Practical TELEVISION

JUNE 1966

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Practical Television

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THE DAY APPROACHES

THE prospect of servicing colour TV receivers has been invested with frightening possibilities. Much of this is exaggerated and seems to stem from the early troublesome days on the American colour TV scene. Nevertheless, although it would be foolish to be overawed about colour, it is equally pointless to become complacent. For, those occupied in servicing who see colour TV as a vague irritation on a distant horizon will, in the foreseeable future, discover that it has become a reality to be faced.

Although much maintenance and repair work will closely resemble that for conventional sets, there are special problems associated with colour receivers. Some of these were recently demonstrated by D. J. Seal at a lecture organised by SERT.

The aerial, for instance, will be of much greater importance, particularly the bandwidth. With the colour sub-carrier and the luminance carrier about 4½ Mc/s apart, inadequate bandwidth may attenuate or even cut off the colour sub-carrier.

The all-too-common casual treatment of the e.h.t. system will need revision, for with 25kV at 1mA the technician will have to tread far more warily—this is a lethal system. The risk of X-rays is greater, of course, and radiation will be quite high with the screening removed. Care will also have to be exercised with metallic objects within arcing range of the e.h.t. system. And the wide variation of the nominal e.h.t. voltage and crude "measuring" tolerated today must give way to a stricter adherence to the specified value.

There will be greater possible trouble, too, with magnetic fields, although automatic degaussing facilities may well be a standard feature. Purity and convergence magnet assemblies will be encountered.

The technician will need adequate test gear. Apart from obvious items he will need an accurate facility for measuring the e.h.t. voltage. He will also need a colour bar generator. And the oscilloscope, gathering cobwebs in some establishments, will be a vital tool; a 'scope with a Y response of several Mc/s will be virtually essential in investigating the colour circuits.

A colour set is not just a black-and-white set with a different tube and more circuitry. Setting up is more complex and will require a good deal of patience and accuracy. Servicing will demand a more precise approach. And since the colour set will be a very expensive piece of equipment, it will need to be treated with a good deal more respect than is often the case. It might be an idea to start thinking on those lines now!

THIS MONTH

OUR NEXT ISSUE DATED JULY WILL BE PUBLISHED ON JUNE 23rd

TELETOPICS

U.S. First with Portable Video Recorder

ENTER the world's first portable television recording camera—and not from Japan either.

The Westel Company of California claim to lead the field with their new battery-operated TV camera and video recorder, made possible by an advance in the magnetic recording of wideband data called the Coniscan system.

The vidicon camera unit and its recording module are completely portable as the picture below shows; their combined weight being 30 lb. The 75 lb., single-head, colour compatible video recorder with a 4·2 Mc/s. bandwidth, plays back tapes recorded on the twin camera unit. It also records and reproduces TV signals from any acceptable source, such as image orthicon, vidicon or Plumbicon cameras.

Coniscan recording, which makes all this possible, uses only a single video head. The one-inch magnetic tape is driven around a contra-rotating mandrel which houses the single recording head.

The recording camera consists of the hand-held camera head (complete with c.r.t. viewfinder; focusing and video level controls) and the recording module which are connected by flexible cable. These two units, which will record 30 minutes of video and sound, are shown above next to Westel's video recorder. Running at 10 in./sec., the recorder operates on America's 525-line, 60-field standards and, with an additional unit, on NTSC colour.

CCTV Teaches Teachers

TELEVISION cameras in the classroom are nothing new, but in Kano, Northern Nigeria, a complete closed-circuit TV system will be installed to help train teachers.

Kano Teacher's Training College in Nigeria's northern region, where there are fewer children in primary schools than in any other part of the country, is accelerating teacher training with the help of United States assistance as well as faculty and administrative support from Ohio University. An educational television system to be supplied by a subsidiary of the Raytheon Company will help, by the application of the most modern teaching techniques, in this acceleration programme.

The equipment will include two studio cameras, a film chain to televise films and slides, production and master control consoles, and a distribution system with 21 monitors throughout the college. The system will make it possible to pick up programmes from two cameras, films or slides, video tape or off-the-air, and broadcast them to classrooms and study areas.

Teachers in training will be able to observe experienced teachers in everyday classroom situations without actually being present in the working classroom.

As well as the usual spare parts and accessories, the Kano College system will include a special vacuum cleaner to remove the fine Sahara sands that infiltrate the area for six months of the year.

TV MISSION FROM MOSCOW

RUSSIA'S first deputy Minister in the electronics industry, Mr. K. I. Mikhailov, recently led a delegation of Soviet engineers and trade officials on a tour of Britain's electronics industry.

During a visit to EMI Electronics Ltd.'s factory at Hayes, Middlesex, Mr. Mikhailov's team saw a wide range of television studio and sound recording equipment and the latest transistor cameras. They showed great interest in the EMI range of camera tubes and in a new electronic tube which can "see" in the dark.

PACIFIC-COAST MICROWAVE LINK FOR U.S. AND CANADA

A 1,300-mile extension to Western Union's transcontinental microwave system which already spans America from East to West, is to be built at a cost of 13 million dollars.

The extension will link San Francisco in California to Portland (Oregon), Seattle (Washington) and Vancouver in Canada. Eventually it will connect with Canadian microwave networks and a link to the Communications Satellite Corporation ground station at Brewster Flat, Washington, will provide international services for television, teleprinter, voice and computer data transmissions.

A large slice of the contract has gone to the Raytheon Company of Massachusetts who will supply the fifty-one terminal and repeater stations for the broadband communications system.

Raytheon's new solid-state microwave radio equipment, which has been specified for the system, has a ten-watt output and operates at a frequency of six gigacycles. The equipment is of a heterodyne design and free of the cumulative distortion commonly associated with microwave equipment that remodulates the transmitted signal at each repeater station.

Design of the equipment is based upon infra-red testing of components for greater reliability. The equipment is said to have an on-the-air reliability rating of 99·99 per cent.

Translators for Band III

TRANSLATORS worth approximately £45,000 have been ordered from Standard Telephones and Cables Ltd.

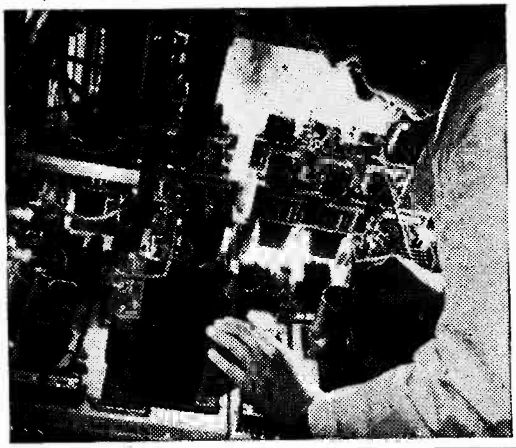
The translators, or "boosters", will be used at ITA stations throughout the country to relay Band III television programmes to many areas with poor reception.

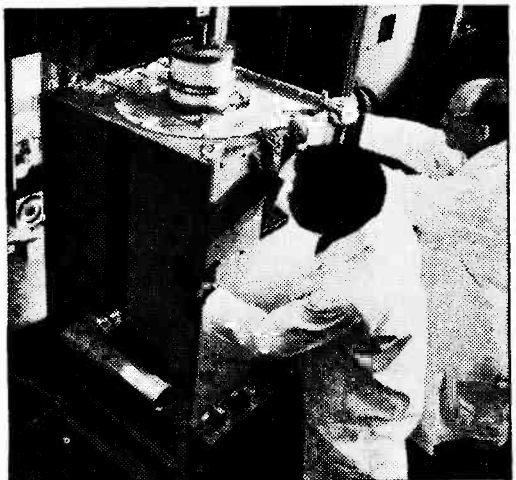
The solid-state units have an output power of two watts. Stations using the translators will be sited on high ground, adjacent to areas of inferior reception, where they receive the programme from the main transmitter and relay it to the "shadow" areas on a different frequency.

The ITA contract follows closely upon a BBC order for a number of Band IV and V translators to serve the Midlands area.

BRITAIN'S WORLD LEAD IN U.H.F. TRANSMITTERS

Britain has taken a world lead in the design and manufacture of u.h.f. television transmitters. Many of those the BBC will use to transmit their second programme are being supplied by Pye TVT Ltd. of Cambridge.





These photographs show two different sections of a typical BBC-2 transmitter during assembly at Cambridge. Above is a liquid-cooled Klystron power amplifying tube fitted into its circuit assembly, while the section illustrated left is the Klystron focus power supply system.

More Boosts for Bad Reception Areas

TWO new relay stations recently began radiating BBC-1 to some 20,000 people outside the service area of their nearest transmitters.

One station at Penifiler in the Isle of Skye came into service during March to provide improved reception for about 1,100 people in Portree, while the other benefits approximately 19,000 people in Kendal, Westmorland.

Both these stations transmit on channel 1 with horizontal polarization. The Kendal station, which is to open shortly, will also transmit three v.h.f. sound programmes.

Another relay station is planned for Portrush in Northern Ireland and a contract for the construction of its 250 ft. aerial which will transmit BBC-1 to an estimated 20,000 in Portrush and parts of Portstewart and Coleraine, has already been placed.

IDEAS FOR..... amateur TV

M. D. BENEDICT.

THE purpose of this series of articles is to help any would-be amateur TV enthusiast who does not know quite where to start constructing a television studio. They are not a step by step guide for a complete beginner but merely a guide for a reasonably experienced home constructor. It is hoped to be able to give some ideas in order to plan a studio and its growth; and to give some details of the individual items of equipment.

There are many other sources of information which will be indicated where applicable, but as the author is only human, it cannot be a comprehensive list.

The equipment needed for the construction of a studio is simply the usual tool kit, some ingenuity and an oscilloscope. It is not necessary to have a very good 'scope but it is often easier if one has access to a double beam 'scope, preferably with strobe facilities. This is particularly true when we come to deal with the pulse generators. Access to a sweep generator operating up to 3 Mc/s or above would be useful for checking video amplifiers, but is not essential. In fact, the only vital equipment is a 'scope, and this is used in the final studio set-up as a waveform monitor.

Studio Set-up

Let us consider a typical small studio (Fig. 1). This shows two cameras connected to their camera control units, which control "lift" (brightness) and "gain" (contrast) in the camera and carry pulse feeds to the camera. The power supplies for the individual cameras are contained in their respective camera control units. The camera control units have two outputs; one of which feeds a vision mixer, the other feeds a picture monitor (a line feed television set) and, via a switch, the 'scope (used to check the waveform).

Vision Mixer

The Vision Mixer is a device for selecting the vision source or sources fed to the studio output. The video signals may be switched (cutting) or mixed (dissolving). Superimposition of two or more sources may also be performed.

When all vision sources are faded down there is no output from the mixer, hence no synchronising pulses are fed to the output. All receiving monitors would therefore lose lock and free run, which could cause damage to the transmitter. Some means of maintaining constant synchronising pulse amplitude, irrespective of picture content, must be found. This is achieved by feeding the mixer output into a stabilising amplifier, which is also fed with sync from the pulse generator. These are re-inserted into the video signal after it has had its sync completely removed. Facilities may be provided, with little extra complication, for carrying gain and black level. It is usual to provide two outputs from the stabilising amplifier, one being the main output, the other feeding the output picture monitor and waveform monitor.

Telecine

The Telecine system is another camera with an ordinary projector shining into it. The projector can be of any gauge, but it is felt that a 16mm. projector is an advantage as a much greater range of films for hire are available in this gauge. Also, 8mm. is not quite good enough for the resolution of even a 405 line system. Another reason for 16mm. system is that sound on 8mm. is a recent development so a new projector would be needed, but with 16mm. sound is well established so an old projector may well have a sound reproducer. If two projectors are available it is possible to combine them optically. A flying spot telecine will also be discussed. The sound from the projector is fed to a sound mixer. This combines the sound from the various microphones, gramophone, tape recorder and film sound as required.

To fade from one camera to another, all the scans must be in exact synchronism. This is done in the studio by triggering the time-base circuit of each camera by the same pulses (line and field drive) and by adding the same synchronising pulses in the cameras. They also need to have the same front and back porch widths so that the same blanking pulses are applied to each channel.

Sync Generator

All these pulses are generated in the synchronising pulse generator and fed to each channel. Efforts should be made to equalise the cable length from the synchronising pulse generator via the camera control unit to the mixer or else the pulses will not arrive in coincidence. Sync signals are also fed to the stabilising amplifier. These points will be developed further when discussing the relevant apparatus.

This, then, is a complete studio and it may appear a very complicated set-up. However, it is possible to build up a studio item by item, providing that a bit of common sense is used.

It is suggested that the following order be adopted, but if a particular item becomes available it would be foolish not to take advantage of it. For example, if one was to find a tube suitable for a viewfinder, the viewfinder could be built at an earlier point than suggested. This list also enables one to collect the items for future projects as they become available.

1 *Simple Pulse Generator*
2 *Test Generator*
3 *Radio Frequency Modulator*
4 *Conversion of television set to monitor*
5 *First camera*
6 *Viewfinder*
7 *Second camera*
8 *Telecine*
9 *Synchronising Pulse Generator (fully interlaced for 405 or 625 lines)*
10 *Vision Mixer*
11 *Stabilising Amplifier*
12 *Sound Mixer*
13 *Distribution amplifiers*

It will be appreciated that the items mentioned above are only the basic equipment needed and as one enlarges the studio, more items can be added, e.g. monitors and viewfinders. However, in the author's experience, contacts with other amateurs simplifies the collection of many of the items.

During the series it will be attempted to deal with other aspects besides the construction of equipment and to give some advice about lenses, lighting and so on.

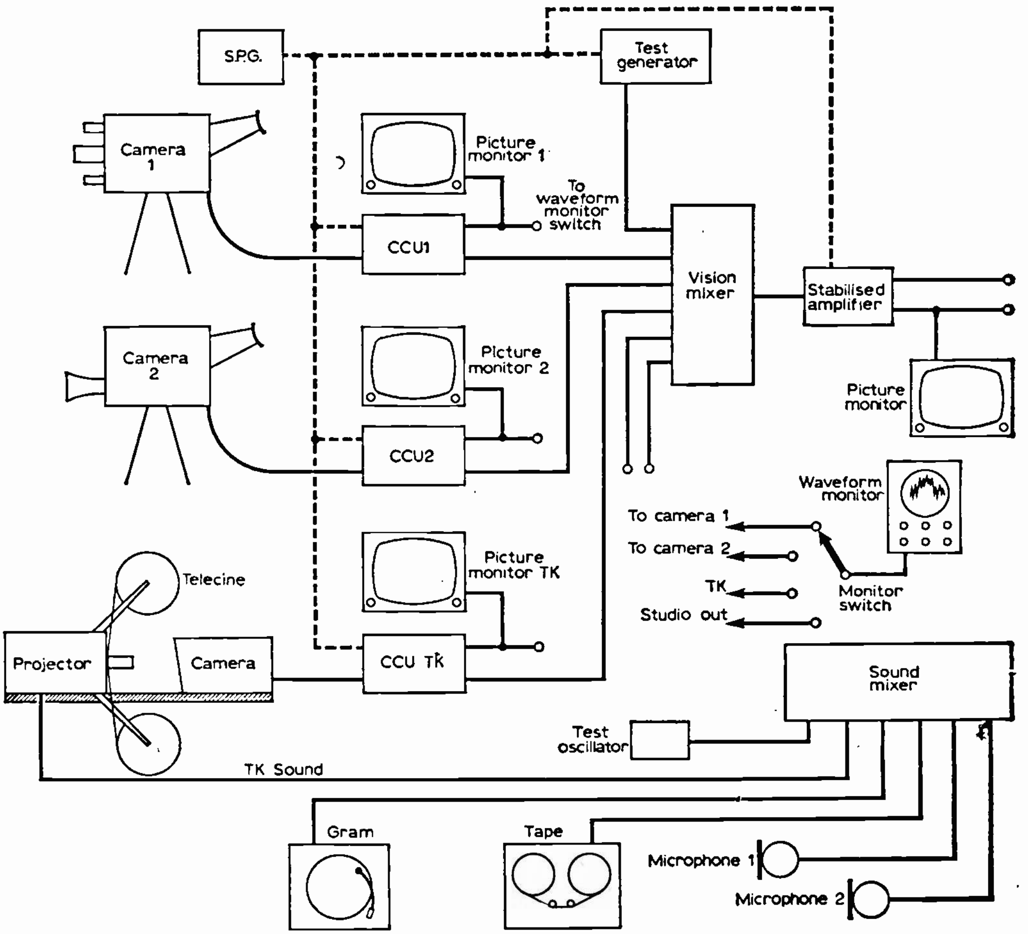


Fig. 1—Layout of typical amateur TV studio.

Synchronising Pulse Generator

The following pulses are required by all picture sources:—

1. Line drive (triggers line timebases).
2. Field drive (triggers field timebases).
3. Mixed (i.e. line and field) blanking. This provides a black "edge" to the pictures by removing information from just before to after the synchronising pulses. This allows flyback to occur during a black part of the signal. It is sometimes required to stabilise the black level; this is done by a "clamp" which acts during the "back porch" period (Fig. 2a, b).
4. Mixed syncs., which are added on after blanking and trigger receiver and monitor timebases.

The exact timing and position for the various pulses are rather complex so that it will not be dealt with now. Similarly the use of broad pulses for field syncs. The simplified system uses only line and field drives which are combined to give a mixed signal used for blanking and syncs. These pulses operate most picture and test waveform sources but suffer from the following disadvantages:—

No broad pulses, no interlace, no mains lock and no blanking outside sync. period. However, it is very much simpler than the complete Synchronising Pulse generator. Such a pulse generator is shown here (Fig. 3).

It consists of 2 free running multi-vibrators, Tr1 and Tr2 which generate a 10 k/cs rectangular waveform with a mark/space ratio of 10:1 (Fig. 2d). This is fed through an output stage and used as line drive. A similar multivibrator Tr4 and Tr6 generates a field waveform at 50 c/s with a mark/space ratio of 50:1 (Fig. 2e). This is also fed through an output stage and is then used as field drive. Two waveforms are combined in Tr7 and Tr8 and this is used as mixed blanking and syncs.

The circuit used has a 12 volt supply but could work with other supplies fairly easily.

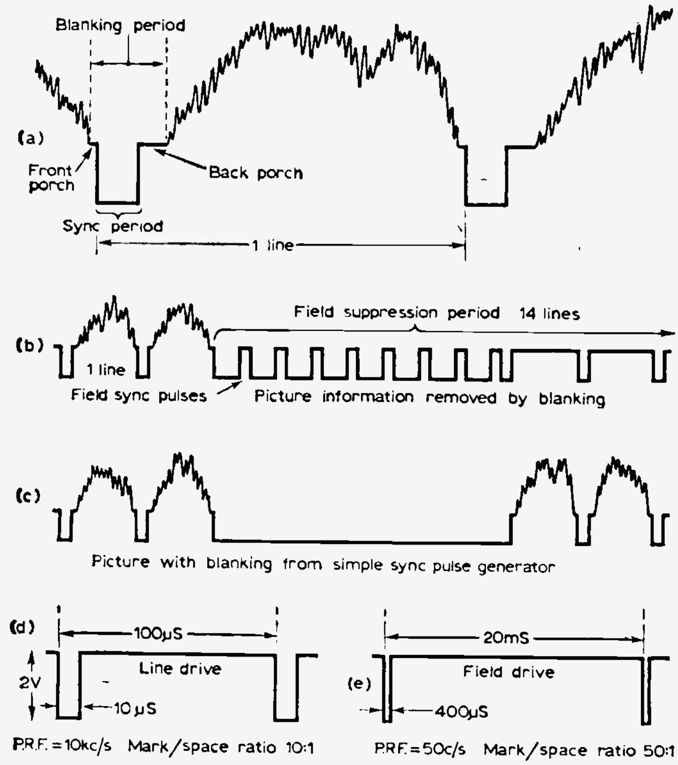


Fig. 2—Synchronising pulses required by all picture sources.

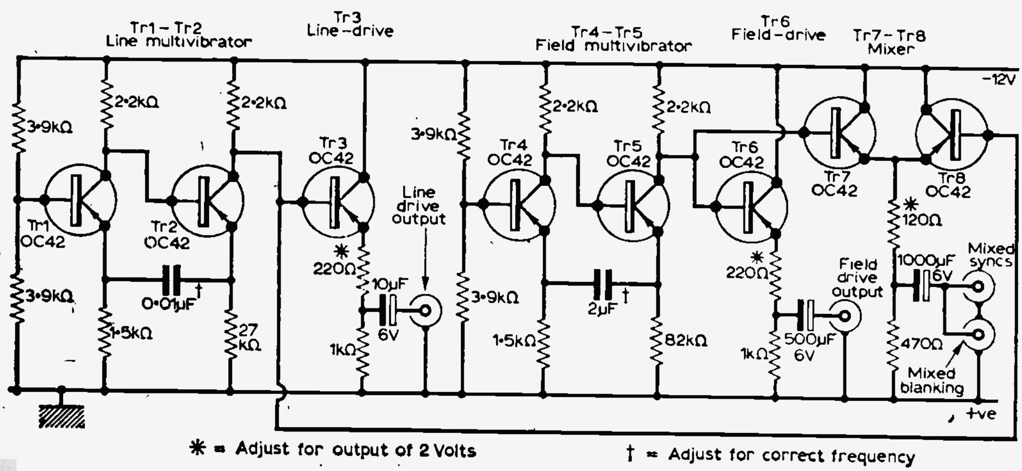


Fig. 3—Synchronising pulse generator.

Power Supplies

It is suggested that all voltage supplies are standardised at 12 volts for most amplifiers, test equipment, etc., 50 or 24 volts for relay operation and where valves are included a separate mains power unit is used. Three different plugs for each supply should be adopted as this will avoid confusion and expensive errors.

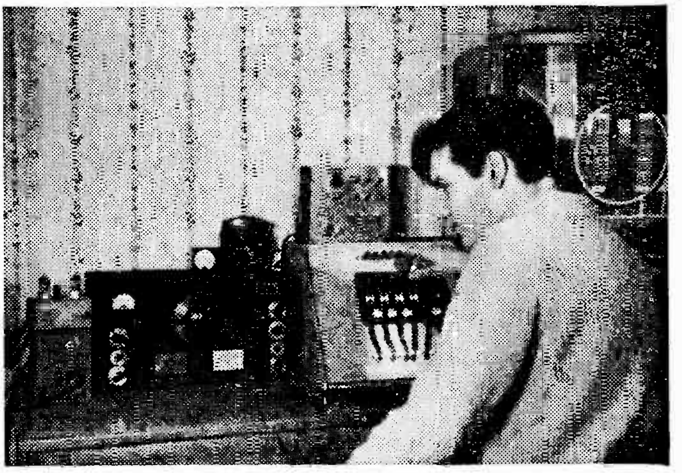
The layout is not critical and the use of Veroboard is suggested. It is also suggested that mixed syncs. and blanking have separate output sockets as shown in the diagram (Fig. 3). This is because the interlaced sync. pulse generator which is built later can be installed without altering any connections.

The Eddystone range of die-cast aluminium boxes are very useful for the small pieces of equipment. It is possible to build this pulse generator into the smallest box but the medium size box allows more room for the various sockets. The sockets used by most amateurs are the ordinary Belling-Lee type of coaxial connector. If a large box is used, however, it is possible to combine the sawtooth generator and the sync. pulse generator in the same box as it is proposed to build a more complex pulse generator later it is advisable to build each circuit on a separate piece of Veroboard. With most of the smaller circuits, the use of off-cut pieces of Veroboard greatly reduces the expense.

Circuit Adjustment

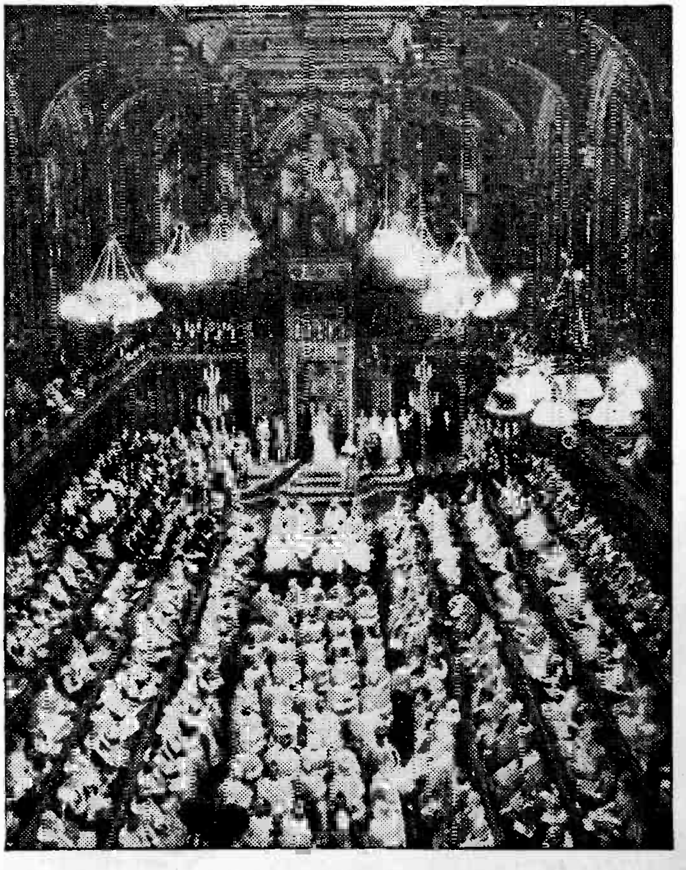
Setting up the circuit is quite simple, with a reasonable 'scope. The frequency of the multivibrator is adjusted by the emitter capacitor and the mark/space ratio by the ratio of the emitter resistors. The output voltage should be two volts into a 75 ohm load. This is altered if necessary by varying the collector loads of the multivibrator of the 220Ω emitter load of the output stage.

Continued next month



Photograph shows HRO communications receiver plus 430 Mc/s converter, aerial rotator position indicator, vision mixer (8 channels) with S.P.G. on top also mixer output monitor.

MAKING HISTORY



Television cameras *were allowed in the House of Lords and the Commons for the first time ever to cover the State Opening of Parliament, which took place on 21st April. This photograph was taken in the Lords as the Queen opened Parliament for the new session. Part of one camera is shown in the foreground; another on the left-hand balcony.*

PIN-POINTING THE TROUBLE AREA

by K. ROYAL

THIS article is not concerned with the actual servicing of a television receiver as such, but more exactly it sets out to reveal how the stage or circuit responsible for a fault condition can speedily be brought to light with the minimum amount of test equipment.

To help us on our way, let us introduce a little basic philosophy. When a television set goes faulty one is inclined to reason that it is doing something that it should not. This may be the case so far as the fault symptom is concerned, but from the circuit point of view it is *not* doing something that it should.

Cultivating the second approach to the problem is well worth while. Let us look at a couple of examples. Take, for instance, the symptom of a rolling picture. Symptom-wise the set *is* doing something that it should not—the picture *is* rolling. Circuit-wise, however, it is not doing something that it should. It is either *not* locking on the field sync pulses or the field oscillator is *not* running at the correct speed, thereby implying that the remaining circuits are in order. In this way, then, we tend to concentrate more on the circuit which is really at fault.

Exercise in Logic

Locating the trouble area is no more than an exercise in logic, and to deal in logic we ourselves must be logical. The set in the above example is doing many of the things that it should. It is producing a picture (even though it is rolling), it is producing sound and line lock and so on. These things alone tell us that the aerial system, the sound and vision i.f. channels, the tuner, the h.t. and e.h.t. circuit *are* in order.

What about the symptom of no picture but sound and raster normal. The circuits are *not* conveying the picture signals to the cathode of the picture tube. This is the trouble in a nutshell. But can the *symptom* tell us more? It certainly can: for example, it tells us that the trouble is (a) *after* the tuner and common i.f. amplifier stage and (b) that it is *before* or *at* the input to the video amplifier stage.

It tells (a) because the tuner and common i.f. amplifier must be working since these stages are handling the sound signal, and it tells (b) because the bias conditions on the picture tube must be reasonably correct for a raster to be produced which can be controlled by the brightness control, and this would be unlikely if there was trouble in the video amplifier stage proper.

The case is thus resolved to the fact that the vision i.f. amplifier stages, including the vision detector, are not passing signal. Can we get closer to the root of the trouble than this? We can by general testing, of course, but let us look at a typical circuit. In Fig. 1 is given the circuit of the vision i.f. stages of a Kolster-Brandes receiver, Model NV40/NV60.

So far we have discovered that the trouble must lie somewhere in stages V4, V5 and the video detector

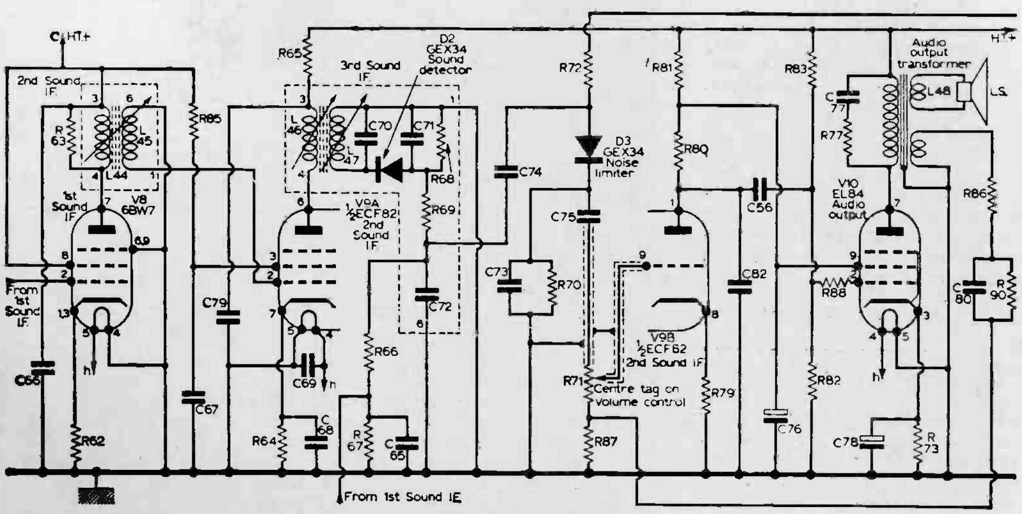


Fig. 1(a)—Sound i.f. and audio stages of the K-B NV40 and NV60 models, which are used as a basis for discussion in the text.

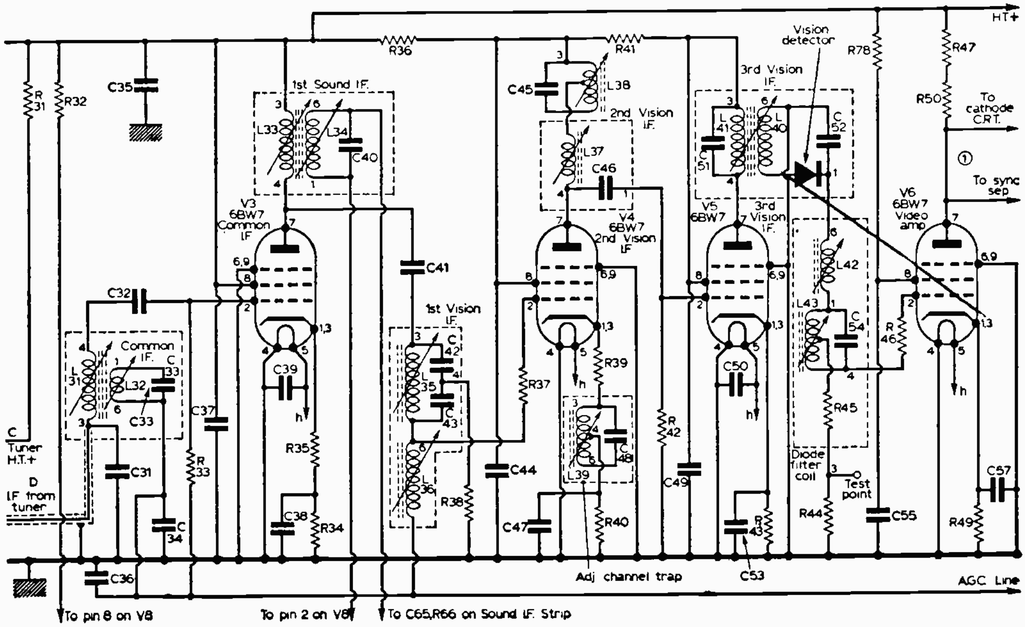


Fig. 1(b)—Common i.f. and video circuits of the K-B NV40/60

(this is a type GD3 diode in the can of the 3rd vision i.f. transformer). We can see that the sound i.f. signal is extracted from the anode tuned circuit of the common i.f. stage V3, so this stage must be working to pass the sound signal on to the sound amplifier V8.

Normally, the temperature of the vision i.f. valves would give us a rough idea as to whether they are conducting or not. If V4 is fairly warm—as it should be—and V5 is relatively cool, then here would be a good clue. V5 would either be low emission or its anode, screen or cathode circuit would be open. The set under examination has parallel-connected heaters from a 6·3V winding on the mains transformer, so here there would be a possibility that the heater of the cool or cold valve is open, but this would be readily apparent. In series-connected heaters an open-circuit heater would probably result in all the heaters being out.

A good test for V4 and V5 would be to substitute each in turn with the sound i.f. amplifier V8, as this is the same type of valve. We could get closer to the fault area, assuming that the obvious factors have been checked, by injecting a modulated i.f. signal from a signal generator at the control grid of V5 and V4 in turn. A fairly strong signal will produce a bar pattern on the raster depending upon the modulation frequency provided the circuit under test permits its passage. If a pattern is produced with the signal at V5 grid but not at V4 grid, then V4 stage is definitely faulty somewhere and normal testing techniques would soon reveal the trouble in detail. However, if nothing gets through the V5 grid, either the vision detector or feed from the detector to the control grid of the video amplifier valve, V6, would be faulty. Again, normal testing would bring the defective part to light.

The diode filter coil sometimes goes open-circuit, and in cases of doubt this can be by-passed by a piece of wire as a test.

The idea, then, is to get as much information from the symptom as possible before delving into the circuits, and finally reduce the fault area as described by performing a series of basic tests and examinations. Normal servicing may or may not be required to establish the actual part responsible for the fault.

No Sound—Vision Normal

This is a fairly easy one, for, again, the symptom tells us that the common i.f. stage and tuner are working correctly and that the sound section is not doing its job. We would tackle this by first discovering whether the trouble is in the i.f. or a.f. circuits. We can be pretty sure that the sound i.f. signal is reaching the control grid of the sound i.f. amplifier valve, but at this stage we have no idea at all whereabouts in stages V8, V9, V10 and the sound detector the trouble exists.

We can get a few clues, however, by listening close at the loudspeaker. If the output valve is passing current, a residual mains hum will be heard in the loudspeaker—this is present in all sets no matter how good the smoothing is. If there is mains hum, turn the volume control slowly over its range and back again, and if this produces a rushing noise or crackle in the loudspeaker—even a weak crackle—the a.f. section all the way through is almost certainly working. This is because the volume control produces little transient bursts of signal as it is rotated and these are amplified and are produced as crackles in the loudspeaker.

We can prove the a.f. stages further by turning the volume control full on and touching the centre tag on the control with the blade of a screwdriver while resting a finger on the blade. This should cause a very loud hum in the loudspeaker due to the amplification of power signal injected by way of the screwdriver blade and the body.

If this happens we can be certain that V10 and associated components, including the loudspeaker, that the triode section of V9 and the sound interference limiter circuit (the GEX34 diode D3) are in working order. This means that the trouble must lie either in the first or second sound i.f. stages or in the sound detector D2 (GEX34). Note that the second sound i.f. is the pentode section of the triode-pentode valve V9.

At this stage we would have proved that the sound i.f. stages are not passing signal, and normal testing as given for the vision i.f. stages should be put into action.

A.F. Stages in Trouble

Let us suppose, however, that we got residual hum from the loudspeaker, but no crackle from the volume control and no loud hum by touching the centre tag of the volume control. Here, then, is a distinct case of a.f. amplifier trouble. This can be checked by touching the control grid of V10 (pin 2) with the blade of a screwdriver while resting a finger on the metal shaft, as the volume control. If the output stage is working a hum should be heard, but less loud than before. In some cases insufficient a.c. injection is impossible at this lower gain point, and a more conclusive test can be secured by connecting an 0·01μF capacitor between the "live" heater tag on the valveholder (pin 4) and the control grid. This will give a very loud hum if the output stage is working.

If positive results are obtained here, then we have proved that V9 triode section is not working. Negative results would, of course, indicate that V10 stage needs looking into.

No Sound or Vision—Raster Normal

This is a clear symptom of trouble in the aerial coupling, tuner or common stages, but if it occurs only on, say, one channel (the other channels working perfectly correctly) the associated aerial or coil biscuit would be in trouble or out of alignment. If one channel is working below par, the trouble could be in the tuner, since a very powerful local aerial signal could mask a tuner defect which would show up only a weak signal—such as that on the channel which is defunct.

Raster Dead Also

The most likely cause here is the power supply or associated circuits failing to do their job. Look for glowing valve heaters, flashing h.t. rectifier, broken mains wiring, open-circuit fuses, faulty on/off switch and so on.

A common cause of this symptom is open-circuit of the surge limiting resistor connected to the anode or positive terminal of the h.t. rectifier.

No Field Scan

This gives the symptom of a bright, horizontal line across the screen. The fact that we have screen illumination and sound indicates that the field timebase is not doing what it should, and that the remainder of the circuits and stages are in order.

Field timebases are usually in two sections, with the field oscillator producing the field signal of correct waveform and the field amplifier changing the signal to power to feed the field scanning coils. We must first establish whether the oscillator or amplifier is at fault.

Fig. 2 shows the field timebase circuit of the receiver already mentioned, in which V13A is the field oscillator (sometimes called vertical generator) and V13B the field output stage. How would we go

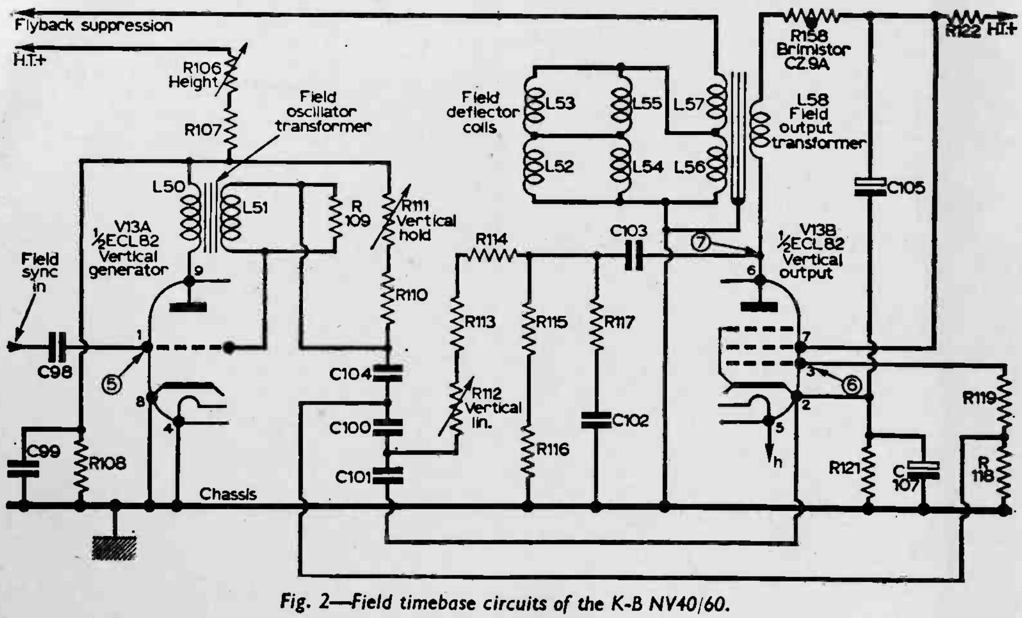


Fig. 2—Field timebase circuits of the K-B NV40/60.

about reducing the symptom of "no field scan" to a particular section? Actually, it is not too difficult, for we can quickly check the amplifier or output stage simply by introducing a small voltage at mains power frequency to the control grid of the valve. This is easily done by connecting an 0·1μF capacitor between the control grid (pin 3) and the "live" heater tag on the valveholder (tag 5).

If the output stage is in order, the horizontal line would open up to form a somewhat distorted field scan of limited amplitude. This would prove that the trouble is in the oscillator stage. Conversely, if this procedure failed to give the expected results (ensure that the heater "live" tag is used), the oscillator would probably be all right and the fault would lie somewhere in the output stage.

Another check for the oscillator is to connect a pair of high resistance headphones, via 0·01μF isolating capacitors (one in each 'phone lead), between chassis and the grid of the amplifier valve. If the oscillator is working it will be heard in the 'phones as a rather loud, rough buzz, the pitch of which can be altered by adjusting the vertical hold control. In that way we can point to a specific circuit section or stage and say "the trouble *must* lie somewhere in here".

The Line Timebase

The line timebase is rather more difficult to analyse in this way since not only does it produce line scanning power, but it also produces e.h.t. voltage for the picture tube, so if it fails the screen goes blank and we have no absolute symptom.

On 405-line sets, the tell-tale line whistle can help with the diagnosis. Note that on 625-line models the whistle or frequency is at 15,624c/s, which is far too high for most people to hear. It helps to adjust the line hold control over its range to bring the whistle down in frequency a bit so that it is less of a job to hear. If the whistle is present, then, of course, the line oscillator is operating.

The amplifier is next to come under attention. A red-hot screen or anode in the valve would point to trouble in the line output transformer, as also would an overheating transformer (assuming that the line oscillator and drive is correct). Checking for pulse voltage at the anode of the amplifier valve and at the anodes of the e.h.t. rectifier is to be highly recommended. Such pulse voltage can be checked by holding the tip of a screwdriver a little distance away from the anode concerned, for if it is present a substantial, blue arc will develop between the screwdriver tip and the anode wire or cap. A word of warning here; take care to ensure that the screwdriver possesses an adequately insulated handle and avoid letting the fingers get too close to the blade!

If there is pulse voltage at the e.h.t. rectifier anode, but not e.h.t. voltage at the cathode, the e.h.t. rectifier valve is in need of replacement, if there is only a weak discharge at both anodes with a normally whistling timebase, suspect shorting turns in the line output transformer or trouble in the booster diode or associated components.

Similar procedures to those detailed in the foregoing can be applied with a little forethought to almost any stage in the receiver, remembering always to acquire as much information as possible from the symptom and then lead up by basic testing to the question—"what is *not* happening in the circuit that should be happening?" ■

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

THIS month I fear that the mixture is very much as before, and the expected improvement in DX conditions has not yet fully materialized. In fact there is still a very long way to go, so I can only say again: patience for a little longer!

I have been checking back over the commencement of good Sporadic E openings over the past few years, and there have been some significant early openings in April. Last year there was a very good one on April 14th, and in every instance by the end of the month the results have been good. May, it seems, has always been good; in fact usually one of the best months of the year.

So I'll stick my neck out and predict that by the time you read this article we must be lucky at last. If not, I fear that some disgruntled would-be DX'er, who has just spent time and thought in converting his 405 line set, might come down here and sabotage my aerial installation by cutting the guy ropes!

I know many friends who, after conversion of their receivers, have had to wait some weeks for some of their successes to materialize. I reckon that I was born lucky because when, some years ago, I first converted a set, I switched-on and promptly got T.V.E. Madrid, and Budapest in the first two minutes!

DX/TV is a very rewarding hobby, and the results are well worth waiting for, so keep that set switched on and tuned, I suggest, to channel R1, or E2, and when you least expect it what you are waiting for will appear on your screen.

CONDITIONS

In spite of the foregoing dismal remarks, there has been some slight improvement in Sporadic E propagation throughout March/April. The openings have been of short duration, and mainly in the mornings between 08.00 and 09.00, with very little activity after 12.00. The best dates here were as follows:—

1966	1966
20/3 E2a Jauerling Austria	29/3 R1 Czechoslovakia
22/3 R1 Czechoslovakia	3/4 E2 Sweden
26/3 R1 Czechoslovakia	5/4 E2a Jauerling Austria

9/4 R1 U.S.S.R. (first time this year in this area).

There has been some slight activity in the evenings on E3 on occasions from either TVE Spain or RTP Portugal, also West Germany Grunten has been about on E2.

Tropospheric reception in Bands I-III and u.h.f. has shown some progress throughout the month, but the unexpected snow on 14/4/66 really made the tropospherics take a beating.

NEWS

(1) I confirm that the "Telefis Eireann" 625 line test card without any lettering or words on it, seen on E3 is of Yugoslavian origin, the transmitter being at Koapanik.

(2) Always a perpetual optimist, and in spite of the unrewarding recent conditions, I suggest that we look hopefully to the future. To this end Roger Bunney and myself have got together to prepare for you a list of "exotic" possibles, the majority of which are African. In spite of this, however, the distances involved are in many cases not greatly in excess of those between the British Isles and, say, the U.S.S.R.

The first three transmitters appear in the official E.B.U. lists, and therefore should be correct. The rest have been gathered from various sources, and there is therefore some possibility that the information is not always precise. It may well prove helpful and worth bearing in mind, when the signals on the screen are unusual, so good luck. All these transmitters operate in Band 1 with norms of 625 lines negative image and f.m. sound.

E.B.U. LIST

Cyprus: Nicosia. E2. Power 1.5 kW polarization horizontal. (Now understood to be 3.0 kW from information given to me by an installation engineer recently on site.)

Lebanon: Fih. E2. Power 1.1 kW. pol. vert.

Lebanon: Maaser El Chouf. E4. Power 60 kW. Pol. hor.

Other sources:—

Canary Islands: Santa Cruz de Teneriffe. E3. Power 300 kW. Pol. hor.

Egypt: Port Said. E3. Power 5.0 kW. Pol. hor. (the E.B.U. lists give this transmitter on E10. Power 25.0 kW, but it is just possible that there are two stations).

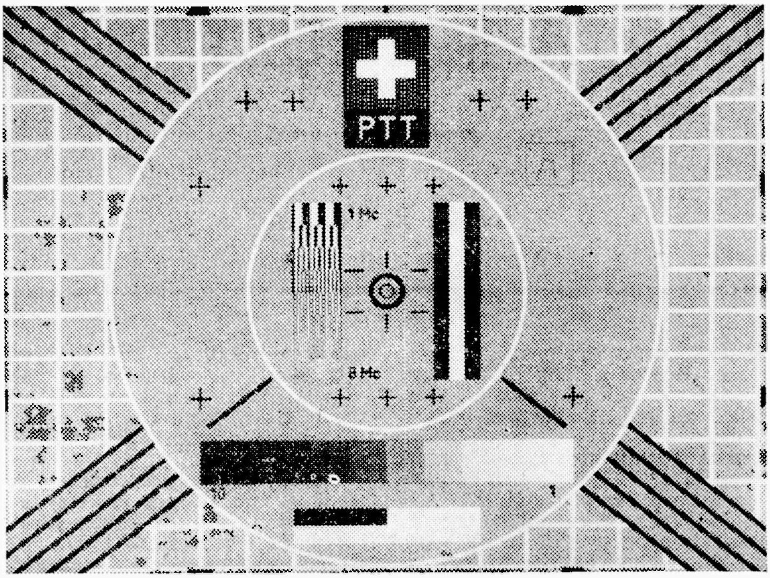
Ghana: Kissi. E2. Power 15.0 kW. Pol. hor. Jamasi. E3. Power 15.0 kW. Pol. hor. Adjankote. E4. Power 15.0 kW. Pol. hor.

Kenya: Nairobi? E4. Power 15.0 kW. Pol. hor.

Mauritius: Forest Side. E4. Power 5.0 kW. Pol. hor. (This is pushing our chances a bit.)

Nigeria (East): Enugu. E2. Power 60.0 kW.

DATA PANEL-10 **SWITZERLAND**



(courtesy M. Aisberg)

Channels—Band I only given.
E2 Bantiger now power doubled 60.0 kW Horizontal polarization. E3 Utliberg Power 60.0 kW Polarization horizontal. E4 La Dôle Power 144.0 kW Polarization horizontal.

The above stations are all often well received in the British Isles, but due to the relatively short "skip" distance for Sporadic E reception is usually more reliable and better in the North than in the South of England.

Test Card—The Test Card carries a small letter at "2 o'clock" in the grey outer circle. This is rather difficult to read unless the signal is strong, but if it can be deciphered it indicates the transmitter as follows:—"B"=Bantiger, "U"=Utliberg, and "D"=La Dôle.

Pol. hor. Aba. E4. Power 60.0 kW. Pol. ??? Jaji (Radio Kaduna TV). E4. Power 40.0 kW. Pol. hor. (The test card used is type "C" with outer circle with the word "Kaduna" below and the letters "R.K.T.V." above.)

Nigeria (West): Abafon (Lagos). E3. Power 60.0 kW. Pol. hor. Ibadan. E4. Power 50.0 kW. Pol. hor.

Rhodesia: Salisbury. E4. Power 20.0 kW. Pol. ??? Bulawayo. E3. Power 3.0 kW. Pol ???

Zambia: Lusaka. E3. Power ??? Pol. ??? Kitwe. E4. Power 13.6 kW. Pol. hor.

READERS' LETTERS

With the poor conditions, by far the greatest amount of mail has consisted of requests for details of conversion of 405 line sets, and reports of results are somewhat limited, however we quote the following:—

D. F. Browne of Hove has returned a good u.h.f. log for France 2nd chain with Brest Ch21, Caen Ch25, Rouen Ch33, ?Rheims Ch45, ?Le Havre Ch43, Troyes Ch24, and Lille Ch27.

K. J. Reed of Bagshot, Surrey, with France, Denmark, West Germany, Hungary, Spain, Norway, Belgium, Holland, Italy, and Portugal already logged and from a test card photo submitted we confirm Poland as well.

SERVICING WITHOUT A MANUAL

by G. R. Wilding

AS every amateur knows, and every entrant to the trade soon discovers, 50% of television servicing comprises simple, routine valve replacement, tuner contact cleaning and general pre-set adjustments.

For instance, poor contrast with excessive grain, especially on Band III is invariably a sign of a low emission r.f. amplifier whether of the older PCC84 type or the latest PC97; poor vertical linearity or fold-over is invariably a faulty field output valve, while swelling and fading of the picture as brilliance or contrast is advanced is almost certainly a low emission e.h.t. rectifier, and so on and so on.

Most fault symptoms are, therefore, easily recognizable, but there is a further 25% or more that require at least some meter work and/or circuit examination, if only to determine individual valve functions, and for which the relevant service manual would be at least most helpful, while for the remaining hard core of receiver defects even the most competent service engineer will require a circuit diagram.

Indeed most service engineers rank a complete set of service manuals and service sheets of equal importance to their multi-range meter, so that they can tackle whatever job comes along quickly and easily. However, it is not normal practice to carry such valuable and easily marked books or papers in the service van, so the ability to diagnose the area of a receiver's defect, to definitely exclude all valve possibilities, and to assess whether or not a set is a "bench job" becomes most important.

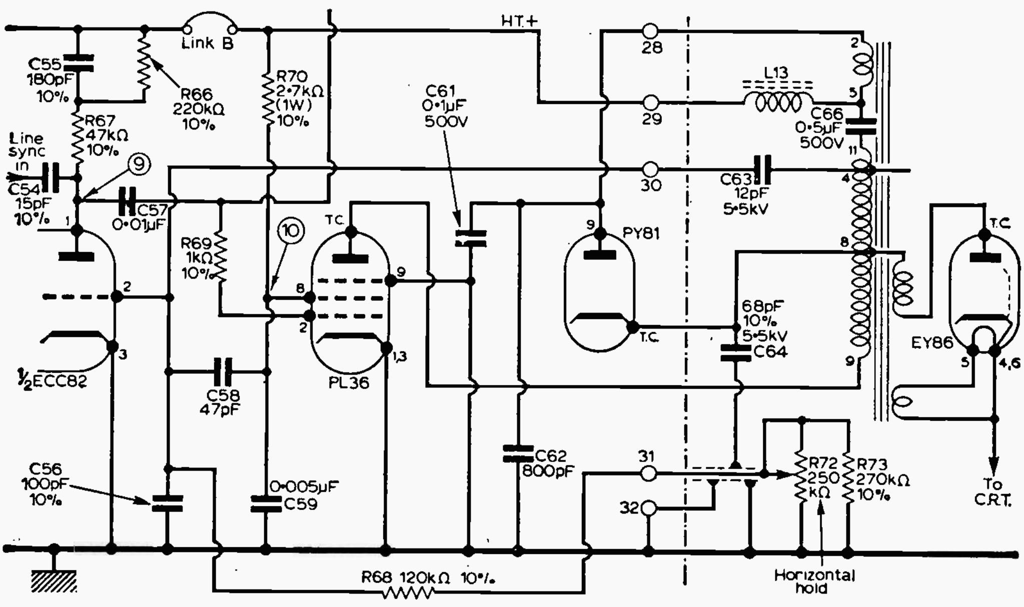


***Fig. 1**—Typical line output stage (Invicta 337) where line output pentode also acts as half multivibrator with ECC82 triode. Note h.w.v. capacitor from tapping on transformer to ECC82 grid for positive feedback.*

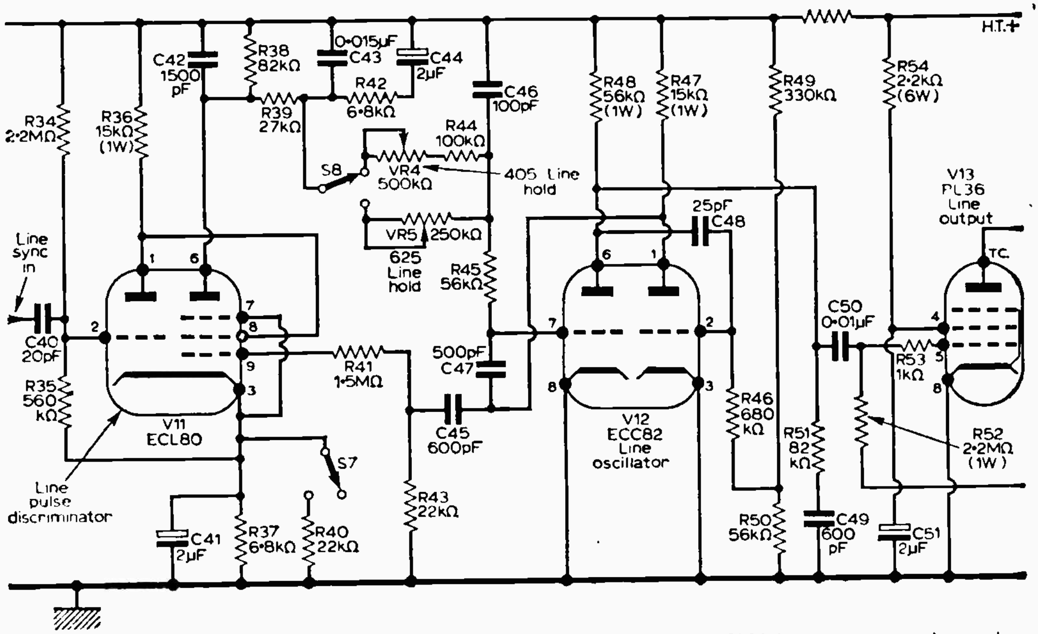


Fig. 2—Typical line output stage (Decca) using duo-triode as line generator with PL36 line output pentode purely as power amplifier. Note cross-connected capacitors to ECC82 triodes.

Furthermore, it is never expedient or good policy to have to constantly consult a circuit diagram or physical layout in the customer's home merely to determine valve functions or identify stages or components.

As an example, a common fault is normal sound with blank but normally controllable raster. It is always wisest to first assume a faulty valve, the question arises, "Which are the vision i.f. valves, and which is the video amplifier?"

To take the latter first, in older models it was often an EF80 type of valve, but with the increasing use of multiple varieties it is now more likely to be the pentode section of a PCL84, PCF80, PCF806, PFL200, or even a straight PL83 as used in many of the latest Philips models.

The easiest and most certain way to locate the video amplifier is to trace the c.r.t. cathode lead to its origin under the chassis. This cathode lead is easily identifiable in all receivers because it is always kept separate from the bunch of other tube leads to minimise its inter-circuit capacitances. It will lead directly to the video amplifier which will also have the additional identifying characteristics of a really high wattage carbon resistor of 5-10 kΩ as its load. These resistors are usually well over-rated to eliminate possible value changes over long periods of use and of course may be coupled to a miniature peaking coil.

Having identified the video amplifier, check that it is working by applying a small positive or negative voltage to its grid and noting the resulting increase or decrease in raster brilliance level. The application of the meter leads on an "ohms" range forms a convenient way of obtaining such a small voltage.

In dual-standard receivers which use a.c. coupling to the tube cathode from the video anode, such a test becomes ineffective and the best policy is to leave the set on 405 or feed a small a.c. voltage to the grid via a small capacitor. The most convenient source of such a small a.c. voltage is the live side of the tube heater.

If the raster is absolutely devoid of modulation but is fully controllable from black-out to full brilliance, it is most unlikely that the video valve is defective, as to enable the raster to appear (again not in a.c. tube coupled circuits) it must be passing approximately normal anode current, otherwise the video valves anode voltage would rise to that of the h.t. rail and cut-off the c.r.t. beam current. If the valve is defective, an internal disconnection to G1 would be the most likely fault.

On the other hand, if weak screen modulation is present, it is more than possible that the valves cathode bias resistor is shorted out or very low in value. While metering in this stage it always pays to check this possibility. If the video stage appears to be working normally or if a replacement valve fails to effect any improvement, the next step is to identify the vision i.f. valve or valves.

In most of the older 405 only models, the i.f. output from the tuner feeds a common sound-and-vision i.f. stage (usually an EF85) followed by one EF80 vision stage. However, in most dual-standard and convertible models there may be two vision i.f. stages using the new EF184 pentodes, and with the common i.f. stage using an EF185 variable-mu version. In either instance, having identified the common i.f. valve, either by its variable-mu nomenclature or its siting close to the co-axial output lead from the tuner, the physical layout of the remaining valve or valves should indicate their function.

When in doubt, some service engineers pull out a suspect valve while the set is working and note the effect is produced. While this is effective, it is not good practice since all valves higher in the heater chain than the one removed are then subjected to a peak heater/cathode voltage strain of 240 x 1·4. A much better plan is to have a dummy base, shorted across pins 4 and 5 and which can be inserted in place of the suspect i.f. valve. Otherwise a piece of wire or thin gauge solder pushed down the valveholder heater sockets will maintain the heater chain and show up the function of any particular valve.

If EB91's are used as the sound and vision detectors, the quickest way of testing their action is transposition, but if a germanium diode is used as the video detector, and possibly mounted inside the last i.f.t. can, it is rarely necessary to expose or isolate it to test it.

In most instances, again keeping to 405 on dual-standard models, detector circuitry is such that by applying an ohm-meter in reverse directions from video grid to chassis, the forward and back resistance difference can be detected, although of course limited by the grid damping resistance of around 5-6kΩ.

Identifying the sync. separator can often be difficult since so many different valves are currently used. For instance, it can be a straight EF80, the triode section of a PCL84, the pentode section of a PCF80, an ECL80 or PFL200, or even as in some Bush receivers, a duo-triode ECC83 as both sync. separator and field inter-lace filter.

Obviously, with multiple valves it is impossible to use the shorted heater technique, and the best plan is to apply the test-meter on a low voltage range, or a medium value capacitor, from G1 to chassis and note the effect on synchronising. Further clues will be the positioning of the sync. separator close to the video amplifier, its capacitive grid feed from the latter, omission of cathode resistor and high negative grid voltage.

While field output valves are easily recognizable by their large size and wattage dissipation, the saw-tooth field generator system is not. The multi-vibrator arrangement is now almost universal, but it can be achieved by a duo-triode ECC82 cross-coupled pair feeding the saw-tooth into a separate pentode, or it can comprise a triode-pentode PCL82 or PCL85 in which the pentode section functions as both half generator and power output.

However, the use of such a triode-pentode does not automatically imply that it is a self-coupled oscillator/output stage since some manufacturers, as Decca, for instance, in their 101 range of receivers use a PCL85 as well as the triode section of a PCF80 as the field valve complement. The two triodes constitute the multivibrator feeding the PCL85 pentode section with the sawtooth wave-form.

The same design possibilities are applicable to line time base circuits. A duo-triode ECC82 may feed the generated wave-form into the usual PL81 or PL36, alternatively the triode section of a PCF80 or ECL80 may be linked with the line output valve to permit the latter to fulfil the dual role of half oscillator as well as power output.

With the service manual the easiest way of checking whether or not the line output pentode also services as generator is to substitute it with another, much older or newer than the one incorporated, and with the line hold control set on the fringe of the lock position. If the output valve is self-oscillatory with an associated triode, there will be a marked difference in the proximity to "lock," while if the power valve is driven from a pair of triodes the only observable difference will be a width change one way or the other.

Then again, the application of a voltmeter to the grid or anode of triodes whose function is in doubt will immediately produce a tell-tale change on the picture.

Thirdly, any duo-triode functioning as a multi-vibrator will have the characteristic cross connected capacitors from each anode to the others grid, or an upbypassed cathode resistor to provide the required positive feedback for oscillation.

If the line output pentode also serves as half the line generator there will be an identifying high working voltage capacitor connected from a tapping on the line output transformer to the grid of the complementary triode.

If fly-wheel sync is used, it is certain that the line generator will be a duo-triode multi-vibrator or single triode blocking oscillator, leaving the output stage quite independent of the generated frequency.

If circuit examination reveals any sign of a burn-up or a resistor being grossly over-run, it is essential to obtain correct replacement values from the service manual, as resistor colour coding changes markedly when subjected to over-heating and a physical test with an ohm-meter will also certainly indicate a value much less than stipulated. ■

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

MARCONI GAIN AWARD

AMONG the first companies to receive the Queen's Award to Industry is the English Electric Co. Ltd., parent firm of the Marconi Company.

English Electric, along with 115 other firms, receives the Award for its achievements in exports.

The new Awards, to be presented annually to selected firms for their export or technological achievements, were announced for the first time on April 21, the Queen's personal birthday.

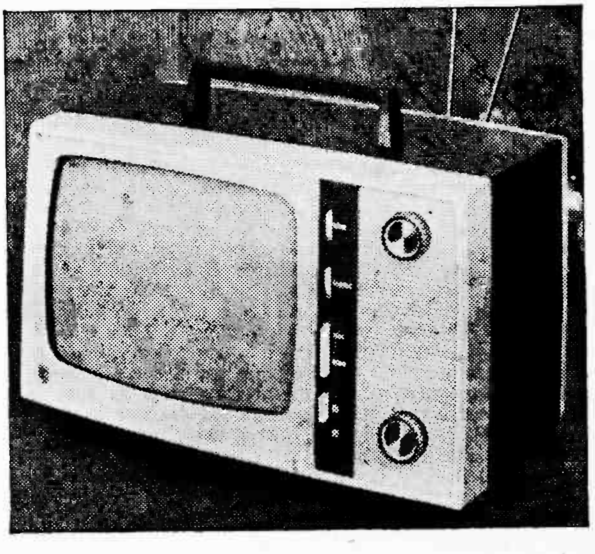
The Marconi Company, as regular readers of P.T.'s Teletopics will know, has scored a number of successes with their exports overseas of television cameras, transmitters, etc.

NEW PORTABLE RECEIVER

A NEW portable television receiver was among a complete range of new equipment to be seen at Philips' trade show held at Brighton, Sussex, during April.

Completely transistorised, the portable features an 11in. screen and dual-standard operation and is shown below. With provision for either mains or battery running, this latest model will be on sale later this year.

The portable set appeared with several other new Philips' receivers. Philips also provided a glimpse of tomorrow's TV world with a demonstration of their EL3400 video tape recorder, built into the cabinet of a standard receiver.



U.S. PROJECTION TUBE

THE instrument shown below, looking like a saucepan or watering-can depending on which way you view it, is the latest television projection c.r.t. from the Raytheon Company of America.

Raytheon claim their tube produces many times the light output of standard projection tubes and has a longer operating life.

Images are projected through a 5in. window, and the handle of the "saucepan" is the electron gun for bombarding the phosphor of the faceplate.

RENTAL TRADE . . .

SINCE 1958 there has been a swing towards renting TV receivers, as opposed to purchase and at present 80% of viewers rent their sets.

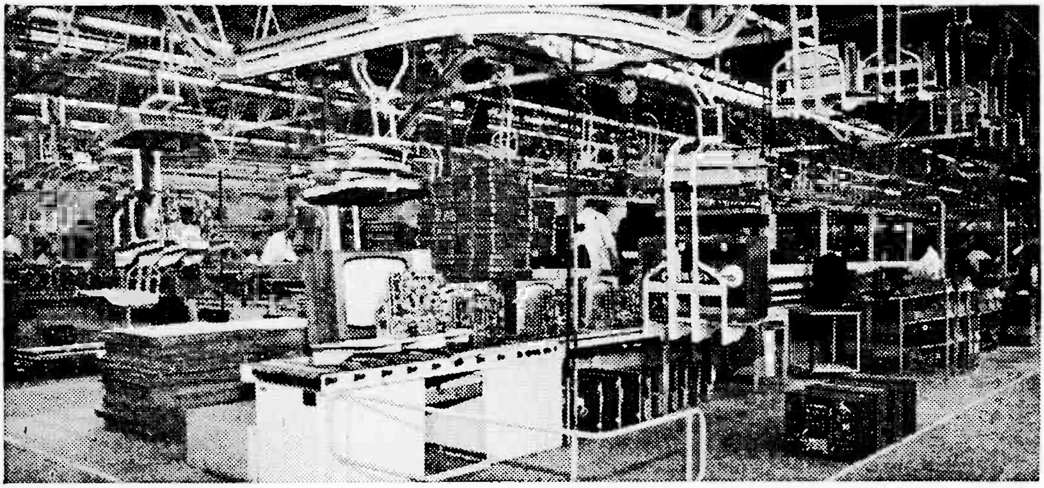
This is one of the facts appearing in a special report on television receivers in the April issue of "Retail Business" published by the Economist Intelligence Unit (Spencer House, 27 St. James's Place, London, S.W.1).

The report states that 90% of households possess receivers, but that second-set ownership is less than 2%. Manufacturers who have benefited from the rental trade because their sets are replaced sooner than those privately owned) are now turning to the untapped second-set market, where receivers are sold principally on their portability.

. . . MERGER

BY acquiring a majority shareholding, Radio Rentals Ltd. has taken over Vista TV Rentals.

However, no alteration in the independent and separate character of the Vista concern is intended, only a slight managerial rearrangement.



MEET THE SETMAKERS

PART 5: PRODUCING THE NEW RECEIVER

P. WESTLAND

OUR new TV set has been born. Prototype models have been built, tested and proved. The design has been finalised in every detail, and all that remains to be done is to produce it. But this is not a simple process, and in fact a long, complex and highly organised series of operations have to be carried out before our brand new, fully packed receivers begin to roll off the end of the production lines.

First we must make our preparations; then we can start production, and finally we must provide a service for our customers if any need help.

Mass Production

Our Setmakers' factory, with its complex organisation, its thousands of workers and its vast buildings exist for one purpose, and one purpose only—to mass produce television receivers. It is our true engineer at work turning out for half a crown what anyone else could only produce for five bob. It is a process tailored to suit a particular set of circumstances, and as in all engineering enterprises, it has its compromises and limitations.

Consequently, it offers some very real and substantial advantages to the customer in terms of careful design, low cost, and consistent quality, in exchange for a few restrictions in choice of product.

What is true mass production? The production manager's dream is to be asked to turn out a single product, in the largest possible numbers for the longest possible period of time. He can then concentrate on finding ways and means of doing this even more cheaply. With the aid of his production engineering department, and his efficiency experts, he will investigate each step of the production process, and then devise new techniques for doing them better, and doing them more efficiently and therefore at a lower cost.

Equipment

With a long production run it will pay him to instal sophisticated equipment that will perform its function more quickly and to a higher standard of quality. He will replace operators, doing dull repetitive work with machines; try to reduce the amount of scrap material; combine several operations into one; introduce shift working to make better use of his equipment and improve the organisation and handling, and reduce the amount of floor space needed. These and many other approaches will result in higher output, better quality and lower cost.

We can see immediately that we have arrived at a more efficient but less flexible method of production. This means that as soon as any element of change is introduced into the process a delay is caused, production falls, and costs go up. When a complex and comparatively bulky product such as a television receiver is being produced at the rate of perhaps a thousand a day, it is even more important to avoid difficulties arising in production.

This is why our sales manager was limited to only a certain number of new models for next season's programme. It was a compromise. If he had asked for more, the resulting dislocation to the factory would have caused a disproportionate increase in unit costs.

To illustrate the effect resulting from small causes. suppose that the factory runs out of stock of one single type of screw, used (probably) in several places on the chassis and cabinet assembly. The throughput down the assembly lines is so large that it is impossible to stockpile more than about one full days' production on the factory floor.

Unless adequate supplies of that screw can be obtained within twenty four hours the assembly lines come to a halt, except for sub-assembly and coil winding departments. Most of the costs continue, production is lost, and unit costs go up alarmingly. Small wonder that near panic occurs at even the very idea of stopping production.

Preparing for Production

Our discussion about mass production shows that the whole process depends upon the co-operation of our staff at all levels, good organisation and careful preparation. At this moment in time, our new design exists only in terms o hundreds of drawings and a few hand-made prototypes but of course preparations for production began a long while ago.

For instance one of the first things the mechanical designers did was to design any moulded components, so that the completed drawings could be sent off to the toolmakers without delay in order that work could begin on them. This ensured that sample mouldings would be ready for checking before the start of production.

All these preparations are drawn up on a master plan, which shows the date by which each stage, and each activity has to be started and completed. Mouldings were probably the first item on the programme. It will be the responsibility of a senior member of the staff to co-ordinate all these activities, and to take immediate action if any of them show signs of falling behind schedule.

Production Engineering

The physical layout of the receiver will have been designed specifically to suit the assembly methods and techniques preferred by the factory. In order to do this a number of discussions will have been held with members of the production engineering department to find out what they wanted, and to send out the production implications of any new design techniques proposed. Long before the design is complete, the production engineering department will be busy devising ways and means of handling any new assembly problems that arise.

Take, for instance, the potted overwind of the new line output transformer. The bobbin with its winding will have to be placed in a mould, with the leads properly dressed, and then filled with an organic resin. The number of moulds needed for a given output will depend upon the setting time of the resin which, in turn, will depend upon the amount of catalyst used and the air temperature of the assembly shop.

There must also be an allowance for wastage and unforeseen contingencies. Clearly some experiments will have to be carried out in addition to designing the moulds themselves.

In the first article of this series, we mentioned the problem of dip soldering. Here again experiments will have to be carried out on the fluxing of the assembled boards, pre-heating if it proves necessary, the optimum temperature of the solder bath, and the time of immersion. How many baths do we need to handle two thousand or more boards per day?

Some of our new models will incorporate implosion safe c.r.t.'s. These involve a slightly different method of assembly. What sort of jig do we need to hold the cabinet whilst the tube is being assembled into it? Or again, since the new receiver has a different type of construction, the layout of the assembly shop will have to be altered to suit the different sequence of operation. How shall we plan this layout, and what orders must be given to the plant department to put this into effect?

These and countless other problems must be solved in time to enable production to be switched over from the old design to the new on the given date, with the least possible delay and disturbance.

The Setfathers

The Setfathers is just one of several different groups that go to form the production engineering department. However the name is so apt that it deserves an honourable mention. The way in which the overall assembly process is split up into a number of separate activities is a matter for decision at a high level, but the Setfathers play a very important part of their own.

The major part of a television receiver is assembled by means of a very large number of separate operations carried out in a carefully controlled sequence. If any single operation is badly planned it will either cause production to come to a full stop, or else a number of operators will be left with little to do.

It is the responsibility of the Setfathers to devise a detailed breakdown o the overall assembly process, and to decide the exact series of operations that each worker has to do. Not only must every single detail of assembly be catered for, but each series of operations must be chosen so that the cycle time lies within the range of about one to ten minutes.

The optimum choice of cycle time depends upon the complexity of the activity concerned, but is generally about three or four minutes. Also of course, where a number of different operations are being done in series, as in a conveyor belt system, the cycle time for each operator must be exactly the same.

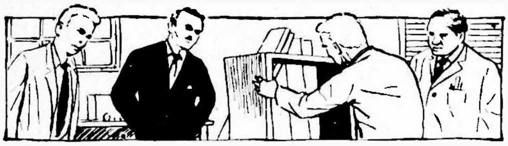
You will readily appreciate that the job of "fathering" a receiver into production calls for a great deal of skill, and considerable understanding of simple human psychology. One is designing human activity—not electronic circuits.

Testgear

It is impossible to mass produce television receivers without a lot of specialised test equipment, and signals piped to numerous test stations scattered about the assembly shop. All this has to be carefully planned to suit the particular requirements of the receiver design, and the overall layout of the whole assembly process.

For instance, if the reciver is not tested until it is completely assembled, most of the equipment and services will be concentrated at one series of points. If however each sub-assembly is tested on its own as well, extra equipment will be needed scattered about all over the shop floor.

The testgear department has the job of deciding what type of equipment is needed and in what quantities. It will then design all manner of items from connecting jigs to complete pattern generators, and buy-in any suitable equipment that can be purchased at an economic price. Someone will then have the job of installing all this gear at the various test stations, and maintaining it in full working order afterwards. It is no mean task.



Checking Components

All the components used in our televison receivers have to be checked carefully. Electronic components will be supplied to a specification agreed with the design department, and these will be batch tested from time to time by our materials testing department.

Items such as cabinets, plastic mouldings, and tooled metalwork of all kinds will have to be subjected to close scrutiny before they can be passed as OK for production. Sample cabinets will be assessed for colour; type and quality of veneer; finish; and for the quality of finish and the fit of any decorative control panels or trim.

Every dimension of the cabinet will also be checked. The other items mentioned will be treated in much the same way.

Purchasing

The purchasing department are responsible for ordering all the materials and components needed to feed the assembly lines, and it must obtain all these items at the best possible price, and in the right quantities at the right time. Preparing for production involves first of all making absolutely certain that every single item can be obtained as specified—or an approved alternative. This often involves a great deal of investigation and subsequent negotiation.

If a new component or material is needed, it may prove very difficult to obtain it at all, and it may become necessary to make it ourselves, or else change the design. The general principle is always to have an alternative source of supply, or to order the same item from two separate manufacturers. Then if one fails you are still able to carry on production.

One should bear in mind the scale of this enterprise. Imagine yourself buying resistors and capacitors in tens of millions per year; wooden cabinets and sets of packing by the hundred thousand, and expensive moulding powder by the ton!

Production

The basic process of production begins at the stores, where a vast array of different items, ranging from metal washers to wooden cabinets, are stacked in their multitudes in bins, bales and boxes. The process ends with a gleaming fully tested receiver in its brand new packing.

In between come an enormous number of assembly operations which depend upon the skill and conscientiousness of each individual operator. It is true there are all sorts of mechanical aids, but the crux of the matter is basically a human one.

The process of assembly is split up into a number of parallel streams which join up at certain points until they become a single stream at the end. Let us follow one or two of these and see how the individual resistors and capacitors, nuts and bolts, all converge to make a complete receiver.

Take a printed circuit board for example. Bins of ready punched boards are stacked beside the first operator at the beginning of a moving conveyor belt. In front of her are storage compartments holding certain components, and a diagram showing where these should go. She picks up a printed board, places it in a jig, inserts the components in the correct holes, makes sure that they are all firmly secured, and then places the panel on the moving belt.

The next operator, sitting behind her, picks up the panel, inserts her quota of components, and returns the panel to the belt. This process is repeated until the panel is complete. Then it is passed to a dip solder machine, soldered, inspected for dry joints and inaccurate assembly, and then placed in special racks for easy handling and protection from damage.

As you stroll down the belt, you notice that all the operators are women. Their ages range from sixteen to sixty, and they come from all over the world. This is a truly international gathering. You admire the dexterity of their flashing fingers, and wonder how they can possibly maintain this speed hour after hour. What are they thinking about, these young school leavers and middle aged married women, and what sort of home will they go back to when the whistle blows at the end of the day?

If our printed boards contained i.f. circuits, its next port of call will be the i.f. alignment belt. The layout here is similar to the assembly line, but the operations consist of trimming all the vision and sound circuits, and checking that the response curves and sensitivities lie inside the prescribed limits. Any reject boards are passed to fault finders, who repair the fault and then return the boards to the beginning of the belt.

Alignment

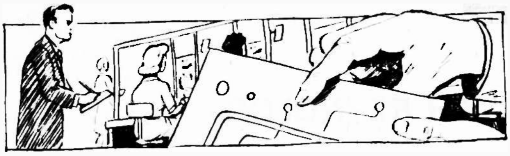
Most alignment nowadays is done with the aid of wobbulators, and each circuit is trimmed for the best response that lies within the limit waveforms drawn on the face of the display c.r.t.

While this is going on, other belts are busy assembling line transformers, the timebase printed circuit board, and the chassis itself. This starts off as a few pieces of metalwork, and storage compartments filled with nuts, screws, and rivets, and finishes up as a complete metal chassis with a number of electrical components already attached to it.

From now on the pace appears to quicken. Tuners, control panels, printed boards, wiring harnesses and other items all converge on the chassis and are rapidly assembled. Each sub-assembly has already been individually tested and inspected, and the chassis, as such, should be in full working order. Now the complete cabinet with c.r.t. and deflection coils appears, and the chassis is quickly fitted into it. Knobs are put on and the receiver is complete except for its back cover.

The receiver is then passed to the test cabins and subjected to a wide variety of tests to make sure it is in proper working order, and fully up to standard with regard to electrical performance. If any defects are found the receiver is rejected, passed to the fault finders, and after being repaired it is again submitted to the test cabins. In other words, an A.F.C. loop is established (automatic fault correction).

Only two more jobs remain to be done. First the cabinet is carefully inspected for minor blemishes, which are skilfully repaired, and then the whole surface is burnished to remove finger marks, dust etc. Finally the back cover is put on and the complete receiver is packed.



Quality Control

Quality is a much misunderstood term. To many people it can be divided into two categories. Good; which means one hundred per cent (i.e. perfection) or bad; which is simply awful. Perfection is impossible; whether the product is hand-made by a master craftsman or mass produced in a factory. In practice the quality level can lie anywhere between these two extremes.

Our set-maker tests and inspects each coil which goes into a live transformer. He then tests and inspects the complete assembly, and then tests and inspects the receiver into which the transformer is fitted. This process is repeated for every other sub-assembly.

Human Element

What more can he do, and how is it that faults occur in spite of all this care? Although some of the troubles can be attributed to faulty components or poor design, the basic cause is a human one. Supposing a tester has a headache, or has just had a quarrel with his wife, he is likely to miss a few defects that in happier circumstances he would have spotted.

Similarly an operator may not notice that the pre-set tongue adjustment of his power driven screwdriver has altered. Some of the screws in a receiver are therefore going to be slightly loose. Careless handling of the carton during its journey from the factory may complete the chain of events leading to a dissatisfied customer.

Test-at-Random

This sort of thing is a constant worry to a setmaker who is trying to maintain a very high level of quality in production. And so, to reduce still further the chances of a faulty receiver slipping through the fine meshes of his inspection net, he has extra staff employing techniques of statistical quality control, and test-at-random.

Test-at-random is just what its name implies. Complete receivers, or sub-assemblies are collected at random and inspected for any signs of assembly faults, and then tested to ensure that the level of performance designed into them are still being achieved in production. This type of testing is intended to show up any faults that have not been spotted at the test stations, and they are immediately referred back to the particular tester concerned.

Statistical quality control is a scientific method of collecting, recording and analysing all the defects revealed by the test stations. The information is plotted on charts which have been specially designed to show three things. These are the average quality level (A.Q.L. to the statistician); downward changes of quality as soon as they begin to occur and not merely after several hundred receivers have passed down the assembly lines; and to indicate clearly the predetermined quality level at which drastic action is needed.

When the quality level begins to fall, an immediate investigation is made to find the cause or causes and to put them right. If this fails, or is only partially successfully and the danger point is reached, the fact is clearly indicated by the charts, and the assembly line is stopped. Receivers already produced are re-controlled and production does not start up again until the trouble has been found and cured.

Test-at-random and statistical quality control are the responsibility of the quality control department, who also have the task of diagnosing any technical problems and devising the appropriate modifications to overcome them.

Service

As setmakers, our responsibilities do not end when our brand new receivers roll off the end of the assembly lines and down the conveyors to our commercial stores. We must provide a service department to help our dealers and customers if they have any problems.

The actual repair work done in the workshops is largely carried out under guarantee, because most dealers do their own trouble shooting. However a large staff is employed at the job of preparing service manuals for each model, and drawing up any special instruction sheets about particular service techniques.

There is also a highly organised stores department that stocks supplies of spare parts sufficient to last the life of the receiver. In addition to all this there is a postal and telephone service that specialises in answering dealers' queries and indulging in long range diagnosis. Any dealer can have the benefit of this advice free of charge.

In Conclusion

And so we have come to the end of our story. It started with an idea, and it finished up with thousands of carefully produced receivers backed by an efficient service department. Of necessity, it has been little more than a mere outline of all the complex and closely interwoven activities that are involved in the making of a modern television receiver.

As engineers we are conscious of the fact that occasionally in spite of all our efforts, our achievements fall short of the high standards at which we aim. To guard against this we issue a guarantee, but we would like also to offer you our apologies and beg your forebearance. ■

ADD-ON SYN

W.H REYNOLDS

NOWADAYS almost every commercial TV receiver uses mean level auto gain control for the video channel. It is cheap, efficient, can be used with dual-standard receivers, but the quality of the picture leaves much to be desired. The system almost completely removes the effect of the d.c. component from the picture. Consequently there is a lack of contrast in "low-key" scenes and any dramatic effect carefully striven for by the programme producer is lost. During pauses in the programme, when no picture is transmitted, the screen should be black, but with this mean level system, it is lit up to almost peak white. For many viewers this causes eye-strain and irritation.

AUTOMATIC BRIGHTNESS

To overcome some of these difficulties, a circuit has been recently developed to automatically alter the brightness level at the grid of the c.r.t. to compensate for this lack of contrast. This works reasonably well, but is really a case of "shutting the stable door". For a more elegant solution, the remedy is to use a gain control system which samples the signal and produces a voltage which varies with the height of the sync pulses. Since these are a constant 30% of the peak value at full white, their height gives a true measure of the strength of the signal irrespective of the picture content of the signal. Such a system must necessarily be of the "gated" type working either at frame or line frequency. There are quite a few of these systems and some are very complicated

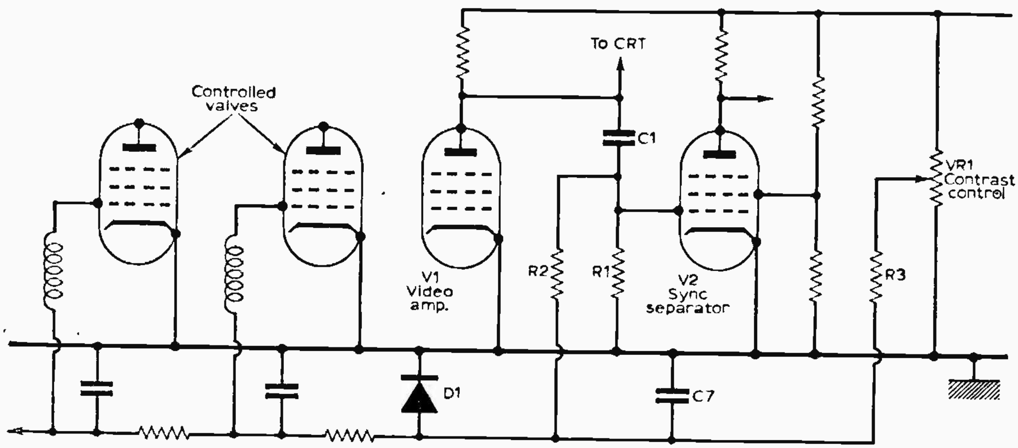


Fig. 1—Typical mean-level auto gain control circuit.

SIMPLE SYSTEM

A simple system which gives extremely good results is called 'sync cancelled auto gain control'. This was very popular a few years ago, but is rarely seen now, probably for price considerations although the circuit only adds about £1 to the price of the receiver. One often hesitates to alter the circuitry of an existing receiver because of the difficulty of installing additional components. This is particularly so with printed circuits. To overcome these difficulties, the unit about to be described was designed. It enables any existing receiver to be converted from a mean level system to a sync cancelled one with the very minimum of alteration.

As a re-cap, a typical mean level auto gain control circuit is shown in Fig. 1. Only the basic components are shown and although different values of components are used by various manufacturers, the principle of operation is the same. The full video waveform from the anode of the video amplifier valve, V1 is coupled to the grid of the sync separator valve V2 via C1, and R1 is the grid leak. The grid of V2 is driven negative by the negative going signal and by diode action between grid and cathode, a large negative voltage appears across R1. This is a necessary part of the correct operation of the sync separator, but it is also a convenient voltage to use for controlling the gain of the video channel. This voltage not only varies in sympathy with the strength of the video signal, (which we want to keep constant), but unfortunately it varies with the picture content and this gives rise to a lack of contrast in the picture. In other words, during periods of constant signal strength, the gain of the video channel is varied in accordance with the content of the picture. This is not desirable.

C. CANCELLED

AUTO-GAIN UNIT

The voltage appearing across R1 is coupled to the a.g.c. line by R2. Part of this negative voltage is cancelled by the positive voltage tapped off from the h.t. line by VR1, the contrast control, and applied to the a.g.c. line by the high resistance R3. A diode D1 ensures that the a.g.c. line never goes positive. Because this form of gain control removes part if not all the effect of the d.c. component, some manufacturers also couple the video amplifier anode to the cathode of the c.r.t. by means of a capacitor on the grounds that there is little point in retaining what is to be thrown away.

Fig. 2 shows what happens in the circuit for three different signals, (a) an average picture, (b) a black picture (c) a white picture. The signals are all of the same strength, but vary in picture content. It will be seen that black is never really black and dark grey becomes light grey. Fig. 3 shows what happens to the same three signals if the d.c. component is retained. Fig. 4a shows a low strength signal compared with a high strength signal in 4b. In both cases, e1 and e2 give a measure of the strength of the signal. The base line could be re-drawn as at 4c and 4d. Again e1 and e2 represent the relative strengths of the signals. If we could use these values to control the gain of the video channel, we would have a system which gave correct contrast rendering to the picture.

MIXING

Fig. 5 shows the result of mixing the negative going signal at the video amplifier anode with large negative going sync pulses from the sync separator anode. The result shown in Fig. 5d is for a much greater strength signal. We see that the tips of the mixed waveform give a true measure of the strength of the video signal. Another way of saying this is that the depth of the front or back porches gives us the control voltage we want. A suitable circuit for obtaining this voltage is shown in Fig. 6. Here V3 is d.c. coupled to the anode of the video amplifier valve and receives the complete video waveform. Its grid is about 90-100 volts positive to chassis. Large

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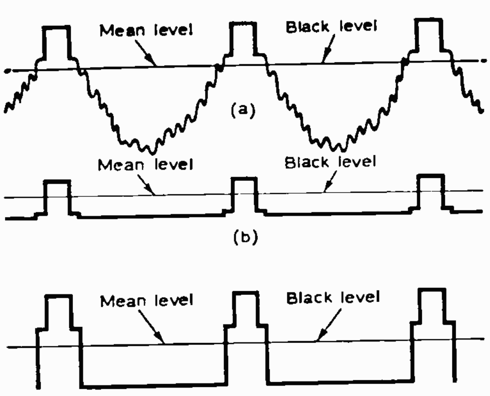

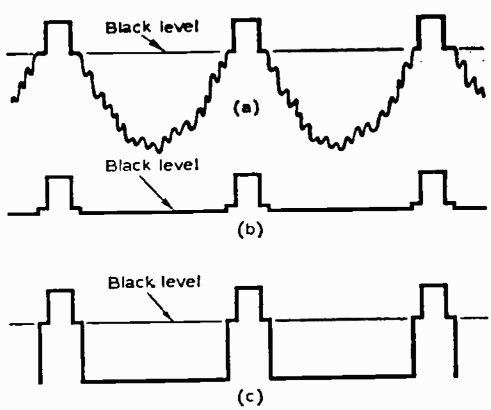

Fig. 2 (above) and 3 (top right)—(a) average picture, (b) black picture, (c) white picture. Note constant position of black level when effect of d.c. component is retained.

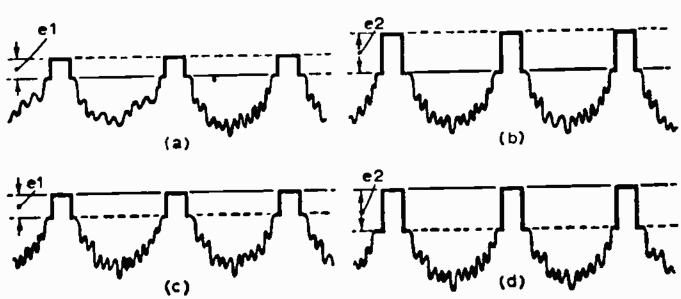

Fig. 4 (right)—(a) Low strength signal, (b) high strength signal, (c) low strength with base line redrawn, (d) high strength with base line redrawn.

negative going sync pulses from the anode of the sync separator are also fed to the grid of V3 by C3, which blocks the d.c. and the combination of R7 and C4 helps to preserve the tips of the pulses. The cathode of V3 is joined to chassis by R8 and C5. V3 now acts as a peak rectifier and charges C5 to the peak value of the composite waveform. The cathode of V4 is direct coupled to the cathode of V3 and its grid is connected to the contrast control. The amount of conduction of V4 depends on the relative potentials of its grid and cathode. If we now trigger the anode of V4 at the same instant as either the front or back porch potential is present at its cathode, we can sample the strength of the video signal at the appropriate moment. This triggering can be done simply by applying large positive pulses from the line coils to the anode of V4 via C6. The side of C6 connected to the anode will charge negatively by the usual diode action and this negative potential will appear across R9. It can be used for controlling the gain of the video channel.

THE CIRCUIT

The complete circuit is shown in Fig. 7. Here R8 has been replaced by R10 and R12 in series. R10 and C8 are for decoupling the a.g.c. voltage before it is applied to the a.g.c. line via R14. C7 and D1 are already present in the receiver. The junction of R10 R12 and R14 is connected by R13 to the warm-up protection circuit. With sync cancelled a.g.c., no control voltage is available until the line pulses arrive at the anode of V4. Hence if no warm-up protection is provided, the video amplifier would be overloaded until the boost diode began operating. All that is required is to arrange for a fairly high negative voltage to be available at the right hand end of R13 until the boost h.t. is available. There are two ways of obtaining this potential, either by obtaining it from the grid of the line output valve or by rectifying a suitable a.g.c. voltage. To avoid any difficulties with stabilised timebases, the latter method was chosen for this unit. R17 is connected to a point on the heater chain where a minimum of 10 volts or a maximum of about 20 volts a.c. is available. The actual value is not at all critical. Since R17 has a high value, and since the current drain is only about 0·5 mA. this will not affect the heater chain. The diode D2 rectifies the a.c. voltage and charges C9 negatively to between 8 and 18 volts. This potential is applied via R16 to the diode D3 and thence to the a.g.c. line by R13 and R14. The anode of the diode D3 is connected to the h.t. boost line by R18. When the boost voltage is available, D3 conducts and effectively shorts the right hand end of R13 to chassis, thereby removing the high negative voltage. R16 now dissipates the negative potential supplied by D2 and C9.

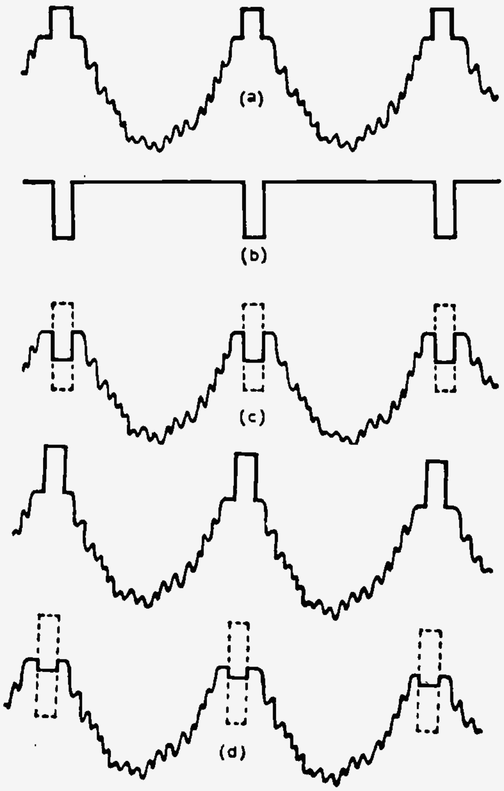

Fig. 5—(a) complete video waveform, (b) large negative sync pulses, (c) result of mixing "a" and "b," (d) result of mixing "b" with larger signal.

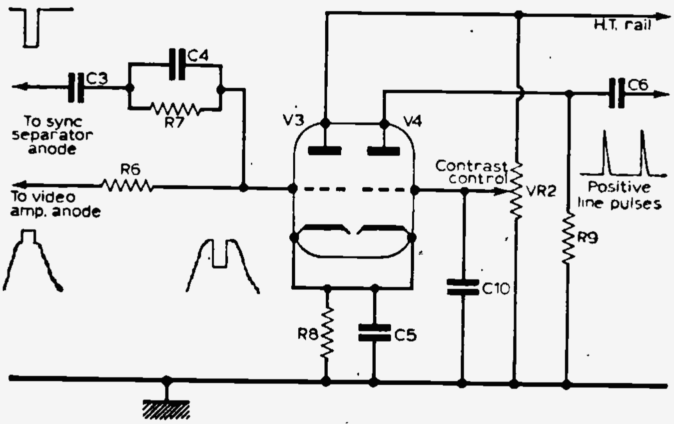

Fig. 6—Circuit for mixing video waveform with negative sync pulses.

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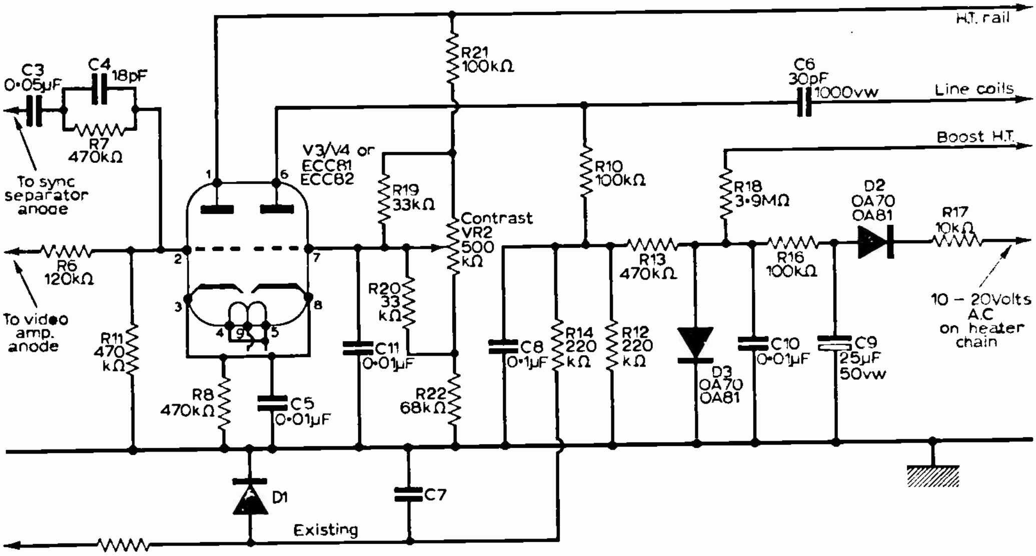
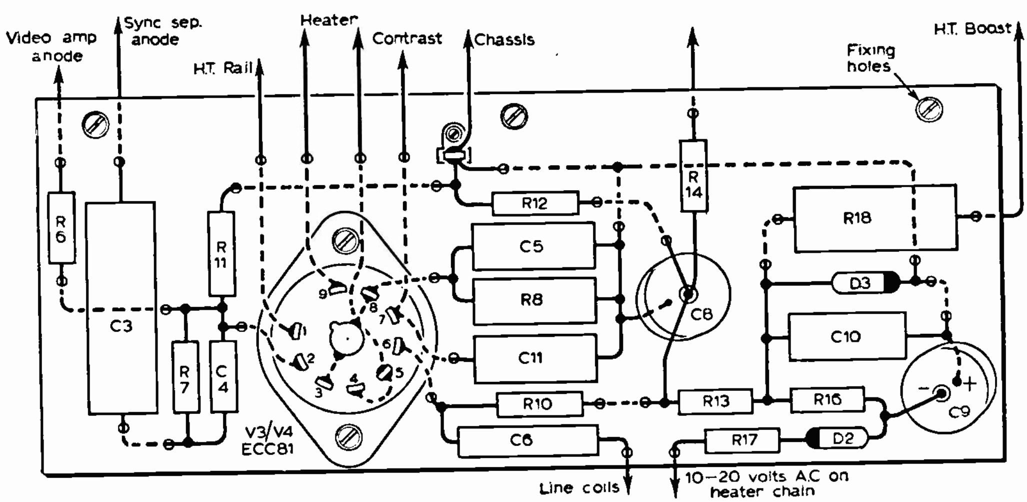


Fig. 7—Complete circuit diagram of the unit.

Fig. 8—Layout of components on panel, viewed from the top.



SYNC CANCELLED AUTO GAIN UNIT COMPONENTS LIST

Resistors:

R6	120kΩ	R16	100kΩ
R7	470kΩ	R17	10kΩ
R8	470kΩ–½W	R18	3·9MΩ–1W
R10	100kΩ	R19	33kΩ
R11	470kΩ	R20	33kΩ
R12	220kΩ	R21	100kΩ
R13	470kΩ	R22	68kΩ
R14	220kΩ		

All 10% ¼W unless otherwise specified.

Capacitors:

C3	0·05μF 350V paper
C4	18pF ceramic or mica
C5	0·01μF ceramic or paper
C6	30pF 1000V ceramic or mica
C8	0·1μF 350V paper
C9	25μF 50V electrolytic
C10	0·01μF 350V paper
C11	0·01μF 350V paper

Miscellaneous:
V3/V4 ECC81/ECC82, VR2 500kΩ, D2 D3 OA70/OA81, paxolin board.

CONSTRUCTION

The complete unit is shown in Fig. 8. It can be constructed on a piece of paxolin or Formica. The latter is useful because the circuit diagram can be inked on its surface for future reference. A normal type valveholder can be used and the connections can either be by wire or with home-made printed circuitry. The unit can be mounted almost anywhere, but it would be advisable to keep the leads to the grid of V3 down to about 6 in. in length. Connections to the receiver are simple. For conventionally wired chassis, the heater chain can be broken at a convenient point, somewhere near the video amplifier valve and the heater of V3 V4 inserted. For printed circuits, there is nearly always a flexible wire connection to the tuner unit or the c.r.t. that can be broken to accommodate V3 V4 heater. Many such receivers have separate panels for the i.f. strips and the time bases, and these have numerous interconnections. A suitable point for inserting the new heater can usually be found. There is no need to alter the value of the mains dropping resistor to allow for the extra 6·3 volts, but if considered necessary, a suitable resistor could be wired across the appropriate part of the mains dropper. The original connection to the slider of the contrast control should be removed and insulated, and the slider now connected to the grid of V4.

OPPOSITE SENSE

It should be noted that the contrast control will now work in the opposite sense. With mean level systems, the movement of the slider away from the chassis connection will usually result in a reduction in contrast. With sync cancelled systems, the opposite is found. For uniformity, it is desirable that the connections to the carbon track be reversed, but if this is not possible, then this reversal will have to be remembered. Since the control is rarely used this is nothing to worry about. Usually the contrast control in a mean level system is about 500kΩ in value and connected directly across h.t. It is helpful to reduce its range of control and the resistors R19 at R22 are used to do this. If the original control is only of about 100kΩ, then the addition of a 100kΩ fixed resistor in the feed from h.t. positive will usually suffice. If the range of the modified control is not sufficient or too much, alterations can easily be made to either R21 or R22. The capacitor C6, which should be of 1000 volt rating should be connected to the "hot" end of the line coils. A suitable position is on the line output transformer at a point remote from the h.t.

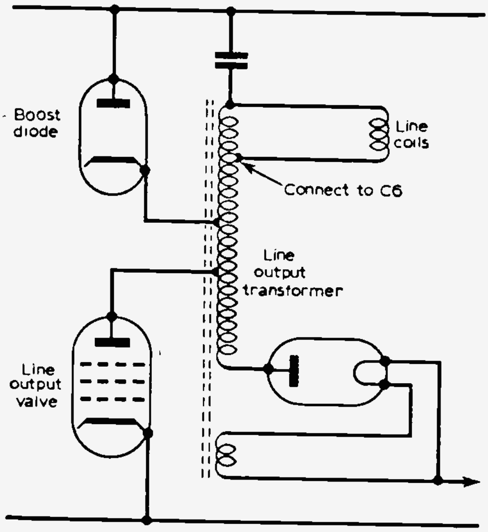


Fig. 9—Connection for C6.

line, see Fig. 9. The existing resistor connecting the grid of the sync separator to the a.g.c. line should be removed, this also isolated R3 of Fig. 1. A lead from R14 should be connected to the a.g.c. line. As mentioned before, some manufacturers use a capacitor to couple the cathode of the c.r.t. to the anode of the video amplifier valve, if this capacitor is present and is not bridged by a resistor of about 100kΩ to 120kΩ, then such a capacitor should be added or the d.c. component will still be missing.

FINAL NOTES

The unit is easy to construct and instal, a couple of evenings at the most. Nearly all the parts are probably available in the junk box. There are no snags and no setting up is required. The results are excellent and the improvement in contrast reduction of glare and strain is well worth while. Since the unit only uses those waveforms after the video amplifier, it should work equally well with dual-standard receivers. It has not been possible to check this practically as BBC-2 is not yet available in the writer's area. ■

Servicing TELEVISION Receivers

No. 124 The G.E.C. BT455 and BT456

By L. Lawry-Johns

THE associated models are the Sobell ST196 and ST291, whilst the McMichael models are MT762 and MT763.

Most of these notes can be used in the servicing of the dual standard versions which are fitted with revised panels and switching. The suffix T denotes a tuner for u.h.f. is already fitted and no modifications are required for reception on the 625 standard.

However this article is mainly concerned with the original 405 dual band, rather than dual standard models. The original v.h.f. tuner fitted closely followed the lines of earlier Sobell group semi-incremental inductance tuners, and used a PCC189 r.f. amplifier and PCF801 frequency changer. The tube fitted in the 19in. models is an AW47-91, whilst the 23in. use an AW59-91. The rectifier is a silicon diode BY100 with a series thermistor to prevent initial high voltage surges. A flywheel sync unit may or may not be found plugged into the timebase panel (PL5).

Servicing

Once the cabinet back has been removed, the majority of the main components can be got at fairly easily. Full access to top and bottom of the panels can be obtained by slackening the two spring-loaded clamp screws at the rear of the sub chassis. With these loose, lift the rear edge clear and move away from the front lug-holes. The lugs can then be engaged in the rear edge slots, thus giving full access to the underside. The receiver may be operated with the panel in this position.

Removing Chassis

To remove the chassis, remove the two retaining bolts beneath the cabinet, also the two retaining nuts at the top rear of the chassis. The channel selector and fine tuning knobs pull off quite easily, and the control panel is released by turning the clips. Remove the control panel outward and then pass it back in through the hole.

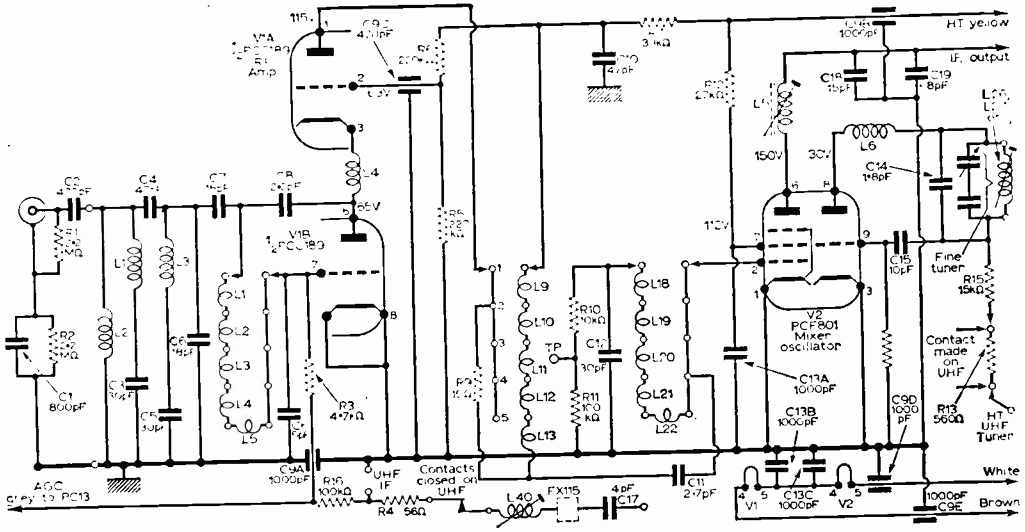


Fig. 1—V.H.F. tuner unit.

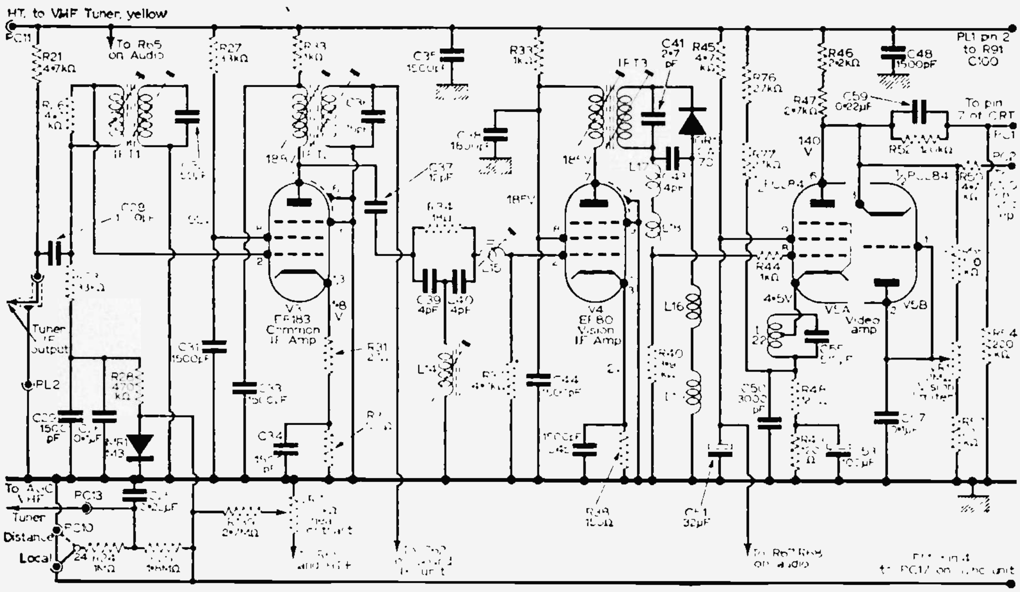


Fig. 2—Vision i.f. and video stage.

The chassis can then be withdrawn to the extent of the loudspeaker leads, which can of course, be unsoldered if required. Some models have the tuner secured to the side of the cabinet by three 4BA nuts.

Cleaning the Screen

Remove front cabinet feet (or legs) and centre retaining screw. Remove bottom rail which will permit the viewing window to be dropped to expose the tube face.

Some Common Faults

Probably the most frequently encountered trouble in these models is failure of R99. This is an 85Ω wire wound resistor, wired in series with the heater chain. This is the separate resistor to the right of the mains selector dropper, which is of course mounted horizontally across the top centre of the chassis. The effect of this going o/c is that the valves fail to light up, although full mains voltage is present at the fuse and the sections of the mains selector. Thus, although the set may appear dead, it should be remembered that full voltage is still at the above points and at TH1. Which brings us to the next common fault, at least in the writer's experience, which, of course, may not be that of other engineers. TH1 is a thermistor (type BL28) which is a quite small circular object to the left of the dropper. Its purpose is to limit the voltage applied to the BY100 until the current passing has warmed it up sufficiently for its resistance to fall to a low enough figure to allow the h.t. voltage to rise to the operating level of about 240 volts (unsmoothed).

The usual complaint is that, although the valves light up, there is no sign of life otherwise. In some cases the body of the thermistor may have dropped away altogether, leaving only the wires originally connected to the sides of the component. A new BL28 is usually all that is required, but a word of caution is not out of place at this point. An h.t. short, a shorted BY100, or shorted C105 will cause a heavy current flow through the BL28, which will normally blow the 1·5A fuse (FS1). However, although the fuse may well be found to be o/c, and of course the valves will not then light, the BL28 may have been damaged and may have decided to drop out of the circuit literally! The moral is to check for shorts across the h.t. line and across the BY100 before putting any replacements into use.

Bottom Compression

The next common fault encountered by the writer is bottom compression. This is to say that the bottom of the picture is not covering the bottom of the screen, although the top is nearly normal or extended.

This is a very commonly met fault on all types of receiver, and the following remarks do not only apply to the subject of this article.

There are several things to check: first the field output valve (V9 PCL85) then the cathode electrolytic capacitor C97 (250µF), the feed back capacitor C94 (·01µF), the bias resistor R88 (390Ω) and last, but not least, in these receivers, the linearity control VR5 (100kΩ Lin).

This pre-set control seems to go open circuit at one end contact. As the centre is strapped to the other end, it may be thought that the simplest solution is to reverse the two end contacts. Quite so. The snag is that the control legs are in the form of a triangle, and to reverse this on the printed panel isn't very practical, neither is re-routing the printed tracks. So put in a new control and save yourself some trouble.

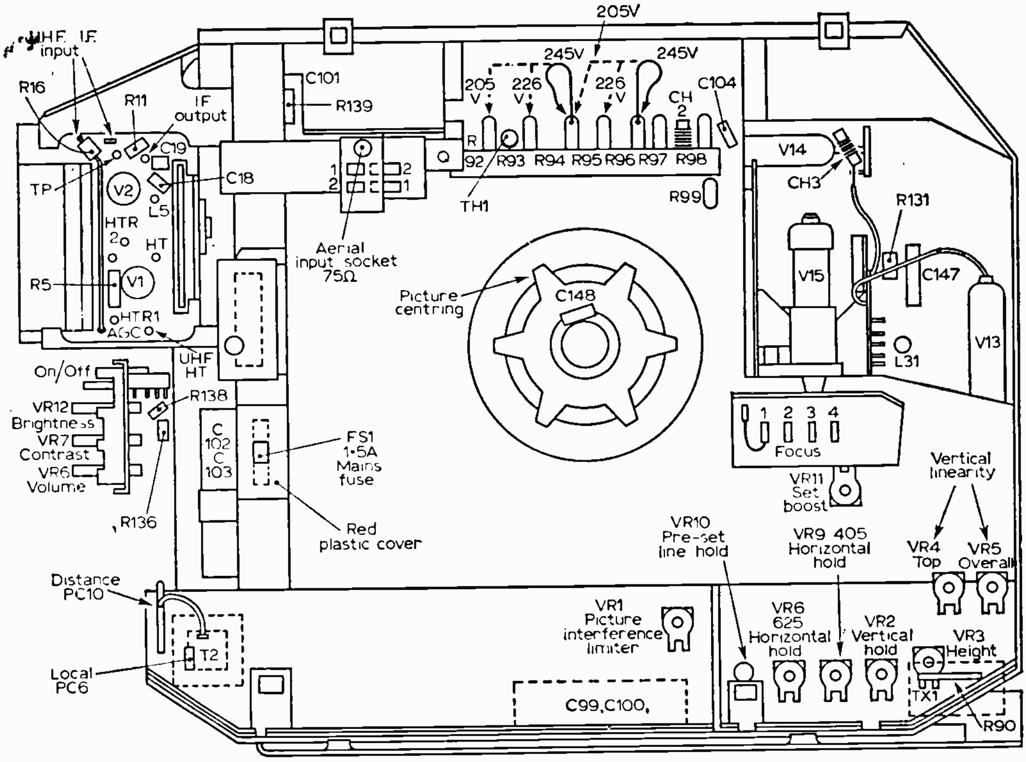


Fig. 3—General chassis layout.

E.H.T. Rectifier

The e.h.t. rectifier is a DY86, and this seems to fail due to an open circuit heater rather than to any other defect. When the time base seems to be operating normally, but this valve doesn't light up, it is quite in order to try another DY86. It is prudent to point out that an EY86 is not a replacement for a DY86. One of our readers assumed, by its appearance, that it was in fact an EY86, and when this type of valve failed to work, went to some lengths checking through the circuit before receiving our advice to try a DY86!

Picture Width

It is essential to leave the pre-set control VR11 well alone, unless a voltmeter set to the 1,000V range can be applied between the boost line (junction of C139 and R127) and chassis. Damage can result if the boost line voltage is not left between 750-790V.

With such a meter applied, adjust the control for minimum voltage, adjust the sleeve on the neck of the tube for optimum linearity (left to right aspect of the picture) then set the control for a reading of 770V. Once the width is set up in this way, the presence of VDR3 compensates for any other variations. If VR11 cannot be correctly set do not omit to check the control itself, as it can and does change value causing width troubles. Do not overlook R126 and R124 when tracing width troubles due to incorrect line drive. We would hasten to point out that lack of width does not necessarily mean a change of value in a component in the biasing circuit of the line output PL500. The valve itself should first receive attention, together with V12 and V14 and associated components.

Line Hold

There are two horizontal hold controls, one for 405, and the other for the 625 standard. These can be set to operate at about their mid-position by the pre-set control VR10.

Vertical Hold

The vertical hold control is VR2, and this sometimes gives trouble due either to improper contact or to actually changing value. The former condition causes erratic hold, and the latter—inability to lock the time base at all. Both conditions call for a replacement control (250kΩ).

continued next month

UNDERNEATH

THE DIPOLE

SCRIPTS! *Scripts!* SCRIPTS! Scripts galore! There must be at least fifty-seven traditional varieties of scripts required for every 'theatre' of entertainment. I am not referring in particular, to the live theatre, which calls for its own special format of scripts for comedy and tragedy; but for the demands of live, taped or filmed television, film production for the cinemas, dialogue for steam radio. Scripts have to be written in their hundreds and thousands to meet the present needs of all the differing types of entertainment.

By far the largest consumer of ideas, story lines, scenarios, dialogue scripts and funny "gags" is the television industry. It is interesting, by the way, to note that the descriptive name of "industry" has been attached to it, like the film industry; yet the "live" theatre continues to be regarded as an art, parallel with ballet and music—and even "pop" has been referred to as "pop art."

It has been said that playwriting cannot be taught any more than acting can be taught—but this is not quite true. There are rules for the shaping of plays and the writing of dialogue, just as there are basic principles and "positions" respectively in music and ballet.

The rules for script writing for TV and films are subject to the individual technical requirements of each medium.

Structure of Plays

The beginnings and endings of stage plays, their intermissions, the continuity and timing of dialogue, the climaxes and the curtain lines are all subjected to the practical restrictions of the live theatre: the reactions of a live audience, the pockets of the live entrepreneurs and the approval of the live Lord Chamberlain. Recognition of the requirements of the inner structure of a play is not easy for a writer to acquire whatever the medium, and in some ways, even more difficult for films or television, which are subject to different sets of (unwritten) rules and technical problems. The timing for TV plays is pretty rigid to fit in with programme schedules and/or slots for commercials.

There has been something of a small breakaway in the live theatre lately in theatre-in-the-round, in the banishment of procenium and tabs in front of the stage, and in the introduction of unpleasant and even obscene dialogue put in the mouths of actors. The Bond play "Saved," produced at the Royal Court Theatre has not yet been put on television, but having half-read the script (after which I abandoned it) I wondered what merit it had to justify the support of several important figures in the theatre for the removal of censorship by the Lord Chamberlain.

Censorship

Here was a case where a shapeless story-line was high-lighted and enlivened (amongst other unpleasantries) by the killing of a baby in a pram by drunken beatniks. The British Board of Film Censors is very liberal-minded with its X Certificates, but if it read the film script of "Saved," it would have asked for considerable deletions to be made, just as the Lord Chamberlain did with the theatre version.

Art Within Art

Script writing for television plays is not a case of merely writing dialogue; it is a method of story-telling which is also a visual art, particularly if film is used instead of tape and exterior sequences are introduced. At a recent informal meeting of TV producers and directors with a number of literary agents, Bill Ward, Executive Controller of ATV, reminded them of the different kinds of technique to be learned and understood for colour television as well as for black-and-white.

TV script writing is not easy. The day when an author can write, rewrite *and rewrite* to highlight dramatic or comedy points, to cut away the "fluff," to eliminate repetition, to economise in words and to clarify the story line with smooth continuity—that day he will have achieved the professional touch. A number of script writers (not very many of them) have acquired the solo master touch, but there are quite a number of brilliant partnerships, especially for situation comedies, which seem to generate crispness of dialogue, characterisation and timing.

This enables a director to get the best out of his actors, completely hiding the mechanics of cutting from camera to camera and other tricks of punctuation. The best directed plays are those in which the hand of the director is unnoticed. This achievement is an art within art made possible by a perfectly shaped and balanced script.

Actors and Scripts

TV scriptwriters, film scenario writers and playwrights do not regard actors as ventriloquial dummies which speak their lines, nor do directors look upon them as puppets whose movements are guided by wires. Dulcie Gray and Michael Denison have written a book: *The Actor and His World*, which takes a good look at the playwrights, directors, producers and technicians that they see in each and every one of the fields of "show biz." They are forthright in their opinions of the value of proper training in drama schools and their attitudes to the differing techniques of films, TV and the live theatre.

Their obvious preference for the live theatre is not altogether due to the reactions of the live audience, but also, as on TV, for the period of time in which an actor can develop a scene without constant interruption, as occurs when filming scenes which only last a few seconds and form a segment of a composite photographic mosaic.

The Puppets

It is always nice to consider a Cinderella-like story in show business, because this is the most successful of all stories in this age of cracked kitchen sinks and foreign spies. Gerry Anderson and his attractive wife have developed the business of filming puppets which started in an improvised studio at Maidenhead, and has now grown to the huge organisation at Slough, in which over a hundred people are employed in making puppet films like *Thunderbirds*, in colour, utilise TV aid techniques and employ processes and methods which make most other film studios look out of date.

They have used closed circuit TV aids for some time with a vidicon TV camera attached to the German Arriflex 35 mm. motion picture camera. Now they have started a new trend by the fitting of a Plumbicon camera to a Mitchell BNC camera, an expensive motion picture camera which is used on the highest budget pictures, such as the James Bond film *Thunderball*. Gerry Anderson's company, A.P. Films Ltd, is making a big budget TV series *Thunderbirds*, which is now being sold to television stations all over the world.

I don't think there is any country in the world which has television which has not shown *Supercar*, *Fireball*, *XL5*, or the *Stingray* series. How many languages it has been dubbed into I don't know—but it demonstrates the TV market that can be reached with motion picture prints on 35 mm. or 16 mm. film, with optical sound tracks. Soon, I wouldn't be surprised if magnetic stripes are used for sound.

Magnetic Stripes

Magnetic striped sound track on 16 mm. film is in common use. for newsreel and magazine items on television, with the negative pre-striped before it is photographed and processed. For precise editing purposes, the sound is transferred from the picture negative stripe (which is separated by 28 frames from its associated picture) to a separate 16 mm. magnetic film for parallel editing with picture. There is of course, a provision at all TV studios for playing off 16 mm. film in negative or positive form with optical or magnetic sound play-off.

The quality of 16 mm. processing and printing is very variable, partly due to faults in transferring from the original magnetic negative to optical sound negative, and to bad contact, slipping and flutter introduced in the printing process. Results are certainly not all bad—in fact, some 16 mm. optical sound tracks are very good—providing the projector play-off is also good.

However, television engineers have their eye on the ultimate use of magnetic sound on both 35 mm. and 16 mm. film prints. The chief snag with black-and-white prints with combined magnetic sound is that the costs are about double that of combined optical track. On the continent, the television studios are adopting the DIN system single magnetic track in the exact position previously occupied by the optical track on 35 mm. film, plus a single balancing stripe, if necessary, and with normal perforations.

"Foxhole" Perforations

The same method has been proposed for adoption by the BBC and ITV companies in Britain. There has been a trend in British cinemas to make use of the much smaller "foxhole" perforations and four magnetic tracks, as used with the original Fox Cinemascope stereophonic system. This was an ingenious device which faded out after a few years, because of the high costs of making prints and maintaining them and the lack of public interest.

The fact was, stereo sound with voices coming from left to right (and even behind you, in the auditorium) was a good gimmick which unfortunately made audiences unduly aware of the mechanics of production.

A recent proposal has been to make use of the four-track magnetic system—for which a number of cinemas were equipped about twelve years ago—but to use it for monophonic sound reproduction. The major difficulty arises, however, from the difference in the size of the perforations, thus introducing an additional technical standard.

An interesting situation has also arisen in the sudden improvement in quality of optical sound tracks of both black-and-white and colour 35mm release prints, which will undoubtedly be followed by improvements in the more difficult processing work for 16mm film and its optical sound tracks.

The improvements on 35mm optical film sound is so great with the newest types of printers in film laboratories that the question is asked—is the difference in quality compared with magnetic striped tracks worth the large increase in costs?

The Crystal Ball

The more I think about the recent developments in colour television and the different systems still under consideration, the more I sympathise with the problems and decisions that face the Postmaster General. Come to think of it, the PMG has always had this kind of problem since the Savoy Hill days and crystal sets. Your clairvoyant, Iconos, consults the crystal again, as he did when NTSC seemed to be a certainty! He forecast PAL as a winner, though he had a hunch that SECAM was a dark horse with good prospects in the race, if there were disqualifications and objections. Well, there have been 'objections' and PAL was awarded by PMG as a *possible* winner, thus coyly leaving the door open to decisions which will be made at the 11th Plenary Assembly of CCIR at Oslo from 21st June for four weeks. The first decision on NTSC was made with BBC advice, the second decision on PAL has been regarded by many as a subtle feint to save a few political faces. The final decision—looking again at my crystal and not at inside information from the stables—is probably going to be a kind of coalition of international technical gimmicks probably known as NIR, which will combine ideas from France, Russia and Britain with those from USA and Germany.

Iconos

TV TERMS AND DEFINITIONS EXPLAINED

Gordon J. King

Part III Contrast and Contrast Control

CONTRAST refers to the ratio between the light and dark shades of the picture. With the brightness control set for the best black-level compromise, an increase in setting of the contrast control will cause the dark parts of the picture to become even darker, thereby increasing the contrast ratio. Advancing the brightness control beyond the optimum setting increases the light parts of the picture and thus decreases the contrast ratio.

The contrast control is really a manual gain control that initially adjusts the gain of the set to suit the signal condition, the a.g.c. then taking over.

Corona

This is a form of electrical discharge associated with high voltages. It can take place either in relation to the high pulse potential at the input of the e.h.t. rectifier circuit or in relation to the direct e.h.t. voltage at the output of the e.h.t. rectifier.

When it occurs on the d.c. side of the rectifier it covers the screen or picture with white spots of interference in orderly formation—as distinct from the horizontal bands of white dots caused by ignition and electrical interference.

When it occurs on the pulse voltage side of the circuit, however, vertical columns of white spots and dashes appear on the screen or picture. Corona in one set can give similar symptoms, due to radiation, on a neighbour's set. The effect is sometimes accompanied by a smell of ozone.

Cross Modulation

This is when the modulation (picture or sound) on one channel modulates the carrier of another channel. The cause is one of non-linearity, often aggravated by overloading. Efficient sound and vision a.g.c. systems tend nowadays to minimise overloading, but it can occur still on modern sets used in a very high signal field.

Early sets had inbuilt aerial attenuators and "sensitivity controls" that could be backed off in areas of extremely strong signal.

Damped Oscillations

When the key-connected hammer strikes the string of a piano the string commences to vibrate or "oscillate" at a frequency governed by its length, tension and so forth and at an amplitude that is related to the force of the strike. While the frequency of the oscillation is retained, the amplitude gradually decays until the string is once again still. The time taken for the oscillation to cease depends on the nature of the string and on whether there is anything tending to suppress the oscillation.

All things that are oscillation-prone exhibit this phenomena, which is called a "damped oscillation". Television sets are particularly prone in various stages to the effect, but here instead of mechanical vibration it is the oscillatory movement of electrons in the circuit that is responsible. Any circuit containing inductance and capacitance will produce damped oscillations if electrically "plucked" and provided they are not heavily "suppressed" or "damped".

The oscillatory frequency is that of the resonance or tuning of the circuit, and the greater the goodness factor—or "Q"—of the circuit, the greater will be the amplitude of the oscillations and the greater the time that will elapse before they are spent.

The effect is that on one swing of the oscillation, electrons flow, say, from the capacitor into the inductor and from the inductor into the capacitor on the other swing. The amplitude diminishes because of resistive losses in the circuit. Proper oscillator circuits, of course, overcome these losses by the energy provided by a valve or transistor—so the oscillation is continuous.

Some illustrations of damped electrical oscillations are given in Figs. 9, 10 and 11. These are displays direct from the screen of an oscilloscope. Fig. 9 was produced by causing a high-Q inductor in parallel with a capacitance to produce damped oscillations by feeding to the circuit a pulse from the timebase in the 'scope. Thus, at the start of each scan the circuit was "pulsed" or "plucked" as it were and the oscillation amplitude was at maximum, falling progressively toward the finish of the scan.

The waveform in Fig. 10 was obtained by the same method, but a resistor was connected across the tuned circuit to suppress or damp the oscillations,

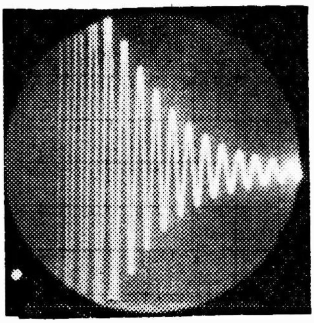


Fig. 9—Oscillogram of unsuppressed damped oscillation.

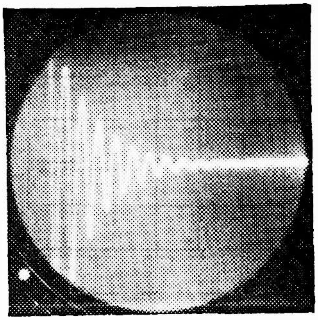


Fig. 10—Damped oscillation suppressed by parallel resistance, as explained in the text.

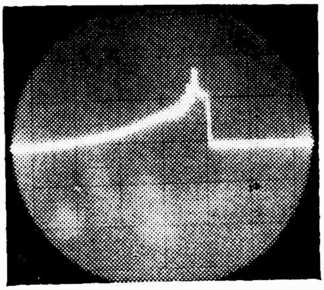


Fig. 11—Damped oscillation on a pulse in the line timebase. This can cause alternate dark and light vertical bars at the left of the picture.

the results being a reduction in amplitude and a quicker decay to zero.

Now, in television sets there are several vulnerable points of damped oscillation, and such oscillations generally have to be suppressed to avoid disconcerting picture symptoms. One such point is the line output stage, the line output transformer and scanning coils themselves oscillating at their resonant frequency due to switching or drive pulses from the line generator. When this happens, the left of the picture may be troubled by alternate dark and light vertical bars.

This is sometimes called "ringing" in the line timebase, the term ringing here meaning damped oscillations. Fig. 11 shows a pulse waveform from the line timebase affected by damped oscillations or "rings" of this kind; these, in fact, produced the picture symptoms mentioned.

Damped oscillations or rings can also occur in the tuned signal stages and in the video amplifier. The picture effect in this case being "black-after-white" and "white-after-black".

Symptoms of ringing indicate either a poor design or maladjustment in the circuit which, of course, could be caused by alteration in value or failure of a "suppression" or "damping" component.

Mismatch on the aerial system—at the aerial or the set—resulting from a defective feeder, diplexer or triplexer can also produce the trouble. In the line circuits a bad line output transformer or failure of a resistor across the line coils or transformer can aggravate rings.

Deflector (Scan) Coils

These are the coils placed on the neck of the picture tube to deflect the scanning spot on the tube face vertically and horizontally to produce the "raster" upon which the picture is built. The line defector coils are fed with a current waveform from the line timebase (horizontal deflection) while the field (or frame) deflector coils are fed with a current waveform from the field timebase (vertical deflection).

The line and field coils are orientated at right-angles to each other, and by rotating the whole assembly on the tube neck the picture can be tilted from side to side—or even turned upside down by rotating the assembly through 180 deg. These coils are sometimes called "scanning" or "scan" coils.

Differentiator

This is a simple network connected between the sync separator stage and the sync input to the line timebase generator. In its simplest form it is a high-pass filter composed of no more than a resistor and capacitor, as shown in Fig. 12.

Its purpose is twofold, firstly to separate the line sync pulses from the frame or field sync pulses at the output of the sync separator and secondly, to shape the line pulses so as to avoid random triggering of the line timebase. That is, to obtain the best synchronising with minimum line tearing.

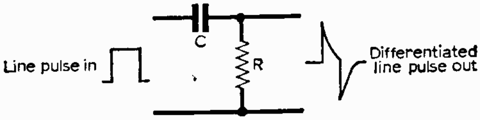


Fig. 12—A simple differentiating circuit.

In the circuit, C lets through the higher frequency line pulses while attenuating the lower frequency field pulses, the differentiated output pulse being produced by C discharging through R before the input pulse has finished.

Diplexer

This is an aerial filter in two parts for combining (or separating) the signals from a Band I aerial and from a Band III aerial to a common downlead without interaction, with little signal loss and while maintaining a correct aerial/feeder match.

A high-pass filter passes the Band III signals to the feeder while a low-pass filter passes the Band I signals to the feeder. Since the high-pass filter has a high attenuation to Band I signals and the low-pass filter a high attenuation to Band III signals any interference or ghost signals in one band picked up by the aerial of the other band will fail to impair the quality of the picture (or sound).

A circuit of a diplexer, with the two filter sections identified, is given in Fig. 13. For the introduction of signals in Band II (the FM sound band) a triplexer is needed (see under "triplexer").

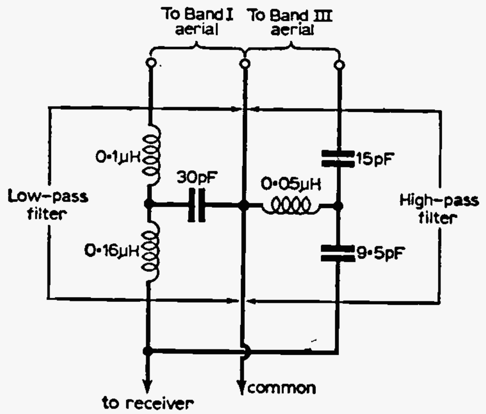


Fig. 13—Practical circuit, giving component values, of a diplexer.

Dipole

See under "Aerial".

Directors

See under "Aerial".

Dual-Standard

This term applies to the latest type of television receiver that can be switched between the 405-line and 625-line standards. The 405-line signals are carried in the v.h.f. channels and the 625-line signals in the u.h.f. channels, so the receiver also needs to incorporate either an "all-band" tuner (of the latest integrated type) or separate tuners for the v.h.f. channels and the u.h.f. channels.

The right tuner is automatically selected by the action of the "system switch". As quite a lot of circuit variations are required from one standard to the other, dual-standard sets must be considered as a necessary design compromise. When eventually the 405-line standard is eliminated, all sets made will be for 625 lines only, and it will then be possible for designers to tailor the circuits for peak 625-line performance.

It is not possible to convert an ordinary 405-line set for dual-standard working, though some experimenters have made a success of "rebuilding" a 405-line set for operation only on 625 lines.

Changeover demands alterations in the line timebase, in the vision detector and in the i.f. stages, in addition to the tuner and, of course, a special aerial is needed for the u.h.f. channels.

Efficiency Diode

See under "Booster Diode".

E.H.T.

This stands for "extra-high-tension" and is the high voltage that is required by the final anode of the picture tube. Modern tubes operate with e.h.t. voltages as high as 18,000 volts, this giving the bright picture and fine focus on the latest sets.

In all sets nowadays the e.h.t. voltage is obtained by stepping up the high amplitude peak voltage which occurs in the line output transformer during the line retrace (i.e., flyback) by means of an e.h.t. overwind and by rectifying these pulses to produce a steady direct voltage. The d.c. voltage is "stored" in the capacitance formed by internal and external conductive coatings of the picture tube, the glass being the dielectric.

Electronic Reactance

Reactance is measured in "ohms" the same as ordinary resistance, and it can be considered from first principles as "a.c. resistance". There are two kinds of reactance, *inductive reactance* and *capacitive reactance*. With increasing frequency, the value of the former rises and the latter falls. Inductive reactance is primarily presented by an inductor or coil while capacitive reactance is the essential property of a capacitor (or capacitance). The current flowing through a pure reactance leads or lags the voltage across it by an angle of 90 deg.

Now, it is possible by the use of a valve to produce synthetic reactance, the circuit "looking" to a signal either like capacitance or inductance. This is "electronic reactance" and it can be used in place of a capacitor (or inductor) in a tuned circuit. Since the magnitude of the reactance can be altered by changing the grid bias on the valve, the resonant or tuned frequency of a circuit using electronic reactance can thus be swung below or above its nominal value simply by altering the grid bias.

Electronic reactance is used in certain flywheel-controlled line sync circuits and in automatic frequency-control circuits, the reactance being placed across the tuned circuit so that the frequency is accurately maintained by the action of a "control bias" applied to the electronic reactance valve.

This control bias is picked up from a discriminator, whose output is either positive or minus, depending on whether the circuit is mistuned above or below its correct frequency. See Fig. 14.

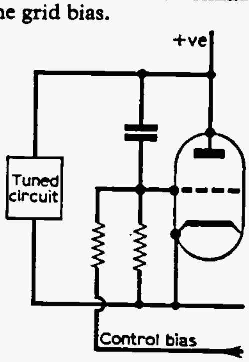


Fig. 14—An "electronic reactance".

Electrostatic Focusing

Electrons comprising the picture tube beam are influenced both by magnetic and electrostatic fields. Magnetic fields produced by the scan coils deflect the beam vertically and horizontally (see under "deflector coils"). Early sets also employed either an electromagnet or a permanent magnet set critically on the tube neck to focus the beam electrons so as to cause the electron beam to converge to a very sharp point of focus on the fluorescent screen of the tube.

More recent picture tubes, however, use instead built-in electrostatic focusing, needing no external magnet. The focusing electrode is a part of the tube electron gun assembly and consists of a short cylinder surrounding a gap in the final anode cylindrical electrode. An electrostatic-lens effect is produced by the application of a small positive potential to the focusing electrode, though in some tubes the effect is present even with zero voltage on the electrode.

The value of the focusing potential is not very critical, and for this reason a preset focus control suffices in sets embodying these tubes. This control consists of a potential-divider across the h.t. supply (sometimes across the boosted h.t. supply) with the tap connected to the tube focus electrode. Once adjusted for the best results, the control rarely needs re-adjusting apart from, perhaps, when the tube is replaced.

End-Fed Dipole

It is possible to feed a half-wave dipole at the end instead of at the centre. At the centre of a tuned dipole the impedance is in the order of 72 ohms (see under "aerials"), while at the end the impedance is much greater, in the order of 3,800 ohms. At that point, therefore, it is impossible to connect ordinary 75-ohm feeder.

A matching device—transforming the end impedance of the dipole down to the feeder impedance—is sometimes used, and the aerial is then said to be "end-fed". Certain commercial television aerials adopt this technique.

Part 4 follows next month

LETTERS TO THE EDITOR

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

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

YOUR PROBLEMS SOLVED

SIR,—Regarding the query by J. H. Wilson of St. Helens, in "Your Problems Solved" in the May issue, the loss of field sync on the Marconiphone 4610 receiver may not be due to a fault on the set at all, as there is a modification to cure this particular fault.

C21 (video coupling capacitor) should be altered to a 1μF component with the negative end connected to L17.

Also, C23 (video screen decoupler) should be altered to a 200pF capacitor. I have come across these symptoms on dozens of occasions, and a cure has always been effected with these modifications.—R. W. Ayres (Luton, Bedfordshire).

LETTER OF THANKS

SIR,—May I through the columns of *Practical Television* thank all readers who contacted me re "Service Sheet Offer" in the Letters section of the April issue of *Practical Television.*

I am afraid that the offer is now closed, as the entire selection went four days after the date of publication.

To those readers who were not lucky, may I apologise once again.—J. G. Day (Stonebroom, Derbyshire).

DX TV CLUB

SIR,—Would anyone interested in forming a DX TV Club please contact me at the address below, or Mr. Reg Roper, 62 Wellington Street, Torpoint, Cornwall, for further details. We are interested in forming this Club and would welcome views and letters from anyone with an interest in this subject.—D. Bowers (95 Grenfell Avenue, Saltash, Cornwall).

VHF AMPLIFIER

SIR,—We have noticed in the March issue of Practical Television, "Letters to the Editor" a letter from Mr. E. Cooke of Bristol, complaining of the difficulty of obtaining components for the VHF Amplifier (October 1965 issue) by G. J. King.

Our Company (Ajax Electronic Products, 18a Rumbold Road, Fulham, London, S.W.6) can supply all the components for this unit. For list, please send s.a.e. to the above-mentioned address.—G W Jenkins (London, S.W.6).

IT'S ALL DONE WITH MIRRORS

SIR,—Whilst searching for the cause of an intermittent interlace fault, plus a very slight fold over and cramping at the bottom of the picture, I stumbled on the following set of resistance figures obtained across the various pins of a PL83.

Pin 9 to 8, 50MΩ. Pin 9 to 7, 50MΩ. Pin 9 to 6, 32MΩ. Pin 9 to 5, 17MΩ. Pin 9 to 4, 17MΩ. Pin 9 to 3, 5MΩ. Pin 9 to 2, 37MΩ. Pin 9 to 1, 15MΩ.

The reason for pin 9 being chosen as the common pin in each case, is that on it a very fluctuating 50V d.c. was discovered, and as no connection could be seen either externally or internally I tried the resistance test. All other voltages and currents appeared normal.

I think the set of resistance figures is self-explanatory, pins 1 to 9 to 3 being the main potentiometer which I am sure the manufacturers never intended to include within the valve.

The reason for this strange phenomenon appears to be due to a mishap during the evacuation process (a misfire in fact!) the inside of the valve-base around the pins that is, resembling a looking-glass. Incidentally the fitting of a new valve completely cleaned up all the above faults.—W. J. Eldridge (Whitstable, Kent).

VIDEO STAGE PICTURE FAULTS

By G. R. Wilding

AS the output stage in a radio receiver introduces by far the major part of the distortion created by the entire circuit so the video stage in a television receiver is responsible for most of its picture defects, particularly when component variations may have occurred.

In this context the video stage extends from the cathode of the vision detector to the cathode of the c.r.t. and, assuming a perfectly aligned receiver with a response curve able to accommodate the entire broadcast waveform, what component defects and value changes in this stage will increase or introduce what type of picture distortion?

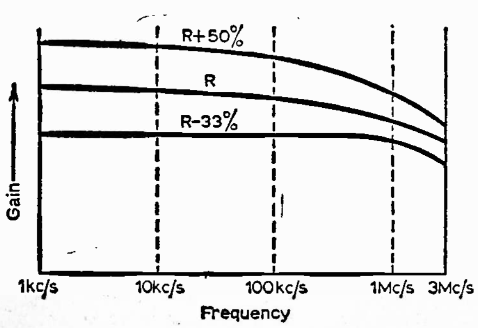


Fig. 1—Effect of increased and reduced values of load resistor on typical purely resistive video amplifier.

Frequency Distortion

It is accepted that no video amplifier can give the same degree of gain to all frequencies in the broadcast range so that there must always be present some form of frequency distortion, although careful design plus the incorporation of peaking coils in the anode or tube feed circuits can produce a very close approximation.

As the dominant features of video stage design are the anode and cathode components and as these are most likely to change after prolonged use it is fitting to start with them.

The video anode load resistors are always composition to avoid the inductive effects of wire-wound types and often increase or decrease in value, simultaneously producing a lowering of picture quality. If they increase in value, greater amplification is given to the lower video frequencies with the result that a contrast setting sufficient to properly modulate the tube with these frequencies is insufficient for the top end of the range and on the test card the 2·5 and 3Mc/s gratings are pale

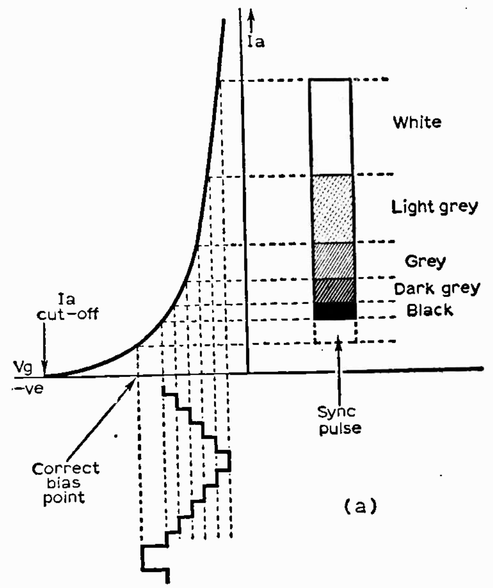


Fig. 2a—Video amplifier waveform operated at the correct biasing point.

and washed out.

This effect is seen because the gain at the top end is mainly determined by the stray shunt capacitances (with a purely resistive load) and by the resonating impedance (when peaking coils are used), while the gain at the lower frequencies is solely determined by the value of the load resistor.

Load Resistance Decrease

On the other hand, should the value of the load resistor materially decrease, although the frequency range would not be impaired, there would be a marked general loss of contrast which cannot

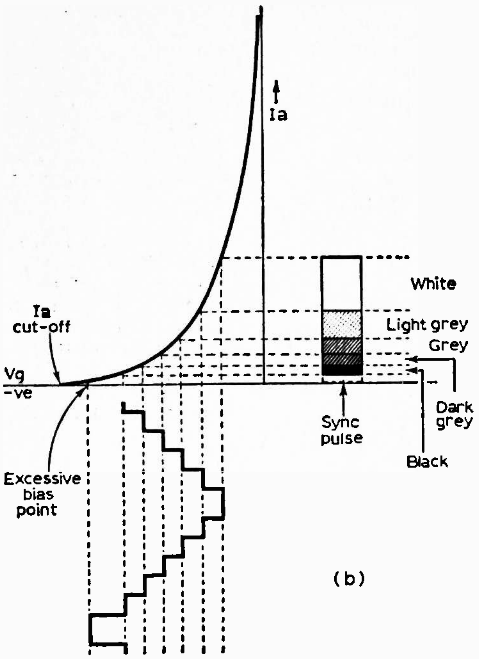


Fig. 2b—Shows effects of excessive biasing (see text).

unfortunately be completely remedied by increasing receiver gain, since the reduction in amplification occurs after the detector.

Fig 1 graphically shows how increases and decreases in load ohmage affects the linearity of the video response curve. It will be seen that a reduced value load actually improves upon the specified value, but considerations of fully modulating the tube with a 20-30V swing from the output of the detector often necessitates the choice of the higher value.

Should the cathode bias resistor increase in value or the subsidiary feed resistor drop in value, causing an increase in applied standing bias, although again there will be no effect on picture definition there will be an impairment of tonal gradation

Dark Square Separation

As is well known it is always most difficult to separate the two darkest squares on the test card due to the combined effect of both the video pentode and the c.r.t. being biased to approaching cut-off at these d.c. levels and excessive bias to the video valve accentuates the effect.

Fig. 2a graphically demonstrates this and Fig. 2b shows how excessive biasing can so reduce the amplification given to the sync pulses that often the owner's main complaint is that picture locking is weak and inadequate. When over-biasing is present invariably the user tends to increase brilliance past optimum in an endeavour to improve the tonal range, but this results in "milky" blacks and overrunning the tube.

Insufficient bias, on the other hand, while it often improves upon the normal dark grading, results in poor highlights, since "light grey" d.c. levels will drive the video amplifier up to the maximum current values normally only occupied by "peak white" signals. Thus all lightish tones will be reproduced with about the same degree of brilliance, resulting in a flat, uncontrasted picture very akin to that produced by a low-emission tube or by a normal tube clipped by an incorrectly set vision limiter. In severe cases peak white signals can drive the video valve into grid current and cause pronounced top clipping.

Reduction in the value of the cathode bypass capacitors when of specific picofarad value is usually most evident on the higher frequency definition but if electrolytic and therefore larger will impair resolution throughout the video band.

Some designs, such as that shown in Fig. 3, have a two-stage cathode decoupling arrangement arranged to produce a linearising effect on the video response curve by completely removing all negative feedback at the top end but progressively applying it as the applied frequency drops, thus in effect lifting the top, where normally gain drops off markedly

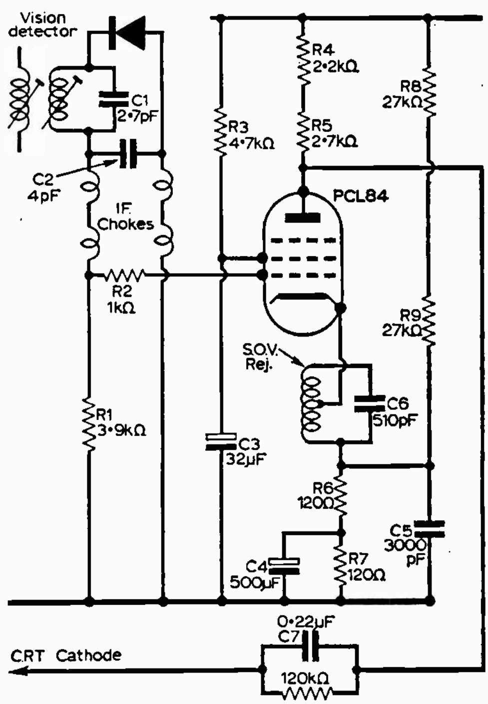


Fig. 3—Video circuit of typical modern 405-line receiver (G.E.C. BT455) embracing details found in practically all other models.

Negative Feedback Removal

Thus the 3,000pF capacitor removes practically all the negative feedback from about 2Mc/s upwards, while the 500pF electrolytic removes at most 50% of the negative feedback developed from the middle to low frequencies.

At and approaching zero frequencies the capacitor is completely ineffective, a desirable feature since near d.c. signals can be relatively over-amplified due to the internal resistance of the h.t. supply circuit being virtually in series with the actual load resistor.

All remarks concerning cathode bypass capacitors equally apply to G2 screen decouplers, which range in value from small value picofarads to high value electrolytics, although some models, such as the dual-standard Ferguson 900, employ two widely differing values in parallel.

In this particular model there are a 4μF electrolytic shunted by a 0·03μF paper foil, the latter capacitor being included to ensure that any inductance in the electrolytic preventing perfect bypassing to the very high frequencies is offered an alternative path.

Increase in the value of the screen feed resistor as well as lowering the voltage at G2 will also increase the negative feedback introduced by this electrode, mainly on the lower frequencies when the bypassing effect of the decoupler is at a minimum. Again referring to Fig. 3, an increase in the value of R2, the grid stopper, will simultaneously cause a falling off in gain at the highest frequencies as it would be equivalent to an increase in the input capacity of the valve.

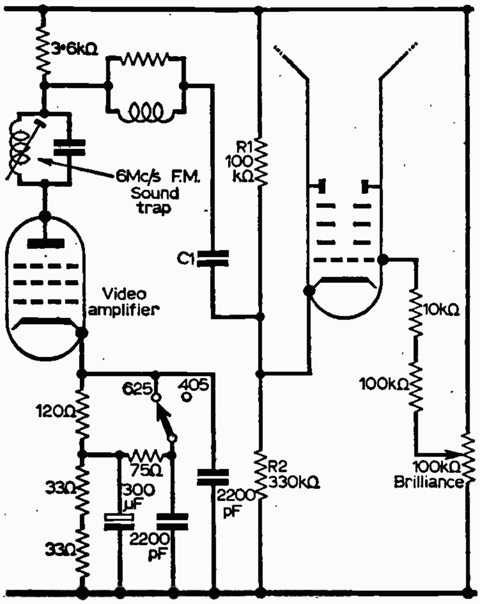


Fig. 4—"AC" tube feed as used in many dual-standard receivers. R1 and R2 form a fixed potential divider holding tube cathode at a predetermined voltage thus keeping brilliance level constant despite bias changes on 405/625 changeover.

Resistance Alteration

Although not a current carrier, and therefore not liable to heat-produced value changes, a temporary short-circuit in the video pentode could cause a current through it sufficiently high to radically alter its resistance.

Similarly, although the vision detector load carries no appreciable current, a short in the pentode can alter its ohmage very quickly.

In all cases, therefore, when a video pentode has developed an internal s/c it pays to check the value of all grid circuit resistors as well as the more obvious cathode, screen and anode feed components.

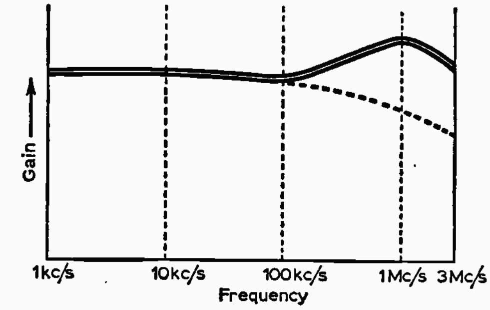


Fig. 5—Typical response curve of video amplifier with series or parallel-connected resistive/inductive load. Dotted trace shows effect of open circuit in coil if paralleled.

The small peaking coils used in many video output stages to resonate with the stray circuit capacitances as a rejector circuit tuned broadly to the top end of the video spectrum, thus boosting gain there, very rarely go open-circuit. When they do in a series L/R arrangement they completely stop the stage working by cutting the h.t. supply to the valve anode, but in a parallel arrangement an open-circuit coil will only cause attenuation of the higher frequencies. However, they are always easy to check since their d.c. resistance seldom exceeds 10Ω, in striking contrast to the average 4·7kΩ of their associated resistor.

C.R.T. Feed

Irrespective of the type of anode load, most of the non-convertible receivers fed the c.r.t. via a parallel combination of high value resistor and medium value capacitor. These components are in series with the cathode lead to the tube and any voltage developed across them biases back the tube by that amount in exactly the same manner as the auto-bias resistor does to an ordinary valve.

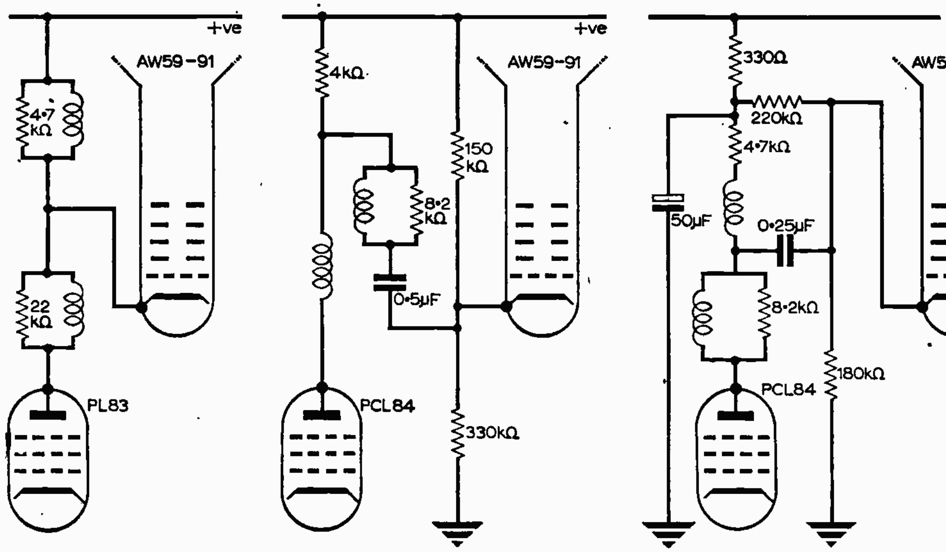


Fig. 6—Typical examples of the three types of resistive/inductive video loads. Left, parallel *(Philips 23TG-122A) centre,* series *(Ferguson 850) right, combined* series/parallel *(Regentone VCI series).*

Thus when high-frequency signals are being handled the capacitor offers an easy path to the signal and an insignificant voltage is developed across the pair, but at very low frequencies and d.c. the reactance of the capacitor becomes so high that the resistor becomes the easiest path and the voltage then developed across the pair becomes appreciable, developing considerable negative feedback to cut down gain.

This is usually necessary because at very low frequencies the reactance of the h.t. supply circuit decouplers becomes so high that they are ineffective, resulting in the video anode load being virtually the normal value plus the series addition of the internal resistance of the supply.

Equal Gain

This arrangement then keeps gain at the lower end no greater than gain at other frequencies and promotes a straight-line frequency response.

In dual-standard and convertible receivers, however, the signal feed to the tube is often a.c. only via a medium value capacitor whose reactance rises to a high value at the lower end of the spectrum, thus effectively preventing a rise in gain. Such an arrangement is shown in Fig. 4 as used in many HMV, Cossor and Ferguson receivers.

R1-R2 form a fixed potential divider holding the cathode of the tube at a predetermined level with the video signal from the pentode modulating the beam via C1, a 0·5μF capacitor, and the resistor loaded compensating coil.

No outline of the causes of poor picture resolution, however, would be complete without reference to the effects of faulty or ageing tubes. The commonest cause, often wrongly diagnosed as incorrect alignment, is sub-standard focusing, resulting in an over-large spot that cannot possibly reproduce the fine test card gratings.

Perfect focusing is essential for high definition and some electrostatically focused types do tend to depreciate in this respect as emission falls off. Boosting often improves for a short period but replacement is the only real cure. An inability to fully black out the raster or alternatively bring the brightness level beyond a certain point is often the sign of an inter-electrode leak in the tube and here again replacement is the only cure. However, should a leak develop between the tube heater and cathode a considerable improvement can be effected, though by no means a cure, by feeding the heater via a low-capacity isolation transformer. ■

PRACTICAL TELEVISION INDEX

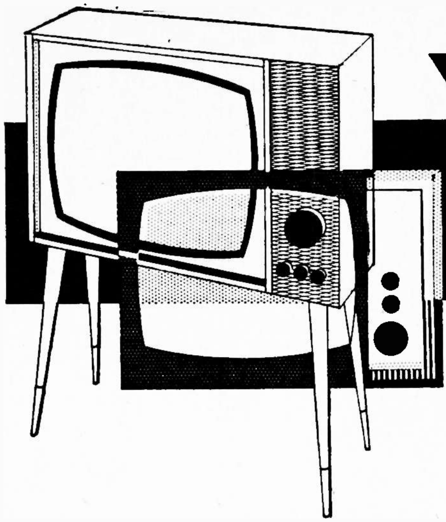
The index to Volume 15 of PRACTICAL TELEVISION is obtainable from the Post Sales Department, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

The price is 1s. 6d. inclusive of postage.

TV STATION MAPS

On page 332 of last month's issue of this magazine, mention was made of maps that could be obtained from the BBC Publications Department. This was incorrect—these should be obtained from the Engineering Information Department, Broadcasting House, London, W.1.

Your Problems Solved



Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 429 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

FERGUSON 505T

I have noticed a gradual deterioration in the picture quality and focus. Could you please tell me the purpose of the spot limiter for, when it is advanced a little the highlights on the picture turn negative. Also, the picture is displaced to the right-hand side, especially when the contrast is turned up. The e.h.t. to the tube is normal so could this trouble stem from the synchronising circuit as the horizontal hold is not too good?—C. R. Mozley (London, W.8).

If advancing the contrast or brilliance causes the picture to go negative or "blush" on the whites it is probable that the tube emission is failing. The limiter is provided to bring interference pulses to the same level as the normal whites. Hence when turned it does tend to deaden the highlights. Check the video amplifier PCL84 and associated components. Check the PCF80 sync. separator-line phase splitter.

PHILCO 1040

The fault in my set is a fold over at the bottom of the picture. I have changed V14, PCL85 and two capacitors C60 (500 μF) and C58 (0·02 μF) but the fault remains.—A. Johnston (Jarrow, Durham).

You will probably find that C59 0·005 μF is leaky. Check this and other capacitors from C55 on if necessary.

FERRANTI 17KG

This set is minus 2 valves, so could you please let me know the layout of the valves and the No. of the Tube?—D. C. Doherty (Londonderry, Ireland).

You require a "service sheet" or manual of this set. We regret that we do not supply these, but you should be able to obtain a copy from one of the advertisers in this respect in *Practical Wireless* or PRACTICAL TELEVISION.

TIMEBASES

O. S. Puckles' book on Timebase appears to be out of print. Could you refer me to any other source which contains details of this 3 valve circuit?—E. W. Morton (Deal, Kent).

We know of no other book fully describing the works of Puckles. However, you should be able to refer to the book, even though it may be out of print, at a library.

Most TV books give timebase details, but we know of no publication specifically devoted to this subject.

BUSH TV75

The on/off switch has gone wrong, could you advise me the best way to do it.—H. Hyde (Wednesbury, Staffordshire).

The on/off switch is part of the volume control—brilliance unit and should be replaced as a unit. The front knobs are secured by clamp bands round the knob shanks, released by inserting a screwdriver from below. With the front knobs off, release the bottom chassis fixing screws, remove the loudspeaker leads (top left) and release the claws either top side. Remove the chassis completely and carefully mark all leads to the unit to be renewed.

FERGUSON 204T

The sound is perfect but there is no screen illumination. The old burnt-out line output transformer has been replaced and the PY81 and EY86 have been tested and found satisfactory. The PL81 was broken down one side so was replaced.

The line whistle can be heard when the line hold is adjusted, and replacing the 0·001 μF coupling capacitor had no effect. The 2·2k Ω screen resistor has also been tested and found satisfactory.—K. A. Edge (Downend, Bristol).

We would suggest that you check the 0·25 μF boost line capacitor—maker's sheet, C131.

ULTRA V17-70

This set has an illusive fault connected with the frame scan. On switching on, the picture appears reasonable, but after an hour or so, the bottom of the picture has crept up some 1½ ins. and the frame scan is decidedly non-linear. The valve (30PL13) has been checked over a period of an hour and seems to be all right. The bias voltages also seem in order. The only odd voltage is that at the top of the "height" potentiometer, which is 360 volts instead of 270. The boosted h.t. is correct (520V) and the feed resistor (270kΩ) in order. There seems to be an excess of picture height and this pot. is set so as to be practically zero. The vertical form pot. is also set to zero.—G. Maycock (Ascot, Berkshire).

You say that the 30PL13 has been checked over a period of one hour. If this is on a valve tester, this may not mean much as few testers are able to simulate timebase operating conditions. It is possible that the field output valve is faulty, and the best way of proving this conclusively is by testing by substitution. Low anode current would give an abnormally high anode voltage, as also would the use of a tester with higher than average sensitivity.

SOBELL T171

My trouble is sound on vision on BBC only, accompanied by distortion of sound on this channel. ITV is perfect on vision and sound. I have tried reducing signal strength on BBC but this does not improve it at all. Do you think the sound rejectors and vision rejectors need adjusting. If so, where are they located?—F. W. Jones (Chaddesden, Derby).

It is unlikely that the rejectors are out of adjustment, otherwise the effects would be present also on the ITV channel. It is still possible that excessive BBC signal is responsible; you say that you have tried attenuating the aerial signal, but not by how much. Try a greater degree of attenuation. If the trouble persists, check the tuner local oscillator (fine tuner) adjustment.

EKCO TC208

As I could not draw a spark with a screwdriver from the e.h.t. connection on the TV tube I deduced that the fault lay in the e.h.t. transformer. I therefore purchased a new one, but on fitting same I still could get no e.h.t. I therefore renewed both the U301 valve also the U25.

I can now draw a spark nearly ½in. from the anode of the U25 but no spark from the cathode of this valve (to tube). No e.h.t. can be obtained with or without the lead to the tube being connected.—T. H. Gardiner (Leicester).

Your symptoms indicate a faulty U25 e.h.t. rectifier, or a break in the heater-winding of the line output transformer which feeds its cathode. As an additional check you could run it from a well insulated 1·5 volt dry cell, which should light the heater, and enable you to obtain sufficient e.h.t. to inspect the raster and see if it is otherwise normal.

BUSH TV62

The picture on this set has bands to the top right. I have had trouble with the line hold. I have to adjust the fine tuner a lot during an evening's viewing as sound-on-vision on ITV is more critical. I adjusted the line drive capacitor and this strengthened the picture but moved the raster over to the left.

Also, if I fit a booster transformer to the tube of a Pye 17, is there a risk of burning out the heater?—W. S. Currie (Portadown, Northern Ireland).

You should change the ECC82 line oscillator and ensure that the two discriminator diodes are evenly matched. Check the 2 μF capacitor in the ECC82 anode circuit and the 0·1 μF capacitor and 12 Ω resistor in the boost line. Retune the sound rejectors if necessary (L22 and L24).

Regarding the Pye set, the application of boost to the tube heater is not likely to burn it out, but at the same time it is not likely to increase the emission for very long.

COSSOR 948

The above set, although pretty old has performed well in the past with minor repairs and replacements made by myself.

Recently I find that during the first hour after switching on, there is an intermittent crackling from the loudspeaker—the vision remaining good. A quick twist of the channel selector switch restores sound for a few moments, then the interference begins again. The selector switch contacts have been cleaned but this has made no difference.—A. J. Cash (Bury, Lancashire).

Quite often the trouble is only due to the PCL82 audio output valve not making proper contact in its holder. Even if this is not so, it is this stage that should receive attention. Probe the capacitor and resistors and check V6 (6BX6) i.f. stage as well.

SOBELL TPS173

Could you please explain the cause of cramping at the bottom of the picture, after half an hour of being switched on, the picture cramps two inches at the bottom. I have tried a new frame amplifier valve but it is still cramping at the bottom.—R. Shevlin (Howdon-on-Tyne).

This trouble often indicates failure of the field output valve to deliver full scanning current when hot. However, if you are sure that the valve is in order, check the ventilation at rear and bottom of set, as overheating of a component can aggravate the effect. Also, make sure that the mains adjustment suits the mains voltage.

If all seems well in these respects, change in value of a coil or resistor in the field timebase should be suspected. Some sets display these troubles more than others and sometimes it is necessary to set the controls after the set is really warm, putting up with slight overscan when the set is first switched on.

ALBA T656

The fault I am getting is a picture completely blanked out at the top, with field and line sync. last, the sound is OK for 10 seconds when switched on and then goes distorted. Have substituted every valve. and replaced components around EF85. Voltage checks seem OK up to tuner also the main Electrolitics are OK as the raster is all right with no faults received. Have also replaced some resistors in tuner which seemed a bit dodgy. Capacitors look OK when I connect meter leads from point H on contact strip and chassis. The sound and vision rectify themselves to a certain degree.—H. Doughty (Dagenham, Essex).

It would appear that the hum voltage is created in the tuner unit. If the tuner valves are not at fault check the heater line in the tuner to see that at no point are any accidental contacts made

SOBELL T346

The picture keeps jumping and ... when I adjust the height control ... +ve gives a broad white band across the ... the picture, distorting the vision. The contrast control seems to have no effect at all.—R. Denholm (Glenrothes, Fife.)

Check the field oscillator-output ECL80 valve, the 0·5 μF capacitor which decouples the height and hold controls and the resistor in series with the hold controls.

QUERIES COUPON

This coupon is available until JUNE 23rd, 1966, and must accompany all Queries sent in accordance with the notice on page 427.

PRACTICAL TELEVISION, JUNE, 1966

TEST CASE -43

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

? *A reader of "Practical Television" was called upon to offer his advice on a set that had the expensive habit of burning up more than an average number of valves. The owner complained that over a period of about two years no fewer than ten valves had been replaced. It was found that there was no particular valve that failed, and it seemed that almost any one was likely to suffer premature failure.*

Enquiries proved that it was the heater of the valve that failed and not the emission. As a consequence therefore, the enthusiast checked the mains voltage tapping on the set and measured the mains voltage at the power plug and found that these two voltages coincided quite closely. Further enquiries revealed that household electric light bulbs and domestic appliances held their service for the expected length of time before replacement was necessary. The possibility of the mains voltage rising to an abnormal value was thus discounted, as this is reflected in bulb replacements.

The heater chain circuit of the set was tested and this seemed to be perfectly correct; the mains dropper, thermistor and bypass components showed no sign of incorrect value or overheating.

The set used 0·3 ampere valve heaters, and an a.c. meter in series with the heater chain gave a reading of a little over 0·34 amperes.

What was the most likely cause of this trouble, and how could the enthusiast prove this?

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

SOLUTION TO TEST CASE 42
Page 381 (last month)

The video output valve in most dual standard sets is switched by the action of the "standard change switch" to different grid bias conditions. This is necessary to satisfy the positive-going vision signals of the 405-line standard and the negative-going vision signals of the 625-line standard. On the 625-line standard, some sets lift off the d.c. coupling to the video amplifier control grid circuit from the vision detector. Now if the video amplifier valve has a tendency towards grid current or if there is any slight inter-electrode leakage, the effect is likely to be emphasised on 625 lines, rather than on 405 lines.

Indeed, the d.c. connection on 405 lines has been known to mask such a valve defect and allow normal reception on this standard, as in Test Case 42.

The trouble was cured simply by replacing the video amplifier valve, and this action is well worth trying in the event of abnormal video operation on 625 lines and normal 405-line reception.

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