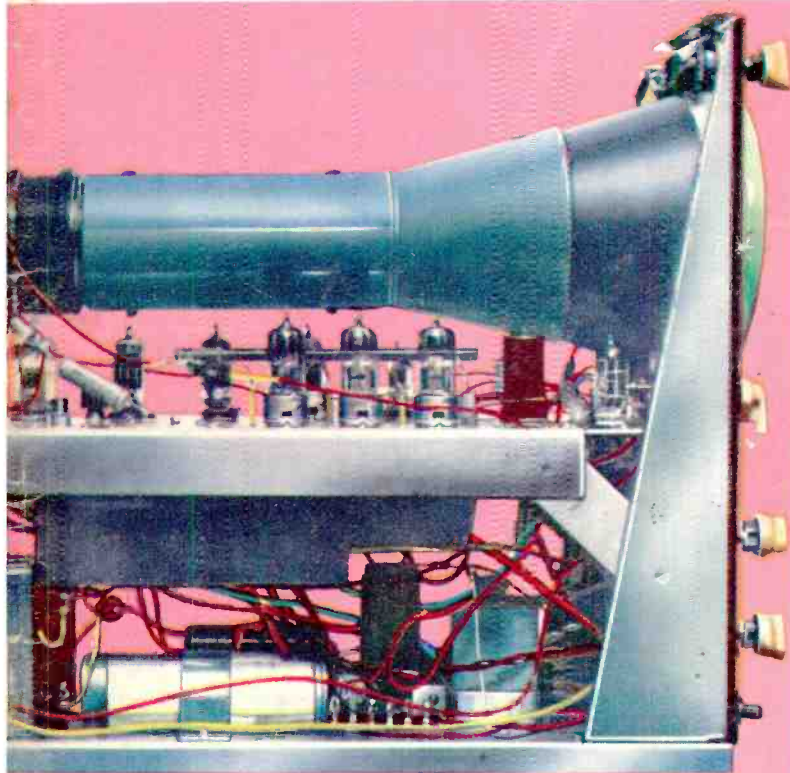


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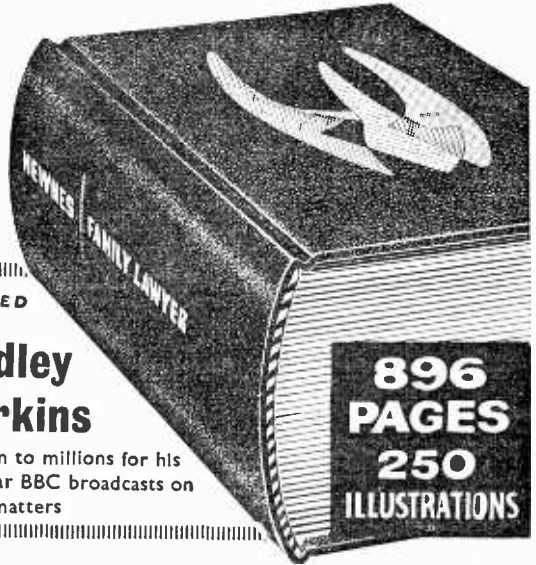
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Practical Television

AND TELEVISION TIMES

VOL. 13, No. 153, JUNE, 1963

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PRACTICAL TELEVISION

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The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television". Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for the manuscripts, every effort will be made to return them in a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to The Editor, "Practical Television", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

Owing to the rapid progress in the design of radio and television apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

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Progress of CCTV

THE possibilities of closed circuit television have, of course, been recognised for many years, but now what was once a novelty is becoming fairly commonplace. In medicine, in industry, in teaching, CCTV is playing an ever-important role.

When one begins to consider the possible applications, or even of the applications today accepted as quite ordinary, the prospect is quite staggering. In the Space Age, CCTV must inevitably prove even more spectacular.

But apart from the obvious serious uses, CCTV is now finding contact with the public. For instance, a large store can televise live fashion shows on a number of monitor receivers placed at strategic positions throughout the building. And more humble shops can, with quite modest outlay, devise customer-attracting displays using modern compact equipment. The potentialities are legion.

With the advances in design and reductions in costs, yet another prospect opens out, and one, moreover, highly pertinent to readers of PRACTICAL TELEVISION. This is the exciting possibility of CCTV as pure entertainment—CCTV in the home.

Modern equipment is sensitive enough to operate in normal room lighting, eliminating the need for expensive lighting installations. The cameras need only the minimum of skill to operate and the controls are no more difficult to use than those of a normal domestic TV receiver. And although monitor units are necessary for more than one outlet, the ordinary home TV set can be used for a single display.

Bearing these things in mind, and taking into account the innumerable uses that come to mind, CCTV could develop into a major feature of home entertainment. And, of course, CCTV is attractive to those with more serious interests and is ideal for such things as TV microscopy.

We have been watching the rise in interest in home constructed CCTV for some time and have been accumulating data. We have also been active in the practical sense, too, and prototype equipment suitable for the home constructor is now being built in our laboratory.

Results are encouraging and we hope soon to begin a series of constructional articles dealing with this equipment, once we are completely satisfied that any possible sources of difficulty, both electrical and constructional, have been eliminated. We want to ensure that the maximum number of readers will be able to construct this equipment.

There are also a number of other interesting constructional items lined up for your future issues and we are particularly pleased to be able to present, in this issue, the Henlow oscilloscope. This is not just another oscilloscope. It is a specially designed piece of equipment for TV work, and a study of the specification given on page 391 will show that it is an instrument worthy of serious consideration for TV experimenters.

Our next issue dated July, will be published on June 21st.

TELETOPICS

MICROSCOPE/TV CAMERA FOR SPACE CAPSULE

RECENTLY at the Royal Microscopical Society in London, members witnessed a demonstration of a "mini-microscope" connected to a closed-circuit television camera which might one day be used to examine closely minute specimens picked up from the surface of another planet. The microscope has been designed to be compact and light enough to be included in a space capsule that would deliver such a load.

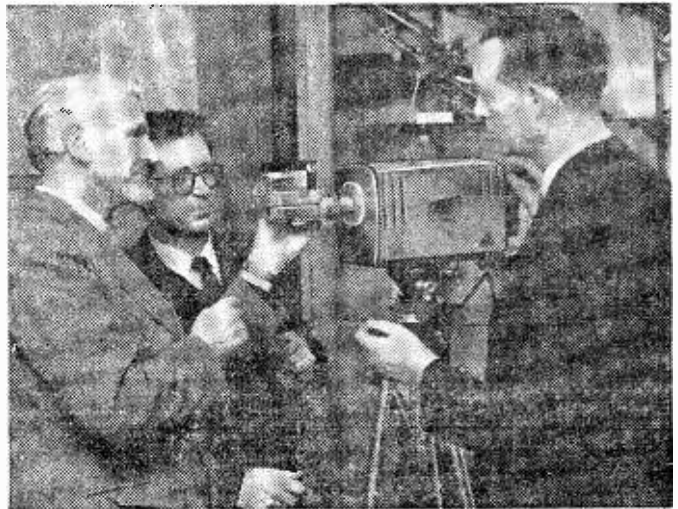
The TV camera which is of specially rugged construction, is marketed in the UK by the Rank Kalee Division of the Rank Organisation, and is at present being used in some American missiles. A major problem still to be overcome, however, is the need for suitable apparatus to transmit the pictures over such vast distances, but this cannot remain an insurmountable problem for long.

A specially designed microscope fitted to a TV camera.

New Station at Forfar

IT has been announced by the BBC that plans are going ahead to provide a new transmitting station near Forfar, Angus, which will serve the southern half of the county and parts of Kincardine, Perth and Fife. This station will improve and extend the coverage of BBC television and v.h.f. sound in these areas and a contract for the supply and erection of the 500ft mast has already been placed.

The station is expected to be complete early next year, and a separate TV relay station is to be built to serve Dundee.



TV EQUIPMENT ON NEW TANKER

A SUNDERLAND firm of shipbuilders is at the moment engaged in the construction of an 80,000 ton tanker for a Norwegian shipping line, which when complete, will be equipped with closed-circuit TV equipment as an aid to its navigation.

The equipment consists of remote-controlled cameras, mounted on platforms fore and aft, and connected to a monitor in the wheelhouse. It is anticipated that this equipment—which has been developed by the Kalee Division of the Rank Organisation—will greatly facilitate navigating the ship through docks and harbours.

New Mast for Welsh Programme

ONLY 160ft away from the existing television mast at Wenvoe, near Cardiff, is the site of a new BBC mast, planned to transmit the future Welsh National Programme. The BBC has already placed an order, with the British Insulated Callender's Construction Company Ltd. for the supply and erection of the mast, which will rise to a height of 620ft.

CCTV for Microscopic Inspection

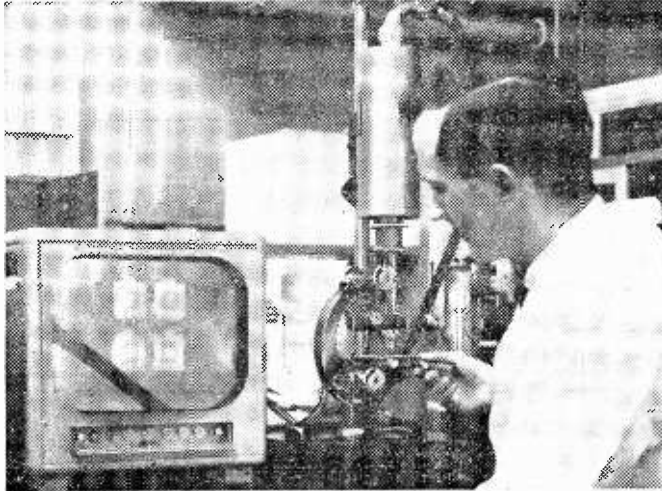
MICROSCOPIC inspection of minute electronic components is more convenient if the image from the microscope can be reproduced on a screen, and at the

Mullard research laboratories at Great Baddow, near Chelmsford, a closed-circuit camera channel is being used to present enlarged images of micro-miniature com-

ponents on a 14in. monitor. This process enables such components as transistors to be shown to more than one person simultaneously and recently planar transistors have been subjected to this kind of inspection for mechanical faults, etc.

The transistors are manufactured on a slice of silicon by a photolithographic process, and therefore, any slice may conveniently be mounted under the microscope. The camera is mounted above the instrument with the eyepiece removed, and the image can then be focused simply by use of the camera controls. The final image displayed on the monitor screen is a magnification of the transistors (which are, in fact, only six thousandths of an inch square) of approximately 300 times.

A camera mounted over a microscope magnifies planar transistors 300 times.



X-RAY IMAGE INTENSIFIER TUBES TO TRACE ULCERS!

BY coupling a television camera directly to a Mullard X-ray image intensifier tube, viewers of the BBC series "Your Life in their Hands" were recently able to see how doctors trace gastric ulcers using this equipment.

TV IN THE SCIENCE MUSEUM

LECTURERS at South Kensington's Science Museum will soon have the use of closed-circuit television to aid them when delivering lectures. EMI Electronics Ltd. is to supply the equipment, which will be installed in the Museum's lecture theatre, and which will transmit close-up pictures from the lecturer's bench to two 23in. receivers placed towards the rear of the theatre.

This will enable people sitting at the back of the theatre to see clearly any small specimens with which the lecturer may choose to illustrate his talk.

The image intensifier tube tracks the path taken by a barium meal, which is swallowed by the patient, so that the location of the ulcer may be revealed by an X-ray examination. Normally the image intensifier tube is linked to a closed-circuit system, which is a great improvement on previous methods of recording X-ray images.

93rd SMPTE Convention

SCIENTISTS and television technicians from all over the U.S.A. and many other countries converged on Atlantic City, New Jersey, during April, to attend the 93rd semi-annual Convention of the Society of Motion Picture and Television Engineers.

During the five days of the Convention, every different aspect of television was covered by films, lectures and exhibits. Many distinguished engineers gave lectures on subjects ranging from transistor camera circuits to educational TV; from Telstar to studio programme production.

Outside Broadcast Unit for Hungary

IN 1960, Magyar Televizo, the Hungarian broadcasting authority, ordered an outside broadcast unit from EMI Electronics Ltd. Recently they have ordered a second unit, of identical design to the first.

The vehicle is to be equipped with four image orthicon cameras and a zoom lens. Like the first unit, the new vehicle will be built on to a 7 ton Bedford chassis, and will be used to televise outdoor events from all over Hungary.



THE HENLOW

wide-band

OSCILLOSCOPE

A high quality instrument specially developed for television application

designed and described by
D. R. BOWMAN

Part One

IN any serious development work with television circuits it is almost mandatory to possess an oscilloscope of reasonably high quality. Just how good it needs to be is not too difficult to establish and this will be dealt with later.

However, the demands of any television system are known to be somewhat severe and it must be expected that the simpler types of instrument will be inadequate except for the more rudimentary aspects of testing. The present design is intended to put within the reach of the amateur a high-grade oscilloscope capable of undertaking both more elementary and more advanced work and at the same time be inexpensive and relatively easy to construct both mechanically and electrically.

The Display Tube

To begin with, the design is centred on the old cathode ray tube VCR97. This was at one time a favourite tube for experimental television receivers and proved to be a good picture tube of its kind. It is still available, as a look through the advertisements in this journal will show, and is cheap. However, there are few serious experimenters who do not have one laid aside somewhere.

There is, of course, no harm and indeed considerable benefit in using a more modern tube if desired. In any case a 5 or 6in. tube is recommended. Although much good work can be done with tubes as small as even 1in. diameter, the convenience of a 6in. display is such that the average constructor will be convinced at first sight.

Oddly enough, the present British 405-line system presents the severest condition in displaying line synchronising pulses. The r.f. picture waveform is seldom if ever required for display except for its primary purpose of producing a picture. In

this system the rise time is less than $0.25\mu\text{sec}$, while in the 625-line system a rise time of $0.256\mu\text{sec}$ is specified. The difference is not great, however.

Rise Time

The rise time is usually given as the time taken for the edge of a pulse to rise (or fall) from 10% to 90% of its extreme values. The frequency response corresponding to this is given by the expression:

$$\text{rise time in microseconds} = \frac{0.7}{0.9 \times \text{bandwidth in Mc/s.}}$$

bandwidth in Mc/s.

Thus a conservatively estimated bandwidth for the 405-line pulses would be 3Mc/s, which is, of course, the allotted bandwidth transmitted.

If, however, an oscilloscope is used whose Y-amplifier bandwidth is 3Mc/s the Y-amplifier is also contributing an error: this amplifier would, of course, display an instantaneous pulse as one whose rise time was $0.25\mu\text{sec}$.

If a pulse of actual rise time $0.25\mu\text{sec}$ were displayed it would appear as if it had a rise time of $0.35\mu\text{sec}$ —an error of some magnitude. While this would hardly matter in routine receiver servicing, development work calls for something better in order of magnitude.

In the instrument here described the Y-amplifier is arranged to have a bandwidth of 20Mc/s. Although this bandwidth can be achieved by conventional amplifiers, here a "distributed" amplifier is used as it has several practical advantages, especially in its relative simplicity and stability; in addition the use of such an amplifier overcomes the difficulty of arranging an output stage capable of developing 80V or more to divide the Y-deflection plates of the cathode ray tube. The design details will be discussed later.

The Timebase

The timebase generator is of the familiar Miller-transition type, modified to obtain extremely fast flyback.

Provision is not made in this circuit for flyback blanking of the cathode ray tube display, although it can be incorporated, if desired, by a simple addition to the circuit. The reason for this

The Henlow Wide-band Oscilloscope SPECIFICATION

Power Supplies

200-250V; 40-60 c/s; a.c. only; consumption 120 W.

Display Tube

VCR97: electrostatically focused and deflected. 6in. diameter screen, medium-persistence green phosphor.

Alternative types: any modern 5in. or 6in. tube of similar character, not requiring high p.d.a. voltage.

E.H.T.: 1,600V, reducing to 1,450 for best astigmatism control setting.

Graticule: removable, rotatable, and without illumination. 6in. dia., engraved lines 1cm. apart vertically and horizontally.

Spot diameter: 0.5mm. maximum at 1,600V e.h.t.

Shifts

X-shift: 100% of maximum deflection.

Y-shift: 500% of maximum deflection. (Both direct-coupled.)

Timebase Output

40V p.p. into 1,000 Ω shunted by 50pF.

Timebases

Ranges: less than 30cm/sec to 10cm/ μ sec in 11 ranges, under unexpanded conditions. With expansion, up to 50cm/ μ sec. Free running.

Calibration: calibration scales not provided as intensity-modulated markers are available on all ranges.

Linearity: up to 20c/s—10% increasing to 2.5%. 20c/s upwards—3% or better.

Trace expansion: up to 8x normal except on highest ranges, where it decreases to 5x normal expansion from centre of trace. Continuously variable.

Sync: external or internal.

Jitter: not measurable with 100n sec rise-time pulse.

Y-Amplifier

Deflection sensitivity: 100mV/cm at 1,600V e.h.t.

Impedance: 1M Ω shunted by 12pF.

Response: 12c/s to 20Mc/s.

Attenuator: frequency independent up to 20Mc/s.

Sag: not measurable at 50c/s.

Linearity: 1.5% of full deflection.

Gain control: stepped attenuator giving \div 1, 2, 4, 8, 16.

Accuracy: 1%.

Compensation: not necessary.

Mains Surges

Y deflection—2cm
X deflection—0.3cm } for 5% sudden change.

Valve and Semiconductor Complement

Sync amplifier—EF95.

Timebase generator—EF91, EA50 or $\frac{1}{2}$ EB91, ECC82.

Sweep amplifier—ECC84.

Pulse amplifier—EF95.

Marker oscillator—ECC81.

Y-input—EC91.

Pre-amplifier—EF91.

Distributed amplifier—EF184 x 3.

E.H.T. rectifier—EY51.

Bias supply and marker clamp OA81 x 2.
Power supplies: silicon diodes 500mA, 1,000V p.i.v. types (2).

Neon indicator—any miniature panel-mounting type.

Limiting Fuse—motor side-lamp 6V 0.5A.

Cathode ray tube—VCR97.

Dimensions

16 $\frac{1}{2}$ in. x 7in. x 15in. (17 $\frac{1}{2}$ in. deep over projecting knobs, 16 $\frac{1}{2}$ in. high over carrying handle).

Weight

19 lb.

Cooling

Natural.

apparent omission is that while at low speeds of scan the flyback pulse falls accurately on the flyback, at high speeds delay occurs in charging up the stray capacitances through the stray inductances of the circuit, and the flyback pulse is a fraction of a microsecond late in arriving at the cathode ray tube.

Thus the first part of the trace is lost and maybe with it part of the pulse which ought to be displayed. Also, the time of flyback is not clearly defined, and so in measurements involving time or frequency, errors may occur because one or more

cycles of the displayed waveform are lost in the flyback.

In this instrument the brilliance can be advanced to show the flyback trace and any part of the display so "lost" can be accounted for.

At the highest speeds the flyback trace takes an appreciable fraction of the scan time and is visible at all but the lowest brilliance set-up. When being used on the first ten ranges, however, flyback is extremely rapid and although visible in a darkened room at fairly high brilliance set-up is hardly noticeable at all in use.

Synchronisation

The timebase generator is synchronised either from an external source or by switching the Y-amplifier output to the sync amplifier. This consists of a pentode valve operated with a low and variable screen voltage. By this means the grid base is much shortened, so causing the valve to operate as a slicer. The actual grid base is determined by d.c. control of the screen voltage, which enables the signal to be kept out of long leads and also provides a measure of automatic synchronisation.

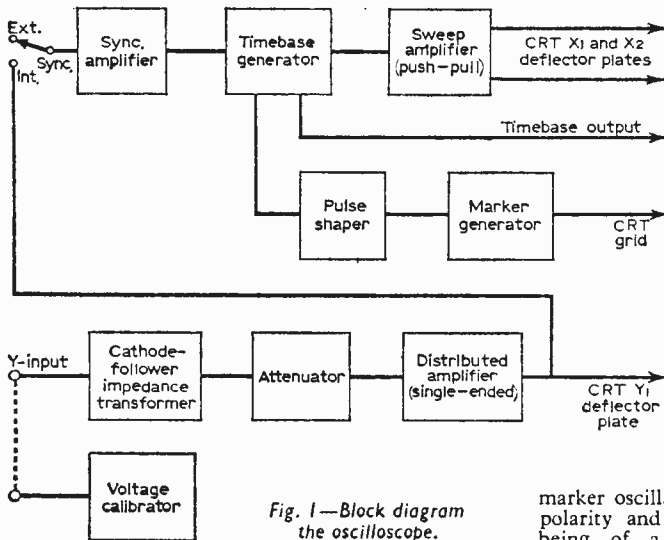


Fig. 1—Block diagram the oscilloscope.

A positive-going signal on the grid of V1 causes the anode voltage to drop considerably; this negative pulse, if of sufficient magnitude to overcome the bias across V2, is passed to the anode of V3 and thence by way of the Miller capacitance to the grid of V3, cutting off the valve and allowing the anode voltage to rise to the level of the h.t. line. Thus the flyback is initiated.

The timebase generator produces a very linear sweep of about 40-60V magnitude. This is not great enough to scan the cathode ray tube and so an X-amplifier of the cathode-coupled triode configuration is employed to produce the necessary sweep voltage. This type of amplifier has the advantage that it is very insensitive to hum voltages and, although the power supply smoothing is of excellent characteristics, any help in this direction is of value.

Another advantage is that a push-pull output is obtained and this is of great value in avoiding deflection defocusing of the trace. With the VCR97 specified, good focusing can be achieved with asymmetrical deflection, but many modern tubes are sensitive in this respect.

Bandwidth

The bandwidth of the X-amplifier need not be very great and the 47k Ω resistors in each anode

need cause no surprise. With triodes, relatively high values of anode resistor, relative to the anode impedance of the valve, must be employed to achieve acceptable linearity of scan.

For this reason the ECC84 is used in this position: the anode impedance is low, even when the effects of the 2.2k Ω cathode resistors—which introduce current negative feedback—are taken into account.

The loss of bandwidth is not severe and in fact the trace is exceptionally linear except that on the highest ranges the corners of the sawtooth are rounded off, causing a little cramping in the first and last $\frac{1}{4}$ in. of the trace; the main part of the trace is still very linear.

X-Expansion

Since the timebase voltage is ample, the provision for X-expansion is readily provided. The trace can be expanded on all ranges to at least eight times the screen diameter, and expansion is from the centre of the trace, which proves to be most convenient in practice. The differential X-amplifier also allows of very ready X shift by varying the grid voltage and hence the differential anode voltages.

Marker Generator

The screen pulse of the Miller valve, on flyback, is used to control the operation of the time-marker oscillator. The direct pulse is of the wrong polarity and is insufficient in amplitude, besides being of a rather indeterminate shape which additionally alters with the position of the range switch. Hence this pulse is shaped and amplified before being put into use.

This is accomplished by means of the pentode V6, which is operated with low anode and screen voltages and is direct coupled to the screen of V3. The 5pF capacitor across the 3.3M Ω coupling resistor is for "speed-up" purposes and its value was determined especially to give the best pulse shape on the fastest timebase ranges, where the problem is most severe.

A good square negative pulse is hardly ever obtained on the grid of V6, but the positive pulse at its anode is well formed and of high amplitude.

V7A and B are connected in an oscillator circuit whose frequency can be switched to any of three spot frequencies, 1Mc/s, 100kc/s and 10kc/s. The oscillator is arranged to operate very "fiercely" and an output waveform is obtained which is rich in harmonics and is therefore a distorted sinewave, somewhat "spiky" in appearance.

This is just what is needed to modulate the cathode ray tube beam so that the display shows, instead of a continuous trace, a series of sharply determined dots whose distance apart is 1 μ sec, 10 μ sec or 100 μ sec as desired.

For switching on this oscillator at the beginning of each scan a special circuit is used which ensures that the oscillator always begins in the same place. If it did not the dots would fall in random positions

on subsequent traces and no markers would be visible.

Arrangements are also made for the grid of the cathode ray tube to be kept below zero volts relative to its cathode: if this was not done the life of the tube would be shortened seriously.

This type of marker is generally preferable to that which causes a "pip" to be superimposed on the waveform displayed. This latter can often obscure small features of the wave, a state of affairs easier to avoid if the markers are of brightness-modulation. Brightness modulation for this purpose is sometimes described as "2-axis" time marking.

Voltage Calibrator

As all three positions are needed for the time-markers, two of the remaining positions of the switch are devoted to the provision of 50-cycle calibrating volages. These are obtained by means of resistive voltage dividers across one of the 6-3V transformer windings; 1V and 0.1V peak values are provided at a socket brought out to the front panel of the instrument, whence a small piece of wire only is needed to connect to the Y-amplifier input.

This is done to avoid internal switching, which necessarily has to be in circuit all the time and adds materially to the input capacitance of the Y-amplifier. In this circuit the Y-amplifier has a very high input resistance—over $1M\Omega$ —shunted by only 8pF, and additional strays of even only a few pF are to be avoided if the care taken in design and construction is not to be nullified.

Step Attenuator

A stepped attenuator is provided, in preference to a continuously variable gain control, for the Y-amplifier, largely because the resetting accuracy is so much better. During development of the oscilloscope the attenuator was given more thought than might be imagined.

It was realised that if time-consuming and delicate adjustments were to be avoided the attenuator used would have to rely upon inherent impedance of frequency rather than upon corrections to be applied after construction.

As is well known, at the higher frequencies the self-capacitances of resistors alter their effective value and a simple voltage-dividing network divides voltage as much by capacitance as by resistance. This can be avoided by using low-value resistors of a few tens or hundreds of ohms, but, of course, if such an attenuator were placed in the grid circuit of a valve the Y-amplifier would have an unacceptably low output impedance.

The case of the "few ohms" resistor, whose errors are due to self-inductance, can, of course, be neglected.

Accordingly, in this circuit, a cathode-follower input valve is used whose bias is given correctly by the cathode resistor employed. The output impedance is very low, suitable for feeding into an attenuator comprising low-value resistors. The attenuator is terminated by the cathode impedance of a grounded-grid amplifier, the anode circuit of which develops the voltage which is fed into the grid line of the distributed amplifier proper.

This type of attenuator arrangement suffers from the disadvantage that the input cathode follower

has less than unity amplification and that only half this reduced output can be developed across the following grounded-grid amplifier input. However, this reduction in gain can be made up later, and the circuit shows negligible frequency-dependence up to 20Mc/s, the bandwidth of the Y-amplifier.

Actually, separate tests show that negligible errors occur up to at least 40Mc/s, so that is plenty in hand.

Power Supplies

Power supplies for this oscilloscope are modest and if the specified transformer is not obtainable a 350-0-350V 100mA type could probably be pressed into service. The e.h.t. is derived from a half-wave 900V winding, giving 1,270V rectified output at low load. The main h.t. supply is 300V at less than 100mA, and as the final anode of the cathode ray tube is connected to the positive h.t. rail a total e.h.t. of 1,570V is available.

Although the VCR97 is rated at 2,000V, and can actually operate at 2,500V to advantage, 1,570V permits of a spot diameter of less than 0.5mm at good brilliance. If a 350-0-350V transformer is used, e.h.t. will total only 1,340V, but this will result in only minor degradation of the display. In this case some slight alterations in the resistor chain may be needed to obtain the correct range of focus adjustment.

P.D.A.

If a modern tube incorporating post-deflection acceleration is used a voltage doubling arrangement raising the e.h.t. to a total of 2,800V can be employed. The intermediate anode should be connected to chassis and the P.D.A. anode to the main h.t. rail; this gives a little post-deflection acceleration, but not very much, and permits normal operation of the tube.

A tube permitting asymmetric Y-deflection should be chosen, as the distributed-amplifier output is single-ended. Alternatively, a secondary-emission output valve can be added to the amplifier, push-pull output being taken from anode and dynode.

Anode and dynode resistance of about 2.2k Ω each would enable an appropriate output to be obtained, with bandwidth of about 30Mc/s.

Construction

The instrument is constructed in double-decker fashion. The lower chassis is approximately 17in. x 7in. and the upper somewhat smaller, about 11in. x 7in. The lower deck is devoted to the larger hardware, such as the smoothing chokes and capacitors, and the transformer also if a stout zinc-metal box is available for encasing it. If not, this item is best separated completely from the oscilloscope, appropriate leads being made up into cable form to connect the "power box" with the main instrument.

The importance of this can hardly be overstressed. The transformer field is certain to distort the trace appreciably unless very effective shielding can be provided, and the usual zinc-metal screen around the cathode ray tube is not normally effective enough to overcome the trouble.

CONTINUED NEXT MONTH

Line Timebase Troubles

by K. Royal

THE line timebase of a television set differs essentially from the frame timebase (see "Frame Timebase Troubles" Practical Television, January, 1963) in that apart from producing electromagnetic power to deflect the scanning spot horizontally from the left to the right-hand side of the screen of the picture tube, it also has to generate the extra high voltage (e.h.t.) to energise the final anode of the picture tube.

This often means that if a line timebase fault develops nothing at all can be seen on the screen. This makes life rather difficult, for one cannot be immediately sure that the trouble is, in fact, in the line timebase section as a whole, for exactly the same symptom would be produced by failures in other parts of the circuit. However, one or two speedy tests soon reveal the fault area.

Before we look at faults, let us get up on the make-up of the line timebase section of a modern receiver. There are three stages concerned, which are (i) the line oscillator or generator, (ii) the line amplifier or output and (iii) the booster diode circuit. As with a frame timebase, the line circuits push a sawtooth current through the line scanning coils (Fig. 1), the rising part of which pulls the scanning spot from the left to the right of the tube at a constant speed. The falling part of the current waveform causes the spot quickly to return to its starting point at the left-hand side of the screen.

To produce a constantly rising sawtooth current in the scanning coils demands a very carefully tailored voltage waveform both in the line oscillator and output stage, and this "tailoring"

is done by resistive and capacitive networks and other artifices which are related chiefly to the design of the circuits and need not concern us unduly in this article.

When the current falls on the trailing edge of the sawtooth, a very rapid current change occurs in the inductive elements of the circuit, the effect of which is rather like a dynamo being spun at a terrific speed over half a revolution. Across the inductances is induced a very high value peak voltage. This voltage (or peaks of voltage) is applied to the anode of the e.h.t. rectifier, so that across the reservoir capacitor in the cathode circuit is developed a d.c. charge. In modern sets this rises up to 18kV and is fed away to supply the tube final anode. Note that the charge in the reservoir is always in excess (or should be) of the e.h.t. current requirements of the tube. The analogy is the water reservoir—or any other kind of reservoir for that matter. If the tube burns up more power than that available in the reservoir capacitor, then the raster "blows up" and goes out, leaving a blank, unlit screen.

First Symptom

Here, then, is our first symptom, and this can be caused by the booster and line amplifier valves failing to provide sufficient power to fully recharge the reservoir and by the e.h.t. rectifier being low emission. The tube taking too much current due to poor vacuum or gas or by turning the brightness too high to overcome a tube fault are other causes of the effect, which should be duly noted. Sometimes misadjustment of the ion trap magnet on the tube neck encourages the symptom, and when all else fails check the ion trap setting with the brightness two-thirds on. Always adjust the magnet—along and around the neck—for maximum brightness.

On 405 lines the timebase runs at 10,125c/s and can be heard as a high-pitched whistle. With age, the response to high-frequency sounds diminishes, so in order to tell whether or not the line timebase is working it may be necessary to adjust the line hold control so as to reduce the line frequency a little. On 625 lines the line speed is 15,625c/s—a frequency which is above the auditory responses of almost all but the very young. This is one thing in favour of the 625-line system, for the shrill 10,125c/s whistle of the

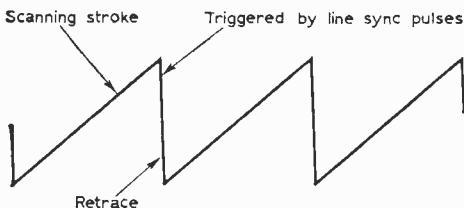


Fig. 1—The scanning and retrace current waveforms which are required in the line scanning coils to deflect the scanning spot from left to right linearly and from right to left swiftly, at 10,125c/s on 405 lines and 15,625c/s on 625 lines.

405-line system is disconcerting to a large number of viewers, and normally there is not much that can be done to alleviate the noise. It is sometimes possible to hear a 625-line timebase by turning the frequency down as far as possible by the line hold control—the whistle, of course, indicating that, at least, the line generator is working.

Listen for the Whistle

If a set from which the line whistle has normally been audible suddenly fails to give screen illumination and the whistle, there is little doubt that the line timebase has ceased to operate. The whistle comes from a magnetostriction action in the core of the line output transformer (magnetostriction means dimensional changes produced in a magnetised magnetic material). Sets using line blocking oscillators may create a small whistle from the blocking oscillator transformer.

Let us look into this in greater detail. Suppose our set uses a multivibrator line oscillator (no transformer) and the whistle and raster fail. We know definitely that the line timebase is wrong, but we cannot be sure whether the oscillator or output stage is responsible. A fault in the output stage, booster diode stage or shorts in the line output transformer could give both effects—as, of course, could complete failure of the oscillator. However, if the oscillator remains functioning, this can usually be heard as a very soft whistle even though the amplifier or boost sections may be totally defunct; but often to hear this soft whistle the ear has to be held close to the chassis and the line hold control turned from one end to the other of its range. Once the whistle is heard under the unlit screen fault condition all attention can be directed to the amplifier/booster section.

If there is no trace of the whistle, one can still not be absolutely sure that the oscillator is bad, and there are three ways by which this can be proved. One is to look at the line waveform by connecting an oscilloscope to the signal grid of the line output valve, another is to concentrate the line whistle into an earphone by connecting it—via 0.001 μ F capacitors (one in each lead)—between the signal grid and chassis and the third is to measure the negative potential at the signal grid of the line output valve, relative to chassis. This requires a sensitive voltmeter (at least 10,000 Ω /V) or a valve voltmeter.

When the output stage is receiving signal from the oscillator, the grid usually goes fairly heavily negative (20-30 volts, depending upon meter load $^{\circ}$), and the potential can be made to vary by adjusting the line hold control. If there is a variable negative voltage at this electrode, therefore, one can be reasonably sure that the oscillator stage is working.

Oscillator Not Working

If it is thus proved conclusively that the oscillator is inactive, subsequent operations become obvious. A few voltage checks in and around the oscillator section, a check of the associated components and the valve itself (note that the valve may be a part of a double valve—such

as the triode of a triode-pentode, for example) will soon reveal the part responsible for the failure.

If the oscillator is working, however, lack of line whistle may or may not indicate a line amplifier fault. Some sets do not produce much whistle even when they are working correctly and—as already explained—there is the possibility that there is a whistle but that it cannot be heard.

If the set is known, then the whistle will be conspicuous by its absence—if it has failed; but on the other hand a set which is not known to the repairer may not give a distinct clue in this respect. The amplifier may be working quite happily but the unlit screen may be caused by lack of e.h.t., back-bias on the tube or, in fact, a faulty tube.

E.H.T. Rectifier Heater

If the amplifier is working the e.h.t. rectifier heater should be alight, since this heater is energised by stepped-down pulse voltage developed across a few turns of wire on the line output transformer. If there is a glow here, then there should be e.h.t. voltage on the e.h.t. lead to the tube final anode. This can be checked by holding the connector end of the lead a millimeter or so away from the metal chassis (hold well away from the wire conductor by the heavy insulation to avoid bad electric shock), and if there is e.h.t. voltage a vigorous discharge will occur between the gap.

If e.h.t. voltage is thus proved, the blank screen is caused by something other than a fault in the line timebase—and that is another story. . . . However, there is one rather important point to remember at this stage, and that is a heater/anode short in the e.h.t. rectifier (this sometimes happens) will put pulse voltage on the tube final anode and this will discharge somewhat more violently than rectified pulse voltage across the reservoir capacitor. Note also that on most recent sets the reservoir capacitor is formed by the capacitance between the inner and outer conductive coatings on the tube flare—with the glass as the dielectric. This means that the tube itself acquires a heavy charge and this can prove uncomfortable if discharged across the hands—it thus pays to discharge the tube before interfering with the e.h.t. circuits.

Rectifier Unlit

If the e.h.t. rectifier is unlit two things could be responsible: (i) open-circuit or otherwise defective e.h.t. rectifier heater or (ii) lack of pulse voltage. If the valve is proved good, useful information can often be obtained by operating the rectifier heater from a dry battery. The heater wires should be removed from the transformer winding and in place connected across a battery of correct voltage. The battery should be set up on a stand of very high insulation, as when the line timebase starts working the whole of the battery circuit will rise to e.h.t. potential. Keep the hands well clear when this happens.

If there is a full line scan with no apparent distortion, the trouble would have been caused by poor insulation on the e.h.t. rectifier heater winding on the transformer. More often than not, how-

ever, there will be a compressed line scan and very little e.h.t. voltage, giving a dim picture. By studying the picture, Test Card or raster one can sometimes pin-point the line amplifier/booster circuit trouble. Excessive compression on the left of the scan would indicate trouble in the booster diode circuit. A low emission diode or faulty booster reservoir capacitor (e.g., that capacitor—often about $0.25\mu\text{F}$ —in the booster diode cathode circuit) can cause this, while compression on the right-hand side may indicate a fault in the line amplifier valve circuit. Here the valve should be checked as well as the capacitor and resistor on the control grid electrode and the screen grid feed resistor and bypass capacitor if fitted.

Scan Coil Shorting Turns

A low overall line scan of a few inches often indicates shorting turns in the line output transformer. A symptom like that shown in Fig. 2 indicates shorting turns in the line scan coils, while a symptom such as that in Fig. 3 shows that the low pulse voltage is caused by the line oscillator running well off correct speed. If this happens the efficiency of the line amplifier falls badly and often the heater goes out. This can sometimes be

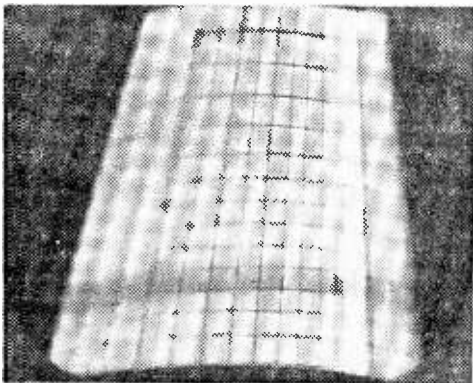


Fig. 2 (above)—The symptom of shorting turns in the scanning coils—often called keystone distortion.
Fig. 3 (below)—The symptom of incorrect line oscillator speed—see text.

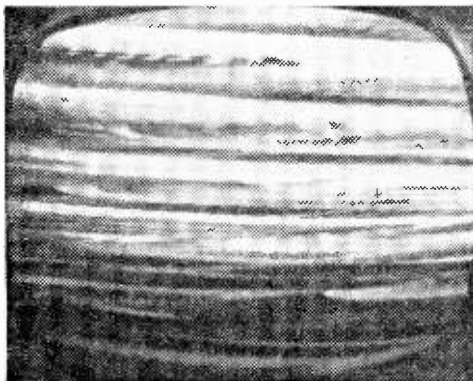


Fig. 4—The symptom of false line lock—see text.

demonstrated by turning the line hold control to the extreme end of its range—the heater will go out and the screen go blank. The trouble here then would be in the time-constant components of the oscillator. In the main the line hold control and its series resistors should be examined.

Shorting turns in the transformer or a definite defect in the amplifier or booster circuits—like a dud valve or shorting capacitor—or open-circuit resistor—would prevent the production of e.h.t. voltage even though the heater of the rectifier is being energised from a battery. There must be pulse voltage, of course, to give e.h.t. voltage, and if this is lacking there is nothing—apart from correcting the fault—that can be done to produce screen illumination.

False Line Lock

This symptom is shown in Fig. 4. Its usual cause is incorrect adjustment to the line hold control, but if a series resistor or time-constant capacitor associated with the control has altered in value it may be impossible to adjust the control for correct line lock, in which case with the control hard against one of its stops the false line lock symptom may occur. Note that if the bad component has changed a lot in value it may be impossible even to get false line lock, and then the effect would be as shown in Fig. 3.

Electron Oscillation

A symptom which is rarely illustrated is shown in Fig. 5. The vertical, ragged line is caused by a form of electron oscillation (B-K oscillation) in the line output valve. Sometimes there are several vertical lines and at other times the line may drift horizontally across the picture. The latter effect results from radiation of the interference from a nearby receiver tuned to a different channel from that being received by the affected set.

The symptom shows up mostly when the aerial signal is weak and in order to display it sufficiently to photograph it was necessary to reduce the

—continued on page 397.

The PRINCIPLES and PRACTICE of TELEVISION

By G. J. King

CIRCUIT REFINEMENTS OF MODERN RECEIVERS

CONTINUED FROM PAGE 369 OF THE MAY ISSUE

BEFORE going on to a new series—"Principles and Practice of Colour Television" (starting next month)—it will be worthwhile to summarise that which has been said over the last eight months and conclude this series by looking at a few recent developments in monochrome (black-and-white) television receivers.

Although colour television features several artifices which are not used in monochrome systems, colour does, nevertheless, have much in common with black-and-white circuit practice, and the salient points in this respect will be revealed in the summary.

In **Part 1** (October, 1962, issue) the requirements for a television broadcasting system were dealt with. It was shown that the system is in two distinct sections for sound and vision, while some of the sections are common to both. The main point is that the dipole aerial represents a tuned circuit but that its response is sufficiently damped to embrace both the sound and vision signals. On Band I the aerial is only one channel wide, while on Band III it may respond to two or even three adjacent channels, and on Bands IV and V up to ten channels may be covered with the one aerial.

Fig. 38 (right)—The line eliminator basic circuit as used by K-B in the VV series.

It should be noted that an aerial takes no cognizance of the information content of the signal. It serves essentially to collect as much as possible of the wanted signal only without mutilation. This means that there is no fundamental difference between the requirements of an aerial for receiving 405- or 625-line monochrome signals (though with the latter extra special attention may be given to the design to ensure that it passes the wider video signal spectrum) and colour signals. In detail, however, an aerial for colour would probably be somewhat more exacting than its monochrome counterpart simply because signal degradation would cause effects that are far less acceptable in colour than in black-and-white.

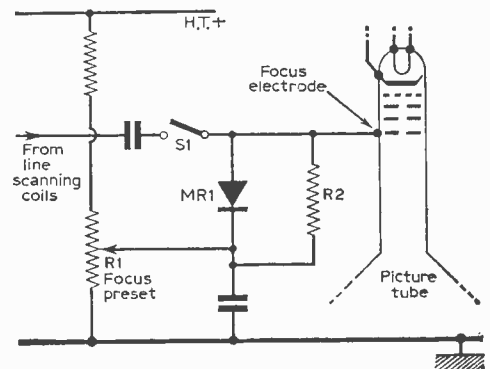
The propagation of v.h.f. and u.h.f. signals was considered in **Part 2**, and this will apply equally to

colour—more so, probably, as revealed in the previous paragraph from the aerial aspect. This article also gave information on line standards and definition. Note that colour television will be launched in Great Britain on 625 lines—probably in Bands IV and V to start with but later in the v.h.f. Bands as well.

Most of **Part 3** was taken up with the question of horizontal definition and how this is related to bandwidth. The size factor of the scanning spot was also dealt with. Everything that was said here applies equally to colour.

Part 4 dealt with types of receiver, including 405-line only and dual-standard models; also those which are at present suitable only for 405-line signals but which can later be altered to provide dual-standard operation. Colour receivers will, of course, be suitable only for 625-line signals and adaptable for operation on any channel in the u.h.f. and v.h.f. Bands.

The characteristics of the signals were also looked at and the technique known as intercarrier sound (that which is used with CCIR 625-line television



systems) was brought to light. The signal characteristics of colour programmes differ somewhat from those in monochrome but there are still quite a few common features which are necessary to make the colour system compatible. Intercarrier sound will also be used on the British colour system.

The main message in **Part 5** concerned the switching in dual-standard receivers and methods of conversion. This theme was taken up again in **Part 6** and developed in terms of extracting the intercarrier sound signal. Information on signal

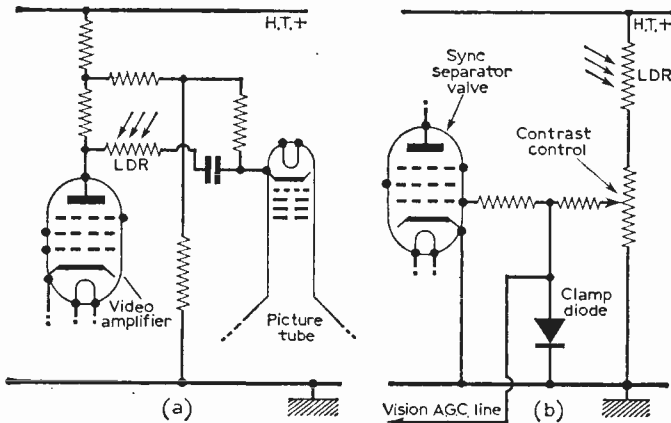


Fig. 39 (left)—Auto controls for brightness/contrast (a) and contrast (b). These work because the light-dependent resistor (LDR) falls considerably in resistance with increase of light falling upon it. The circuits are described in the text.

polarity and video amplifier biasing was also included. None of these things has any specific significance so far as colour is concerned.

Part 7 gave details of u.h.f. tests radiated by the BBC, details of u.h.f. aerials and an introduction to communal aerial systems.

Part 8 (last month) expanded the communal aerial system, showed how it could be used to carry 625-line signals originally radiated in the u.h.f. Bands, and finally gave details for planning a small system. The article concluded with details of reception of the u.h.f. test signals radiated by the BBC at distances up to 50 miles from the transmitter.

We now conclude this short series, which was designed to give a sort of bird's-eye picture of the television art as a whole, with a little information on the most up-to-date components and circuits to be found in today's television receivers.

Controlled Warm-up

As new as British 625 lines is the controlled warm-up feature of all new Mullard valves designed for operation in television series heater chains. Many experimenters will have noticed that when first switching on a television set from cold not all the valves heat up together. One or two of them may flare up brightly when the set is switched on and then gradually dim to normal brightness as the other valves warm up.

This state of affairs is caused by the heating characteristics of all the valves not being equal. The current flowing in a series-connected heater chain is governed by the total resistance of the chain, while the voltage developed across any heater depends upon the resistance of that heater.

Now the resistance of any heater is greater when it is hot than when it is cold. This means, then, that if one valve warms up more rapidly than the rest in the chain the effect on the current will be insignificant, while on the voltage across that valve it will be grave. Indeed the voltage could rise in excess of 50 per cent above the normal heater voltage. This can be damaging to the heater and will result in premature failure.

In the past this trouble has been alleviated by the use of a thermistor in the chain. A thermistor has a high resistance when cold and a low resistance when hot—the opposite to that of the heater. Thus

when the set is first switched on the chain current is limited by the high resistance of the thermistor, but as this gets hot so its resistance decreases, but it does this gradually and pushes a progressively rising current into the chain, thereby avoiding damaging surges.

The new Mullard valves, however, now make the thermistor somewhat obsolete in this application anyway, for the new method of manufacture under accurate and controlled conditions ensures that, without added protection, the voltage developed across any heater will not exceed the permitted 50 per cent above normal during the warm-up period. New sets, therefore, will appear without thermistor heater protection and due to this the warm-up time will be shorter, which means the faster appearance of the picture on the screen.

Line Eliminator

An ingenious method for the elimination of the scanning lines has been evolved by Kolster-Brands and is in use in the VV range of receivers. The basic circuit is shown in Fig. 38.

In effect the scanning spot is slightly defocused so that it is just about the right size to fill the space between the scanning lines without overlapping. The system is tied to the electrostatic focusing used in this range of models. Normally the electrode for focusing is not very critical so far as voltage is concerned and it is usually fed from a potential-divider preset from the h.t. line (R1 in the circuit).

The idea is to adjust this preset for the optimum results when the set is first set up and it is usually never necessary to alter the setting unless the tube or some other major component in the line time-base circuits is replaced. However, if the electrode is taken too positive, effects of poor e.h.t. regulation would occur—e.g. defocusing on whites, but if taken fairly high in a negative direction the degree of defocusing remains reasonably consistent over the whole brightness range of the picture.

This, then, is how the line elimination artifice works. With S1 open the focus electrode receives around 200/300V for optimum pin-point focus. When switch S1 is closed to bring in the line eliminator, pulses from the line scanning coils are fed to the rectifier MR1 (which is a high peak inverse voltage type by STC). The pulses are thus rectified and the d.c. output is developed across

the load resistor R2. Here there is about 500V, and since this adds in opposition to the positive voltage applied via the focus preset the tube focus electrode receives in the region of 200/300V negative relative to chassis. It is this heavy negative voltage which gives the line elimination effect.

Baby Alarm

This range of sets also incorporates facilities for a baby alarm or one-way intercom. A two-stage transistor amplifier, suitably isolated from the mains supply and receiver chassis, is powered from the set's h.t. line and picks up a signal from a microphone in the infant's bedroom. The output of the amplifier is switched to the a.f. stages of the set in such a way as to bypass the volume control.

Thus, despite the setting of the set's volume control, any disturbance in range of the microphone will give full output from the receiver's speaker and usually outweigh the sound volume of the programme itself.

Automatic TV

The present trend is for the introduction of automatic control devices to displace the manual control knobs. The aim in this respect, of course, is to reduce the "user" controls on a receiver to just one—the on/off switch. Although this has not yet come to pass we are well on the way. Already we have sound and vision auto gain control, compensating circuits in the frame and line timebases to cater for changes in power voltage and normal wear in valves and components and automatic contrast and/or brightness control circuits to adjust the set to its ambient lighting environment.

The circuits in Fig. 39 show how the latter auto control works in practice. The LDR is a light-dependent resistor which has the property of decreasing in resistance considerably as the illumination falling upon it rises. In Fig. 39(a) the LDR is connected between the video amplifier and the picture tube cathode circuit so that when the ambient lighting increases the decreasing resistance of the device causes a greater signal to be applied to the tube, thereby increasing the brightness and contrast to compensate.

In the circuit at (b) the LDR is connected in series with the contrast control so that a rise in ambient lighting results in an increase in positive voltage at the top of the control. This counteracts the negative a.g.c. bias from the sync separator stage as applied to the a.g.c. line, causing the line to go less negative and the gain of the vision channel to rise. In this way, therefore, the rise in lighting is balanced by an increase in contrast.

On some models the fine tuning control has already been dispensed with (except as presets) and on the u.h.f. channels tuning is often maintained accurately by automatic frequency correction working in conjunction with a phase discriminator in the i.f. stages. Designs for such u.h.f. tuners are already available.

We also have motorised tuning and press-button control, also automatic tuning systems operated by flashing a torch on a LDR. Yes, indeed, we are certainly entering the automatic era and this is just as well, for without auto controls on many circuits the owner of a colour television set would be impelled either to take a course in colour television receivers or employ a full-time service engineer . . . but more about colour next month. ■

LINE TIMEBASE TROUBLES

— continued from page 396 —

signal applied to the receiver, which is the reason why the picture of Fig. 5 is rather grainy.

Changing the line output valve usually effects a complete cure, but this is often expensive as the valve may be otherwise perfectly sound. The oscillation can be varied and sometimes cleared by surrounding the valve envelope with a magnetic field, and in this respect a discarded ion trap magnet is useful; but a small bar magnet may do equally as well. Some commercial receivers feature a small magnet round the line output valve specifically to clear this trouble.

Note that the disturbance is emphasised by a weak aerial signal and by a mismatch between the aerial and the set. The use of a set-top aerial really reveals the trouble if the set is that way inclined.

In conclusion, it is as well to remember that the first half of the line scanning energy is provided by the conduction of the booster diode, while the latter half of the scan is provided by conduction of the line output valve. Thus, if cramping or distortion is present on the first (left) half of the scan the trouble is most likely in the booster diode section of the circuit, while if present in the right hand half the output valve and electrode feed components should first be investigated.



Fig. 5—This vertical, ragged line is caused by a form of electron oscillation in the line output valve.

Check H.T. Voltage

The line timebase on most sets needs to run at full efficiency to give a full scan and freedom from distortion, and even a slight fall off in efficiency will cause some trouble or other. One thing that should be looked into for lack of width and distortion is the h.t. voltage, for the efficiency of the stage drops rapidly with fall in h.t. voltage. Replacement of the metal mains rectifier clears 80% of these troubles. ■

TV ALIGNMENT

by H. W. Hellyer

PART 2: VISUAL METHODS

IT is quite possible to align a television receiver with a high degree of accuracy, using nothing but an amplitude modulated signal generator and an output meter. Plus, it should be said, a fair amount of patience.

As indicated in last month's article, the correct technique is to match the input signal to the appropriate circuit point, and interpret the output readings intelligently. Before going any farther, it may be as well to clear up a few loose ends about spot-check methods. First, is the question of selectivity, sensitivity and bandwidth. These three terms are often applied indiscriminately.

Selectivity can be defined as the ability of a receiver to tune within stated limits to the transmitted signal rejecting unwanted signals. Fig. 1 shows the frequency coverage and receiver curves of a vestigial sideband system, represented ideally. (For further reference, see also Fig. 1(a) and (b) of Part One.)

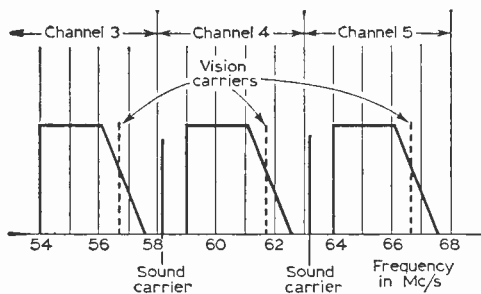


Fig. 1—The frequency coverage of a portion of Band I, showing the channel spacing.

The important thing to remember is that these curves have a certain amount of "spread" in practice, and tuning must be such as to achieve separation between adjacent channels, to keep the sound channel accurately spaced and aligned, and to retain the shape of the response curve so that second channel interference is also eliminated. This means that proper selectivity is also tied up with bandwidth, and adequate sensitivity depends on both.

Bandwidth is the difference in frequency between two points on a response curve at which the measured gain is a stated amount less than at the resonant frequency. For the television signal, good resolution depends on the bandwidth being maintained level over the response curve for 2.7Mc/s (in the 405-line system) and the correct falling away towards the sound carrier at the lower end, achieved by the sound rejector circuits, as we have already seen, plus the shaping of the higher frequency slope, with adjacent channel rejection.

FAULTS CAUSED BY MISALIGNMENT

Incorrect bandwidth gives rise to a number of different faults, quite apart from the loss of resolution. If, because of misaligned sound-traps, the vision channel is responsive to signals in the lower sound channel, sound-on-vision will result. A peak in the top of the response curve will give the symptom of "overshoot". This shows as a black line following the right-hand contour of a white object, and is easily discerned on Test Card 'C'.

While a certain amount of "shaping" of the curve is introduced by manufacturers to sharpen up the resolution, any mistuning of the i.f. circuits or alteration in the cathode capacitance of the video amplifier can cause severe overshoot, with the noticeable black-after-white effect. Tuned circuits that are misaligned will tend to oscillate at their tuned frequency during the sudden change in modulation level from black to white, or vice versa.

In practice, a waveform as in Fig. 2(a), passing a distorted response curve as at (b), would produce a picture pulse something like (c), where the ringing effect following the pulse form is clearly seen. Serious misalignment can produce the plastic effect, where the amplification of the low-frequency components of the video signal is limited. The picture tends to assume a mean level of brightness, and the outlines of objects are over-emphasised.

Conversely, an over-emphasis of the low-frequency video component will give the symptoms of "flare", a smudging effect that follows a black object. This is easily seen, again, on Test Card 'C', where a black horizontal bar at the top is transmitted to show distortion of this nature. It should be remembered that component failure can

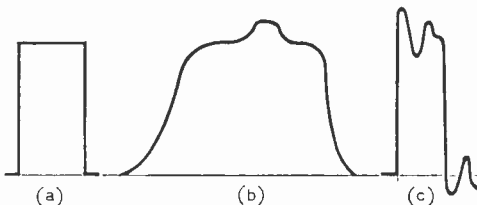


Fig. 2—A pulse of the shape (a), passing through a circuit with the response of (b), would be reproduced in the distorted form of (c).

be responsible for the above defects, as well as misalignment, and here the visual observation of the receiver's response curve can be a rapid aid to servicing, enabling the engineer to make a more accurate diagnosis.

LACK OF SENSITIVITY

Sensitivity of a receiver, as previously stated, depends on the bandwidth and selectivity being correct. Low gain with good picture quality is not

likely to be the result of misalignment. If both sound and vision channels are lacking in sensitivity, the fault is probably a common one, such as a low-gain tuner or first i.f. amplifier, but may well be due to a lack of high tension voltage, or some other such fault—although this would more often give rise to secondary symptoms. Sensitivity figures are given by manufacturers, and vary too widely for exact quotation. But as a rough guide, a $100\mu\text{V}$ signal at the aerial should produce peak white modulation (having reference to the c.r.t. operating figures), with contrast and sensitivity controls set for maximum gain. Some standard receivers will reach this gain level with only $50\mu\text{V}$ input, and a fringe model requires only 10 to $30\mu\text{V}$, depending on the amount of a.g.c. incorporated.

VISUAL TESTING

From the foregoing it is obvious that test techniques demand first a correct diagnosis of the fault or general condition of the set, second, a check on the response, third, the selectivity, and lastly, the overall gain. The advantage of visual testing is that diagnosis is speeded up, response is immediately assessed, and both selectivity and sensitivity can be measured while the response curve is under observation. The tedious clamping of tuned circuits is also eliminated.

Instruments required for visual alignment are, basically, a wobblator (frequency-modulated oscillator), a marker generator and an oscilloscope. (An alternative method, using a waveform generator, which has a complete range of test

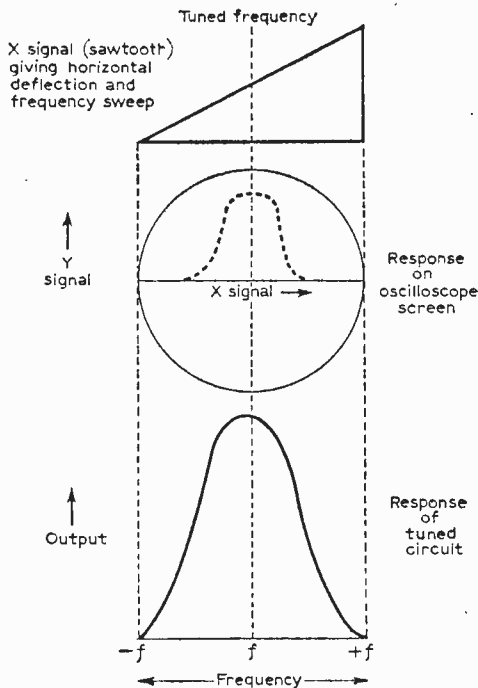


Fig. 3(a)—A portion of the sawtooth signal used by the oscilloscope timebase (horizontal deflection) is fed back to the wobblator.

applications, also employs the visual technique by using the display on the receiver's c.r. tube.)

The technique consists of swinging a signal over a suitable range of frequencies, at a regulated period of swing, and apply this frequency-modulated input to the frequency-changer grid with a marker signal loosely coupled to the same input point. The sweep of the wobblator must be greater than the pass-band required to be measured but not so great that the eventual trace occupies only a narrow portion of the swept band. For overall television response checking a sweep of 7Mc/s is adequate. (The i.f. response requires only 4 to 5Mc/s sweep.)

SYNCHRONISING THE WOBBULATOR

The deviation frequency is synchronised to the timebase of an oscilloscope either by connection from the X-timebase terminal, where a sawtooth waveform is available, or by synchronising the wobblator deviation to the mains frequency and coupling this to the X-timebase of the oscilloscope, with the internal horizontal timebase of the latter switched off.

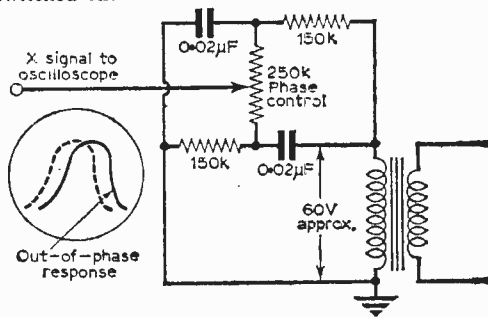


Fig. 3(b)—A phase-correcting network. (The inset shows out-of-phase response.)

This last method has disadvantages, for the power supply frequency is (theoretically) sinusoidal and a perfectly linear sweep, such as obtained by sawtooth deflection, cannot be obtained. A displayed curve on forward and return traces of the sinewave can result in a double display, and to avoid misinterpretation of the curves it may be necessary to suppress one half cycle of the sweep waveform or correct the phasing.

The sawtooth X signal application is shown in Fig. 3(a) and a simple phase-correcting network in Fig. 3(b). Some wobblators have built-in power supply modulation and, with these, some correction may be necessary. On the other hand, there are usually phase-correcting networks incorporated in good-class instruments. But a sawtooth waveform is the best method and the repetition frequency should be set just high enough to avoid a flicker of the trace.

The vertical timebase of the oscilloscope is fed from the detector output of the receiver under test via the Y-amplifier, the complete hook-up being as shown in Fig. 4. (For reproduction of this diagram and the two previous figures acknowledgements are due to Gordon J. King and Odhams Press Ltd. See *Television Servicing Handbook*, p.193, and *Radio and Television Test Instruments*, p.109, et seq.)

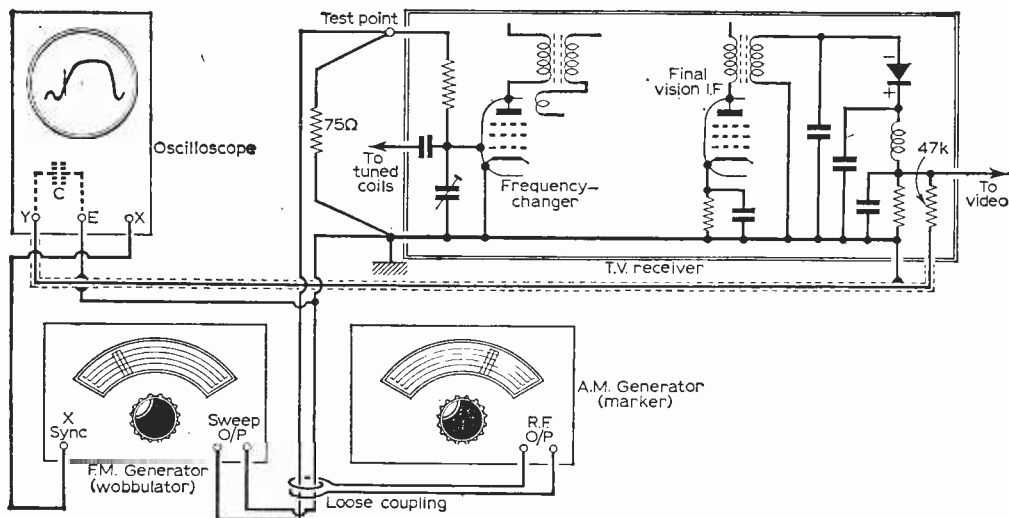


Fig. 4—The method of connecting instruments to a receiver for response curve testing.

POSITIONING THE TRACE

The marker generator supplies an unmodulated signal at a spot frequency in order to position the trace correctly over the required frequency range.

When the carrier signal of the marker generator is tuned to a frequency within the pass-band of the wobbulator a "pip" will appear on the trace displayed on the oscilloscope, its exact position on the horizontal scale (frequency) being determined by the relative frequencies of the two generators. Thus, by setting the wobbulator to deviate about a fixed frequency, and altering the calibration of the marker generator, the position of the pip can be moved along the response curve and an accurate assessment of bandwidth obtained.

Where a wobbulator has a built-in marker this usually takes the form of a crystal-controlled reference, with a "mark" at regular intervals, say 2Mc/s, depending on the fundamental frequency of the oscillator. But a standard a.m. signal generator can be calibrated against the sound carrier by tuning for zero beat.

A further refinement which enables a response curve to be traced from a part of the receiver—and which is very useful when a set is so badly misaligned that the overall curve is hopelessly distorted (a gremlin-inspired condition that practising engineers will recognise)—is an oscilloscope probe. This consists simply of a rectifying and filter circuit, usually made up on a screened probe, with a crystal detector detecting the i.f. and feeding a rectified voltage to the Y-amplifier of the oscilloscope.

Some practical considerations are needed before we continue. As mentioned previously, the sweep frequency should be adjusted so that the trace gives at least two-thirds of the available X-timebase display but is not overlapping the screen diameter. A narrow curve indicates too great a deviation and an overlap too little a deviation.

The wobbulator output is coupled to the fre-

quency changer grid, which is usually a convenient test point on the tuner unit; it should be terminated by a suitable dummy load when coupled to this point. Unless otherwise stipulated by the receiver manufacturer, a resistor of 75Ω or thereabouts should be satisfactory for this purpose. The carrier tuning of the wobbulator (central frequency about which the sweep swings) should be set so that, with the oscilloscope X trace centralised, the curve obtained is within the centre of the screen.

Input level depends upon the state of the tuned circuits and the gain of the Y-amplifier of the oscilloscope. It is possible to obtain a larger trace, for initial adjustment of a badly misaligned set, by connecting the oscilloscope to the video output instead of the detector load. But overloading, both of the receiver and the Y-amplifier, should be avoided.

As with spot-check methods, as low a signal as is compatible with accuracy should be maintained and output levels progressively reduced when alignment provides more reasonable results on the oscilloscope screen. A.G.C. must be disconnected or compensated by a positive voltage from a small battery.

Another factor to be considered is the possibility of low-frequency distortion: the Y circuit response must be maintained down to the timebase frequency, which will be 25 or 50c/s, a sub-multiple of the mains frequency helping to eliminate hum voltage and scurious pick-up in the wiring. In practice the fine frequency setting would be adjusted for the steadiest trace.

KEEP INPUT LEVELS LOW

The point to be remembered about overloading is that too high an input signal may result in a trace which has a very attractive flat top because one of the valves in the receiver, or the amplifier of the oscilloscope, is running into grid current.

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1A7G7	9/6	6AQ5	6/-	6L7GT	4/6	19A11	6/6	5763	7/6	6B31	3/-	EF40G	1/6	6Y44	14/6	6F84	16/2	6Y6	10/-	6UCL83	11/-	0A19	25/-
1C5	7/-	6AT6	5/-	6L17	12/6	20D1	14/11	7475	3/-	6B33	20/6	EF73	5/-	6Y66	6/6	6F86	6/6	6Y6	10/-	6UCL83	11/-	0A22	23/-
1D6	9/6	6AU6	7/-	6L18	7/9	20F2	15/-	AZ31	7/6	6B34	7/6	EF80	4/6	6Z41	6/6	6F82	7/3	6Y6	10/-	6UCL83	11/-	0A26	25/-
1G6	7/-	6BA3	5/6	6L20	15/7	20L1	14/-	A424	12/3	6B34	7/6	EF83	5/6	6Z41	6/6	6F83	9/6	6Y6	10/-	6UCL83	11/-	0A28	17/6
1H54T	9/6	6BE5	5/6	6P25	11/6	20P1	14/6	333	5/9	6B30	7/6	EF85	7/-	6Z50	6/9	6F84	6/3	6Y6	10/-	6UCL83	11/-	0A29	27/6
1L4	3/-	6BB4	8/-	6Q74	5/-	20P3	12/3	414	22/10	6B38	9/-	EF88	7/9	6Z41	6/6	6F84	6/3	6Y6	10/-	6UCL83	11/-	0A35	18/-
1L53	4/3	6BB5	8/9	6Q7GT	6/-	20P1	14/-	4133	12/-	6B39	7/9	EF91	3/6	6Z80	7/6	6F86	10/-	6Y6	10/-	6UCL83	11/-	0A36	21/6
1L55	4/6	6BQ7A	8/-	6RT7	6/-	20P5	15/-	4Y31	7/6	6C70	12/6	EF92	3/-	6Z32	7/6	6F88	21/4	6Y6	10/-	6UCL83	11/-	0A37	9/6
1N5GT	9/-	6BR7	8/6	6U53	5/-	25Z4G	7/-	DAC32	8/9	6C81	27/6	EF97	13/-	6Z34	13/6	6F846	4/6	6Y6	10/-	6UCL83	11/-	0A44	9/3
1R5	5/3	6BR8	9/3	6U64	4/-	27S0	25/11	DAC91	4/3	6C92	11/3	EF98	13/-	6Z39	29/1	6F88	13/9	6Y6	10/-	6UCL83	11/-	0A45	9/6
1S4	7/6	6BM6	10/6	6X1	4/6	3AC1	7/-	DAP96	6/9	6C34	21/11	EF98	8/-	6Z41	9/-	6F88	9/6	6Y6	10/-	6UCL83	11/-	0A48	22/6
1S5	4/3	6BW7	5/-	6X5	4/6	30C13	10/-	DD41	13/7	6C35	8/9	EF98	8/-	6Z39C	6/-	6F88	25/11	6Y6	10/-	6UCL83	11/-	0A49	25/6
1T4	3/-	6C4	2/6	630L2	9/-	30F5	6/-	DF33	9/-	6C34	9/6	EF801	22/3	6K35	32/4	6L41	8/-	6Z51	9/6	6Y41	6/-	0A70	6/6
1T5	6/3	6C5	5/-	737	7/9	30F11	9/6	DF61	15/-	6C31	4/6	EF83	7/6	6K41	12/-	6L2	6/-	6Z51	12/6	6Y85	6/-	0A71	6/6
3A4	7/-	6C6	3/6	7C5	10/-	30F12	12/6	DF91	3/-	6C32	4/9	EF83	8/6	6K41	9/6	6L3	6/-	6Z52	14/3	6Y85	7/-	0A72	8/-
3A5	7/6	6C7	11/6	7T1	10/6	30L1	9/6	DF93	6/9	6C33	4/9	EF83	8/6	6K41	8/6	6L3	7/6	6Z51	12/3	6Y85	10/3	0A73	10/6
3B7	12/6	6C7	12/6	7A7	6/-	30L15	11/-	DF97	7/6	6C34	7/-	EF83	12/6	6K41	9/6	6L3	8/6	6Z51	9/6	6Y85	9/6	0A74	8/-
3D6	4/-	6C83	8/-	7V7	5/-	30P4	12/6	DF63	5/6	6C35	7/6	EF83	12/6	6K41	13/6	6L3	10/6	6Z51	6/-	6Y85	10/3	0A75	8/6
3Q4	6/-	6CW4	24/-	7Y4	5/-	30P12	7/6	DK32	9/6	6C38	11/6	EF81	8/-	6K48	43/6	6Y32	9/6	6Z51	18/6	6Y85	20/5	0A76	8/6
3Q5GT	7/6	8P1	10/-	9BW6	14/11	30P14	10/6	DK31	5/3	6C30	8/3	EF82	9/-	6K46	7/6	6Y34	10/6	6Z51	18/6	6Y85	15/6	0A77	12/6
3R1	5/-	6P6G	4/-	10C1	10/6	30P15	9/6	DK32	7/6	6C32	8/6	EF81	8/9	6L3	3/-	6Y30	10/6	6Z51	8/6	6Y85	17/6	0A78	8/6
3V4	6/-	6P13	6/9	10C2	13/6	30P14	21/4	DK36	7/6	6C36	19/5	EF86	7/6	6L3	12/6	6Y30	10/6	6Z51	12/6	6Y85	18/6	0A79	8/6
FR4G7	9/-	6P23	10/6	10C1	10/6	35L9G	5/-	DL33	7/6	6C38	21/4	EF84	6/6	6L3	12/6	6Y30	10/6	6Z51	12/6	6Y85	18/6	0A80	10/6
6U46	4/6	2A12	11/6	10L11	11/3	35W4	6/-	DL66	17/6	6C42	22/3	EF85	9/9	6Z41	25/11	6Y30	10/6	6Z51	12/6	6Y85	20/5	0A83	6/-
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5Y3GT	5/3	6S4	3/-	10P14	12/-	35Z3T	7/-	DL72	15/-	6C42	8/6	DL66	3/-	6Z48	23/1	6Y30	10/6	6Z51	12/6	6Y85	20/5	0A85	8/6
6Z4	18/5	8A5	3/6	12A35	13/5	30C5	5/-	DL62	5/-	6C41	7/-	DL66	8/6	6Z48	12/6	6Y30	10/6	6Z51	12/6	6Y85	20/5	0A86	10/6
6Z4G	7/-	6Z74	4/9	12A10	18/10	30L6GT	7/-	DL94	6/-	6C48	8/-	DL66	27/-	6Z49	15/-	6Y30	10/6	6Z51	12/6	6Y85	20/5	0A87	17/6
6A7	9/-	6Z74T	7/-	12A46	12/3	85A4	12/-	DL95	6/9	6C48	14/7	DL66	13/2	6Z41	2/9	6Y30	10/6	6Z51	12/6	6Y85	20/5	MAT100	7/6
6A8	7/-	6K74	2/-	12A17	5/-	90A4	67/6	DL70	5/-	6C48	6/6	DL66	19/6	6Z41	1/6	6Y30	10/6	6Z51	12/6	6Y85	20/5	MAT101	8/6
6AC7	3/-	6K74T	4/6	12A18	9/-	90A5	87/6	DL71	9/9	6C48	8/-	DL66	20/5	6Z41	1/6	6Y30	10/6	6Z51	12/6	6Y85	20/5	MAT120	7/6
6AC5	2/9	6K8G	4/6	12A16	5/-	90C1	16/-	DL56	7/-	6C48	18/11	EM31	9/6	6C35	13/-	6Y30	10/6	6Z51	12/6	6Y85	20/5	MAT121	8/6

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The accuracy of the marker is important. Where a standard signal generator is employed, any doubt as to its spot-frequency accuracy should be proved before commencing the alignment procedure or, once again, we can obtain very attractive curves yet have a set which evinces all the disturbing symptoms of sound-on-vision, ringing or plasticity that we were trying to avoid.

CRYSTAL CONTROLLED MARKERS

It is now general practice to use a crystal-controlled reference oscillator to calibrate the

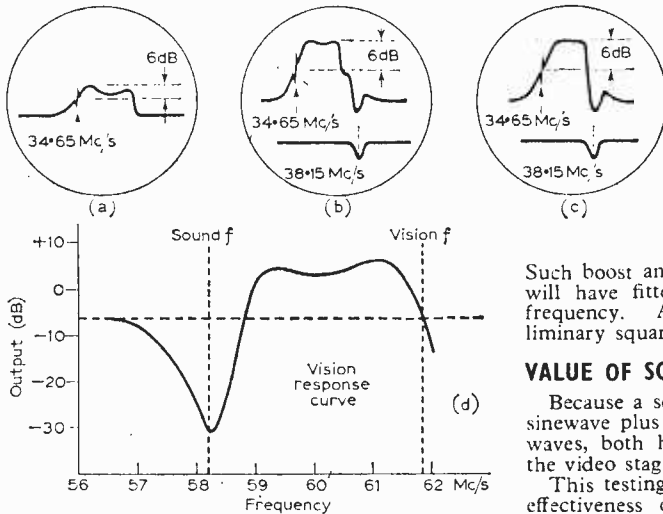


Fig. 5—Contour traces at various test points: wobbulator input to (a) final vision i.f.; (b) first vision i.f. (with lower trace showing marker set at sound i.f. for adjustment of rejectors); (c) wobbulator to frequency changer grid (tuner unit test point). (d) Overall response curve, input to receiver aerial.

marker and various instruments have this complete range of facilities inbuilt. The marker "pip" is, in effect, a short burst of r.f., seen by the sweeping wobbulator carrier. When an external marker is used, as in our hook-up of Fig. 4, there may be a tendency for this r.f. burst to spread, obscuring the contours of the trace, and some decoupling at the Y-amplifier of the oscilloscope is helpful in sharpening up the outline. This capacitor, shown dotted at 'C', can be between 0.002 and 0.01 μ F, depending on the frequency of the marker.

The marker can, of course, be set to provide a pip at any point along the trace, and thus the frequencies at which the various contour changes occur can be determined, as in the traces depicted

in Fig. 5. Note here that the trace of Fig. 5(d) is the overall response curve obtained by applying the wobbulator input to the receiver aerial. There is no need for any matching at this point, for the wobbulator output, in practically every case, will be matched to 75 Ω .

The actual contour of the trace may be any one of four inversions of that shown. Where a receiver has reversed signal polarity the trace will be "upside down" and if the receiver has its oscillator frequency (and thus the sound intermediate frequency) below the carrier frequency the trace will be transposed from left to right.

Inspection of the initial response curve gives an immediate clue as to modulation polarity and oscillator placing but does not always enable the operator to determine exact tuning of individual circuits.

The normal method of wobbulator testing is to apply the input to successive stages, working from the last i.f. toward the aerial, obtaining the curves of Fig. 5. But the manufacturer may well have "tailored" the response of the receiver and, in particular, have adjusted the video response to compensate for certain irregularities of the curve. With a swept input, such as has been described, this video response may be misleading. For example, when the carrier is at the 3Mc/s end of its sweep, only the appropriate circuits tuned to the actual input frequency will be responsive, but this is still only an effective d.c. response at the video.

Such boost and corrector chokes that the setmaker will have fitted are not responsive to the signal frequency. A more complete answer is preliminary square-wave testing of the video stage.

VALUE OF SQUARE-WAVE TESTING

Because a square wave consists of a fundamental sine wave plus a series of harmonically related sine waves, both high and low frequency response of the video stage can be tested.

This testing procedure, however, depends for its effectiveness on the accuracy and width of the response of the oscilloscope's Y-amplifier. Extra precautions have to be taken: the Y signal may be applied directly to the Y plates, to eliminate the possible distortion of the amplifier and avoid overloading, without the need for interposing an attenuator. All connecting leads must be as short as possible. There should be a minimum of self-capacitance; therefore, screened lead is not used for connections at high frequencies in tests of this sort. Input and output leads must be well separated to avoid spurious pick-up and feedback, and the provision of the small bypass capacitor at the Y-to-earth position becomes essential.

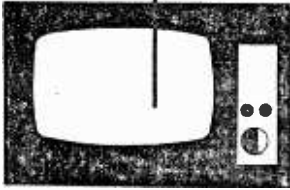
A number of signal generators have the facility of square-wave modulation, but for complete testing a commercial instrument is required which has available the higher frequency fundamentals for video testing.

The overall response of a video stage extends from almost d.c. to at least 2.5Mc/s (ideally, 3Mc/s).

— continued on page 419

A MONTHLY COMMENTARY

Underneath the Dipole



THE outlook is foggy! Television producers and directors have been worried for quite a long time about the quality of picture reproduction on home television sets. They say that the highly variable picture "black level" on most of the sets, particularly the new ones, limits the scope of their work and often compels them to avoid scenes in a low key of lighting. If they use "mood" lighting, they run the risk of the home sets automatically raising the level of such scenes until the actors appear to be in a grey fog instead of a dark cellar! This point was made recently by a well-known BBC producer, who expressed the opinion that the average modern television receivers are in some respects distinctly inferior to the sets of five or six years ago. This is not a unique complaint. The British Society of Cinematographers complained 12 months ago about inferior reproduction on modern television sets of their films, an opinion which was supported by the British Kinematograph Society, the Television Society, the BBC and the ITA.

Modern TV Receivers

The television receiver manufacturers in this country have heard of this complaint many times in the past, but this year the grumbles are stronger than ever. One is entitled to ask, are sets getting worse? Of course, it depends what you mean by "worse". The manufacturers may boast about their latest average gain control circuits

which eliminate aircraft flutter, increases sensitivity slightly and makes tuning adjustments much easier. They may refer to the brilliancy of the tubes, enabling a picture to be viewed in a fully lighted room, or for that matter, in bright daylight. They might claim loudspeakers are around the back and out of sight, their sets are "super-slimline", and that the cabinet has a bit more gilt on it than the rival manufacturers' have. All of these are, in the eyes of many people, big improvements—so they say.

These "improvements" have, however, resulted in a deterioration and ironing out of the light and shade of the picture until it is reminiscent of an under-exposed holiday snap taken on a box camera on a dull day.

Disillusioned

The manufacturers are unrepentant. They claim that it is the cabinet that sells the set and that Mrs. Everybody doesn't appreciate the acoustic improvement that would be brought about by a forward-facing loudspeaker. Slimline sets are convenient, too, and if the linearity drifts out of adjustment within a few weeks, she doesn't notice it. As for the black level—well, she has all the room lights on to do her knitting, so the picture should be light all over so that she can glance up and see what's going on now and again. To appreciate tonal values and pictorial qualities of a picture necessitates the room lights being turned low or out, and that doesn't appeal to her at all. The technical purists who ask for a true black level to be maintained by some form of d.c. restoration in the TV set circuitry must realise, say the manufacturers, that the set adjustments will be more critical, aircraft flutter will show up and the receiver will cost more. The manufacturers, therefore, are completely disillusioned. "A good cheap set, easy to adjust and

with a posh cabinet is what is wanted", they maintain. "Besides, the complications of dual standards for 625 and 405 lines makes the present time an impossible one for introducing such complications. There is just no demand for such sets, especially in the hiring-out trade." So now we know. I, for one, would have thought there is always a market for a quality article, whether it is a motor car, a hi-fi radiogram or a television set.

Goonantics

The importance of quality pictures on a television set is a matter of taste. So is the matter of television humour. The Goon Shows were not to everybody's taste, and the lunatic humour in "A Show Called Fred", "The Kathode Ray Show" and similar hellzapoppin epics, passed over (or under) the heads of many viewers. The fantastic burlesques involving Peter Sellers, Harry Secombe, Spike Milligan and others were released before the commencement of the present craze for satirical and sick humour. I suppose that "T.W.T.W.T.W." arose from the bluebleached ashes of these early goonantics. Frankie Howerd appeared in one of the last editions of this show. Speaking about the Budget, this experienced and spontaneous comedian gave a magnificently professional exposition of satirical virtuosity which was inoffensive and very, very funny. I thought he made most of the performers in this programme look like a lot of amateurs. When the teleprompter stops, they're sunk. Frankie Howerd ad libs around subjects with the spontaneity of an Experienced Goon (First Class, with bar). I now look forward to the return of the Goons, whose voices are being used with puppets in a new BBC series. Welcome back to Bluebottle, Eccles and Major Bloodnok!

Advertising Agencies

"You can't burlesque burlesque" is an old music hall adage. The comic clown is funnier if he keeps a perfectly straight "dead pan" face and takes himself seriously all the time, even when making his funniest falls. I always thought that the advertising agencies and film-makers whose business is the production of TV advertising commercials, conducted it in a manner which was incapable of being burlesqued. I therefore looked forward to A.T.V.'s "*I Can't Bear Violence*", which largely took place in an advertising agency, with its larger-than-life characters, its pseudo-professional jargon and its continuous flashes of wit and corn. "*I Can't Bear Violence*" turned out to be

been a plodding kind of job in the true sense of the word, involving the making of hundreds of drawings on paper or transparencies which are photographed by the "stop-motion" process on to film. This means that each sketch is photographed separately, one frame at a time—a laborious but unavoidable method of converting still pictures into motion. The earliest successful line drawing cartoons were made in this manner in the days of the silent film, and many cinemagoers will recall the exploits of Mutt and Jeff, and the antics of Felix the Cat, both series being made in the USA. In England, cartoon films were first made at the old Neptune (later called Ideal) Studios at Boreham Wood, on the same site as the magnificent

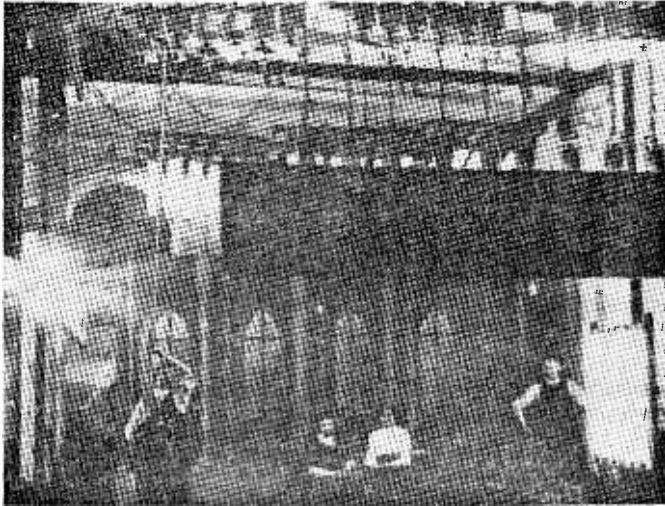
jumpy, but was adequate at that time.

Visimotion

Thousands of entirely separate drawings are still necessary for cartoon films, but at a recent trade television equipment exhibition, a device called visimotion was on show, which once more enables hinged cardboard characters to be used, controlled by manual operation of magnets behind the drawing board. Life-like movements can be obtained by expert manipulation of the hinged figures and the slow process of multiple drawings is avoided. Movements of the cardboard figures is restricted, of course, but the method will enable television producers to introduce cartoon characters for titles and short sequences at short notice. Thus, a return to the early method of cartoon making has been possible with modern magnetic aids and a closed-circuit TV camera and monitor used alongside a motion picture camera, as in the Electronic-Cam system.

Pole Operated Lighting

Another modern innovation in television studios that really dates back to the earliest days of film making in this country, is the "pole operated" spot lamp. This is a lamp housing which has a number of keyways which control focus, tilt, rotation, "barn doors" and other critical adjustments which used to require the presence of an electrician behind the lamp. With telescopic lighting suspensions for the lamps, this is not possible. But with a special lightweight pole with a suitable connector at the top, the electrician can make the adjustments with ease from the studio floor. I have a photograph of the lamplighter pole at work in a studio, but the picture was actually taken in the old silent days at the Pathé Studio in a basement in Great Portland Street, before the Pathé "Big Ben" Film Company moved up to the Alexandra Palace Studios! The lamps used at both places were Westminster enclosed arcs and low pressure mercury vapour tubes. The pole was used to tilt the latter to make them strike and light. It only goes to show that an old idea is never too old to be re-examined and possibly used again!



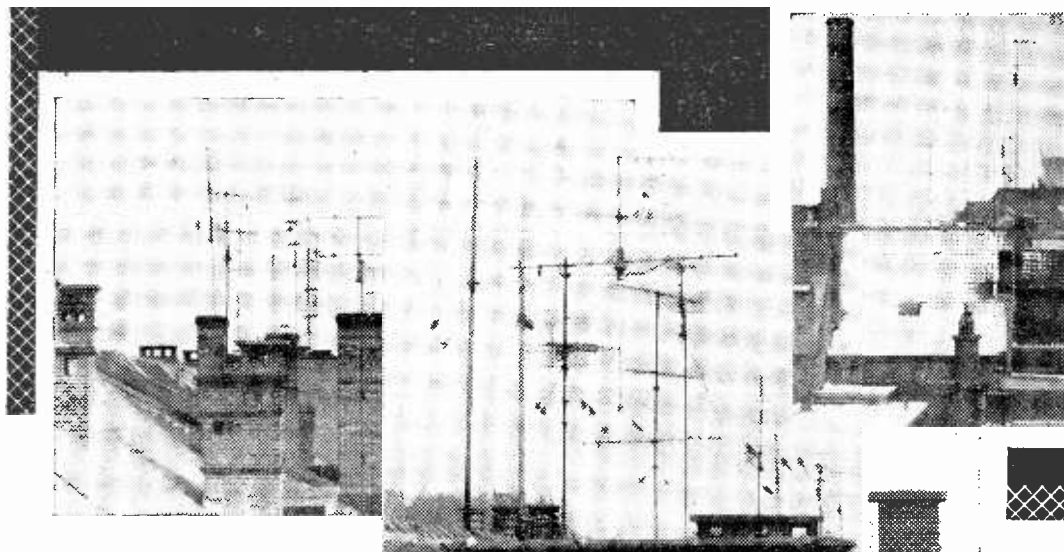
Pole operated lighting at Pathé (Big Ben) Studio, Great Portland Street, London, in 1912.

a thriller in which murder was committed in the quest for a valuable advertising account. Well-directed and acted, it suffered from having not a single sympathetic character and a most implausible story. Good atmosphere was secured by the excellent settings, good lighting, restless camera movement and the expert handling of the small parts and crowds.

Cartoons

The making of film cartoons, like the production of puppet films, has been a most laborious business for years. It has always

A.T.V. television studios. In England, "John Bull's Sketch Book" and "Bully Boy Cartoons" were early cartoons series, with drawings by Anson Dyer. In these, you saw a lightning drawing grow up before your very eyes, line by line, until it was complete. It took the form and style of a newspaper cartoon, and was often of a political character. After being held in a static position for a few moments, it usually ended with a few simple movements, accomplished with cut-out figures on hinged pieces of cardboard, which were moved frame by frame by hand. This was crude and inclined to be



With dual-standard television reception getting so much attention, it might be useful to give a few experiences of someone living within the service area of six TV transmitters, bringing in four different programmes in four different standards from three different countries; and with test transmissions now starting on two more channels, the further prospect of two more programmes and one more standard in the near future.

The author of this article is a Dutch subscriber living in Belgium, working for an American company in Britain, Germany and other European countries. He has a keen amateur interest in current television developments, and has compiled some facts and views on European television reception that will undoubtedly be of great interest to our readers.

I STARTED my TV experiments when I discovered that my portable 17in. Ekco TP748 of CCIR standard, and with three further standards added by the Belgian importer, has more than average sensitivity in spite of its compact, 13-valve design.

I added one of the German "u.h.f. converters"—a self-contained u.h.f. tuner delivering a Band I signal, and further an American war-surplus "Dynamotor", converting the 12 volts of my car battery to 220 volts. This allows me to use the receiver in my touring caravan with a wild array of aerials for checking local signal conditions in various countries, and also once in a while pulling in clear pictures from stations up to 800 miles away.

My only annoyance is that all I get on cross-Channel channels are distorted pictures, because the British standard is the only one my British set does not cope with! But I'm trying to remedy this.

With single-standard sets now becoming obsolete in Britain, it is amusing to note that here in Belgium, four-standard sets are being cleared out since recently the industry started flooding the market with five-standard sets.

To explain things, Table I gives a listing of the channels serving my town (St. Niklaas, 12 miles

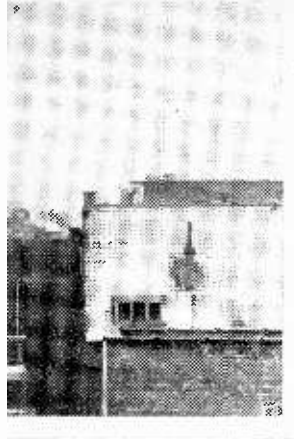
west of Antwerp) which is a situation typical of many Continental areas.

With the two u.h.f. channels still in preparation, we therefore at present have the choice of four programmes, which in most cases are tuned in on channels 7, 10, 8 and F8A. This has the advantage that a single, rotating, motor-driven, band III aerial can be used—although in the last few years in most cases three separate aerials fixed in three directions (channels 8 and 10 are co-sited) are installed. The separate aerials are cheaper, more reliable and, of course, individually tuned.

All aerials are of the horizontal, six to 15-element Yagi type and, because the frequencies are very close, each requires its own downlead.

In quite a few cases, one or all three aerials are two-tier arrays (to my feeling, more to show the salesmanship of the dealer or the status of the owner than out of necessity) and all are fairly high above the roof-line. With only a few apartment blocks having common aerials, you can imagine what a beautiful sight our skyline is to TV-experimenters and what a ghastly sight to city-planners!

What will happen when the two u.h.f. channels come on the air? Our fixed aerial masts will just have to grow and stack up two more Yagis. However, the new tendency here is clearly back



STANDARD SWITCHING AND U.H.F. EXPERIENCES ON THE CONTINENT

By W. Berssenbrugge

to the rotating array controlled from the set. It carries one wide-band high-gain band III aerial, and one wide-band IV/V. This provides for all six programmes and any new ones being added (which all undoubtedly will be u.h.f.).

FOUR-STANDARD RECEIVERS

Now, about those standards. From the listing in Table I it is obvious that each of the four programmes presently received in St. Niklaas—and large areas in and around Belgium—has a quite different standard.

The Dutch programme is CCIR. The French standard is 819 lines, a.m. sound, positive vision drive and a very wide vision band, necessitated

by the high scanning speed and explaining the wide separation of 11.15Mc/s between vision and sound carriers.

The two Belgian standards are a strange mixture of the previous two. Both use a.m. sound and positive vision modulation, both also are on CCIR standard channels.

The Flemish television, wishing to exchange programmes with Holland and other CCIR countries, has chosen the 625-line definition, whereas the French-language TV, wishing to do the same with France, decided on 819 lines.

The strange combination of 819-line definition and 7Mc/s standard-width channels produces a picture much better than could be expected, though of somewhat less quality than the 625-line picture—apart from less line visibility.

TABLE I

Network	Channel	Band	Distance between Transmitter and Receiver	Vision E.R.P.	Vision Freq. (Mc/s)	Sound Freq. (Mc/s)	Number of Lines	Carrier Separation (Mc/s)	Vision Modulation	Sound Modulation
Netherlands Television	4	I	65 miles	100kW	62.25	67.75	625	5.5	A.M. neg.	F.M.
	7	III	25 miles	5kW	189.25	194.75				
Neth. Commercial TV (in preparation)	29	IV	25 miles	?	535.25	540.75	625	5.5	A.M. neg.	F.M.
Belgian TV (Flemish language)	2	I	35 miles	100kW	48.25	53.75	usually 625	5.5	A.M. pos.	A.M.
	10	III	40 miles	100kW	210.25	215.75				
Belgian TV (French language)	8	III	40 miles	100kW	196.25	201.75	usually 819	5.5	A.M. pos.	A.M.
French TV	F8A	III	60 miles	200kW	185.25	174.10	819	—11.15	A.M. pos.	A.M.
French 2nd programme (in preparation)	24	IV	60 miles	1000kW	495.25	501.75	625	6.5	A.M. pos.	A.M.

Operating and planned television stations serving the home town of the author, providing six programmes in five standards, from three different countries.

It is even common knowledge that a French 819-line picture, received with a full-bandwidth French receiver, is not noticeably better than a modern 625-line picture.

AUTOMATIC SWITCHING

Then, the switching. All of the sets sold in Belgium are of the four-standard or five-standard "switchable" type, but practically none carry external switches. It's all done inside—coupled to the channel switch.

In four-standard sets, on the channel selector spindle a second turret is mounted next to the coil drum with, for every channel, a sort of cam which actuates the various switches and which can be exchanged or preset in three different positions: one for CCIR, one for Belgian and one for French standards. Thus, any of the twelve channels can be preset for any of the three standards to suit local conditions.

This leaves out the actual switching of lines. This is done completely automatically and electronically—sometimes in the middle of a programme without the viewer touching the set or even noticing it.

You will have noticed that for the two Belgian systems their "usual" line definition was quoted. This is for programmes which originate from their own cameras. If they relay programmes from countries with the other line standard, they will not use a line converter but put them on the air in the line standard received.

So when a Eurovision programme originates in, say, Stockholm, all of Belgium will see the original 625-picture while France (and Britain) will have a poor, converted picture. When a programme originates in France, all Belgian transmitters will carry the 819-line definition while all other European countries (including Britain again) will look at a converted picture.

Thus on a busy Eurovision afternoon with sports events all over Europe and the local announcer popping in repeatedly, there is a lot of line switching all in the same channel. The Belgian sets take care of it automatically by means of two tuned circuits—one to the 15,625-line frequency of the 625-picture and one to the 20,475-line frequency of the 819-transmission. These govern the automatic line switch.

THE FIFTH STANDARD

To complete the "story of the standards", the "Fifth Standard" has caused quite some confusion here.

In Belgium, several manufacturers have simply installed u.h.f. tuners in their four-standard sets and advertise them as "five-standard". In their instruction book they advise the viewer to tune in the new French channel on the (continuous) u.h.f. scale and switch the v.h.f. selector (and therefore the standards switchgear) to "any Belgian channel" (the line switch takes care of itself). They simply ignore the difference in carrier separation of 1Mc/s, which probably does not matter much, anyway.

Others, however, have introduced a (manual) switch to compensate for the 1Mc/s difference which really makes the fifth standard. So these sets are also advertised as "five-standard", even if the u.h.f. tuner is not yet installed.

Two of the described developments: electronic line-switching and switching of the other standards coupled to the channel selector or push-buttons, might sooner or later show up in British receiver design and make the line switch, so proudly displayed on recent sets, obsolete.

This could be especially useful when a situation develops where 405- and 625-line networks will exchange live programmes without using the infamous line converter which ruins the picture and has given British live television its bad name on the Continent. Such an exchange will at least require that the v.h.f.-u.h.f. and the 405-625 switches operate independently.

V.H.F. ON THE WAY OUT?

It is not generally realised that when the 405-v.h.f. networks change to 625 lines, the present 5Mc/s channels have to be scrapped and to be replaced by wider, 7 or 8Mc/s channels. This again means that Band I and III combined will have barely enough channels to bring one programme, to say, 99% of the population.

The often-expressed view then, that Britain will ultimately have one network in Band I, one in Band III and four in the u.h.f. bands, is most unlikely. It would not be too revolutionary to foresee a complete evacuation of the v.h.f. bands in favour of bands IV, V and VI, as is the tendency in Germany and the U.S.A.

With Britain firmly decided on co-siting all u.h.f. transmitters, it offers the perspective of receiving any number of programmes with one single, fixed, broadband, high-gain u.h.f. aerial—if "pipe-line" house-to-house signal delivery has not yet materialised by that time.

WIDENING HORIZONS

There is another aspect of the 625-line system that gets very little consideration in Britain.

In discussions and Press comments the point usually is whether or not the 625-line picture is really of so much better quality, and if it justifies all the trouble and expense. An important consideration could be that once Britain and France have adopted 625 lines on at least one network, unlimited interchange of European programmes of uniform quality would be possible.

We cannot judge if this will be of great value to the British—but it is to most Continentals, and they want Britain to participate.

People of the smaller countries especially have a keen interest in what is going on around them, the language is not too much of a barrier to them and their ultimate wish is to be able to tune in any European television programme, as they used to do on radio.

In fact in some of these countries, where another network is in preparation, there is a strong demand not to use it for another national programme—hinting that it is difficult enough to keep just one

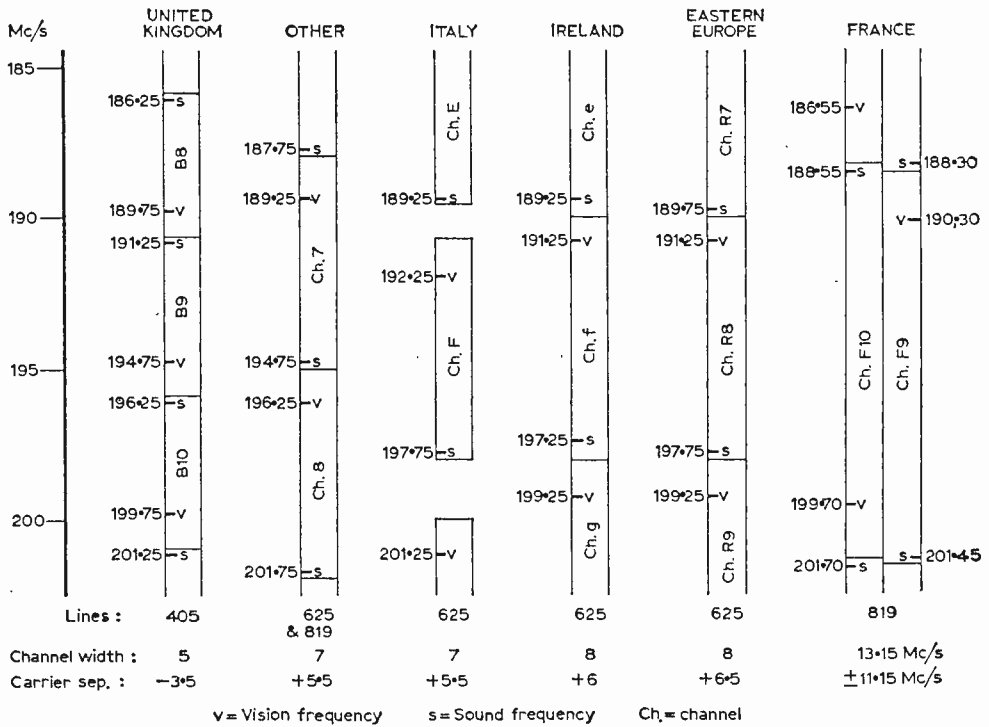


TABLE II

A section of the Band III spectrum, showing part of the frequencies and channel limits in use in various European countries. Note how the Irish (and future British!) channel limits and vision frequencies match those of Eastern Europe, and mismatch those of all other 625-line countries.

going—but to use it for relaying selected, but integral foreign programmes that are out of normal reach.

It seems, however, that British television authorities are well aware of this aspect of the 625-line system. It was quite a surprise, when looking at the Farnborough Airshow last year via Eurovision, to get a live, unconverted 625-line picture of superb quality—the spectacular airshow might have contributed to this impression. It is easy to imagine what such transmissions do towards a better appreciation of British television.

What I would like to know is, if at those times British viewers are looking at a converted live picture, or if a second, 405-line camera crew is at the scene. Or is there such a thing as a simultaneous, dual-standard TV camera? This

would come in handy when the “duplicate” networks go on the air!

U.H.F. IN PRACTICE

For a further look around Europe, West Germany had 87 u.h.f. transmitters in use on November 1st, 1962, in channels ranging from 21 to 58. Of these, 54 stations, most of them with c.r.p. ratings of 200 to 500kW, carried the second programme.

The remaining 33 stations joined the then existing 369 v.h.f. transmitters (ranging from 7mW to 100kW) of the first programme, to provide service—without noticeable co-channel interference—to those last remaining few hundreds of a percent of the population.

Some of these first-programme u.h.f. stations however are duplicating some Band I channels that are destined to go off the air.

The result of course is, that the second programme does not yet have nearly the extensive coverage of the first programme. This also results from the shorter range of the u.h.f. stations—unless special measures are taken, such as the several thousand kilowatts of some Italian stations or the 1,300ft tower carrying the first Dutch u.h.f. transmitter.

The Farnborough Airshow referred to was in fact converted from the 405-line system to the 625-line system prior to transmission across the Channel by u.h.f. link, and so followed the normal practice when U.K. contributions are made to the Eurovision network. We are advised by the BBC that only on rare occasions are wholly 625-line pictures originated in this country for relaying exclusively to Eurovision.—Ed.

However, in all densely-populated areas of West Germany there is perfect reception of the u.h.f. stations, sometimes with such simple aerials as a piece of adhesive transparent plastic sheet on a window facing the signal, with printed on it a metallic shape in the form of a butterfly dipole.

In weak signal areas a fairly long (11ft) high-gain (16dB) multi-element (27) three-channel Yagi is a typical outfit. Even the most selective u.h.f. aerials have equal response to at least three adjacent channels.

The most common u.h.f.-gear on German rooftops and in the accessory shops are 8- to 15-element wide-band Yagis, accommodating either Band IV, Band V or Band IV and V. All Yagis invariably have a single folded dipole, 1 to 6 reflectors (no wire mesh screens) and up to 46

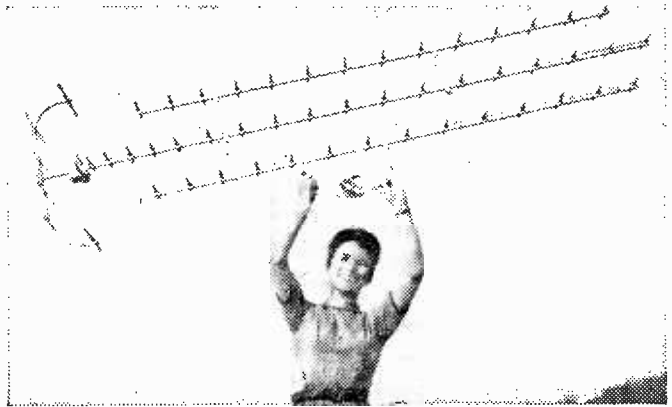
All sets have a v.h.f.-u.h.f. push-button switch, which in Germany usually serves as a switch from the first to the second programme. If both programmes come in on u.h.f., it is often necessary to hand-tune from one channel to another, and in those cases a more expensive type set is preferred, which has three push-buttons for three pre-selected u.h.f. channels and three for three v.h.f. stations.

A popular gadget at the moment is a switchable line suppressor, which in the best sets really makes the picture line-free without loss of detail, but in other cases just throws the picture badly out of focus.

There is a lot of argument on the merits of this feature other than it being a sales gimmick, so an on/off push-button is always provided. The

The super-wide-band aerial seen here, is capable of receiving all Band IV and V transmissions.

(With acknowledgements to "Fubabild".)



directors (in up to three stacks). Two-tier outfits are very seldom seen.

In many areas of West Germany both programmes can be tuned in on u.h.f. Unfortunately, there has been little co-operation in siting the transmitters, with the result that they are seldom co-sited. So, two often identical aerials are needed pointing in two different directions—unless a single rotary one is employed.

Reflections and shadows offer more of a problem than in v.h.f. and often reception from a distant, but clear station is chosen instead of a strong, local, but obstructed signal.

The above two facts explain the seemingly completely erratic directions of u.h.f. aerials on the roofs of some German towns.

Whereas in v.h.f. a few vertically polarised channels exist, those in u.h.f. are invariably horizontal—as they will be in Britain. This contrary to the impression usually gained from British diagrams.

FEATURES OF PRESENT RECEIVERS

The receivers now on the market in West Germany and in most other countries are all u.h.f. equipped and mostly have continuous tuning from channel 21 to 68. Only last year this was 21 to 60. A few years ago, before the channels were officially numbered, the same scales read 14 to 53, or something like 1 to 100.

older, permanent, optical screens have disappeared.

This would seem a worthwhile feature on British sets, as of course the change to the higher definition will cause a considerable swing from the 19in. to the 23in. screen (in Belgium, no currently produced set under 23in. is on the market).

From personal observation in British and Continental homes I would say that at present the average comfortable viewing distance of a 405-line picture on a 19in. screen is equal to the one of a 625-line picture on a 23in. screen.

So, when switching back from 625 to 405 lines on dual-standard sets—as will be frequently necessary during transition time—the line suppressor could cut in automatically and make it unnecessary for the viewer to move his chair further away from the screen. ■

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TUNER BISCUIT MODIFICATIONS

by Gordon J. King

THERE are hosts of turret tuners now available on the second-hand and surplus markets, and experimenters should have no difficulty in securing a suitable replacement tuner or even a model which would be suitable for converting an old-style five-channel model for multi-channel operation.

One big problem, however, is that very few of these tuners have their full complement of coil biscuits to provide operation on all channels in Bands I and III. Under normal conditions, of course, only two or at the very most, three channels are required in any given area; but unfortunately, it often happens that the local channels required are not present on the tuner, and subsequent investigation reveals that coil biscuits to fill the vacant channels are almost impossible to obtain.

The problem is often aggravated so far as surplus tuners are concerned owing to the fact that the tuner cannot easily be identified in terms of make and type; indeed, in many cases the tuners offered for sale are those which were designed for the receivers of a specific manufacture, and for obvious reasons this information is not usually made available to the purchaser—even if it is known by the supplier.

This, then, means that the experimenter is faced with the task of producing a biscuit set for the local channels often unaided, and this—it is hoped—is where this article will help.

Check Tuner

Before delving into the coil alteration or winding problems, a few "things" should be made clear on the tuner itself. Firstly, it should be ensured that the tuner chosen produces i.f. signals on both sound and vision which match the frequencies of the sound and vision i.f. channels of the set itself. It is one problem to alter the coil biscuits, and an entirely different one to change the intermediate frequencies.

Secondly, the tuner should feature valves whose heater *current* matches that of the valves in the receiver if of a.c.-d.c. mode or whose *voltage* matches that of the valves in the receiver if of a.c.-only mode—that is, with a mains transformer instead of series-connected heater chain.

In the former event, it is simply necessary to introduce the tuner valve heaters in the series heater chain of the set, and this is usually accomplished by removing the r.f. amplifier valve and connecting the two series-connected tuner valve heaters across the heater tags of this valveholder. In the latter case, the tuner valve heaters are connected in parallel anyway, so the heater wires are connected direct across the matching heater winding on the mains transformer.

When tuners are "wired in", the set's frequency changer valve is often rewired to form a low-gain i.f. stage into which the tuner's i.f. signals may be injected. Injection is either at the control grid, across a 100 Ω resistor, or across the cathode resistor, but in either case it is best to feed the signal *via* a 0.001 μ F isolating capacitor in case there happens to be a d.c. voltage on the tuner's i.f. output cable.

The h.t. supply for the tuner is normally picked up direct from the set's h.t. line (relative to chassis which is connected to tuner negative or "black" lead), or from the screen grid tag on the r.f. valveholder. The latter connection gives extra decoupling in most circuits via an 0.001 μ F capacitor and 1k Ω resistor—make sure that the resistor is sufficiently large to handle 30mA or so of tuner current.

After that little recapitulation on tuner fitting and choice, let us now get back to the point in question!

The tuner will almost always contain at least two biscuit sets—one on Band I and the other on Band III. Lucky purchasers will either find that these two channels correspond to their local stations or that the turret has its full complement of biscuits! Unlucky ones, on the other hand, will find that the missing coils are those corresponding to the local channels.

If the make and model of the tuner is known the missing biscuits or, at least, those for local channel operation may be obtainable from the manufacturer. In this respect, however, there are one or two factors to have in mind. Remember that it is totally impossible for any manufacturer to supply coil sets or biscuits unless he is furnished not only with the model number of the tuner, but also with the sound and vision i.f. combinations.

Oscillator and I.F.'s

The i.f.'s are produced by the difference between the incoming signal frequencies and the oscillator frequency, so it follows that any odd biscuit—even though it may be designed for the required channel—just cannot be employed. For example, take a channel 5 oscillator coil; for sound and vision i.f. signals of 10.5Mc/s and 16Mc/s respectively (a common combination) the coil will have to tune over 82.75Mc/s. Now, for the same channel, sound and vision i.f.'s of 38Mc/s and 34.5Mc/s (another common combination) would demand an oscillator coil tuning over 101.25Mc/s. This is 18.5Mc/s higher than for the 19.5/16Mc/s i.f.'s, so one can realise why one coil would not serve both requirements.

In the foregoing examples it will be seen that the sound i.f. is *above* the vision i.f. This is current

practice but on some older sets the sound i.f. is below the vision i.f., so that to achieve the 16/19.5Mc/s i.f. combination on channel 5 the oscillator would have to work at 47.25Mc/s. Note that when the sound i.f. is above the vision i.f. the local oscillator frequency is above the signal frequency, while when the sound is below the vision the oscillator frequency is below the signal frequency. This is a useful law to have in mind when messing about with tuners.

Tuner Circuit

In Fig. 1 is shown the circuit of a very well-known make of turret tuner, in which the coil biscuits are shown in dotted line. The aerial biscuit comprises essentially coil L1 with its aerial coupling winding, while the other—and larger—biscuit is made up of three separate coils—L3, L4 and L5.

Coils L1, L2 and L3 (the aerial, r.f. anode and mixer coils respectively) are all tuned to the approximate centre of the required channel. This means that whatever the i.f. output and i.f. combination these will always be the same as they are not concerned in governing the i.f.

L5 is the oscillator coil, and this is probably the most important of them all, since not only is it much more critical in tuning than the others but it also governs the sound and vision i.f.'s.

These are factors which are also well worth remembering, for let it be supposed that a tuner is without channel 5 coils—the channel it is required to receive—but has coils on channel 4. Now, the difference between any adjacent

channel (except relative to channel 1) is 5Mc/s. This means, then, that channel 5 could be received on a channel 4 coil-set if the oscillator could be swung 5Mc/s—at the moment forgetting coils L1, L3 and L4.

The oscillator frequency is controlled by the fine tuner (C16 on circuit) and the trimmer C13, but under normal conditions the fine tuning control is unable to swing the oscillator over 5Mc/s and—most important—the trimmer *should not be touched* for maladjustment here would put all the other channels out. Actually, the oscillator frequency can be swung 1Mc or so by a core in the oscillator coil former, and by moving this to the end of its travel—in relation to the fine tuning control—it is often possible to bring the *adjacent* channel within range of the fine tuning control. This has been described simply to reveal that a channel change is *possible* by moving only the oscillator frequency—but this is not a good way of tackling the problem as we shall see.

The above method may be warranted if the coil set was designed for the required channel but for use with a tuner having a different i.f.: Here, then, coils L1, L3 and L4 would be designed and aligned for the required channel, which would come in as good as ever just by correcting the oscillator frequency.

In the first example, one would be relying upon the relatively wide passband of the tuned circuits L1, L3 and L4 to pass both the sound and vision of an adjacent channel and; although a simple shift of oscillator frequency would make this possible,

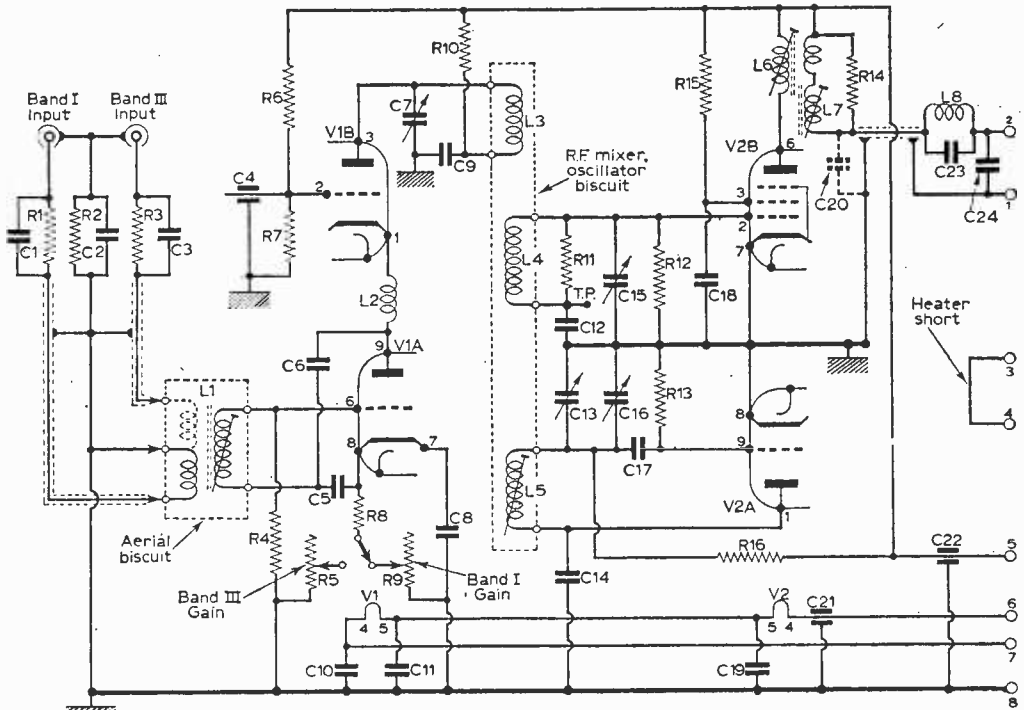


Fig. 1—The circuit diagram of Cyldon turret tuner.

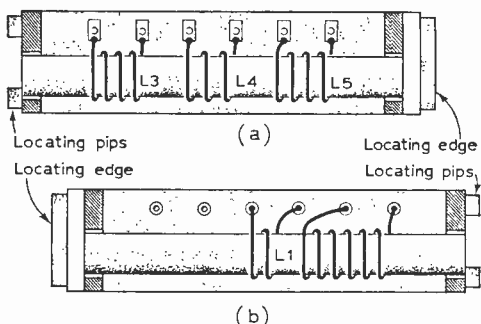


Fig. 2—Coil biscuits: (a) the r.f., mixer and oscillator windings, L3, L4 and L5 respectively, and (b) the aerial windings.

the performance would be poor and the sound/vision balance would be destroyed.

Sub-standard Biscuits

At this stage it should be understood that turret tuners are very accurately aligned when first produced at the factory—a special alignment jig being used for this purpose. Now, the alignment is set in relation to specific coil biscuits as designed by the manufacturer by means of small preset trimmers mounted on the chassis of the tuner—such as C7, C13 and C15 in Fig. 1. The idea behind this exercise is that a “standard” is established, so that when coil biscuits are fitted for other channels one would be sure that optimum efficiency is secured. Also, that to set the tuning of any other channel only the coils need be adjusted. This mode of design and adjustment, therefore, means that coil sets other than those specifically designed for the tuner—even though they may fit—are virtually unsuitable.

The solution is not in realigning the tuner by the present trimmers, for this would bring in those channels using sub-standard coil sets and maladjust all the other channels using the correct coil sets! What must be done, of course, is to carefully tailor sub-standard coils to fit the existing alignment of the tuner—never being tempted to alter the preset adjustments under any conditions.

Let us suppose that we have a tuner which is working correctly on, say, channel 2 (and possibly other distant channels) and that the local channel 8 ITA station is required, but that there is not a coil set for this channel—only a set for the adjacent channel, channel 9. What can be done in a case like this?

Turns Spacing Adjustments

The best idea would be to alter the channel 9 coils until they give optimum reception of the channel 8 transmission. On adjacent channels

this is relatively easy, and on adjacent Band III channels the number of turns need not be altered at all, the change in channel being accomplished by the brass screw-in cores (in the formers) and by adjusting the spacing between the turns.

In Fig. 2 is shown at (a) a typical r.f., mixer and oscillator biscuit, and at (b) a typical aerial biscuit, whose coil numbers correspond to those in the circuit of Fig. 1. The first thing to do to satisfy the example is to drop the oscillator frequency by about 5Mc/s. If possible, it is best not at this stage to alter the brass core in the former, but to bring in the sound with the fine tuning control at range centre simply by altering the spacing between the turns of L5.

Since the oscillator frequency needs to be lowered the turns should be spaced closer together, starting at one end of the winding and taking care to avoid shorting the turns. It is not difficult as the wire is fairly stout and once bent it remains solidly in position. After each adjustment the turret will have to be switched on to channel and the tuning tested for frequency. After a few trial runs it will soon be discovered just how much the spacing needs to be adjusted to give the best results. Finally, a close adjustment of oscillator frequency can be made with the core by using a non-metallic trimming tool through the hole beneath the fine tuning control in the normal way.

Fig. 3 shows how the biscuits are located on

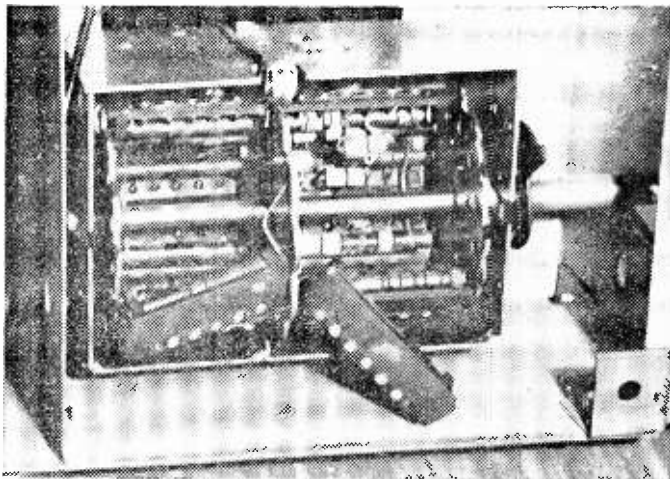


Fig. 3—Showing how the coil biscuits are unclipped from the turret. Note that it is necessary to turn the turret several channels to make the biscuit under adjustment accessible.

the turret, and from this it will be seen that the channel selector will need to be turned off channel to make the biscuit under adjustment accessible—after first removing the screen from the bottom of the tuner, of course. The aerial biscuit is that in the half of the turret remote from the control knob, and the biscuits are clipped in by means of locating pips and ledges (see Fig. 2).

When maximum sound of the required channel is obtained with the fine tuning control at approximate range centre, the turns spacing of coils L1,

—continued on page 419

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 90: ALBA T655

THE Alba T655 is a 17in. table model with a 90° tube, electrostatically focused. The majority of the valves and components are mounted on two printed circuit panels which are detachable for replacement as a whole or for servicing. Many of the components are close soldered to the panel and require care on removal if damage to the panel is to be avoided.

One side of the mains is connected via a fuse and

the on/off switch to the chassis. Two thermistors are used, one in the heater circuit VA1015, the other in the vertical linearity circuit VA1008.

Heater Chain

The valves are numbered according to their position in the heater chain, for example the c.r.t. heater is the last in the chain with one side to

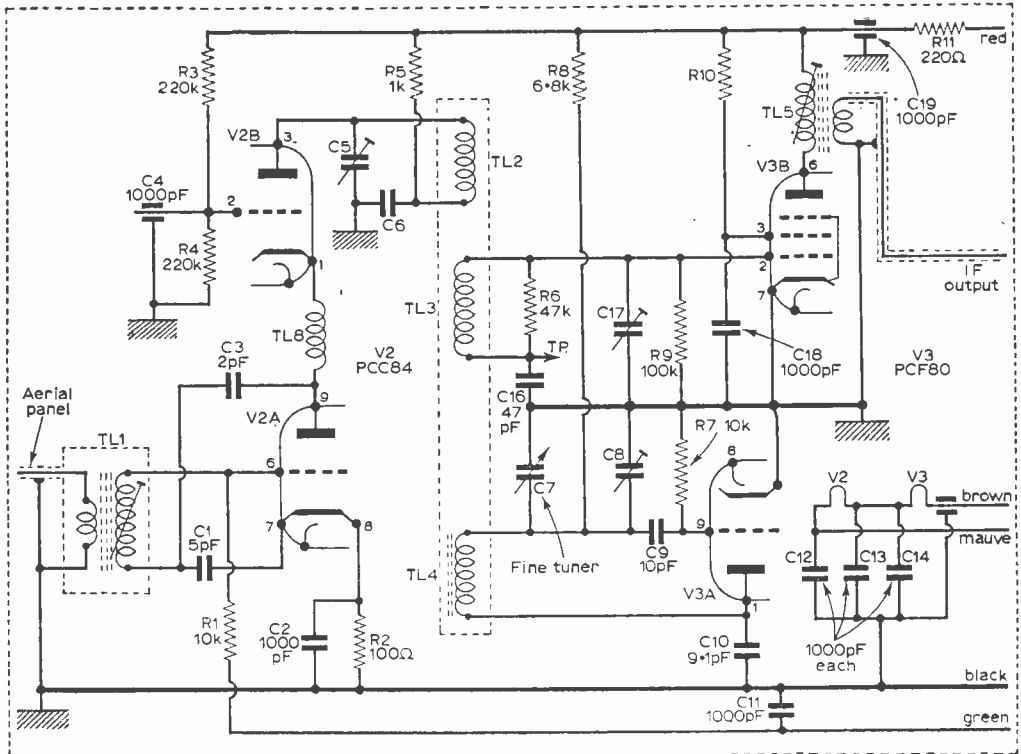


Fig. 1—The circuit of the tuner.

chassis and the tube is therefore referred to as V1. The PCC84 on the tuner unit is next in the chain and is V2, the PCF80 V3 and so on. This has the advantage of immediately identifying the position of the valve likely to be at fault if some are lighting and others are not. For example if valves (or heaters) one to eight are not lighting whereas nine to 14 light brightly it is obvious that V8 and V9 should be checked for heater-cathode shorts without further ado.

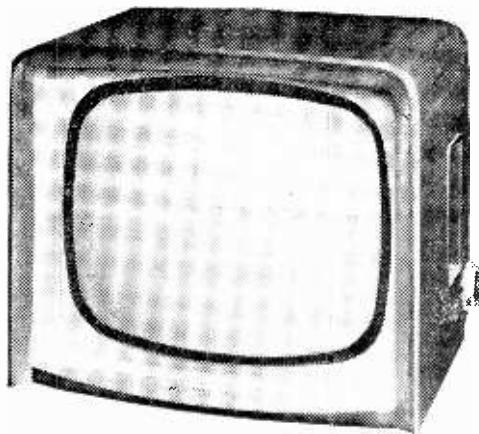
Removal of Safety Glass

Another good point of this particular model is the ease with which the front safety glass can be removed for cleaning and access to the front of the tube. There are three screws fixing the bottom front strut which comes away to allow the glass to be removed.

The gilt motif on the bottom strut tends to catch in polishing dusters, unless care is used, resulting in ends bending up or snapping off.

Removal of Printed Panels

To remove the top panel remove the panel fixing screw which passes through a rubber grommet,



The Alba T655

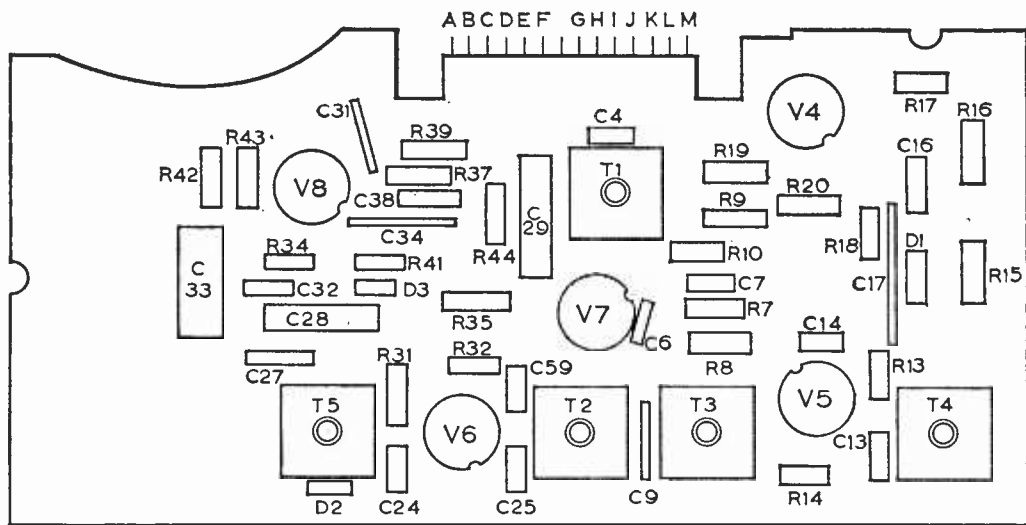


Fig. 2—The i.f. panel.

this being located to the left of the sync separator V9. The panel can then be lifted off in an upward direction from its connector block.

Bottom Panel

Remove the fibre board bottom cover of the cabinet. The panel fixing screw passes through a rubber grommet located between V4 and V5. Remove this, and also one screw in the latch retaining arm, situated just left of V6. The panel can then be withdrawn from its connector block in a downward direction.

Chassis Removal

Remove panels as above or at least remove the two fixing screws and remove the side control knob escutcheon (two screws) and the two tuner knobs. Unplug loudspeaker leads, e.h.t. connector and tube base socket, ion trap magnet and centring device (having first noted their exact positions). Release the two chassis fixing screws one on the right of the frame output transformer, the other is located through a hole in the back control panel adjacent to the Band III sensitivity knob. The chassis should then be tilted slightly backwards from the top,

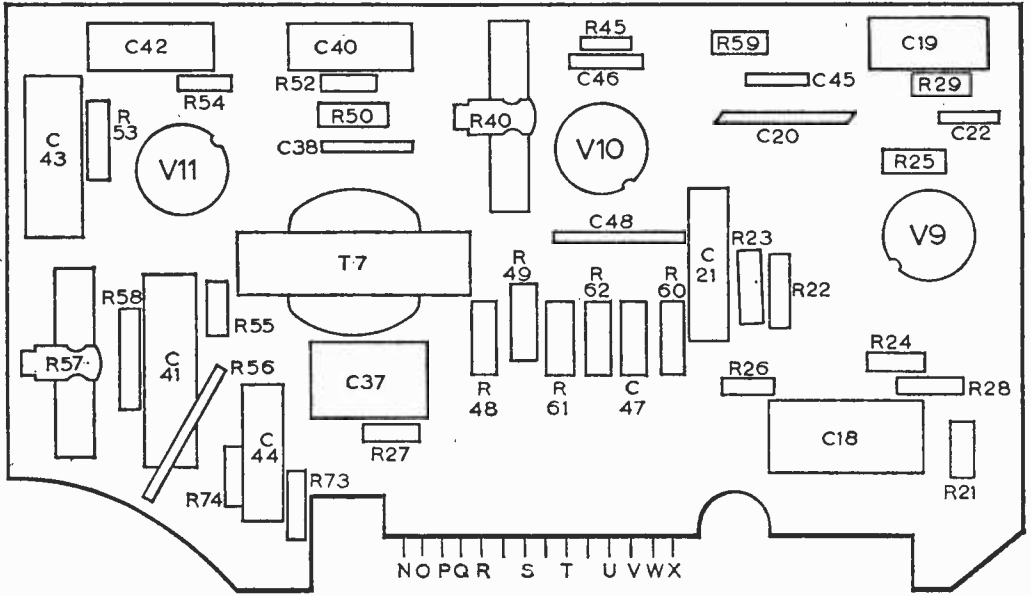


Fig. 3—The timebase panel.

allowing the lower fixing clips to be unhooked. The chassis is then free of the tube.

Removal of Complete Assembly

Remove side escutcheon and tuner knobs. Remove the fixing screw immediately at the top of the tube and the two screws in the base of the circuit. This allows the whole assembly to be withdrawn—but keep an eye on the loudspeaker whilst removing.

When refitting, enter the left side of the chassis into the cabinet first about half way up in order to clear the loudspeaker of the upright cabinet member.

Faults to Expect

Probably the most frequently encountered fault is due to failure or impending failure of the h.t. rectifier PY32. Normally the first symptom is that the sound comes on after a slight delay but the vision is delayed for a further period, often of considerable length becoming progressively worse until perhaps the best part of an hour may elapse before a small picture finally appears.

Examination of the PY32 will probably show a blue glow in the glass envelope and this effect has been dealt with several times in past articles in this series. Replacement of the PY32 (preferably a PY33) will effect a complete cure. A defective PY32

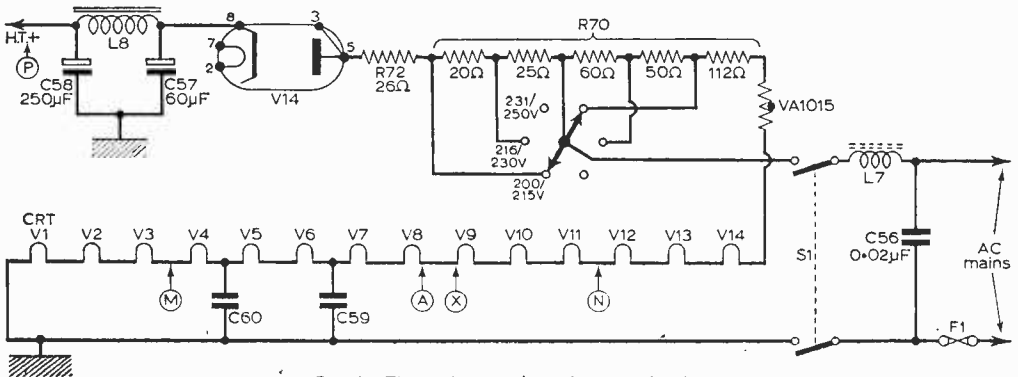


Fig. 4—The mains supply and power circuit.

can also result in a blown fuse and/or failure of the 26 Ω (R72) surge resistor. When the fuse fails, of course, there will be no sign of life in the receiver, no valve heaters glowing and the set will appear dead. This does not happen when R72 fails as only the h.t. is absent resulting in the receiver being inoperative of course, but the valve heaters continue to function as their supply is via R70-R71.

It should be pointed out that the fuse is in the neutral side of the mains from chassis via the on/off switch. With this type of circuit the use of a neon indicator will result in a glow being obtained at all parts of the receiver, including chassis, if the fuse fails and if the mains polarity (wiring of the plug) is correct.

No Picture, Sound Normal

No raster displayed when the brilliance control is advanced. Listen for the line timebase whistle which should be clearly audible (if you haven't got a cold that is); if present, this indicates that the line timebase is functioning. Investigation will probably show that c.h.t. is present up to the EY86 top cap but that this valve is not being heated. Fit a new EY86 and in nearly all cases a picture will be restored.

When there is little sign of a timebase whistle first check the PL81, then the PY81 and the wire-wound resistor to pin 8 of the PL81, R64 (1.5k Ω). If the PL81 runs red hot check V10 (ECL80) and associated components including the horizontal hold control R63 (100k Ω).

Lack of Width

When a black band appears from either side and the height appears to be excessive, the PL81 is usually at fault as whilst low h.t. (weak PY32) will cause lack of width it will also give rise to lack of height as well, more so at the bottom of the picture.

Lack of Height

Continuing from this, if the width of the picture is normal but full height is not obtainable, more particularly at the bottom, check V11 and notice whether R52 (330 Ω) is discoloured. If it is, change it as a new PCL82 will rapidly fail if R52 falls in value. If V11 is not at fault and R52 is of correct value check the bias electrolytic C40 which has a value of 100 μ F 18V (or 100 μ F 25V). If this capacitor becomes o.c. heavy current feedback results and the frame current is seriously affected. In the event of V11, C40 and R52 being found in order, check C42, C43 and C44, and then the varite R56. If in doubt replace R56 with a resistor of 10-15k Ω .

TO BE CONTINUED

TUNER BISCUIT MODIFICATIONS

—continued from page 415

L3, L4 and L5 should be adjusted in a like manner to secure the best sound/vision balance and the best definition of Test Card C. The tuning of these coils is less critical than that of the oscillator, but most biscuits feature a core or cores for finalising the adjustment, though this cannot always be done with the biscuits in position. It is usually necessary to make the adjustment, reinsert the biscuit, try the set and then follow up with other adjustments if necessary. On Band I channels it is often necessary to alter the number of turns to get one set of coils to work on a different channel. It is impossible to say exactly how many turns will have to be added or removed as, again, the turns spacing plays a great part in determining the tuned frequency. To go up or down a channel 1.5 turns should be removed or added respectively, and final adjustment undertaken by altering the turns spacing and core adjustment as already explained. ■

TV ALIGNMENT

—continued from page 405

DUAL-STANDARD RECEIVERS

The problem is considerably increased when we come to consider the alignment of dual-standard receivers. However, there have been several instructive articles on 625-line specifications in these pages recently and space limitation prevents a discussion of the special alignment techniques demanded by the later receivers.

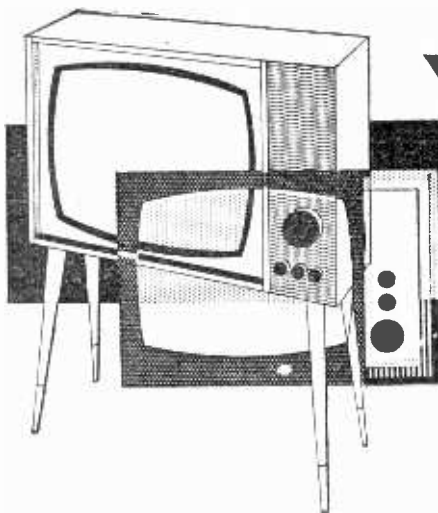
Further details of the instruments and their wider range of facilities will be found in the appropriate articles of this series at present appearing in our companion journal, PRACTICAL WIRELESS. The use of a double-beam oscilloscope, for example, gives the added advantage of direct comparison of input and output waveforms, making such tests as the square-wave input much more effective. Specifications for such instruments also cover a wide range of audio and radio tests and have many uses in direct fault-finding.

THE PATTERN GENERATOR

The pattern generator requires only a brief mention at this point. Such instruments as the Taylor 94A have the facility of a still-pattern transmitter and permit the complete appraisal of the television receiver.

In general the proper use of these elaborate instruments requires close adherence to the instructions supplied by their makers.

If space allows there may be an opportunity later of detailing the specifications and applications of the specialised instruments at present available. ■



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

PYE VT17

The picture is good until a camera change is made when the picture disappears leaving horizontal lines over the screen. Adjustment of the horizontal line control occasionally restores a very dim picture covered with a patterning. The only sure way to restore a good picture is to switch the set off for about half a minute and then switch on again.

I have replaced the PCF80 twice, which only temporarily cures the fault. I have a Trader service sheet.—A. Smith (Berwick-on-Tweed).

Make sure that the PCF80's are above suspicion, and then check by substitution, X2, MR1, MR2, C61 and C62.

SOBELL T175

The sound is correct but recently a horizontal line appeared across the screen. I changed the frame output and sound output valves and on switching on the horizontal line appeared for a few minutes and then disappeared. This lasted for two days and then on switching on again the horizontal line once again was present. A new frame output valve again cured the fault, but only temporarily. I cannot understand this situation and I hope you can help.—J. Hawkins (Sidcup, Kent).

The trouble lies in the frame timebase, and the changing of the valve here may disturb a poor soldered connection, thereby clearing the fault for a while. Check for defective components and poor soldering on the tags of the ECL80 valveholder.

EKCO T205

The picture on this set consists of two complete frames instead of one. I have replaced the 20L1 in the frame circuit but with no effect.—J. F. Warburton (Malvern, Worcestershire).

Suspect a faulty 1M Ω resistor which is between the slider of the frame hold control and the blocking oscillator transformer. It is located below mid-chassis, near the seam between the i.f. and timebase sections.

MURPHY V240

The raster width has shrunk to about five inches and fold-over is present in about three places.

I have checked the line output (20P4), line oscillator (20L1) and efficiency diode (U329) valves and all have been found in order.—H. Price (Horndean, Hampshire).

Replace the 0.25 μ F efficiency diode capacitor which is wired across the 20P4 and U329 valveholders.

DECCA DM14

Could you please tell me if it is possible to fit a 17in. tube in this receiver?—W. E. Campbell (Manchester).

The DM14 uses an MW36-24 tube. A 17in. MW43-64 or MW43-69 may be used with pin 7 strapped to pin 11 with no other electrical alterations.

The cabinet is not suitable, however, and it would perhaps be possible to obtain a second-hand DM17 cabinet from a local dealer which would also contain the chassis members.

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No. 6. TELEVISION SERVICING CYCLOPAEDIA. Harold P. Manly, 47/6. Here is a most reliable reference source of information on television. One of the most interesting books we have ever seen. You will enjoy reading this publication, it's not stuffy, or hard to use. It's not a glorified dictionary as the title may imply, but a thoroughly readable book of 868 pages representing the best value in television information. The chapters are in alphabetical order and cover such subjects as Alignment, Amplifiers, I.F. Tuners, Amplifier Stages, and Video, Antennas, Biasing, Brightness controls and so on. We feel that you will want to add this book to your library once you have seen it, so why not send in the coupon now? You can always send it back if you don't agree with us.

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PYE V7CD

The picture is quite good except that there is a continual "shimmering" pattern over the screen. I have ascertained that the aerial system is not at fault.—C. S. Jex (Carlisle, Cumberland).

These symptoms indicate interference from the local v.h.f. radio station. Try fitting a coaxial stub in parallel with the aerial plug. Start with a six-foot length and cut it off an inch at a time, until an optimum point is reached.

ULTRA 917

The picture is lacking in width by $1\frac{1}{2}$ in. and this cannot be rectified even by adjustment of the control on the transformer. I have changed all the valves without success, including the U25.

The picture quality is reasonably good but the sound is very weak.

I can obtain the correct width with the horizontal hold control, but this also results in multiple images and loss of vertical frame.—A. Norbron (Brierley, Yorkshire).

Check the h.t. voltage (200V). If this is low and you are sure the U801 is in order, check each 100Ω resistor to the anode pins. About 200V a.c. should be recorded at pins 3, 4, 5 and 6.

If the h.t. is in order, check the $1.5M\Omega$ anode resistor of the 20L1 (pin 5) and the screen resistor ($4.7k\Omega$) to pin 4 of the 20P4. Check the cathode components of the 20P4. These are a 100Ω resistor and a $50\mu F$ capacitor.

EKCO T205

The picture quality on this receiver is excellent on close-ups, but poor on distant shots. The contrast control is fully advanced. I have changed the U25 and fitted a new $100+200\mu F$ capacitor.

When first switched on, the picture is very bright but after about three minutes it returns to its normal condition. Apart from the tube, could any other components be at fault?—T. L. Hume (London, N.20).

These symptoms do sound like a faulty tube, but a video amplifier fault could also produce these conditions. The tube is fairly easy to replace and you can use either a CRM141 or CRM142.

BUSH 24A

It is almost impossible to adjust the line hold control as it is so critical, and readjustment is necessary every few minutes to keep the picture steady. The picture is always distorted and fold-over occurs in the top left-hand corner.

The frame hold control is also very critical.—D. M. Blachlin (Oldham, Lancashire).

We would advise you to replace the EF80 and ECL80 valves on the right side of the main deck.

DECCA DM4C

The contrast control appears to be completely inoperative and the picture on Band III varies in contrast and lacks highlights. The picture was slightly improved by changing V7 (EB91) but the control still has no effect. The sound volume on Band III is also poor.

Line tearing appears to be associated with these faults and the line hold control is very sensitive. Also after prolonged use, some frame "bounce" or "judder" occurs.

I have changed V1 (PCC84) without improvement.—M. H. MacDermott (Marden, Herefordshire).

We would not be inclined to suspect one particular fault causing all the symptoms described. If the tube is the original, this could well be failing and so produce loss of highlights, apparent loss of contrast, etc.

The fact that the control does not work at all, could be due to an open circuited contrast control. A shorted a.g.c. line capacitor or a faulty controlled valve. Check the PCL83 audio output valve and clean the volume control if necessary.

BAIRD

I would like to know if it is possible to convert this set to using a 21in. c.r.t.?

I can find no model number on the receiver, but it has a five-position switch on the front for BBC stations only. The tube type is MW43-64.—J. Rose (Grantham, Lincolnshire).

This receiver is apparently a Baird P2017. A Mullard MW53-20 21in. tube can be used with no electrical alterations, but this, of course, will demand considerable mechanical alteration.

PHILIPS 1238U

The h.t. is very low on this receiver. After cutting off the anode wire of the EY51 there was a reasonable spark from the transformer. I have fitted two new EY51's but the fault remains. Without the EY51 in circuit, the h.t. at the transformer seems normal.—A. Rogerson (Lancashire).

We presume your reference to the h.t. voltage really refers to the e.h.t. associated with the EY51. The h.t. voltage is that derived from the PZ30, and applied to the various stages of the receiver.

If this is indeed low, check the PZ30 and the $100\mu F$ reservoir electrolytic capacitor under the front of the left-side chassis.

If the e.h.t. is low, note whether the EY51 heater lights up with the tube anode clip removed from the side of the tube. If the EY51 anode becomes red hot, disconnect the e.h.t. capacitor from the front end of the line output transformer panel on which the EY51 is mounted. If the EY51 does not get red hot, and does not light, check the PY80 and PL81 and the electrolytic boost line capacitor near the PY80 valve base. Also check the h.t. applied to pin 8 of the PL81 valve base.

INVICTA 137

The picture height is considerably less than normal and there is a pronounced fold-over at the top of the screen. I have also noticed that the h.t. is low.

I have checked the sync separator (PCF80) and the frame output (PCL82) valves by substitution, but without improvement.

If the mains rectifier needs replacing, can you suggest an available type?—L. G. Wilkes (Manchester).

A direct replacement FC101 metal rectifier may be fitted. This may help to restore the normal frame scan but it may be necessary to check the components in the frame linearity circuit if the pre-set top linearity control is correctly adjusted.

EMERSON E701

When first switched on both the height and width of the picture are half their proper size. After twenty minutes or so the picture completely fills the screen apart from $\frac{1}{2}$ in. vertical strips at the sides of the picture.—F. E. Millington (Gillingham, Kent).

You should replace the PY32 h.t. rectifier valve. A PY33 is a more modern and reliable valve. Also check the PL36.

SPENCER WEST 181

A few months ago I had to replace the mains dropper and later the surge resistor. More recently I renewed the PCL82. Up to a week ago the set was performing well but then a crackling noise became discernible when the channel selection switch was touched.

This noise gradually became more persistent and finally the picture collapsed leaving none of the valves alight, except the one nearest the mains dropper, which glowed brightly.—T. Barnes (Birmingham).

If the PY82 lights brightly but the other valves do not, check both the PY82 and the PY83 efficiency diode, as either may have a heater-cathode short.

MURPHY V350

When first switched on a wicker-work pattern covers the screen. After about ten minutes the picture becomes normal. The sound is not affected at any time. The line hold control is turned fully clockwise.—L. Steel (Shiremoor, Northumberland).

Replace the 30P4 line scan generator valve in the e.h.t. unit. If possible use one of the new 30P19 valves, which are an improvement on the 30P4.

PHILCO 1968

The fault on this set first becomes evident with a reduction in width followed by the screen darkening, sometimes to such an extent that the picture is no longer visible. The local mains supply of 240V seems to vary, as during the day there is a good picture. I tried changing the voltage selector to 245V but the set then goes completely dead.—F. Prentice (Liverpool).

The receiver goes dead when the selector is placed in the 228-245V position due to an open circuited resistor in the mains dropper section.

The lack of width is due to a failing FC101 (14RA1282) contact cooled metal rectifier. Check the PL36 line output valve if necessary.

BAIRD TV19

One evening the screen of this set went blank. The U26 valve was replaced and the picture restored. However, now another fault has developed and after the set has been operating for about an hour, a flurry of bright spots appear and then the picture leaves the screen, only to return a few seconds later with the spots still present. This only happens rarely and only on the BBC channel.—A. J. Webb (London, E.11).

The fault could be caused by a faulty U26 valve, but we would be inclined to suspect a poor connection to its base or top cap due to the intermittent nature of the fault. Close examination of the line output stage and U26 wiring should reveal the fault.

SOBELL TPS173

The picture breaks up into horizontal lines and this is accompanied by a change in the line whistle.

With the aerial removed the raster is very ragged at the edges. Also, when a picture is received, the outlines are ragged, no focusing is possible and the contrast control is inoperative. When the horizontal hold control is fully advanced, the line whistle becomes very loud and a general arcing takes place at the heater wires of the EY51. This arcing stops when the control is in a position when it will not hold the picture. The picture is also extended at the top.

I have checked all the valves by substitution.—J. J. Chitty (Horam, Sussex).

The arcing from the EY51 denotes that this valve has been incorrectly soldered. It is essential to use a hot iron, making well rounded "blobs" with no sharp edges, no bent wires or wire ends protruding.

The contrast control will not work on a weak signal and a weak signal will also produce ragged outlines.

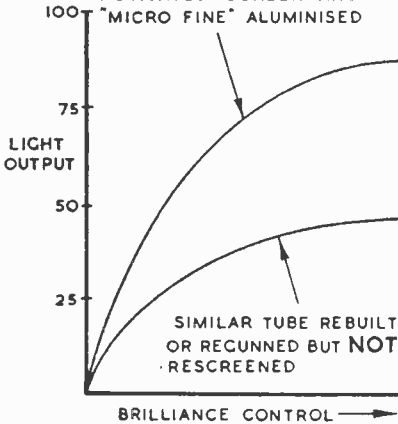
Check the aerial first and the tuner unit valves, particularly the PCC84. Also check the cathode components of the right side PCL82. These are a 330Ω resistor (R74) and a 100μF electrolytic capacitor C69.

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G.E.C. BT318

This set has developed a pronounced hum on the BBC channel only. This varies with picture content.—J. E. Mumberson (Loudwater, Buckinghamshire).

This appears to be vision on sound. If the fine tuner will not clear the fault, alter the oscillator trimmer very slightly, keeping the fine tuner at its mid-way position.

BANNER B124

There is no sound on this set and no e.h.t. All the valves light except the EY51. I have checked all the valves satisfactorily.—H. Cornell (Birmingham).

Check the h.t. voltage to ensure that this is somewhere near 200V. If it is very low, check the main electrolytic capacitors.

If the h.t. is in order check the h.t. supply to pin 8 of the PL81 and the cathode bias resistor from pin 3 to chassis. Then check the 0.25 μ F boost line capacitor before finally suspecting the line output transformer.

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This coupon is available until JUNE 21st, 1963, and must accompany all Queries sent in accordance with the notice on page 420.

PRACTICAL TELEVISION, JUNE, 1963

TEST CASE -7

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.

? An experimenter's receiver was found to exhibit the symptom as shown in the photograph. On Test Card C the effect is of "cogging" while on a picture, impaired line hold and distortion, as determined by the picture content and movement, are most evident. The symptom is often called "pulling on whites" and the illustration reveals that sections of the picture finishing in white are horizontally displaced.

What are the most usual causes of this symptom and what tests can be made to establish the circuit section at fault?

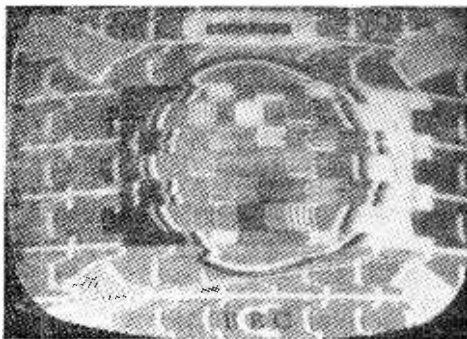
See next month's PRACTICAL TELEVISION for the solution.

**SOLUTION TO TEST CASE—6
(Page 379, last month)**

The effect described last month must not be mistaken for timebase trouble, for when the frame or line timebases are to blame for raster distortion, the edges of the picture are always symmetrical although sometimes compressed or extra bright.

The progressive "spreading" of the picture across the screen indicates that the formation of the raster is being suppressed by repelling electrostatic charges developed upon the screen surface. In many cases this signifies that the tube is waning, and this should be suspected if the symptom is accompanied by the typical "worn tube" effects, such as a dim picture which tends to go negative as the brightness control is turned up in an endeavour to brighten the picture.

Note, however, that the effect—if the picture is otherwise normal—can be caused by dampness on



The effect of "cogging"

the tube face or flare, and for this reason it may sometimes occur when first switching the receiver on after it has been left for a period, particularly during the winter or damp weather, in a cold, damp room.

In this event the trouble clears when the set has thoroughly warmed up, and a normal picture can be accelerated by quickly advancing and then retarding the brightness control. In obstinate cases it may be necessary thoroughly to dry both the tube and the mask in front of a fire to clear the trouble, and it should be remembered that old-style sets sometimes used masks which developed electrostatic tendencies.

On modern sets care should be taken to see that the external conductive coating of the picture tube is adequately bonded to chassis via the spring clips or springs used for this purpose, and it often pays to treat the screen with an anti-static polish when it becomes necessary to remove the tube or implosion guard for cleaning purposes.



LETTERS TO THE EDITOR

TELEVISION PHOTOGRAPHY

SIR,—I would like to say how much I have admired the photographs that have appeared in recent issues of PT, illustrating various fault symptoms as they appear on the screen. These indeed clearly indicate any effects of faulty components or circuitry and eliminate the ambiguities that could arise if the author were to try to describe with words the same symptoms.

I would like to attempt photographing television pictures but being a very inexperienced photographer I can foresee many problems in such attempts and I wonder if there is any reader who would care to pass on any hints about such a task.—D. V. CHAPMAN (Corby, Northamptonshire).

CONTINENTAL VIEWING

SIR,—At the moment, Continental television reception is just another outlet with which the amateur experimenter may test his skill, but I should imagine that if every viewer knew of the possibility of picking up foreign transmissions, there would be a good deal of interest aroused. For the language student, for example, watching a foreign TV show would provide an excellent test for his knowledge of the language. Also, there must be many people who would enjoy watching a Continental programme for its own sake, perhaps in preference to a BBC or ITA show.

But whatever the reason for Continental viewing, since we shall soon be using a 625-line system and with sets already on the market capable of receiving such signals, it seems a good idea to let the general public know that reception may be possible, and with the improved sensitivity of modern receivers perhaps watching foreign programmes will become so popular that the "Radio Times" will have to publish programme times of their French, Belgium, etc. counterparts.—S. D. DUDLEY (Swansea, Glamorganshire).

STANDARD RECEIVER DESIGN

SIR,—It appears to me that nowadays all TV receivers are much the same in design and that only the external appearance differs from set to set. No doubt individual manufacturers try to make their sets attractive by adding circuit refinements, but no single set incorporates all the "extras", with the result that, although each set will have advantages over its rivals, it is bound to lack some other feature. There is nothing basically wrong with this arrangement and no one could expect the manufacturers to bring out receivers including every

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

improvement at the competitive prices asked for modern sets; but the unfortunate part of this situation is that the person who wants to buy a quality receiver employing the best design possible, is frustrated by the fact that no such set is available, even though he is willing to pay considerably more than the normal cost of a TV set.

In other words, there is, it seems to me, no "Rolls-Royce" of television receivers on the market which leaves us with a TV industry producing more or less standard equipment.—I. N. GILBERT (Broadstairs, Kent).

BOOK REVIEW

RADIO VALVE AND TV TUBE EQUIVALENTS MANUAL

By B. B. Babani; published by Bernards (Publishers) Ltd.
24 pages, 7½in. x 9½in. Price 3s. 6d.

THIS Manual will prove to be a most useful "tool" for the professional serviceman as well as for the amateur who, whether by choice or under duress, finds himself involved from time to time in the maintenance of receivers belonging to friends or neighbours.

The multiplicity of valve types is one of the headaches of this kind of work, and a handy reference book such as this manual is an indispensable aid to the selection of appropriate substitutes from the inevitably limited range of valves carried in service stores or spares boxes.

Included in the general index of this manual are receiving valves of the Octal, Loctal, B7G and B9A varieties that are of current manufacture or still in common use, together with many current types of television picture tubes. On each line of the table of commercial equivalents are listed valves or tubes that are directly interchangeable, the entries being divided into seven columns according to manufacturer (Mullard, Ediswan Mazda, Brimar, G.E.C.) or other classification (U.S.A., C.V., European).

Other tables provide commercial equivalents for C.V., British Service and U.S.A. Service valves—information that is sure to be a boon to the ardent seeker of bargains in the ex-government equipment field.

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DL96	8/- EL32	4/8 PL82	7/6 5L4G	7/- 12074T	6/3
EABC80	7/3 EL33	9/- PL83	8/- 5Y3	8/- 20D1	8/6
EAF42	9/- EL34	7/6 PL84	8/- 5Z4G	9/6 20F2	12/3
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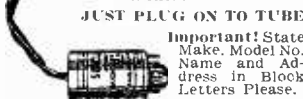
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Tel: Coventry 73595

Cotton T.V. Service Ltd.
63-65 Oundle Road
Peterborough
Tel: Peterborough 2169