Practical TELEVISION

SEPTEMBER 1966

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MODIFYING FOR BBC2

Practical Television

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A TOUCH OF THE WILLIES

WELL, it's all over now. The last corner has been taken, the last free kick awarded, the last goal scored and the final whistle blown. The soccer-loving public can sit back, like contented and well-fed leeches, with their memories. And the football-hating community can heave a sigh of relief and settle down to their routine viewing which was so very rudely interrupted.

The World Cup, and the extensive coverage given to it, particularly by the BBC, came in for some hearty criticism. But the grumblings of the World Cup Willies (as distinct from World Cup Willie) would have borne more weight if presented in a constructive manner. As it is, the critiques basically congealed into the negative fundamental of: We don't like football.

A feeble case, indeed. Much of the programme time displaced by World Cup broadcasts was the customary pre-packaged pap which can be seen year in year out if one is so disposed. And did the Willies ever think of viewers thoroughly disgruntled with the *nightly* offerings on both main channels, escape from which was a merciful release?

Three distinct issues arise from the controversy. Few responsible people will dispute that television viewing should be discriminatory; to look at programme lists and select particular items. Those who switch on instinctively and find they don't like what's on the screen can always switch off. *You can't please all the people all the time!* TV used as a background serves no useful purpose to anyone.

This is not simply a partisan for-or-against-soccer squabble. England, for the first time ever, was host country to the world's greatest football championships. Most of us will never again have the opportunity to see these top performers and teams in world soccer (except for television). Therefore, was it more important to show one of these matches than, for instance, another episode in a cheap-budget American 'soap opera'? And one must remember that the World Cup held sway for less than a month—which can hardly be called excessive by any standards!

The third issue will be examined next month. In the meantime, let us offer our congratulations to the ITA and BBC (notably the latter) on the magnificent coverage of a unique sporting event. It would be churlish to do otherwise.

W. N. STEVENS—*Editor*

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OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON OCTOBER 20th.

TELETOPICS

FIRST INTERNATIONAL TV AND RADIO SHOW

FOR the first time London will be the centre for a major international trade exhibition of audio and video electronic equipment—including colour television receivers—when The Television and Radio Show is at Earls Court, London from August 22 to 26, 1966. As well as many thousands of retailers and wholesalers and their salesmen and service technicians, attendance will include hundreds of traders from abroad.

Unlike previous national public radio shows at Earls Court, this year's is international and trade-only. Organised with the backing of the distributing side of the trade and British and foreign manufacturers and import agencies, it is timed to enable the home trade prepare for an exceptionally vigorous sales drive this winter.

The show will highlight the way in which compact transistor equipment and small but good loudspeakers are making good quality reproduction available to everyone, not just the comparatively small group of hi-fi music/electronic enthusiasts.

RUSSIANS SEE BUSH MURPHY COLOUR TV AT MOSCOW EXHIBITION

THERE were never less than 200 people watching colour television demonstrations on the four Bush Murphy monitors which were operating continuously ten hours a day at the British Industrial Exhibition in Moscow.

The picture shows senior members of the Soviet Ministry of Foreign Trade enjoying a colour cartoon. They include (extreme left) Mr. Sushkov, Chief of Main Department for Imports, taking notes, with, on his left, Mr. Kolobovnikov, senior ministry expert, and Mr. Semichastnov, First Deputy Minister of Foreign Trade.

The display included Rank Xerox copiers, Taylor Hobson television lenses and measuring instruments, Wharfedale Hi-fi equipment, Bush Murphy Colour Television receivers and "Flying-Spot" film scanner, and film studio equipment from the Rank Audio Visual Division.

FOUR HUNDRED MILLION CAN'T BE WRONG

THE gnomes of mass communication—if that might describe the backroom boys in this game that is every bit as international as the loading and offloading of sterling—must be preening themselves at their own world record on Saturday afternoon. Four hundred million viewers in four—or was it five?—continents were transfixed to their tellies watching twenty-two footballers. The last occasion when viewing on this world scale went on was during the funeral of a true world statesman—Churchill. But Saturday's figure exceeded that by fifty million.

Four hundred million—just over half the population of China. The comparison will divide those who think, "What an awful lot watching a football match", from those who think, "What an awful lot of Chinese" . . . We must wait until the Chinese get going with mass production of the people's model television set, and then the watchers of the World's Cup may find themselves knocked into touch.

The risk is plain. Just as England is now far enough in front not to be overtaken as a world language, so football (Association, not Rugby) has the largest following. It can set going jubilation or rioting anywhere from Pyongyany to Santiago, and no one has ever claimed that for any other sport. But Chinese play football too, and it is this combination of China and football that will produce the largest audiences. No doubt the Chinese will practise diligently before venturing on to the international arena. If the day arrives when the Chinese team get into the World Cup final, then the mass Chinese audience, *plus* the self-discipline that would make their viewing compulsory, would bring the total well over a thousand million. On that day may England repeat Saturday's triumph. May the play be as dashing, the gratitude to the English team as full, and the tonic to the whole country as invigorating, as they have been this weekend. **THE TIMES, 1st August 1966.**

More EMI Colour for BBC

FOLLOWING the recent contract for EMI Colour Television Cameras Type 2001 the BBC has placed an order with EMI Electronics for a Telecine Colour Vision Switching System to meet the exacting requirements of routing both NTSC and PAL colour signals.

The EMI system includes Video Switching Modules Type 767 and Video Amplifier Modules Type 254 arranged as three independent matrices within one assembly. Matrix 1 has fourteen inputs and six outputs, Matrix 2 has twenty-one inputs and four outputs, and Matrix 3 seven inputs and six outputs. The modules are fed from a Power Supply 231 with automatic standby facilities.

M-O V. TAKE OVER CERTAIN MULLARD INDUSTRIAL C.R.T.'s

THE M-O Valve Co. Ltd. have taken over the marketing as well as the manufacture of certain professional cathode ray tubes previously handled by Mullard Limited. This arrangement, involving some 50 tube types, became effective on August 1st 1966, and M-O V. took over the supply of all requirements at that date. New orders and enquiries for these tubes are now being received by M-O V.

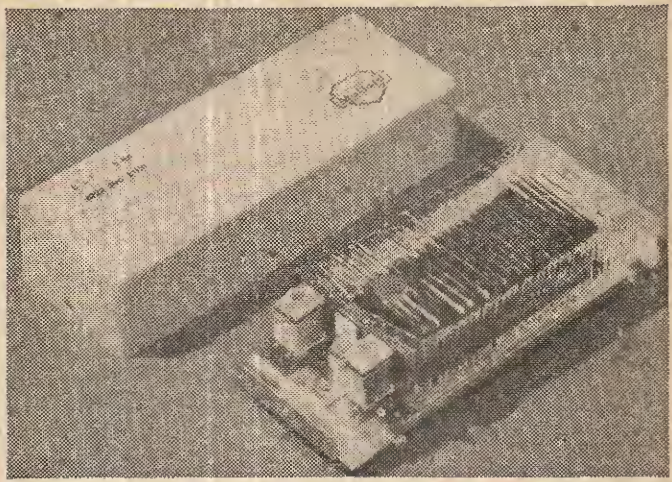
Under this arrangement, M-O V's wide range of c.r.t.'s is further extended enabling the company to offer a comprehensive range of modern instrument, radar and monitor cathode ray tubes for professional electronic equipment.

Manufacture is being carried out in the company's expanded facilities at Hammersmith and this production is supported by a team of engineers and designers who are engaged on the development of the new tubes necessary to meet future requirements in this field.

BBC-2 75% BY END OF 1968

THE Postmaster General, Edward Short, stated in Parliament on July 6th that by the end of 1967 it is estimated that 65% of the total population will be able to receive BBC-2, and that by the end of 1968, BBC-2 will be within the reach of three quarters of the population.

GLASS DELAY LINE FOR COLOUR TELEVISION RECEIVERS



ADVANTAGES of this pre-adjusted, ultrasonic delay line introduced by Mullard for PAL colour receivers are simplification of the receiver's decoder circuitry and the elimination of *in situ* adjustment of delay time.

The line—a folded, reflecting, glass type—gives the required delay of 63·943 micro-seconds at 4·43361Mc/s. Insertion loss is only 10dB.

Accuracy of the delay time is pre-set during manufacture, first by precision grinding of the glass block and, finally, by adjusting the variable in-built inductors.

The line is shown with its cover removed.

BBC-1: FOREIGN INTERFERENCE

THE BBC states that during the summer months many BBC-1 viewers find that interference from foreign stations affects their picture or sound. This interference arises because there are now too many high power television stations in Europe for the number of channels available, in spite of the use of each channel being regulated by international agreement. This interference rarely happens on ITV or BBC-2 because the channels they were given are largely free from interference.

To counter this interference, the BBC is building a very large number of low-power relay stations. Because of channel-sharing problems, most of them have a strictly limited range, but they have been sited so as to serve as many people as possible in the areas where the interference is worst. In addition, two high-power Band-III stations at Sandale and Winter Hill transmit BBC-1 on Channels 6 and 12 respectively.

NEXT STAGE AT EMLEY MOOR

FULL power trade test transmissions began on Wednesday, July 13th from the aerials mounted on the new 1,265 ft mast at the Independent Television Authority's Emley Moor transmitter in Yorkshire.

The new aerial is mounted 800 feet higher than the old one. For a great many viewers this makes no significant difference. For viewers who used to receive a weak or unreliable signal it brings improvement provided in some cases any necessary adjustments to the receiving aerial are made. For a small percentage of viewers who at present receive a good picture, this greatly increased height may make it necessary to reorientate the receiving aerial to maintain a good ghost-free service. Any viewer who finds his picture worse than it was should consult his local dealer. In the vast majority of such cases a simple adjustment to the aerial should solve the problem.

MODIFYING an old set 405 v.h.f to 625 u.h.f.

by H. PETERS

IN recent months many letters have passed through the hands of our "Query Service" on the subject of changing the line standards of an old television set so as to be able to receive BBC-2. It is not an impossible task for the experienced reader who has a clean and serviceable 405-line receiver and all the necessary test equipment. One must, however, realise that there is a lot more in it than changing a few components and adding a u.h.f tuner. As far as test equipment is concerned, you will need at least a signal generator, an oscilloscope and a multimeter.

SYSTEM TECHNICALITIES

To get things in their right perspective, there are few similarities between the two systems used in the United Kingdom. Briefly, up until a few years ago there was only the one standard—405-lines—and all television transmissions were—and still are on this standard—radiated in the 5Mc/s channels allocated to broadcasting in Bands I and III (40, 70 and 175 to 220Mc/s). Each transmission is made up of two carriers, one carrying the sound and the other the picture information. These carriers are 3·5Mc/s apart, with the amplitude modulated sound carrier at a lower frequency than the positively modulated video carrier.

Bands IV and V, which extend from 470 to 960Mc/s, have been allocated and are now used for 625-line broadcasting. Within these Bands, the BBC radiate their second television service on a number of different channels (8Mc/s) up and down the country. Again two carriers are used, but the sound is frequency modulated on a carrier 6Mc/s above the video carrier which, incidentally, is negatively modulated (peak black under maximum modulation conditions).

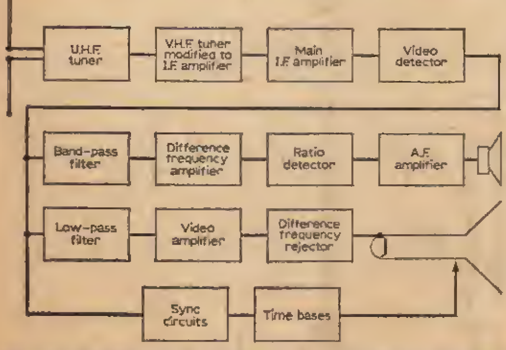


Fig. 1—Simplified block schematic of a "modified" 625-line inter-carrier receiver.

The field frequency for the two systems (coded A and I in the monochrome line standards laid down by the C.C.I.R.) is the same—50c/s. The line time base frequencies are, of course, different, the 625-line receiver running 5kc/s faster at 15kc/s. Also changed is the ratio of picture time to sync time. This effects the relationship between the scanning and flyback strokes, which in turn, affects the e.h.t. level.

INTER-CARRIER SOUND

Since the radiated frequencies of the 625-line broadcasts are considerably higher than their 405-line counterparts, one cannot use the same receiving principles without using extremely stable local oscillators. To overcome this problem, 625-line receivers employ the inter-carrier sound technique of keeping the video and sound signals together right up to the video detector stage. This enables a less stable local oscillator to be used with wideband r.f. and i.f. amplifiers. An article on inter-carrier sound appeared in the December, 1962 issue of *Practical Television*.

In the inter-carrier sound system, the video detector (being a non-linear device) also acts as a local oscillator and is used to produce a difference frequency of 6Mc/s. This is achieved by subtracting the 33·5Mc/s sound carrier from the 39·5Mc/s video carrier. The modulation content of both carriers is also mixed by the video detector and is present on the difference frequency which is applied, via a tuned band-pass filter and amplifier, to a ratio detector. At this point, the ratio detector demodulates the f.m. sound and blocks the video content since it is amplitude modulated. The demodulated f.m. sound signal is then amplified in the usual way and applied to the loudspeaker.

A parallel output from the video detector is applied, via a 4·5Mc/s top-cut filter, to the c.r.t. in the usual way.

This method of handling video and sound signals is quite straightforward, but as you can see, it is very different to the method employed in the 405-line only receivers. It is thus extremely difficult to convert a 405-line only set into a dual standard receiver.

It is not, however, quite so difficult just to change the line standards if the job is tackled systematically, starting at the first link in the chain.

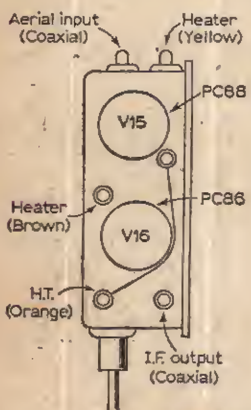
AERIAL

A specially cut aerial will, of course, be needed for the converted receiver. Although 625-line aerials are fairly broadband, they only cover a few channels and it is necessary when buying (or constructing) one to ensure that it will cover the frequencies used ur area. Also, it must be fairly sensitive as the of the modified receiver will probably be less the modern dual standard receiver.

H.F. TUNER

As the 625-line transmissions are radiated at gher frequencies, it is necessary to change the front d of the receiver. This is best achieved by fitting ne of the many u.h.f. tuners that are on the market. /alve and transistor versions are readily available and can easily be fitted, since they are designed to be "plugged-in" to the convertible and dual standard receivers. Almost all of the valve tuners make use of PC86 and PC88 valves as does the valve version illustrated on this month's cover and in Fig. 2.

The requirements of the valve tuner are quite modest: 7·6 volts at 30mA for the heaters, and a few milliamps h.t. Both of these can be obtained from the parent set without any difficulty. The u.h.t. tuner heaters can be fitted in series with the main heater chain just below the v.h.f. tuner heaters, and the h.t. can be taken from h.t. rail via a 560Ω (1 watt) resistor, or two separate 1·5 kΩ resistors if you prefer to have an independent anode supply to each valve. This brings their anode voltages to about 160V as measured at the lead-through capacitor.



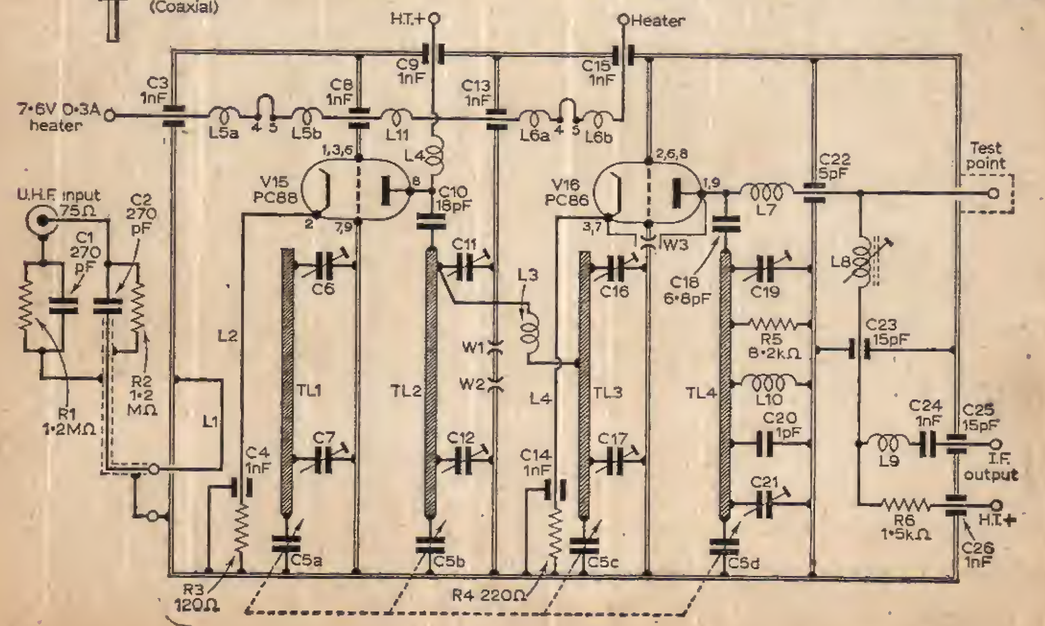


Fig. 2—Layout and circuit diagram of the Cyldon UT 228 valve tuner.

Continuity check between the i.f. output terminal and the h.t. line to see if the anode circuit of the mixer, which is the first i.f.t., is isolated from h.t. If it is not isolated, a small blocking capacitor will be needed between the i.f. output of the tuner and the input circuits at the former mixer stage of the receiver (in the v.h.f. tuner). Remember also that the u.h.f. aerial lead will need an aerial isolator fitted to prevent the array from becoming live if the set is of the "live chassis" type. Most u.h.f. tuners have an isolator and are provided with a connecting lead. If you have to construct your own isolator, some experimentation with insulating washers etc. will be needed, as the type normally used on v.h.f. tuners tend to attenuate the signal.

V.H.F. TUNER

The best purpose to which the now redundant v.h.f. tuner can be put is to provide additional i.f. amplification. The simplest way to achieve this is to connect the i.f. output of the u.h.f. tuner between the grid of the mixer pentode and chassis on the v.h.f. tuner. The former local oscillator should be disconnected by breaking the h.t. lead to its anode. For more gain the whole tuner can be utilized, with the i.f. output from the u.h.f. tuner fed into the former aerial socket, and the v.h.f. tuner switched to channel 1, again with the local oscillator disconnected. It is quite practical to tune the Channel 1 cores down from 41-45Mc/s to 33-39Mc/s using small fixed capacitors (usually about 5pF) across each r.f. coil. The trimming capacitors usually provided on top of the tuner can be used for final adjustments. The u.h.f. tuner will, of course, need matching to the v.h.f. tuner input, and this is best done by a loading coil of low "Q" flatly peaking over the i.f. band, or a resistor of about 270Ω (½ watt) assuming you are introducing the signal at the former mixer grid. At the aerial of the v.h.f. tuner the i.f. from the u.h.f. tuner will not need matching, but in both cases the last drop of gain can be squeezed out by adjustment of the i.f. core on the u.h.f. tuner. This can normally be identified as being the only trimmer accessible on the tuner which is not sealed up by paint.

VISION I.F. STRIP

At this point you will begin to feel on your own, and the practical advice we can offer is limited by the varity of i.f. strips. The basic requirements are threefold: To broaden the vision i.f. bandwidth to 6Mc/s, to move the rejector tuning points, and to modify the sound strip. A glance at Fig. 3 will show the different requirements

On 405-line receivers the sound i.f. is normally 38·15Mc/s and the vision i.f. 3·5Mc/s lower at 34·65Mc/s and, since vestigal side-band transmission is used, the vision i.f. strip runs from just below the vision carrier to as near the sound carrier as it can safely go without causing sound-on-vision. If you live where many signals are present. you may tend to get interference from the sound of the channel higher up appearing at 33·15 Mc/s on the i.f. strip, or alternatively the vision of the channel below at 39·15Mc/s. It is for this reason that rejector circuits are supplied for 33·15, 38·15 and 39·65Mc/s. Usually there is one of each, with possibly a second at 38·15 Mc/s to make absolutely sure that no sound-on-vision occurs.

On 625-line receivers everything is different. The position of the sound and vision i.f.'s is reversed, with sound at 33·5Mc/s and vision at 39·5Mc/s, a spacing of 6 megacycles. The rejectors, therefore, come at 31·5Mc/s, 33·5Mc/s and 41·5Mc/s. The existing rejectors can be used without modification, except perhaps for the "own sound" traps, which will need to be moved from 38·15 down to 33·5Mc/s. As

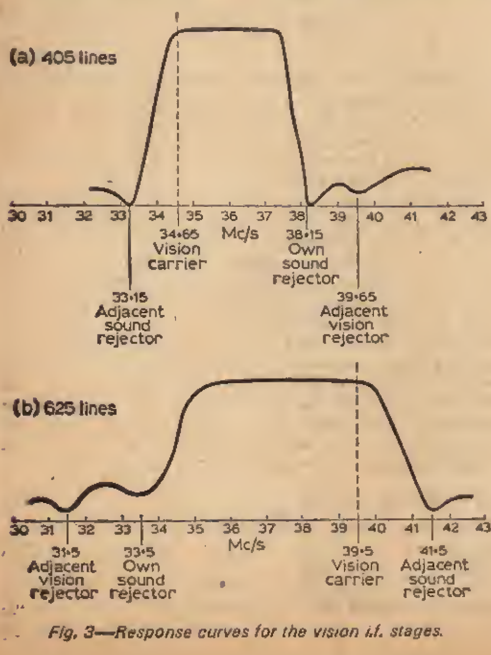


Fig. 3—Response curves for the vision i.f. stages.

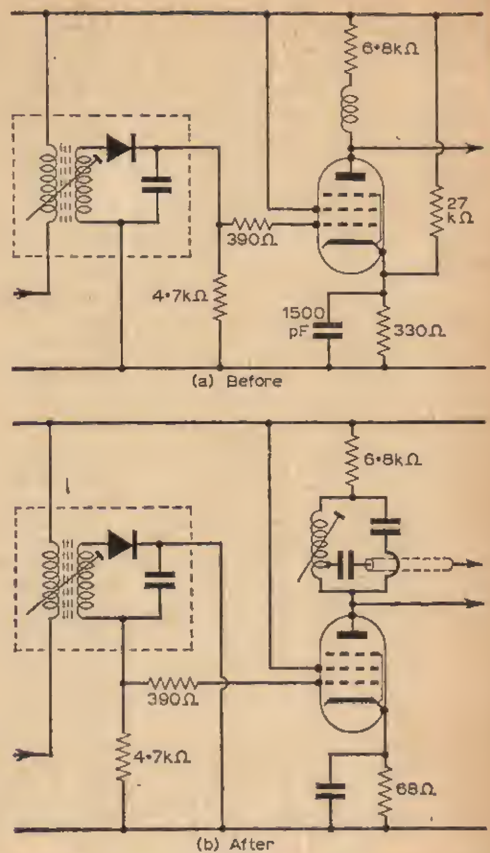


Fig. 4—The vision detector stage before and after modification.

you will see from the response curves in Fig. 3 the sound i.f. is not completely rejected but merely attenuated, since some of it must be left at the vision detector to provide the 6 megacycle inter-carrier. Some form of damping will therefore be needed, or if two sound rejectors exist in your present i.f. strip, one may possibly be omitted. The broadening of the overall bandwidth of the i.f. strip will bring with it the problem of loss of gain, and make the conversion of the v.h.f. tuner into an extra i.f. stage particularly important. Just how you broaden the bandwidth depends upon the strip. Generally the first and last coils of the strip are damped by associated circuits and tune rather flat. These can be left at about mid-band, and the intermediate transformers adjusted to equalise the response.

VIDEO STAGE

The use of negative modulation will involve reversing the vision detector diode. This is simply done if you can get at it, but a number are sealed in the last i.f.t. In this case the simplest way of doing the job is to trace out the two secondary leads and change them over as in Fig. 4. Invariably the vision diode is d.c. coupled to the video amplifier, thus preserving direct coupling to the c.r. tube cathode, and you will probably find that the video amplifier is biased to around cut-off by a cathode resistor in the order of 390 ohms, which is sometimes stabilised by a 27kΩ to h.t. These two should be removed and a value of around 68 ohms (1 watt) substituted between cathode and chassis. The h.f. bypass capacitor (around 1500 pF) across the previous resistor can be retained, but any 3·5Mc/s trap in the cathode or grid circuit should be removed. If this can be rewound to resonate at 6Mc/s and fitted in the anode circuit it will form the take-off point of the inter-carrier sound channel.

SOUND CHANNEL

The requirements of the sound channel are simple; a two stage amplifier accurately tuned to 6Mc/s coupled into either an f.m. detector (which can be be a ratio detector), a Foster-Seeley discriminator, or locked oscillator detector. This can prove to be the most difficult part of all, as nothing quite like it exists in any receiver designed only for 405 reception. The nearest range of receivers to approach the requirements is the Murphy "Double Superhet" group of TV/FM sets, where an f.m. i.f. strip in the 6Mc/s region is already fitted. Unfortunately the more compact of these receivers suffer a cramped layout giving little room for modification, and the tuning cores are usually well and truly seized. Some other models, such as the Ekco T345, have a 10·7Mc/s f.m. i.f. strip, which can be adapted without too much trouble, but for the majority of sets the work needed will no doubt involve stripping the 38Mc/s inductances down and rewinding them to 6Mc/s.

A fascinating project for the enthusiast, but not for the man who needs BBC-2 in a hurry. Let us hasten to add that a 33·5Mc/s sound i.f. strip is perfectly possible and will produce results provided the mechanical characteristics of the u.h.f. tuner permit very fine adjustment, and its electrical stability does not give rise to drift causing the user to have to retune every few minutes.

LINE TIMEBASE

The requirements here are to increase the scanning rate from 10125c/s to 15625c/s in the oscillator stage, and then amend the width and e.h.t. constants of the line output stage to give a full sized picture in focus. If your standards in this respect are not too exacting, your job will be a lot easier. Line oscillators fall into two groups—the blocking oscillator, and the multivibrator. To alter the speed of the former it is necessary to decrease the C and R components in the transformer circuit as in Fig. 5 until the speed is correct with the old control set midway. Bear in mind that the blocking oscillator itself is a switch which suddenly discharges another C/R combination in the grid circuit of the line output stage, and the "C" value of this combination will probably need reducing as well. Multivibrators on the other hand do give a suitable sawtooth output at one of their electrodes, and once modified to the correct speed should drive the line output stage satisfactorily. Their scanning stroke is determined by the anode-grid coupling which has the C/R components with the larger values. The flyback time is determined by the other coupling, or on cathode coupled types by the value of the cathode resistor. Some multivibrator circuits use the line output valve as one half, and the coupling back from the line output transformer is the one which determines the flyback in this case. The action of the line output stage is rather complex, and

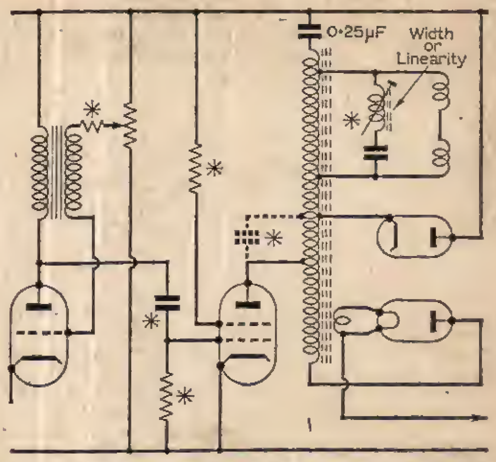


Fig. 5—A simplified line output stage. Asterisks indicate the points where adjustment can be made to improve line scan and e.h.t. on 625-line operation.

unless the receiver under conversion has the older 70° type of cathode ray tube fitted, the current waveform that the stage delivers to the scan coils will be "S" shaped rather than the accepted sawtooth.

A component which determines the amount of work the line output valve performs is its screen grid feed resistor, usually about 2·7kΩ, (5 watt). At the risk of shortening the life of the valve, it can be reduced to 1·8kΩ, or if width and e.h.t. are excessive, it can be increased to 4·7kΩ. The ratio of the energy fed from the line output transformer to the scan coils and to the e.h.t. rectifier is determined by the design of the transformer. Unfortunately a number of these will have their leakage inductance tuned to the third harmonic of 10125c/s to improve their efficiency, and this advantage is usually lost on 625 lines. Dual standard receivers have transformers with a number of switched tappings to overcome this, but the reader will usually have to content himself by trying various values of "pulse" condenser between the anode of the line output valve and the cathode of the boost diode (between the two top caps).

The boost diode provides the first 3rd of the line scan, and the line output valve takes over to provide the remainder. Distortion therefore, on the left of the screen should be associated with the boost diode circuit, and distortion on the right with the output stage. If a bright line of fold-over appears a third in from the left of the screen the boost diode is ceasing to provide scan before the output valve takes over, and the boost capacitor (usually about 0·25μF 700V) or the line output grid circuits should be suspected. The efficiency of the e.h.t. part of the stage can be judged by the colour of the e.h.t. rectifier heater, which should be noted and remembered on 405 line before conversion began.

OTHER CIRCUITS

Generally there should be little need to modify the remainder of the receiver. Line synchronising tends to be more ragged on 625, hence the increasing number of sets fitted with flywheel sync. The frame timebase should not need amendment. A.G.C.tends

—continued on page 543

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

NEW SERIES

PART 3. Line Oscillators

IT is in the perverse nature of things * that we should have to commence this section of the receiver with a reference to the field circuitry we have lately been discussing. This arises from a letter from R. W. Ayres, obviously an experienced engineer, who advised us, in the June issue, of a modification to the video circuit of the Marconi 4610 series which will improve field sync. This is, of course, the basic Thorn 850 chassis mentioned in our first article, and the point is not really irrelevant, as we shall see. Mr. Ayres is right on the ball when he directs us to the video stage for investigation into some sync faults.

The sync pulses must be preserved in good shape up to and beyond the video amplifier. Poor decoupling is a prevalent cause of misshapen pulses and thus erratic triggering of the timebases, and it depends on the particular circuit in use which timebase will be more affected. Unfortunately, there is no "typical" video circuit to illustrate this point. As an example, the cathode bypass decoupling of the video amplifiers of several different ranges of receiver may vary from a 100μF electrolytic (as in earlier Philips models), through a 3,300pF as in the Defiant 9A30 and half that value in some Albas to the complicated networks we find in some Pye and Invicta video cathode circuitry. The aim, always, is to maintain the frequency response of the amplifier, while supplying the correct drive for the cathode ray tube—not always an easy design factor.

DUAL-STANDARD SWITCHING

The matter is further complicated by dual-standard circuitry, where both the video and the line oscillator sections will be affected by switching. The complicated part of the change-over happens in the grid-cathode circuit of the video amplifier, which is just where a fault will crop up to affect our synchronisation. But this will be dealt with in a later article, and for the present we shall concentrate on the line oscillator section itself, assuming that the sync pulse is at least leaving the video output stage in good shape and correct amplitude.

We did not complicate matters when discussing the field circuits, as dual-standard switching does not concern us so greatly, a 50c/s timebase frequency being common to both 405 and 625-line reception. Some switching may be incurred, where a change in boosted line voltage providing h.t. for the field oscillator has to be compensated. But this is straightforward, and the writer is not aware of any "stock" fault that this small section has developed. (No doubt he will be promptly disabused by our experienced readers!) But please, no reminders that the field timebase is no longer locked to mains frequency for 625-line reception; we have already mentioned that important point.

Line oscillators are a very different kettle of fish. The repetition frequency has to be increased by some 50 per cent, giving a need for increased drive. Output stages are particularly affected by the need for getting the same horizontal scan at one-and-a-half times the speed, with consequent higher peak voltages. The feature of the line oscillator that differs most from the 405-line only set is the provision for flywheel sync. And it is here that we often meet trouble.

FLYWHEEL SYNC

Flywheel sync itself is not new. In fact, many earlier sets used it, as service engineers know to their cost, Latterly, it had fallen out of favour, except when added as a feature of "fringe" models. Now, with dual-standard sets, it is back in full force, many manufacturers marketing plug-in, add-on units which modify the circuit and convert from direct to flywheel synchronisation. Mighty cunning, these designer wallahs, except that by the time their ideas were interpreted into cost-production (see the recent series *Meet the Setmakers* by P. Westland) the add-on unit becomes a rather flimsy panel inclined to flap about when father turns the wick up. Poor connections at slide and spade joints, and at plug-in holes of printed panels should be investigated when intermittent symptoms occur, before delving too deeply into the circuit. A case in point is the Sobell ST287D7 where line tearing may be caused by faulty plug-in connectors.

One of the most common faults associated with this type of circuitry is a breakdown of one or both of the discriminator diodes. As an example of the type of circuit, Fig. 8 shows the plug-in unit adopted by Sobell for their earlier types of dual-standard receiver. Here, the sync pulse arrives via C56 and C57 and is applied to both D5 and D6 so that a d.c. voltage output is developed across R73, at the other end of the network. At the same time, a sampling pulse from the flyback section of the line output transformer is fed into the discriminator circuit via R67 and C58. If the flyback pulse falls out of step with the incoming

* *Hellyer's First Law: the toast always falls butter-side down.*

sync pulse, the d.c. voltage varies, and is arranged in such a way that it controls the line oscillator repetition frequency, bringing it back into step. Because of the long time constant (relative to pulse time) the d.c. potential changes fairly slowly and tends to smooth out any sudden changes that would otherwise affect sync pulses—hence the term flywheel. In practice, it has been found that interference on u.h.f. is not so severe as was at first feared.

Nevertheless, flywheel sync is with us, and the added components may spell added possibility of breakdown. The substitute panel, with a mere three components and a link, is also shown in Fig. 8, to illustrate the difference. On the connector panel, 1 goes to the sync separator anode, 2 to h.t. and 3 to to the anode feed resister of the first half of the ECC82 multivibrator, 4 to grid and 5 to chassis.

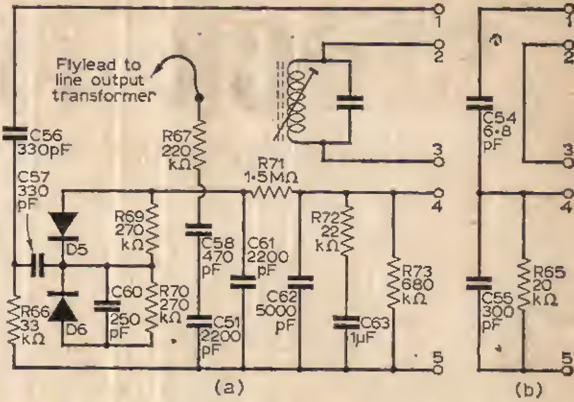


Fig. 8—Plug-in sync units used by Sobell. (a) flywheel sync circuit panel, and (b) alternative "normal" sync panel.

DIODE FAILURE

As we have stated, diode failure is such a teaser, common to many quite different sets, and it would be invidious to single one out. However, it may have different effects, and the following notes may provide a clue in some cases. The Bush 125 receiver is a case in point. Switching from 405 to 625-line operation and back may tend to alter the speed of the line oscillator. When the control is adjusted, the oscillator suddenly stops, line drive is lost, and we have to switch off and start again. *Cherchez la diode!* The Pye 17-25 is another culprit, where the pair should be changed. In fact, it is good practice, even when the double-diode is not a combined unit, to change the pair, and check for stray d.c. voltages that may have injured them before ruining the replacements. (Open-circuit the feed and test before fitting the new ones.)

The Murphy V789 has another symptom. When line oscillation ceases the sound and vision also cut out. This is a protecting feature on a number of other models. The a.g.c. derives a preventative bias from the line output stage which biases back the controlled amplifier valves before damage can be done by overdrive—the prime object being to protect the set during warming-up time. If the sound appears to be trying to pump through, but no vision and no line oscillation takes place—again, check the diodes. The 82pF sync coupling capacitor to the grid of the line oscillator is another cause of this kind of fault.

SYNC FAILURE

The effect of sync failure may be to cause the line oscillator to cease completely, or simply to refuse to lock, although rotation of the hold control sweeps the line oscillator frequency through a wide range. The characteristic line whistle can be heard, and a very obvious "step" in the changing frequency is noted when the correct in-step position with the sync pulse is reached. Many field engineers use this aural test as a first determinant when a "no raster" fault may possibly have its origin in a lack of line drive.

Where a raster is present, and the line refuses to lock, the presence of a sync pulse can still be found by rotating the hold control and noting the change in the lines that make up the broken raster. A very interesting lecture on the dual-standard line timebase was delivered by L. H. Briggs of Radio & Television Services Ltd., to the S.E.R.T. some while ago. During this, the method of determining line speed by counting the sequence of apparently haphazard lines and checking their slope was explained. If the lines slope from the left, downwards, the timebase is running fast; from the left, upwards, the timebase is slow. In the first case, ageing valves or a failing capacitor in a multivibrator circuit are possible causes. A slow-running timebase is more often caused by a faulty anode or grid resistor going "high".

OSCILLATOR VALVE

In practical terms, we usually note the presence of the sync pulse by looking for the vertical black bar on the fast side of the timebase, coming in from the left side of the picture. Unlocking the raster to give a false lock and observation of the edges of the bar, the "smear" effect of certain faults and its tendency to break at top or bottom can tell an engineer a lot. However, this is not the place to launch on a dissertation about "visual" fault-finding, interesting though the subject may be.

Failure of the line oscillator valve itself is perhaps an obvious symptom, but as the effect is to rob the line output valve of its drive, with some circuits the fault may appear to be in the line output stage. Examples of this can be found in receivers using ECC82 valves as line oscillators, or the triode section of PCF80 valves. Notable offenders were the Philco 1000, etc., Emerson and Raymond receivers, the older Beethoven models, and some later Regentones in the Ten-4, Ten-6, Ten-17 ranges. These were discussed in the previous series.

More often, the oscillator failure is caused by a lack of h.t. at the anode. In a number of instances, this will be the result of something quite simple. Many receivers have a separate fuse for this section of the h.t. circuit. In Philips, Stella and Peto Scott models of two or three years ago, a tendency to hide this fuse in the jungle of components on the printed board, allied to the "inter-board wiring" system, gave many an investigator a frustrating search.

LOW-R S/C

A more serious thing happens with models such as the Pye TV 11, where the anode feed resistor to the line oscillator is part of a network that also feeds i.f. amplifiers. A nasty fault is the low-resistance short-circuit that clears almost as soon as one switches off the set to investigate. On this model, if the 560Ω resistor feeding h.t. to the anode of the PCL84 triode begins to "cook" and there is no obvious cause, try replacing the EF184 vision i.f. amplifier which has been known to develop inter-electrode short-circuits and impose severe strain on the h.t. line.

Another model, typical of Pye circuitry, is the 40F, which is dual-standard set using transistors in a number of amplifier stages, but with ECC82 line and field oscillator (see Fig. 9). The video amplifier-cum-sync separator is a PFL200, which should be first suspect if there is no sync at all, or a reluctance to lock line and field when changing standards, or, in bad cases, merely changing channels. Incorrect screen grid voltage of the sync separator can cause these effects also, and the culprit here is usually the 100kpF decoupling capacitor. If this has developed a leak, look also to the 68kΩ and 120kΩ anode and screen resistors, and do not overlook the possibility of an open-circuited 47kpF sync coupler from the video amplifier section.

Where the line speed is wrong on this model, a leak in the vital 820pF capacitor from the bottom end of the grid winding of the blocking oscillator should not be overlooked—and again, the dual-diode discriminator can be at fault.

Note the method used to obtain separate horizontal hold control with this model, and observe that the h.t. carrying resistors, to the anode of the first half of the ECC82 and thus to the hold controls themselves, must be the correct value. Where valve failure has occurred, look for a possible change in value due to overheating.

Another example of this changed value due to failure of a decoupling capacitor occurs in the Bush TV99. The anode resistor of the line oscillator is the sufferer, and the odd symptom is that resetting the preset line hold capacitor will temporarily lock the line.

A tricky one is found in a later Bush circuit. Here, the TV135R uses part of the heater supply line to provide d.c. voltage for the screen grid of the PFL200 sync separator section. Fig. 10 illustrates the device, and it is not so crazy as it appears. Raw d.c. (i.e. before filtering) is used in this instance to cut down the heat dissipation of

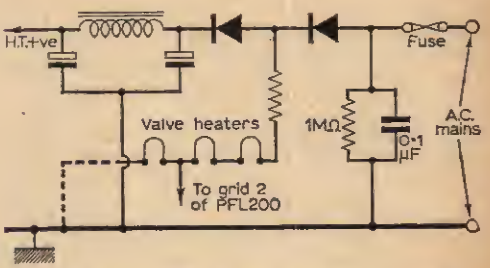


Fig. 10—A protection circuit used in the Bush TV135, which feeds unfiltered d.c. to the heater circuit to reduce heat dissipation in the mains dropper, and taps off h.t. for the screen grid of the sync separator from a point on the heater line.

the mains dropper resistor. By tapping part of this d.c. from the heater chain to the sync separator, a warning of rectifier failure is provided in good time to avoid over-running the valve heaters. A bit confusing the first time it is encountered!

Sync coupling capacitors have already been mentioned, and the effect of a leak in this component can be quite drastic upon the finely balanced discriminator circuit. In the Bush TV83, TV1115 etc, the 5000pF coupler may develop a leak which gives the symptom of touchy line lock, upset by changes in contrast. "Line flips when going from programme to adverts on ITV" is the sort of complaint one gets. Something rather similar happens to the Philips 19TG122A and associated models when the PL83 video amplifier (a returned old favourite!) loses efficiency. In fact, the prime cause is a change in inter-electrode capacitance—a point which further underlines our previous remarks about the external capacitance in the networks around the video amplifier and sync separator stage.

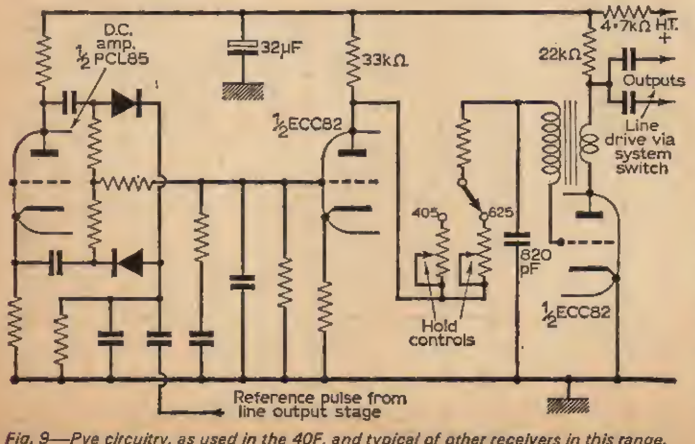


Fig. 9—Pye circuitry, as used in the 40F, and typical of other receivers in this range.

Fig. 11 shows the discriminator and line oscillator section of the Bush TV125, illustrating the use of presets to stabilise the line frequency, with a common line hold control. Also shown in this circuit is the preset capacitor TC1, previously mentioned in another Bush circuit. This diagram is given both as a typical example and to show the method of setting up that is required for correct line hold operation of a flywheel sync circuit. In this case, preliminary adjustment is made with the set switched to 405 lines. The line hold should lock in the mid position, turning back from a fully clockwise position. If the lock is too far off centre, return the hold control to mid-place, short-circuit the input to the discriminator, across the 12kΩ resistor as shown, then adjust TC1 for a still picture. Then switch to 625 lines and adjust the present line hold. The picture holds still, but a solid lock is not obtained until the short-circuit is again removed. If the pull-in range of the main hold control is not great enough, or is too one-sided, the 2MΩ phasing control may need adjustment. But do not attempt to use this as a line-hold preset, or the complete setting-up procedure will have to be undertaken again. Normally, 3VR1 does not need to be touched.

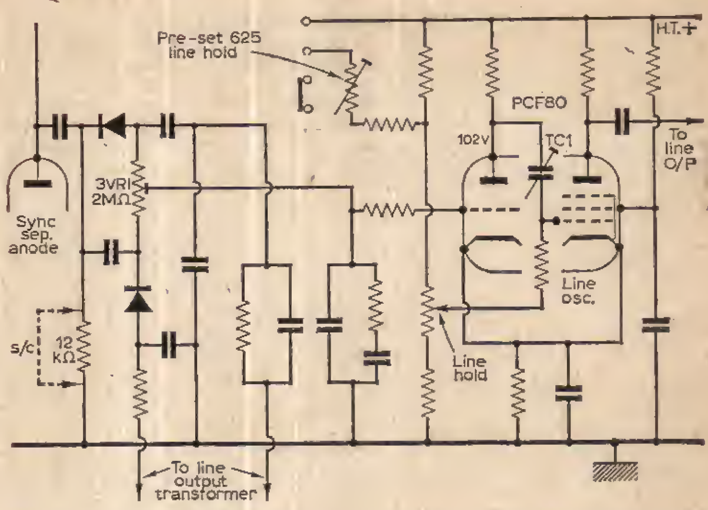


Fig. 11—Flywheel sync discriminator circuit and line oscillator used in Bush TV125.

DISCRIMINATOR FAULTS

Faults that may be encountered with this type of circuit again include diode failure, with the clue that a high anode voltage of the PCF80 triode, and a possible negative grid reading (depending on the meter used) means the stage is being cut off by an unbalanced discriminator. The balance control itself has been known to develop a "hot-spot", resulting in a wavering line hold, usually worse on one standard than the other.

In this circuit a little cheating was done, to reduce complication as much as possible, by showing two connections arrowed toward "l.o.t." This is the source of the comparison pulse, discussed at the outset of this article, and is perhaps more easily illustrated with reference to the Thorn 850 circuit (Fig. 12). We make no apology for returning to these "popular" receivers, as the chassis formed the basis for so many different models. Here we have a more conventional discriminator circuit, with a flywheel d.c. amplifier (triode section of the PCF80), and a blocking oscillator (triode ECC804). But note that the screen grid of the second sound i.f. amplifier is fed from a part of the d.c. amplifier network. Decoupling this h.t. line, at the sound i.f. part of the circuit, is a 1,000 pF capacitor which, when it develops a leak, has the effect of killing the line oscillator and producing distorted sound. A combination of these

—continued on page 543

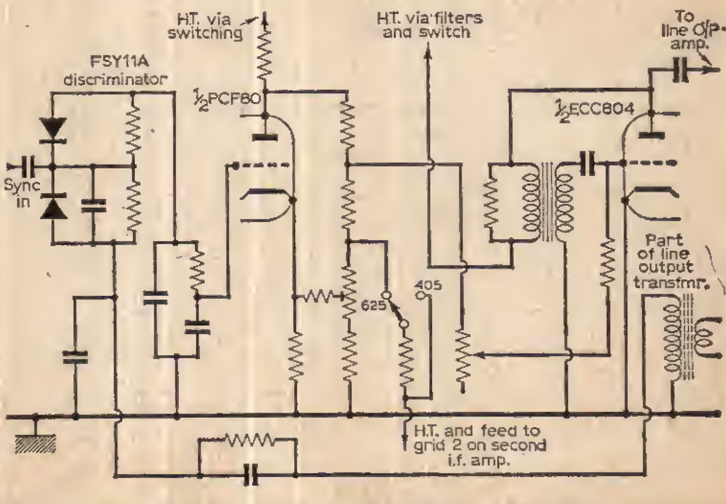


Fig. 12—A redrawn section of the popular Thorn 850 line oscillator circuit, used in many different models.

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

I DID not think that after last month's good conditions that I would have any cause for complaint in this month's article, but the fact is that at least during the early part of the period I was beginning to wonder if we were moving backwards instead of forwards! The end of June and early July were not as profitable as the corresponding periods of May and June.

In fact, I feel that some comment in detail would not be amiss, if only to reassure our DX-TV friends that they did not miss much Sporadic E reception early in this period if for any reason they were inactive.

Between the 20th and 24th of June there was a complete "blank". The 25th and 26th were, however, excellent days for all areas of reception, then the 27th to the 30th were almost "blank" again, and apart from a little activity on the 1st and 4th July this depressing state of affairs continued until the 7th July.

Don't say I wasn't trying! I was! And other DXers' reports show that reception in different parts of the country was not good either, and that there were far too many "blank" days for us to be really happy.

I am thankful to report, however, that there has been a startling improvement from the 7th to 18th July, and we have really got back into business again with daily openings and good reception from most countries. Just to risk a further prediction, after the late opening this year, I feel that the best Sporadic E may well be yet to come, and I for one will be ever vigilant!

The Tropospherics, including u.h.f. during the above period, have been quite good at times, so don't forget about them in the excitement of Sporadic E activity!

NEWS

(1) JRT Yugoslavia. Just to add to the general confusion here, still another type of Test Card is now being used at times, as well as those mentioned last month. This "new" card is like the Austrian card, but has the letters JRT at the top, and the name of the studio of origin—i.e., Zagreb—at the bottom.

A correction here to keep the record straight, the new E.B.U. supplementary list shows that there is an extra 100kW station on E4 at Psunj, so may I suggest Sliema mentioned last month be deleted from the Band I list, as it appears to operate in Band III. The original information came from an unofficial list that had better be nameless, while we were awaiting the arrival of the official one.

(2) "Exotics". I have just heard via **R. Bunney** of a most interesting report from **F. Smales**, of Pontefract, Yorkshire, and it may well be that another of our list of "exotic" stations can be ticked off as received.

On 4/7/66, at 09.45 on E3, he reports a programme with African coloured announcers, a man and a woman, followed by a cartoon film, followed in turn by a tuning caption with a picture at the top left-hand corner (church steeple or TV mast), and a word across the centre of the screen, unfortunately difficult to decipher on a weak signal, but the first three letters appear to be "NAI———" then three unidentified letters, the word ending finally with "I". The problem posed is, could this word be Nairobi?

In our list we gave Kenya as possibly on E4, and we did say that our source of information was not official, and this source was wrong in respect of Sliema above, so there may be a Kenya station on E3, and we hope that **F. Smales** will send his report to Nairobi for what I hope will be confirmation. As for myself, I am keeping a close watch on E3 at the time indicated, and I suggest that other DXers do the same.

(3) More new ones from our friend **Mr. R. Bunney:**

U.H.F. Spessart DBP 3 West Germany Ch 51 220kW hor.

Heidelberg DBP 3 ditto, Ch 53 500 kW hor.

Horby Sweden Ch 43 500kW hor. (a possible, see readers' reports re Stockholm TC).

Finland: Kajaani E4 15 kW hor.

Hungary: Tokaj R4 now up to 20kW (already received here).

Just for the future the next sun-spot maximum will be in January, 1968, so that looks like the time for the really distant DX via F2 Propagation.

(4) In conclusion, the Swiss TV services are now using a tuning signal consisting of three vertical alternate black and white wide bands before the Test Card.

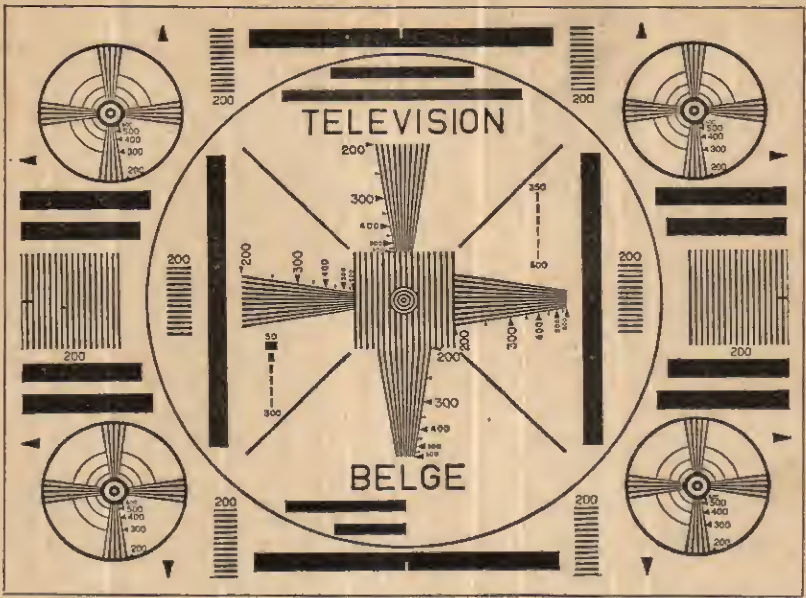
READERS' REPORTS

A. Allsopp (Cardiff) has a possible Nicosia Cyprus E2 report for 11/7/66, 1300—1400, and for the Canary Islands on 12/7/66. Have any other readers news of these?

J. L. Lochhead (N. Berwick) has sent us a sketch of a Test Card which we identify as Finland, so once again confirmation that the transmitter is **not** closing for the summer season this year.

D. Mulcahy (Cork) a new reporter has already an excellent log, including USSR, Czechoslovakia, Rumania, W. Germany, Austria, Norway, Sweden

DATA PANEL-13 BRT/RTB BELGIUM



(courtesy M. Aisberg)

Test Card: as per photo. BRT/RTB also use a card similar to that used by Poland and Hungary but the card always carries the letters BRT/RTB.

The BRT service is in the Flemish language, and the RTB service in the French language, both services use "E" channels with 625-line *positive* image with *a.m.* sound, except occasionally the RTB service when relaying France ORTF still uses 819 lines as it did until 1/1/65.

Channels—Band I. E2 BRT Ruiselede-Aalter 100 kW Hor. E3 RTB Liege-Ougree 100kW Hor.

Band III. E10 BRT Wavre 100kW Hor. E8 RTB Wavre 100kW Hor. E11 RTB Anlier 10kW Hor. E5 RTB Anseremme 10kW Hor. The first 4 stations in this list have been well received here.

Times—Test Card times usually on Test Card during mid-afternoon until start of evening programme.

Programmes start at 1830 to 1900 daily until about 2300 BST.

Finland (once again), Italy, France, Spain, Switzerland and Poland.

A. G. Challis (Beighton) gives a good log of W. German u.h.f. stations, but his most interesting catch is Sweden Ch 43, a very good distance for u.h.f.

G. J. Deaves (Hitchen) encourages with Band II successes with Kalingrad R4, with programme plus a USSR Test Card floating on it, indicating that all USSR stations do not, in fact, carry the same programme or transmission. He is compiling a list of tuning captions, etc., which seems a useful idea.

P. Swain (Harpenden) reports France F2 via Sporadic E. This looks like short skip from Limoges unless, of course, the origin is from Corsica ! His log now includes USSR, Czechoslovakia, Italy, W. Germany, Austria, Spain, Norway and Finland.

LETTERS TO THE EDITOR

I CAN HELP

SIR,—On glancing through PRACTICAL TELEVISION, I noticed a request concerning Puckle's book on Timebases in the "Problems Solved" section. I have this book and if Mr. Morton would care to write to me, I will be pleased to forward it to him. I do not wish payment for the book as I was going to throw it out in any case.—A. WOOD (30 Faulds Gate, Kincorth, Aberdeen).

SIR,—I have the issues of PRACTICAL TELEVISION that reader A. Brody of Bradford, requires (April to October). If he will get in touch with me I will be able to help him out.—L. LOBB (122 Slades Road, St. Austell, Cornwall).

CURING LOW GAIN

THE commonest cause of low gain is, of course, low-emission valves, particularly those in the tuner. But if, having changed all relevant valves, low gain persists—what then!

Clearly, if the alignment has not been disturbed, one or more components are faulty. Do not assume, however, that alignment is at fault when it is possible to increase gain by resetting any particular slug, because even with a perfectly aligned receiver, straight from the maker's test bay, it is *always* possible to increase gain by slug adjustment.

These slugs are not set for maximum gain but for highest gain consistent with adequate bandwidth response, a very different thing.

First Checks

Assuming that alignment has not been tampered with, which an inspection of the i.f. transformers and test card response will soon indicate, and after checking that local/distance or sensitivity controls are properly set, note if gain is increased when the metal body of the coaxial plug is touched. If it does, this is a sure sign of an o/c capacitor between the outer ring on the socket and the chassis.

Next remove the coaxial plug from the aerial lead and contact with the inner conductor each side of the miniature capacitors connected to the central part of the aerial socket. If the capacitor is normal, equally good results will be obtained on contacting either end with the aerial and, although these components do not often break down, it is always wise to check them before proceeding further.

Faulty Decoupling

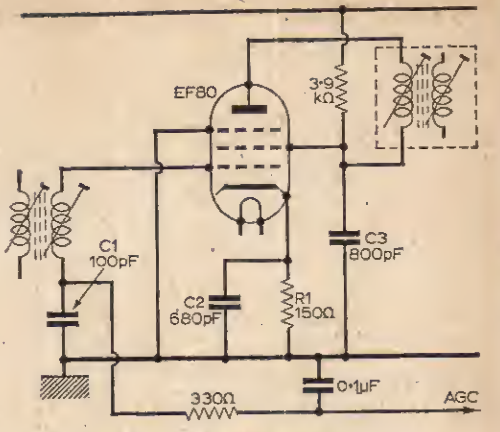
Having eliminated these small and often overlooked components it will pay now to remove the chassis or inspection panels to permit access to the underside of the valveholders and i.f. transformers in the i.f. strip.

After valves the commonest cause of low gain is an o/c miniature decoupler connected to the screen and cathode of the EF80-type valves or to the bottom end of the i.f. transformer windings. The easiest way to check suspects is to shunt a known good equivalent across them, noting any improvement in picture contrast.

Obviously if the cathode bypass capacitor goes o/c the negative feedback developed across the cathode resistor will reduce gain, but it is not so easy to see why an o/c screen decoupler similarly affects gain.

The reason is that in a pentode the control grid affects both the G2 and anode voltage so that as G1 goes more positive G2 and the anode go less positive and vice versa.

Unfortunately the screen also has an effect on the anode voltage so that as G1 is making the anode less positive G2 tends to make it more positive and a reduction in amplification occurs. A remedy is to connect a capacitor from G2 to chassis large enough to hold the screen voltage constant.



A typical i.f amplifier using an EF80.

Other Causes

Another common cause of poor contrast is a defective germanium or crystal detector and here substitution or comparison tests with a new one prove the best way to assess its efficacy.

An often overlooked cause of low gain is changed value cathode bias resistors, occasioned by shorts in the associated valve. It always pays to check the values against the maker's figures.

A.G.C. Faults

Another cause of low gain is a defect in the mean level a.g.c. systems that are so widely employed in modern receivers and where the negative voltage derived from the grid circuit of the sync separator is reduced by a positive voltage tapped from the contrast potentiometer shunted across h.t. line and chassis.

At low contrast settings in these circuits the a.g.c. line will be (measurably) negative with respect to chassis, reducing to zero as the contrast control is increased. It is a very simple matter to test the working of such a circuit in the following manner:

Tune in a station with just sufficient contrast to hold and then momentarily short the a.g.c. line to chassis. Contrast should immediately rise to maximum. Then, with the contrast control fully advanced, again short the a.g.c. line, but this time there should be no appreciable gain increase.

If there is, it is a sure indication that the positive supply from the contrast potentiometer is failing to overcome fully the negative voltage supply, and attention should be directed to the contrast control itself and the resistor feed from the slider to the a.g.c. line.

Valves

Another point worth checking is that the correct valves have been fitted in the tuner (for instance, a PCC89 in place of the PCC84 or vice versa) and that in the receiver itself no valves have been transposed (such as EF85 with an EF80).

Lastly check that in all valveholders the G1 valve pin is making good electrical contact with the socket and not merely getting a capacitive feed. Also that all riveted earthing tags are well bonded to chassis.

S. GEORGE

MODIFYING 405 TO 625

—continued from page 535

to be more critical on converted sets with the contrast control giving a sharper action. From an analysis of some of the modern circuits mean level systems seem to predominate. There is, after all, no need for a gated system on u.h.f. since 100% modulation is radiated at every line sync pulse.

U.H.F. TUNERS

The u.h.f. valve tuner (Cyldon) shown on the front cover this month and fitted to many dual-standard receivers was supplied by Radio & T.V. Components (Acton) Ltd., 21B High Street, Acton, London, W.3. The smaller of the two tuners shown on the cover is transistorised. This unit (fitted to the Perdio Portorama III) was supplied by Lasky's Radio, 3–15 Cavell Street, Tower Hamlets, London, E.1. There is little difference in the price of these tuners, the valve unit costing 35s and the transistor unit 39s 6d.

Readers wanting more information before attempting the conversion, should make reference to the series of articles published by *Practical Television* in 1963 under the title "Towards 625" in the July, August, September and October issues. ■

STOCK FAULTS

—continued from page 539

symptoms often points to this common fault.

It will be noted that the reference pulse is obtained as in previous instances, from a winding on the line output transformer. In Fig. 12, this is shown as a small transformer, although it is part of the whole. A lack of line synchronisation which *improves* as the set warms up can be caused by poor joints in this winding, perhaps held by the insulant to prevent a complete open-circuit. This is not quite the same as the "green-spot" trouble we used to experience with transformers, width and deflection coils on several older receivers. The trouble is more likely to be a plain dry joint, and usually at the earthy end of the winding. Testing with an oscilloscope soon reveals that the reference waveform is distorted and probably low amplitude.

On this model, as a final note, do not overlook the possibility of "line drain" which occurs when the PL36 line output valve goes gassy. The misleading symptom is a low anode voltage reading at the ECC804 line oscillator.

to be continued

PRACTICAL TELEVISION INDEX

The index to Volume 15 of PRACTICAL TELEVISION is obtainable from the Post Sales Department, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.
The price is 1s. 6d. inclusive of postage.

MORE ABOUT VIDEO CIRCUITS by G. R. Wilding

Part II — A.C. Coupling

DIRECTLY coupled video circuits were, if you remember, discussed last month. In this article we move on to a.c. coupling which, with the advent of 625-lines, is regaining popularity. It is, of course, possible to cater for the positively modulated 405-line signals and the negatively modulated 625-line signals in a dual-standard receiver by changing the bias levels for the two systems, but this involves switching which is not necessary with a.c. coupling since the anode current for both systems is the same. Changing the bias levels to obtain the optimum settings for the two systems would, in fact, effect the brilliance level of the tube making it necessary to readjust the brightness on system change-over.

An a.c. feed from the video anode to the tube cathode can overcome this problem. Possibly the easiest way to change from conventional d.c. to a.c. coupling is shown in Fig. 1 which illustrates a typical but simplified 405-only video output stage and two a.c. fed systems. One of these varies the brilliance by holding cathode voltage constant and changing the grid 1 voltage while the other holds G1 constant and varies the cathode voltage with the brightness control.

Precise resistive values cannot be given since they will depend upon the value of the individual brilliance control and the tube. These values must be so chosen that rotation of the brightness control completely blacks out the raster well before the minimum position, yet permits full brilliance without over-running the tube at the other extreme. This means in practice that the tube grid must not be allowed to get over positive with respect to its cathode.

The R1/C1 combination in Fig. 1a determines the degree of low video frequency attenuation, whereas in the a.c. coupled circuits, the reactance of the feed capacitor plus the value of the associated resistors are the main arbiters of the l.f. response. Naturally if it was desired to further tailor the response at the lower end of the video spectrum an additional CR pair can be connected in series with the video feed capacitor, as is done in several commercial dual-standard receivers.

There are limitless permutations of component values that can be used, but care should be exercised in mounting additional components to keep the total video circuit capacitance as low as possible.

Since the cathode of the c.r.t. is electrically divorced from the video anode when a.c. coupled, experimental changes and variations in video grid bias, G2 voltage and anode load will only affect the operating conditions of the stage and not the static brilliance, so that it is unnecessary to make constant brightness re-adjustments before assessing the effects of any change.

A minor advantage of a.c. coupling is that once set the brilliance level tends to be more stable than with conventional d.c. coupling since slight overall current variations in the video valve after long periods of use produce no visual effect.

To obtain increased gain from video stages with purely resistive loads and with no deterioration in top-end response, there is probably no better field for experiment than the substitution of a triode-pentode cathode-follower for the conventional pentode, since it has a high input impedance with low input capacitance and has a low output impedance. Also, it can handle frequencies up to about 10 Mc/s with little attenuation.

Although this type of video stage has been used on and off for many years, it appears to be regaining

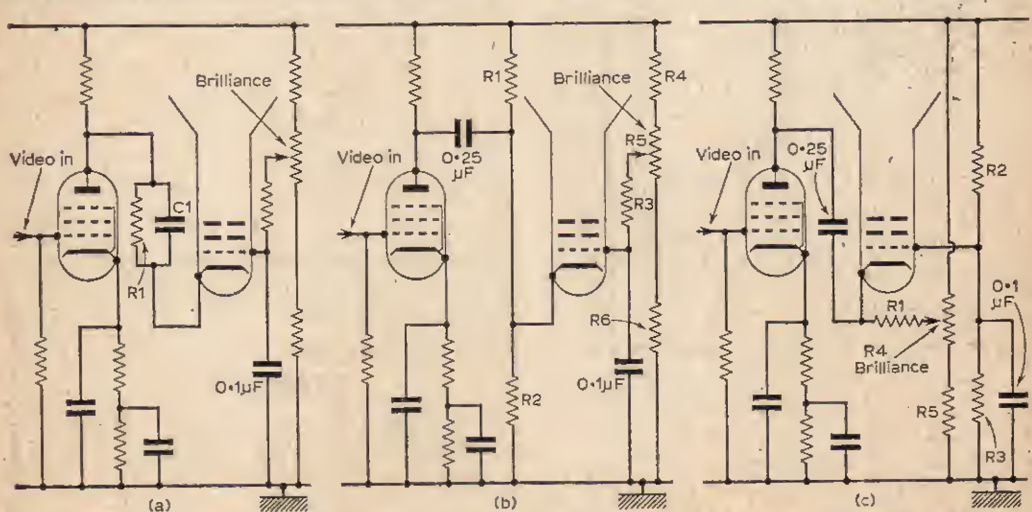


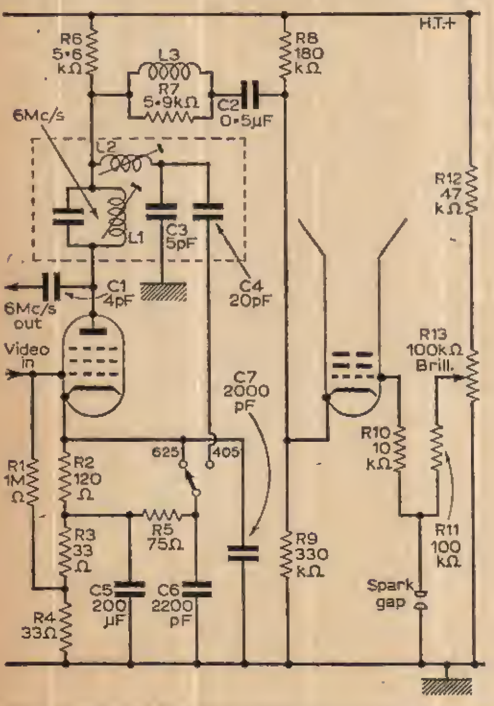
Fig. 1—A skeleton circuit of a typical 405-line receiver with d.c. coupling is shown in the (a) illustration. In (b) the circuit has been modified for a.c. coupling. The R1/R2 potential divider network maintains correct cathode voltage on the tube and the divider R4 to R6 is used to vary the brilliance level. In the final circuit (c) which has a.c. feed, the control grid is held constant by R2/R3 and the brilliance is changed by varying the cathode voltage by the R1, R4 and R5 network.

popularity due to its high gain/bandwidth factor, and Murphy, Bush and Decca all employ the cathode-follower in this way. A PCF80 is often employed in this role. This makes life easy for the experimenter since the same valveholder can be used with a minimum of alteration to the base connections.

As stated last month, anode loads of around 10kΩ are common in cathode-follower video amplifiers, but for the experimenter out for maximum possible gain, it is possible to utilise load resistance of up to 15kΩ without undue h.f. attenuation.

We stress resistive loads, since those receivers that incorporate series or parallel "peaking" coils to resonate at about 3Mc/s do so by including the total circuit capacitance.

If such L/R combinations were transferred to a cathode-follower stage, but with the resistive section increased to take advantage of the system, the "peaking" coils would then resonate at a much higher frequency than that aimed for by the designer, and would probably tune outside the video spectrum.



Therefore to try out a C-F stage use only a resistive load for both the pentode anode and the triode cathode, keeping both comparable in value.

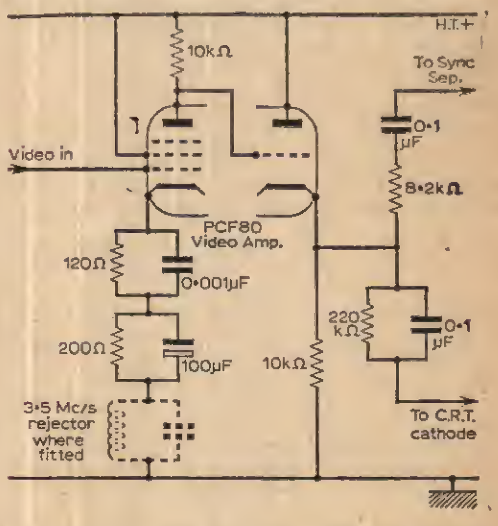
Naturally the grid voltage of the triode equals the anode voltage of the pentode but in operation the triode cathode will develop a voltage slightly in excess of this potential, so that the valve will still be slightly negatively biased.

Thus in the example shown in Fig. 3 the triode cathode voltage is 101 and 109 volts on 625-lines and 405-lines respectively while its grid voltage is 98 and 104, thus giving it an effective bias of 3V and 5V on each system. This illustration is the basis of the Decca circuit used in their DR 101 to 606 range of receivers.

If you find that changing to any of these systems is inhibited by the action of the limiting circuit, it is best to temporarily remove the latter till the experimental work is concluded. In most instances all this entails is the disconnection of one lead. Finally the author must point out that there is little to be gained in changing the coupling of a 405-line only set. ■

Fig. 2 (left)—A.C. Video output system as used in many Ferguson dual-standard receivers. The fixed potential divider R8/R9 holds the cathode voltage of the c.r.t. constant, while R13 varies the brillianco

Fig. 3 (below)—Basic cathode-follower as used by Decca.



BUYING A USED TV RECEIVER . . .

. . . and how to improve it

PART 2
by
W. HENRY

READERS who are still with me after the shameless advice to do rough and ready repairs, given in the first part of this article, may take heart at the news that Britain is likely to go ahead with the PAL colour television system. This means that many people who were clinging on to receivers while decisions were being made, may now trade them in for sets that they know will not be outdated by the proposed systems. We can, therefore, anticipate a few more reasonable bargains, mainly of early convertible and dual-standard receivers. Manufacturing standards having improved in latter years—whatever the trade sceptics may say—and these "snips" should be worth the small amount of work we may have to put into them.

In the previous part, we considered power supplies and the favourite cause of discarded sets—the faulty cathode ray tube. But there are often hidden reasons for an owner growing weary of his receiver and discarding it, which may not be so obvious. An example is the set that constantly gives trouble. Usually the trouble is in one particular section, and the annoyance may be increased by an incompetent field engineer who cannot get to the bottom of the cause.

WATCH THE FIELD . . .

Favourite sources of these persistent faults are the timebases and the field timebase in particular. A frame that trips and rolls at the least noise impulse or even a change of camera; a raster that creeps insidiously up from the bottom no matter what cure is attempted; and a picture whose characters appear to be some refugees from a freak show are among the frequent complaints. Some evidence of their presence can be found before purchase. Look at the preset knobs and the area of cabinet or escutcheon immediately around them. No amount of camouflage will hide the signs of heavy wear.

If you buy such a set that shows the evidence of much manipulation, you must be prepared to tackle the possible faults. With the aid of other, more specialised articles published in *Practical Television*, may help you more than the previous repairman. In any case, it is as well to remember that renovation jobs we are willing to carry out on our own "bargain" may have been uneconomic for a dealer to attempt. These include redesigning and rebuilding certain sections of the receiver if necessary. A study of more recent field circuits shows that the use of voltage dependent resistors will help eliminate the warming-up fault that causes changes in picture height. Modifications to the feedback circuit will help maintain linearity. An oscillator can be improved by stabilising its voltage feed and by improving the signal that produces the synchronising pulses.

Also check the preset controls themselves, especially the skeleton types that are operated by a rod which terminates in a small knob. There is a tendency for the wiper to work loose at its central clamp, making an intermittent contact with the track. Where several of these are fitted, often self-supported on a printed circuit, it is an advantage to replace them with more robust types, mounted on a small sub-panel, or even via jumper wires on the back of the receiver itself. Such an expedient would be frowned upon by a regular service department, but will often solve our home problems.

Look to the current-carrying resistors in the field stages; anode loads, cathode resistors, and screen grid fixed potentiometers. After much use, these often change value causing a multitude of faults; replace with resistors of adequate wattage. Our cost-conscious friends the manufacturers have a habit of fitting components that come just within the necessary rating, making little allowance for the fact that the set may be used in an ill-ventilated corner for years on end. We can afford to be a little more idealistic, having got ourselves a "cheap" set.

. . . AND THE LINE

Line timebases are a different proposition. It does not pay to modify these, and faults that are not caused by valve deterioration can be expensive to rectify. The same advice as before applies to the oscillator section—remembering that this stage must supply adequate drive to the line output section. Some peculiar faults can arise from the simple origin of a weak oscillator that starves the line output valve of its required drive, even to the extent of causing premature failure of the latter. Again, poor field service may have discouraged an owner, after several line output valves are replaced in succession. Line output screen grid resistors, boost capacitors, and line oscillator anode resistors are the weak links that should be checked in cases of this nature—presuming that we have first ensured the valves are up to scratch.

A dim picture—again a cause of trade-in that the busy dealer may not have bothered to investigate—can be caused by such inexpensive items as the e.h.t. rectifier, or boost diode. Often the tube is suspected, and that is as far as some dealers will go. If the dim picture tends to swell and disappear when the brightness or contrast controls are advanced, voltage trouble is the cause, and the e.h.t. regulation is likely to be at fault. This could be due to a "soft" rectifier, or even a poor joint at its base. A possible fault is the small resistor, consisting of a couple of turns of resistance wire wound on a component, mounted on the base in series with the heater of the e.h.t. rectifier.

The line output transformer is not easy to substitute. Width, linearity and deflection coils are all part of the complete design, and do not allow simple replacement. If these items are faulty, and unless it is known that a replacement is likely to be available, the "bargain" set may prove an expensive acquisition. Line transformers, when they fail, sometimes develop a single shorted turn.

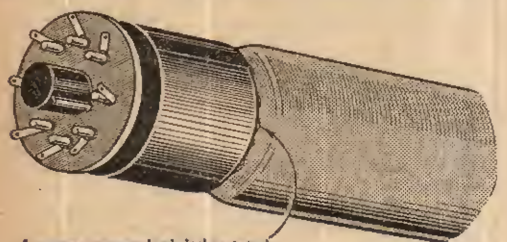


Fig. 3: Intermittent vision on an older receiver may be caused by loose connections at the tube base. Look for dried-out cement at the neck where the cap is fitted, and resolder the pins.

This does not show and will not make a noticeable difference to an ohmeter reading. Only a shorted-turns tester will show the trouble up. The fault prevents the line output stage from operating, and can usually be deduced after preliminary tests. When making these tests—if one is allowed to do so before buying—first check that h.t. is present at the line output anode. This proves continuity. Next, check the top cap of the efficiency diode, with the cap connected, and then with it removed; h.t. should be present at this point. Then transfer the meter (or neon tester) to the connecter, with is held away from the cathode top cap. A reading at this point, with most circuits, indicates a leaky boost reservoir capacitor, but again proves continuity of the upper section of the transformer. If it is possible to disconnect the scan coils, recheck under these conditions. With some circuits, the removal of this damping will temporarily spark the line output stage to life. A shorted-turn scan coil, or a leak to the yoke, is a frequent cause of trouble.

SHORTED TURNS

Width and linearity coils are vulnerable items and must be inspected for signs of overheating, which a shorted turn or leak to mounting will incur. Although some circuits allow replacement of these by odd items, unless one is sure, again some caution should be exercised.

Line circuits driven by a flywheel oscillator are common fault sources, and there are occasions where these may have been used under poor signal conditions, giving frequent trouble. If your signal is good, the line section may prove less irksome. In many cases, reversion to a plain oscillator circuit is possible. Notes on these reconversions, which are well worth considering when renovating an older set, have appeared from time to time in these pages.

SYNC AND VIDEO

The sync separator and the video circuits are vital to correct timebase operation. Where a good raster can be obtained, and one or other timebase is apparently unstable, the other tripping too easily, the fault may have its origin in one of the earlier sections and may not be too troublesome to trace and cure. Sync separators are very voltage conscious. Their method of operation depends on correct anode and screen grid voltage levels as well as a good signal from the video circuits. Again, look for changed resistor values.

Similar strictures apply to the video output stage, where the screen grid and cathode regulating potentiometer network may have changed value on an ageing set. The change is often insidious, and the viewer may be quite unaware until one day he awakes to the fact that his picture has lost its sharpness and clarity. Again, the tube is often wrongly suspected and the set traded in before proper investigations are made.

The small chokes in and around the video stage are another possible "age" fault. Wound with fine resistance wire on a normal carbon resistor, they tend, with the regular passage of current and the heat cycle of a set in frequent use, to develop fractures, intermittent contact and even open circuits at the ends. As there is still the resistance in circuit the video stage may still operate, but with impaired efficiency.

Yet another cause of deterioration in an older set is the crystal detector whose reverse resistance falls after a time causing the video signal to loose contrast. This is often hidden away inside the final intermediate frequency transformer screening can. In severe cases, streaking and plasticity may be noted. The cure is cheap and simple, yet all too often overlooked, because the component is not immediately obvious.

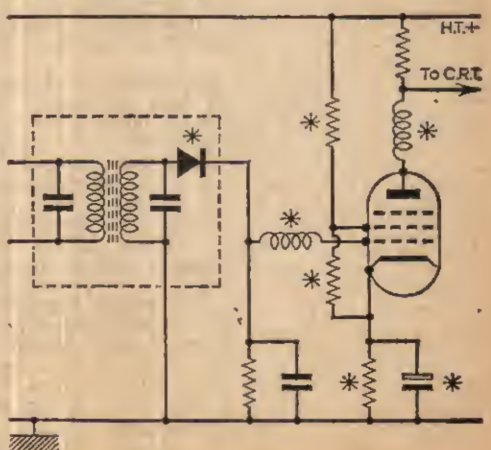


Fig. 4: Circuit of typical video stage, showing points to check on an old receiver.

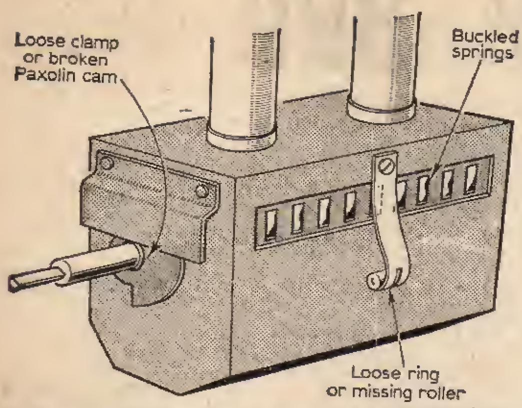


Fig. 5: Many different types of tuner unit have been fitted, but the mechanical points shown are first suspects on older sets, and may be virtually incurable. Cams may sometimes be cemented back in position but springs seldom retain their elasticity after bending and straightening. There is also a possibility of coil biscuit damage. On later types, variable inductances were used, and worn threads of the tuner device or present push-button setting rods are common reject causes

It is not within the scope of this article to discuss the various faults than can occur, and detail their cures. This has been done elsewhere, and reference should be made to the specific sources when troubleshooting is undertaken. At present we are concerned with pin-pointing the most likely trouble spots on an older set that has been cast aside, and to give some warnings where the signs of previous repair and adjustment may indicate more trouble in store. One such warning sign is the chewed iron dust core of the i.f. transformer. If you have a chance, take a quick look at these before buying. When the slots are worn away, or the hexagon type hole slugs are cracked, the attention of some previous "cowboy" is betrayed. Often, the only remedy is careful drilling out of the broken slugs, re-newing, and re-alignment. In any case, damaged slugs will warn us that the alignment is not likely to be correct. Without the necessary instruments, this can be a tedious job; sometimes impossible on certain classes of receiver.

On the other hand, if we possess a good signal generator and the know-how, it is possible to perk up a set that someone else has given up as a hopeless "response" job. Given the time and the persistence, backed by alignment information for that particular model, we may be more fortunate than the harassed "professional" engineer.

Sound-on-vision and vision-on-sound are other troubles that indicate misalignment, but can also have different origins. If the establishment from which we obtain our second-hand bargain does a lot of rental, this may be a rejected rental receiver. It is as well to remember that the field man does not dig too deeply into fault conditions —they do not have the time, even if they are sufficiently knowledgeable. Thus we may find the type of fault that gives misleading symptoms, and that has been overlooked.

Mention of the sound stages leads us to what is perhaps the least worrying part of the set. There are few sound output sections that could not be improved by the modifications an enthusiast would be happy to carry out. A new loudspeaker of sufficient quality to do justice to TV sound is not likely to break the bank.

TUNER TIPS

This leaves just the front end of the receiver—and the section which can possibly give us the most worry. Because of the styles of construction of the various tuner units, failure can be electro-mechanical, and replacement parts may be unobtainable. This particularly applies to fine tuner devices; a diagram shows the early "conventional" type used by a number of makers, and pin-points the likely fault that may have led to frequent re-tuning and possible damage to coils. If it is possible to get at the tuner and inspect the coil biscuits or printed-circuit wafers, before purchase, try and do so. If not, and there is a chance to manipulate the controls, look for erratic contact symptoms, and for excessive play in the fine tuning device.

The problem is not insurmountable. We could always substitute the tuner and modify the mounting. Standard intermediate frequencies have been the order of the day for a long while, and some older tuner units are available from the many factors who advertise in these pages.

Where dual-standard sets are being vetted, look for the coupling from the tuner unit to the standards switch, where worn linkage may be impossible to cure without a bit of "ironmongery". Again, this is the sort of jab that the professional service department will not tackle, but that we may be happy to do ourselves. The system switch itself is a prime trouble source. If our second set is to be used on one standard only—usually Bands I and III—there is nothing wrong with disconnecting the linkage, permanently fixing the switch in its required position, and even wiring across switch sections that are worn or buckled. The long slider type of switch is a formidable brute to change on a printed circuit panel; hence the dealer's decision to reject it. We may anticipate a few such bargains on the second-hand market in the years ahead—well worth picking up cheaply as stand-by receivers.

CABINET—WHO CARES?

It is rare for a receiver to be thrown out because of a tatty cabinet, but a couple of years ago many sets were made which are an eternal insult to the industry. The circuits were adequate, the construction fair, though too often constricted, but the cabinets and backs were plastic and gilt horrors that soon showed the effect of heat, and after one or two attempts at service, practically fell to bits. The home handyman should not overlook the chance of a good set in a broken cabinet. Unit furniture is the fashion nowadays, and we can find ways of building our receiver into a more solid enclosure at a reasonable cost. Care must be taken to ensure good ventilation, but apart from this, any construction work should present little difficulty. We would be interested to hear from readers who have done just such renovation jobs and would like to pass their tips on to others. ■

WORLD CUP 1966

W. Twyford describes the vast technical effort which was needed to show the Championships to home viewers and to the rest of the world.

AS Great Britain had the honour of being host country for the World Cup Football Championships, an organisation was created to cope with the demand for television, sound radio and news film coverage. This organisation was set up by the BBC and the Independent companies in the form of the World Cup Consortium.

Some idea of the coverage required may be gathered from the fact that some 35 broadcasting authorities asked for television coverage and 300 for sound radio facilities. These broadcasting authorities requested the Consortium to cover all the matches which were played at: Ayresome Park, Middlesbrough; Goodison Park, Liverpool; Hillsborough, Sheffield; Old Trafford, Manchester; Roker Park, Sunderland; Villa Park, Birmingham; Wembley and White City, London.

From these grounds eight outside broadcast units were fed to the BBC Television Centre where all co-ordination took place. Construction of a new building at the Television Centre to be used for Television News studios was speeded up to allow the space to be used for the Consortium's technical and co-ordinating facilities. Sound radio facilities were also dealt with here. Television sound and radio sound are basically similar except that radio coverage can be sent direct to any country, but television sound is recorded along with the pictures for those countries unable to take the vision directly.

At each ground an Outside Broadcast mobile control room with four cameras covered the matches, one of these cameras being used for interviews and score captions in a special interview studio. At Wembley, however, there were seven cameras and two mobile radio cameras. The BBC had two control rooms there; one for the Consortium, the other for BBC-1. The ITV companies also had their own control room to feed their own network. In addition, film camera positions were provided at each ground.

The sound side of the coverage was by far the most complex. This is usual in most international television programmes because of the large number of commentaries in different languages. Each commentator used a standard unit which allows the commentator to control his own microphone or a spare; provides a headphone to monitor his own output or International sound (this is effects, such as crowd noises, etc., without any commentaries or interviews); and incorporates a telephone. At each ground 20—30 of these positions were used, each position being in a small soundproof cubicle containing the commentary unit and a television monitor. Thus 40-60 circuits were used at each ground to deal with the commentaries alone. Another ten circuits were used for International sound, talkback and various supervisory and spare circuits. An International Commentary Area in the Television Centre was set aside for more commentary positions for 'off the tube' commentaries, i.e. viewing a monitor.

All the matches, with appropriate commentaries were sent direct to the Eurovision and Intervision networks (Intervision is the equivalent to the Eurovision network behind the Iron Curtain). Hence many of the matches were recorded in the countries concerned or broadcast direct. It is on these occasions that telephone lines to the commentator are used to co-ordinate the commentary into the rest of the country's network programmes or to allow timing of the commercial breaks.

The Early Bird satellite was used to transmit pictures to Mexico and South America. As the satellite is "synchronous" it does not vary much in its position above the Earth, making continuous coverage possible. Due to its height (about 22,000 miles) the delay in the vision signal being returned to earth was such that a magnetic tape was used to delay the sound by the same amount, the sound circuits being by transatlantic cables or by direct radio links.

ENGLAND 4 WEST GERMANY 2

Where a country could not take a programme direct it was video tape recorded on one of the eight machines. Each of these machines records in synchronism with a 12 track Telefunken sound tape recorder, which recorded 10 commentaries plus International sound, the last track being used to synchronise with the video tape recorder. These recordings were later dubbed on to another tape or a film recording with the required commentary and International sound. The tapes and films were then flown to the countries concerned and were available for transmission the following evening. All countries concerned used the 625 line standard except for Great Britain (405), Mexico and certain South American countries (525 lines, 60 fields). For home use an electronics standards converter was used but an optical converter was used for the American line standard.

For particular requirements, any organisation could bring their own video tape recorders to the Television Centre where feeds were made available. This facility permitted special editing to programme requirements.

To complete the facilities offered, there was a "unilateral" studio for interviews, introductions and comments. This studio, located in the Television Centre, used three cameras with the new Plumbicon camera tube.

The BBC used a slow motion video tape recorder with still frame facilities to show in detail the most exciting moments of play. This is similar to the device used by the Japanese in Tokio for the 1964 Olympic Games. As many of the other BBC programmes as possible were recorded during the World Cup period and many of these were replayed by ITV and other organisations. ■

THE OLYMPIC II
Transistor TV
— AUTOMATIC GAIN CONTROL

by D. R. Bowman, B.Sc.

THE provision of automatic gain control for a television receiver is undoubtedly a refinement which might well be optional. In the first place, unless the signal strength is quite high there is always a tendency towards a "grainy" if not "noisy" picture, because of inherent receiver noise on the one hand and interference on the other. As a result—unless one is a DX enthusiast, the favourite reception is of high field strength stations, and these are necessarily near enough to be not normally subject to severe fading.

Nevertheless, any programme can be sadly marred by the effect of "aircraft flutter", a form of interference that has always been with television and is likely to get worse in the future. This phenomenon is due to wave-interference arising from double-path reception, and is often accompanied by the formation of positive or negative "ghosts" on the picture tube face. Few effects, except perhaps severe mains-borne static are more unpleasant, since in many commercial receivers (in fact, in the majority) such consequences as rapid variation in picture size as well as brightness and contrast appear, together with break-up of the picture, vision-on-sound and sound-on-vision due to an overloaded input stage and so on. Automatic gain control, in an area where aircraft are a nuisance, is thus a definite advantage.

The original Olympic II was not provided with a.g.c., since this represented a major design problem if it was to be done properly. The increased expense would have been hardly noticeable perhaps; but since the production of the prototype was undertaken in an aircraft-infested area, and the effects noted were not really objectionable with the circuitry as published, it was decided to make quite sure what the 625-line conversion would be before adding a.g.c. The conversion design has already arrived at the point where the construction of a first prototype can begin. Consequently the a.g.c. unit here described is likely to prove effective on both 405- and 625-line transmissions.

EFFECTIVE A.G.C.

Automatic gain control in the vision channel can be had for next to nothing if one is not too fussy about it, but really effective a.g.c. is not quite so cheap. The favourite type of control in commercial practice is "mean-level" control, and this can be had (for example) at the grid of the sync separator valve. The trouble with this is that the mean level of the signal is by no means the ideal reference, since it necessarily varies with the picture content. Thus, a picture containing large dark masses has little modulation on it, and if the control voltage depends on mean level the gain of the receiver overall will increase—producing a rather noisy raster together with a largely grey screen. It all comes right again when a more highly modulated signal reappears, the correct black level being restored approximately. However, a picture whose noise and black level depends on picture content can hardly be regarded as satisfactory. An audio analogy would be a.g.c. which operated on modulation rather than a carrier; speech and music would be reduced to a monotonous level whose chief variation would be in noise.

The only part of the transmitted waveform which is maintained at constant level for a given field strength is the sync pulse modulation; the amplitude of sync pulses of the detector does vary with aerial signal and nothing else. This is therefore, the only part of the

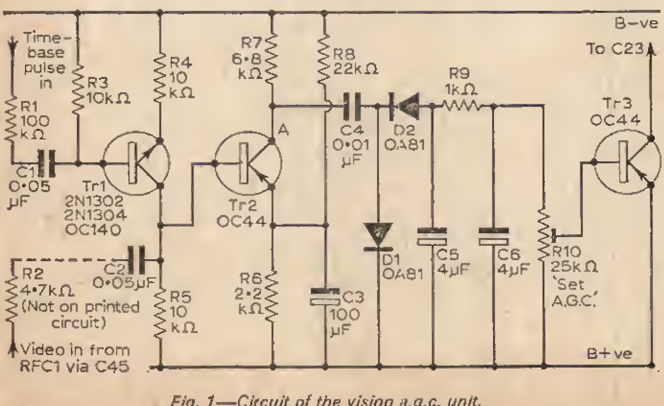


Fig. 1—Circuit of the vision a.g.c. unit.

received signal which will give correctly-arranged a.g.c. There are two ways in which the sync pulses can be made use of.

In the first place, line sync pulses occur regularly and during the pulse there is no picture modulation. Hence, if line sync pulses can be sampled for amplitude, an error signal can be obtained which is independent of picture content. Secondly, during the field sync period and the picture suppression during the flyback period, field sync pulses only appear. Again, if these pulses are sampled for amplitude an error signal independent of the picture can be had. In principle, either sampling can be done readily enough by means of suitable circuitry. The a.g.c. unit developed for the Olympic II is of the field-sync sampling type, and the reason for this is as follows.

To sample the amplitude of a line sync pulse a "gating" pulse has to be provided which effectively connects an amplifier to the video signal during the sync pulse. The gating pulse must therefore occur after the "front porch" has begun and must finish not later than the end of the "black porch", and can thus be only about 18μS in width. It recurs every 98·7μS. Any delay in starting the pulse will lose some of the 18μS, and any delay in terminating the pulse will mean that some of the picture content of the next line will be included in the "sample". Delays in transistor circuits tend to be rather large because of the effects of changing base charge, and although the thing can be done it is not simple. The likeliest way would be to use the line sync pulse to gate an amplifier to sample the sync pulse, but as soon as an amplifier is used to get enough of a pulse to do the gating, the delays reduce the available pulse width, and the system is insensitive.

However, the field sync pulses last for a much longer time, and an amplifier delay of a few microseconds wastes very little of them. This is economical, relatively easy to get going, and cheap.

CIRCUIT OPERATION

The circuit diagram is given in Fig. 1, and the method of operation should be relatively easily understood from the following brief description.

Tr2 is the amplifying transistor whose function is to deal with the video signal. It is arranged to operate in the common-emitter configuration; R5 and R4 are the base-bias resistors and R6 provides emitter bias in the usual way. Between the base of the transistor and R4 a further transistor Tr1 is interposed, and this is normally cut off because its base is returned to the B- rail. The transistor is an n-p-n type, for convenience in circuit arrangement.

Since Tr1 is cut off, Tr2 base receives no d.c. bias and is also cut off. However, the base of Tr1 is connected through the pulse-shaping network R1 C1 to the collector of the field output transistor, and when field scan is completed the flyback pulse causes Tr1 base to draw current—it is in fact switched hard on by the pulse. This action connects d.c. bias to Tr2 base, and Tr2 cuts on.

A suitable network R2 C2 connects the base of Tr2 to the emitter follower section of the video amplifier, and when Tr2 cuts on the whole of the video signal is applied to Tr2 base. An amplified version of the signal then appears at Tr2 collector, and is rectified by the diodes D1 and D2, smoothed by C5, R9 and C6, and a voltage proportional to the video signal is developed across R10. Since during the field flyback pulse the video signal consists of sync pulses varying between approx. black level and zero, the object of the exercise has been achieved.

The voltage developed across R10 is a negative-going voltage because the diodes D1 and D2 are appropriately wired into circuit. Part or all of

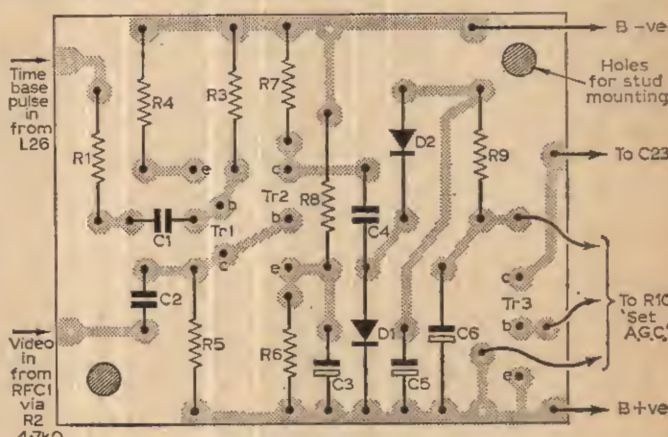


Fig. 2—Printed circuit layout.

this voltage is applied to the base of a further transistor Tr3, and base current flows. The effective resistance between collector and emitter of Tr3 is dependent on the base current, and thus as far as direct current is concerned Tr3 becomes a resistor whose value decreases with increase of signal strength.

Referring now to Fig. 10, page 359 of the May, 1965 edition of PRACTICAL TELEVISION; VR1 may be removed and the junction of R20 and C23 connected to the collector of Tr3 above. At the same time for best results R19 should be increased in value to 18kΩ. R1 is connected direct to the "live" (non-earthy) end of the field output choke feedback winding—see PRACTICAL TELEVISION, August, 1965, page 491, where the lead may be connected to the circuit board PC5 at the edge connector labelled "To L26 choke". Video signal to Tr2 base is supplied by soldering a 4·7kΩ resistor to the circuit board shown in Fig. 11 (May, 1965, page 360, PC3) at the point labelled "sync", with a lead from the resistor to C2 in Fig. 1 above.

The suggested printed circuit for the a.g.c. unit is shown in Fig. 2. R10 is a "set a.g.c." control, and is intended to be pre-set, if required, user-adjustable.

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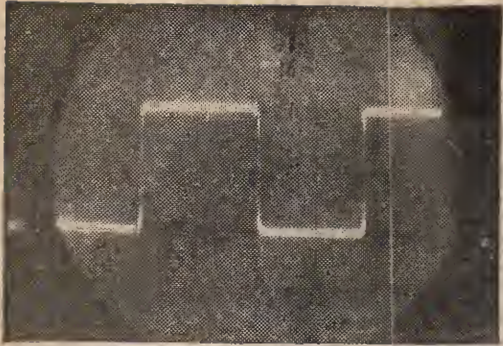
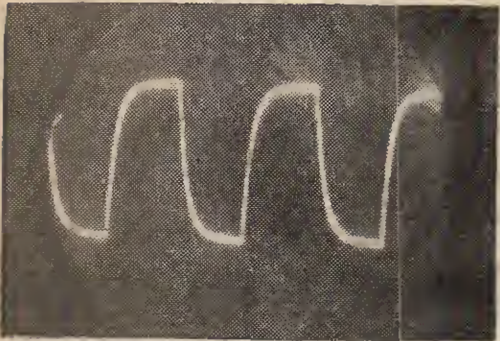
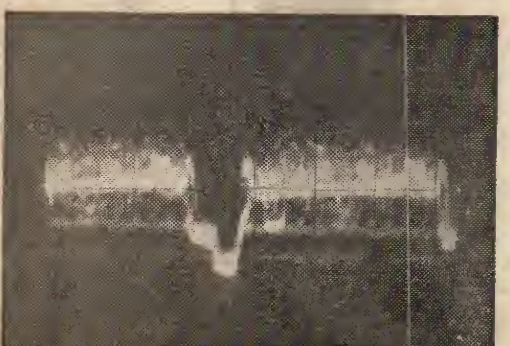






VIDEO AND S

by K

THE 405-line picture modulation and sync pulses are carried on the very high frequency (v.h.f.) vision signal. This signal along with the sound signal is picked up by the aerial and passed to the tuner, where it is first amplified. After amplification in the tuner, it arrives at the frequency changer, where its frequency is translated or converted to the vision intermediate-frequency (i.f.). The tuner's frequency changer also delivers the translated sound signal as the sound i.f. signal.

Bird's Eye View

The sound i.f. signal is then developed across tuned circuits, filtered and passed through the sound i.f. amplifiers and transformers so that it arrives properly processed and amplified at the sound detector, at which point the carrier is deleted and the modulation extracted for audio amplification and final power amplification to work the loudspeaker.

The technique differs just a little on 625 lines in practice in that both the sound and vision signals pass through a single i.f. channel, the sound signal (still modulated, but frequency-modulation on this standard) then being parted from the vision signal at the output of the vision detector, since at this point it takes on a carrier frequency of 6Mc/s. This is the difference in frequency between the sound and vision signals, and is called the *intercarrier frequency*.

Sometimes the intercarrier signal is permitted to pass through the video amplifier, along with the vision modulation (i.e., picture modulation and sync pulses), but either at the vision detector or video amplifier output the intercarrier signal is amplified a little at 6Mc/s and then follows the same route as the 405-line sound signal.

In this article we are concerned only with the vision signal, but it is just as well to get a bird's-eye picture of what happens to both signals (sound and vision), especially so far as the 625-line standard is concerned.

Now, vision modulation and sync pulses differ greatly from ordinary sound signals. Television sound signals have sine-wave components that rarely go much above 12kc/s. Vision signals, on the other hand, are much more of a pulsative, transient nature, with very fast rising and falling leading and trailing sides, often of very small duration.

Figs 1–4 (left–from top to bottom)—(1) A square-wave representative of a video signal (see text). (2) Distortion produced on a square-wave due to insufficient bandwidth. (3) Distortion produced on a square-wave due to poor low-frequency response in the amplifier. (4) Picture signal during a line period, as taken from the cathode of the picture tube.

YNC FAULTS

OYAL

Sync pulses are rectangular with a flat top (or bottom), also with very fast leading and trailing sides. A square-wave depicts this sort of signal, as shown in Fig. 1.

A perfect square- or rectangular-wave would rise from and fall to its datum value in zero time. But this is impossible, for in practice there must be some finite time for the signal to rise and fall. The rise and fall times are greatly influenced by the bandwidth of the amplifiers and circuits through which the signals are caused to pass. Moreover, the shape of the waveforms are influenced also by any time difference between the passage through the circuits of signal components of different frequency (an aspect of phase).

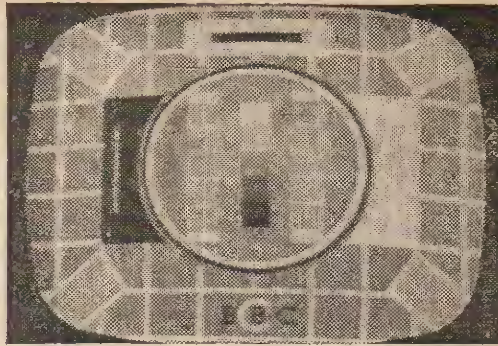
Square- and rectangular waves derive their shape from the addition of many odd-number harmonics of the basic repetition frequency of the signal. These harmonics are really sine-waves, and the wave-shape arises when they are added to the fundamental in specific amplitude and phase relationship. This applies to any complex waveform, triangular, sawtooth, transient and so forth. Indeed, all waveforms, no matter how complicated they may be, can be broken down to component hormonically-related sine-waves.

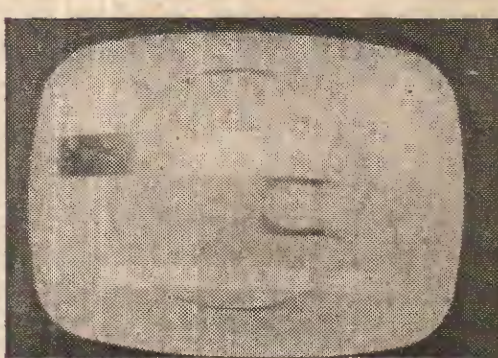
Clearly, then, if a square-wave or any other complex wave is applied to an amplifier which is incapable of passing the harmonic components properly or which alters the phase and/or amplitude relationships of the harmonic components, the output signal will differ in shape from that of the input.

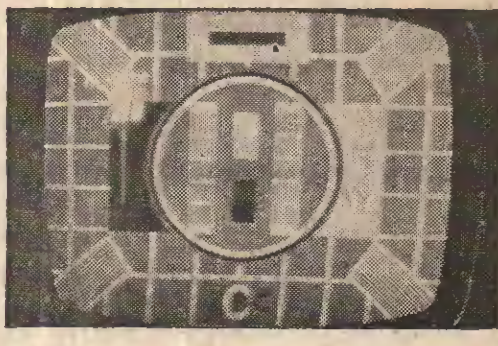
This is revealed in Fig. 2. Here is the square-wave of Fig. 1 after it has passed through a video amplifier of limited bandwidth. Some of the higher order harmonics have been attenuated and others deleted, thereby causing the rounding of the leading corners and a substantial increase in rise time.

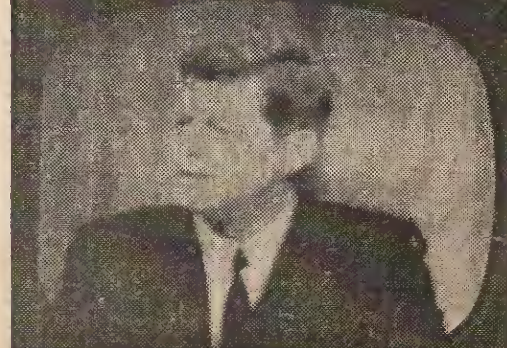
Fig. 3 shows what happens to the same wave after passing through an amplifier having a low-frequency response. If phase distortion is also present, the tops and bottoms of the waves will appear curved as well as tilted.

All this goes to show how the sync pulses and picture modulation waves can be affected by passing through an amplifier of insufficient bandwidth. This can happen due to misalignment of the vision i.f. channel or due to trouble in the video amplifier and picture modulation carrying circuits.









Figs. 5–8 (right–from top to bottom)—(5) Lack of bandwidth shows as poor horizontal definition on a test card. (6) Grossly maladjusted video channel, resulting in flaring as well or very poor horizontal definition. (7) The definition of this test card is about 2 Mc/s. (8) The lack of definition on this picture results not from the set but from bandwidth impairment on the transmission channel (Telstar in this case).

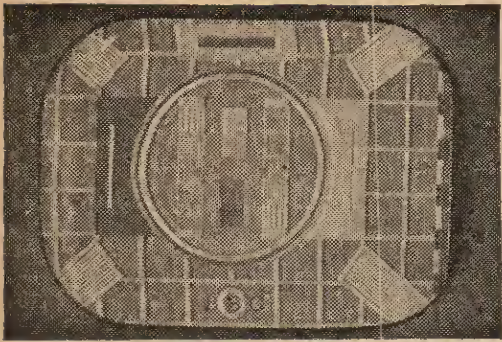


Fig. 9—The symptom of black-after-white and white-after-black due to overshoot in the tuned circuits.

Fig. 4 shows the actual vision signal at the cathode of the picture tube on 405 lines. The oscilloscope was adjusted to display one line sync pulse and parts of picture lines either side. Theoretically, the sync pulse should have perfectly square corners (like the square-wave in Fig. 1), but distortion in the vision circuits always introduces slight rounding and tilting. This is really not too bad, and would not prevent the set from working, but a little more distortion would almost certainly affect the synchronising in some way.

The separate elements of the picture signal cannot be seen clearly in the oscillogram (Fig. 4) because they were continuously changing with the picture content when the photograph was taken. However, they often consist of very complex waveforms with rapidly rising leading edges. A change between picture white and black or between black and white would demand an almost instantaneous change in the amplitude of the signal element for the best definition of the finer horizontal parts of the picture. This is like the square-wave in Fig. 1. If the amplitude change is delayed due to insufficient video bandwidth, the picture tube would fail to record fine horizontal detail of the picture owing to the increased rise (and/or fall) time of the picture waveform. This can be appreciated by looking again at Fig. 2.

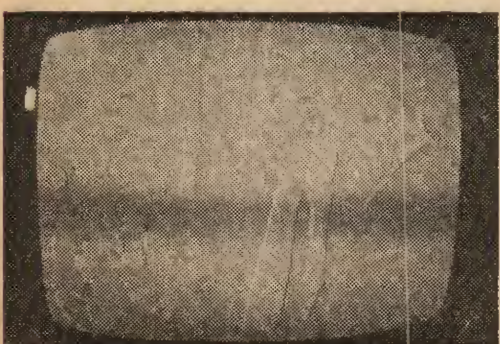


Fig. 10—The symptom of plastic.

The result is that the picture is said to have poor definition, and this can be judged by the frequency gratings on a Test Card. Fig. 5 shows poor horizontal definition on Test Card C. The vertical bars of the 1Mc/s frequency grating are displayed with reasonable contrast, the 1·5Mc/s bars are barely visible, while the 2, 2·5 and 3Mc/s gratings (beneath) fail to show any of the fine vertical lines which make up their squares. This is because the restricted bandwidth of the vision section has effectively delayed the amplitude changes between picture elements carrying fine detail, so that in fact there is no change between them, the whole grating being represented by one composite signal.

Poor Definition

If the bandwidth falls below about 1Mc/s, not only is the horizontal definition very badly affected, but flaring may take place from blacks and whites, as shown in Fig. 6. This flaring can result from phase distortion effects caused by one or more tuned circuit in the vision i.f. channel being considerably out of alignment.

Fig. 11—The cog-wheel symptom.

The symptom can also be caused by trouble in the video amplifier stage (that is, the stage between the vision detector and the picture tube cathode). If the anode load of the valve increases in value, for instance, the gain of the amplifier will be abnormally high and the bandwidth low. The effect will be excessive contrast coupled with poor horizontal definition. Similar effects will occur from value increase of the vision detector load resistor and sometimes due to alteration in the value of the capacitor connected to the cathode of the video amplifier valve.

If the bandwidth of the vision channel is down to about 2Mc/s a fairly reasonable picture will be obtained of definition shown in Fig. 7. In poor reception areas of low signal and probably high interference, a definition of this quality would not be too bad, for extended bandwidth under such conditions can highlight the effects of interference and noise.

The bandwidth of the whole television system, from camera to picture tube, has to be maintained to secure the best picture definition. It sometimes happens that the set may be in good alignment

Fig. 12—The symptom of picture signal at the output of the sync separator.

and order, yet the definition of some transmissions is poor. One cause of this trouble lies in suppressed bandwidth somewhere in the transmission link. Typical in this respect is the bandwidth limitations imposed by some of the early satellite links. Fig. 8 shows a rather historic television picture, via the Telstar network. While the set from which this picture was taken had a video bandwidth up to 3Mc/s, the bandwidth of the picture is around 2Mc/s.

Early video tape recordings also suffer from bandwidth limitations, especially some of the early American ones which were networked in this country, and some outside broadcasts, via non-too-good landlines suffered likewise. The video bandwidth required for good 405-line pictures is about 3Mc/s, while 5Mc/s or so bandwidth is needed for 625-line pictures of horizontal definition equal to the improved vertical definition potential given by the greater number of lines.

Impaired 625-line video bandwidth will reduce the apparent definition of a 625-line picture more than similar 405-line bandwidth impairment will reduce the apparent definition of a 405-line picture. This is because of the higher line scan velocity of the 625-line system. Owing to this, of course, the broadcasting authorities have a special need to ensure that the cable and radio links are well equalised up to at least 5Mc/s.

Fig. 13—Line pulling and slight curving at the sides of the picture due to hum.

Aerial Systems

Viewers working from some shared aerial systems and relay systems, the engineering of which leaves something to be desired, may have to put up with picture definition below that of other viewers working direct from well designed and installed aerials. Unfortunately, some such systems (by no means all of them) have a vision bandwidth limitation in the order of 2Mc/s (the author has even seen less !).

The aerial thus enters into the bandwidth equation, and when colour comes along, impaired bandwidth will be even more of a problem than it is today, for it could quite probably severely attenuate—or even cut off altogether—the colour information in the signal, leaving just poor definition monochrome. Not many viewers will like this after paying £200 or more for their set ! The best of the u.h.f. aerials being made today are designed to ensure adequate colour bandwidth and minimal phase distortion (the latter which can alter the colours).

Fig. 14—Severe hum in the video channel due to hum on the tube grid.

In many instances of poor definition, where the set rather than the signal is at fault, results from unskilled or poor alignment of the vision i.f. stages. Dual-standard sets in particular can represent large problems in this respect, for on the 625-line standard the video bandwidth has to open up to embrace the sound carrier (at a critical level) as well as the vision carrier and its high definition modulation. On the 405-line standard, filters are switched in circuit that serve to reduce the bandwidth to about 3Mc/s. It is often surprising just how much more horizontal definition can be added to a picture by carefully undertaking the alignment exercise in strict accordance with the maker's instructions.

Fig. 9 shows what can happen if the alignment causes peaks or troughs along the top of the vision response curve. A sharply changing picture signal element (from black to white or vice versa) can cause what is termed *overshoot* in relation to the misaligned circuit, and this appears on the picture as black after white and white after black —a typical symptom of misalignment or mismatch.

If the tuned circuits are adjusted in a manner to limit the amplification of the lower video frequencies, relative to the high frequencies, an effect called *plastic* occurs. This is shown in Fig. 10, where the picture tends to assume a mean level of brightness, while the outlines of objects seem considerably over emphasised.

If the emphasis is in favour of the lower video frequencies, then *flaring* from black and white picture content occurs, as already shown in Fig 6.

Another symptom of misalignment is the *cog-wheel effect,* shown in Fig. 11. On a Test Card bordered by black and white rectangles, the effect is shown by displacement of strips of picture at levels corresponding to the white rectangles. If the displacement is to the right, the trouble may well be caused by misalignment resulting in attenuation of the higher video frequencies (also shown by poor definition of the higher frequency gratings on the Card). However, if the displacement is to the left, the passage of picture signal through the sync separator, due to a sync separator stage fault, is a likely possibility. In this case, the frequency gratings will not show impaired high-frequency response.

Picture on sync shows on a picture as bands of picture pulling across the screen, the effect being related to changes in the picture material, as shown in Fig. 12. In severe cases the picture material can displace the line completely, as shown in Fig. 13.

The presence of picture signal at the output of the sync separator nearly always means that a component connected with the sync separator valve has changed in value. Checks should thus be made of the anode and screen grid resistors and of the resistor and capacitor connected to the control grid, picking up signal from the video amplifier. In obstinate cases, the valve should also be checked by substitution.

Hum in the vision channel, often from a leak in the heater/cathode insulation of the vision detector, video amplifier or picture tube, produces severe horizontal shading on the picture, as shown in Fig. 14. On some sets in which the control grid of the picture tube is purposely arranged to be at relatively high impedance for the introduction of flyback blanking pulses from the field timebase, hum can get into the vision circuit through the tube control grid. This can be checked fairly easily by connecting a fairly high value capacitor (8μF or thereabouts) between the tube grid and chassis (or h.t. negative circuit). If the hum is in this way considerably reduced, a check should be made of the tube grid circuit and the network to the field timebase.

Hum in the timebase circuits themselves, as distinct from the video channel only, will cause the edges of the picture to curve, something like the effect in Fig. 13. This may or may not be accompanied by shading across the picture, depending on whether hum is actually modulating the electron beam in the picture tube. ■

AUTOMATIC GAIN CONTROL

—continued from page 551.

It is important to realise that R10 cannot be used as a contrast control, since it is inside the a.g.c. feedback loop. It can be correctly adjusted only when a further modification to the receiver has been carried outt; since by taking out VRI the set has been deprived of its contrast control, it is now necessary to put in again such a control, this time outside the a.g.c. feedback loop.

This is readily done by removing R34 (May, 1965, page 359) and substituting a 2kΩ variable resistor in series with a 33Ω resister. The slider of the variable resistor is connected to "earth" via a 100μF capacitor (+ve end to chassis), and this variable resistor now constitutes the contrast control. R36 is replaced by a 6·8kΩ resistor. VR2 (15kΩ) is next re-adjusted so that the transistor Tr8 takes 2·5mA collector current.

Contrast control is effected by varying the negative feedback applied across the 2kΩ variable resistor; part or all of this is de-coupled by the 100μF capacitor, and so the gain of the output stage can be varied by rotating the slider, without altering the direct current flowing. Control is effective from an overall gain of 3 to an overall gain of 25 for the stage.

Setting up R10

To set up R10 in Fig. 1 the contrast control is adjusted for maximum gain, and a milliameter placed in series with R18 (May, 1965, page 359), R10 is adjusted until a current of 1·5mA is obtained, with a good signal being received at the aerial. No further adjustment is required. Changes in signal strength of 25dB voltage at the aerial input produce changes of video output of 6dB (voltage), and then a control range of about 10 : 1 is achieved. This, over a single i.f. stage, is adequate for most purposes.

Fig. 3—Waveform at collector of Tr2.

If an oscilloscope is available, it is instructive to use it to ascertain the wave-form at the point A in Fig. 1 above (Tr2 collector). The appearance of the display should be closely similar to that in Fig. 3, all trace of picture-content waveform being removed between field sync pulses, while during field pulses the field sync waveform appears.

It is important to see that no spurious pulses appear at the collector of Tr3. While these would not appear on the picture (since they occur during field flyback) they might have an effect on the d.c. level at Tr3 collector and so affect the a.g.c. action. C5 and C6, together with R9 and R10 represent a small time-constant which will deal with most aircraft flutter quite well. If, however, C5 and C6 had to be increased to remove spurious pulses the time constant would be lengthened and the a.g.c. made slower in action. In such a case it could be best to connect a further 4μF capacitor between the slider of R10 and "earth", setting the slider some way from its maximum position. ■

EMMY GOES WESTWARD

A Regional Station Succeeds Against the Odds in the International Field

by Baynham Honri

MOST of us have heard of OSCAR, the revered name of an American statuette.

The equivalent statuette for the television industry is EMMY, which is awarded by the National Academy of Television Arts and Sciences. It is in New York and Hollywood that a mass of television subjects on tape or film are viewed on closed-circuit by the judges, covering (like OSCAR does) a wide variety of subjects, artistic and technical, submitted by the American television industry.

There is, however, a special single EMMY award for the international field covering fictional and documentary subjects, for which there were this year 46 entries by 28 broadcasting organisations from 16 countries all over the world.

The BBC and the "Big Four" programme companies of ITV regularly enter their outstanding TV plays, episodes of a series, spectacular or documentary programmes for this award. From time to time one or two of the medium-sized regional ITV stations have been contestants and have won an award or commendation.

This year, in true fairy-tale tradition, it was an entry from one of the smaller British ITV regional companies, Westward Television (Plymouth) which won the award with WYVERN AT WAR.

The smaller regional companies (Ulster, Border, Westward, Grampian, Channel) do not possess comprehensive engineering facilities on the scale of the medium regionals (Scottish, Southern, Anglia, etc) and of course, far less than the major four, Rediffusion, A-TV, Granada and ABC. Their respective activities are restricted by the boundary limitations of their area and its viewing population (their revenue) size of staff and their equipment. Yet, like other small regionals, Westward has only four programme directors and no producers, other than the Programme Controller himself, John Oxley. Regional stations inject local items amounting to six or seven hours per week including local news and magazine material. Much of this is naturally parochial, but from time to time a programme item strikes a national, indeed an international note. Such as WYVERN AT WAR.

WYVERN AT WAR comprises a series of three 45-minute documentaries telling the story of the eleven months' campaign of the 43rd (Wessex) Division, a typical territorial infantry division, to liberate Europe in 1944/45. Before a recent private viewing in London of a 16mm film transfer from videotape of the programme, John Oxley related the birth-pains of this ambitious project and explained Westward's method of integrating events and people of 1944/45 with those of today.

Practical production problems had to be tied in with the normal day-to-day local Westward programmes, no outside broadcast or elaborate film being available.

The idea for the subject came to John Oxley whilst holidaying with his family in France near

Peter Cadbury, Chairman of Westward Television, holding the 1966 EMMY International Award which he received for the Company's WYVERN AT WAR programme. With him (left to right) are W. H. Cheevers, Joint Managing Director of Westland Television; Lord Hill, Chairman of the ITA; Roger Gage, Producer and Director of the award winning programme; and Sir Robert Fraser, Director-General of the ITA.

where the "Wyverns" had fought during the bitter campaign of 1944. This had been photographed by several army battle film cameramen and the 35mm film records were held by the Imperial War Museum, together with maps and still photographs. It was decided to integrate present day interviews with various people who had taken part. From this point onwards, the form of this notable documentary began to take shape.

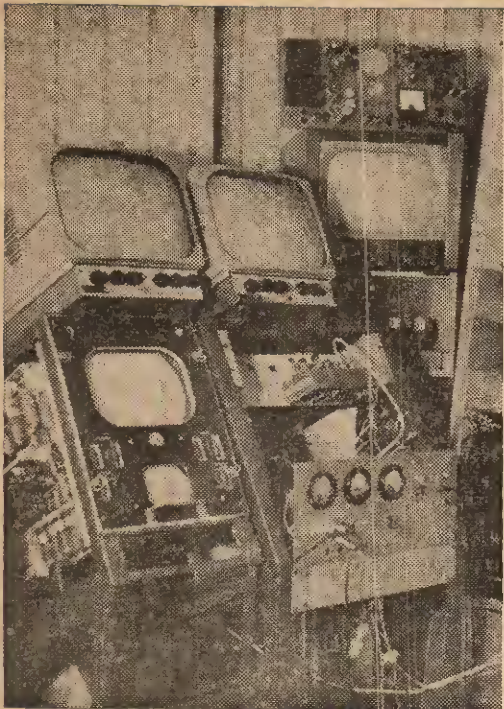
Major General Essame, who had written the Divisional History, agreed to be Military Adviser to the production. Roger Gage, one of Westward's TV directors, was assigned part-time to the project and the experienced writer and narrator Willoughby Gray, set to work, collected and collated an immense quality of battle stories. The PRO of the present 43rd Division at Taunton, Peter Clare, helped to track down the survivors who recorded their own stories at special film and recording sessions set up by Roger Gage at Bodmin, Bath, Taunton and Salisbury. Willoughby Gray prepared the basis for three master scripts and a rough narrative sound track was made. John Campbell, film editor on the series, built up montages to illustrate the stories culled from battle film shot in North West Europe and borrowed from the Imperial War Museum. Where none was available, present day local sequences were intercut.

Photographic credits are due to the dozen or so Army cameramen who took part in the actual war operation, some of whom lost their lives or were wounded in the early stages of the campaign. Credit must also be given to Gerry Ewens, the Westward cinematographer, whose photography of present day scenes fitted the complicated framework. All of these films were transferred to videotape for transmission at Westward.

This programme was subsequently again transferred to 16mm film for submitting for the American EMMY award and for use by other TV companies.

Peter Cadbury, Chairman of Westward, and John Oxley, flew to New York to receive the award, a handsome statuette.

Since the award was made, John Oxley has devised an interesting introductory scene, shot in the Westward Studios, with a reunion of several of the officers and men who took part in the action —and in the film. One of these survivors is Major General Sir Brian Horrocks. ■



IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part IV

THE stabilised power supply (Fig. 20) delivers 12 volts at about 1 amp. The maximum current which may be drawn depends on the diodes and transformer ratings. The output supplies are derived from a second transformer via a high voltage power supply. The second transformer would be needed for the tube heaters supply unless all three windings are found on one transformer (if four heater windings are available on one transformer, three of these windings in series would be suitable for the 12 volt power supply). If the scan coils obtained are not of a modern design they may be high impedance and a higher voltage supply required for the focus coils. A suitable high voltage power supply will be shown in the next part of the camera article.

The tube connections are shown in Fig. 19, which also includes a blanking generator to cut off the vidicon beam during flyback. Line and field drive are fed direct to this and amplified, the output being applied to the Vidicon cathode. With the interlaced pulse generator, to be discussed later in the series, this blanking will always lie inside mixed blanking period, as mentioned when discussing the processing amplifier.

The camera and its circuits so far discussed could take one of two forms and it is the constructor who must now decide which type to build. The first type is the complete camera mounted in one case with all the controls, video outputs, mains plugs, mounted on the back of the case (Fig. 21). The second version (Fig. 22) consists of a slightly smaller case containing a vidicon and its coils with the scan circuits and head amplifier. Line and field drive are fed down co-ax cables to the scan circuits in the camera and the video from the head amplifier fed back up a third co-ax to the processing amplifier. This is mounted along with the power supplies and all operational controls in a case with the camera control unit (c.c.u.) and connected by cable to the camera. This system is used in television broadcasting and has its advantages when more than one camera is to be used. It allows one person (the cameraman) to point and focus the camera while a second man adjusts the controls for all cameras, viewing on a large monitor screen and with a 'scope to check the levels of the video signals.

A simple combined camera should produce the same quality pictures but is not suitable for operation when scene or lens changes are likely to be required; the camera with separate c.c.u. is operationally much more flexible.

There are many sizes of lenses used in closed circuit television from about 1·5 cms to about 12 cms focal length. If a more complex camera is being considered, a turret of three or four lenses could be made. Lenses for use with 16 mm film equipment are nearly ideal for television use so

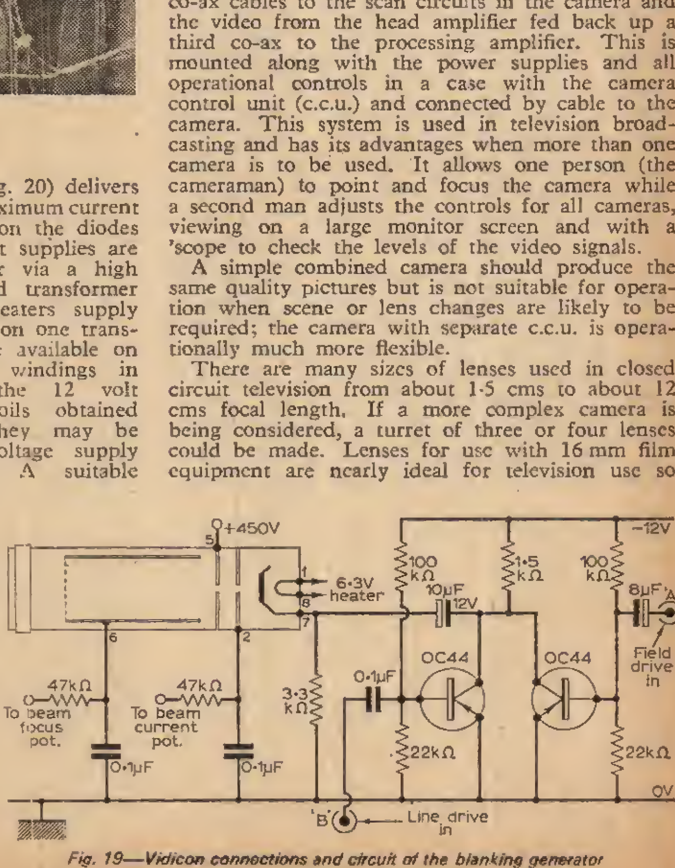


Fig. 19—Vidicon connections and circuit of the blanking generator

most amateurs use these. 8 mm zoom lenses have proved fairly satisfactory except for poor definition on the corners and some corner shading. If one of these zoom lenses were to be used it would be useful to line up the channel with an ordinary 16 mm lens with improved characteristics in the corner of the picture. Lens mounts for 16 mm lenses can be obtained through the British Amateur Television Club (see below).

Optical Focus

The decision to use fixed or variable focusing of the tube depends mainly on the type of camera. If a single lens is to be fitted, little or no adjustment of focus will be required, and the focus movement of the lens mount itself will be satisfactory. Zoom lenses usually have variable focus and it is possible to use Bowdon cables to remote these and the zoom action to a more convenient position on the back of the camera. This will depend on the lens used.

If variable focus is required, brass curtain rail fixed to the baseplate makes a suitable good rail for the carriage, which consists of four small ball-bearings bolted to the frame of the scan coils. The bearings run on the curtain railing and the carriage is locked by two curtain runners adapted by soldering a "U" shaped strip of brass with a slit in it, from which is bolted the curtain rails holding the assembly to the carriage. The top of the strip of brass is fixed to a spring which passes round the coil to the opposite side where a similar assembly is fixed.

Movement of the coils is effected by an epicyclic tuning mechanism of the sort used for radio tuning dials, a layout or ordinary cord and two pulleys. The mechanism is fixed to the base-plate on the left hand side of the camera with a large (more than 2in. diameter) knob on the slow motion drive shaft outside the camera case. The whole carriage must work smoothly over a range of about ½in. A similar assembly can be made out of suitable pieces of Meccano or similar construction kits. The shortest focal length lens to be used

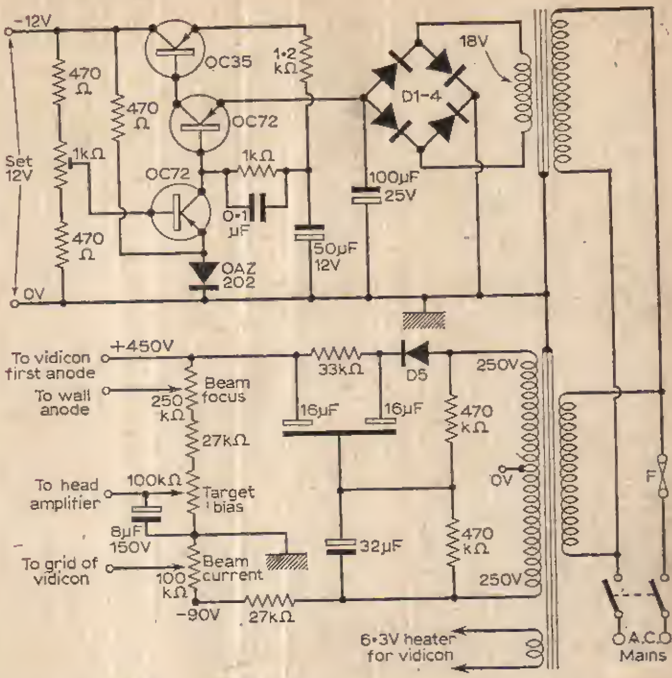


Fig. 20—Complete stabilised power supply unit. D1–D4. 1A silicon diodes. D5. 500V 1mA.

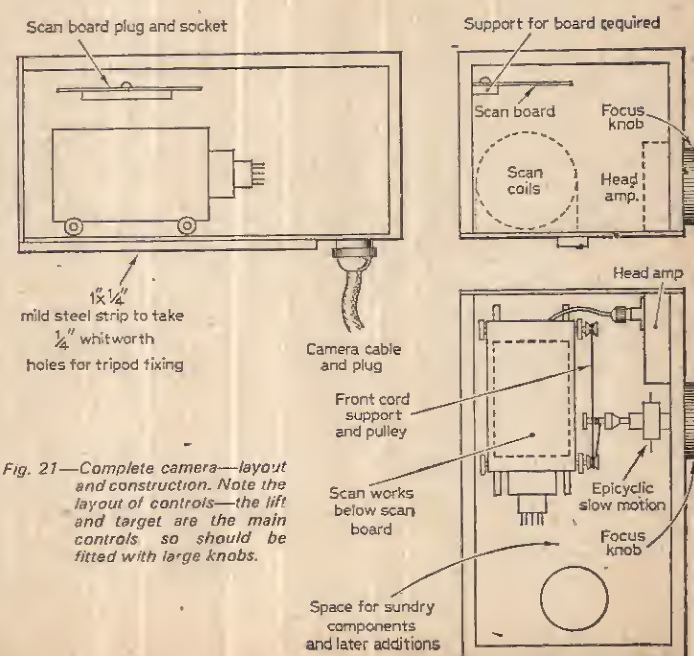


Fig. 21—Complete camera—layout and construction. Note the layout of controls—the lift and target are the main controls so should be fitted with large knobs.

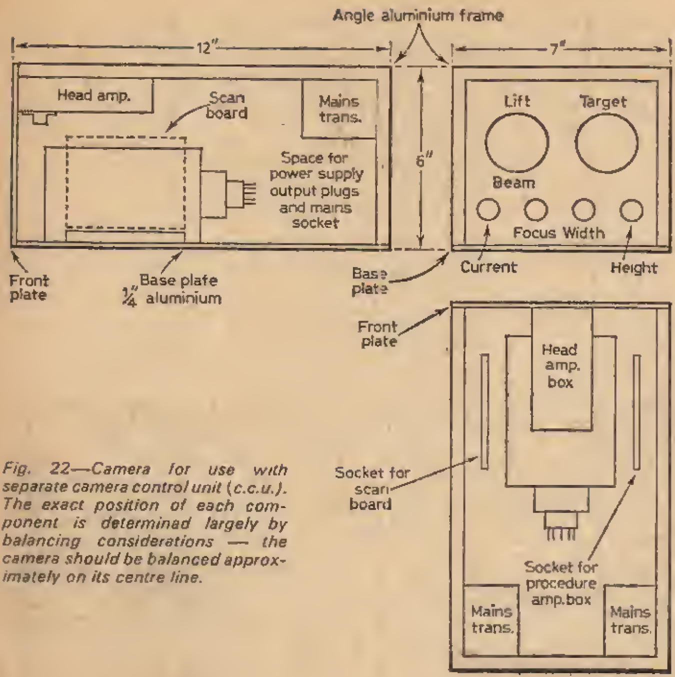


Fig. 22—Camera for use with separate camera control unit (c.c.u.). The exact position of each component is determinad largely by balancing considerations — the camera should be balanced approximately on its centre line.

Turret

If a turret lens is to be fitted, then the longer focal length lens should be mounted in a tube so the focal points of distant objects of each lens are at the same distance from the turret. This is where the near point of the tube carriage will be fixed. The layout to be discussed allows a gear drive to the turret, past the scan coils, with an operating handle on the back, A 4 : 1 reduction gives complete rotation of the lens change handle for each lens of a 4-lens turret.

The Vidicon and Coils

The main difficulty for most amateurs is obtaining the scan coils. Most camera manufacturers will supply them but they can be very expensive, except for those produced by E.M.I.'s for amateurs. These scan coils are available to amateurs along with the vidicons suitable for amateur use. Total price with Vidicon base would be £16. There are also separate mesh tubes with low wattage heaters available at £24 with coils and base; the article on telecine will deal with saparate mesh tubes. Address: E.M.I. Electronics Ltd., Valve Division, Hayes, Middlesex.

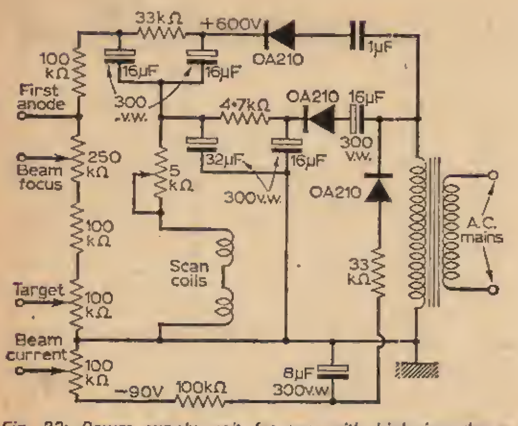


Fig. 23: Power supply unit for use with high impedance scan coils.

determines the position of the coils with the fixed coils lens, or the front point of the range of carriage movement (end stops should be fixed on the rails to stop the carriage coming off the rails). The focal length of the lens is easily checked by producing an image of a fairly distant window on a sheet of white paper. The distance from lens to paper is the focal length (note that the actual lens is well away from the mounted end of the lens assembly).

Horntons Electronics, of Birmingham, sell scan coils made by various small manufacturers of c.c. TV equipment as well as some tubes and lenses: however, the author has no personal experience with any of these coils but it is known that the N.E.V. scan coils (sold after this company ceased business) are of rather low impedance for the scan circuits used.

The British Amateur Television Club has coil-winding data available; also complete coils available as well as vidicon tubes for amateur use. The British Amateur Television Club is a very helpful organisation, particularly as many of its members are engaged professionally in television work and much useful information may be gleaned from their magazines, CQ-TV, as well as personal contact with other amateurs. Quite a lot of equipment is obtainable through the B.A.T.C. besides the items mentioned, and it is strongly suggested that anyone contemplating building this camera should join the B.A.T.C. Information on membership can be obtained from: The Hon. Secretary, White Orchard, 64, Showell Lane, Penn, Wolverhampton, Staffordshire.

The scan coils have a spring-loaded target connector which should go to the inner of a few inches of co-ax. The outer is connected to the screening which surrounds this target connector. The co-ax cable should be just long and flexible enough when connected to the head amplifier to allow for movement of the focus carriage.

The scan coils are of two types with high or low impedance focus coils. The low impedance type (all modern types) are about 100Ω resistance and can be run through the 12V supply in series with the 50Ω potentiometer. The high impedance coils (about 5kΩ) need a 250V supply and a 4·7kΩ potentiometer in series with the coils. This would need an alternative high voltage supply (Fig. 23). The focus current potentiometers are pre-set types and control "magnetic" focus.

Layout

It is essential that the base-plate of the camera be very sturdy; ¼in. aluminium is rather expensive but easily worked. The front plate, which also should be sturdy, is similarly of ¼in. aluminium. Considerable rigidity is required for these components as the slightest movement of the image projected by the lens with respect to the vidicon produces a much larger movement on the screen.

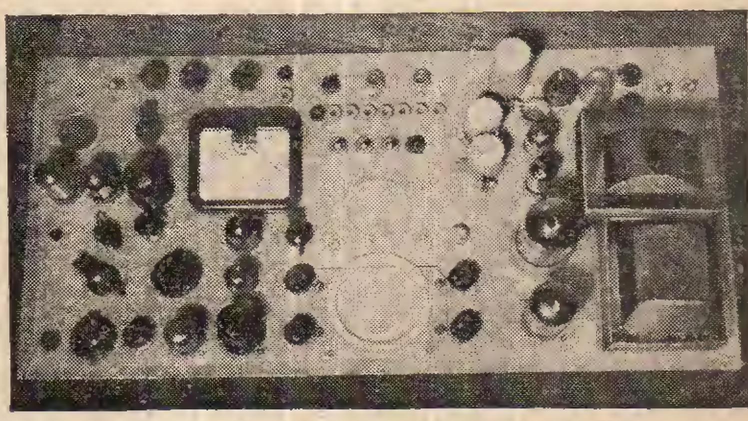
For the complete camera a framework of aluminium angle is used. To cover the sides of the camera, aluminium sheeting is used, attached by hinges to the base-plate and held at the top by quick-release clips or wingnuts.

The version of the camera with a separate c.c.u. can be built in a similar way but it is not really worth making it much smaller as the design allows a view finder to be placed on top of it, hence the case (Fig. 22) is much the same size.

On the base of the camera, under the baseplate along its centre line, a strip of steel about ⅜ x 1in. is bolted on each end. This has several ¼in. Whitworth holes alternating with ⅜in. Whit. holes drilled and tapped so as to attach pan and tilt head when mounted on a tripod. The ¼in. are British standard and the ⅜in. are Continental standard.

Camera Cables

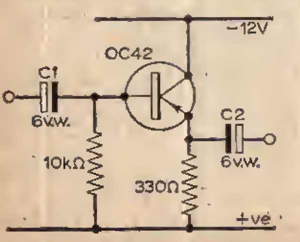
The camera cable can be made up from the required number of cables passed down the middle of 1in. plastic tube. This tubing is a flat strip of plastic tubing and may be black or transparent. It is used by gardeners and smallholders and may be obtained at hardware and gardening shops. The cables inside should be bound together in a bundle with insulating tape at suitable intervals. A single multi-way plug with a locking ring of the Plessey or Cannon type will carry video so is suitable for use (keep the line drive connections away from the video connection points), but if not available, the Jones type of plug is suitable provided separate co-ax sockets are used for the video and line drive connections. The Jones plug should be lockable and so carry the weight of the cable so that the co-ax plugs and sockets are not under load. The various cables should then be tapped into their relevant positions. It is not really necessary to feed field drive down the co-ax but if not a twisted pair of cables should be used. The earth for the processing amplifier and drive emitter followers in the c.c.u. is fed back down the cable to avoid earth loops. Two spare wires (used to carry mains to the viewfinder) plus two wires for a 2-way intercom system called talkback are included. Talkback is the studio director's instructions to the cameramen and instructions from the c.c.u. operator. A carbon microphone at the camera allows the cameraman to speak to the c.c.u. operator (camera or reverse talkback in studio pariance).



The photograph shows a rack mounted waveform monitor.

The camera control unit or panel comprises beam current, beam focus, lift and target controls. The processing amplifier is mounted behind the panel along with power supplies and two emitter followers (Fig. 24). No specific layout is to be recommended as this will depend on the case which may be available, but it could well be mounted on a panel along with space for the controls of any other channels planned.

Part V next month



	C1	C2
Line Drive	1μF	10μF
Field Drive	50μF	500μF

Fig. 24—Emitter follower circuit.

ADDENDUM

In the article describing an "Ohmmeter for Low Resistance Measurements" (July 1966 issue), the formula given for calculating the series resistors was incorrect. It should have been $R_s + R_m = \frac{E}{I}$.

UNDERNEATH THE DIPOLE

TIME marches on! It must be seven or eight years ago that the writer of this column, in company with three colleagues looked around the House of Lords, taking exposure meter readings of the intensity of the normal artificial lighting level of that dignified chamber and ante-rooms. Hiding places for camera positions (which were hard to find) were considered, and places where additional lights could be fixed were noted.

"Icon-007"

I need hardly say that at that time this mission was highly secret, and that the venture took place during a night when peers, MPs, distinguished guests and almost everyone else had long departed and the field was clear for reconnaissance. Piloted by an official of the Parliamentary house staff, we reverently walked, crawled and clambered in all kinds of unusual spots, where we thought that, without causing too much inconvenience to Royalty or to their Lordships, a number of cameras could be set up.

Putting on the Heat

The problem was not only how to deal with black-and-white television, but with the much more complicated requirements of colour cinematography. Consideration had to be given to the additional light that would be required, the additional power supply from outside the premises (from mobile generators) and the cables connected from them. From the extra lighting units (to be faded-in gently and artistically with rheostats) would be radiated a few kilowatts of unwelcome extra heat, to depend upon the effectiveness (or not) of existing ventilation, the camera noises, the camera-cable runs and, last but not least, the desirable invisibility of the cameras and their operators. All of this was in connection with a very much off-the-record preliminary investigation being carried out by a Government department.

Parliamentary Pottage

The opening of Parliament by H.M. the Queen is an event of historic importance and ceremonial interest. Hitherto, this had been concerned with exterior shots only by both newsreels and television. Both were certainly not everyday occurrences where interiors were concerned, which started with television only and developed into a dual operation with film cameramen. In quite a different category is the proposed regular televising of the business of the House of Lords, to be followed, perhaps—but also (thank goodness) perhaps not—by even more regular doses of oratory from the Commons. We shall see. The technical problems of reproducing TV sound and picture of the Peers in debate are difficult but not insurmountable, if sufficient equipment is made available—cameras, microphones, videotape or telerecording apparatus and adequate staff to operate it all. Add to this the mixture of politics and ethics which will have to be sorted out by the editor of this "Hansard in the Home." The editor and his staff will have a great responsibility to bear in achieving complete neutrality. Huge expensive footages of film or videotape will lie on the cutting-room floor, in the breaking down of hours of boring debates into half-hour snappy reportage. The Peers will be disappointed when their witty wisecracks dissolve into a mess of pottage—or should it be footage?—which disappears into the film waste bin.

Standard Converters

Are the BBC programmes turning over a new leaf? Repeats of the best of their television plays on alternative channels, BBC-2 or BBC-1, are a good thing, especially if a viewer misses the first transmission and has read good press notices of it. But the decision not to repeat "Up the Junction" and similar down-beat, kitchen-sink trash was a good one. The pity is that some of this tasteless and shapeless kind of stuff was ever presented by the BBC, or by ITV, for that matter. The computer type equipment for transferring 405 lines to 625 or vice versa was a brilliant electronic development by BBC engineers, for which there are two versions which are based upon two different methods of achieving the same object. Both are far better than the earlier standards converters in which a 405 line television camera (usually of the CPS Emitron type) was pointed at a high-class 625 line monitor, with spot wobble. The same procedure (which was naturally less satisfactory) was using a 625 line camera to pick up a picture from a 405 line monitor. You can't expect to obtain the picture information of 625 lines from the smaller amount that is squeezed from a 405 line picture. There should be more information and quality in a 625 line picture, if the signal from the transmitter is good and free from interference. It will be necessary for dozens—nay, hundreds—of u.h.f. transmitters to be erected all over the country to achieve really good pictures, as good as those on 405 lines. No wonder there is pressure from some quarters for the present 405 line transmitters to be used for colour. The number of viewers who look regularly at BBC-2 is pathetically low, especially in the London area—unless the viewer lives close to the BBC-2 transmitting aerial or is very favourably situated, with a good, high receiving aerial.

Pay TV

Pay-TV—is it worth putting money in the slot for closed circuit programmes? Full of optimism and enthusiasm, there were at one time about seven companies which applied for licences to transmit experimentally, by closed circuit pay-TV. Their enthusiasm waned and only two of them got so far as obtaining the necessary telecine, control and distribution equipment for sending the pictures and sound to subscribers, and of course, for the slot or other equipment for collecting the fee for the programme selected. Pay-TV Limited actually is the only company which has got so far as sending out programmes via Post Office and other lines, which were already in use for the distribution of BBC and ITA programmes in lieu of aerials.

The new TV service has been in operation for about six months, in the Westminster and Southwark areas in London, where about 5,000 subscribers now have sets connected up. The response has been surprisingly good and the programmes have been mainly selected from films shown recently at cinemas, plus one or two special sporting events, including boxing.

Films have all been of a high standard and have been repeated three or four times, the average percentage of sets in operation being 20%, and the highest figure achieved for a single showing being for "The Magnificent Seven," which achieved 27% for one showing and a total of 46% of the subscribers saw the film over the first and repeat performances. The measurement of the audiences each night is absolutely accurate and the "top ten" of films so far shown is as follows:

	per-cent
The Great Escape	48
The Magnificent Seven	46
The Birds	41·5
The Guns of Navarone	38
633 Squadron	36
Whatever Happened to Baby Jane?	36
A Shot in the Dark ...	36
The Ipcress File	35
Father Goose	34
She	33

This go-ahead Pay-TV company now proposes to expand their London area to take in another 1,500 potential subscribers in Lambeth. An experimental licence has also been applied for the Sheffield area, where piped television of the "free" BBC and ITV programmes is already in successful operation and can be served with pay-TV in the same way as the pioneer closed-circuit system in London.

Dual-Purpose Stages

It had to come! There has been talk about stream-lining film studios for years, but little progress has been made until now. Film Studios have carried on with more or less the same facilities that they had 20 years ago, with an output of 2½ minutes of cut film per stage per day, compared with the 25 to 30 minutes of finished videotaped production per stage per day on British television. Something had to be done about it; indeed, it has been done!

Two production stages have just been completed at Pinewood Studios which have been designed for multi-purpose use:

(a) for feature films for the cinema
(b) for films specifically for television
(c) for live television
(d) for taped television.

These stages are each 112 x 86 ft. with clearance heights to a television type lighting grid of 30 ft. and to the apex of the roof, about 50 ft. The television grid, which enables telescopic lighting units to be moved rapidly along slots and adjusted to various heights from the floor, is much heavier than the usual television station grid. It will also carry the heaviest type of tungsten or high-intensity arc-lamps with their operating electricians on cradles, as required for big technicolor spectaculars.

The stages themselves are of the normal television type with a concrete base and lino covering for rolling the TV cameras in any direction. However, Pinewood have added a removable wood floor over it for the requirements of film producers who prefer to secure the scenery by nailing braces and supports to the floor.

Ventilation is carried out with telescopic ducts for inlet air, which can be directed (completely silent) down inside the settings while hot air is extracted from the apex of the roof, with 4½ air changes per hour.

The old method of studio ventilation was for fresh air to be conducted down the walls through ducts which terminated with outlets about 3 ft. above the floor. Naturally, when canvas backings or scenic cycloramas are suspended around a stage, they obstruct the circulation of fresh air. An alternative method has used outlets at a higher level, which directed air at a higher pressure downwards at 45°—and usually, with a higher noise level!

The front aspect of the two new dual-purpose stages at Pinewood.

The new Pinewood stages were built entirely separately 35 ft. apart. There were no steel joists or other connections between them which might carry structure-born noises. Having almost completed these two "islands", the space between them, together with the frontage area, was filled with a new T-shaped building, entirely self-supporting and connected with the stages in a manner which also avoided structure-born noises.

Iconos

Servicing TELEVISION Receivers

No. 126 Regentone 192 and R.G.D. 619 continued

By L. Lawry-Johns

Field Hold

Control at the end of its travel, check R82 (2·2MΩ) and R83 (3·3MΩ), then V7, V12 and C75 (0·04μF).

Sound Troubles

Weak sound with the picture normal should direct attention to V13 PCL82, C80 (100μF), R99 (220kΩ), C85 (8μF), MR2 and MR3, V14 and applied voltages, in that order.

Severe distortion; check V13 C83 (0·01μF), R95 (560Ω), R104 (1·8MΩ), MR2 and other associated components. R99 will cause distortion if too far off tolerance.

No Sound

Note if there is any response from the loudspeaker as the volume is advanced. If none, check V13 (PCL82) sound output valve, and the

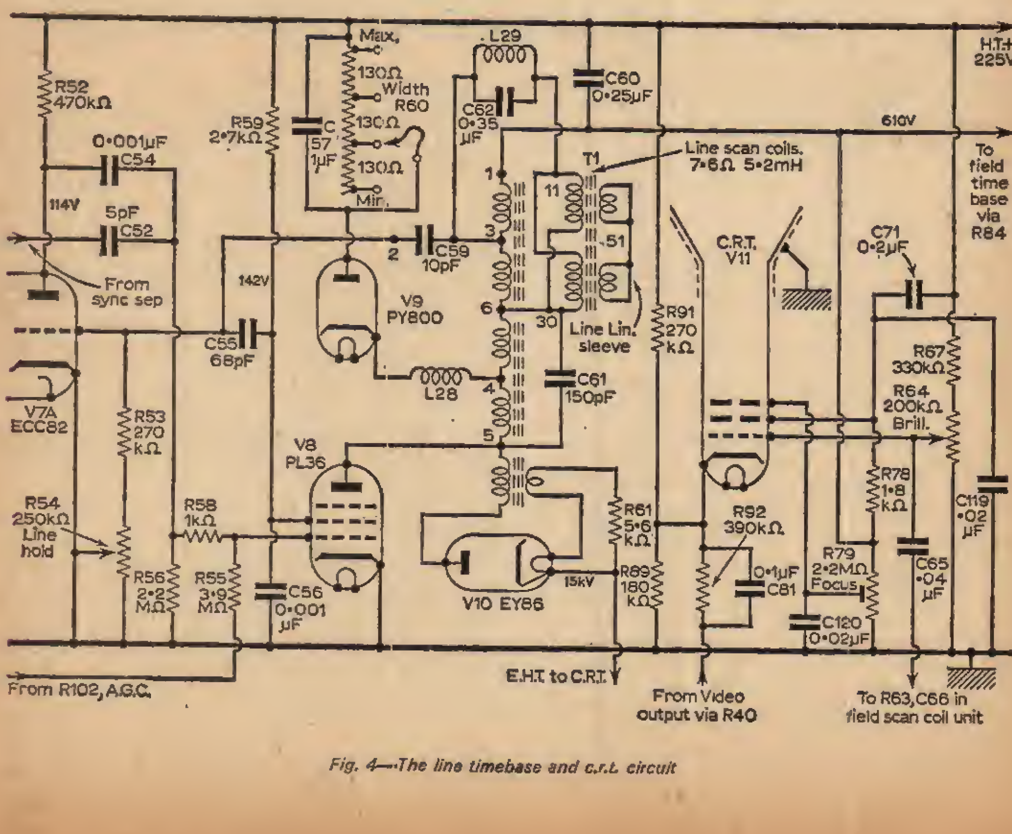


Fig. 4—The line timebase and c.r.t. circuit

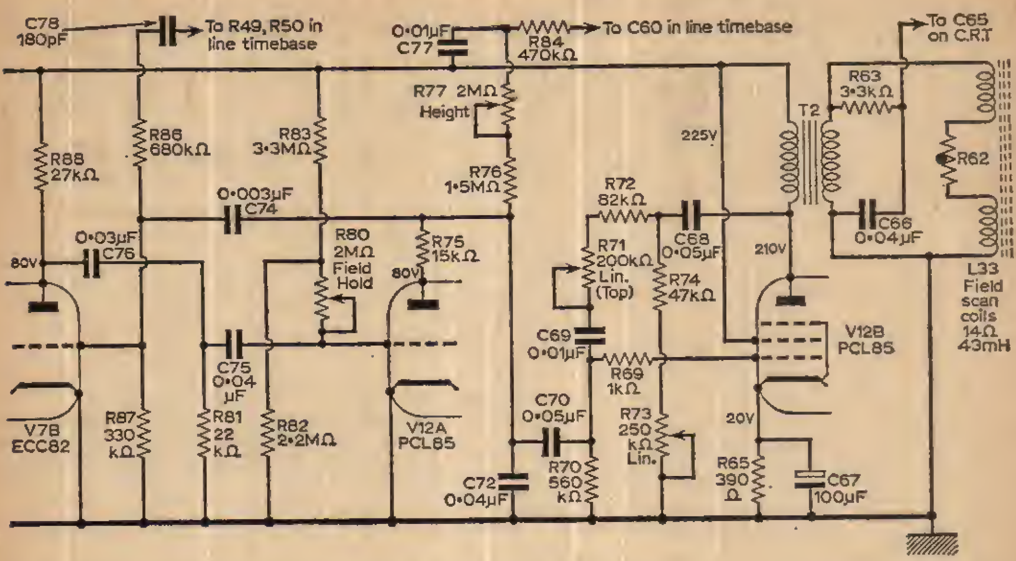


Fig. 5—The field timebase circuitry

continuity of the sound output transformer primary. If the latter transformer is faulty there will be no h.t. applied to pin 6 of the PCL82. If the output stage seems alive check back for response from the volume control noise limiter, detector and the V14 (EF80) stage, last sound i.f. stage.

No Vision Signals

Check V5 PCL84 and applied voltages, associated resistors, R35, R36, R39 etc. Check MR1 (OA70), series chokes and the V4 stage EF184 and applied voltages. If the PCL84 is overheating and the screen peak white check C37 0·001μF, pin 8 of V4 to chassis.

No Sound or Vision Signals

If there is a background noise from the loudspeaker and the screen illuminates as the brilliance is advanced first check the aerial input and the tuner unit valves 30C15 and 30L15. Then check V3 and applied voltages before making a more thorough examination of the tuner unit. Tuner unit resistors R10 (5·6kΩ), R11 (3·3kΩ) and R12 (22kΩ) are mainly suspect. If the tuner unit valves are accidentally transposed it will be necessary to check resistors R7 (1kΩ), R6 (100Ω) and R13 (33Ω). If it is suspected that the tuner has previously been tampered with it is necessary to check the channel slides (right position) and contacts. Ensure the side coaxial and supply leads are properly made.

No Results

This presumes that there is no life in the screen at all and no sound of any kind, either from the loudspeaker or from the timebases. First ascertain if the valves are glowing or not. Valves glowing normally; tube heater and the heater circuit obviously intact. Check 500mA h.t. fuse. If this is o.c. check for h.t. shorts. In this connection the article which appeared in the April issue of PRACTICAL TELEVISION, page 308, should be studied and its helpful lessons applied. If the 500mA fuse is intact check the mains input to the MR5 silicon diodes via the yellow lead, along the mains dropper to the blue lead connection. An open circuit will probably be found in this part of the supply. If a section is o.c. note whether there are any signs of overheating and check the F1 fuse to see that this is not overrated. Check C118 and MR5 as previously mentioned if a short is suspected. Then check the main electrolytics 100+400μF.

Faulty Electrolytics

The 100+400μF electrolytic referred to above can become defective and the following fault symptoms will be noted when it does, or at least amongst those noted! The effect of the 100μF section becoming open circuit is a drastic drop in h.t. voltage perhaps leading one to believe that the rectifiers are at fault. A quick check is to shunt another capacitor from the rectifier output to chassis. The effect of the 400μF smoothing section becoming defective is severe distortion of the picture, heavy shading and hum on the sound.

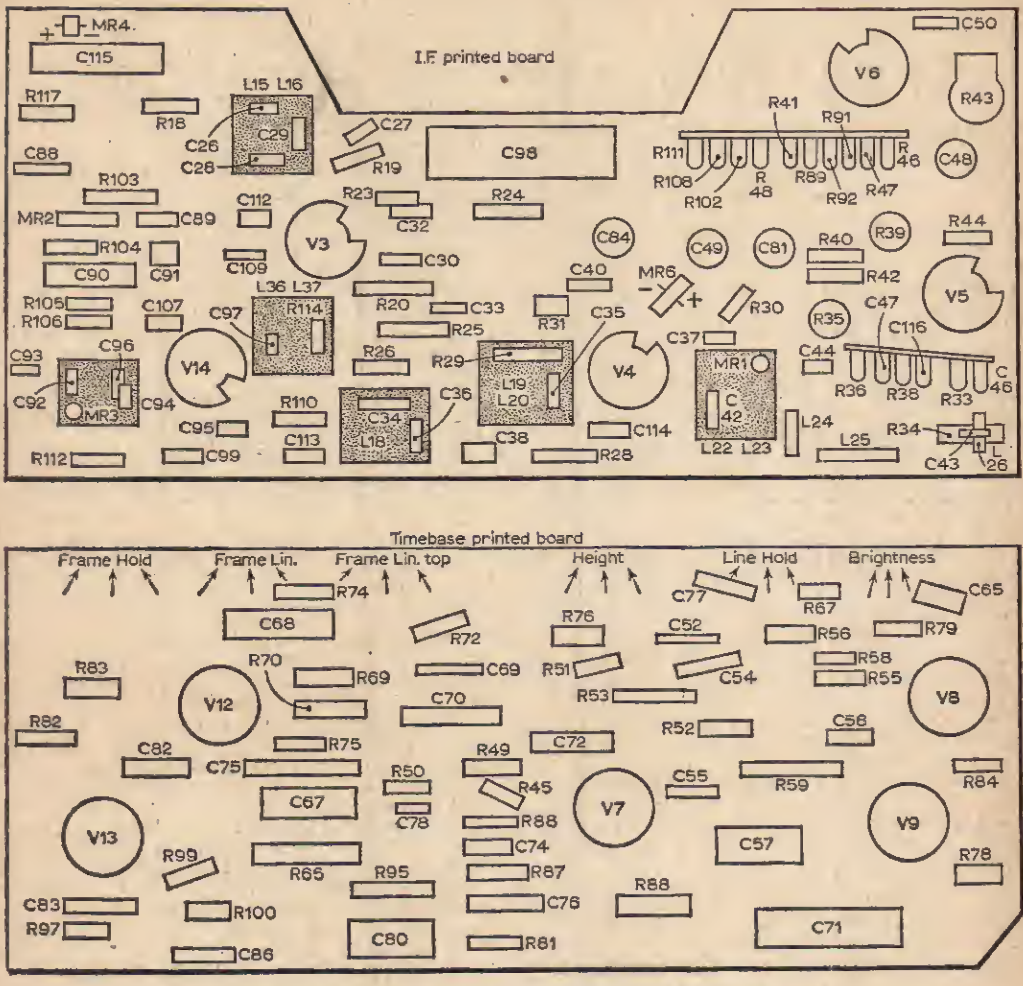


Fig. 6—Component layout for i.f. and timebase printed boards.

Sound on vision and vision on sound effects will be experienced if and when C87 ($16\mu F$) becomes defective.

Valves Not Lighting

Check F1 and the mains supply from the blue lead of the dropper to the brown. Then follow the supply through the thermistor, V8 heater, along heater chain. If there is no indication of mains voltage at any point check the on/off switch and supply lead, source plug and socket, etc.

No Control of Contrast

Although there are many possible causes for loss of control it is prudent to check MR4 and MR6 (M3 diodes) for shorts, also the $0{\cdot}5\mu F$ capacitors in the a.g.c. circuit.

TV TERMS AND DEFINITIONS EXPLAINED

Part VI of this article has been held over until next month

C. Rafarel

LONG DISTANCE TV RECEPTION

PART TWO OF A NEW SERIES OF ARTICLES DEALING WITH THE BASIC ASPECTS OF DX-TV RECEPTION

THE Continental TV systems in use may be classified as follows:

(1) **British Isles** and certain Eire transmitters in Bands I and III—405-line positive image with a.m. sound with a sound to vision spacing of 3·5Mc/s, named "B" channels.

U.H.F.: BBC-2 625-line negative image with f.m. sound, spacing 6·0Mc/s.

(2) **France** 1st chain: Bands 1/III 819-line positive image with a.m. sound, spacing 11·15 Mc/s, named "F" channels. France 2nd chain: U.H.F. 625-line positive image with a.m. sound, spacing 5·5M/cs. Numbered channels.

(3) **Belgium:** Bands I/III 625-line positive image with a.m. sound, spacing 5·5Mc/s, named "E" channels.

(4) **West Europe** (except as above, Italy, and certain Eire stations, but including East Germany and Yugoslavia): Bands I/III, 625-line negative image with f.m. sound, spacing 5·5Mc/s, named "E" channels.

(5) **East Europe** (except as above): 625-line negative image with f.m. sound, spacing 6·5Mc/s, named "R" channels.

(6) **Italy:** Bands I, II, and III, 625-line negative image with f.m. sound, spacing 5·5Mc/s, but different frequencies from "E" channels above, named "I" channels with capital letter, i.e., IA, IB, etc.

(7) **Eire:** Certain transmitters in Bands I/III, 625-line negative image with f.m. sound, spacing 6·0Mc/s, named with small letters, i.e., "b", "d".

You will see that there are many systems in operation, with variations in type of transmission and frequency, and a full list of all stations and systems would take up more space than is available. To obtain complete details of all stations send an International Money Order for one pound to the address below, asking for the current list of European TV stations.

The European Broadcasting Union,
Technical Centre,
32 Avenue Albert Lancaster,
Brussels 18,
Belgium.

Most Continental channels lie between the British ones, and this helps in avoiding local station interference to some extent.

Aerials

The relatively strong Sporadic E signals in Band I do not require elaborate arrays and all that is often required is a pair of simple dipoles, one cut to Ch B2 and the other to Ch B4. These will cover all Band I Continental channels quite well. Height above ground is not very important, as the reflected Sporadic E signal arrives at a comparatively steep angle, and nearby obstructions will affect it less than a Tropospheric signal.

Broad-band multi-element arrays for Band I are somewhat difficult to construct for the relatively uninitiated and are better postponed until later, since there are not many Tropospheric signals available in Band I.

Band III and u.h.f. Tropospheric reception of DX-TV, however, calls for very different techniques. Here the efficiency of the receiving aerial is of primary importance; **aerials must be of high gain** and of the multi-element type, and to avoid the use of many arrays for different channels, they should be broad-band. J-Beam Ltd., of Northampton, can supply at least two versions through your local dealer. The arrays should be mounted high (at least 30 ft. if possible) and low-loss cable should be used for the down-leads.

It would appear that no broad-band arrays are as yet available here to cover all u.h.f. channels, so to begin with try a 21-or 23-element array cut to the l.f. end of the bands, where DX propagation is more effective. And since almost all Continental transmitters employ horizontal polarisation, mount all arrays for Bands 1/III, and u.h.f. horizontally, and make them rotatable.

Next month: British 405-line receiver conversion for Continental picture reception.

TRADE NEWS • TRADE NEWS • TRADE NEWS TRADE NEWS • TRADE NEWS • TRADE NEWS

NEW CLEANER/LUBRICANT

SPECTRA CHEMICALS LIMITED of Caterham, Surrey, are now offering two new grades of Spray-Clene safety solvent containing lubricant. While the original Spray-Clene cleans and degreases, the new grades clean and lubricate in one operation.

Besides cleaning all electrical switches and relays without fire risk from the ignition of flammable vapours by arcing, Spectra Spray-Clene with Switch Lubricant prevents tarnish and corrosion and provides excellent mechanical lubrication. It is harmless to most commonly used insulating materials.

Spectra Spray-Clene with Instrument Lubricant will clean precision mechanisms down to watch size leaving a fine film of highly refined colourless, odourless oil to lubricate moving parts and protect from corrosion.

All grades are supplied in 12 oz. aerosols fitted with angled extension tubes giving "one hand reach anywhere" action at full pressure. This facilitates cleaning without dismantling, while low toxicity and non-flammability permits use in most situations. Price: Standard Spray-Clene 7/6d. each. Spray-Clene with either lubricant 8/- each.

WIREWOUND POTENTIOMETERS FOR PRINTED CIRCUITS

W. GREENWOOD (LONDON) LTD., 21 Germain St., Chesham, Bucks., introduce a new wirewound adjustment potentiometer specifically designed for direct mounting on to printed circuit boards.

This precision component is a single turn potentiometer with outstanding humidity performance. It has a power rating of $1\frac{1}{2}$ watts at 50°C. and is available in a resistance range from 10Ω to 50kΩ. The solder pins are gold plated.

The potentiometer is one of a comprehensive range manufactured by Contelec of Switzerland.

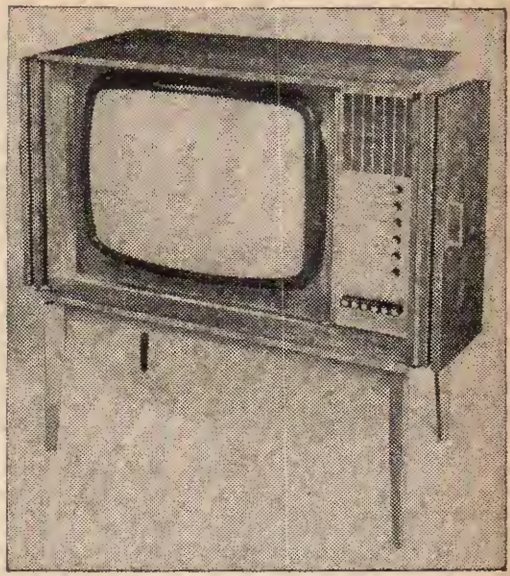
It is a competitively priced component and delivery is ex stock.

NEW HEATHKIT CATALOGUE

DAYSTROM LTD., GLOUCESTER, announce their new Heathkit catalogue No. 86/3. It covers the full range of Heathkit kits and includes some new models to the range, such as the Analogue Computer Kit, model EC-1U and De-luxe Transistor f.m. Tuner Kit.

The full Heathkit range of British and American models can be seen at the Heathkit Centre, London, 233 Tottenham Court Road, London, W.1.

PYE COLOUR RECEIVER



THE first mass-produced colour television receiver for British viewers is now fully developed and tested and will go into production early next year. It is the Pye Group's colour set, a hybrid de-luxe dual standard model with a rectangular 25in. screen, transistorised circuits and automatic "degaussing".

The set will also receive all the existing black and white TV programmes from BBC and ITV. It is very simple to operate and has only one extra control knob. It will cost around £260.

Colour development started over 11 years ago in 1954, before even experimental transmissions were available and when it was necessary to design and build a colour picture and pattern generator before work could start on the set itself.

The first receiver was a 405-line NTSC model employing some 67 valves and was hardly suitable for the average sitting room. Development work continued, the circuit was gradually reduced to 35 valves and it was decided to gain production experience in the factory.

Limited production of colour sets took place on a standard flow line basis in 1964/65 and these receivers have been supplied to the BBC, ITA, GPO and technical colleges. They have played a useful part in the evaluation of colour techniques and in the training of engineers for eventual installation and service work. These receivers have also been installed in hospitals in conjunction with the Ekco Electronics gamma camera and have been supplied to Australia to assist in closed-circuit colour development and research "down-under". A number of the Pye Group colour sets were given rigorous field trials in homes of executives and specially selected members of the general public.

Following this extensive test programme, colour receivers were developed for the 625-line u.h.f. and v.h.f. standards and further models were designed to operate on the French SECAM system to help in the evaluation of this type of transmission when it was under consideration as a European standard.

AERIALS

"DALE" U.H.F. television aerial, 6 element array with built in tilting clamp, 14/6. P. & P. 2/6. STAN WILLETTS, 16 News St., West Bromwich, Staffs. Tel. WES 2392.

TV AERIALS

Band I, H. Mast Fitting	£1 15 0
Band III, 5 Ele Mast Fitting	£1 10 0
Band I/III, S/D and 4-Array	£1 15 0
Band IV, 9 Ele Array	£1 10 0
Band IV, 18 Ele Array	£2 18 0

Lashing Kits from 10/-; Poles, Cox-ax 8d. Grade "A" 1/4. Plugs 6d.
P. & P. 4/6. C.W.O. S.A.E. for list.
TELEINDUSTRIES LTD.
BREAKSPEAR ROAD, RUISLIP, Middlesex.

MISCELLANEOUS

CONVERT ANY TV SET into an Oscilloscope. Instructions and diagrams 12/6. REDMOND 42 Dean Close, Portslade Sussex.

PRINTED CIRCUIT BOARDS only 6d. sq. in. Component Bargains. S.A.E. lists. BEEJAY ELECTRONICS (P.TV.), 106 Reddicap Heath Road, Sutton Coldfield, Warwickshire.

SETS & COMPONENTS

"HEATHKITS" can now be seen in London and purchased on H.P. Free brochure. DIRECT TV REPLACEMENTS LTD., 126 Hamilton Road, West Norwood, S.E.27. GIPsy Hill 6166.

R. & R. RADIO & TV SERVICE

44 MARKET STREET
BACUP, Lancs. *Telephone:* 465

LOOK! Valves 5/- each, Emission Guaranteed 60% upwards, Minimum order 1 doz. post paid. PCF80, PCC84, EF80, PY81, PY800, 30P4, 30P19, PL36, PCL83, PCL84, EY86, ECL80.

Rectifiers, BY100 complete with 10 watt 27 ohm res, 5/- post paid.

P.B. Tuners, use valves type 30L15 & 30C15. Limited quantities at 25/- post paid. MW43/69 and MW43/80 £1 to callers only.

EKCO line output trans, U25 Type 30/-, U26 Types 35/-. Post paid.

New valves, 6K8, 6R7 4/6. 6K7, 6F6, 6B8G 3/-.

8"x5" High Flux Speakers, 12/9 post paid.

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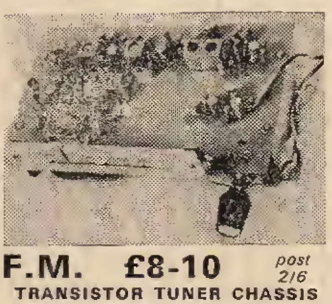

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