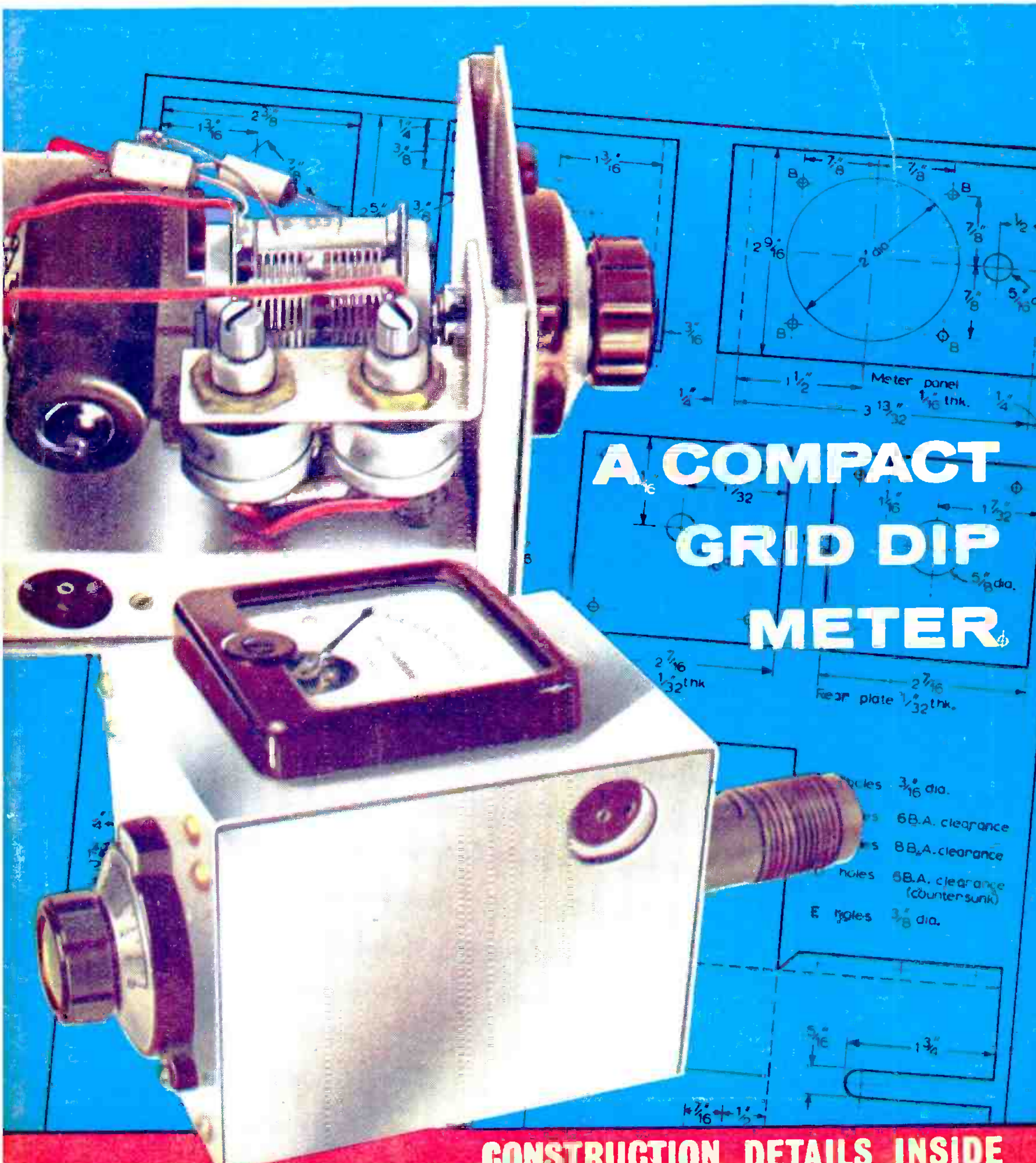
Practical TELEVISION

AUGUST 1963 2/-



A COMPACT GRID DIP METER

CONSTRUCTION DETAILS INSIDE

Practical Television

AND TELEVISION TIMES

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Contents

Extended Vision

FOLLOWING the announcement that the BBC's second programme on u.h.f. will open in April next year, the television industry is completing its plans for launching an intensive sales campaign in London and the Home Counties during the coming months. The prospect of a 625-line system on the u.h.f. band is welcomed generally by manufacturers and retailers alike as a much needed stimulant to a flagging trade.

Outside these circles enthusiasm seems less marked, indeed there are those who suggest, cynically perhaps, that stagnation in the receiver market is the real reason for the decision to go ahead with the additional service. Some people argue that the improvement in picture quality will be appreciated only by the more perceptive minority of viewers, therefore it is far better to wait until colour television is a practical proposition, for then the public will have something really worthwhile in return for the expense incurred in buying a new receiver and aerial. This point of view will certainly be echoed by some of those who are particularly allergic to high pressure salesmanship.

One immediately obvious answer to this argument for delay is provided by the official statement that when colour television does become a reality (in 1965—at the earliest) it will be transmitted only for a few hours per day initially.

But there is, we believe, another more important consideration which demands the early establishment of 625-line standards in this country. As a means of communication television has the ability to surmount frontiers and to entertain or inform a multi-national audience to an extent far beyond the capabilities of sound radio with its language barrier. Surely we must wish to see this latent power exploited in the furtherance of international understanding and goodwill.

In order to participate to the full in the interchange of programmes with Continental countries, we must first come into step and adopt the standards already established in the majority of Western and Eastern European countries.

True, we do at the moment occasionally contribute to, and receive from, the Eurovision network, but each transmission involves the use of line conversion equipment at the U.K. end of the cross-channel microwave link. This is, at least, an encumbrance restricting operational flexibility — even assuming the picture suffers little loss of quality in the process.

Let us look upon the introduction of the 625-line system not simply as a further step in the evolution of our domestic television service, but (more realistically) as a step towards a closer association with the Eurovision network and ultimately to a world wide television network.

And who can deny that the inclusion of a few Continental courses into our homemade programme diet will have beneficial revitalising results on our digestive processes?

Our next issue dated September, will be published on August 22nd.

TELETOPICS

TV ENGINEERING AWARD

A NEW television engineering award will be presented for the first time in 1964 to an individual or team who makes any outstanding contribution in this particular field. The award is an international one and will be presented each year by the Television Society.

It has been named the "Geoffrey Parr Award" in recognition of the long association of the late Geoffrey Parr and the Television Society. The designer of the award, Mr. John McCarthy has fashioned two interlinked sine waves as an appropriate symbol for a television science trophy.

The new "Geoffrey Parr Award" to be presented for the first time next year.

Colour Demonstrations for EBU

MEMBERS of the European Broadcasting Union and OIRT (representing the broadcasting organisations of Eastern Europe) met in London recently to attend demonstrations of colour television. The demonstrations provided the opportunity for all the members to compare the results obtained in the recent series of experimental colour transmissions carried out by the BBC (in association with other bodies) on each of the three systems under examination—the NTSC, Secam and PAL systems.

Pictures were transmitted in each system and compared on both colour and monochrome receivers.

It is planned to hold a meeting of the EBU later this year to review the results of these and other demonstrations in the hope that some recommendation may be made on the future choice of colour systems.

BETTER THAN EXPECTED TV COVERAGE IN WALES

DETAILED field strength measurements in West and North Wales has shown that the population coverage of the two new ITA transmitters now in operation at Arfon and Moel-y-Parc is 28,000 more than the estimated number. The Arfon transmitter, it has been found, serves a further 20,000 and the Moel-y-Parc a further 8,000. This, of course, means that the primary and secondary service areas of both stations reach beyond the predicted areas, so that the town of Bangor, for example, is now within the primary service area of the Arfon transmitter.

The total number of people now within range of these two stations—for which programmes are provided by Wales (West and North) Television—is 505,000.

Measured coverage figures of the third transmitter serving this area—that in the Prescelly Mountains in Pembrokeshire—will be made available at a later date.

New Aerial Ordered for Welsh Programme Transmitter

IN the June issue of PTV the order of a new mast for the BBC's Welsh programme transmitter at Wenvoe was reported. It has now been announced that EMI Electronics Ltd. have been given the contract to supply and erect the aerial for the new transmitter which is sited only 160ft. from the present Band I transmitter. This has made careful design of the new aerial essential so as to avoid distortion of its radiation pattern by the existing mast. The aerial will have a 60ft aperture with full wavelength dipoles mounted on 10ft panels.

Transmissions will be in Channel 13 and will be vertically polarised.

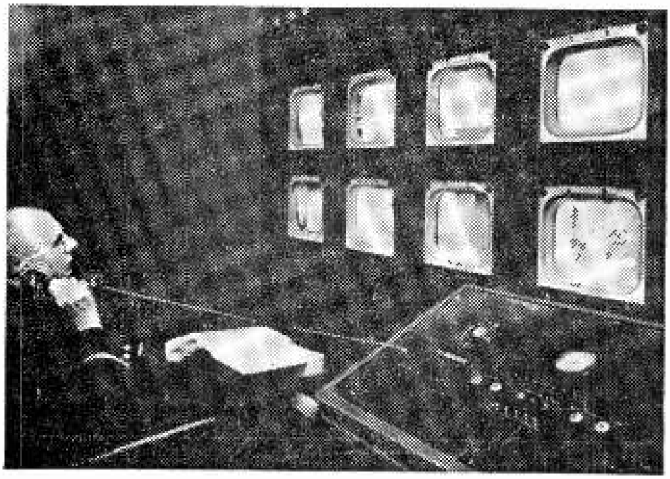
CCTV USED FOR BANK'S SECURITY

SOMETHING new in the way of security systems has been installed recently in a large Chicago bank. The system employs 12 television cameras mounted strategically about the different departments of the bank, to relay live pictures of all customers and bank personnel back to a central control console where security officers keep a constant surveillance on all the bank's activities.

Facing the single officer on duty at the control console are eight monitor screens and a control panel. From this position he can see every part of every department, as each camera scans its specific area, or study any one shot by switching in another monitor. Immediately any suspicious activities are noted, the officer has only to push a button on the console to alert the Chicago City police and the other security officers within the building.

All the equipment for this unique system has been supplied by the manufacturing associates of Rank Kalee, a division of the Rank Organisation.

In two departments, 70ft long rooms would have presented a problem to standard cameras and so special wide angle lenses were employed. Another interesting feature of the system is the facility included in the control console monitors to record automatically on film, any of the pictures appearing on the screens.



The control console and monitor of a CCTV system recently installed in a Chicago bank.

Television Aids to Surgery

A NEW Marconi vidicon colour television camera was used recently in a demonstration given to medical specialists from all parts of the U.K. and overseas. The demonstration, which took place at St. Johns Hospital, Chelmsford, gave the visitors a chance to evaluate the usefulness of colour television as a medical teaching aid.

The new camera relayed colour pictures from an operating theatre to a nearby room where the audience were able to see every detail of each operation on a 12ft x 9ft screen. The pictures were projected on to this screen by a special projection receiver.

Marconi's have designed this new camera specially for medical use and so even with only the normal theatre lighting, perfect colour pictures are assured. Compact and lightweight, the camera can be mounted in the most convenient position and can be fully controlled from a remote position. The camera also features either a four lens turret or a zoom lens to enable views of greater or less detail to be selected.

TV PREVIEWS FOR VISITORS

IN September this year the British Industries Fair will open to visitors at Zurich's Hallenstadion exhibition halls. Inside the main entrance, visitors will be able to see a preview of some of the exhibits on television screens.

The latest all-transistor cameras made by EMI will be used and coaxial cable will link them direct to the receivers in the entrance hall.

ANOTHER TRANSMITTER FOR SCOTLAND

THE new BBC TV station at Ashkirk, Selkirkshire, began regular programme transmissions during June this year and at the same time brought BBC television within the range of a further 70,000 people. The service area of the new transmitter includes the towns of Galashiels, Lauder, Duns, Selkirk, Hawick, Jedburgh and Coldstream; in all a population of more than 100,000.

The station is sited between Selkirk and Hawick, on Dryden Hill, 900ft above sea-level. Transmissions are in channel 1 and vertical polarisation is used.

Telecines for Second Programme

FOUR new flying spot telecines have been ordered from Rank Kalee by the BBC, who plan to use them when the new second programme begins next year. The order, which is for two colour and two monochrome 16mm machines, requires that the equipment be suitable for both 405- and 625-line systems. The order is worth £65,000.

STOCK FAULTS

By
H. W. Hellyer

AS every television engineer knows, there are more circuit variations than one man's memory can cope with. This knowledge is usually forced upon him when he is miles from base, late at night, armed only with his toolbox.

Circuit variations bring with them specific fault symptoms when things go wrong, and familiarity with the particular circuit, or some data on it, speeds the process of fault finding. But, as the engineer is well aware, the great majority of faults are what might be termed "stock faults", common to most models and types of receiver. He is thus aided by experience of general symptoms.

It is the amateur, the set owner, who is then at a loss, for his receiver is the only one on which he can base his diagnosis—and a fault that may well be a routine matter to the engineer becomes as baffling as the more obscure breakdown to the one-set man. The following notes are an attempt to gather some of those general fault conditions, their symptoms and cures. Obviously many of them will be well known to readers of *Practical Television*. Nevertheless, our Problems postbag proves that many readers who have no service data available to them have a good deal of difficulty with faults that prove to be simpler in origin than they feared. Although the notes are collected into sections this is not in order of fault prevalence but for convenience of reference.

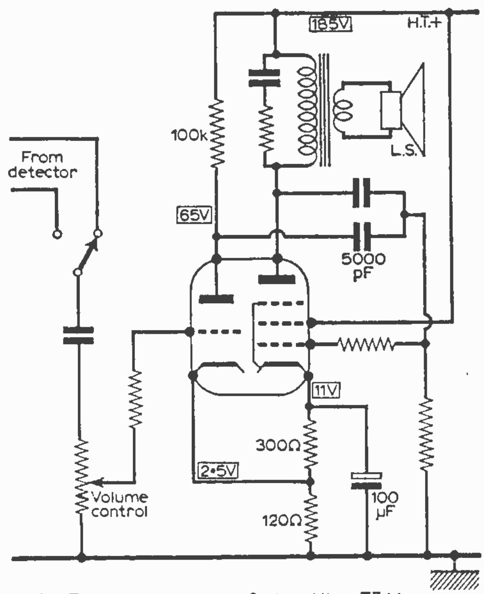


Fig. 1—The output stage of the Alba T744.

SOUND STAGES

Symptom: muffled or distorted output

Many receivers have an audio section consisting of a triode-pentode, such as the PCL82 or PCL83, with the triode section as driver and pentode section as output valve, as shown in Fig. 1. The circuit is of the output stage of the Alba T744, chosen for its conventional style.

The valve is a PCL83. Most usual cause of the fault symptoms is a leak developing in the 100μF electrolytic capacitor decoupling the cathode.

Next possibility is a leak in the coupling capacitor 0·005μF from the anode of the driver section to the grid of the pentode, putting unwanted d.c. on the grid and clipping the waveform at the peaks, giving a quite characteristic harshness of sound. A 500V working paper capacitor should be used for replacement.

Note that the anode voltage of the triode should be only 65V. A common fault in many stages which use this type of circuit and an even higher anode load than the 100kΩ resistor shown here is for the resistor to overheat and change in value. If it goes high the audio drive to the output stage is reduced and the fault is a cumulative weakening of signal. As the common cause of the fault here is a leak in the coupling capacitor, or a faulty valve, the symptoms may be masked by distortion. When the original fault is cured we are left with low output and a voltage check may reveal this damaged component.

Symptoms: weak output with or without distortion or hum

In a circuit such as Fig. 2(a), the sound detector and interference limiter circuit of the Cosser model 945, two germanium diodes are used. W1 acts as the detector and the audio is taken from across its 100kΩ load via a filter network and W2, which is effectively in series, to the volume control and thus the grid of the driver. If W2 goes open-circuit the audio will reduce considerably. Before this happens there is usually an onset of distortion and afterwards some hum. On this model the fault is easily proved by setting the interference limiter plug to the minimum position, when the sound returns to normal. On other models, such as the 948, this cannot be done and the diode should be temporarily bridged to prove the fault.

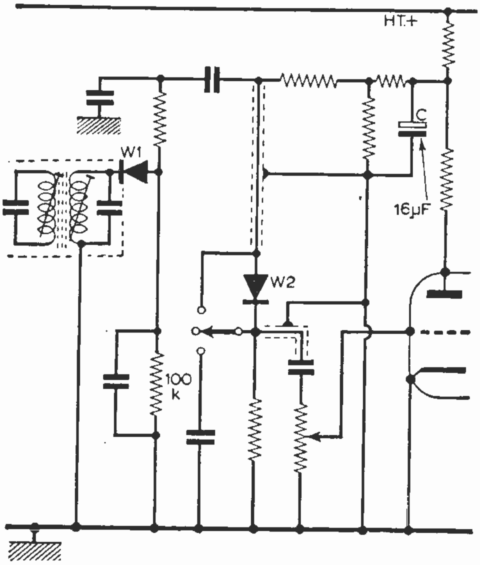


Fig. 2(a)—The sound detector and interference limiter circuit of the Cossor 945.

Symptoms: noisy audio and distortion

A variation of this circuit, using a valve (EB91) for the same purpose, is shown in Fig. 2(b), which is part of the Philco model 1000 sound stages. Note the 4·7MΩ resistor connected between the h.t. line and the anode of the second diode. The purpose of this component is to give a fixed bias for limiting, but if it goes "high" the valve limits seriously on peaks.

The further cause of noise, a rough track on a volume control, hardly needs mentioning here except to state that there are circuits which incorporate this control in the grid of the output section, not the driver, as in Fig. 1, and here again there is the possibility of a leaky coupling capacitor being responsible for the fault origin. Other circuits use a volume control return to a point on the cathode bias network, for biasing reasons, to give a measure of feedback, and a noisy control in this type of circuit can have even more severe effects.

Symptom: distorted f.m.

Before leaving the audio stages it may be as well to mention a popular cause of distortion on the combination receiver with TV/f.m. facilities. Where the fault sounds very like misalignment there is a disturbing tendency on the part of the handyman to twiddle the cores of the i.f. coils indiscriminately.

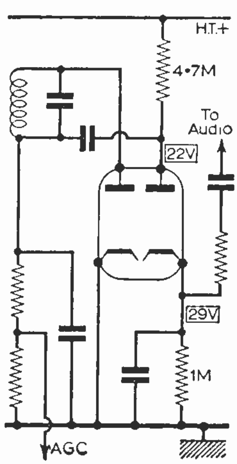


Fig. 2(b)—Part of the Philco model 1000 sound stages.

As the slug of a broadly-tuned transformer can be moved quite a way before one's ears register a difference the ultimate effect is even worse distortion. Very often the trouble is no more than a small adjustment to the core of the *final* winding in the discriminator transformer. This invariably needs setting after the receiver has been tuned up and quite a small change in inductance can improve the signal.

Symptom: hum

There are many causes of hum, but where this is only evident on sound and does not affect the vision stages the origins are most likely to be:

(a) Breakdown of an electrolytic smoothing capacitor decoupling part of the audio h.t. line (C in Fig. 2(a).

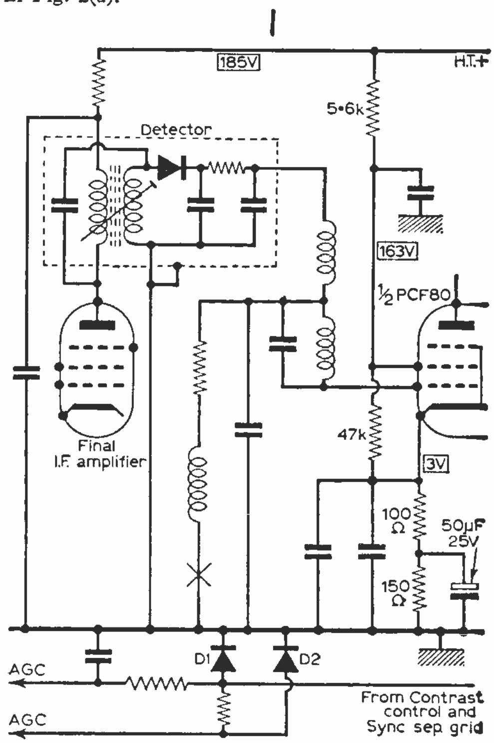


Fig. 3—The vision detector circuit of the Ferguson 516T.

(b) Heater-to-cathode short-circuit in one of the sound channel valves. If the symptoms are reduced when the volume control is turned down check all valves pre the detector, especially the double diode if fitted. If the volume control has no effect on the hum check the output valve.

(c) Vision on sound. If sound i.f. circuits are not sufficiently selective part of the vision signal is amplified, reproduced as a buzz. Before resorting to retuning check i.f. decoupling and take-off adjustment, particularly the i.f. coupling coil from the tuner unit.

(d) Cross modulation. Too great a signal level results in the a.g.c. system being overcome and resultant sound-on-vision and vision-on-sound.

Attenuate input. If this has to be attenuated to a point where the signal is too weak for normal viewing check the a.g.c. decoupling.

VISION STAGES

Symptom: weak picture

If sound is strong but the picture weak and watery, sometimes accompanied by a loss of sync, the trouble is often a non-conducting crystal diode detector. Where a valve is used check by substitution to eliminate the possibility of heater-to-cathode leak, which can cause this fault.

To check the crystal measure detector output. The best way is to insert a microammeter in the earthy lead of the crystal load resistor (point X in Fig. 3, which is the vision detector circuit of the Ferguson 516T). A normal input, say 100-200μV, at the aerial of a standard receiver and between 20 and 50μV at the aerial of a fringe model should give peak white modulation which will provide a reading of between 400 and 500μA (giving approximately 3V detector output).

Weak a.g.c. can also cause this fault and when testing note the a.g.c. voltage, which should remain constant over a wide range of signal strengths. Compensate the a.g.c. by applying a 3V battery (positive to chassis) to provide a fixed bias. If a.g.c. is faulty check the clamping diode (D1, D2), usually a crystal diode, used to bypass excess a.g.c. voltages and prevent overload.

The crystal can be measured for back and forward resistance with an ordinary ohmmeter, expecting less than 1,000Ω forward and 100 times as much back resistance; but this is a d.c. test and does not necessarily prove the crystal's efficiency at h.f. The best test is substitution—even though this component is often buried in a jungle of other components or hidden within an i.f. can.

Symptom: sound-on-vision

Most common cause is an offsetting of the sound rejectors. These can often be identified as single-cored coils adjacent to the vision channel but their position, both physically and in the circuit, can vary from set to set. They should be adjusted for minimum sound interference on vision, *not* for maximum sound. Take care, when adjusting, to note the original position of the iron-dust core and return to this position if no improvement is effected. As noted previously, the tuning of the i.f. take-off coil of the tuner unit is important for stable reception. This is normally adjusted for best balance of sound and vision and not for maximum vision output.

Symptom: weak or non-existent picture

Video burnout. Referring again to Fig. 3, note the potentiometer, formed by four resistors, 5·6kΩ, 47kΩ, 100Ω and 150Ω, across the h.t. The screen grid and the cathode of the video amplifier are fed from tappings on this potentiometer to receive the appropriate voltages. The valve develops a grid 1 to grid 2 short-circuit and a chain of calamities quickly follows: the cathode resistors overheat, the screen grid passes too much current and the 47kΩ resistor burns out completely. Safest procedure is to replace all four resistors and the 50μF capacitor, which may be punctured due to excess voltage over its safe rating. The deceptive factor here is that after component replacement—usually obvious—the circuit may appear to work, but the danger remains and the valve will probably fail again when hot. Replace the video amplifier.

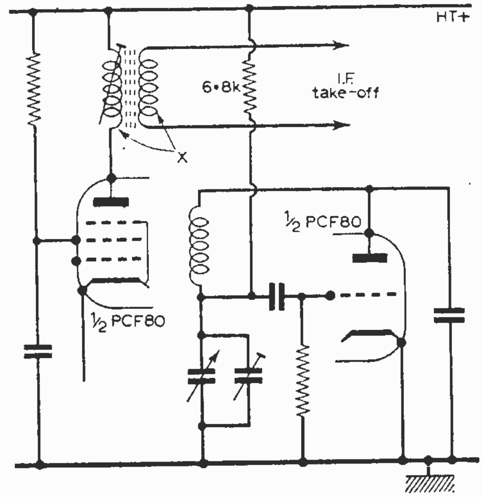


Fig. 4—A PCF80 frequency changer stage.

Symptoms: oscillator drift and ultimately no sound and vision

Another burnout, again precipitated by valve failure, is that of the oscillator load in the tuner unit. The 6·8kΩ resistor feeding the anode of the triode section of the PCF80 frequency changer in Fig. 4 burns out after a period of overheating (when

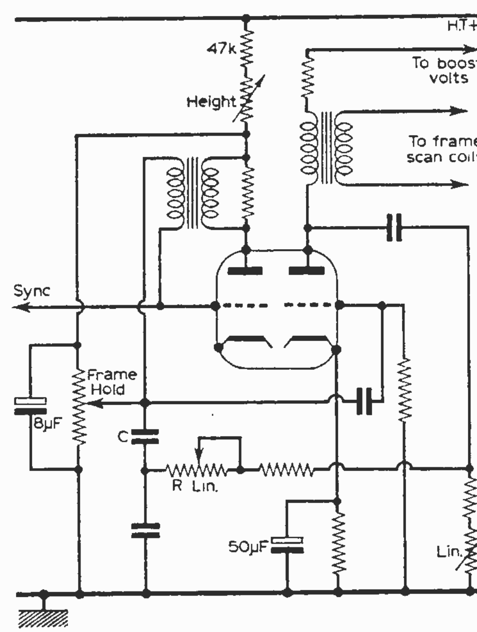


Fig. 5—The frame blocking oscillator and output stage of a Masteradio TE7.

the drift symptoms occur). Replace both resistor and valve. Use a 1W non-inductive type and fit this replacement in as near a physical replica of the original as possible.

A further tuner unit fault sometimes bothersome is a short-circuit across the i.f. take-off coil where this is carrying h.t., as shown at point X. Some circuits use a tapped coil and a coaxial take-off cable which carries h.t. and is also vulnerable, especially at the point where it passes through the screened casing.

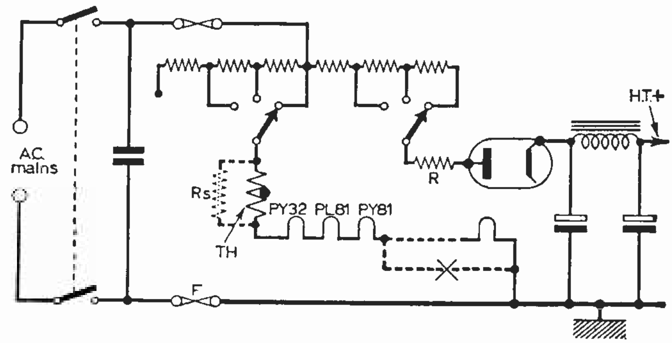


Fig. 7—A typical power supply and rectifier circuit.

FRAME TIMEBASE

Symptom: lack of height

The circuit shown in Fig. 5 is of the frame timebase of the Masteradio TE7 series, chosen because it illustrates several possible fault sources. This is a blocking oscillator with the height control varying the h.t. to the anode of the oscillator. Where a variable control with carbon track carries h.t. there is always the possibility of a hot-spot and symptoms of intermittent height, frame locking only at reduced height, etc., can often be traced to this control.

A further cause of reduced height is change in value of the h.t. dropping resistor in series with the height control. Another common cause is the h.t. feed to the output valve—often taken from a point on the boost voltage line. On several Philips, Stella and Cossor models this voltage source is the focus control, a 2MΩ slider preset resistor from the boost line to chassis. This component reduces in value with little obvious effect on the focus and causes symptoms of reduced height and non-linearity which can be very baffling the first time they are met.

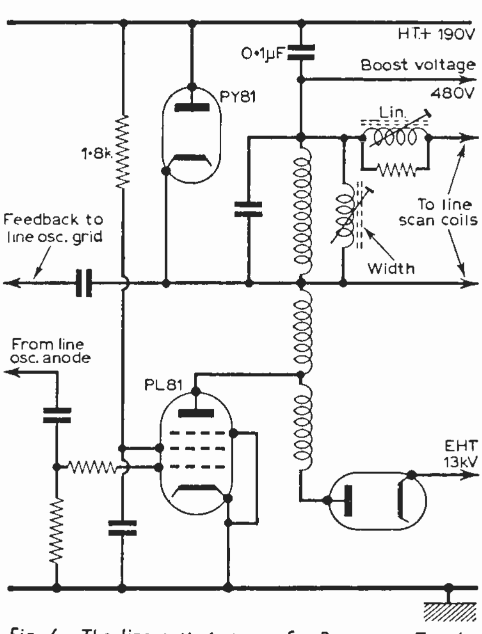


Fig. 6—The line output stage of a Regentone Ten-4.

Symptoms: reduced height with cramping at bottom

Although a low emission output valve is the most frequent cause of this fault, many times it is aggravated by a leaky cathode decoupling electrolytic (50μF in Fig. 5).

Symptoms: stretched picture with non-linearity

The exact form of this depends on the individual circuit but is often caused by an open-circuited feedback loop. The principal culprits are the vertical linearity control R and the capacitor C in Fig. 5.

Symptom: frame hold at end of travel

Where the frame hold is pre-biased, as in the circuit shown, a gradual change in potentiometer values, as can be caused by the 47kΩ resistor going "high", will cause a shift of the locking position and ultimately a frame lock that can only be obtained when height is reduced (i.e. greater voltage available at the hold control). A less frequent fault is the failure of the decoupling capacitor of this potentiometer chain, 8μF in Fig. 5.

LINE TIMEBASE

Symptom: gradual reduction of width

Line timebase faults are many and varied and depend very much upon individual circuitry, but there is one fault common to many circuits that is illustrated in Fig. 6. Although this is actually part of the Regentone Ten-4 circuit, similar configuration will be found in many other makes and models. Cause of the fault is overheating and eventual failure of the 1·8kΩ screen feed to the PL81. Always use a resistor of generous power rating here. The modern tendency is to increase the ohmic value of this part of the circuit and a 2kΩ 5W wire-wound component is a suitable replacement.

Symptoms: lack of width, lack of focus, possibly lack of frame

Reduction in boost voltage (480V in the circuit shown) can be caused by an open-circuited boost capacitor, the 0·1μF (often 0·25 or 0·5μF and in at least two popular models an 8μF electrolytic), and

—continued on page 511

PRINCIPLES AND PRACTICE OF COLOUR TELEVISION

CONTINUED FROM PAGE 459 OF THE JULY ISSUE

BY G. J. KING

LIGHT is electromagnetic radiation (like heat, radio and X-rays) with a waveband extending approximately from 0·00004 to 0·00007cm. The micron (μ) is the unit of wavelength universally adopted for optical work and colour television and it is equal to 1/1000mm, but is often reduced to "millimicrons" (mμ) where 600mμ, for example, are equal to 0·6μ.

The colour spectrum starts at red one end and finishes at violet at the other, but just before red becomes visible light it passes through the infra-red part of the spectrum, while violet at the other end fades away into the ultra-violet part of the spectrum. White light split into its component colours with corresponding wavelengths (not to scale) is shown in Fig. 10.

Fig. 11 reveals how the light spectrum as a whole fits into the electromagnetic spectrum. Note that infra-red gradually changes to heat while ultra-violet gradually changes to X-rays—first "soft" rays and then "hard" rays which have a deep penetration.

There is no definite demarcation between adjacent forms of radiation, and this also applies to colours. Here the merge into adjacent hues is imperceptible.

Colour is essentially a "sensation", which means that one can reason that there can be no colour without sight, as there can be no sound without hearing. People respond to colours differently. Some people are colour-blind, for example. This does not necessarily mean that these unfortunates cannot see colours, for in the majority of instances it simply means that the response or sensitivity of the eyes is lower than that of so-called "standard" eyes at one end of the spectrum; indeed, the sensitivity may be greater than the standard eye at some other part of the spectrum.

The response of the standard eye to colours is shown in Fig. 12. Now we must be careful here since this curve reveals the brightness (sometimes called luminosity) of colours that the eye *sees*. The eye, then, is something like a tuned circuit, with Fig. 12 the response curve. Looking at it this way, the tuning is set at about 550mμ (corresponding to a greenish colour—Fig. 10) and the response is such that the sensitivity tails off either side fairly evenly. Normally, of course, the sensitivity is zero at ultra-violet and infra-red, thereby making these radiations invisible.

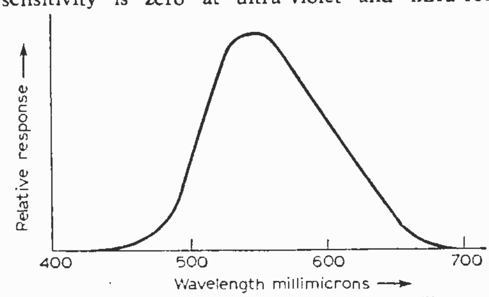


Fig. 12—Curve showing how a "standard" eye responds to different colours.

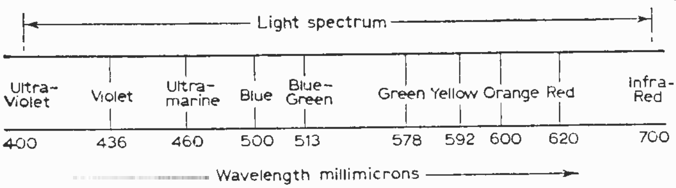


Fig. 10—The overall light spectrum from ultra-violet to infra-red.

The Lumen

The Lumen relates the response of the eye to the colour in terms of luminance. It is important to remember that it is not directly related to the output of a light source—that is, in terms of brightness. This can be better understood by considering the eye viewing two lights of different colour. Now, when these two lights *look* to the eye as though they are of equal brightness, then their lumen values are equal. Actually, it would be the standard eye on which the calculations of subjective brightness would be based. Under such a condition of balance, a check of the light output of the sources would reveal that these may be well off balance; indeed, one may be in the ultra-violet region and have quite a hefty output and yet have zero lumen value since it is invisible.

White light, it will be recalled, can be produced by adding the three primary colours. If we add the colours in terms of equal energy, then we get so-called "equal energy white light". At this stage it must be brought to mind that the overall luminance of the colour television picture is governed by the sum of the individual lumens of

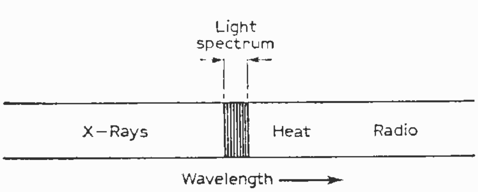


Fig. 11—Showing how the light spectrum of Fig. 10 fits into the electromagnetic spectrum as a whole.

the colour components. This means that green light contributes most towards the luminance of the picture, as is apparent from the curve at Fig. 12.

We shall see later that the compatible monochrome signal (Y') is representative of the overall luminance of the picture and is obtained by adding fractions of the red, green and blue signals. We would not, of course, end up with the correct monochrome representation simply by adding equal amounts of colour signals for the reasons already given above, bearing in mind that equal energy white light is obtained by the addition of equal light outputs and *not* equal lumen values. The fractions of colour signals thus used are related to the response in Fig. 12.

Brightness and Luminance: The difference between brightness and luminance should now be defined. Actually, the only real difference between the two terms is that brightness is somewhat relative. For example, a torch can look very dim during the day and yet very bright at night. Brightness and luminance both relate to intensity of light but luminance—which is used frequently in colour television literature—is an absolute measure.

A BASIC COLOUR TELEVISION SYSTEM

To display colour there must either be a monochrome picture tube with tricolour filters of some kind or a tricolour picture tube of some kind, such as the shadow mask variety, about which more will be said later. Similarly, to transmit colour pictures there must either be a monochrome camera system with colour filters or three separate camera tubes (or tricolour camera tube) and an optical system to channel the three primary component colours of the scene to the corresponding camera tubes (Fig. 13).

Each camera tube has a colour filter in front of it and each one gives a signal output corresponding to the colour-indexed image fed to it. The video signal resulting from each colour can thus modulate the carrier of a transmission system in exactly the same way as the monochrome signal modulates the carrier of a black-and-white television system. With three separate signals in colour to form ultimately the luminance of the picture, however, each colour signal would require almost as much bandwidth as a monochrome signal. Thus, on a 625-line system with a monochrome video bandwidth of, say, 5·5Mc/s, a colour system of the nature described would demand a theoretical bandwidth of about 16·5Mc/s. In practice pictures in good colour can be obtained with a bandwidth somewhat less than this, but for the simple type of colour system under discussion a bandwidth greater than that for comparable monochrome transmissions is essential.

This simple system is called the "simultaneous colour television system" because the three primary colour make-ups of the original scene are transmitted simultaneously. The main disadvantage of the system, of course, is that it is wasteful of bandwidth.

Simultaneous System

The basic elements of the simultaneous system are given in Fig. 13, which also reveals the general make-up of a colour television camera. It works in the following way.

Blue, green and red light reflected from the scene to be televised is picked up by the turret lens L1. On arrival at the "dichroic mirror" D1 the blue light is reflected by D1 while the green and red lights pass through it. A dichroic mirror has the property of being able to reflect a light of one colour while passing lights of other colours, and these are used extensively in colour television systems, mainly at the camera.

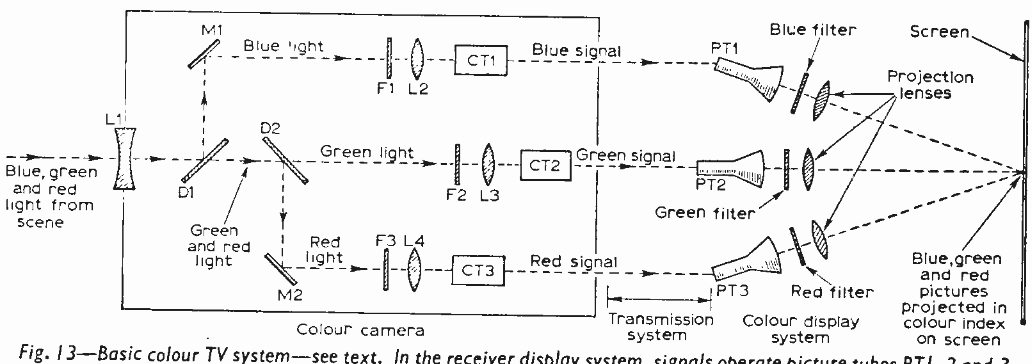


Fig. 13—Basic colour TV system—see text. In the receiver display system, signals operate picture tubes PT1, 2 and 3, while filters and lenses project the three primary-colour pictures on to a screen.

The blue light is bent by the silvered-surface mirror M1, passed through the correction filter F1 and lens F2 to give the blue make-up of the scene on the screen of camera tube CT1.

The green and red lights from D1 are split by the second dichroic mirror D2; the green passing through the mirror, correction filter F2 and lens L3 to give the green make-up of the scene on the screen of camera tube CT2.

The red light reflected by D2 is bent by mirror M2 and passed through the correction filter F3 and lens L4 to give the red make-up of the scene on the screen of camera tube CT3.

Thus it is seen that the original scene is simply split into its basic primary colours by the optical system in the camera. There are, of course, other ways of securing the optical requirements so that each camera tube records only one of the primary colours, but that shown in the camera section of

Fig. 13 has very much in common with current practice. A colour television camera, therefore, is designed to give output signals on three "channels" corresponding to the blue, green and red pictures.

In the camera there is nothing more involved than three monochrome camera tubes and an optical system to split the light of the image into its three primary colours. The video output of each camera tube looks just the same as monochrome video output obtained from the tube of a black-and-white camera, for each tube in the colour system is scanned in exactly the same way as a monochrome tube in a black-and-white camera. The colour camera, then, can be said to analyse each part of the scene to be televised both in terms of luminance and colour (chrominance) and to give three voltages corresponding to the amounts of blue, green and red required to be added to produce a colour rendering of the original scene.

Now, when white is transmitted each camera tube gives an output of a voltage such that will activate the display system at the receiver so that each colour has the correct luminance to produce the sensation of white light when all three are added. Owing to the response of the eye (Fig. 12) and to other shortcomings in the camera system and in the receiver, the voltages at the output of the camera need to be corrected, and means are available on the camera for adjusting the gain of each colour channel.

The blue, green and red voltages at the output of the camera are denoted E'_B, E'_G and E'_R respectively. The little dash at the top of the E (which stands for voltage) signifies that the voltages have been corrected.

Transmission system

Owing to the poor use of bandwidth, the simultaneous colour system is not used for over-the-air transmissions, but it may be used for closed-circuit systems where separate conductors can be used to convey the signals of each colour to the display device or receiver.

Over-the-air experiments have been carried out with the system, however, and it was found that reasonable colour reproduction is possible by reducing the bandwidth of the blue channel to about one-third of that of the green and red channels when each of these has a bandwidth equal to a monochrome channel. The overall bandwidth, including the sound channel and separation, still works out to something around 12Mc/s for a 405-line system.

Colour display system

Again, the colour display system depicted in Fig. 13 has been employed mainly in certain closed-circuit colour television applications. Thus, the colour signals are fed from the camera along separate cables to a monitor display unit, in which each signal produces a picture in its own appropriate colour. This is achieved either by the use of picture tubes whose light output is in colour or by the use of filters in front of ordinary monochrome tubes, as shown in Fig. 13.

Some optical method is adopted to superimpose the three pictures one upon the other so that the colours add (Fig. 1) and the viewer has the sensation of viewing a picture in full colour. A projection system is illustrated in Fig. 13 and it will be seen that lenses are used after colour filters to project the combined picture upon a screen. There are other ways of doing this but they are all somewhat of an electronic/optical compromise.

The biggest problem is in keeping the three pictures in perfect index over the entire area. To achieve this demands elaborate correction lenses to put right optical shortcomings, such as astigmatism and key-stone distortion, and an incredible degree of linearity correction on each picture, bearing in mind that while there may not be undue difficulty in securing registration at the centre of the picture, the edges are extremely vulnerable due to only a slight unbalance of the frame or line linearity of each picture colour separation.

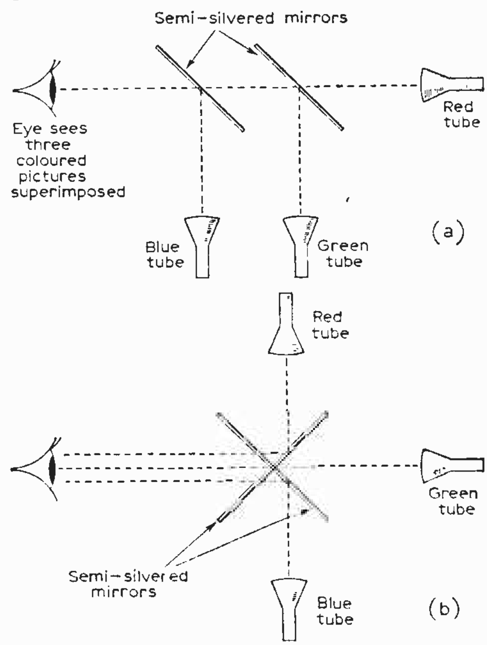


Fig. 14—Optical methods by which the three coloured pictures may be superimposed so that the eyes of the viewer see a single, fully-coloured picture.

Other ways by which the three coloured pictures may be superimposed so that the eyes of a viewer see a single, coloured picture are shown in Fig. 14. At (a) half-silvered parallel mirrors are employed, while at (b) the same principle is used but the mirrors are at right-angles. Unfortunately, these methods lose quite a lot of the light from the picture tubes and the resulting coloured display needs to be viewed in semi darkness.

Note that each display tube is scanned in the ordinary manner and that each has brightness control so that the luminance of each colour may be adjusted to suit the viewer and display tubes and optical arrangements.

SERIES TO BE CONTINUED

THE HENLOW wide-band OSCILLOSCOPE

A high quality instrument specially developed for television application

designed and described by

D. R. BOWMAN

Part Three

CONTINUED FROM PAGE 455 OF THE JULY ISSUE

PROPERLY speaking, the Y-amplifier comprises the valves V9, V10, V11 and V12 with their associated circuits. However, V8 also carries the Y signal, so it will be convenient to treat this whole series as one. Refer to Fig. 3.

In order to provide gain control the problem of resetting accuracy has to be solved. In this instrument continuously variable gain control has been avoided, partly because it is very difficult to make such a control independent of frequency, but chiefly to allow the use of a stepped attenuator whose resetting error can be nil.

The usual type of input attenuator is a frequency-compensated network consisting of a ladder of resistance and capacitances. Resistors can be selected from stock to high accuracy, or 1% tolerance components can be bought. The compensating capacitors however have to be adjusted, after the attenuator has been constructed, until the attenuator is independent of frequency. This can be a very patience consuming operation and may take several days of spare-time work. It was decided to use a simpler method.

Resistors of relatively high value—2kΩ and upwards—are increasingly frequency-dependent in value (the Boella effect), due most probably to inherent self-capacitance effects. Resistors of some 100Ω and below are increasingly frequency-dependent because of their self-inductance. In the range of about 100 to 2,000Ω the reactive effects are generally negligible up to around 50Mc/s at least, providing that good quality carbon composition resistors are used, without a spiral track. The problem of frequency-independent attenuators then resolves itself into a method of using this range of resistors to obtain the necessary attenuation, having regard to the fact that the impedance of a Y amplifier as a whole must be high and as non-reactive as possible.

Cathode-follower Input

This is accomplished by using a cathode follower input stage, followed by an earthed-grid pre-amplifier; the attenuator network is placed between these two valves—V8 and V9 in Fig. 3.

The valves V8 and V9 cannot be selected without careful consideration of various factors. They should ideally require the same bias and take the same anode current. In both, inter-electrode capacitances should be small, and the inductance of leads ought to be small also. Mutual conductance must be high, and anode current cannot be too small or the voltage output may be restricted unduly. In the case of V8 a triode can be used as the anode is earthed to alternating current. V9 might also be a triode, but a pentode has the advantage of having extra screening between cathode and anode because of the extra two grids. Consideration of these and other matters resulted in the choice of the type EC91 for V8 and the type EF91 for V9.

The cathode resistors of these valves have to be low in value to enable the required bandwidth to be obtained. The values are 175Ω and 180Ω respectively; the resistors should be selected to these values within 1%, and should be of adequate power rating and preferably of composition type.

Calculation of Attenuator Resistance

Fig. 7(a) shows the input circuit in simplified form, and it will be assumed that R1, R2, and R4 are small compared with the anode slope resistance of the associated valves. The method of calculating the values of attenuator resistance will be given, in case the constructor wishes to provide for attenuation ratios different from those used in the prototype oscilloscope.

Impedance at A-A, looking into R1, is 1/gm1 in parallel with R1..(1)

Impedance at B-B, looking into R2, is similarly 1/gm2 in parallel with R2..............................(2)

In (1) above, impedance Z1=70Ω (EC91)

In (2) above, impedance Z2=76Ω (EF91)

Because of an input signal at the grid of V8 a voltage is generated in the circuit formed by Z1, R3 and Z2 (see Fig. 7(b)). Let this voltage be E1. This causes a current I to flow in the circuit—note, this refers only to the a.c. flowing.

$$\text{Current in the circuit } I=\frac{E1}{Z1+Z2+R3}$$

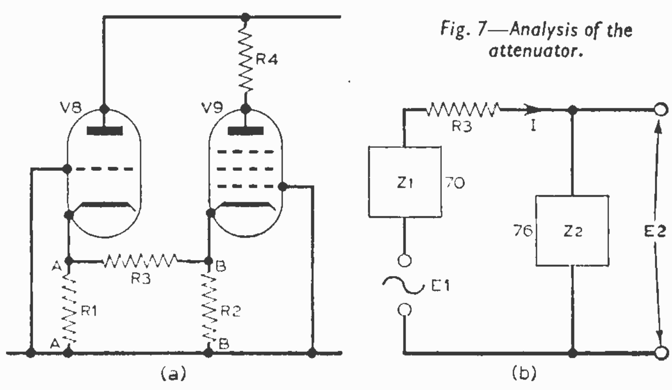


Fig. 7—Analysis of the attenuator.

The output voltage E2 in the figure is the quantity IZ2 (Ohm's law) and so

$$E2=\frac{Z2\ E1}{Z1+Z2+R3}$$

$$\text{Attenuation}=\frac{E2}{E1}=\frac{Z2}{Z1+Z2+R3}$$

If E2/E1 is replaced by 1/n (n being regarded as the number of "times" the signal is to be divided by)—the expression becomes

$$n=\frac{Z1+Z2+R3}{Z2}$$

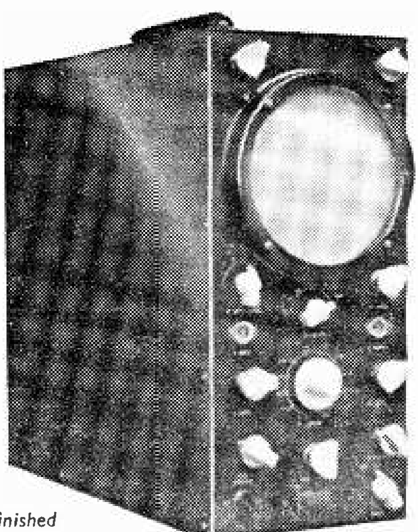
which simplifies readily to

$$R3=(n-1)\ Z2-Z1$$

R3 can now be computed for any degree of attenuation with any pair of cathode impedances desired.

Using the values of Z1 and Z2 already found, the following values of attenuation are found:

Attenuation	R3	Attenuation	R3
$\frac{1}{2}$	6Ω	$\frac{1}{16}$	1070Ω
$\frac{1}{4}$	158Ω	$\frac{1}{32}$	2286Ω
$\frac{1}{8}$	462Ω		



The finished oscilloscope.

To keep the actual values of resistance low in value, a series connection is adopted, and thus the actual resistors used in the attenuator are 6, 152, 304, 608 and 1216Ω. These, counting in series from the first, total to the required value at each step. It may be noted that all these resistors fall within the frequency-independent band mentioned above. Consequently with this simple switched attenuator no compensating capacitors are required.

It will be seen that the value of attenuation is not calculated for the ratio unity. The exercise is left to the reader, and the result is not surprising; for "nil" attenuation (n=1) the result shows that a *negative* resistance is required. A moment's consideration will show that the maximum transfer of energy form Z1 to Z2 is $\frac{1}{2}$, when impedances are equal. Thus an actual attenuation of $\frac{1}{2}$ is seen as "divide by 1", an attenuation of $\frac{1}{4}$ as "divide by 2", and so on. The latter are the values actually marked on the front panel of the instrument.

In practice the 6Ω resistor is included with the 152Ω resistor without appreciable loss of accuracy, and a direct connection used for the minimum attenuation position of the switch. Referring to Fig. 3 the values of resistors R34, R35, R36 and R37 are thus 158Ω, 304Ω, 608Ω and 1,216Ω respectively. These are quite close to the nominal preferred values of 150Ω, 330Ω, 600Ω (or 680Ω) and 1·2kΩ, and may be selected from stock. They should be of the miniature $\frac{1}{4}$W type, of carbon composition, and in soldering on to the switch S4 (in series) they should be stood away from the wafer by $\frac{1}{4}$in. leads. The leads to the attenuator should be as short as possible.

Maximum Input Voltage

When the attenuator is in its minimum attenuation position V8 and V9 act as a long-tailed pair and there is no current feedback. The maximum voltage to V8 grid without overloading is thus the grid base of the valve, namely about 1·5 to 2V. A full vertical scan of the cathode ray tube is however obtained with this voltage input, and so any larger input requires the attenuator to be switched to a higher position.

In the maximum attenuation position (÷16) the input voltage acceptable is about 6V peak-to-peak for undistorted vertical deflection, but higher input is permissible if only the positive peaks are to be observed. For greater than 6V input however it is better to use an external attenuator suitably compensated, or the valves V8 and V9 may be replaced by valves with a longer grid base. About 36V input could probably be accepted by a pair of EL90 pentodes, but at the cost of an extra 60 to 70mA of h.t. current—a not very economical proposition!

The valve V9, an EF91, with screen by-passed to earth is not acting as a pentode in this circuit but as a triode. It might be wondered why the EF91 is used rather than another EC91. The reason has already been mentioned, namely the need for the best possible screening between cathode and anode which the extra two earthed grids give. The main amplifier is connected to the anode of V9, and the smallest unwanted feedback could give rise to the most disastrous effects, either in phase distortion or downright instabilty.

Short Leads Vital

It is most important to ensure that the anode of V8 is by-passed to earth by the 16μF capacitor C25, and decoupled by R32, *right at the valve socket and by the shortest possible leads.* During development the oscilloscope was tested with square waves of very short rise time (about 50ns), and a most conspicuous "ringing" was observed, at a frequency of about 12Mc/s, at the beginning of each horizontal part of the trace.

This effect persisted even when pulses of much longer rise time were used, though the effect decreased with increase of rise time. Eventually it was found that the ringing was due to the leads to V8 anode being an inch or two in length, and relocating the decoupling components effected an immediate cure. A further practical point to be watched is that the input socket to the Y-amplifier cannot rely upon earthing through the front panel of the instrument. A stout braid lead must connect the "outer" of the coaxial socket to the chassis earthing point of the V8 cathode resistor, and an equally stout braid is used for the connection between the "inner" of the socket and V8 grid. Thus inductive effects are minimised. A suitable braid is the outer covering of ¼in. coaxial cable. Alternatively, a strip of copper foil ½in. wide might be used.

Problems of Wide-band Amplification

The necessary Y-amplifier bandwidth of 20Mc/s can be achieved well enough by the use of conventional amplifier techniques. So can the gain needed. However, when an output of some 80 to 100V is needed there are difficulties. A valve such as the 6CH6 with a small anode resistor would provide the necessary output, but at the expense of a large anode current. Also, in order to use a conventional amplifier of cascaded RC circuits the bandwidth of each would have to be increased because of the well known bandwidth narrowing effect. This would lead to the use either of compensated couplings, with the attendant problem of overshoot, or of further reduced anode load resistances which by decreasing gain would involve the requirement of extra stages of amplification—possibly with cathode follower stages between the main amplifier valves. Not only is a large number of valves needed but such difficulties as probable unwanted feedback have to be faced. By no means a small problem would be the dissipation of the extra heat developed.

The "Distributed" Amplifier

In order to provide a readily-constructed and "tame" amplifier of high gain and relative freedom from any tendency to instability it was decided to use a "distributed" amplifier. This type of amplifier has in addition the advantage that nearly all the h.t. current supplied contributes directly to the provision of output voltage for Y-deflection at the cathode ray tube, and the heat dissipation problem is much eased.

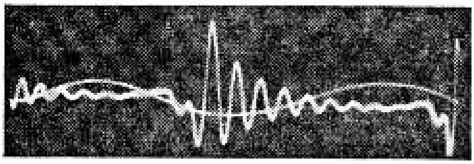


Fig. 8—Reflection of pulse in coaxial cable open-circuited at both ends.

The pre-amplifier V9, already referred to, has as its anode load a 910Ω resistor R38, and since this valve has to drive only a very limited capacitive load the bandwidth resulting is great. The gain is not about six, as might be expected from considerations of load and mutual conductance, since the cathode resistor is not by-passed—necessarily so, since the input voltage to V9 is developed across it. Actually the gain is approximately 3 for this stage and the anode load resistor could be increased except for the fact that it has to feed the grid line of the distributed amplifier, whose impedance is 910Ω. As will be seen, this stage causes no bandwidth limitations.

The distributed amplifier consists of three EF184 valves. Their mutual conductance is about 15mA/V and since they are effectively in parallel as regards gain the low frequency gain is about 100 with an anode load of 2·2kΩ. At high frequencies the gain is the same, of course, because although the valves are in parallel as regards gain they are not in parallel as regards inter-electrode and other capacitances.

The principles of the distributed amplifier were discussed in this journal in September 1960 (page 621), and design equations were given. For new readers the following account may be helpful.

Principles of Operation

Referring to Fig. 3, imagine a sudden change of voltage occurs at the anode of V9. This is impressed on the line of inductors L10, L11 and L12 with which are associated the grid-cathode capacitances of valves V10, V11 and V12. The impulse does not travel along this line with the speed of light but at a speed determined by the values of inductance and capacitance in the grid line. As the impulse passes each grid the valve generates a corresponding but larger impulse at its anode.

Consider the anode pulse at V10; this has two paths open to it, "left" and "right", and if the impedance of the anode line of inductors is the same as the anode load resistor half the pulse travels in each direction. The pulse going to the "left" is absorbed in the resistance R42, while the rest of the pulse begins to move to the right along the anode line of inductors L5, L6, L7 and L8. If these have been correctly proportioned with the anode capacitances the pulse will reach the anode of V11 just as the grid pulse arrives at the grid, and this process is repeated all down the line. The result is that the travelling pulse is augmented at each anode.

The process may be visualised as a pulse travelling along the anode line and receiving a good push as it passes each anode. Eventually it arrives at the cathode ray tube deflector plate, where it causes the appropriate deflection and is then *reflected back along the line*, travelling back to R42 where it is absorbed. R42 must match the anode line, or else the pulse will be reflected again and eventually reach the deflector plate once more—mixed up with subsequent pulses generated. This would cause very great interference with the proper functioning of the amplifier, as might be expected.

Line Termination

The valves are seen to be *not* in parallel, and their inter-electrode capacitances do not add up to reduce the bandwidth of the amplifier. They may be considered as being in "delayed parallel". Fig. 8 shows the way pulses are actually reflected back and forth along a piece of coaxial cable open-circuited at both ends, and this may underline the need for good matching between the anode line and the anode load resistor.

The pulse travelling down the grid line must *not* be reflected at all however, since if it were it would excite the grids in reverse order and cause spurious signals in the anode line.

To prevent reflection the grid line must be terminated in R46, the correct value of resistance, at its "far" end. The small inductors and capacitors L4, L9 and L13, TC1, TC2 and TC3 are added to the delay lines in order to provide that the terminating

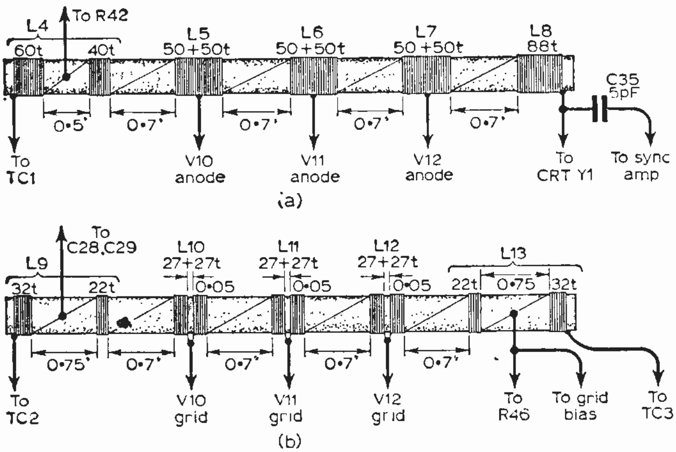


Fig. 9—Winding details of anode and grid lines.

resistors behave in a frequency-independent fashion at the higher frequencies covered by the amplifier.

Winding details for the anode and grid lines are given in Fig. 9, and these must be adhered to strictly if the best results are to be obtained. It should be noted that Fig. 3 shows the anode and grid lines diagrammatically only, and Fig. 9 must be consulted for details of winding and for connections.

Constructing the Delay Lines

The delay lines should be constructed so as to be self-supporting in the circuit. This may be done readily by using fairly heavy-gauge wire for the

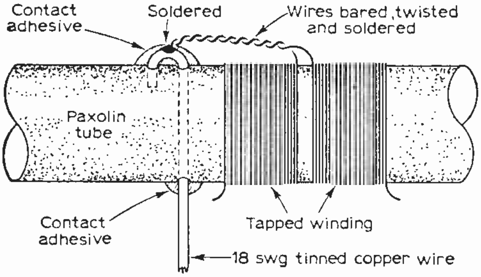


Fig. 10—Termination of the delay line winding.

tappings. The terminal is made by drilling a small hole through the paxolin tube near the end of the winding. A length of No. 18 gauge tinned copper wire is forced through the hole, emerging on the opposite side of the tube, the end is bent over through 180° and pushed into a further small hole drilled in the tube. The winding tapping is then soldered to the terminal and the joint is covered with a good blob of contact adhesive to make all firm. Fig. 10 shows this method of construction in detail.

The terminal wires are then cut all to the same length, about 1·5 to 2in. These leads can then be soldered direct to the tags of the valve sockets, leaving the delay line supported in the circuit a little over 1·5in. above the metal chassis.

The trimming capacitors TC1, TC2 and TC3 are of the Philips beehive type, 2—10pF, and are soldered on to tags fixed to the chassis at convenient points.

Associated Capacitors

It will be noted that C28 and C29 are in parallel, as also are C33 and C34. The reason for this arrangement is that at the higher frequencies the larger-value capacitors may have an inductive reactance. They are paralleled by the smaller mica or ceramic capacitors so as to provide proper coupling. If desired, a 10Ω resistor may be added in series with the larger capacitor; this is only necessary if because of the physical characteristics of the larger capacitor there is any tendency for the paralleled capacitors to behave as a tuned circuit and to resonate at or near some frequency in the pass-band of the amplifier. If this happens it will be shown up as "ringing" on fast pulses or as a kink in the response curve of the amplifier. C25 should be of the smallest physical size practicable in any case, to minimise external capacitance to earth. In the prototype it was not found necessary to include these small resistors, but it will do no harm to include them and may be advisable. Fig. 11 shows the connections.

In order to make the coupling between the distributed amplifier and the pre-amplifier independent of frequency the values of C28 and C33 should be matched as accurately as possible, preferably to 1%; the same applies to C29 and C34.

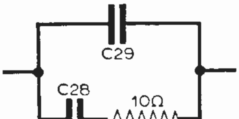


Fig. 11—Additional C and R to eliminate resonance in coupling capacitor.

The screen decoupling capacitors C26, C27, C30 and C32 must be wired as closely as possible to the valveholders, with the shortest possible leads. In addition, if the length of h.t. lead between the power supply and the amplifier exceeds a few inches an additional 16μF capacitor should be used to decouple the amplifier, and should be placed as close as possible to the tag-strip carrying the service.

The grid bias supply for the distributed amplifier is obtained from the 6·3V heater supply as shown in Fig. 4. This d.c. supply is rectified by D1 and smoothed by C36, C37 and VR6. The potentiometer VR6 may be of wire-wound television type. The value of R48 is fairly critical for the proper functioning of the amplifier over long periods of continuous use. R47 limits diode current on first switching on, and must not be omitted. Note: The polarity of D1 in Fig. 4 is incorrect, and the symbol should be reversed.

The next article will deal with the mechanical construction and arrangement of components.

CONTINUED NEXT MONTH

DX TELEVISION

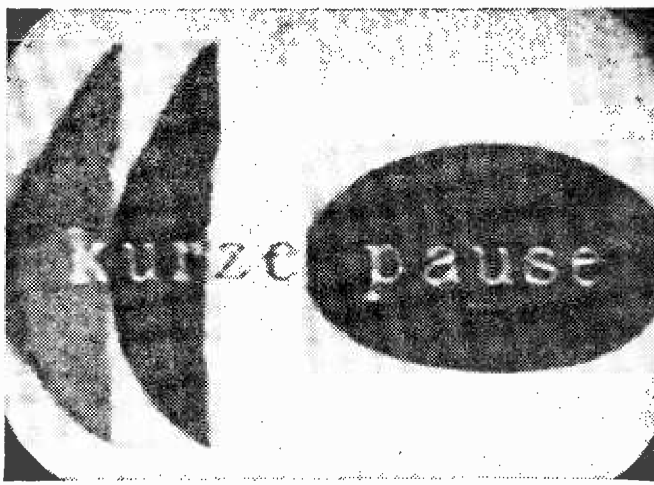
Further information on the reception of long distance 625-line TV transmissions is provided in this article. The author, who is a professional service engineer, and a colleague have both received transmissions from over one thousand miles using ordinary 405-line sets and dipole aerials.

BY J. HURRY

THERE are quite a few different systems and line standards in use on the Continent. The Western European TV stations use the 625 CCIR standard while the Eastern European stations use the 625 OIR standard. Both of these have negative modulation with f.m. sound.

Belgium, on the other hand, has 625-line transmissions with positive modulation and a.m. sound. They also have 819-line transmissions along with France. This system uses positive modulation and a.m. sound. Last but not least comes Britain with 405-line positive modulation and a.m. sound. About the only thing that is common to all systems is the field (frame) timebase frequency, which is 50c/s.

During the actual reception of a 625 signal it has been found that there is a slight difference in the shape of the sync pulses, and this requires a different line hold setting for CCIR and OIR stations.



This photograph is of a West German TV "interval" card.

Weather and Sunspots

There is no doubt that weather plays a large part in the setting up of the right conditions for long-distance reception, but the biggest factor appears to be sunspots.

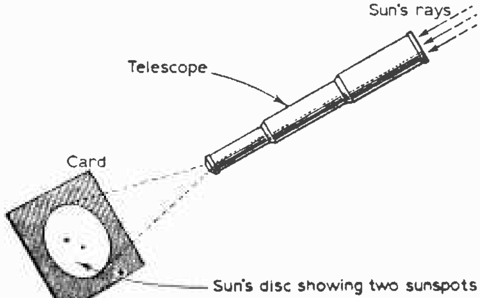


Fig. 1—The correct method of observing the surface of the sun.

It is quite easy to find out if there are any sunspots by the use of a telescope (see Fig. 1). BUT REMEMBER, NEVER LOOK DIRECTLY AT THE SUN. The image should be projected on to a card or white wall.

If there are sunspots they will appear as black dots or marks on the sun's disc when the telescope is focused.

It is now quite easy to predict within five or six hours when reception can be expected. A combination of sunspots and high pressure makes reception almost 100% certain. This is borne out by the fact that during the winter when the earth's north pole swings on its axis away from the sun there is no reception. In the summer, of course, the north pole moves over to the sun and the long-distance reception is restored. Even low pressure and heavy rain has been found to be no drawback to receiving Russia, etc., when there have been some large sunspots.

When we first tried out a set on negative modulation the Spanish test card was received, but the timebase was running at 7·5kc/s or half the line frequency, which is, of course, 15kc/s. The set was a 12in. Ferguson which was eventually made to run at 15kc/s. Other sets we have used include a Pye 14in., K.B. 14in., Defiant 17in. and also a number of 21in. sets. I am now regularly using a Marconi VT68DA.

Requirements

The requirements for a TV set for D.X. use are that it should be able to tune over the whole of Band I and have a switch fitted to give three positions as follows: 405 positive, 625 negative and 625 negative (see Fig. 3).

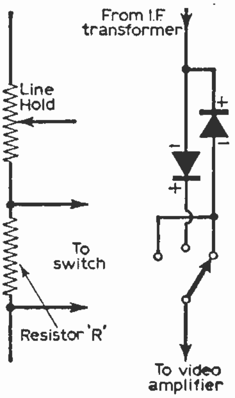


Fig. 2 (left)—The line hold circuit modification.

Fig. 3 (right)—The circuit of the diode switching.

The Switch

The switch is an ordinary Yaxley type which can be obtained from any radio dealer. The wiring from the diodes should be as short as possible, otherwise the set will be very unstable and the gain will fall off as well. The extra diode is for use on 625 negative so that the correct polarity of pulses are fed to the video amplifier, sync separator, tube, etc. The most suitable value for resistor R in Fig. 2 is found by experimenting with values near 20kΩ. This resistor is inserted in series with the original line hold control. When the switch is in the 405 position R is shorted but is brought into circuit when switched to 625. The length of the wiring to the line hold is not critical.

Aerials

For all-round (non-directive) reception a vertical dipole for channels 3 or 2 mounted as high as possible is best, but an X or H type aerial serves almost as well. A simple wire aerial slung over a picture rail has been used to receive Spain and West Germany. The best arrangement, of course, would be a multi-element array with a motor to turn it, but this is not very practical in an ordinary dwelling house.

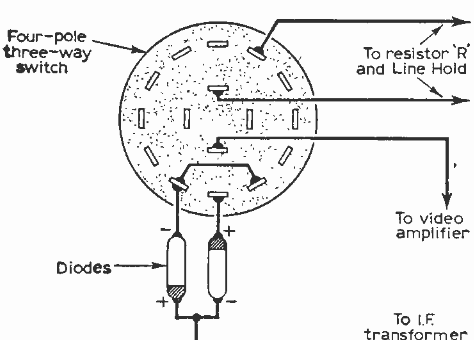


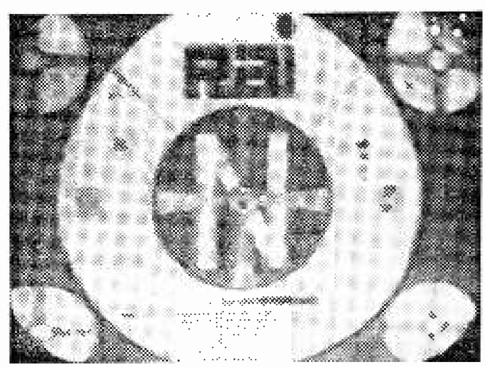
Fig. 4—The switch wiring.

Photographs

It is quite easy to take photographs from the TV set by using a high-speed film and a developer that gives the maximum speed from the film. The camera used by the author was a Voigtlander Vito B set at 1/30sec at *f*2·8 with H.P.3 film, which is rated at 400 A.S.A.

The photographs have been examined by officials of Scottish Television, and the Swiss TV station at Bantiger have sent a letter to verify that the negatives sent to them were of their test card.

The author took this photograph while receiving Spain.



The test card of Italian television.

Log Book

A log book should be kept to record the stations received, weather, time and if any sunspots were showing. Some of the stations we have received include Denmark, Estonia, Spain, West and East Germany, Hungary, Italy, Holland and Belgium on Bands I and III.

This Year

This coming summer we are hoping to get some more information on the cause of interference which is shown on some of the photographs and also the question of being able to predict exactly when to expect "The Foreigners". ■

For notes on telescopes see *Observer's Book of Astronomy,* page 151.

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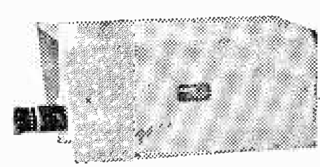

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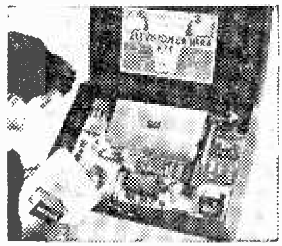

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SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 92: FERGUSON 406T, H.M.V. 1870, MARCONIPHONE VT157

THE Ferguson 406T, the H.M.V. 1870 and the Marconiphone VT157 all are 17in. table models. The 21in. versions are the Ferguson 408T, H.M.V. 1874 and the Marconi VT160.

An identical chassis is incorporated in all these models, the picture tubes used being the Mullard AW43-80 (17in.) and AW53-80 (21in.). These tubes are electrostatically focused and have the closed loop sleeve on the tube neck under the scanning coils for linearity adjustment.

Further associated models using the same basic circuit but incorporating v.h.f.-f.m. radio facilities are the Ferguson 436T (table model) with the 17in. tube, 416T the console version, 438T being a 21in. table model, equivalent H.M.V. receivers are the 1872 and 1876, the Marconiphone VT159 completing the group.

Metrosil Elements

The design uses two metrosil elements, Z1 and Z2. Z1 is the e.h.t. metrosil and is located on the lower front part of the chassis and is normally out of sight. The purpose of this component is to present a constant load to the EY86; its resistance falls as the voltage rises, and thus presents more of a load, causing the voltage to fall to its original level. As the e.h.t. voltage falls (due to an overall increase in brilliance) its resistance rises and the load is eased. Z1 is a long tubular element connected at one end to the e.h.t. supply and at the other via a 100kΩ resistor R132 to chassis. The purpose of this arrangement is to allow a meter (AVO 8 10V range) to be connected across R132, the clip on the metrosil then being adjusted for a reading of 7V on the meter with the brilliance adjusted so that a raster is just faded out.

The presence of this metrosil is not absolutely essential to the working of the receiver.

The second metrosil Z2 is connected across the frame output transformer primary and has a similar compensating effect, the element being much smaller in this case as the voltage is much less.

Common Faults

These receivers have the usual crop of recurring faults (not on the same receiver of course) some of which are obvious and present no problem as far as diagnosis is concerned, some more obscure but once encountered are easily remembered.

The most common "easy" fault is due to deterioration of the PY32 h.t. rectifier. This gives rise to the complaint of weak sound and no picture for an increasingly prolonged period until the

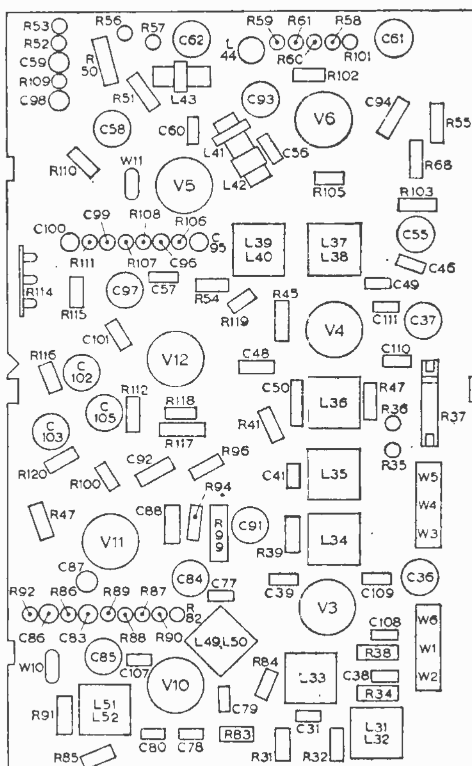

Fig. 1—The receiver unit showing the location of components.

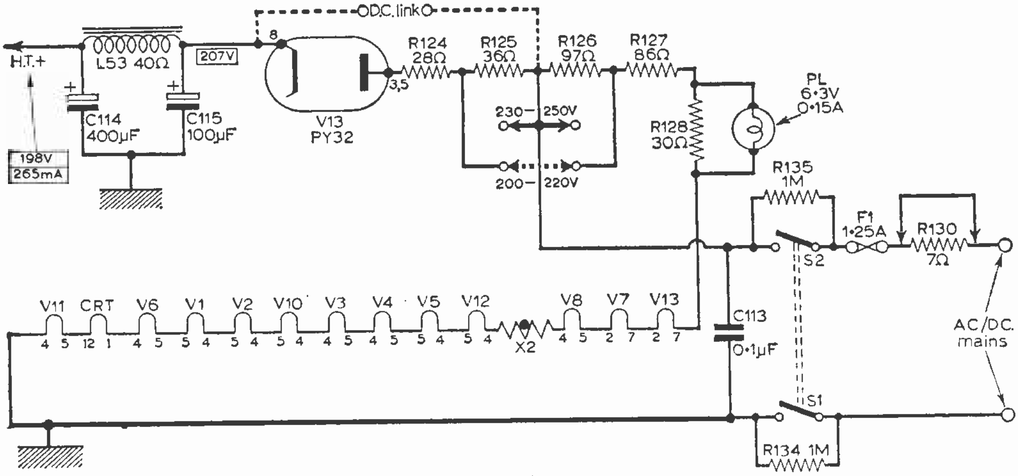

Fig. 2—The mains input and power supplies circuit.

picture may take half an hour or more to appear, then appearing small and defocused. In most cases a bluish haze will be seen in the PY32 during this warming-up period. These symptoms do not always present themselves however and the only indication of loss of emission may be lack of width and some cramping at the bottom, the warming-up period not being unduly long. A meter check is of course the best and most reliable check and generally the h.t. output as pin 8 of the PY32 should not be much below 200V.

The newer type PY33 will generally be used for replacement and is a superior valve in all respects, no modifications are entailed in its use although the h.t. line voltage will be a little higher than those specified on the circuit diagram as there is less voltage drop across this valve.

Dropper Connections

Another extremely common fault is that of no signals with no valve heaters glowing.

Sometimes a tap on the cabinet will bring on the pilot lamp and the receiver will then function for a short time. This should direct attention to R124-127 which is the large dropper on the left side.

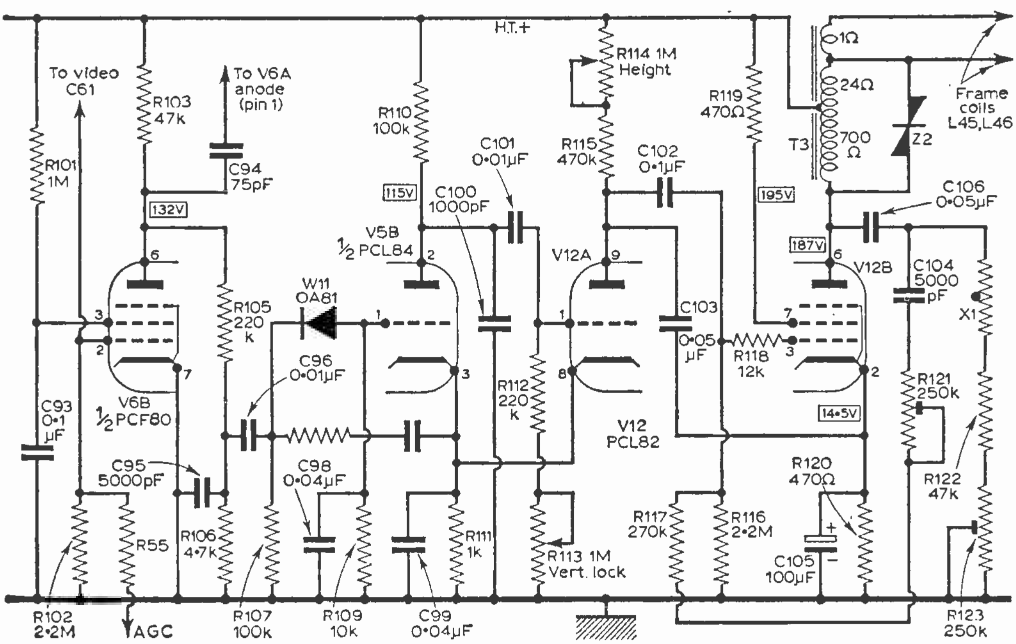

Fig. 3—Sync separator and frame timebase circuits.

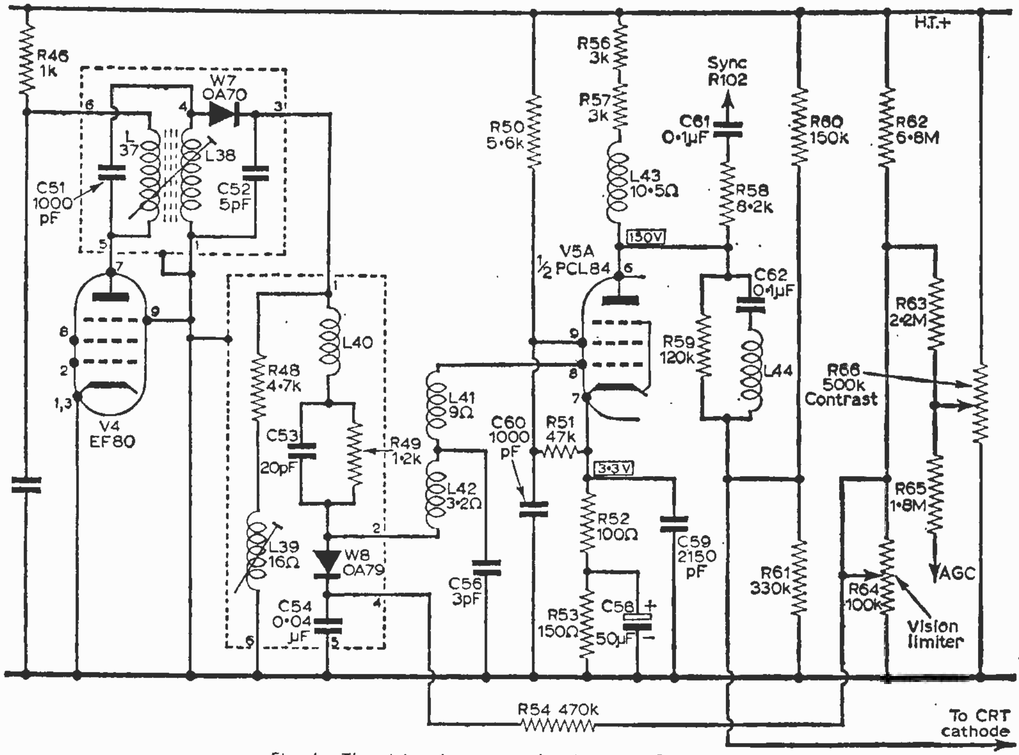

Fig. 4—The vision detector and vision amplifier stages.

There are five contacts from this component which go through the panel. These are soldered to the printed tracks on the reverse side, these tracks completing the circuit to the mains voltage selector, the PY32 and R128.

In a large number of cases close inspection will reveal that the pegs of the dropper are not making proper contact with the printed panel due to the heat having caused the solder to deteriorate.

Quite often it is not satisfactory to resolder these contacts and a more reliable method of repair is to clean the peg ends, tin them properly, tightly wrap a lead round and solder, and then take this lead to the voltage selector or R128 whichever is necessary.

A fault of this nature need not put out the pilot lamp and valve heaters, but will render the set inoperative if the contact from R124 to the PY32 anodes is upset. Again the answer is to insert a jumper lead from the top peg to pin 3 or 5 of the PY32 base.

Video Chokes

An inspection of the circuit of the video amplifier will show a choke, single wound, L43 in the anode circuit of the V5 video amplifier; also a double wound choke L41—L42 in the control grid circuit.

These chokes have proved troublesome due to (mostly) the ends not being properly soldered when they were first made. Sometimes they do go completely open circuit due to a break in the winding but usually it is the ends which are at fault.

The symptoms produced by this sort of trouble can be misleading when encountered for the first time. It may be thought that an open-circuited choke in the anode of the video amplifier would produce the symptom of uncontrollable brilliance, but this is not so as the cathode in this case is held constant from a d.c. point of view by R60 and R61.

The symptoms which are produced are a weak, negative, streaky modulation which cannot be held by the hold controls due to the almost complete lack of sync pulses. When these symptoms are presented a voltage check at R56—R57 and L43 will immediately reveal the trouble and in some cases the application of the probe will temporarily cause the choke to complete itself and a normal picture will result. The voltage at one end of L43 should be the same as that at the other as its proper d.c. resistance should only be 10·5Ω.

If the choke is intact and the video stage is functioning properly a voltage of about 150V should be recorded. If the choke is troublesome, remove it and resolder the ends. If this is not effective fit another choke and put a jumper lead across the ends until it can be obtained in order to keep the set functioning.

The grid chokes L41 and L42 present a different problem and set of symptoms since these complete the d.c. path of the control grid via R49, L40, R48 and L39 to chassis. Thus an open-circuited choke here leaves the control grid floating, resulting in

—continued on page 524

COMPACT GR

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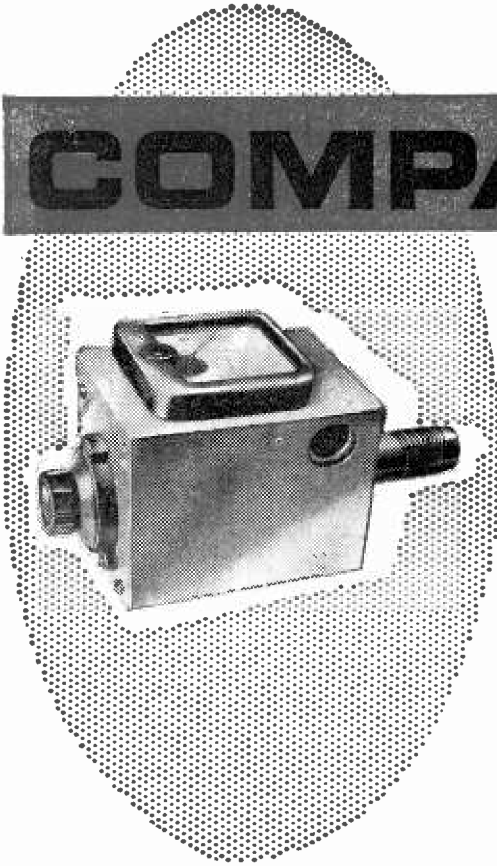


PERHAPS one of the most useful items of test apparatus which the amateur experimenter can acquire is a grid dip meter. This instrument has the facility of providing an indication when it is introduced in close proximity to any components that can form a tuned circuit, be it a conventional inductance/capacitive unit or a piece of metal resonant at a specific frequency.

The instrument is fundamentally an oscillator tuned to a position where the grid current shown on the instrument meter reduces to a minimum when the external " load " absorbs maximum power, i.e. both circuits are " in tune ".

The Circuit

The circuit is shown in Fig. 1 and consists of a Colpitts oscillator followed by an amplifier. This circuit will produce a reading on the meter when tuned to resonance of between 3 and 5mA.

The choice of meter is not critical but should be between 100μA and 3mA full-scale deflection in order to give a reasonable indication. As the meter is used only for indicating purposes no accurate calibration of the scale is considered necessary; there is, in fact, considerable latitude of adjustment possible by means of the potentiometers.

The meter used in the author's instrument has a 100μA f.s.d. and an internal resistance of 100Ω, but it must be realised that the more sensitive meter used the more critical is the balancing point of the " backing-off " potentiometer, but the indication is much more definite on a sensitive meter.

The tuning circuit uses two-pin plug-in coils in order to simplify construction, the coil being tuned by a 100pF x 100pF split-stator capacitor VC1, VC2. The moving vanes are at earth potential.

The choice of capacitor is not critical, a 50 x 50 or 75 x 75pF variable may be used, but it should be realised that whilst the maximum frequency to which the instrument will tune may be extended with a smaller capacitor there is not much coverage per coil and more coils will be needed to cover the whole range. It may also mean that there is considerable overlap of the frequencies covered by each coil.

An h.t. blocking capacitor C1 is connected between the anode of the first section of the double triode (V1a) and the tuned circuit, the signal being applied across R2 and VR1 via the capacitor C2.

VR1 controls the sensitivity of the circuit and the signal applied to the grid of V1b, the capacitor C3 providing decoupling. VR2 and R6 form a potential divider to provide the " backing-off " voltage on the meter.

Separate Power Supply

A power supply with a valve rectifier is recommended; this allows the valve in the unit to heat up in about the same time as that in the power unit. This will prevent the meter needle going hard over on the stop when first switching on, which would occur if a metal rectifier is used.

The power is applied to the instrument via a flexible three-wire cable terminating in a three-pin plug similar to those used for battery h.t. connections. The supply should be 200V h.t. (in order to give satisfactory oscillator operation at the higher frequencies) and 6·3V a.c. for the valve heater.

Construction

Cutting and drilling details of all the metal parts are given in Fig. 2.

The cover should be constructed first and the slots and holes cut and drilled before it is bent up and riveted. If countersunk rivets are used the rivet holes should be very slightly countersunk so that the rivets may be filed flat with a fine file after assembly.

Cut out and drill the front panel before making the two bends. The foldover on either side of the front panel should slide into the cover with $\frac{1}{16}$in. clearance at each side.

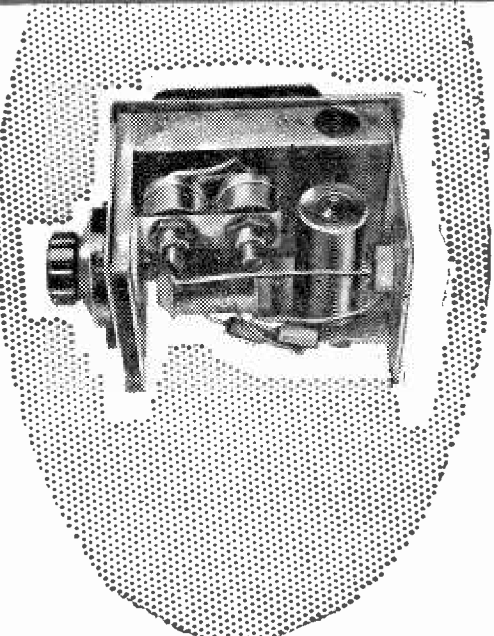
Cut out the main chassis and drill. The cut-out in the top of the chassis is designed to accommodate the moulded terminal block of the meter. Fold down the four sides.

Make up the rear panel and assemble this and the front panel to the chassis by four bolts. Check that the complete panel and chassis assembly slides

D DIP METER

MENT COVERING 2-400Mc/s

—By A. W. HARTLEY



easily into the cover. It may be necessary to slightly trim the front and back panel to ensure a good fit. Make the large circular cut-out on the meter panel and the smaller hole for the lamp indicator.

Bend up the ends of the panel so that it is a tight fit on the open end of the cover assembly. Do not drill the four fixing holes at this stage.

Make up the valve mounting bracket and assemble the B7G holder with a 6B.A. solder tag under the securing nuts. Mount the five-pin tag board in the position indicated. Do not mount the assembly on to the chassis at this stage.

Bend up the potentiometer mounting bracket and assemble the two potentiometers but do not mount on front panel. Assemble the power input socket, securing with two 6B.A. screws and nuts, with a solder tag under the securing furthest from the rear panel.

Mount the fuseholder on the chassis by the 6B.A. screw and nut, ensuring that the locating pips fall into the appropriate holes.

Assemble the variable capacitor to the front panel and the B7G valveholder to the rear panel, ensuring that pins 1 and 3 will be uppermost.

Mount the meter on the meter panel, securing with four nuts and washers. The meter should be the correct way up when viewed from the dial end. It may be necessary to shorten the fixing stud adjacent to the power plug if there is any danger of this fouling the tags.

Insert the G.P.O. lamp lens in the hole—it should be a tight fit—and cut off any surplus protruding to the underside with a small hacksaw. This lens may eventually be secured in position with Araldite or similar adhesive.

Wiring

The valve bracket may now be wired up.

Secure the valve bracket to the chassis with 6B.A. screws and pass the six wires from the tag strip along the edge of the chassis and through the hole just behind the front panel.

Connect up the two potentiometers as shown with R6 connected between the centre of VR1 (indicated by dimple in case) to earthy end of VR2. The wires from these potentiometers pass to the underside of the chassis via a second hole located behind the front panel.

Connect up the two ends of the fuseholder as shown to the l.t. terminals of the power plug.

Wire up connections to potentiometer, ensuring that sufficient length of wire is left to enable the bracket to be correctly assembled. Fix the bracket to the front panel.

Enough wire should also be left for the two meter leads which are terminated in 4B.A. solder tags.

Dress the wires in the cableform neatly and tie at intervals with strong cotton or nylon binding tape.

Now connect the two capacitors C1 and C2 to the fixed vanes of the variable; C1 connects from the rear tag of the fixed vanes to pin 2 of the valveholder and C2 is connected between the front of the capacitor and pin 5.

With two pieces of 18s.w.g. tinned copper wire connect C2/VC2 tag to pin 1 on the coilholder and VC1/C1 to pin 3.

This completes the wiring of the instrument.

Assembly

Place the festoon lamp in the fuse clip.

In order to concentrate the light into the lamp lens and avoid it shining through the edges where the top panel mates with the cover a small sleeve of insulating material may be slid over the lamp.

Lay the meter panel on the underside of the chassis so that the terminal block on the meter panel projects through the cut-out slot in the chassis. Connect up the two wires terminated in the solder tags to the meter terminals, observing correct polarity.

Fit the valve (ECC91) and the screening can.

Slide the chassis into the cover so that the panel fits on the open end. This should fit tightly down on to the cover. Spot drill four holes (two at front and two at back) for securing the meter panel turnover to the cover. The hole in the panel turnover should be slightly larger diameter than that in the cover to accommodate round-head P.K. screws. The front plate, which serves to conceal the slot accommodating the capacitor shaft, is spot drilled and secured to the cover by four P.K. screws. The rear plate is secured in the same manner.

Any good miniature tuning dials may be used. There are some good drives such as the T501 (Relda Radio) which are suitable. The drive may be bolted on the front plate by two bolts when the unit is finally assembled.

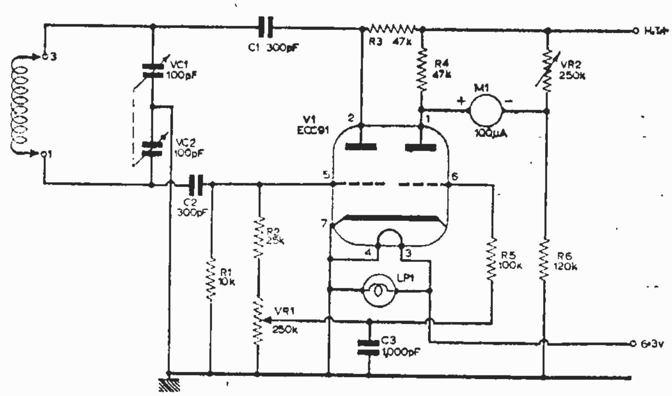


Fig. 1—The Circuit.

Tuning Coils

All the tuning coils with the exception of L6, L7 are wound on ¾in. paxolin tube. The bases of the coils are the protective caps found on B7G valves for preventing damage to the pins. The coil connecting pins are small brass nails of similar diameter to those on the valve. Four pins are used; only two are required for connection, the other two serve as guide pins.

COMPONENTS LIST

Resistors:

R1 10kΩ R4 47kΩ
R2 25kΩ R5 100kΩ
R3 47kΩ R6 120kΩ
All ±10% $^1/_{10}$W (Morganite XL)
VR1, 2 250kΩ preset potentiometer, screwdriver slot (Morganite type BJ or Painton type RVL)

Capacitors:

C1 300pF ceramic (Erie Type K)
C2 300pF ceramic (Erie Type K)
C3 1,000pF (Erie K1700AD 20% 500V)
VC1, 2 100 x 100pF miniature split stator variable

Other Circuit Components:

L1–7 See text and Fig. 4.
LP1 Festoon lamp 6·3V (Mazda)
M1 Moving coil meter, 100µA f.s.d. 100Ω 2½in. square (Turner)
V1 ECC91, 6J6G or CV858

Miscellaneous:

Two B7G valveholders, one with skirt and screening can. Fuseholder (Belling Lee 510). Tag strip, 5-pin. Battery connector 3-pin (Cinch plug 2735; socket 75/443 shell 2710). Lens top from G.P.O. clamp fitting. Slow motion dial 2½in. (Relda Radio type T501). Six coil formers, Tufnol or Paxolin ¾in. dia. x 1¾in. long. Six B7G valve protectors. Flat hard copper strip 6in. x ½in. x $\frac{1}{32}$in. thick. Two Perspex or polystyrene strips 1½in. x ⅜in. x ⅜in. Material for chassis and cover (see Fig. 2). Wire, 6 and 8 B.A. nuts and bolts, P.K. (self-tapping) screws, solder tags.

Pins 1 and 3 are wired, pins 5 and 7 are guide pins.

Wind the coils as per instructions given in Fig. 4 and Table 1, leaving sufficient length of wire at start and finish to push through the holes in the former and pass down the inside, projecting about 1in. at the bottom.

Clean off the wires and loop round the head of the brass pin so that the head is level with the end of the coil (see illustration). Solder the wires.

Prepare the coil bases by assembling brass pins to the positions 5 and 7 will occupy, ensuring that the head of the pin rests in the countersunk holes of

TABLE 1: COIL WINDING DETAILS

(see Fig. 4, page 508)

L1	2—5Mc/s:	83¾t.	34s.w.g. en.	(105µH)
L2	5—10Mc/s:	37¾t.	28s.w.g. en.	(22µH)
L3	10—22Mc/s:	18¾t.	20s.w.g. en.	(6µH)
L4	22—45Mc/s:	7¾t.	18s.w.g. en.	(2µH)
L5	45—100Mc/s:	2¼t.	18s.w.g. en.	(<1µH)
	(L1—L5 close wound)			
L6	100—250Mc/s		L7 220—400Mc/s	

the protective base. Bind thin, tinned copper wire close up to where the pin projects through the insulated base and secure with a spot of solder.

Now pass the two pins which are connected to the coil through the insulated base so that there is now a blank position between each pin. Lock the pins into position in the same manner as previously and secure the base to the body of the coil with adhesive. On the outside of the former mark the start and finish of the winding to assist in ease of location into the coilholder.

For L6 coil cut a piece of polystyrene or high-grade Perspex as shown in Fig. 4, drilling the two fixing holes as shown. The stiff wire used for making the connecting pins is passed through two holes in the insulating base and made off to solder tags under the bolts securing the copper strip. Bind the lower ends of the pins with tinned copper wire and solder.

Coil L7 is made in a similar manner.

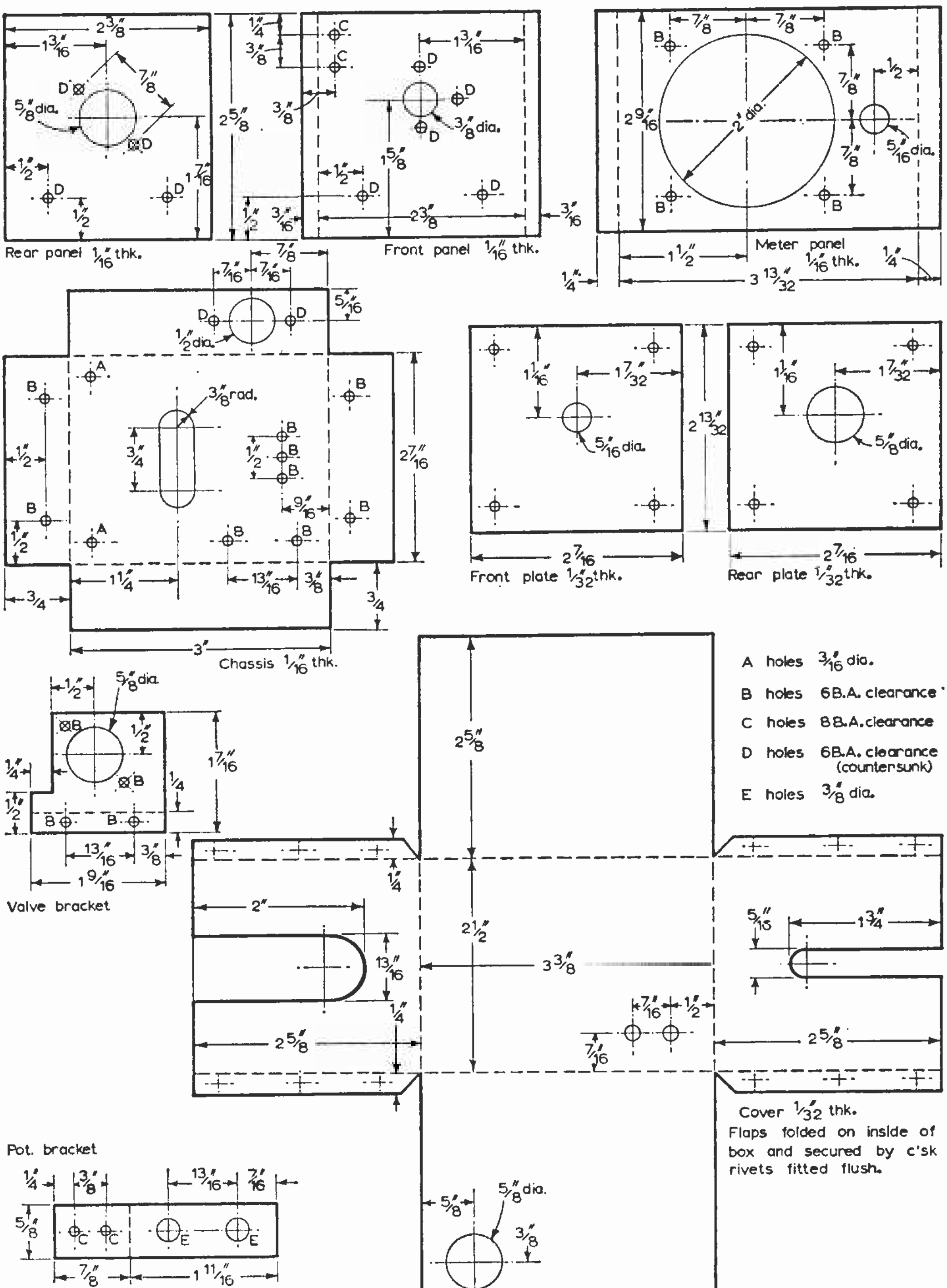


Fig. 2—The complete details of the chassis and case component parts.

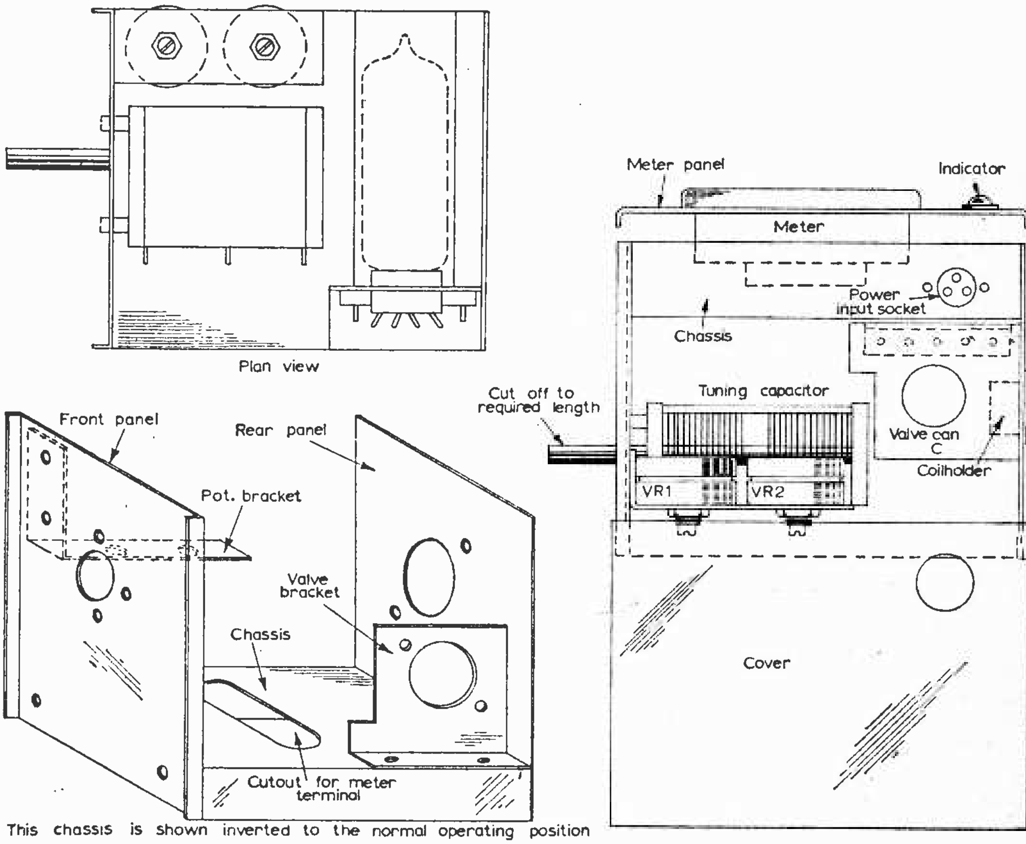


Fig. 3—Three views showing the assembly of the instrument.

Calibration

Calibration may be carried out with the aid of one of the following: (1) A communications receiver, (2) an absorption wavemeter or (3) another grip dip meter.

Set the potentiometer VR2 for approximately three-quarter scale reading when first switching on.

Fit appropriate coil and set VR1 for good indication at frequency to be measured.

If a communications receiver is used the coil of the grid dip meter is then introduced into the vicinity of the aerial tuning circuit of the receiver. Care must be exercised to avoid picking up a false reading on the oscillator of the receiver.

The limiting point will be heard in the receiver and indicated by a resonance dip on the instrument meter. The tuning dip can then be read off on the receiver dial. A similar procedure is carried out with the absorption wavemeter, and once the range of the coil has been determined the various tuning points may be plotted and a graph drawn showing frequency against dial readings.

If another grid dip meter is used it is only necessary to have one of them switched on—preferably the instrument being calibrated. ■

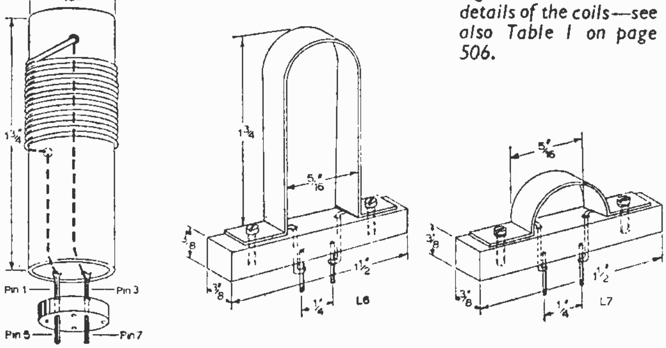


Fig. 4—Constructional details of the coils—see also Table 1 on page 506.

TOWARDS 625

A Guide to TV Conversion

PART TWO OF A SERIES DESCRIBING THE CONVERSION OF VINTAGE 405-LINE SETS TO RECEIVE 625-LINE PROGRAMMES

CONTINUED FROM PAGE 440 OF THE JULY ISSUE

by D. ELLIOTT

THIS month we shall consider modifications to the vision detector, video amplifier and sync separator stages. In Fig. 6 is shown the vision detector, vision noise limiter and video amplifier stages of our "typical" experimental receiver.

It is understood, of course, that not all receivers chosen for this experiment will have circuits identical to those of Fig. 1 (see Part One—July issue) and Fig. 6, but the basic set-up will be very similar and there should be no undue difficulty in establishing the circuit sections to be modified. In all cases, the modified circuits should conform to those of Fig. 4 (Part One) and Fig. 7.

Now, on the 625-line system the negative picture modulation means that bursts of impulsive interference—such as generated by car ignition systems, etc.—create black or grey spots on the picture, for which reason a vision interference limiter circuit is not required. Thus, that section of Fig. 6 is deleted in Fig. 7.

Owing to the opposite vision signal modulation polarity, the detector circuit also needs to be slightly modified, and it was found that the best way of doing this is by the use of a germanium crystal diode—thereby getting rid of V6 stage altogether.

HEATER CHAIN BALANCE

To keep things neat in the experimental chassis, it is best to take out V6 valveholder and remove all the redundant wiring associated with the old circuits. At this stage, however, it must be stressed that the experimental receiver will almost certainly be of the a.c.-d.c. type, where a mains dropping resistor is used in conjunction with series-connected valve heaters, instead of a mains transformer. This means that when a valve is removed continuity must be maintained through the remaining heaters. This is accomplished either by shorting the wires which were connected across the heater tags of the now unwanted valve and then adjusting the heater ballast resistor accordingly (usually by stepping the mains tapping to the next highest point) or by introducing a resistor to take the place of the missing heater. In the case of a 6·3V 0·3A heater (such as in an EF80 and EB91) the equivalent resistance is 21Ω. To avoid excessive overheating a 5W component is desirable, and a suitable 21Ω, 5W wire-wound component is available from Radiospares Limited (via a dealer).

DIODE POLARITY

Another point to note is that the experimental receiver may, in fact, already feature germanium diodes for vision detector and interference limiting, in which case there will be no complications regarding balancing the heater chain; but make sure that the diode is connected round the correct way for the negative-going modulation. Normally, the black or "anode" side of the diode is connected to the i.f. transformer winding, but as will be seen in Fig. 7 the reverse is true in the present case; that is, the red or "cathode" (positive) side is connected to the winding.

A.C. COUPLING

In Fig. 6 direct current coupling is used between the vision detector and the signal grid of the video amplifier valve V7. However, in the modified circuit of Fig. 7, a.c. coupling is used—the d.c. connection between the two circuits being eliminated by the 0·1μF capacitor.

Old hands may consider this as rather strange since they have been brought up to believe that d.c. coupling is essential right through to the tube cathode from the vision detector. D.C. coupling undoubtedly has many advantages, but it has been discovered that domestic receivers give quite acceptable results even with the d.c. coupling partially or completely removed. It is partly removed in nearly all domestic models by the C48 and R67 combination of Figs. 6 and 7, while in the majority of popularly-priced sets it is eliminated almost completely by the action of mean-level vision a.g.c.

A.C. coupling in our experimental model is adopted because it tends to facilitate mean-level vision a.g.c., and this is the kind of system that we shall be using. This means, then, that the video amplifier stage can be biased to class A conditions, a function which is satisfied by the cathode circuit network of V7.

VIDEO CIRCUITS

In the majority of models selected for conversion, the video amplifier anode circuit can be left almost the same as per the original circuit, with the existing "peaking" coils (L7 and L8) and the screen feed circuit arrangements. However, to secure optimum response at the high-frequency end of the video spectrum (bearing in mind that there

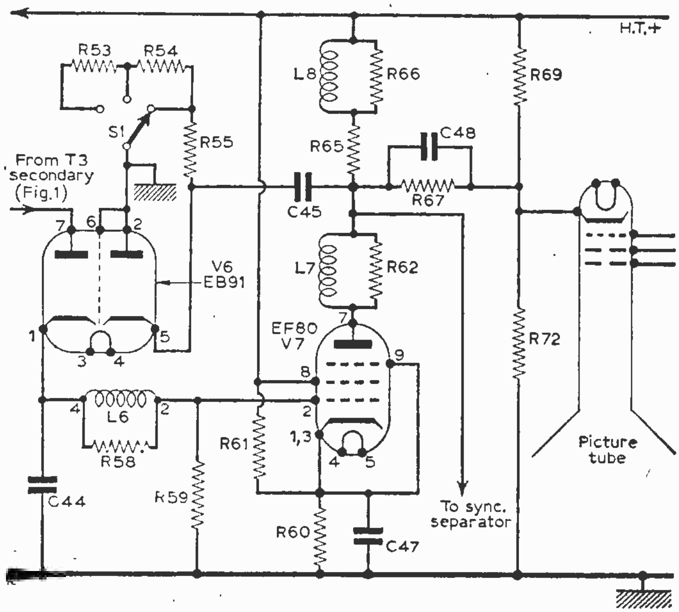


Fig. 6—The vision detector, vision interference limiter and video amplifier stages of the experimental receiver.

is more high-frequency video in a 625-line signal than in a 405-line one), it is often desirable to reduce the value of the anode load resistor, and the value given in Fig. 7 (R65) seems to provide a reasonable compromise between gain and bandwidth in conjunction with an EF80 valve.

BRIGHTNESS CONTROL BALANCE

Resistors R69 and R72 form a potential-divider which ensures that the cathode of the tube does not go too positive with respect to the heater—a condition which avoids the danger of heater-cathode breakdown. When the anode load resistor is changed in value the conditions relating to the potential divider will also change, but the change is usually so small that it can be ignored. However, if the brightness control fails to operate correctly after the video amplifier changes, the potential divider resistor valves should be adjusted by a small amount to secure the original control function.

It is not normally a good thing to alter the resistive elements of the brightness control circuit to restore the correct balance on the control if correction is possible within the scope of the potential divider. In some cases, however, it will be necessary to alter the value of the resistor connected to the top (h.t. side) of the brightness control, but the basic brightness control circuit should not need altering.

INTER-CARRIER SOUND TAKE-OFF

The signal from T3 (Fig. 4) contains both sound and vision, and on arrival at the vision detector diode (OA70) the two i.f.s beat together and produce a frequency which is equal to the frequency difference between them; in the British 625-line system this is 6Mc/s. Thus, in addition to the detected video signal at the output of the vision detector there is also present a 6Mc/s signal—called the intercarrier sound signal. This is frequency-modulated and, after amplification, is fed to an f.m. detector (see next month).

To take off the 6Mc/s signal a 6Mc/s tuned transformer is employed, this being T4 in Fig. 7. The idea is to take off the 6Mc/s signal while preventing it from getting into the video amplifier, and the latter effect is accomplished by the primary of T4 acting rather like a rejector circuit at 6Mc/s, thereby completely absorbing the signal into the secondary and preventing a through path to the video amplifier.

In some commercial receivers the 6Mc/s is allowed to pass through the video amplifier, and

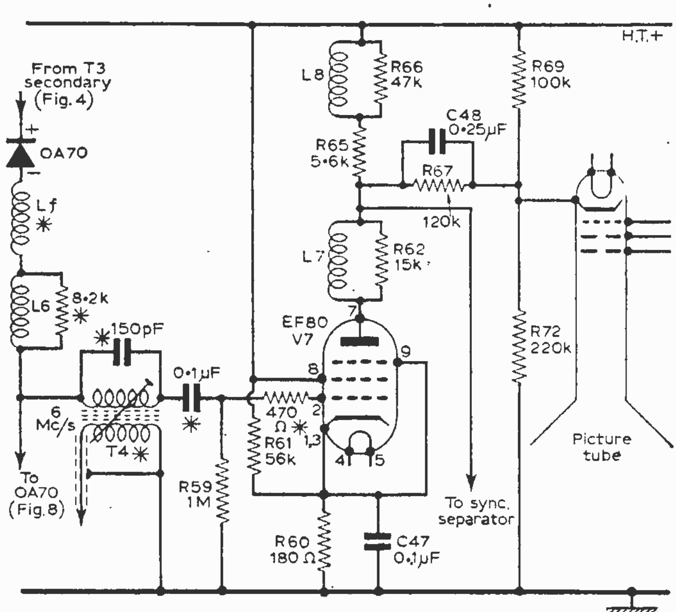


Fig. 7—Showing how the circuit of Fig. 6 is modified. The EB91 valve is deleted, and the detector is formed by the OA70 diode.

then the sound take-off is in the anode of the video amplifier valve. This has several advantages as well as disadvantages, and on balance it was decided to use detector extraction. Even with this arrangement some 6Mc/s signal may get into the video amplifier and commercially this is rejected by a 6Mc/s tuned circuit in the valve cathode; but this was not found necessary in the experimental conversion. However, it is a point worth bearing in mind as the conversion of models differing from the "prototype" may give slightly different results.

TRANSFORMER

The sound take-off transformer is wound on an Aladdin former Type PPF16411/6 and uses core Type PP5985/16002 for tuning. The primary winding (that connected in the detector circuit) is made up of 20 turns, close wound 24s.w.g. enamelled-covered wire, while a single turn link of the same wire forms the secondary winding. This is wound directly over the centre of the primary winding on a thin card former. This method of coupling provides a high attenuation to video signals arriving at the input to the sound intercarrier amplifier (see next month). There is usually no need to screen the transformer, but it should be located as close as possible to the video detector stage.

Inductor Lf may or may not be included in the original design, but if not it can follow closely the make-up of L6.

SYNC SEPARATOR

The modified sync separator stage is shown in Fig. 8. To avoid confusion it was considered best not to show a sync separator stage from the unmodified set, as these differ considerably from model to model. There may be an EF80 pentode or the pentode section of a triode-pentode valve—such as that in Fig. 8.

At this stage, it is desirable to retain the anode and screen circuits of the sync separator circuit as existing in the experimental receiver, but to modify the control grid circuit so as to provide a method of mean-level a.g.c. (note that some sets may already be arranged in this way—or nearly as shown in Fig. 8).

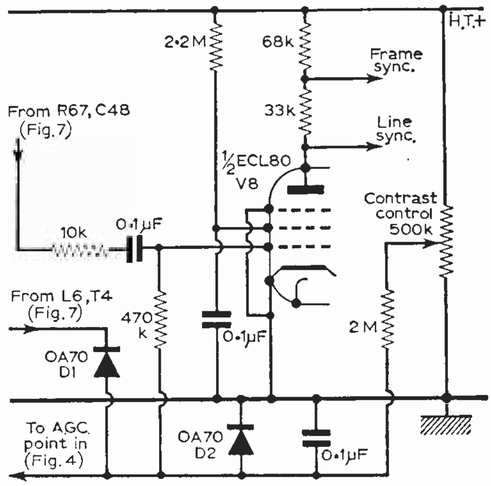


Fig. 8—The modified sync separator stage, showing also how the a.g.c. potential is derived.

A new contrast control may also need fitting, since the control of contrast is achieved by the application of a positive potential—from the contrast control and as determined by its setting—to oppose the negative sync separator potential.

Diode D2 will probably already be present, and its purpose is chiefly to avoid the a.g.c. line going positive due to blocking or lack of signal. Diode D1 serves to put onto the a.g.c. line a little of the negative potential formed by rectification of the vision signal at the vision detector. This negative potential supplements the normal a.g.c. potential and avoid blocking effects which, with negative going picture signal and mean-level a.g.c., may otherwise happen. The a.g.c. feed from the sync separator is connected to the a.g.c. point in Fig. 4.

Next month we will deal with the sound circuits and the line timebase.

CONTINUED NEXT MONTH

STOCK FAULTS

—continued from page 489

total loss of boost voltage by a short-circuited component. Where e.h.t. regulation is poor the symptoms may be excess of picture size, accompanied by lack of focus; other circuits may reduce e.h.t. to the point where no raster is available—except that the spot will resolve on the screen as the set is switched off, which can be a valuable clue.

POWER SUPPLY

Symptom: no h.t.

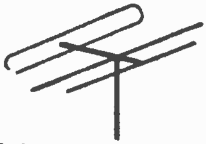
A very prevalent fault is the burning out of the surge limiter, R in Fig. 7. This will usually be between 20Ω and 30Ω and a 5W wire-wound component is required. If a value greater than 30Ω is used a 10W component should be fitted. Some receivers use two 50Ω resistors, each feeding a single anode of the rectifier, or separate rectifier valves. Reduced h.t. may result from one only of these burning out.

Symptom: no heater voltage

A burnout of one of the sections of the mains dropper may be caused by a heater-to-cathode short-circuit of a valve near the "top" of the heater chain, as shown at X in Fig. 7. This is often the PY81 and the clue will be that the valves above it begin to overheat rapidly before the fault becomes severe. The snag is that replacement of the resistor which has burned and subsequent switching on may appear to have cured the fault, but as the line stage warms up the short will again develop and another resistor will have been wasted.

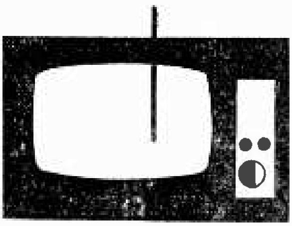
Symptom: slow warming up

The two principal causes are (a) a faulty efficiency diode and (b) a faulty thermistor. The latter may not always be obvious; very often a resistor of fairly low value is shunted across the thermistor both to provide some protection from excess hot currents and to cut down the waiting period. If this resistor, shown dotted, Rs, goes open-circuit the warming-up period will be protracted. ■



A MONTHLY COMMENTARY

Underneath the Dipole



BY ICONOS

GLOOM! Dejection! Despondency! These words describe the prevailing atmosphere of many TV and film studios I have visited during the last few weeks. It's those Television Bill Blues, a haunting conversational theme which brings depression to the stoutest hearted ITV executives, technicians and trade unionists, but which is whistled cheerfully by BBC men.

Clause 7

The crux of the matter is Clause 7 of the new Television Bill, which proposes a special tax on the revenues of the ITV programme companies. Only the first £1,500,000 of the income of each company would be free of tax. The ITV brasshats and the trade unions have joined forces in supporting an amendment that the tax should be on profits, not on the total advertising revenues. The debate in the Committee Stage has been prolonged, but the outcome, at the time of writing these notes, is almost certain. The trade unions fear that the revenue tax will result in a reduction in production budgets, with consequental redundancies in staffs, threat of unemployment, lowering of standards of programmes, decreases in the production of special films for TV in British studios, and a substantial cut in the large amounts of money allocated by the leading ITV companies to engineering research and development.

Leering Old Auntie

In TV engineering circles, there have been sarcastic exchanges of opinion between slightly smug looking BBC men and the dejected ITV technicians, who are trying to face up to the astronomical costs of changing line standards to 625 on heavily cut budgets. "It's all very well for Auntie BBC, who's over forty, to approach her difficult period of a change of line standards, with equanimity", said Mr. X, a bitter ITV technician. "Bejewelled with riches indirectly filched from her younger chaste rival, and drunk with the power and licence tacitly allowed by the Government", he continued, "she even bites the very hand that feeds her by producing some programmes which are virtually unofficial anti-Government party political broadcasts!" BBC engineer, Mr. Y., remained unmoved. Taking a deep breath, the ITV man warmed up: "Featherbedded with her new wealth—indirectly taken from *us*—the ITV companies are to be bled black and white, shackled with taxation, red tape, restrictions and discouragements!" Fiery words these, but there's no smoke without fire. "Calm down, you hot-headed music-hall tycoon!" was the soft rejoinder from Mr. Y. "Music-hall!" spluttered Mr. X. of the ITV. "The music-hall at least respects the monarchy, the British Constitution. That's something that the night-club fringe in the BBC are incapable of doing!" At this stage of the proceedings, a voice off called "Time, Gentlemen, please!"

Pub Scene

It should be a far cry from the alleged sophisticated night-club humour favoured by BBC to the gusty, boisterousness of the Pub Sing-Song, presented by A-R in "*Stars and Garters*". But perhaps there isn't so much difference after all, if the sing-song is compered in the style of Ray Martine. Full of confidence, nods and winks, he introduced a number of talented and not-so-talented artists, who had a rip-roaring time with the captive crowd artists. There were moments in this show which viewers enjoyed almost as much as the paid audience, particularly when Tommy Bruce and Al Saxon were doing their turns. The best of them performed with the zest of good music-hall performers, but the link dialogue written for Ray Martine, savoured more of the smuttier type of BBC show than of the ITV. This kind of stuff is tolerable if it is funny. But it ought to be "whiter than white" when on the commercial channel, especially from a company with such high standards as Associated Rediffusion.

Consolation Prizes

The ITV programme people can take consolation in the fact that their TAM ratings are once more improving in all areas. The pendulum continues to swing. Both BBC and ITV programmes are magnificent as compared with any others in the world, but the public is fickle, and fashions in entertainment seem to change more rapidly every month. A pop vocalist song now holds its place in the top twenty for a week or so, only to spiral down to oblivion, excepting, of course, Cliff Richard, Adam Faith and one or two others. Kitchen sinks are out. Plays without real endings are as frustrating to viewers as they are to the characters in the stories. But at least there is sport, and both BBC and ITV can now let themselves go on all the outdoor activities which are beyond the ken of the influential night club set.

Robert Helpmann

Variety is the spice of life, they say, and boxers aren't the only personalities who try another line of public appearance. Robert Helpmann, the famous ballet dancer, for instance, has appeared in films and straight plays. In the BBC's biographical programme *"An Evening with Robert Helpmann"*, he extended his performances to include pop singing to playback (in the manner of the B and W Minstrel Show), dancing the Twist and the Charleston, reciting (with a few fluffs) a speech from Shakespeare's "Richard III", and, of course, dancing excerpts from ballets (with an interview superimposed). Linked between these vigorous and versatile performances were a number of interviews in which he breathlessly answered an unseen compere — a little too breathlessly, I thought, to match up with the preceding demonstrations of his virtuosities in such differing fields. There is no doubt about his brilliance, which dazzled and held viewers for a whole hour, and as is usual with all shows produced by George Inns, it left viewers a little breathless, too.

O.B.'s On Tap

In the more prosperous days of commercial television, even the smallest regional programme companies started operations with the intention of making their mark with local programmes which were rather more ambitious than parochial magazines. Anglia and Tyne Tees, for instance, built their stations with elaborate stages and equipment suitable for the production of plays and musical features for sending back to the network. Westward, smaller still, sited their station in the centre of Plymouth and supplemented their studio facilities with permanent camera cables, lines and lighting in the adjacent Athenaeum Theatre, a delightful newly-built 400-seater with a revolving stage. This is used periodically for Westward's audience participation shows, such as *"Treasure Hunt"*. The choice of site has now been further enhanced with the opening by another neighbour of a fine large covered swimming pool. Naturally, cable ducts have been prepared in this direction, too, so that special swimming events can be televised.

"Emmy" for Manchester

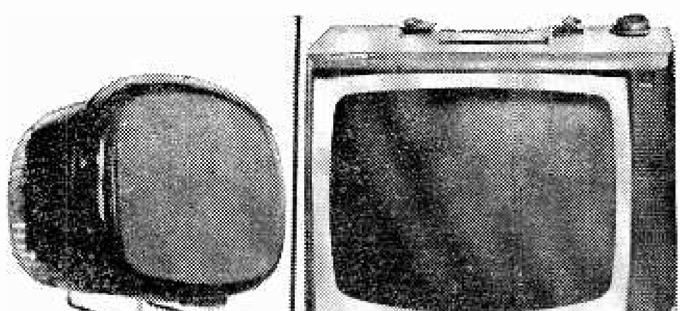
There is quite a lot of fine E.M.I. technical equipment in Manchester at the Quay Street Studios of Granada, and the Didsbury Studios of A.B.C.-T.V. But another kind of "Emmy" came to the city via the Ringway Airport recently, welcomed by Sidney Bernstein, Chairman of Granada, and the production team that made the TV version of *"War and Peace"*. The "Emmy" in question was the first international award of America's National Academy of Television Arts and Sciences, a new kind of "Oscar".

"War and Peace" was a magnificent effort, if you stayed the lengthy course of about three hours, and although Mr. Bernstein said there was no particular virtue in a three-hour production, there are rumours of another lengthy epic from the Manchester Studios in a few months' time.

Famous for their ever popular *"Coronation Street"*—the twice-weekly mainstay of the ITV network—Granada are continually breaking new ground in television drama, and very old ground, too. *"The Victorians"* is a series of revivals of plays which were first produced in London or Manchester a hundred years or so ago, and *"London Assurance"* was one of the first of these. Immaculately produced, with appropriately ornate setting, it was directed without any of the usual burlesque treatment so often applied to very old plays. It should not be forgotten that important trends were started in the theatres of Manchester and Liverpool, notably the pioneer work of Miss Horniman's theatrical stock company at the Gaiety Theatre, Manchester, and of Basil Dean at the Playhouse, Liverpool.

Special Effects

Both BBC and ITV companies are racing ahead with ideas for special effects, following up the realistic results which are now so commonplace in films. Fires, earthquakes, explosions, cobwebs, rail smashes and the like can be evolved slowly and carefully by specialists in this work, which is closely allied with photographic special effects obtained in the camera, such as slow motion photography (used for model work, especially sea scenes in tanks), stop-motion or slowed down photography (for speeded up Keystone comedy tricks). It is not so easy getting these effects on live or videotaped television, for obvious reasons. First of all, television studio stages, with their linoleum-covered floors and delicate electronic equipment, do not take kindly to wind, water and smoke. Scottish Television poured lots of water on their Stage C floor for the thrills in *"The Tower"*, but I haven't heard any enthusiasm by anybody about repeating this severe strain on studio facilities. I suppose that in due course, some of the major companies may have special "commando" studios, with concrete floors and watertight equipment, but I will hazard a guess that motion picture cameras will be used as a recording medium instead of TV cameras. The West German television organisations have approached the problem with this policy, making great use of plastic floors, elaborate back-projection, mirror and glass shots, slow-motion film cameras and the like. These spectacular German television films are expensive to make, but are shown all over the world, dubbed into different languages. *"The Magic Umbrella"* was a typical example in which elaborate trick effects and gimmicks were introduced into a gay musical revue.



At the "Interplas" plastics exhibition held in London recently, these two receivers were commended for the design of their cabinets, both of which are made from plastic materials.

CIRCUIT PRACTICE AND DESIGN PRINCIPLES FOR

OSCILLOSCOPE TIMEBASES

CONTINUED FROM PAGE 467 OF THE JULY ISSUE.

BY
M. L. MICHAELIS

A POINT of great disadvantage still maintained even in the Puckle timebase described last month, is the h.t. requirement for the pentode. The sawtooth output amplitude achievement is thus necessarily less than the total h.t. supply by an amount equal to the h.t. requirements of the pentode.

Thus, although output amplitudes as such are good, the required total h.t. voltage is rather high in proportion. An idea to offset this disadvantage, which led to further developments, was to vary not R to compensate the falling drive voltage, but to repeat the capacitor voltage and add it to the effective driving voltages, thus keeping the charging *current* constant, and getting linear rise of capacitor voltage by voltage compensation.

This action may be likened to lifting oneself by pulling the laces of one's boots, which led to the general name of "*bootstrap circuit*" for devices utilising this principle.

Fig. 6 shows the two most common arrangements found in this class. The actual voltage that the capacitor has reached at all moments is fed to the grid of a cathode follower, so that a fully decoupled repeat version is produced in the cathode output, and can be added in series to raise the initial drive voltage for further charge. The difference between total drive voltage and capacitor voltage is thus constant, leading to constant charging current and thus linear voltage rise.

Bootstrap circuits always need an external device to produce the relaxation effect giving the flyback. This can even be of mechanical nature, such as the closing of relay contacts, in a circuit such as Fig. 6(a) suitable chiefly for *very slow* timebases running at one cycle in minutes or hours. Or it can be a driving waveform, such as in the normal speed circuit of Fig. 6(b).

The extreme slowness, i.e. ultra-low frequency operation, of Fig. 6(a) is given because the effective difference voltage between total driving voltage (voltage across 5kΩ resistor in cathode circuit) and capacitor voltage is only approximately the grid-base of the EC92, i.e. a few volts, yet the ultimate voltage reached on the capacitor is equal to the maximum anode current voltage drop across the 5kΩ resistor, which is some 50V, at least ten times the grid-base.

The range of bootstrap action voltage-lift in this circuit is thus very large compared to the effective charging voltage difference, which is equivalent to an effective increase of capacity of the capacitor by the same large factor. The circuit thus reaches enormous times of run, of minutes or hours, before a flyback takes place, using quite reasonable actual and practical values of capacity.

A practical version of this circuit as a process-timer was published in PRACTICAL WIRELESS, July and August 1962.

The second valve reaches cut-on at a certain stage, and causes then a current avalanche in the relay, assisting the steepness of the relaxation for the flyback.

Normal Speed Version

The second popular form of a bootstrap circuit is shown in Fig. 6(b). The valve B, which is the switch valve, to which the externally produced relaxation signal is applied, is normally resting at heavy conduction, because its gridleak is returned to h.t. positive. It thus holds the timebase capacitor, C, short-circuited, and thus discharged fully, or nearly so.

The relaxation waveform to be applied to valve B is a negative-going squarewave pulse, cutting the valve off, i.e. opening the switch, for the desired duration of the sawtooth forward-run. When this driving-pulse ends, it re-opens valve B, causing immediate discharge of C again, i.e. flyback. C2 rests charged to the full h.t. voltage, and represents the source of charge-driving voltage for C once valve B is cut-off. Thus C2 must have a capacity very much greater than C, so as not to lose voltage appreciably when delivering charge through R to C.

Whatever voltage C has reached at any time is applied to valve D grid, and thus repeated, by cathode-follower action, across the 22kΩ cathode resistor. But there it is in series with the h.t. voltage across C2, adding itself to the total drive voltage, so that the difference remains equal to the h.t. supply at all times. The total driving voltage, which is thus greater than the h.t. supply as soon as C has attained any charge at all, appears across R and C in series, i.e. between valve A cathode and chassis. In other words, diode A cathode is more positive than the anode, so that the diode is cut-off, and the h.t. line cannot interfere during the sawtooth-run; C2 plays the role of charge-source, as already pointed out.

Full use is made of the available h.t. voltage in this circuit, and linearity can be excellent, especially if the correction feedback arrangements shown in Fig. 6(c) are employed. Curiously enough, this circuit has found little application in oscilloscopes, though it is reasonably common in radar-display timebases and control circuits.

The circuit of Fig. 6(a) often suffers from appreciable non-linearity; its great advantage is in getting really long runs, i.e. marking out considerable time intervals.

The Miller-Integrator

We saw how we have three available items in the simple charging capacitor circuit which can be varied or controlled, namely the capacitance, the

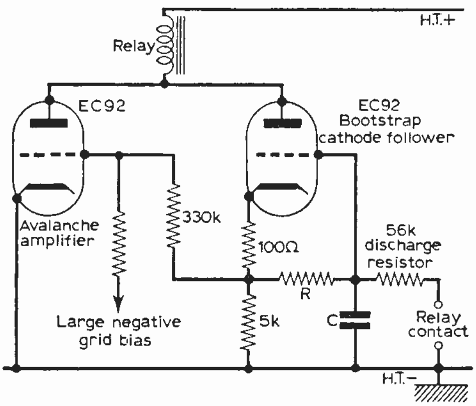
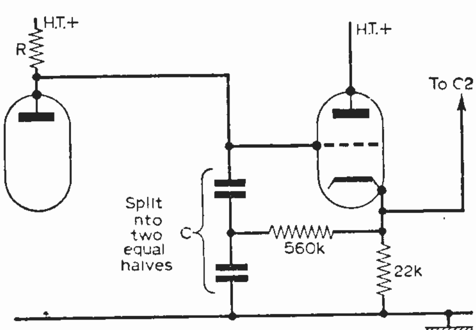


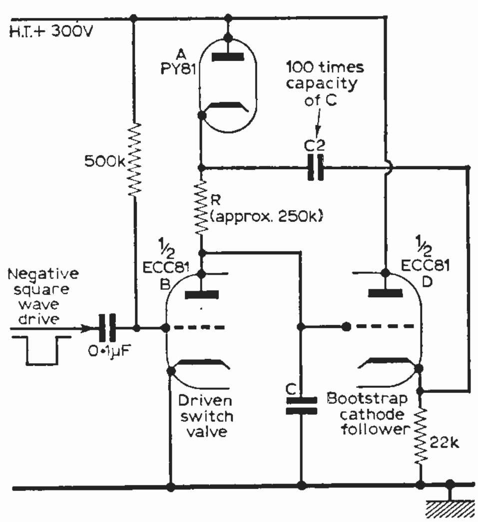
Fig. 6—Bootstrap timebases, having the characteristic of linearising the charge exponential by exerting charge-voltage control. (a) above—An ultra-low frequency bootstrap timebase. (b) right—A bootstrap timebase for external drive. (c) below—A method for further improving linearity of (b).



resistance and the supply voltage. We saw how the resistance can be replaced by a pentode valve for linearisation-control of the charging process. We then saw how the same linearisation effect, or other useful features, resulted if the supply voltage was controlled in follow-up during the charge, giving the bootstrap-circuits. The only item of the basic circuit which has so far not been influenced is the capacitance itself. Ideas on these lines led to the class of sawtooth-timebase generators known as the *Miller-Integrator Group*, which proved ultimately the most successful of all, and are used virtually exclusively in modern oscilloscope circuitry. The basic Miller-Integrator again needs a driving relaxation-waveform to produce the flybacks, which must be produced from some additional source.

All Miller-Integrator circuits utilise a greatly exaggerated version of the simple Miller-Effect familiar from wireless circuits, by raising the anode-to-grid capacitance of a valve by connecting the timebase-capacitor between these two points. We remember, from simple wireless-amplifier circuits, that the Miller-Effect for a resistive anode-load of an amplifier stage implies that the grid input circuit of the stage behaves as if it had an extra shunt-capacity equal to the anode-to-grid stray capacity multiplied by the stage-amplification factor. We remember that the effect makes the high-frequency response of a triode audio amplifier stage poorer than that of a pentode stage which has a much lower anode-to-grid stray capacity, and thus less Miller-capacity at the grid.

Consider now the circuit of Fig. 7(a), showing the basic Miller-Integrator timebase circuit. The timebase capacitor, C, is placed between anode and grid of an amplifier valve. The result is thus



absolutely equivalent to a capacitor A times C between grid and chassis, where A is approximately the gain of the amplifier stage. This very large virtual capacitor is then the real timebase capacitor, and R is its charging resistor.

Now the range of charge voltage required on this virtual capacitor between grid and chassis is merely the gridbase of the valve. If we choose a short-gridbase valve, therefore, the range of voltage rise required for the entire sawtooth run is very tiny, only a few volts. Yet the charging supply voltage applied to R is a large fraction of the total h.t. voltage selected on the 100kΩ potentiometer, and this high voltage is the ultimate one aimed at exponentially during the charge of the virtual grid/chassis capacitor. So we see that we are picking out an *exceptionally* tiny portion of initial start of an exponential charge, which is for all practical purposes *extremely linear*. However, because this tiny portion of the exponential appears immediately at the grid of an amplifier valve with short grid-base, it suffices to drive the valve right through the entire linear part of the characteristic, giving a faithful linear reproduction at high amplitude in

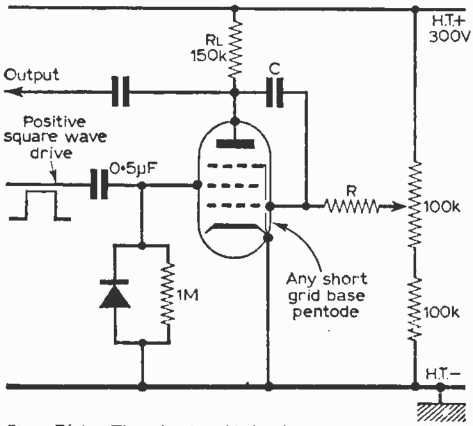


Fig. 7(a)—The basic Miller-Integrator timebase employing the principle of capacity amplification through the Miller effect.

R and the high virtual grid-to-chassis capacity, the valve grid input signal being taken off this capacity alone, any input waveform appears in its *integrated* form at the grid, and thus an amplified integrated form at the anode. This means, for example, that a squarewave input is converted to a triangular wave, a sine wave is shifted exactly 90° in phase in the output instead of the usual 180° of an amplifier stage, and any sharp transients (short pulses) are entirely ignored, i.e. absent in the output.

The prime design quantity is given by the product of R in megohms, C in microfarads and the stage amplification factor. The product of all these three together gives a time in seconds which must be at least ten times as long as a cycle of the lowest frequency waveform which we wish to integrate.

This circuit has found some uses as line and frame sync separator in television receivers, by choosing the product ACR to be much greater than the duration of a line sync pulse but much less than the duration of a frame sync pulse. A convenient value is the square-root of the product of line and frame pulse durations. The circuit then sees the line pulses as transients, and rejects them, but passes the frame pulses.

Other Applications

The same operative amplifier has also been used

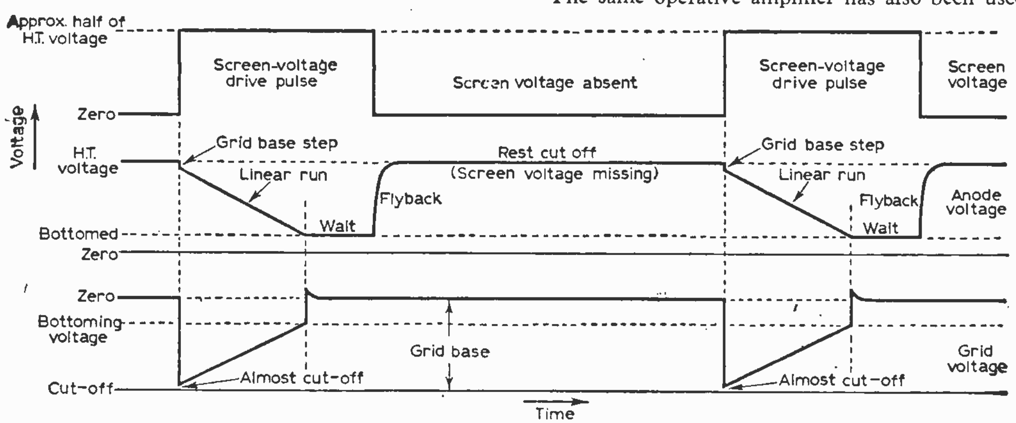


Fig. 7(b)—Miller Integrator waveforms.

the anode circuit. The extreme simplicity of this circuit, both in principle and practice, is its most striking feature, and let to its rapid and almost universal adoption in one form or another.

Integration

The name "Integrator" is derived from additional uses of the same circuit for other purposes. The use of a pentode is, in the timebase arrangement, dictated only because of the need for an additional control electrode for the relaxation-drive.

If used for its alternative purpose, as a so-called "*Operative Amplifier*", the valve may be a triode. The valve is then given a cathode bias resistor of the usual size, to establish the normal operating point when resting without an input signal, and the resistor R is not returned to an h.t. bleeder, but to a gridleak to chassis and point of feed-in of a signal to be handled. Because of the series-connection of

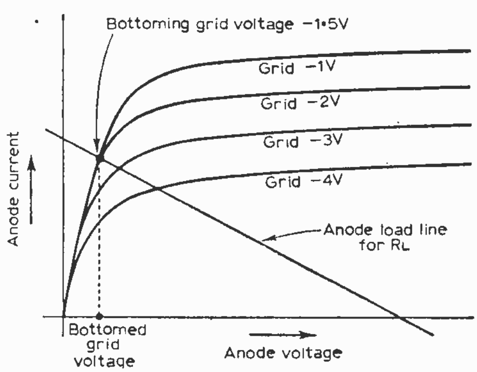


Fig. 7(c)—To illustrate pentode bottoming (see text).

in certain f.m. transmitter modulators, which produce f.m. by shifting the phase of sidebands in relation to the carrier for an initial amplitude modulation.

Finally, it is used most extensively in analogue computors, because of its property of fast signals directly at the grid being repeated with equal amplitude, i.e. gain unity, but opposite phase, at the anode. Hence the circuit has sometimes received a third name, "*The Anode-Follower*". Another most useful property of this circuit arranged as an operative amplifier is the extremely low a.c. impedance at the grid represented by the large virtual Miller-capacity from grid to chassis. Several signals may thus be fed in, each through a separate high resistor R from its source, all commoned at the grid, without any appreciable back-reaction of the various signal sources amongst each other. This, again, is exploited in analogue computor applications.

It is felt that the previous paragraph, which has strayed somewhat from the narrow subject of pure timebase circuits, has been by no means out of place, as it has brought out the extreme versatility of the Miller-Integrator circuit types. This should have aided their thorough understanding, essential for further progress in this article, and have explained their wide popularity in a diversity of circuits and functions.

Detailed Action of the Basic Miller-Integrator

The above discussion served well for a comprehension of the extremely simple underlying principle of the Miller-Integrator class, but now a more stereotype, phase-for-phase consideration of the circuit action in timebase types is more convenient for further progress in mastering these circuits.

Fig. 7(b) illustrates the formal action of the basic Miller-Integrator of Fig. 7(a) in this sense. The pentode valve used is normally resting without screen voltage, i.e. cut-off. The driving relaxation waveform consists of a positive square wave pulse of about 150V amplitude and lasting for the time-duration that the virtual grid capacitor requires to build up a charge voltage about equal to the grid-base, i.e. the time that C requires to charge through R to a voltage equal to the grid-base, times the amplification of the stage. The diode across the 1MΩ screen leak functions as d.c. restorer, to make the screen waveform go positive from zero, and not settle down at some mean pure a.c. condition. The detailed action of these important ancillary devices will be discussed below.

As soon as the screen-drive pulse starts, anode current will try to commence. But the slightest change of anode voltage is impressed onto the grid, in full, through the capacity C, in an opposing sense, i.e. to tend to cut-off the anode current again. The immediate initial action is thus no more than the start of a tiny anode current, giving a small voltage drop across RL equal to the grid-base, holding the valve now almost cut-off at the grid. This initial action produces the small grid-base step, or "Miller Step" in the output, shown in Fig. 7(b). Thereafter, as the virtual grid-chassis capacitor slowly charges (on account of its large effective capacity), anode current can gradually build up in the linear fashion already explained.

Provided that the squarewave relaxation-drive at the screen does not stop this process prematurely by terminating too soon, the process is self-terminating when the grid voltage has risen to the "Bottoming Voltage". This voltage is that value of (still negative) grid bias for which change of bias in a positive direction fails to bring about further rise of anode current. This condition gives maximum anode-current, i.e. minimum anode voltage, under the prevailing circuit conditions; one speaks of the anode voltage as being "bottomed" in this condition.

The Production of Bottoming

The production of bottoming requires a high value anode load resistor, whose load-line on the characteristic curves crosses the knee-stroke at a point above which still some anode-lines for negative bias-values emerge. This is clearly illustrated in Fig. 7(c), which shows how bottoming at grid bias minus 1·5V takes place in the example.

Once the Miller-Integrator has bottomed, it simply rests there at maximum anode current until the relaxation wave at the screen chooses to terminate and cause the flyback. It is most undesirable to make the relaxation drive pulse much longer than the time needed for the Miller to bottom, because the waiting time of the spot at the end of the trace before it is made to flyback creates a brilliant spot at the end of the trace, which could damage the c.r.t. when the general brilliance is turned up enough to make the rest of the trace sufficiently visible. On the other hand, the relaxation drive should not be so short that it dictates a flyback long before bottoming is reached in the Miller—unless, as is in fact often the case in practical circuits, this is desired as a method of timebase-amplitude control.

Reduction of the relaxation drive pulse *time* reduces the output sawtooth *amplitude*. The speed of run, i.e. slope of the sawtooth (volts per second) is determined *solely* by changing the value of C, R or the driving voltage from the 100kΩ potentiometer.

A coarse speed control on a practical oscilloscope will be in the form of a switch selecting various capacitors for C. The fine speed control may be either in the form of making R variable, or by using the potentiometer in the h.t. bleeder, keeping R fixed in value. The latter method has the advantage of good stroke-to-flyback time ratio even at the high-frequency end of the control range, because R can always be kept much greater than the anode load RL then. It is the ratio of R to RL which determines the ratio of stroke to flyback times, because the principle discharge-resistance on the flyback is RL.

When varying R for fine speed control, the range of control is greater in principle, but at low values of R the flyback takes rather a long time in relation to the stroke, although, of course, the stroke does not deteriorate itself. Some thought is therefore necessary in designing a practical circuit.

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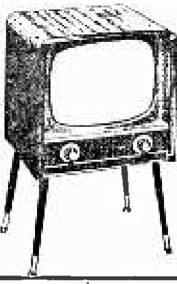

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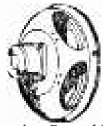

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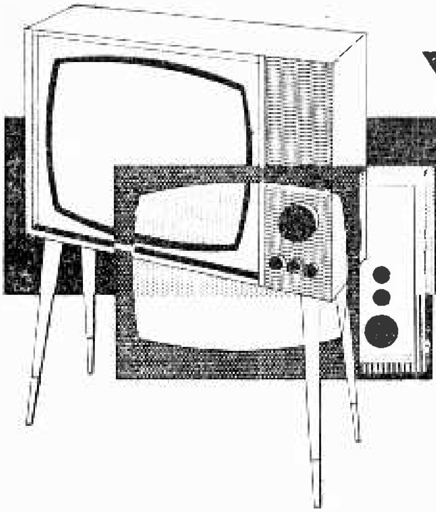


Your Problems Solved

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. 523 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

EKCO TC 346

After being switched on for approximately 20 minutes, the vision and sound would both disappear. Heater voltage and current was found to increase when the fault occurred.

I replaced the sound output valve (30PL1) which cured the fault but left a picture with " streaking " at the edges.—J. H. Birks (Greenford, Middlesex).

Look for the fault in the h.t. circuits. Suspect the PY32 rectifier and also its 23Ω surge limiter resistor, which is wired near the valveholder.

COSSOR 939F

When I bought this set, the contrast control was missing so I would like to know its value.

At the moment, the screen is blank except for a narrow vertical white line down the centre of the screen. The PY81, PL81 and both PY82 valves are new and a new c.r.t. has been fitted recently. The PY51 appears to overheat.—W. McNeil (London, N.W.5).

The value of the contrast control potentiometer is 100kΩ. If the fitting of this control does not settle your other fault symptoms, check for faulty line scan coils.

PYE VT7

On switching on, the raster appeared with the sound, but no picture was present. The raster then collapsed to a strip 1in. in depth across the centre of the screen.

I have changed all the valves except the EY51 and the PY81. I have checked the c.r.t. and scan coils with another chassis and have found them to be in working order. I have also renewed L18 and R30 with no improvement.—J. W. Wood (London, S.W.13) .

Since the raster began to form before the loss of frame scan, the fault is probably due to a lack of h.t. in part of the circuit. We advise you to check that all anode and screen voltages are present and to trace back to any common feed resistor from those which are absent.

MARCONI VT-63-DA

The picture suddenly went out of focus after the set had been on for about five minutes. Then, on increasing the brightness, the picture " blew-up " and disappeared.

I replaced the PL81 and the picture reappeared only to " blow-up " and disappear once again after ten minutes.

I then replaced the PY81, PL81 and EY51, and now there is no picture whatsoever. There is no e.h.t. at the EY51 and no h.t. on the top caps of the PL81 and PY81. All the valves light except the EY51.—R. T. Smith (Belgrave, Leicester).

Listen for the line whistle. If it is lacking, check the line oscillator stage and feed to the PL81 signal grid. If it is present, check the voltages on the PL81 and if low, suspect shorting turns in the l.o.t.

REGENTONE 143

The fault on this set is one of line tearing, the effect being that some of the lines slip off to the left.

The curious part of the fault is that it is only noticed on middle distance shots and only on ITA.—C. H. Ogilvie (South Shields, Co. Durham).

The effect could be caused by a form of electron oscillation (B-K) being radiated from a nearby TV receiver working on BBC only. It is hardly likely that your set is radically at fault, otherwise the trouble would appear also on BBC.

PHILIPS 1756U

The horizontal hold control is set at its maximum for optimum results but it is still necessary constantly to adjust this control to keep the picture steady.—R. B. Homes (Bridlington, Yorkshire).

This model incorporates flywheel line sync and a discriminator composed of two OA71 germanium diodes. Check these diodes and replace if one is low or out of balance. Also check V14—the ECL80 line oscillator/reactance valve—by substitution. V14 is located on the timebase chassis between the PL81 and PY81 valves. The diodes are between a tag strip underneath (approximate centre) of the same chassis.

BUSH TV63

I would like to know how to remove the three vertical bands which appear on the left-hand side of the screen. Each band is about 1in. wide. —F. Thompson (Sheffield, 7).

You should replace the 47kΩ resistor wired across the linearity coil associated with the scan coils assembly and check the 35pF capacitor and trimmer if necessary.

FERRANTI T1001

Is it possible to fit a 17in. c.r.t. to this set, which has, at the moment, a 14in. tube?—L. S. King (Wincanton, Somerset).

It is quite in order to fit a Mazda CRM 172 17in. tube to this set. In fact, there is no electrical difference between the model T1001 with a CRM 144 14in. c.r.t., and a model T1002 with a CRM 172, except that a 60pF 6kV capacitor is connected across the line scanning coils of the latter receiver, and very slight differences which exist in the frame linearity circuit.

DECCA DM4C

The trouble with this set is that although the ITA picture is strong, the BBC is very weak. I have tried using various aerials and have replaced all the valves with known good ones. I have also tuned C15 with only slight improvement.—E. C. Canning (London, S.E.15).

If you are sure that the oscillator coil core (adjusted from the front) is correctly adjusted for maximum sound, check the channel 1 coil biscuits. It is quite possible that one or both may have been damaged or that one of the coil leads may have broken away from its tag.

MURPHY V240

The picture quality is quite good but the whole picture has moved slightly to the left, and no adjustment I can make will restore it to its normal position on the screen.—H. J. Rowlanes (Croydon, Surrey).

The picture positioning adjustment is by means of a shuffle plate between the scan coils and the focus magnet. This plate has a black knob at the top to facilitate its movement, but the setting is usually locked by a 2B.A. brass nut just below the knob, and this nut should be released before adjustment is made.

PYE CTM17T

There appears to be three images on the screen at the same time, although otherwise the picture is quite good.—F. H. Taylor (London, E.C.1).

You should replace the PCF80 line oscillator valve. This is just outside the e.h.t. unit near the mains input panel.

COSSOR 918

When the line locks, there are two complete pictures side by side on the screen, separated by a black band down the centre. Alternatively, there is one picture in the centre with two half-pictures on either side.

When I first obtained this set, the line output transformer had burnt out and so this was replaced. I have also replaced R37, C25 and C26. A. H. Yallop (Luton, Bedfordshire).

Suspect a faulty 30kΩ line hold control and also the 270kΩ resistor in series with the slider of this control and the blocking oscillator.

MASTERADIO TG7T

There is no raster whatsoever on this set. All the heaters light, except the e.h.t. rectifier (EY51). I have replaced this valve and also the line output (50CD6) and efficiency diode (PY83) valves. The line output transformer checks for continuity and there is a 10kc/s whistle coming from the blocking oscillator.—J. C. Baker (London, W.3).

Shorting turns in the l.o.t. are probably causing the trouble, and these would not be revealed by a continuity check of the windings. However, before replacing this component, check the screen voltage of the line amplifier valve and the booster circuits and components.

FERGUSON 506T

Shortly after switching on the PY32 gets red hot and its anode glows brightly. This is followed by the fuse blowing.

I have replaced the main electrolytic capacitor and the PY32. I have checked the mains dropper, mains on/off switch, the Varite and the smoothing choke without discovering the cause of the fault. I also noticed that the ECC82 glows very brightly on first switching on.—A. Bailey (Manchester, 9).

The initial glow build-up of the ECC82 is often quite normal. Your remarks, however, indicate that there is an almost dead short-circuit on the cathode feed from the PY32, and you should have no difficulty in tracing this with an ohmmeter.

ULTRA VT917

A fault has arisen in the contrast control circuit which prevents the contrast being reduced sufficiently, although the control is still operative.

This fault was cured temporarily by reducing the cathode voltage of V96 ('Trader' service sheet) but the fault re-occurred. All the valves in the a.g.c. circuit have been checked by substitution, and there is no leak in the coupling capacitor from V96 to the contrast control.—R. C. Morris (Birmingham, 23).

This trouble could exist in the signal circuits, for the negative voltage sent out to the controlled valves is obtained from rectification of the vision signal. Now if there is insufficient signal, then there will be insufficient negative voltage to cut vision channel gain to zero. Alternatively, trouble in the circuits and components feeding the control voltage to the controlled valves may be responsible. Check also the clamping a.g.c. diode.

SOBELL T171

A black horizontal band, about 1½in. wide, appears at the bottom of the screen. This can be reduced in width to about ¾in. by adjustment to the height control but then the top part of the picture is much extended. Also, the picture sometimes has the appearance of being unsteady.— A. R. W. Fitch (Ruislip, Middlesex).

The gap at the bottom of the screen is caused

by a fault in the frame timebase. The most likely cause is low emission of the frame output valve; but if this checks normal, check, preferably by substitution, the components associated with that stage. Also ensure that the vertical form control is adjusted for the best vertical geometry of the picture in conjunction with the height control. The mains adjuster should also be checked to see that it is set correctly.

ENGLISH ELECTRIC 16T11D

The picture takes a very long time to come up after switching on.

I have replaced the thermistor; also the PL81, PY81, two ECL80's and V1, V2 and V3 (EF80's).

When the picture eventually does fill the screen, it is very dark but then it gradually increases in brightness until it is normal.

I would also add that I have just fitted a new tube to the set but with no improvement.—S. J. Evans (Rhondda, Glamorganshire).

The delayed picture effect, if not due to the thermistor, is probably caused by a tired valve. Have all the vision valves tested for emission and replace any that do not reach full emission after three minutes.

QUERIES COUPON

This coupon is available until AUGUST 22nd, 1963, and must accompany all Queries sent in accordance with the notice on page 519.

PRACTICAL TELEVISION, AUGUST, 1963

TEST CASE -9

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.

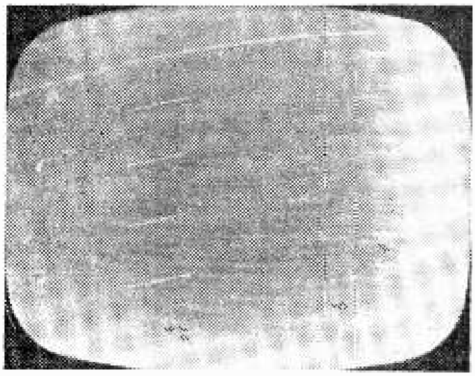
? *Here both the sound and vision were affected. Across the picture appeared a series of white, horizontal lines, as shown in the accompanying photograph, while a gentle hiss could be heard behind the sound.*

Several tests were made to establish the cause of the trouble, and it was found that when the aerial was removed and the brightness control turned up, the lines were still present, but now they tended to develop as a vertical column of short, irregular horizontal lines towards the right-hand side of the screen. The hiss was also present from the loudspeaker with the volume control turned up towards maximum.

It was also discovered that the symptoms were present on both BBC and ITA, but that they were more severe on the BBC channel. The trouble seemed to be worse when the set was switched on for the first time after being left all night, and that they tended to reduce considerably towards the end of a day's viewing.

What would be the most likely cause of these symptoms, and what steps could be taken to prove the trouble and restore normal working?

See next month's PRACTICAL TELEVISION for the solution and for another problem.



Typical vision symptoms of this month's Test Case.

SOLUTION TO TEST CASE 8
(Page 472 last month)

Last month's Test Case was a typical example of "magnetic distortion". The better replacement loudspeaker unfortunately had an external magnetic field of such a strength that it was interfering with the normal deflection of the scanning spot on the picture tube. It was, in fact, influencing the electron beam.

The best solution to this problem would have been to change the loudspeaker with one having considerably less external magnetic field—sometimes called a closed-field speaker. Loudspeakers of this type are now used extensively in television sets for the reasons given.

Alternatively, the speaker field—if not too great—could probably have been neutralised by positioning a small bar or rod magnet near to the flare of the tube, on the side opposite to the loudspeaker. Modern sets in fact feature small rod magnets around the tube to correct the geometry of a large-screen, wide-angle picture.

Magnetic distortion may, of course, also be caused by placing a cabinet-type extension loudspeaker on top of the television set. Fitting a tube heater booster or isolating transformer too close to the tube can have a similar influence on the electron beam, as also can the inadvertent magnetisation of the metal parts of the set surrounding the tube by the use of a magnetised screwdriver!

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LETTERS TO THE EDITOR

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

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

STRAIGHT TO THE POINT

SIR,—I am inclined to agree with the opinion expressed in your July Editorial that " the days of the purely practical service man are numbered "; and yet I sometimes wonder at the ability of a few of the television repair men I regularly come in contact with, who, without any reference to circuit diagrams manage to hunt-down faulty components in a matter of minutes.

They admit, of course, that much of their skill has come from years of experience and that stock faults considerably lessen the number of problems which require detailed trouble-shooting; however, bearing in mind that any fault symptom appearing on sound or vision can originate from a large number of sources, their ability to go straight to the offending component is something to be envied as even the most advanced academic training, as far as TV repair work goes, does little more than give a better understanding of the step-by-step eliminating tests known to every service man.

Of course, theoretical knowledge in this field is becoming increasingly sought after, but I feel that potential servicing engineers should remember that a heavy, dusty chassis, covered with unidentified components and tangled wiring, is a far cry from the neatly laid out and clearly labelled chassis diagram of a text book!—R. P. HILLMAN (Dudley, Worcestershire).

REDUNDANT COLOUR CODE

SIR,—I really think that in these days of tremendous technical advancement in receiver design the colour code used for resistors is now completely out-dated. Surely the colour code was introduced in the days when a component was likely to be wired into a circuit so that any printed value would be obscured by its orientation or by another component or by thick dust.

Nowadays, however, when each component has its own position on a printed-circuit board and dust has little chance to settle on the plastic bodies of components, colour coding proves a waste of time and is likely to lead to confusion where colours become indistinct. Also the practice of colour coding capacitors ended long ago, so why should resistors be the only component in a TV or radio receiver still to be labelled in this archaic manner?—C. DENBY (Ruislip, Middlesex).

TELEVISION ADVERTISING

SIR,—I seem to remember that two or three years ago a good deal of public interest was aroused when some of the advertisements screened on ITV programmes came under sharp criticism. As a result of this it was resolved that the Authority should not permit comparative tests between specific products and similar, unnamed brands to be used as subject material for advertisements appearing on commercial television.

Whilst I could never understand the objection to this type of advertising, it does surprise me that no one has commented on the reappearance of such advertisements which have been televised in the intervening time between then and now.—A. C. CHILTON (Manchester).

[As Mr. Chilton states, there was a certain amount of criticism of TV advertisement material some time ago and steps were taken to ban some forms of advertising employing comparative tests. However, this ban applies only to washing powder and detergent advertisements. Any advertisements of this type which have appeared since then have been of products of completely different categories.—Ed.]

SERVICING TV RECEIVERS

—continued from page 503

oscillation and hum bars (black and white horizontal bands) with no picture modulation. The d.c. resistance of L41 is 9Ω, L42 is $3{\cdot}2\Omega$. An open circuit in L40 or L39 (16Ω) will produce similar symptoms.

If the fault is of an intermittent nature, disturbing these items with a probe will often reveal which is at fault. A short lead with a crocodile clip on each end is an extremely valuable item to keep handy as it enables suspect chokes etc. to be shorted out without the side effects which are often introduced if the hand is brought near sensitive parts of the circuit.

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