vision on sound or sound on vision on the stronger signal. If P4 has no effect check the a.g.c. components for short, particularly C37, V1 and V3.

Loss of Gain

When the stronger signal presents a fairly good picture but the weaker one (usually Band III)

(Continued on page 117)

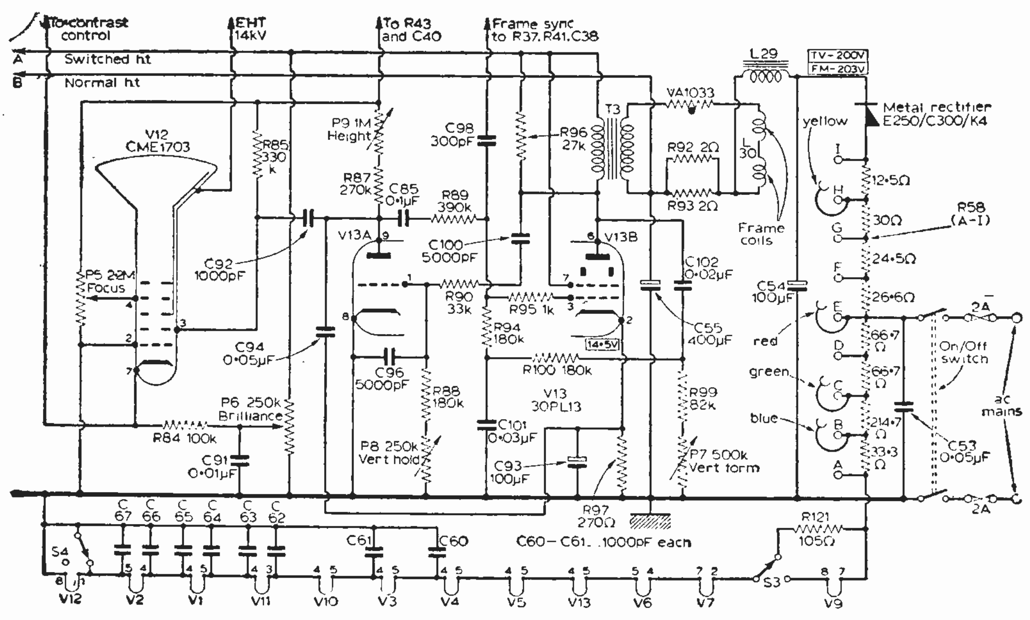


Fig. 3—The frame timebase, c.r.t. and mains input sections of the V17-70.

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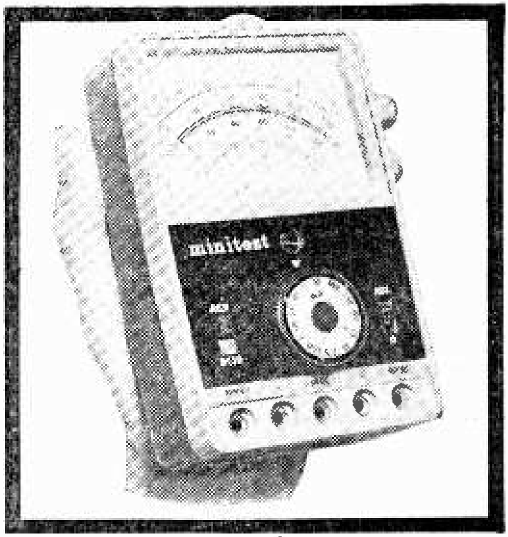

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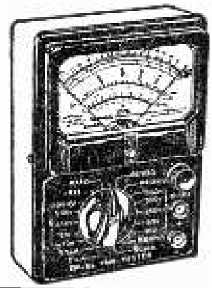
One of the easiest ways to learn anything, is to "tape" it and then keep playing it back. Try this new learning technique—you will be amazed. The industrious Japanese have really gone to town on tape recorders this year and many bargains are on offer. It is the writer's opinion that there is bound to be a big demand for them as Christmas presents so there is a good reason why you should buy your tape recorder immediately. Prices range as follows:

Child's Model	£4.19.6	Assemble yourself Model	£6.19.6
Model No. Hil-3	£7.15.0	The "Pocket Secretary"	£14.14.0

The first two are not really good enough for music but they are quite good for speech. The last two are reasonable also for music. All have a value out of all proportion to their cost.



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MODEL TP5S. (Illus. on left). 20,000 ohms per volt. D.C. volts. 5 ranges up to 1,000 A.C. volts. 5 ranges up to 1,000 resistance. 2 ranges up to 10 meg., capacity 2 ranges up to 0.1 decibels —20 to +26. One switch control really beautifully made precision instrument, size only 3¾ x 5¼ x 1⅛in., price only **£5.19.6.** Post free.
MODEL TP10. Similar in size and appearance to TP5S, but sensitivity 2,000 ohms per volt, price **£3.19.6.** Post free.
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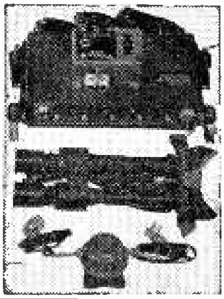

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SERVICING TELEVISION RECEIVERS

(Continued from page 114)

presents a grainy ragged picture, the 30L1 (PCC84) should be checked by replacement. We are often asked what happens when the tuner valves have accidentally been transposed, resulting in a trace of smoke indicating a damaged component before the mistake is realised.

When the valves are returned to their correct positions there is either no signal at all or severe loss of gain may be experienced. It is the resistor (usually 100Ω) between pins 7 and 8 and chassis in the tuner which suffers and quite often changes value. It will often keep its value for some time after the accidental transposition but breakdown at a later date, so that close examination if not immediate replacement is always advisable.

Raster Present, No Picture, Sound in Order

Check anode voltage of V5A (30FL1), which should be about 165V. If absent check P1 contrast control. If correct check L18, L19, D1 and V4. If very low when signal is applied but returns to normal when aerial is removed check C30 and C31.

If one of these decoupling capacitors is open-circuited the resultant oscillation renders the vision amplification stages inoperative. Check the V4 base voltages.

In some cases C30 may short to chassis resulting in the total absence of voltage at pins 7 and 8 and R29 will be found damaged by the heavy flow of current.

(To be continued)

PRINCIPLES AND PRACTICE

(Continued from page 111)

of the picture, the more noticeable will be the impairment of definition. And a very narrow, hair-like line may not be resolved at all. A fairly wide black or white vertical picture element, on the other hand, will come out very well, since the brightness changes are related only to the edges of such an element, and the eye will be taken from these since the element as a whole is very large.

Bandwidth

The speed of which the brightness of the scanning spot can change is related to the bandwidth of the vision channel. If the bandwidth is narrow, say, only 1Mc/s, then picture elements in which there are very little brightness changes will be resolved fairly well, though rather hazy, while narrow picture elements over which there are substantial brightness changes will not be resolved at all.

To a certain limit, the wider the bandwidth the more closely will the practical waveform of Fig. 17b approach the ideal waveform of Fig. 16b. In the 405-line system, the overall vision channel bandwidth is of the order of 2·7Mc/s, and this, on a correctly aligned receiver, should permit the resolution of the 3Mc/s vertical definition bars on Test Card C. On most sets the resolution will not be perfect, and the lower frequency bars will be resolved much better, but they should be visible when the set is correctly adjusted.

625 Lines

Let us now suppose that 2·7Mc/s bandwidth is retained on the 625-line system. Here we have the scanning spot scanning a line faster than that on a 405-line system (it will be recalled that the line speed is 15,625c/s on a 625-line system and 10,125c/s on a 405-line system). This means, then, that the change in brightness of the spot will occur over a greater distance of scan, and this in itself goes towards reducing the overall horizontal definition.

Clearly, then, the 625-line system must have a wider vision bandwidth than the 405-line system, not only to give *equal* definition, but also to improve it and make it *balance* the improved *vertical* definition given by the greater number of lines.

This is done by stepping up the vision channel bandwidth on 625 lines from about 2·7Mc/s to around 4·5 to 5Mc/s. Thus, we have now discovered that a dual-standard receiver, in addition to having some means of changing the line timebase frequency, must feature a switching arrangement to increase the vision bandwidth on 625 lines. This, of course, reflects into the channel width of the new 625-line u.h.f. stations—a subject which will be dealt with next month.

(To be continued)

UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

BY ICONOS

EVER since the early days of television studios at the Alexandra Palace, the production side has borrowed certain ideas, techniques and equipment from the theatrical stages, from recording studios and from films. Lately, this traffic has been in the reverse direction. The ambitious and spectacular musical play, "Blitz", at the Adelphi Theatre is a case in point. Radio and television techniques for lighting, special effects and stage management has been utilised in this new musical opus by Lionel Bart. A 152-way Strand Electric TV type lighting control panel has been fitted with additional patching for the remote control of an extra 80 light sources. These include most types of lamp used in television studios, plus two 4kW special effects scenic projectors, which give amazing flame effects for the fire scenes. The dimmer control bank is of the electro-mechanical type used at most TV Studios.

Complete cueing control is maintained with radio telephones between a stage director and various technicians stationed around (or within!) the elaborate mobile scenery, which is self-propelled. Sound reinforcement in the auditorium makes use of stereophonic reproduction from time to time, both for voices and for sound effects. Thus, all the most modern methods in use by television companies have been harnessed to handle spectacular scenes of a magnitude only previously attempted (in a more primitive manner) at the Theatre Royal, Drury Lane. The result is most startling and effective.

"Live" TV Exports

Britain is the home of live television, which, as I have said before, includes all shows which are recorded on magnetic videotape or film, from TV cameras. "The Black and White Minstrel Show" comes into this class, and is usually produced on Stage 3 at the BBC Television Centre, White City. This glossy prize-winning show grows from strength to strength and is exported on tape or film to all parts of the world, bringing in dollars, francs, marks and what-have-you. Producer George Inns sets a wonderful pace in this spectacular, which specialises in new camera angles, zooms and special effects. Star names sparkle as guest artists and the staging and costuming reaches the highest possible standard. The only drawback is the fact that it *is* so black-and-white.

Disillusionment

On some badly adjusted receivers, this becomes a little hard on the eyes, especially when the screen is full of fast moving figures. But the show now has a world reputation, so it is too late to change them into grey-and-white minstrels, even if they did recently run out of their supply of black greasepaint when on a tour in the North of England! This surprised me. I always thought that the traditional method of "blacking up" minstrels was with burnt cork!

Cinema Commercials

I've been going to the cinema again, partly to keep my eye in trim for colour television. I have thoroughly enjoyed the programmes, even the lengthy interlude of coloured advertising films and trailers. But I was astonished at the running time taken up by these commercials. First, there were films reminding the audience that it was ice cream-and-lemonade time; then there were a number of short local commercials, followed by two longer films boosting national products—a brand of cigarettes and a shampoo. Next came trailers of future programmes (with extra loud sound and poor photographic qualities!) ending with a final frenzied appeal on behalf of the ice cream sales-ladies, who were "spotted" with the limelight. The total "commercial" time was about 18 minutes plus about five minutes in which to buy and consume the oleaginous but not unpleasant frozen concoction which is called ice cream. My timings of "commercial breaks" at several cinemas have varied from 15 to 22 minutes, not counting the "sales interval." Not bad, taking up nearly half-an-hour in a three hour programme and being paid for it by the audience! The ITA allows a maximum of six minutes of commercials per hour and viewers get the ITV programmes "free." But I don't think the cinema people would welcome the suggestion of letting the audience in free as a quid pro quo for looking at a double-ration of commercials!

Programme Interchange

Exchange of tapes and films between British and American television companies, and joint co-operative production of television productions to be shared are now becoming more common. Both ITV and BBC have arrangements of various kinds with American networks but the difference in line standards puts a limitation on the use of tape.

Some British companies have already used 525- or 625-line tapes for recording programmes for American or Continental consumption, with transfer to 405-line tapes for the British television networks. Results of this transfer have not always been good.

★ REPAIRING O/C C.R.T. HEATERS

DAMAGED PICTURE TUBE HEATERS MAY SOMETIMES BE WELDED TOGETHER

by F. P. ROZEE

To find that the heater of a cathode ray tube is open-circuit is often considered to be absolutely final. This, however, is not always so. A permanent repair is sometimes possible, and can be accomplished in just a few minutes.

Welding the ends of the open-circuit heater is obviously the only solution, so that what is required is a voltage of sufficient amplitude to bridge the space between the ends of the break in the heater. Also there must be sufficient current available to effect a weld, and the regulation of the supply must be rather poor in order to obviate the possibility of a further fusing on completion of the weld.

These requirements exist in the television set itself, the source of this supply being the cathode of the booster diode. There is a pulse of some 3,000 to 4,000V at this point. Tapping the supply is usually easy as modern booster diodes have a top cap cathode. With some older valves the cathode is brought out at one of the base pins and where this type of valve is used, connection will have to be made under the base at the appropriate pin.

There are other points in a set where it may be thought that a suitable supply exists, one being on the line deflection coils and another at the anode of the line output valve. These points are, however, unsuitable as there is a risk of burning out the line output transformer on completion of the weld.

Preparations

Check first to make sure that the open-circuit is not at the point of soldering the lead out wires from the tube to the base pins, nor caused by poor contact between the pins and the holder. When it has been definitely determined that the o/c is in the heater itself, proceed as follows.

Make certain that the set is switched off. Remove the holder from the base of the tube and short the heater contacts on the base connector together to give continuity of heaters through the set (this is, of course, not necessary with parallel heater sets). Clip a jumper lead between one of the heater pins on the tube base and the chassis making certain that the clip at the tube end is clear of other electrode pins.

Take a short piece of e.h.t. lead or other well insulated wire, strip the insulation back sufficiently to wind and twist up round the shank of a high voltage insulated screwdriver. This will serve as an insulated prod, the other end of the wire being stripped back and connected to the cathode of the booster diode, either by placing it under the top cap clip or soldering it to the cathode pin at the base, depending on the type of valve. Preparations are now completed and the weld can be made.

Making the Weld

Switch on the set and hold the screwdriver prod clear of the chassis, when the line output circuit is well and truly functioning, touch the prod against the *free* pin of the tube heaters, ensuring that no other electrode pins are touched when doing this.

An arcing will be seen inside the tube neck and this will continue for a second or so then cease. Remove the prod immediately. The weld should now be completed.

If the arcing continues and a weld is not made, it is possible that either the heater wire is brittle and has shattered, or that its fusing was caused by a great excess of current and the gap in the wire is too wide to be bridged.

The writer has had some measure of success. One repaired heater has been working for well over a year and another worked for about three months before going heater to cathode s/c. A third refused to weld.

A check was made with each of the above sets, as it should be, to see if there was a reason for the heater failure. With the first two sets everything was in order, but with the third it was found that an h.t. decoupling capacitor had been cut into by a valve heater tag. This had passed h.t. through the lower part of the heater chain and had no doubt blown a sizeable piece out of the tube heater.

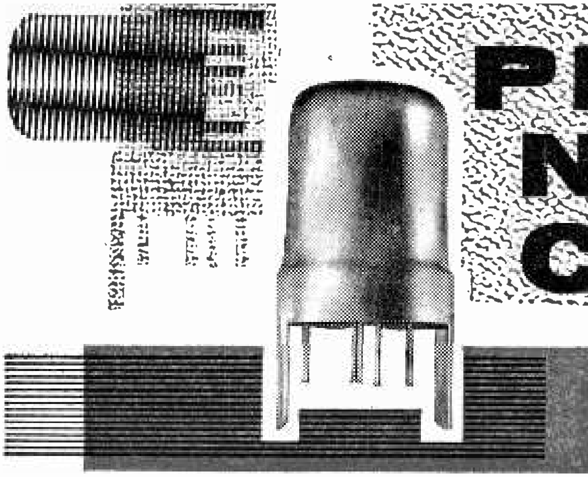
Based on the above experiences, it would seem that there is probably a 50/50 chance of a successful repair, but as the tube is useless there is everything to be gained by attempting to save this very costly component.

Precautions

The reader is advised to take more than ordinary care when handling the wire connected to the booster diode.

Owing to the high voltage present and the availability of current in this highly inductive circuit, a very severe shock will result from any contact.

When connecting the set to the mains, make absolutely certain that the chassis is connected to the neutral pole. ■



PRACTIC NUVIST CIRCUI

By K. Royal

RIGHT from the beginning it has been the aim of electronic engineers to create equipment for the amplification of very weak radio signals which itself does not add spurious noise signals to the radio signals. The maximum usable sensitivity of any radio or television amplifier is governed directly by the amount of noise signal that the process of initial amplification produces.

Very high gain amplifiers are relatively easy to make, but these are of very little use if the signal to be amplified is so weak that the noise generated masks the amplified signal.

It has been intimated in past articles dealing with noise that a "snow" free television picture is only possible when the noise contributed by the initial amplification is at least 200 times (46dB) down on the required signal. This makes it clear that the weaker the signal to be amplified, the better must be the noise performance of the amplifier itself to maintain that 200-to-1 ratio.

Even the very best of amplifiers produce some noise signal, but modern techniques have greatly reduced the noise content. For example, the first amplifier on the *Telstar* receiver has a very low noise factor indeed, this being essential because of the incredibly weak signals picked up on the aerials from the satellite relay station.

Noise is generated not only in the amplifier but also in the aerial, and then, of course, there are those noises attributable to general static and space signals from stars and so on. Excluding the first amplifiers in the receiver, therefore, some noise will always be present resulting from the mode of radio propagation as we know it at present.

Nevertheless, under practical conditions, the majority of the noise is produced in the first amplifier, for after that the signal is usually strong enough to outweigh the noise contribution of subsequent stages.

Much work has been undertaken to enhance the noise performance of low-level amplifiers, and in one sphere the transistor is being found to be of considerable help, because here there is virtually no "thermal" noise resulting from the emission of electrons from a hot cathode to a positively charged anode.

There is already available a v.h.f. transistor preamplifier whose noise performance of some 3dB better than that of a valve counterpart, and this is designed for the radio and television v.h.f. bands.

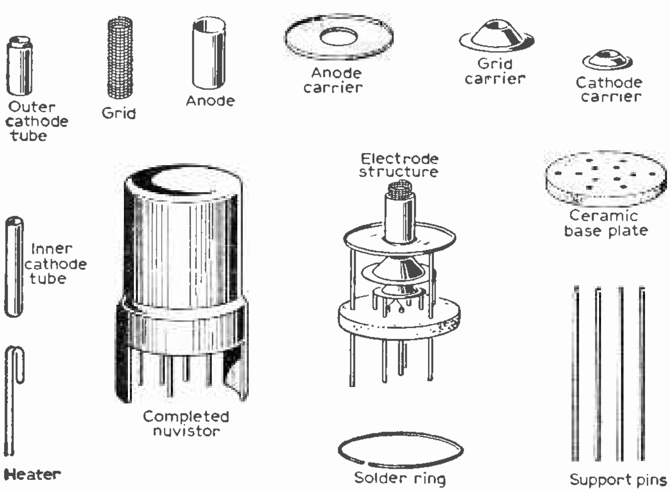
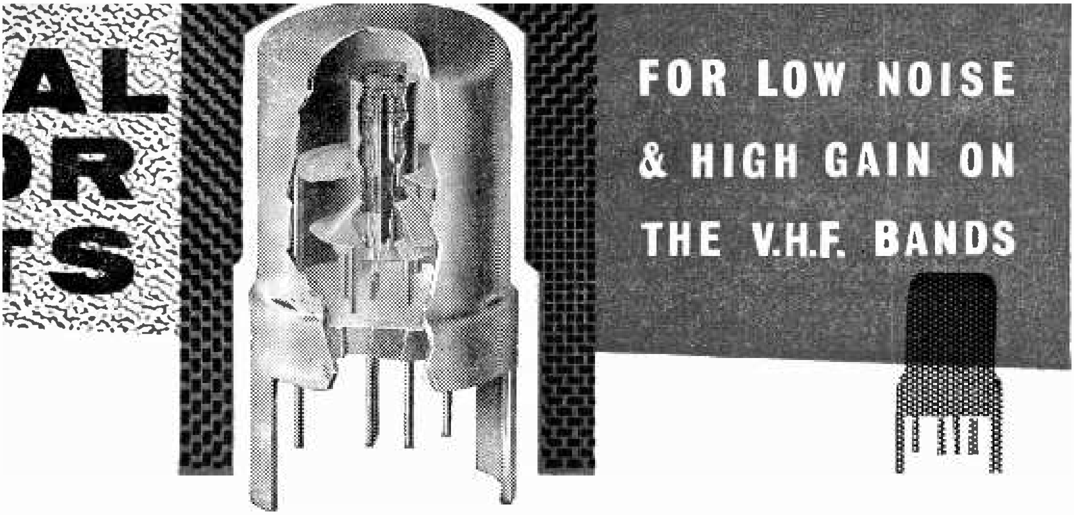


Fig. 1—The component parts used in the Mullard Nuvistor Triode.

THE NUVISTOR

Competition to the transistor in this respect has been offered by the fairly recent Nuvistor. This is either a triode or tetrode valve of special design, which in the past was of American origin, under the designation 6CW4. Of recent months, however, a Mullard counterpart has been evolved under three main versions. The 7586 which is a medium-μ triode, the 7895 which is a high-μ triode and the 7587 which is a sharp cut-off tetrode.

Although Nuvistors are really designed for professional and



industrial applications, they may, nevertheless, prove of interest to the experimenter. Indeed, one excellent design for a Nuvistor Band III Amplifier has already been published in these pages (*A Nuvistor Band III Pre-Amp*, PRACTICAL TELEVISION, June 1961, p.156). This employs the American 6CW4, but there is no reason at all why the Mullard high-μ version could not be used instead.

WHAT IS A NUVISTOR?

The type of electrode structure employed in the Mullard series of Nuvistor valves is based on a concentric arrangement of cylindrical electrodes.

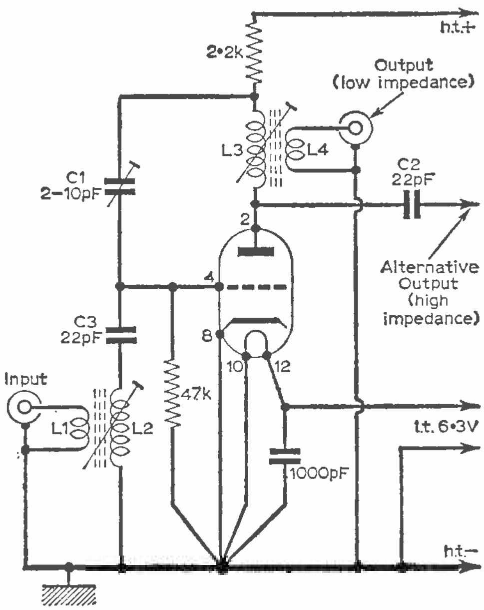


Fig. 2—The circuit of a v.h.f. amplifier using a Nuvistor triode. This is arranged in the earthed-cathode mode with grid-leak bias and capacitive neutralisation. Note the common earthing point on the chassis.

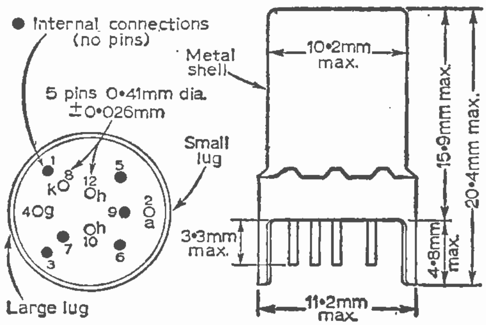


Fig. 3—The basing and dimensions of the Mullard Nuvistor Triode.

These are supported by three pins which project through a ceramic base plate (see Fig. 1). The valve is finally encased in a metal shell which needs to be adequately bonded to the chassis of the amplifier for optimum stability.

Although pins are available for earthing the metal shell it is rather important that something better in the way of earthing is produced by means of the earthing lugs on the metal shell. During the course of experimenting with the American version, it was found on several occasions that instability tendencies resulted from poor r.f. earthing of the shell, even though the earthing pins were in excellent d.c. contact with the chassis.

CHARACTERISTICS

The characteristics of the Type 7895 Nuvistor are given in Table 1. This shows the very low internal capacitances and the high slope (9·4mA/V) which is attainable under the operating conditions specified.

The characteristic range values for equipment design are given in Table 2. The valves can be

continued over page

used with either grid-leak (e.g., grid current) biasing or conventional cathode biasing. The low internal capacitances coupled with the very small lead inductances permit the valves to be used in the earthed-cathode mode, with the input signal applied to the grid. Under this condition, however, neutralisation is necessary to secure optimum stability and noise factor.

BASIC CIRCUITS

In Fig. 2 is shown a basic amplifier circuit using grid-leak biasing and capacitive neutralisation. Here it will be seen that the cathode is strapped direct to chassis and that a resistor is used in the grid circuit. Owing to electrochemical activity between the cathode and grid, a small potential develops across the grid resistor, and it is this which is used to bias the valve.

This type of biasing usually permits a slightly greater gain to be obtained from an r.f. stage as compared with cathode biasing. The noise figure is also slightly better with grid-leak biasing in most cases, depending upon how well the unit is designed, neutralised and mechanically constructed.

Neutralisation is effected in Fig. 2 by the pre-set trimmer C1, and if the amplifier is to tune over a band of frequencies it is best to adjust for optimim neutralisation at the low-frequency end of the band. This does not apply, of course, to v.h.f. radio and television preamplifiers, for then it is the usual practice to adjust at the vision carrier frequency.

NEUTRALISATION ADJUSTMENT

Possibly the best way that the experimenter can adjust for optimum neutralisation is first to disconnect the l.t. feed to the valve, then apply a very strong signal at the required frequency and finally adjust the neutralising trimmer for minimum output.

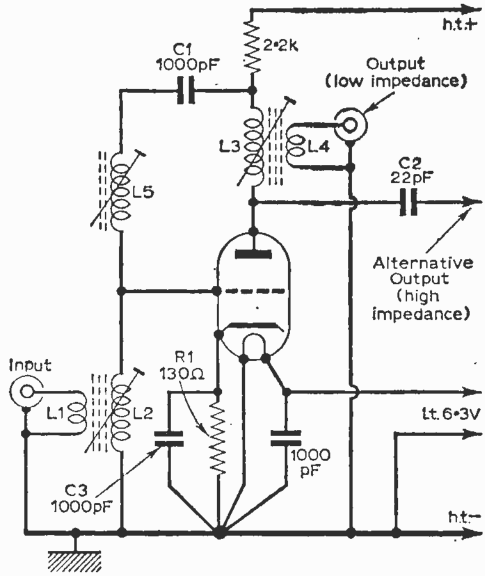


Fig. 4—A Nuvistor circuit using cathode bias and inductive neutralising.

This is fairly easy to undertake when the stage takes the form of a preamplifier in front of a television receiver. The applied signal can either be on the sound or vision carrier frequency. If the former, the receiver's volume control should be set at maximum and sufficient input signal applied at the aerial terminal of the preamplifier to be heard adequately in the speaker (the signal modulated, of course).

(Continued on page 139)

Left, TABLE 1—Below, TABLE 2

Heater voltage	6·3V
Heater current	0·135A
Grid-to-anode capacitance	0·9pF
Input capacitance (grid-to-cathode)	4·5pF
Output capacitance (anode-to-cathode)	1·7pF
Anode-to-cathode capacitance (excluding shell capacitance)	0·22pF
Heater-to-cathode capacitance	1·3pF
Anode voltage	110V
Anode current	7mA
Grid voltage	−1·1V
gm (mutual conductance)	9·4mA/V
mu (amplification factor)	64
ra (anode resistance) ...	6·8kΩ
Grid voltage for 10μA of anode current	4V

The Characteristics of the Mullard Type 7895 high-mu Nuvistor Triode.

	Min.	*Typical*	*Max.*
Anode current with 110 volts of anode voltage and −1·1-volt grid bias ...	5·5mA	7·0mA	8·8mA
Amplification factor with 110 volts of anode voltage and −1·1-volt grid bias ...	54	64	74
Mutual conductance with 110 volts of anode voltage and −1·1-volt grid bias ...	7·9mA/V	9·4mA/V	10·9mA/V
Input capacitance	3·4pF	4·2pF	5·0pF
Output capacitance ...	1·3pF	1·7pF	2·1pF
Anode-to-grid capacitance	0·8pF	0·9pF	1·0pF
Anode-to-cathode capacitance	0·16pF	0·22pF	0·28pF
Heater-to-cathode capacitance	1·0pF	1·3pF	1·6pF

Characteristic range values for the Mullard Nuvistor Type 7895 high-mu triode.

The Inter-carrier TV SOUND system

A DESCRIPTION OF THE SOUND SECTION OF CCIR, 625-LINE RECEIVERS, LIKELY TO BE INCORPORATED INTO FUTURE BRITISH SETS.

By M. L. Michaelis

THE CCIR 625-line television standard offers remarkable simplifications for the sound section of a receiver because almost the entire vision receiver, up to and including the video output stage, if necessary, may be included in the sound channel. The actual additional components, operative in the sound channel only, may comprise only a simple two-valve circuit in the cheaper receivers, yet still give excellent performance if properly adjusted.

A top-cut filter is thereafter inserted, passing on all below about 4·5Mc/s as vision modulation to the c.r.t., and a 5·5Mc/s tuned band-filter after the vision detector selects out the sound channel second i.f. ("difference frequency" or "d.f.").

If desired, the filters may be placed after the video amplifier, and not straight after the video detector, so that the video stage is also taken into the sound channel, functioning as first sound d.f. stage. This, however, aggravates problems of sound-in-picture and picture-in-sound (frame-pulse buzz).

A good quality CCIR standard receiver places video signal and d.f. signal separation filters immediately following the video detector and uses two

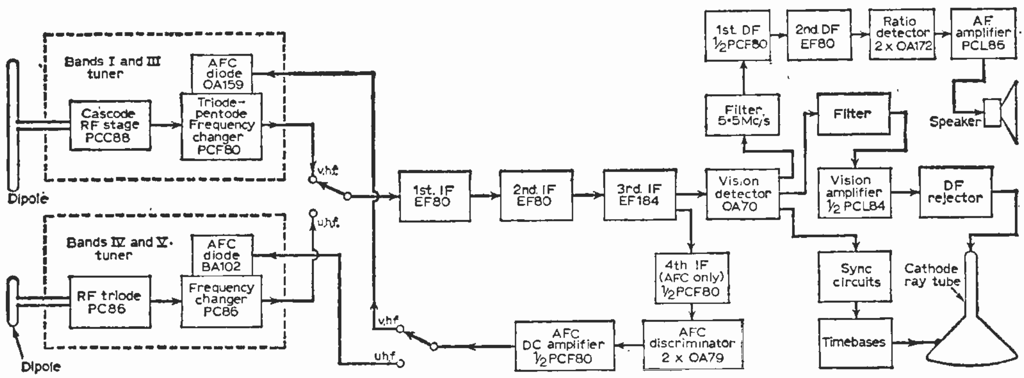


Fig. 1—Block layout of a typical Continental inter-carrier television receiver.

This type of sound channel system is known as the "inter-carrier" type, for reasons which will become clear later. In effect, it is a special type of double superhet using the vision signal carrier as the local oscillator for the second frequency changer, and the vision detector diode as the second mixer.

The entire r.f. section, first frequency changer (together comprising the tuner), the main i.f. amplifier, and the video detector are given sufficient bandwidth (about 6Mc/s for principally single sideband operation) to pass both the vision and the sound signals. All these stages are therefore common to vision and sound.

At the video detector, the video waveform is produced as usual, and also, at its upper frequency limit, the sound channel second i.f., which has a frequency of 5·5Mc/s carrier, obtained by beating sound and vision main i.f. carriers at the video detector.

stages of d.f. amplification followed by a ratio detector and good audio section. The quality of sound reception in modern European television receivers using this system, provided the receivers are properly aligned, is very good indeed.

Problems of the System

In an inter-carrier system, the vision signal is used as a second local oscillator for the sound signal, at the video detector. But the vision carrier is itself modulated with the video waveform, so that the d.f. produced will be modulated with both the vision and the sound signals simultaneously. The sound detector must be able to distinguish between these two modulations, which means that they must be fundamentally different.

It is therefore clear that the fundamental factor allowing the use of inter-carrier sound in CCIR standard receivers is the use of amplitude modula-

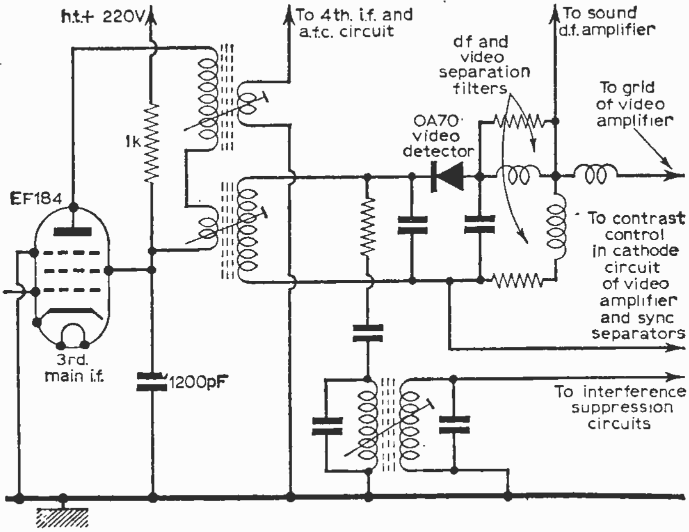


Fig. 2—Circuit of the sound d.f. ratio detector of a typical receiver. Note the provision of a loading balance preset control for optimum increase of tuned circuit damping with increasing amplitude, to give optimum a.m. rejection. The time constant on C1, as usual, also improves a.m. rejection at moderate and high frequencies.

tion of the vision carrier and frequency modulation on the sound carrier.

Where both carriers are amplitude modulated, as in the present BBC standard, the use of inter-carrier sound is impossible.

Signal Level

The level of the d.f. signal at the vision detector is reasonably high, so that, as far as pure gain requirements are concerned, a single d.f. stage of amplification would be ample. However, all good receivers use two stages of d.f. amplification, both of which are operated as limiter stages in the manner already familiar in v.h.f.-f.m. sound broadcast receivers.

This assures that the d.f. amplifier is strongly over driven, so that all traces of amplitude modulation, resulting from the vision signal, are destroyed in the d.f. chain. Only the frequency modulation component of the d.f. modulation remains, which is the pure sound signal.

A ratio detector is used as the sound demodulator, which is known to be inherently insensitive to amplitude modulation, on account of the long time constant on C1 (Fig. 2) and the detailed action of loading imposed on the tuned circuits dependent on input amplitude.

Naturally, proper alignment of the ratio detector tuned circuits, and optimum Q valves in relation to diode impedances and loads are required for optimum a.m. rejection in a ratio detector. The cheaper receivers rely on a well adjusted ratio detector after a single d.f. stage, and give quite reasonable sound, though this is usually noticeably mixed with a background of frame pulse buzz.

The frame pulses represent the principal modulation component of an average vision waveform, and their frequency, being low, is less effectively rejected by a ratio detector if present as a.m. in its input than higher frequencies, such as the line synchronisation, would be.

Modulation Character

CCIR picture modulation is negative, i.e. a dark scene represents high carrier amplitude, the frame and line synchronisation pulses full carrier amplitude, and a bright scene very low carrier amplitude. This is the exact opposite to the BBC standard.

It has the great advantage that ignition interference produces black spots instead of white ones, which are far less noticeable, and that the synchronisation pulses, representing 100% carrier amplitude, afford an easy reference voltage for automatic gain control for fringe area receivers.

The effect of negative picture modulation in the inter-carrier sound, in a cheap or poorly adjusted receiver, is as follows. If the televised picture is a dark scene, the vision carrier rests at a high

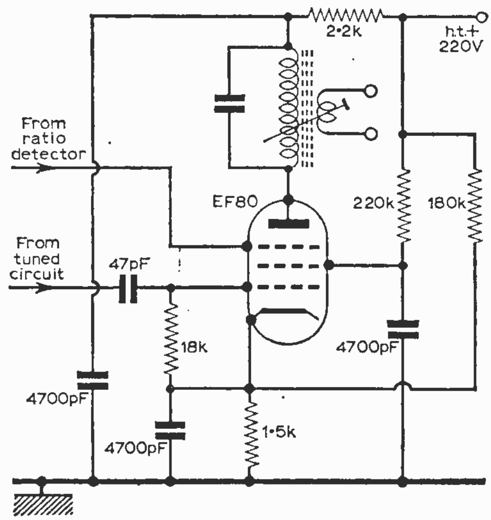


Fig. 3—Circuit of the second d.f. amplifier of a typical receiver. The standing screen voltage is only 40 and the anode voltage 200; under these conditions the valve "bottoms" relatively early. The stage then overloads at relatively small drive; i.e. it functions as a limiter.

means amplitude, broken by the then relatively small sync pulse excursions to full amplitude, whereas if the scene is bright, the vision carrier rests at a low mean amplitude, with huge sync pulse excursions to 100%.

In other words, the frame frequency modulation component in the sound d.f. after the video detector, is low for a dark picture and high for a bright picture. If the a.m. rejection is poor, the frame buzz on the sound comes up suddenly in intensity when there is a camera switch from a dark scene to a bright scene. This can be extremely irritating and noticeable, far more so than a steady buzz of even greater amplitude, to which the ear rapidly becomes accustomed.

Scene Change Buzz

This trouble is probably the most common simple fault of CCIR receivers using inter-carrier sound. Where it is not due to an inferior d.f. amplifier of a cheap receiver, it usually results from incorrect alignment of the d.f. amplifier and ratio detector, or low amplification (low emission) of a d.f. valve. It must be stressed that a good average receiver, properly aligned and using two d.f. stages and a properly adjusted ratio detector, is fully free of frame buzz and scene change buzz for all normal purposes.

Although a completely separate sound channel of normal design, having only the tuner and possibly the first main i.f. stage common to the vision channel, would give, theoretically, the greatest freedom from interference, the extra expense compared to a properly designed and adjusted inter-carrier channel is certainly not justified.

Distortion

To prevent the production of harmonic distortion of modulation present in a signal carrier at a frequency changer, it is necessary to make certain that the amplitude of the local oscillator is much greater than the greatest signal carrier amplitude to be dealt with. Preferably, the local oscillator should have ten times the amplitude of the larger signal carrier it is required to mix.

In the case of inter-carrier mixing at the vision detector the situation arises whereby two signals are transmitted in a definite known ratio of intensities, and thus, are received in the same ratio of intensities (which will be taken as about equal for the sake of argument). It is thus necessary to tune the main i.f. amplifier chain of the receiver so that the gain for the sound i.f. is only about a tenth that for the vision i.f., or at any rate much smaller than the vision i.f. gain.

To be more precise, the I.f. passband must be such that, when the vision i.f. carrier is tuned to the optimum point (near one end, to give quasi single sideband operation as usual), the sound i.f. carrier falls on the linear flank at the other extremity of the passband, with the necessary reduced gain.

It is clear that this places rather stricter demands on the correct alignment of the main i.f. amplifier than is usual for conventional BBC standard receivers. Misalignment of an inter-carrier CCIR receiver i.f. amplifier clearly produces consequences more serious than mere loss of sensitivity; badly distorted sound can result.

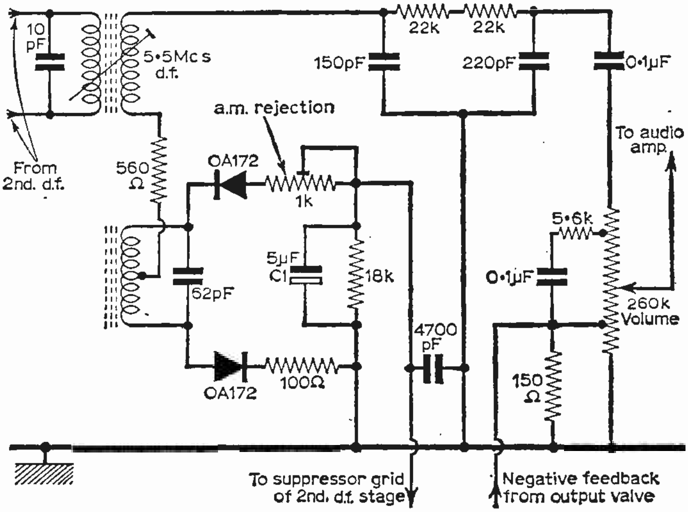


Fig. 4—A sketch of the signal arrangements at the video detector of an inter-carrier receiver.

There is a second possible cause of distortion, again connected with the same misalignment of the main i.f. amplifier. The sound i.f. must fall on the remote flank of the main i.f. amplifier passband but a further demand is that it must lie properly on this flank, well within its linear section, and not on the curved portions at the ends of the flank.

The said curved portions of the flank have a non-linear relation between phase shift and frequency, which would introduce harmonic distortion into the sound frequency modulation. This problem is, in fact, the same as for a v.h.f.-f.m. broadcast sound receiver—misalignment producing harmonic distortion of the audio output, not only a loss of sensitivity.

Automatic Tuning

Apart from the absolute necessity of exact alignment of a CCIR standard television receiver, it is clear that the actual tuning point of the channel selector is rather important.

The d.f. never depends on this tuning point, as it is fixed solely by the difference between vision and sound carriers, which is fixed at 5·5Mc/s *at the transmitter*, but the all-important positions of the sound and vision main i.f.'s, within the overall i.f.-amplifier passband, are rather critical and depend on the fine tuning.

The cheaper receivers use a turret tuner to select the channel, and have a manual fine tuning control for exact adjustment within the channel, and no more than this. The user must adjust the fine tuning by sight and hearing, for optimum picture and sound quality. This arrangement is used, very satisfactorily, in British receivers, because the consequences of slight mistuning are little more than a loss of sensitivity.

However, CCIR receivers tend to produce more unpleasant effects if the fine tuning is even slightly displaced—the quality of sound reception deteriorates. The deterioration is then often unnoticeable on quiet bass passages, but appears as heavy "scratching" distortion on sibilant treble peaks. This is because the main sound i.f. does not fall on the proper portion of the passband when mistuned, as previously explained.

In view of this state of affairs, the great majority of good CCIR receivers have gone over to automatic frequency control of the main tuner. A frequency conscious discriminator stage is driven from a late stage in the i.f. amplifier, and produces a d.c. voltage of magnitude and polarity according to the displacement of the vision i.f. carrier from its proper position in the i.f. passband.

This d.c. voltage is used to bias a special semiconductor diode whose capacity is dependent on the applied d.c. voltage in the non-conducting direction. This diode is across the local oscillator tuned circuit of the main tuner, and thus corrects the tuning automatically.

The vision i.f., and consequently also the sound i.f., provided the alignment is correct, are thus automatically pulled into position as soon as the manual tuning is close enough for lock-in.

Finally, then, the inter-carrier television sound system's main advantage is extreme simplicity of adding the components required for the sound channel, beyond those already present in the vision-channel. This makes for quite considerable reduction of production costs.

The major disadvantage is the extremely critical nature of the alignment if optimum performance is to be maintained, so that great attention must be paid to good alignment of a CCIR receiver.

It is perhaps of advantage, for the purpose of clarity, to point out that the vision and sound signals at the transmitter are separate transmissions, each with their own carrier, as with the present BBC signals. The separation is standardised at 5·5Mc/s, which is the CCIR d.f., therefore. There is no question of a combined single-carrier transmission containing both vision and sound. ■

Servicing Data and Modifications

(Continued from page 108)

Good Aerial and Earth System Essential

If the Post Office interference investigation team is called in to investigate line timebase interference, the first move is to establish that the aerial and earth system of the radio receiver is reasonably efficient. It is understood, of course, that modern receivers require considerably less in the way of an aerial and earth than their counterparts of past days.

Nevertheless, a good system is still essential to maintain a reasonable signal-to-interference ratio in certain areas, and this applies to the pick-up of timebase interference from nearby television sets.

The odd bit of wire strung round the picture rail will be highly responsive to locally generated interfering signals and contribute only a small amount to the pick-up of the required programme. If the person whose television is causing interference is co-operative, then it is essential for the person whose set is being affected to be equally co-operative, to the extent of (a) improving the aerial and earth system and (b) repositioning the receiver in the room for the least interference. Some modern radio receivers incorporate rotatable ferrite rod aerials, and adjustment here invariable gives the required amount of interference rejection without further ado. The effect does not, of course, occur on v.h.f.-f.m. receivers.

In very bad cases where the receiver requires a reasonable aerial for normal reception, the actual "collector" part of the aerial should be erected outside the zone of the interference and the signal should be conveyed to the set through the interference zone via a screened cable. Several aerial firms have special broadcast aerials available for this purpose, including Belling and Lee and Aerialite. A good earth connection to the set also helps if an earth socket is available, but never connect an earth to the chassis of an a.c.-d.c. receiver.

Mains-borne Interference

Mains-borne interference can be reduced by connecting a good earth to the receivers. This can be done on a.c.-d.c. models (both television and radio) by connecting the earth through an 0·05μF 250V a.c. *working* capacitor. If the interference is still bad, reversing the power supply to the television or radio receiver (or both) sometimes helps and, in certain cases, has been known to overcome the trouble completely.

Most of the harmonics at the power point, however, can be eliminated by connecting two 0·01μF capacitors (these must be, at least, 250V working) to the power plug as shown in Fig. 43. This plug must itself be "earthed" through the earth socket to which the plug is connected. ■

The ABC of TV Circuits

AN ANALYSIS OF THE DEVELOPMENT OF TELEVISION CIRCUITS

By T. L. May

(Continued from page 61 of the November issue)

OWNERS of fairly recent receivers sometimes wonder where the line linearity control or adjustment is fitted. On early receivers this question never arose for the control was clearly indicated at the rear of the chassis and took the form of either a slider type of rotatable wire-wound potentiometer or an inductor with an adjustable dust-iron core.

In the early days the horizontal linearity was corrected by a capacitor in series with the line linearity potentiometer, the combination being connected across the line scanning coils (Fig. 18). During the line scan periods the resistor-capacitor circuit had little effect, but during the higher speed

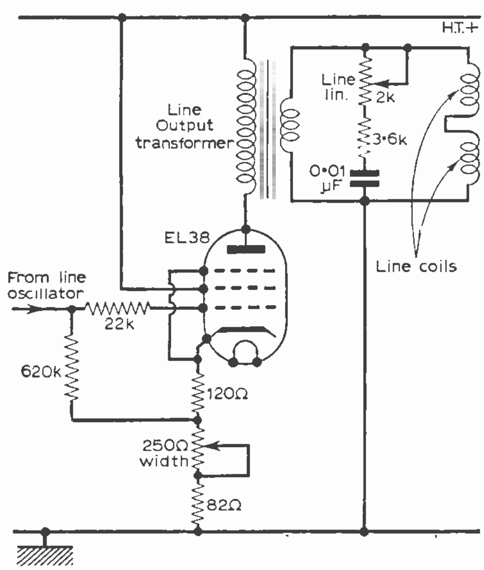


Fig. 18—An early type of line output stage showing the line linearity control connected across the line scanning coils.

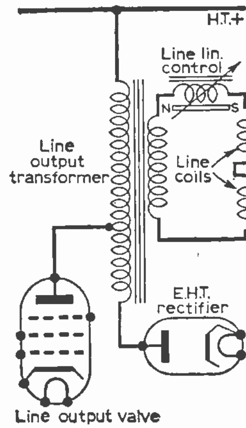


Fig. 19—On more recent receivers a saturated reactor is connected in series with the line scanning coils, and correction is possible by adjusting the position of a small permanent magnet in relation to the core of the reactor.

of the line flyback or retrace the line coils were loaded essentially by the resulting smaller impedance of the capacitive element with the through current being limited by the resistive element.

This caused a modification of the scanning current in the line coils towards the end of the trace and during the flyback, and by adjusting the variable resistor it was possible to change the shape of the line scanning waveform and the flyback time. The effect on the picture was either compression or expansion at the left-hand vertical edge. Thus, the variable resistor or potentiometer gave a control of line linearity.

The circuit also served to damp out any ringing or oscillation in the inductive elements of the line scan circuits, for in the very early days a booster diode was not used to enhance the efficiency (see November issue). Moveover, the e.h.t. voltage for the picture tube was obtained from a separate e.h.t. winding on the mains transformer and not from the line flyback, as it is in receivers of this age.

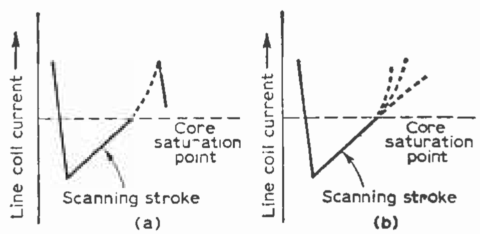


Fig. 20—Showing at (a) how the current in the scanning coils rises after the scanning stroke passes the core saturation point, and at (b) how the final rise of scanning current can be altered by adjusting the core saturation point by repositioning the permanent magnet.

Saturated Reactor

An interesting development for the correction of line non-linearity is shown in Fig. 19. Here the line output stage is of the more conventional design, incorporating both a booster diode and an e.h.t. system. In series with line scanning coils is connected a rather special type of inductor. This has a ferrite core, and in addition, a small bar magnet which is adjustable.

Any iron-cored inductor, when passing an increasing current, tends to become "saturated" when the magnetic field created by the current in the winding exceeds the magnetic capabilities of the core material. This means that the core just cannot accept any further magnetism.

To a rising current, as is produced in the line scanning coils, the impedance offered by the inductor reduces past the saturation point, which means that the line scanning current rises, as shown in Fig. 20a. This rise in current affects the linearity towards the end of the scanning stroke as revealed by the dotted line.

Now, since the core is under the influence of a permanent magnet, the point at which saturation occurs can be controlled simply by altering the position of the magnet in relation to the core, and it is this feature which is adopted to modify the linearity towards the end of the scanning stroke so

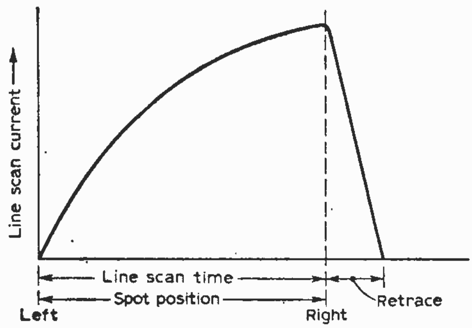
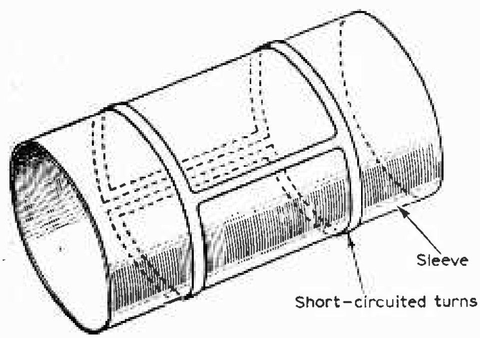


Fig. 21 (above)—The exponential current waveform in the line coils which is usually responsible for bad line linearity.

Fig. 22 (below)—The short-circuit turn sleeve which is pushed under the scanning coils to correct for non-linearity, as explained in the text.



that optimum line linearity occurs on the picture—Fig. 20b.

The magnet is usually pivoted at its centre or arranged in a slider, but in either case adjustment is relatively simple.

The Latest Idea

The latest type of line linearity control simply takes the form of a special winding wound on a former and introduced between the neck of the tube and the inside of the scanning coil assembly. The winding—or linearity correcting coil, as it is usually called—is designed purposely as a short-circuit turn.

The turn is positioned for optimum performance at the factory, and it should be noted that impaired efficiency will most definitely result if the turn is maladjusted or pushed too far under the scanning coils.

Non-linearity in the line scan almost always results from an exponential current waveform in the line scanning coils, of the nature of that shown in Fig. 21. This causes stretching at the start and cramping at the finish of each line scan, and happens because the scanning flux produced by the current also rises exponentially instead of linearly.

Now, the short-circuit turn has induced into it, from the line scanning coils, an exponential current similar to that in the scanning coils but of a smaller amplitude. The current in the short-circuit

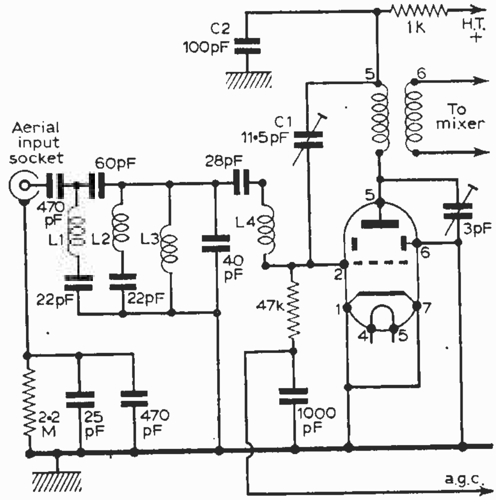


Fig. 23—Circuit of triode R.F. stage now used in television tuners.

turn thus produces a magnetic flux itself, but this is rather different from that produced by the scanning coils, for being of opposite polarity it tends to retard the main scanning flux.

The net effect is that when the scanning spot would normally traverse the screen at an increasing rate—due to the non-linear waveform—a larger correcting flux is produced in the short-circuit turn, which reduces the speed of the spot and causes it to travel from left to right across the screen in a far more linear manner.

Correction is thus given by correcting the magnetic flux which is responsible for deflecting the electron beam (and hence the scanning spot) horizontally. This is somewhat different from the previous type of linearity correction devices considered.

The amount of correction is accomplished by varying the coupling between the line coils and the short-circuit turn, since this alters the strength of the correcting flux. In practice, adjustment is usually possible by first slackening off the scanning

(Continued on page 140)

SIGNAL INPUT EQUALISER

by K. F. Perry

IN areas of low signal strength, or fringe locations, it is essential to ensure that the aerial arrangements are efficient, to ensure that as much of the signal as possible reaches the receiver. A weak signal causes the received picture to be dirty and ragged in appearance with a snowy accompaniment, and the sound channel carries a great deal of valve noise or hiss. Pre-amplifiers invariably increase the noise level.

The trouble is usually worse when the set is switched to receive Band III signals but results are generally slightly better if a separate feeder is used for each aerial instead of a common downlead.

If two feeders are in use, and assuming that both aerials are orientated for maximum signal pick-up, the problem sometimes arises of connecting the two inputs to a receiver which has only a single aerial socket. The two leads cannot be connected in parallel or severe attenuation will result, but they could be connected to a switch that may be thrown to connect either as required. This is not generally convenient and may be considered unpractical.

The easily made device shown here enables both aerials to be left permanently connected and is not only cheaper than a diplexer but is also adjustable so that best results can be obtained by the experimenter. The items required for its construction are few in number and the unit may be quite easily built into a tobacco tin or on a suitable piece of metal, etc.

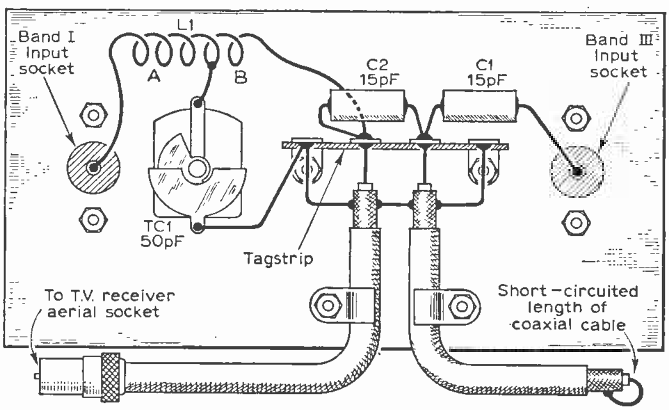


Fig. 1.—The wiring involved in this simple unit.

As may be seen from the diagram, two standard coaxial type sockets are fitted to receive the plugged ends of the Band I and Band III aerials while a single coaxial lead carries the required signal to the receiver.

The Band I signal reaches the receiver via L1 whilst the Band III signal is applied via C1 and C2. The inputs are influenced by the effect of TC1 and by the short length of shorted line fitted.

Coil L1 consists of five turns of 16s.w.g. tinned copper wire wound on to a ¼in. diameter former and allowed to spring off, the turns being spaced wire thickness. A tapping is made so that section "A" has three turns and is connected as shown to the small 50pF ceramic trimmer.

The length of line used to connect to the junction of C1 and C2 is initially about 16in. but is eventually shortened as will be described.

Setting up

To do this the two aerials are plugged into the unit as appropriate, the single outlet plug being connected to the receiver which is switched on and adjusted to receive the Band III signal, contrast, etc., being adjusted as required. With trimmer TC1 set to half travel the 16in. length of coaxial line is snipped off ½in. at a time, leaving the ends open-circuit, until a point is reached where the signal is completely attenuated, i.e., screen blank and sound very weak.

The ends of the line are then short-circuited this causing the picture to reappear. Trimmer TC1 is also adjusted. The receiver is next switched to Band I and the picture checked to see that no degradation occurs due to TC1, etc.

When correctly adjusted, the picture obtainable via either the Band I or Band III aerials should be just as good via the unit as when directly connected to the receiver. It should be noted, however, that although the unit might make possible an improvement in picture reception it cannot manufacture a signal if none already exists. ■

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. 136 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

SOBELL T517

The picture is slipping very badly on this set. I have replaced the ECL80 valve, but it makes no difference. I have also reduced the input from 250V to 220V, reducing it by 10V at a time. After each reduction the picture kept steady for about a week. Could you please let me know what else I can do to stop the slipping? The picture itself is perfect during the afternoon and the trouble starts about five and then keeps on all evening.—C. W. Griffiths (Ebbw Vale, Monmouthshire).

Your letter does not convey any information other than the fact that the picture persistently slips, particularly when the mains voltage is low. You do not say whether the hold control is at one end of its travel or not or whether the picture rolls up or down or both. If the frame timebase ECL80 has been replaced, you should first cut the link across the 220k resistor, which is wired from the hold control to the 820k resistor, which connects to the frame blocking oscillator transformer. If the roll is worse, replace the link and change the 820k resistor.

BAIRD P167

This set has recently developed a few faults. The picture is jumpy and white lines appear across the screen. It will not quite focus correctly. I have service sheet for this set.—R. Cornwall (Stratford).

If the fine focus control will not resolve the scanning lines, loosen or tighten the three focus magnet screws equally until focus is obtained. If the tube is of low emission, correct focus will be well-nigh impossible. The vertical jitter could be caused by a heater-cathode leak in the tube, which may also account for the lack of focus if this is intermittent. If the tube is responsible, fit a 2V heater isolating transformer. If the tube is not responsible, check V12 (20LI) by replacement and check V8 (10F1) and associated capacitors.

MURPHY V410

This receiver has recently developed a fault in which there is a complete picture break-up in the Channel 1 position (with a hum on sound). This can often be corrected by rotating the turret switch, but it breaks up once more after a few minutes. Often the Channel 9 picture drifts across the screen instead of the Channel 1 picture. The receiver works normally on Channel 9, although the picture takes a few seconds to lock. The turret switch contacts appear to be in order and adjustment of the Channel 1 oscillator core gives no improvement.—E. Howes (Wembley, Middlesex).

As your fault is confined to the BBC channel only we suggest that you try changing the Channel 1 coils for new ones. You should be able to obtain these for a few shillings from your local Murphy dealer and their fitting is quite simple.

FERGUSON 968T

I should appreciate it if you could give advice concerning the following trouble. The 0·5μF condenser in the PY31 cathode circuit, short circuited causing arcing in the PY31 and, eventually, the fuse to blow. I replaced the condenser and, being unable to obtain a PY31, replaced it with a 25Z4 which, I am told, is a suitable substitute.

However, now no raster is obtainable unless the anode lead is disconnected from the efficiency diode. If this is done, quite a good picture is obtainable if the brilliance is well advanced though with some loss of horizontal linearity.

Must I now assume that the line output transformer is faulty? The relevant sections show continuity. Is it harmful to run the set in this condition?

With the diode anode connected there does not appear to be any current flowing through the valve and the cathode voltage is only 240 instead of the normal 320.—E. S. Greenfield (Bromley, Kent).

This is indeed a curious fault. The line amplifier anode gets its D.C. via the efficiency diode and with the anode of the latter disconnected there would be no continuity. The cathode would also be at zero. There is either a wrong connection on the line output transformer or a short between adjacent windings. It would not be advisable to run the set in its present condition.

PETO SCOTT 1611T

After being switched on, the frame locks perfectly for five minutes; from then on the frame shrinks, the flyback lines appear, and the whole picture vibrates making it impossible to control and view. The only way the picture can be brought back to normal is by switching to any channel other than 1 or 9 for five minutes, and switch back again. This process has to be repeated for half an hour before the frame locks.—E. Tallowin, London, E.10).

There are two valves concerned with the frame timebase, the PCL82 and the PCL84. Both should be checked by substitution. If necessary, check the 1500pF flyback suppression capacitor (C44) and the 0·03μF cross-coupling capacitor (C41) and 500pF (C43).

(Continued on page 135)

FERRANTI 14T3F

This receiver has frequent loss of frame hold and the frame hold control is often ineffective in curing this.

I have replaced the ECL80 frame output valve and the EF80 sync separator, without any improvement.

Could you please suggest any further components which if replaced would cure this fault? —G. L. Page (Burgess Hill, Sussex).

This trouble is often caused by poor insulation in the frame blocking oscillator transformer.

ALBA T644

I would be most grateful if you would let me know the value of the dropping resistance to the screen grid tag of the PL81 valve.—N. McShane (Bishop Auckland).

The screen resistor to pin 8 of the PL81 has a value of 15k.

BUSH TV53

Recently the brilliance has diminished and the picture can only be seen in a dark room. Increasing the brilliance over-emphasises the highlights and it is impossible to get a balance between brilliance and contrast controls.

When first switched on the picture takes a long time to come on the screen. Also there is a half-an-inch horizontal black bar across the top and bottom of the picture.

I have changed the EY86 without improvement. Do you think the tube is due for replacement? —T. W. Rogers (Birmingham).

The tube is most definitely at fault and is in need of replacement. A 5K 10W resistor wired from the fuse holder to pin 12 of the tube base socket would increase the tube emission for a temporary period.

H.M.V. 1824

The fault here is lack of height and very critical vertical hold. I have changed the LN152 with a new ECL80, but this only resulted in my being able to extend the height, but the vertical hold would then not lock. To make the picture stable, I must reduce the height until there are gaps of one inch at the top and bottom. Even at this setting the picture jumps occasionally.—A. Day (Stockton-on-Tees).

This is possibly caused by increase in value of one of the resistors associated with the frame hold control. The correct locking point should occur well within the range of the control, and if the lock occurs hard on one stop, then one of the time-constant components (such as a resistor mentioned) has altered in value.

FERRANTI 14T3

The picture and raster suddenly disappeared as I was adjusting the width control, leaving the sound only. I changed both the PL81 and the PY81, also the resistor R70 (1·8kΩ) on the screen grid of the PL81. I checked for continuity and with complete success the line transformer, the width control, the horizontal linearity control and the line coils. I have also checked C68, R85, and R104 but without finding any faults. I have checked for a spark on the e.h.t. rectifier but without any results.—W. T. Turner (Lichfield).

This model uses a self-oscillating line amplifier (PL81), and from your remarks we feel that shorting turns in the line output transformer are responsible for the lack of line drive and e.h.t.

H.M.V. 1827A

There is no sound or picture on this receiver, only a thin white vertical line in the centre of the screen. This appears on channel 14 but on channel 1, a broken white line with sound interference is present. Before it disappeared altogether, the picture was prone to fading with shrinkage and distortion which worsened until it was impossible to view.—H. M. Peters (Haywards Heath, Sussex).

This symptom indicates that the line scanning coils have become disconnected from the line output transformer. The line timebase itself must be working to produce the vertical white line. Check the wiring from the line output transformer to the line coils and also the coils themselves for continuity.

FERGUSON 992

This set is working well on both sound and vision, but the PY81 burns blue near the base and the PL81 flashes and produces sparks inside its envelope.

I believe the line output transformer has been changed recently and the one fitted is possible from a model 998, as the overwind reads 9·5kΩ instead of 15kΩ. Also the first anode on the c.r.t. reads over 600V.—G. A. Allan (Stepney, London, E.14).

The use of the incorrect line output transformer would over-run the line amplifier and booster diode. Shorting turns in the transformer would also give the same effect, however.

PHILIPS 1100U

The frame output stage was not working on this set, and so I replaced the frame output valve, the cathode resistor and the de-coupling capacitor. This produces a complete raster, but when the aerial is plugged in there is a 2in. gap at the bottom of the screen. When I try to open the picture out, it folds over. If I adjust the frame and line hold controls, the picture fills the raster but produces multiple images. All the voltages on the frame stage and sync separator are correct.— G. Browne (Brixton, London, S.W.2).

Check the ECL80 frame timebase valve and make sure that its emission is up to standard. If normal, check the 100μF electrolytic capacitor connected to the pentode cathode (pin 3) of the valve.

ALBA T744

The sound is perfect but there is no picture whatsoever on BBC or ITA. This fault appears to be caused by a lack of EHT.—A. Trye (Elstead).

If the line whistle can be heard when the line hold control is adjusted, the trouble lies somewhere in the line output stage. Check the line output valve and booster diode first of all, and if these

(Continued on page 136)

Letters to the Editor

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

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

AMATEUR TELEVISION

SIR,—Your article in the November issue on closed-circuit TV interested me and some of my friends a great deal. Before reading Mr. Peters' article I had never thought that this sort of thing was within the reach of the general public, but now I realise how useful it could be in, say, youth clubs and societies.

Although it is obvious that the most basic equipment can be used, the main problem remains, which is of course, the cost. I would like to see some articles on building closed-circuit television equipment, as I believe this would bring the expense involved down considerably.—D. M. EVANS (Portsmouth).

[We are already preparing some articles on home-built equipment suitable for use in a closed circuit television system.—Ed.]

OLYMPIC TRANSFORMER

SIR,—After a good deal of research I was able to trace the line output transformer used in the PRACTICAL TELEVISION "Olympic" receiver, and I have discovered that it is the same as that used in the Philco model 1010.

I have obtained one of these for myself, and as they are still available, it should be possible for readers wishing to construct the "Olympic" to do so.

I am pleased with my receiver, although I had to alter the values of the capacitors in the frame section of the receiver to obtain linearity.—J. RANKIN (Harpenden, Hertfordshire).

UHF AERIALS

SIR,—It seems to me that one of the problems of 625-line and colour television will be the need for larger aerials.

Surely the answer is for communities to erect one large aerial on some vantage point and to feed the signal to individual homes by cable. A yearly charge could be made for this service to cover installation and maintenance costs.

The advantage of such a system would be two-fold. It would save the house owner the initial cost of an aerial and would reduce the complete cost of changing to u.h.f. reception appreciably so encouraging more and more people to do so, thus speeding the whole procedure.

Another all-round advantage would be the disappearance of the hundreds of ugly "toast-racks" we can see perched on houses nowadays. D. BARRINGTON (Liverpool).

YOUR PROBLEMS SOLVED

(continued from page 135)

are in order a check should be made of the associated smaller components. If all seems well, shorting turns in the line output transformer could be responsible.

PYE LV20

I cannot control the frame timebase on this set with the result that the picture rolls continuously. I have changed all the valves associated with that part of the circuit. The picture normally rolls upwards, but as the frame hold control is altered the picture becomes cramped top and bottom and starts to roll downwards.—G. Phillips (Hampton Hill, Middlesex).

These symptoms normally are caused by a faulty blocking oscillator transformer or a change in value of the 470kΩ resistor from the frame hold control slider to the grid winding of the transformer. This is probably marked R40 on your circuit and various values can be tried in this position until a suitable hold range is obtained.

ECKO T161

Below a certain level of volume, there is some distortion of the sound, which varies with the contrast control setting. On the vision side, there are vertical striations over the whole screen and black spots appear on the highlights of the picture. Both the vision faults may be removed by detuning the oscillator coil so that the screen is dimmer.—G. W. Pickard (Manchester).

The symptoms suggest i.f. instability. This is usually due to the failure of one of the 0·003μF or 0·001μF capacitors in the i.f. strip, and these may be checked by bridging a good one across each.

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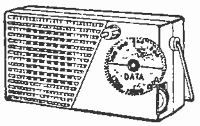

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PRACTICAL NUVISTOR CIRCUITS

(Continued from page 122)

The neutralising trimmer is then adjusted for minimum output at the speaker. On the vision carrier, a modulated signal will give horizontal bar patterns on the raster, and the neutralising adjustment should be carefully set to minimise these.

Alternatively, the adjustment can be made for the best noise performance, but as this requires a noise generator it can rarely be undertaken by the experimenter and, in any case, there is very little difference in the overall performance whichever method is used.

The circuit of Fig. 2 shows a common earthing point for the various components, and this should be maintained so far as any additional decoupling of r.f. by-pass components are concerned. The base connections and dimensions of the valve are given in Fig. 3.

The circuit shown would be suitable for a television preamplifier on any channel in Bands I and III, and it is hoped later to experiment with the valve on the u.h.f. bands, when further details will be published. As a television preamplifier, low impedance coupling windings would be used to apply the aerial signals and extract the amplified signal—L1 and L4 respectively. If a high impedance output is required, however, L4 would not be used and the signal would be extracted direct from the anode, via C2.

The number of turns and mode of construction for the coils L2 and L3 will depend on the channel which it is required to amplify. Normal coil winding techniques should be followed, and the dust-iron cores should be used to provide a range of inductance control for tuning. The low impedance coupling coils should be positioned towards the C3 end of L2 and the C1 end of L3.

INDUCTIVE NEUTRALISATION

A slightly modified circuit is shown in Fig. 4, where inductive neutralisation is used instead of a capacitor and cathode bias is used instead of leaky-grid bias. R1 provides the bias due to the volts drop across it, while r.f. across the resistor is by-passed by C3. The grid of the valve is returned direct to chassis through L2, and neutralisation is effected by L5. C1 here acts solely as a d.c. blocking capacitor to prevent h.t. from reaching the grid circuit and being shorted through L2.

This kind of circuit has a slightly less effective mutual conductance due to the effect of the cathode bias, but due to this is probably less critical from the stability point of view.

Note that inductive neutralisation may be used with leaky-grid bias and capacitive neutralisation with cathode bias. The inductive neutralisaton and cathode bias combination is shown in Fig. 4 simply to compare with the opposite combination in Fig. 3.

Inductive neutralisation has several design problems, one being that the very low grid-to-anode capacitance of the valve demands rather a lot of neutralising inductance. Another is that it is often difficult to avoid coupling between the neutralising inductor and the tuning coils, especially in a small compact chassis with closely positioned components.

If there is coupling between the two circuits the grid-to-anode feedback may be increased rather than decreased (neutralised), and great problems of instability will result.

From the experiment's point of view capacitive neutralisation is invariably the best bet. The neutralising capacitor should be of the air-dielectric variety, and the concentric type of trimmer is ideal for this purpose.

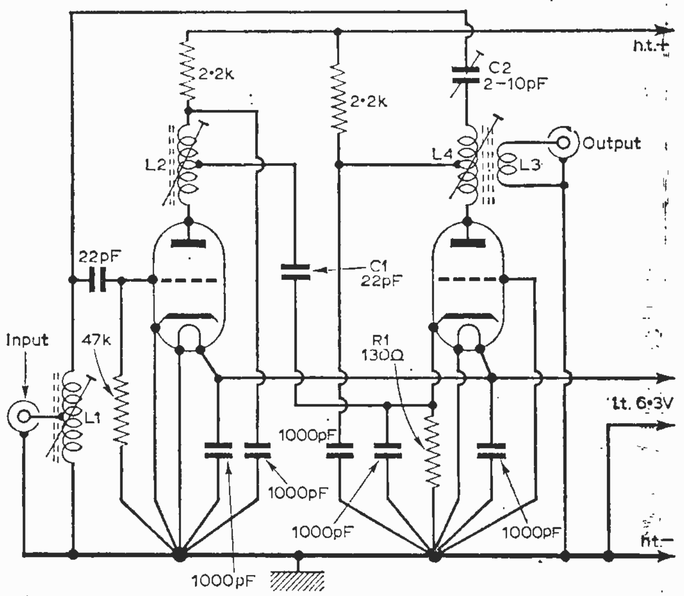

Fig. 5—A circuit using two Nuvistors in cascade, one as an earthed-cathode triode and the second in earthed-grid mode.

A TWO-NUVISTOR CIRCUIT

Fig. 5 shows how two Nuvistors may be connected in cascade. The first is arranged in the earthed-cathode mode with leaky-grid biasing, as in Fig. 2, while the second is wired in an earthed-grid circuit with the amplified signal tapped off L2 at a suitable point to match the cathode circuit of the second valve. Ordinary cathode bias is used on the second stage by R1, and the neutralisation is applied capacitively from the end of L4 to the grid circuit of the first stage, via C2.

Cascaded circuits are rarely required, however, for a single-stage Nuvistor circuit operating in front of a television tuner will almost certainly give a 2-3dB improvement in the noise figure while also providing a gain up to 40 or 50 times, depending upon the bandwidth and how well the amplifier is constructed and neutralised. ■

ABC OF TV CIRCUITS

(Continued from page 128)

coil clamping screw and then pushing the plastic sleeve to which the short-circuit turn is attached in or out of the coil assembly.

If the short-circuit turn is pushed too far into the coil over-correction will result and the width of the picture will also be reduced due to excessive damping. This is a dangerous condition, for the line coils will heat-up and possibly break down if the set is run for any length of time. Adjustment, therefore, should be made first by pulling the turn as far out of the scanning coils as possible and then very slowly pushing it in until the optimum line linearity is obtained, as revealed on Test Card C.

On some sets it may be necessary to switch off each time the coil is adjusted to avoid the risk of electric shock. Fig. 22 gives some idea of the appearance of the short-circuit turn.

Triode R.F. Amplifier

Until recent months all television tuners featured a double-triode r.f. amplifier valve connected in the well-known cascode circuit. Recently, however, the new Mullard PC97 triode has halted this convention and tuners are now being made with a single triode r.f. stage.

The general idea of the r.f. circuit is shown in Fig. 23. It may surprise some of our readers to see that the valve is connected in the earthed-cathode mode instead of the more usual (from the v.h.f. point of view) earthed-grid mode. The earthed-grid configuration was demanded in past days to avoid instability resulting from the inter-electrode capacities of the r.f. amplifier triode. With the grid earthed, the capacitances are broken up by the grid and feedback is usually avoided.

However, the new PC97 has such a low grid-to-anode capacitance (about 0·5pF compared with 2 to 4pF of the double-triode cascode valve) that the circuit can be arranged in the earthed-cathode mode without the need for elaborate neutralising.

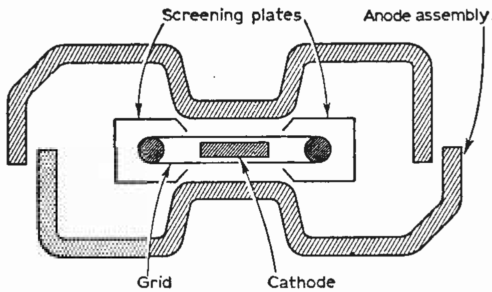

Fig. 24—The electrode structure of the new Mullard PC97 triode.

Generally speaking, a higher stage gain can be obtained from an earthed-cathode circuit than from an earthed-grid circuit using the same valve, and since the slope of the new triode is somewhat higher than that of its older counterparts—brought about by the frame grid construction—the overall gain of the new r.f. stage is almost the same as that of the former stages using double-triode valves. Moreover, the noise performance is improved as the result of the valve itself.

The low internal capacitance is achieved by the employment of a specially shaped earth screen situated partly between the grid and the anode assembly, as shown in Fig. 24. In effect, the screen acts as an electrostatic shield between the side of the grid assembly and the anode, without affecting the normal function of the valve.

In essence, the low capacitance means that the stage can be designed with a non-critical neutralising circuit, and in Fig. 23 the neutralising trimmer is C1. This is connected between the low signal potential side of the anode coil L5 and the grid. By normal adjustment, a signal from the anode is fed back to the grid, and since this is of equal amplitude and opposite phase to the signal reflected into the grid circuit from the anode via the anode-to-grid capacitance of the valve, adequate neutralisation is effected.

(To be continued)

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