# Practical TELEVISION

SEPTEMBER 1964

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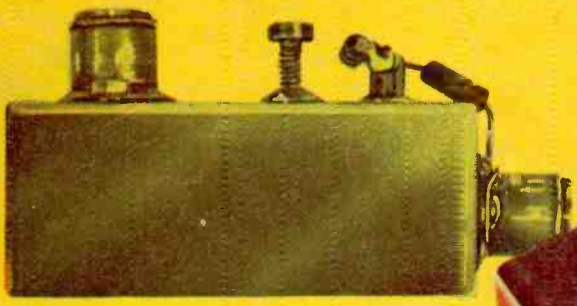
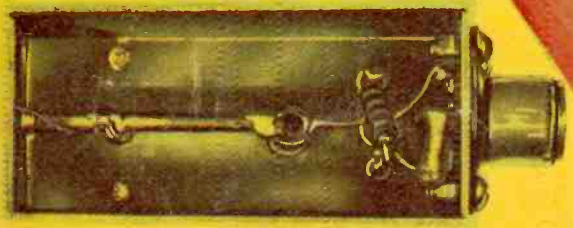
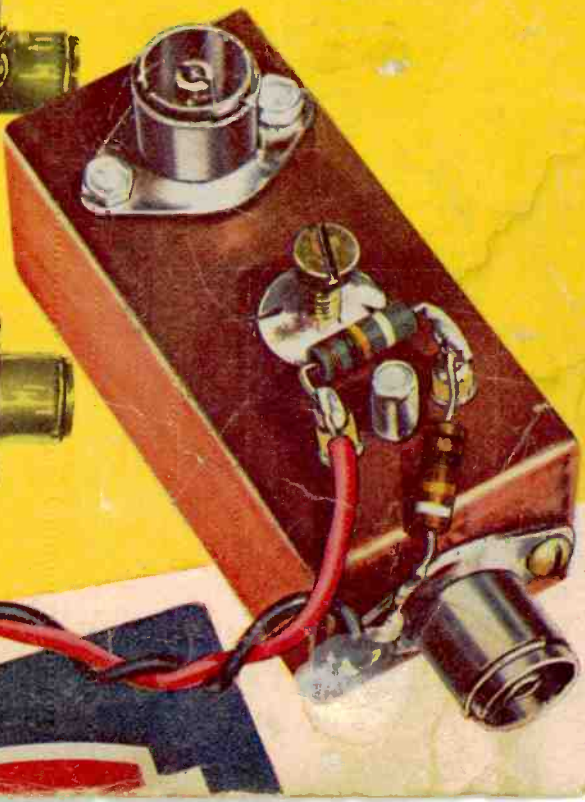
## A U.H.F. TRANSISTOR PRE-AMPLIFIER







# Practical Television

AND TELEVISION TIMES

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## Contents



*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 if 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.*



# Evolution of an Exhibition

ONCE again the Radio Show is with us. Once again the public will flock to Earls Court to gaze at the sets, ply the salesmen with questions, collect sales literature, contemplate buying a new receiver, and wearily seek out the haven of the refreshment rooms. Years may come and go but the Radio Show is a veritable permanent magnet!

This year, of course, it is all back under one roof again, following the trade-only experiment of last year. And how it has changed!

In the pioneer days, the exhibition was aimed largely at the home constructor and experimenter and was a golden opportunity to meet fellow enthusiasts to talk shop. Even in the last "Radiolympia" before the war, there was still a lot for the home constructor and "ham" to see and many amateurs to seek out for a chinwag.

But by this time, the main emphasis had veered towards the ordinary listener and viewer. Elaborate attractions were sponsored by the BBC, including special studio programmes which were not only seen by the audiences but were broadcast live on the radio.

After the war, the character of the show changed even more rapidly, this coinciding with a change in venue from the cosy Olympia to the more stark Earls Court, a move made necessary by the demand for stand space.

Displays and features of particular interest to the amateur enthusiast began to vanish quickly and television took over the dominant role, not only on the stands but with TV shows organised by the BBC. In recent years even these have changed.

Truth to be, the Radio Show has in essence become more and more a trade show cunningly disguised as a public exhibition. Manufacturers are mainly concerned (and who can blame them?) with filling their order books and not a few of the exhibitors have little or no direct point of contact with the general public.

From small beginnings the industry has developed octopus-like tentacles. This has led to more specialised exhibitions. For instance, component manufacturers prefer to support the RECMF Component Show, a strictly trade-only exhibition where they reach set manufacturers and overseas buyers. The audio people, after an abortive effort to introduce an audio section at the Radio Show, stick steadfastly to the Audio Fair, although this is open to the general public. And for the average amateur, we still have the annual RSGB exhibition where we can meet fellow enthusiasts for a get-together and see a few components.

This year's arrangements at Earls Court are a compromise to the conflicting interests of the Trade and Public—the exhibition is the same but opening hours are divided between both factions. Neither is entirely satisfactory to that large minority the amateur radio and TV enthusiast. Despite this, however, large numbers of us will still walk through those turnstiles again this year!

**Our next issue dated October will be published on September 22nd.**

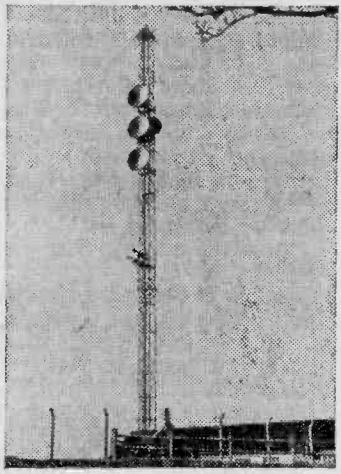
# TELETOPICS

## New Eurovision Microwave Link

IMPORTANT new microwave links are to be established between London's new 600ft. GPO tower and Lille in northern France. This equipment, which will be provided by Standard Telephones and Cables Limited, will boost the number of international telephone circuits and also provide a permanent 625-line Eurovision link to replace the BBC's temporary system between Folkestone and London.

STC will supply their very latest transistorised microwave equipment, operating in the 6,000Mc/s band and providing two both-way (one working plus one standby) television channels between the GPO tower, London and a 200ft. tower on Tolsford Hill, near Folkestone. There will also be two (one plus one) unidirectional TV channels in the London to Tolsford Hill direction.

Television signals will be carried to Lille by an existing link completed in 1959 by Le Materiel Telephonique (LMT), STC's French associate company. LMT engineers will install new STC equipment on the French side of the Channel.



*The 200 ft. radio mast near Folkestone.*

## CLOSED-CIRCUIT TELEVISION AT DENTAL CONFERENCE

AT the 84th Annual Conference of the British Dental Association, held recently at the Royal College of Surgeons in Lincolns Inn Fields, London, closed-circuit television was used to enable all the delegates to see simultaneously, details of the various demonstrations.

The television equipment, which was provided by the Marconi Company, was installed in a specially constructed studio adjacent to the Edward Lumley Hall where the delegates met, and consisted of three miniature vidicon camera channels, type V3020. Two of these were manually controlled cameras fitted with zoom lenses and the third camera was used for telecine applications, showing either 16mm film or slides.

The television pictures from the studio were relayed to the main lecture theatre, where a Marconi large screen projector presented each picture or programme from the studio on a screen measuring 8ft. x 6ft.

## TV STANDARDS CONVERTER IS NOW REVERSIBLE

THE BBC Research Department Line-store Electronic Standards Converter has been made to be reversible in operation, i.e., it is now able to convert television signals either from 625 lines to 405 lines or from 405 lines to 625 lines, all at the turn of a switch.

This standards converter, which was developed at Kingswood Warren by a team of engineers under Mr. Eric Rout, was originally installed at the Television Centre in time for the opening of BBC-2. It works on a somewhat similar principle to the one-way converter developed by the BBC Designs Department (see "Teletopics," October 1963 issue).

The Research Department converter has already been used in service a number of times for the conversion of 625-line programmes to 405 lines; it was also used during June to convert from 405 lines to 625 lines during the transmission of the Irish Sweeps Derby. This programme originated at the Curragh (Dublin) on 405 lines and was broadcast in the United Kingdom on the 405-line standard. It was then converted to the 625-line standard for transmission to Belgium over the Eurovision circuit.

The standards converter, which is contained in a single bay of equipment 3ft. wide, stores one scanning line of television picture in 576 capacitors. There are 1152 high-speed switches, each of which can charge or discharge one of these capacitors in one twenty-millionth of a second.

# Wired Television Speeds BBC-2

THE first relay television network in Colchester began operation on July 1st this year. From that date, viewers on the relay system were able to switch on to BBC-2, although transmission of the new programme to this region is not scheduled to begin until August 1968.

The network has been installed by the British Relay organisation, providing subscribers to the service with four television programmes —BBC-1, BBC-2, London ITV and Anglia TV—and four radio programmes.

Programmes are received at a special 160ft. high master aerial, mounted alongside the main receiving station in Lexden, Colchester. From this central station, programmes are relayed by wire to many thousands of homes throughout the town.

## C.C.TV Watches Cars at Dover

MOST of the drivers of the 500,000 cars which are expected to pass through the Dover Car Ferry Terminal this year on route to Calais, Ostend and Boulogne. will be unaware that their progress through the terminal is being observed on television screens. In fact, pictures from six cameras, covering the quarter of a mile from the entrance to the ferry berths, will be relayed to the traffic controller's office by a closed-circuit television system recently installed by the Dover Harbour Board, and supplied by Pye Telecommunications Ltd., to assist the control of traffic. During peak periods 7,000 cars a day pass through the terminal to board ferries arriving and departing every half-an-hour.

The two 19in. television screens in the control room show pictures from any of the six cameras, enabling the traffic controller to spot any likely bottle-necks and to know what instructions to give over the public address system to maintain an easy flow of traffic.

The cameras are remotely controlled by a telephone dialling system, which automatically selects the required camera for focus, rotation and tilt action.

## Aerial for Isle of Man ITV

THE Independent Television Authority has placed a contract with EMI Electronics Ltd., for the design, supply and erection of a transmitting aerial at Richmond Hill, Isle of Man, for the re-transmission on channel 8, of Border Television programmes picked up from Caldbeck, near Carlisle.

The bi-directional pattern of the horizontally polarised aerial will ensure coverage of the populated areas of the island without interfering with TV reception in the North-west of England.

## AMATEUR TV CONVENTION

THE Convention of the British Amateur Television Club is to be held this yaer in the Conference Suite of the Independent Television Authority's headquarters at 70 Brompton Road, London S.W.1. The date of the Convention is September 12th, when members of the Club from many parts of the country will meet for an exhibition of equipment, the Annual General Meeting and a short symposium of technical papers on television topics, all to be held between 10 a.m. and 6 p.m. Subjects for the Convention's lectures will include "Semiconductors at 70cm", "Pulse Generators", "Camera Tubes" and "Video Testing Techniques for Amateur Television".

## STANDBY AERIALS FOR ITA

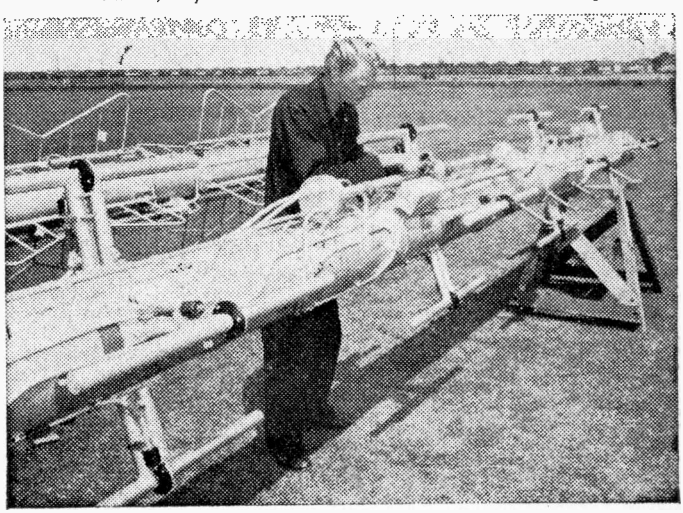
TO reduce to a minimum the time that ITA programmes would be off the air in the event of a transmitting aerial being seriously damaged, the Authority has placed contracts with EMI Electronics Ltd to supply a reserve mast and two Band III aerials—one vertically and one horizontally polarised. These will be kept on constant standby in readiness for such an emergency.

This is the first time that precautions of this kind have been taken by a broadcasting organisation in the United Kingdom.

Both aerials will be stored at the ITA's station at Lichfield, near the centre of England, for speedy transportation to any transmitting station in the country of whichever aerial is required.

The 250ft. mast can be erected in eight hours by a team of seven men, ready for the appropriate aerial to be erected and powered.

*The aerials being assembled at E.M.I., Hayes.*



18dB gain ★ 35Mc/s bandwidth ★ 7dB noise factor

A SIMPLE

# U.H.F. Preamp

## using a quarter-wave cavity

by C. H. Banthorpe

THE start of a u.h.f. television network in Britain has brought some interesting problems, but one of the most objectionable features has been the higher "noise" level of the received pictures in many areas compared with the v.h.f. signals. The viewer is therefore reminded of the difference when changing programmes. In due course these fringe areas will be served in some way, repeaters or piped signals, but this must take many years. There are also people who will not, or cannot, have an efficient aerial system and this noise problem is also a serious one for them.

The gain of a television receiver is spread over the r.f., i.f. and video frequencies, but from a signal to noise ratio point of view, gain at signal frequency is best. In many ways it is also the most difficult to achieve.

One of the largest contributions to the noise of the receiver comes from the frequency changer and if the signal can be amplified sufficiently before it is applied to the frequency changer so that it is larger than the effective noise at the input of the frequency changer, then an improved signal to noise ratio results.

The introduction of u.h.f. transistors has made possible very simple and efficient amplifiers and the recently developed Mullard A.F. 186, p.n.p. alloy-diffused transistor is by far the best so far tried by the author.

It was found to work ideally in a simple λ/4 tuned cavity. This is not only easy to make but is also efficient and robust.

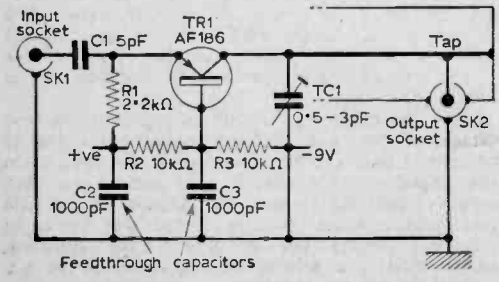



*Fig. 1—Circuit diagram of the u.h.f. preamplifier.*

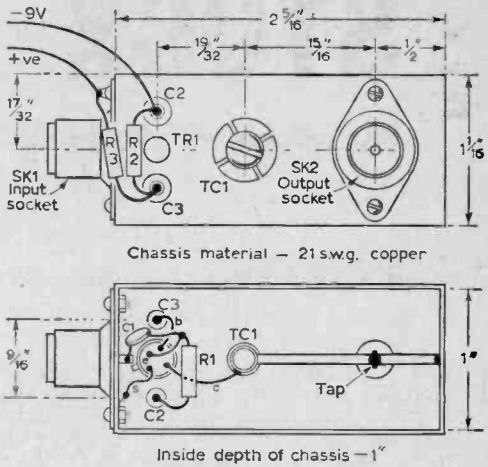



*Fig. 2—Top and underside views showing the wiring details.*

### Construction

λ/4 tuning lines can be twin or coaxial and this one can be considered as coaxial with the outside part made of square section for ease of construction and with one long side omitted. The box is made from a piece of 21 s.w.g. copper approximately 3in. x 4¼in. 1in. squares are cut from each corner and the four sides are then folded up and the four corner seams soldered, making a box 2¼in. x 1in. x 1in. The inner part of the tuner consists of a piece of 1 5/8in. x ⅛in. diameter copper tube or rod, one end of which is soldered to the centre of the end of the box and the other end is soldered to the "hot" end of the trimmer. This tuning capacitor is of the type consisting of a threaded ceramic tube into which a brass screw is inserted. The screw forms one plate of the capacitor and a tinned silver ring on the outside, the other. The silvered ring on the outside is the "hot" side of the trimmer. These are widely used on v.h.f. tuners and in this amplifier it also makes a convenient support for one end of the ⅛in. copper rod.

The output socket inner contact is soldered to the copper rod where shown.

The transistor is push-fitted into a suitable hole and the feed through capacitors are soldered into suitable holes each side of the transistor. Leads should be kept short, particularly the base lead to the feed through capacitor. It is very important that all the soldering operations to the box should be completed well before fitting the transistor as the box becomes very hot during its construction.

The common base circuit is used (Fig. 1) and the input is untuned because the emitter input is a

—continued on page 565

BY H. W. HELLYER

# STOCK FAULTS

## PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

CONTINUED FROM PAGE 494 OF THE AUGUST ISSUE

## PART 5
## THE SYNC SEPARATOR

FAULT-FINDING around the sync separator stage has always been a bit of a bugbear. This is partly because the conditions under which the stage operates are stringent, partly because test procedures vary widely, partly because symptoms can be inconclusive and misleading.

More than in any other stage of a television receiver, knowledge of the common faults can be a boon when dealing with the synchronising separator in its various forms.

First thing to consider is what the stage is and what it is supposed to do. Next, to take a swift look at some of the different circuits. Although the principles behind synchronisation, and the practice of separation, have been dealt with theoretically in these pages at past times, it is felt that a repeat of the salient points will do no harm, and will help illustrate the peculiarities of some of the more complex circuits that may be encountered.

### *Composite Waveform*

The television signal waveform is shown as a composite whole in Fig. 24a. This is a positive-going signal, in that the voltage increases from zero to black level at 30 per cent of total peak voltage and continues to increase until the 100 per cent value represents peak white.

But the term positive-going is applied to the way the signal is fed to the cathode-ray tube; this operates as a valve, and a signal applied to the grid, making it positive with respect to cathode, will cause an increase in beam current. It is more normal to apply the signal to the tube cathode, and this needs a reversal of matters, with a negative-going signal producing the same effect.

The important thing to remember is that, regardless of whether the eventual application of signal is positive or negative-going, the principle remains the same; an increase in signal voltage makes for extra brightness.

It is no great difficulty to reverse the signal polarity; this is done by using an extra valve or taking off the signal from cathode instead of anode. A video amplifier, for example, accepting a positive-going signal at its grid, delivers a negative-going signal from its anode.

The sync separator's job, quite simply, is to suppress the picture content of the signal, then split up the field (frame) and line pulses to "key" the oscillators at the correct moment to keep the picture in step. Like many another "quite simple" job, this is easier said than done. Fig. 24b shows one reason why.

This is the Ia/Vg curve for a saturated pentode type of sync separator, perhaps the most popular. Reference to later notes and diagrams will show the principal features of this type of circuit.

The valve is held in a non-conducting condition by several volts of negative grid bias, caused by grid current. The low screen grid voltage and the high time constant of the grid circuit components, plus the use of a high-gain pentode with short grid-base, limits the anode current so that the signal application drives the grid even more negative, keeping the valve cut off, but when the sync pulse arrives and the grid becomes positive, heavy current flows, the valve becomes saturated and anode current remains approximately constant for further increases in grid voltage.

### *Square Pulse Shape*

The result is the square pulse shape shown in Fig. 24b. The duration of this pulse is about 10 microseconds, and the intervals between pulses are about 100 microseconds. d.c. restoration, which is necessary for the maintaining of a correct relationship of sync input with the applied signal, and effected by the diode action of the grid circuit across the grid leak, which becomes a load resistor as grid current flows, or by the addition of an external diode.

From the foregoing, it will be apparent that the voltages of the valve, and the component values of the critical time-constant portion of the circuit are very important. For overall sync faults, i.e., both timebases refusing to lock, this should be the first check, and it must be remembered that valves of apparently similar type can give rise to variations, and anything that affects the regularity of the h.t. line will affect synchronising.

### *Hum Fault*

A common fault, on many receivers, regardless of the types of circuit, is a hum on the h.t. line, caused by a leaky smoothing capacitor. This does not always show the secondary symptoms of a hum bar or an audible hum, but the application of an oscilloscope will quickly prove this kind of fault.

Note that it is not always possible to overcome the fault symptoms by bridging with a substitute electrolytic: an advanced state of "drying out", even if it does not give secondary symptoms, can only be proved by oscilloscope tests or complete substitution. But that should not prevent the "bridging" test being made—a few minutes with a spare 100$\mu$F and a couple of flyleads can save hours of fruitless head-scratching.

Referring again to the foregoing theoretical remarks, it will follow that a weak or distorted signal applied to the sync separator stage will cause inaccurate discrimination of the sync pulses. (In this context, the term discrimination is used to indicate the separation of sync pulse from picture modulation. the separator's primary purpose.)

Fig. 24 demonstrates that the vital point of the waveform is the 30 per cent "black level", below which the sync separator conducts. Variation in this black level, relative to the overall signal, will produce erratic synchronising.

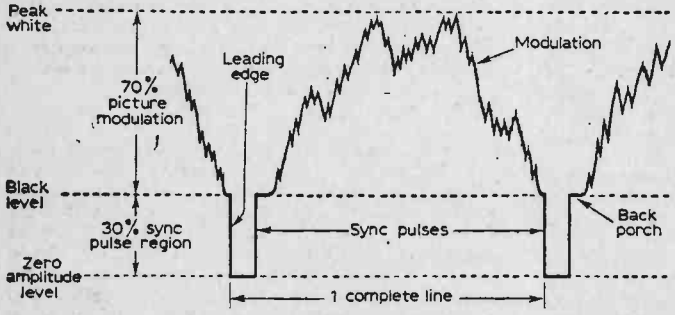



*Fig. 24a—Signal waveform, showing relative positions of synchronising pulses, zero, black and peak white amplitude levels.*

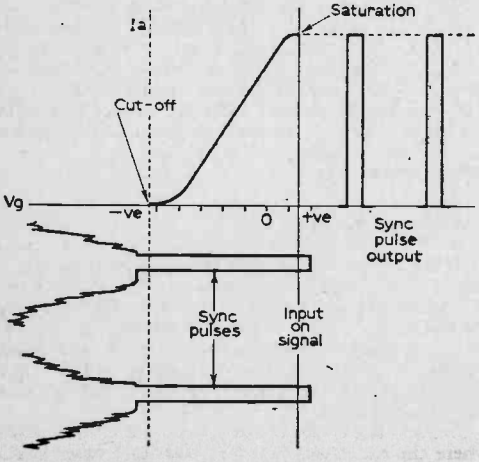



*Fig. 24b—Vg/Ia curve for saturated pentode type of sync separator, with input as Fig. 24a. Polarity of applied signal is arranged to drive the valve rapidly from cut-off to saturation when the sync pulse arrives. Anode current drops rapidly again when the sync pulse ceases. Duration of sync pulse is approximately 10$\mu$S, occurring at 100$\mu$S intervals.*

### *D.C. Restoration*

Faults that cause this variation are those that affect the d.c. restoration, such as a leak in the sync coupling capacitor, change in screen grid voltage or, in applicable circuits, cathode biasing conditions. Once more, it is possible that one timebase will be affected before the other, depending on design limitations.

Note that the sync coupling capacitor from video to sync separators very often rated at a quite high working voltage perhaps higher than is apparently demanded by the circuit voltages. This is to accommodate the peak signal voltages which can appear across it, adding to the d.c. for instantaneous breakdown voltage at odd times. It is false economy to fit an inferior type of capacitor in this position: voltage tolerance is very often more critical than capacitative tolerance.

Similarly, application of a sync pulse that is not "clean", i.e., has a leading edge that is erratic due to bad timing, will cause faults that depend, again, on the type of circuit.

This can be caused by picture information breaking through on the sync pulse. An oscilloscope will quickly show this as "grass", or higher frequency variation on the square top of a pulse waveform.

### *Unstable Line Lock*

Because the line frequency is higher than the frame, faults which cause this effect very often show symptoms of unstable line lock before the frame becomes erratic. An inspection of the "train" of sync pulses with picture information removed shows why this is so. Fig. 25 is a simplified diagram of the sync pulses for the last, and first four, lines of the television raster.

It is not within my brief to go into the exact details of the television signal; its make-up and duration of pulses, etc. Indeed, a separate article could be written on this subject alone—and the patience of both reader and Editor is not inexhaustible!

But, basically, the detail of Fig. 25 shows that the line pulse leading edge, which is the part that does the timing job, occurs every 100 microseconds and the pulse is of 10 microseconds' duration. When the frame pulse comes along, at the first four lines of the raster, it consists of eight pulses, at 40 microsecond intervals, returning to black level for 10 microsecond periods.

The reason for this method is to preserve the line synchronisation, even when the frame timing is being applied. Picture modulation is absent from the waveform during this period, and, indeed, for the first 14 lines of the raster.

### Discrimination

The second function of the sync separator is to discriminate between the line and frame pulses and pass these on to their respective oscillators without either having an interfering effect upon the other. The outputs must be isolated from each other, pulses must have very definite leading edges to trip the time-bases at the precise, required instant.

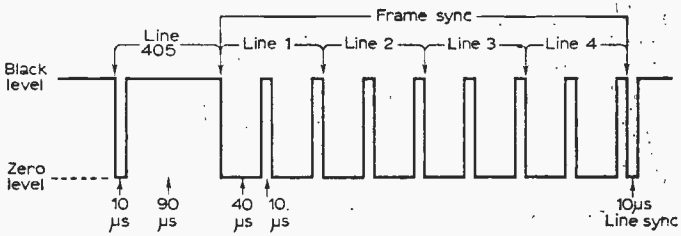



*Fig. 25—Train of pulses at commencement of frame. The frame pulse is integrated from the eight half-line pulses of the first four lines of the picture. Each half-line pulse is separated by an approximate 10µS interval, to trigger the line timebase correctly during the frame period.*

The line pulses are differentiated by application across a series capacitor and resistor of a suitable time constant, the output being taken off across the resistor, producing a pulse with a sharp leading edge. Frame pulses are integrated, that is collected together from the train of frame pulses, by production across a series resistor and capacitor combination, the values again being chosen to give the right time constant.

Theoretical circuits to illustrate this have been deliberately omitted—because in practice, the values of differentiator and integrator circuits vary very widely between makes and models of receiver.

Perhaps the best example of the foregoing circuit descriptions can be found in the Pye V200 and associated models, the sync separator circuit of which is illustrated in Fig. 26. Here, the sync pulse is fed, via a long time constant circuit of C65, R84, R83 to the grid of V18A. (These are component numbers from the manual, to simplify reference.)

The screen grid is held at 63V by the potentiometer R85, R86 and the anode is at about 140V. The large negative voltage is tapped off from the grid as a.g.c. (or as Pye call it, Automatic Picture Control), via suitable filter circuits, clamps, etc. More about this subject in the next article.

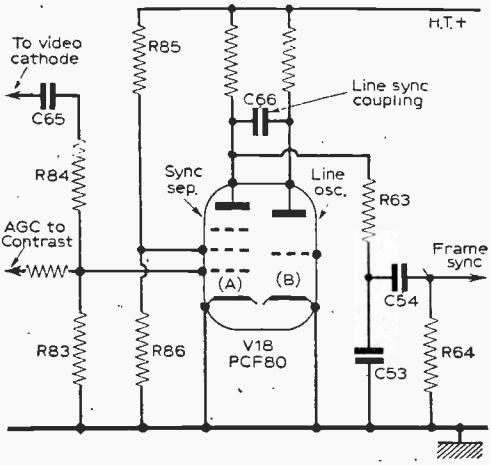



*Fig. 26—Pye V200 sync separator. Component values: C65, 0·1µF; R84, 10kΩ; R83, 2·2MΩ; R85, 47kΩ; R86, 22kΩ; C66, 15pF, 750V; R63, 220kΩ; C53, 220pF; C54, 0·01µF, R64, 150kΩ.*

### Integration

Frame pulses are integrated by R63/C53 and C54/R64, giving a sharp wave front, and being applied to the interlace circuit—about which more later—and reference to the table of values shows that the time constant figures are nowhere near the theoretical values we might expect. This is because allowance has to be made for "hidden" circuit impedances, and demonstrates that servicing around the sync separator usually requires reference to the circuit diagram of the particular model under test.

Line sync is tapped off via C66 to the anode of the first half of the line multivibrator, which is the triode section of V18.

Fig. 26 brings us to the severely practical matter of sync faults. It was mentioned previously that the sync is often affected by fault conditions quite remote from the actual sync separator circuit.

In this instance, a short-circuit of the noise suppressor diode, or even a severe leak across it, affects the line sync. This is because the diode is connected to the anode of the video amplifier by a 0·03µF capacitor (1·5kV working voltage), and the reactance of this component is more critical at the higher line frequency.

### Video Stage Response

It has already been stressed that anything which impairs the frequency response of the video stage, or, indeed, the vision i.f. stages, will affect the synchronisation. This is especially evident in circuits which employ a hefty decoupling of the video cathode, as in Fig. 27, the McMichael, Sobell range. Drying out of the video decoupler, 1,000µF can have drastic effects.

Similar faults are found on the Pye CTM4, where the decoupler is 25µF, and, to a more subtle degree, with the Alba T766, where line tearing on Band III has been noted, despite quite strong signals, when the 1500pF cathode decoupling of the EF80 video amplifier becomes leaky, or increases in value.

This fault was also noted on the Ekco TC388F, when the cathode resistor, through ageing or fault

conditions resulting in overheating, increased from its correct 330Ω value.

Further to this, a signal weakness due to detector or video fault, though not always apparent on the screen, can affect the sync in a serious way. If there is tearing, prevalent at the top of the picture, it is quite likely that the low frequency response of the receiver has been spoiled by misalignment.

Very often, a set is "peaked" for maximum signal, and such a hit-or-miss method of alignment is just not good enough for correct synchronising, although it may produce a signal of apparently adequate strength.

Bent verticals, although not directly a sync fault, may have similar origins, especially where flywheel sync circuits are used in the line oscillator. Typical of this is the Pye VT17, where the 4·7k h.t. feed to the line sync and flywheel circuits goes low in value, the h.t. rises from its correct 165V to something near the h.t. rail value.

### *Flywheel Sync*

A flywheel sync circuit which will receive our attention at a later date is the Cossor 948F. At this juncture it is only necessary to mention that many obscure, and prehaps intermittent, faults can be cured by simply tightening or remaking the earth tag connection of the braided flylead from the line output transformer assembly to the main chassis.

On the Murphy V250, a similar fault occurs, but for quite a different reason. Here, the sync separator itself is quite conventional, but from the output the line pulse is taken across a transformer, which has a tertiary winding to neutralise the line waveform and prevent its interfering with the frame pulse.

A leak across the windings, or even a short-circuit to core, can cause these curious faults. Also, the frame circuit of later models included a Metrosil in series with the feed to the triode buffer stage, shunted by a resistor of about 100kΩ. When,

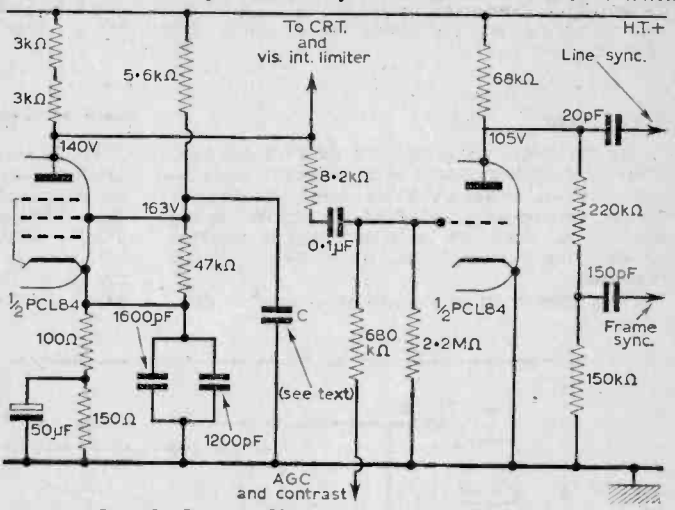



*Fig. 28—Ferguson 506T, etc., video output and sync separator circuit, using a single PCL84 valve.*

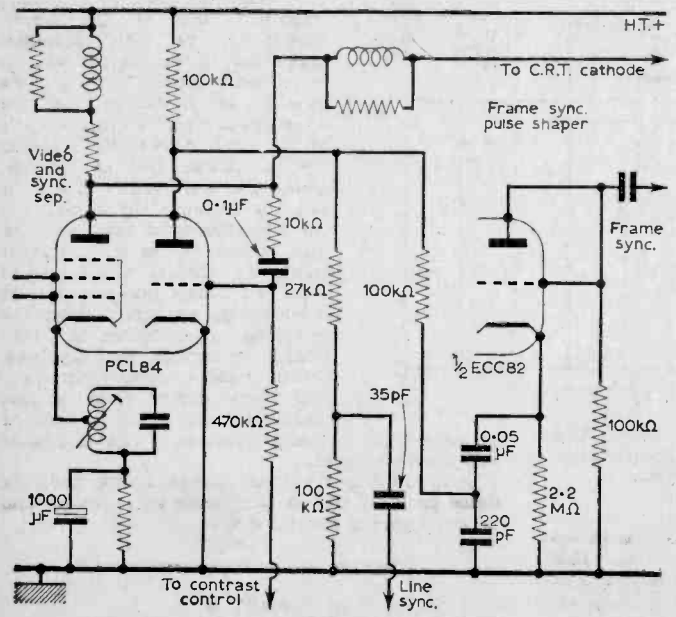



*Fig. 27—McMichael MP18, etc., video, sync separator and frame pulse shaper circuit.*

and if, this Metrosil goes open circuit, the result is not always a purely frame oscillator fault, but often looks more like a problem in the sync department.

### *Pure Sync Faults*

Purely sync faults are rare, and usually quite definite, as for example, the screen grid voltage of a circuit such as the Bush TV128. Here, the screen grid is decoupled by a 0·1μF. This can develop a short-circuit, resulting in a burnout of the 9kΩ feed resistor, and no screen grid voltage—reference to the previous theoretic remarks will show what happens next.

It will be noted in the Pye circuit of Fig. 26 that there is no decoupling. This is not unusual with a circuit of this type, as the variations have been "ironed out" prior to the application to the sync separator. But where decoupling is employed, as in the capacitor C of Fig. 28, the sync separator and

video output circuit of the Ferguson 506, 546 and HMV 1890, 1893 range of receivers, it is most important that this be preserved—and adequate.

In fact, earlier models of this range had a 1,000pF capacitor in this position, which was later modified to 0.03$\mu$F to reduce cogging on the Test Card.

Also worth noting, while on this model, is the comparatively low value of the line sync pulse coupling capacitor, 20pF. The catch is that if this goes open-circuit there is still some semblance of line sync, but it becomes extremely touchy. This range should have quite a definite line lock; in fact, the frame circui give much more trouble—but that's another st .

### A.G.C. Fault

Another story, too, is the a.g.c. fault on this range caused by open-circuited clamp diodes (there are two FSY11A diodes used). It is only worth mentioning here because the effect can lead one to suspect a sync fault, and it is necessary to ascertain whether the signal is indeed reaching the sync separator.

The opposite set of circumstances arises when a sync separator fault causes symptoms that mislead one into investigating elsewhere. Impossible? Don't believe it. Take for example the Phillips 1768U and other similar models that employ an ECL80 sync separator.

This particular valve in this particular function (and I stress the carefully chosen phrase to forestall howls of criticism against my defamation of that popular odd-job valve the ECL80!) has a habit of developing inter-electrode short-circuits which cause most curious side effects.

A hum on the sound, with sympathetic picture flutter has several times been noted; on the 8617, etc., a buzz on the sound, apparently tuneable, makes one plunge for tuner unit faults. The reason is probably that the special form of circuit results in a.c. feedback along the a.g.c. line, but from a purely practical point of view it is wise to substitute the ECL80 sync separator as first test when one of these "covered up" faults is noted.

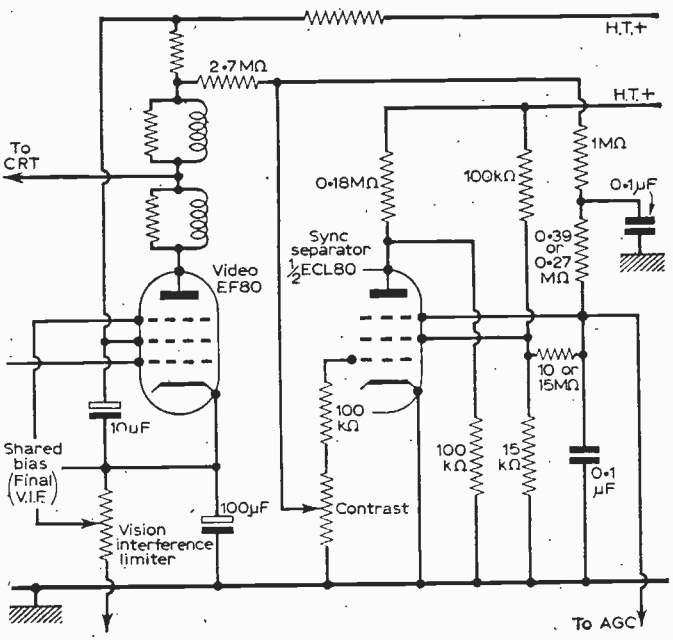



*Fig. 29—Philips TG100U, etc. Video amplifier also acts as interference limiter and sync separator is used also as a form of a.g.c. clamp.*

### Lack of Contrast

To demonstrate the Phillips design, and bring up another stock fault, Fig. 29 shows the video amplifier and sync separator circuit of the TG100, 106U, etc., range. Where poor sync, coupled with lack of contrast is noted, and the disconcerting effe of an improvement as the contrast control is turn d down, the fault often lies earlier as noted in a previous article, in the vision i.f. stages, where dry joints in the transformer cans make a stage unstable.

A glance at Fig. 29 shows why this should be so, for the contrast control sets the bias level of the suppressor grid of the ECL80 pentode section, and this portion of the circuit acts as diode clamp. Again, this exceeds our brief and more weight will be given to this type of circuit in a later article.

Not shown in Fig. 29, but quite important also, is the circuit related to the video amplifier suppressor grid, which acts as interference limiter. Note also the method of decoupling of the screen grid, with the negative pole of the 10$\mu$F electrolytic returned not to chassis but to cathode, from where a further 100$\mu$F is used to decouple the circuit, the cathode sharing a bias with the final vision i.f. valve; a further stabilising device, which works well, but causes queer symptoms when things go wrong. From the foregoing, it is obvious that sync faults are closely tied up with other troubles. Indeed, an a.g.c. fault may derive from a sync fault, and vice versa, as may be apparent from the small selection of typical circuits that have been given.

In the next part we may digress a little from the signal progress and consider these a.g.c. circuits and their troubles in greater detail.

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**PART 6**

**FOLLOWS NEXT MONTH**

*a new series for the intending professional serviceman*

# The business of SERVICE

PART I

## by John D. Benson

RADIO and television are now an established part of the nation's life and as such are relied upon not only as a source of entertainment but as a vital link with the happenings of the world in general. This being the case, it is of paramount importance that the equipment used should, in the first place, be of reliable design and secondly, that in the event of breakdown, and even the finest of equipment is liable to this, it should be repairable in the minimum of time and at a reasonable cost.

In the first instance it can be definitely stated that our manufacturers are second to none and the standard of efficiency, taking into account that receivers, whether radio or television, are mass produced, is of the highest order. But it must be borne in mind that in order to compete in a highly competitive market and to keep prices within reasonable limits, manufacturers are forced to design within very narrow limits and in consequence components have to work at their maximum capacity.

In the early days of television, the reliability factor was very low and it has taken many years to produce the modern receiver with its high standard of reliability. Nevertheless, in spite of this, breakdowns still occur for various reasons. It is then necessary to effect a repair. It is at this juncture that we come, so to speak, to the object of our exercise, i.e. the business of service.

## POTTER OR PLAN?

Straight away we are faced with a decision that must be made before we can proceed any further. There are two definite courses that can be taken—(1) we can decide to tinker about without any proper equipment and hope to stumble across the answer, or (2) the whole subject of servicing can be approached as a serious study which requires adequate equipment and knowledge to execute it efficiently.

Thirty years' experience has taught the writer that the first course can be dismissed without further comment and left to the few who will always be known as dabblers. The second course is the only way a successful and profitable business can be built up. Here the exception is worth mentioning. It *is* possible for efficient repairs to be carried out on the kitchen table, so to speak, by the serious amateur, and I have encountered a number of such cases, but these are only odd jobs and cannot be compared with the running of a business with its attendant overhead charges, etc.

Having decided then that the second course is the correct one, it must be considered where the source of knowledge and experience is to come from. In the case where the prospective business man has had adequate training and experience it is possible to start with the minimum of staff, which is, of course, half the battle.

On the other hand, the principal may be without the technical know-how, but has business experience, in which case it will be necessary to employ experienced labour which of course adds considerably to the costs.

Whichever set of circumstances prevails, to run a successful service department, there must be at least one skilled operator and the wise business man will also employ a youth to train as an apprentice.

A question I have been asked many times is: "Can service be made to pay?" and the answer is yes, providing an efficient system is used from the start, coupled with adequate equipment and at least one experienced service engineer.

## TIME AND MATERIALS

The basis of an efficient service department is the recording of the time and materials used on each job, plus a brief outline of the nature of the breakdown. All this information is recorded on a card, i.e. job card, which issued as soon as the item to be repaired is received into the premises.

It should be noted here that all receivers should be taken into the workshop and not repaired on the customer's premises, though there are rare exceptions which will be dealt with later.

### Job Card

On the job card is entered the customer's name, address and 'phone number (if any), date, model and serial number of the receiver. When completed, the engineer or apprentice responsible for the work signs the card, and so a complete history is to hand if the receiver should develop further trouble or break down within the guarantee period for the work carried out.

The recognised guaranteed period for repairs is three months from the date of return. Strict adherence to the guarantee period, on both sides, is essential, although the wise business man will make exceptions in hairline cases.

### Final Cost

The most difficult aspect of service work is the assessing of final cost. There are no hard and fast rules which can be applied and it is only from experience that final prices for repairs can be made.

In some businesses a fixed handling charge is

laid down and charged to each job as received. This practice is not advocated because it can give rise to anomalies which only succeed in irritating the customer, which leads to a reputation for over-charging, and a good reputation for fair dealing is the cornerstone to building a successful servicing business.

*Every* job cannot be made to pay, but with experience the average cost can be assessed and the final total taken over a number of repairs made to show a reasonable working profit.

Let it be clearly stated that the hope of making large profits quickly on service work is doomed to failure, but a steady reasonable income can be made if the system as described is adhered to.

## Practical Example

Reverting to the statement that every job cannot be made to pay, let us take a practical example of what is meant. A television receiver, several years old, is collected from Mr X, the complaint being that " the picture won't keep still."

First examination shows that it is a model and make that has never been handled before. Reference to the manufacturer's data shows that the receiver has a complicated type of a.g.c. circuitry. Experience tells us that the fault lies within these circuits and after preliminary preparation the hunt for the fault is started.

After a number of weary hours the fault is located—it proves to be a faulty silver mica capacitor—and the receiver is finally assembled and left on test. The job card is completed and although the replacement component is only valued at six-pence, the number of hours spent on the job, plus overheads, presents a hefty bill.

Common sense tells us that to charge the customer the amount shown would only give rise to bad feeling and a dissatisfied customer, for it must not be forgotten that from the customer's point of view the fault was only slight.

## Repeat Fault

Now let us suppose, and it sometimes does happen, that within a few days we have yet another receiver of the same make and model with exactly the same fault, the service engineer will chuckle gleefully, and within a very short space of time the offending fault will be cleared and the receiver put on test. The corresponding job card will show a minimum amount of time has been spent on effecting a repair and with the application of the example of the first fault of a similar nature, a fair price can be arrived at.

If an average is taken of the number of hours actually worked on both receivers it will be found that a profit, if somewhat reduced, has been made. The most important factor is that knowledge has been gained which can be applied again and again in the future which will wipe out the deficit suffered in the first instance.

This example shows the principle on which service is built up. Compiling the cost per hour for service, and it is by far the major item in repair work, is not a simple task and unless great care is taken, errors can slip in which give a totally erroneous figure.

## Rent and Rates

The proportion of rent, rates, insurance, light, heat, etc., can be fairly easily arrived at, but often the proportion of clerical charges to be made is difficult, especially where the service department is not large enough to justify a whole time clerical staff.

Being aware of the problem is half the battle, but it has been known where this side has been overlooked, with disastrous results.

The opinion has often been expressed that the sales side of a business should carry the service side, but this is a fallacy and generally indicates that the service is in the hands of incompetent engineers. A proof of this statement lies in the fact that there are a number of large firms which specialise in service alone and are ready to work for traders at a price on which the trader himself can show a profit. The answer to this is that such firms only employ highly efficient engineers.

# APPRENTICES

## Training

The employment of an apprentice has been referred to earlier, and again this is a point which some people will say is a mistake. The efficient engineer welcomes the apprentice, for properly handled he can be a great asset.

The idea that an apprentice is another name for messenger boy is still believed by many. Those days are past, for under the present regulations a registered apprentice must spend an allotted portion of his time at a recognised Technical College and remain there during the term of his apprenticeship. In his final year he sits for recognised examinations and can obtain Diplomas which will guarantee his future in the field of electronics for life.

The subject of training apprentices is too large to be fully entered into in this article and will only be dealt with briefly.

## Records

The choosing of an apprentice calls for a great deal of experience, but in this matter help can be obtained from the local Youth Employment Centre, where the complete record of the boy's progress through school is kept, and also, a most important factor, his health record.

These reports in themselves are not enough, for the boy's character and disposition must also be assessed. A bright youth with a surly disposition or quick in temper is of little use in the world of servicing where, eventually, he will be in direct contact with the public in their homes.

## Probationary Period

It is quite impossible to assess all these qualities in a few brief interviews and the system adopted was that of a probationary period of three months, during which time the experienced service engineer gains a very fair insight into the boy's character and temperament.

Honesty is obviously a very necessary characteristic, especially in a small business, but apart from the test of time and trust, no method has

been found providing whether the particular apprentice is or is not honest!

It is fairly obvious that the apprentice is a liability at first, but experience has proved that under the guidance of a skilled engineer, who himself has gone through an apprenticeship, in a very short time—about two months—can become an asset in any workshop. He can be quite safely employed on polishing cabinets, locating service data for each receiver and preparing receivers by cleaning, about which more later, for the service engineer.

It can therefore be stated with confidence that the well chosen apprentice, although not a direct source of profit in his early years of training can be an asset in relieving the service engineer of many irksome and time-wasting jobs.

## PREMISES

The subject of staff has been given priority because of its vital importance to the success of a servicing business; second in importance is the choice of premises for workshops. Ideally they should be at ground level in order to obviate the labour involved in carrying weighty receivers, radiograms, etc., upstairs. However, if the workshops have to be located above ground level then it should be seen that the stairway is well lighted and the steps provided with non-slip fittings on the treads.

Good window lighting is imperative, with a northern aspect if possible. Adequate heating is a must, for no staff can work efficiently if they are cold. Service work calls for very little movement, which further increases the effect of cold.

## WORKSHOP FURNITURE

### Benches

The benches used for service work should be of the strongest construction with their surfaces covered with a pliable covering such as rubber or cork linoleum. The covering should be stuck on and not nailed as nails not only work up and play havoc with polished cabinets but also provide good discharge points for the high voltages met with in the modern television receiver!

The benches should be the correct height, about 6in. below the elbow when bent, measured on a man of average height, i.e. 5ft 8in. This is important if strain is to be avoided when lifting equipment on to them.

Each bench should be provided with a tool rack, two anglepoise lamps and drawers where personal belongings can be kept. At the end of each bench a sheet of asbestos is a useful asset; it can be used for placing soldering irons on or fittings which have to be pre-heated to solder.

There should also be a distribution board fitted with all the various types of power sockets likely to be found within the area covered by the service business. This fitting is a great time saver.

### Seating

Seating accommodation for each employee is an essential. For bench work a personal choice is the organ-type stool which gives freedom of movement over a fairly wide area. Chairs should be of the high office stool pattern so that the sitter is above the level of the work on the bench.

Every workshop should be equipped with a test bench fully equipped with power points on which finished receivers can be given a time test whilst still within the view of the service engineer concerned.

A further bench should be supplied which is reserved for mechanical work and it is surprising the amount of work of this nature which has to be done during the repair of television and radio receivers. A vice, grinder and bench drill, with an adequate supply of twist drills, are a worth-while investment and quickly repay for the outlay.

### Floors and Walls

For floor covering, again a personal choice is a good quality hard-wearing linoleum, plain and light in colour—it is amazing how this assists in finding dropped screws!

For wall colouring, emulsion paint, non-glossy and one of the pastel shades, preferably green, is very restful to the eyes and does not produce glare. It also has the added advantage that it can be washed down during spring cleaning time. The ceiling is best white so that all the benefit of the reflected daylight can be obtained.

### Shelving

An adequate amount of shelving should be provided; it keeps the floor space clear of oddments. One shelf should be reserved for text books and the various catalogues which are required for reference. The storage of instruments, data sheets and manufacturers' manuals will be dealt with later.

### Tea Break!

Every workshop should be provided with a small table in one corner where tea can be brewed, and it generally falls to the apprentice to carry out this very necessary task and the wise employer will supply the ingredients. They are a worth-while investment and can be set off against tax.

## TRANSPORT

Some sort of transport must be provided for the collection and delivery of receivers. A private car can be pressed into service and so made to serve a dual purpose, but from a loading and unloading point of view a lightweight van is much more adaptable.

The van should be lined with some type of protective material in order to save cabinets suffering damage in the event of emergency stops, etc.

Whichever type of vehicle is used it should be reliable, for there is no worse time-waster than a motor-vehicle that is constantly requiring service. Cheap second-hand vans or cars are tempting to the small business man with limited capital but this is one item where outlay should not be skimped.

Most service engineers can already drive but it is money well spent if the apprentice is trained when he attains the correct age.

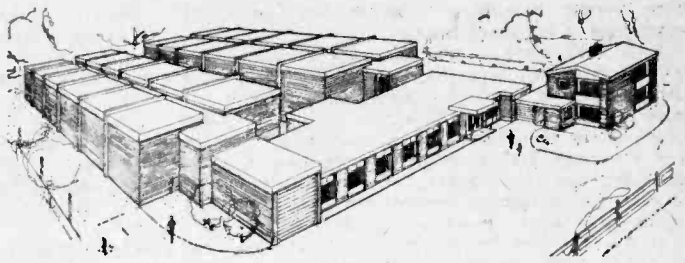
So far only the type of premises and choosing

*—continued on page 560*

*ICONUS*

*takes a look at*

# THE NATIONAL FILM ARCHIVE



ABOUT 30 years ago the British Film Institute established a National Film Archive in which have been preserved examples of topical, theatrical, scenic and "interest" films dated from the very beginning of the cinema in about 1896. As a matter of fact some of the films in the archive were made before there were such places of entertainment as cinemas. Films were first viewed by looking into a peephole machine rather like the later "What the Butler Saw" slot machines on seaside piers. The first peephole machines were invented by the celebrated Thomas A. Edison in about 1889.

## Sound Came First

It was Edison who invented the phonograph on which sound recordings were made on wax cylinders and reproduced on the same machine. He wanted to follow up the recorded sound with an animated picture attachment and he and his assistants devised a camera which recorded photographically a series of pictures spirally on a glass disc. George Eastman (of Kodak) invented an improved type of celluloid as an alternative to glass for use as a base for photographic emulsion. Edison immediately saw the possibilities of this new material for motion pictures if made in long strips of perforated film, 35mm wide, which could be used on his latest peephole machine, which he called the "Kinetoscope"—which became quite a nine days' wonder in New York even without the complications of synchronised sound from the phonograph, which was developed separately and independently and was subjected to long-drawn-out legal patent actions. There are very few examples of Kinetoscope film still in existence as the highly inflammable nitrate film base has, in most cases, shrunk, deteriorated chemically, become brittle or sticky with age—and in some cases disintegrated or burst into flame by spontaneous combustion.

## Ancient Vintages

Nevertheless film archives in various parts of the world have recovered a few of the historic pieces of Edison's first films and have succeeded in making duplicate negatives and prints on the more stable, fireproof, safety film of today. The British National Film Archive, whose curator is Ernest Lindgren, has probably been more successful than any similar organisations in other countries in recovering and preserving old film which was photographed during the long period before anyone thought of establishing film museums. It has expanded and continued to collect film prints of fairly recent vintage in addition to those of 50 years or more ago.

*(The sketch heading this article is an artist's impression of the new store for acetate films designed for the National Film Archive at Aston Clinton).*

## Film Gauges

The Edison film gauge of 35mm continues to be a world standard, though other gauges with widths of 70mm, 17·5mm, 16mm, 9·5mm and 8mm have all been used for cinema and many other purposes, amateur and professional. The television stations here and abroad use both 35mm and/or 16mm film prints on normal intermittent movement projectors which shoot the picture into vidicon television cameras. Alternatively there is the more complicated flying-spot telecine equipment in which the film travels steadily and continuously through an optical system (as indeed Edison's original Kinetoscope did) but in which the picture is arrested by electronic or optical methods for transmission on television. So we now find that newsreels, dramas and "interest" films of 60 years ago have, in fact, become of real interest to television viewers. Edison's original speed of travel was about 40 frames a second but improvements made by Robert Paul in England and Louis Lumière in France enabled 16 frames per second to be photographed and projected. By special modifications to telecine equipment these films made on non-standard speeds can be reproduced without the speed distortion which is particularly noticeable when films photographed at 16 frames are played off at 25 frames per second. which is the standard speed on telecine in this country, or 24 frames in the USA.

## "Interest" Films

The "interest" films of the early years of this century are now called "documentaries", a name invented by John Grierson, well known for his regular series on *This Wonderful World* on Scottish Television. The so-called "interest" films have progressed a long and interesting way since the days of Edison and the earlier documentaries which showed clothes, transport and something of the way of living of those days. The films Lumière photographed in Paris in 1896 of his workers leaving the factory, catching trains or embarking on river trips are as fascinating in their way as the pomp and circumstance of the Royal processions filmed by Cecil M. Hepworth or the

*Examination of old nitrate film prints. On the right are electric ovens for the artificial ageing test. On the left can be seen the Editola viewer.*

Bronco Billy cowboy films from the USA. Examples of films of the Boer War, the winners of each year's Derby or Grand National, the early epics of D. W. Griffith, Charles Chaplin, Sarah Bernhardt, Duse, Rudolph Valentino and the Keystone Cops can all be found in the National Film Archive, painstakingly restored, treated, duplicated or stored in the National Film Archive's well-designed vaults at Aston Clinton, Buckinghamshire.

## Nitrate Film

There are still a good many cans of film containing nitrate film stored away in enthusiasts' homes, in cellars, potting sheds and lofts, and forgotten in the passing of time over the years. Although cellulose nitrate film base has not been made by any manufacturer for over ten years many a film company's vaults, specially built for storing inflammable film, still retain a few cans of it, standing side by side with the more modern safety film. Nitrate film has always been a fire risk but it becomes more dangerous as it ages. In all cases the nitrate film should be put in a safe place, destroyed or sent to a safe place such as the National Film Archive. Who knows? The interest value of the film may justify the preservation or duplication of the film subject on to safety film, held for examination and possibly for extracts to be shown at the National Film Theatre or on one of those historic film programmes on television.

*Checking thermograph and hygrograph in the vaults.*

## Film Preservation

During the last 25 years the National Film Archive have developed preservation techniques which have improved year by year. By thermostatically controlled electric heating in the vaults the films are kept at a constant temperature around 50 to 60 deg. Fahrenheit all the year round, though the lower temperature would be ideal providing air conditioning was available. This is followed up by a systematic artificial ageing test on the old original nitrate film prints to determine when the prints are due for duplicating on to safety film which, apart from being completely non-inflammable, is less subject to shrinkage and consequent variation in the pitch of perforations. This is an expensive process and decisions have to be made upon each film as to whether the subject matter justifies the cost. Deterioration of colour film prints over the years presents a particularly difficult problem.

Film vaults are being extended at the National Film Archive at Aston Clinton to provide for large storage units holding many thousands of feet of film and these will be air conditioned. Safety film copies will be enclosed in sealed plastic bags to retain the plasticiser, a method which is only practicable where humidity as well as temperature are controlled very rigidly. The National Film Archive technicians have lately made further improvements in the copying of early films which are on non-standard gauges, are badly shrunk or have different shaped perforations.

## Scrapbooks for ITV

The National Film Archive is not a film library which makes a business of providing snippets of early film in competition with a number of commercially operated film libraries. It is a specialised museum of filmed historic events and examples of the art of film making over the years, and copies of these films can be printed and made available to organisations in both film and television industries who are compiling special programmes on subjects of historic importance. A charge is, of

*—continued on page 549*

CONTINUED FROM PAGE 511 OF THE AUGUST ISSUE

# CHANGING CATHODE RAY TUBES

## PART 6: THE S.T.C. GROUP

By H. Peters

THIS month we deal with the 110° tubes of the three main brand names: RGD, Regentone and KB, which comprise the STC Group. Included also are a number of Argosy models and a Defiant receiver which incorporate similar chassis types.

The final merger between the Harris Group (Regentone, RGD, Argosy) and the KB Group is comparatively recent, thus a common chassis to all models is only to be found in the current range of receivers, where the influence of previous KB design is very noticeable.

To find the instructions for changing the tube in your own set look it up in the index table and read the text associated with the model given in column 3. Where an asterisk * is shown against this model it denotes that it is a near equivalent and that minor differences, usually of cabinet details, will be found. These should not prevent the tube being changed without difficulty by following fairly closely to the text.

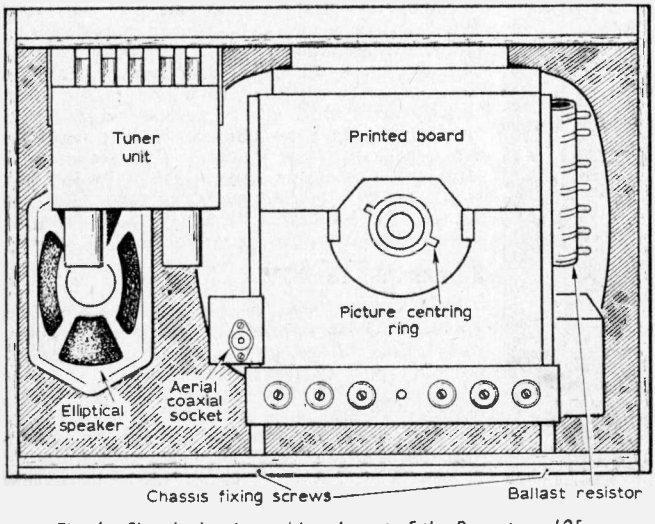



*Fig. 1: Sketch showing cabinet layout of the Regentone 195.*

### REGENTONE TEN 17 Series

#### Chassis Removal

Unplug and remove back. Remove channel selector, fine tuner, contrast and volume knobs. On models with side tuner or press buttons the contrast and volume knobs pull off, revealing two insulated spindles. Care must be taken with these models not to tilt the chassis forwards or these two spindles will snap off.

Remove the base fixing screws. These will either be a pair beneath the cabinet indicated by arrows printed on the base cover or else securing side brackets at the rear of the chassis.

Unplug loudspeaker and withdraw chassis.

The plastic front surround may then be detached by removing the two screws into the chassis at the bottom and two screws into the frame at the top.

#### C.R.T. Removal

Discharge the e.h.t. lead more than once and disconnect e.h.t. and tube base connections. Mark and unsolder scancoil leads, remove scancoils. Measure distance from front edge of tube strap to a straight edge held perpendicularly to c.r. tube face. Remove tube strap clamping screws and withdraw tube carefully forward. Clean all parts before replacing in reverse order.

On models with a "shorted turn" linearity sleeve this should be adjusted for optimum width and linearity with the width control in mid-position.

### REGENTONE 17-18

#### Chassis Removal

Place the receiver face downwards on a protected surface. Withdraw two screws from the back cover and one from the rear edge of the base cover and remove covers. Two wooden runners are fixed

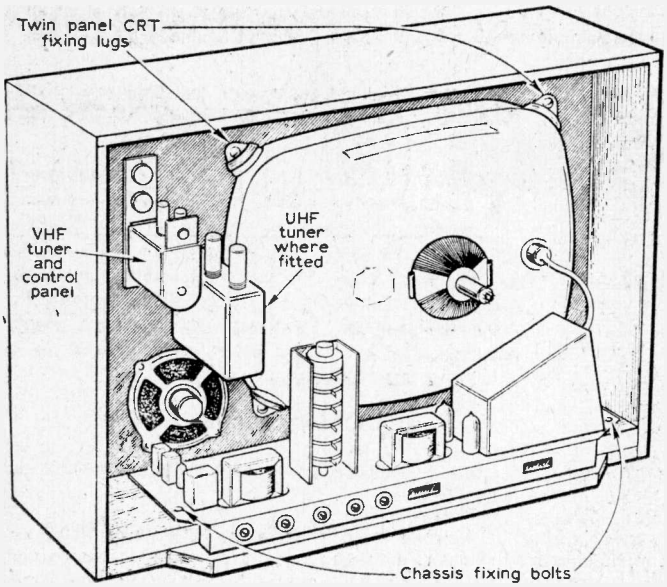



*Fig. 2: Back view of the K-B Model WV20, showing location of major components.*

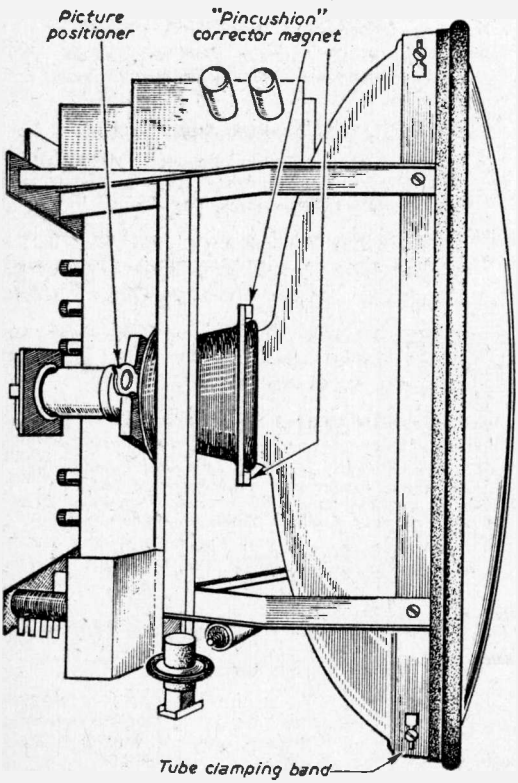



*Fig. 3—Sketch showing the layout and chassis assembly of the Regentone Ten 17.*

to the bottom of the chassis; remove one Phillips screw from the rear end of each. Remove the screw which fastens the c.r.t. frame to the angle-plate in the centre of the cabinet top. Lift off the cabinet shell.

The front cover is held at the bottom by two screws in the chassis and at the top by two screws in the frame; take out these screws to remove the cover.

**C.R.T. Removal**

As for Regentone Ten 17.

## REGENTONE 192

**Chassis Removal**

Place the receiver face down on a protective surface, taking care to support the weight by the cabinet, not the implosion guard. Remove the back cover (four screws). Pull off the volume and contrast control knobs and release the tuner unit and control panel from the cabinet by undoing two wing nuts. Disconnect the loudspeaker leads. Remove the four chassis securing nuts and withdraw the chassis and tuner unit.

**C.R.T. Removal**

As for Regentone Ten 17.

## REGENTONE 195 Series

**Chassis Removal**

Remove back (four screws at back, two at bottom). Remove 4 x 2BA slotted nuts holding chassis to cabinet. Pull top of chassis towards you and remove chassis. If necessary remove tuner unit by pulling off knobs and removing nuts holding the mounting plates to the cabinet.

**C.R.T. Removal**

Discharge e.h.t. and remove anode and base connectors. Slacken the scancoil clamp and the tube retaining strap. Carefully remove c.r.t. from chassis, sliding the scancoil assembly back along the neck as you do so (assistance may be needed here). Clean all parts, refit in reverse order, making sure that the maker's label does not insulate the earthing spring. With width control in mid position adjust the line linearity sleeve inside the scancoils for optimum width and linearity.

## KB WV20 Series

**Chassis Removal**

Remove cabinet back, discharge and remove e.h.t. lead, unplug scancoil leads, remove c.r.t. base connector and disconnect loudspeaker. Where fitted unplug u.h.f. tuner from v.h.f. tuner, remove v.h.f. channel selector, fine tuner, brightness and volume control knobs. remove three fixing nuts and

# 87 Experts guide you to advancement and higher rewards

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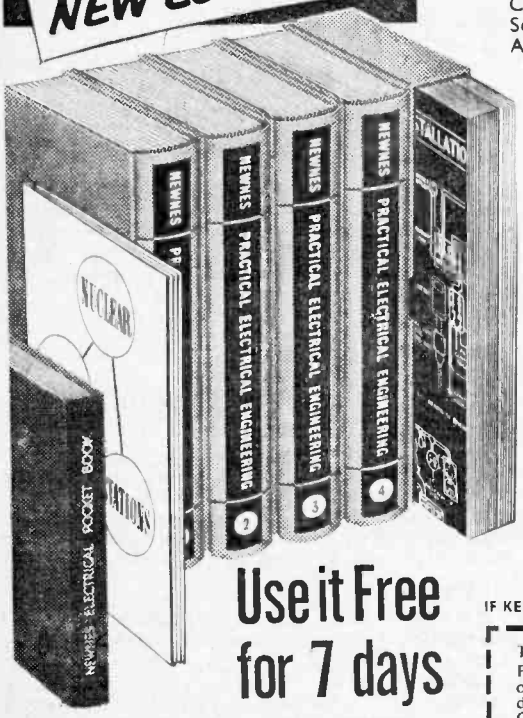


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## TABLE OF TYPES

### S.T.C. Group

**REGENTONE**

| Model | Specification | C.R.T. | Basic Type |
|---|---|---|---|
| Ten 6 | 17" P. | AW43/88 | Ten 17 |
| Ten 6 FM | 17" P. v.h.f. | AW43/88 | Ten 17 |
| Ten 17 | 17" T. | AW43/88 | Ten 17 |
| Ten 17 FM | 17" T. v.h.f. | AW43/88 | Ten 17 |
| Ten 21 | 21" T. | AW53/88 | Ten 17 |
| Ten 21 FM | 21" T. v.h.f. | AW53/88 | Ten 17 |
| R.3 | 17" T. | AW43/88 | Ten 17 |
| 17/18 | 17" P/B | AW43/88 | 17/18 |
| 191 | 19" T. | AW47/90 | 192 |
| 192 | 19" P/B | AW47/90 | 192 |
| 193 | 19" T. | | 192* |
| 194 | 19" T. | | 192* |
| 195 | 19" T. | AW47/91A | 195 |
| 196 | 19" T. | AW47/91A | 195 |
| 197 | | | WV20 |
| 198 | | | WV20 |
| 298 | | | WV20 |

**RGD**

| | | | |
|---|---|---|---|
| 519 | 19" T. | AW47/90 | 192* |
| 612 | 17" P/B | AW43/88 | 17-18 |
| 619 | 19" T. | AW47/90 | 192 |
| 620 | 19" T. | AW47/90 | 192 |
| 621C | 19" C/ette | AW47/90 | 192 |
| 622 | 19" T. | | 192* |
| 623 | 19" T. | | 192* |
| 624 | 19" T. | AW47/91A | 195 |
| 625 | 19" T. | AW47/91A | 195 |
| 626 | | | WV20 |
| 627 | | | WV20 |
| 628 | | | WV20 |
| 710 | | | Ten 17 |
| 711 | 21" T. | AW53/88 | Ten 17 |
| 723 | 23" T. | AW53/90 | 17-18 |
| 726 | | | WV20 |

**ARGOSY**

| | | | |
|---|---|---|---|
| 17K10 | 17" P. | AW43/88 | Ten 17 |
| 17K10 FM | 17" P. v.h.f. | AW43/88 | Ten 17 |
| 17K11 | 17" T. | AW43/88 | Ten 17 |
| 17K11 FM | 17" T. v.h.f. | AW43/88 | Ten 17 |
| 17K12 | 17" P/B | AW43/88 | 17-18 |
| 17K14 | 17" T. | AW43/88 | Ten 17* |
| 19K17 | 19" T. | AW47/90 | 192 |

**DEFIANT**

| | | | |
|---|---|---|---|
| 9A41 | 19" T. | AW47/90 | 195 |

**KB**

| | | | |
|---|---|---|---|
| TV15 | 19" T. | C19AH | TV15 |
| TV20 | 19" T. | C19AH | TV15 |
| TV30 | 19" T. | C19AH | TV15 |
| SV20 | 19" T. | C19AH | TV 15* |
| VV10 | 19" T. | A47/13W | WV20 |
| VV20 | 19" T. | A47/13W | WV20 |
| VV30 | 19" T. | A47/13W | WV20 |
| VV70 | 23" T. | A59/13W | WV20 |
| VV80 | 23" T. | A59/13W | WV20 |
| WV05 | 19" T. | A47/13W | WV20 |
| WV20 | 19" T. | A47/13W | WV20 |
| WV60 | | | WV20 |
| WV70 | 23" T. | A59/13W | WV20 |

Key to model identification: C.=Console, C/ette=Consolette, P.=Portable, P/B=Pushbutton, T.=Table Model, v.h.f.=Band II f.m. radio, *=near equivalent.

withdraw v.h.f. tuner. Remove two chassis fixing screws and withdraw chassis.

#### C.R.T. Removal

Unclamp and remove scancoils. Lay cabinet face down on protected surface. Remove four corner plates securing bonded faceplate plugs to cabinet and withdraw c.r. tube. Reassemble in reverse order.

### KB TV15 Series

#### Chassis Removal

Remove back. Remove channel selector, fine tuner, brightness and volume control knobs (on TV20/30 models ensure that no piano keys are depressed). Unplug speaker leads from sound output transformer. Remove two chassis fixing clips at rear of chassis and one screw in the middle of the top chassis bridge. Withdraw chassis.

#### C.R.T. Removal

Discharge e.h.t. and remove e.h.t. and base connectors. Remove width control sleeve and scancoils. Mark and remove two screws from top of bridge and two more from underneath chassis. Withdraw tube complete with tube strap and gasket.

When replacing, tube should project $1\frac{3}{4}$in. from strap and gasket with flange of gasket to the rear. The centre of the tube should project $1\frac{3}{4}$in. from the front edge of the tube strap. The whole assembly is now returned to the chassis, making sure that the four fixing screws are in their original positions relative to their slots.

*Part 7 next month*

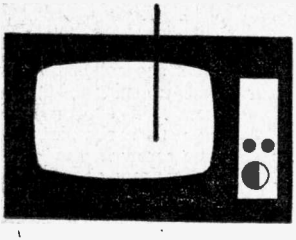
## NATIONAL FILM ARCHIVE

*—continued from page 544*

course, made for this service. Films shot in the first World War have often appeared in television programmes and those of the second World War can be seen in *The Finest Hours*, which is now released in cinemas and is virtually Sir Winston Churchill's own story as told in his memoirs in a film version. The earliest film dramas and comedies no longer interest the cinemas but excerpts are often required for television programmes. It would be mutually advantageous if television companies persuaded viewers who have very old films knocking around their homes to send them to the National Film Archive for preservation—but they should give details of titles and types of subject before sending the films along as some items may already have been salvaged. However, they should also bear in mind the dangers of keeping the old nitrate film around the house. A film fire is a dreadful affair and if a reel ignites in an enclosed space can spread to other films in the same room or vault and might even cause explosions. If the old films have historic value then the proper thing to do is to put them in the care of experts, who will store them under controlled conditions and in many cases have safety film copies made. This is where the National Film Archive comes into it. Some of these films will, no doubt, be seen again by television viewers in the historical and biographical programmes on BBC-1, BBC-2, ITV and—who knows?—Pay-TV as well. ■

A MONTHLY COMMENTARY

# Underneath the Dipole



BY ICONOS

THE campaign launched by the BBC, the TV receiver manufacturers and the radio retailers to persuade viewers to buy new 405/625-line sets, or to have recent sets fully converted, has not achieved much success—yet.

The TV correspondents of a number of newspapers have blamed the viewers' apathy upon the types of programme broadcast, while others have referred to the high costs of the final conversion and aerial fittings and fixtures to get the extra programme on their screens. In some cases, TV receivers which were purchased a year or so ago as being "convertible" at a small extra charge, have been found to be subject to extra charges amounting to more than £30.

I haven't seen many newspaper comments about the quality of the pictures on these converted sets, which, though they have more lines and the potentiality of greater definition, fall short of what can be achieved. Certainly the quality of the pictures is far below that seen on the monitors at the BBC, even when the BBC-2 aerial is in a reasonably good position.

The sets do, in fact, reveal many of the faults noticeable on ordinary 405-line receivers of recent vintage, the main one being the application of automatic gain control with consequent grey tones on dark, low key scenes.

### *Soft and Woolly Pictures*

On many of the 625-line sets I have seen, this results in a picture less sharp and clear than the 405-line transmissions of BBC-1 or ITV. Fortunately, a new technique has been developed for re-inserting the d.c. component in the circuitry of domestic receivers by producing a separate brightness signal from the video output, and applying it as a correction signal to the control grid of the picture tube.

As stated by Mr. P. L. Mothersole of Mullard Laboratories, this technique considerably improves the tonal values of low key scenes and simplifies the adjustment of the receiver brightness and contrast controls.

### *United We Stand!*

It is interesting to note that complaints to members of the British Radio Equipment Manufacturers' Association about the effects of a.g.c. on picture quality produced no results over several years.

Then, suddenly, the British Society of Cinematographers, an association of professional film cameramen, deplored the reproduction of low key and "mood" scenes which had been photographed by its members, and this complaint led to a combined effort made by the British Kinematograph Society, supported by BBC, ITA, ITV engineers, the Society of Film and Television Arts, and the Radio and Television Retailers Association.

Something had to be done without necessarily resorting to the d.c. restoration methods of early types of domestic TV receivers. Something *has* been done, but it will not be available in receivers in the radio shops for some months yet. Results are fine on reasonably good sets which have been modified with the Mothersole circuitry.

### *Sound in Front*

Domestic TV sets with small loudspeakers at one side of the set have always been at a disadvantage, as I have often mentioned in this column, but there is at last a trend towards front-facing loud speakers situated below the TV screen. I would think that there is a market for receivers with absolutely first-class sound as well as vision, with separate sound inputs so that record players or tape machines could be plugged in.

Television receivers in the top-class often reproduce a fair proportion of bass notes, and are able to reveal the reduction in the amount of bass which has been cut-off in recording in the film studios, particularly those of fairly old vintage as sent out by the BBC on Sunday nights.

This bass cut is necessitated by the high sound level reproduced in cinemas, and applies mainly to dialogue recording. There is much more bass sound content in "on air" or video tape recorded programme material, but the differences are more noticeable on top quality TV receivers.

When will stereophonic sound be applied to television? Well, I should say, never. It has been introduced on some "steam radio" stations in the U.S.A., Canada, Germany and Holland, apart from experimental transmissions from the BBC Wrotham station. A decision on a world standard has yet to be made on the FM-Multiplex system to be adopted, so that the two sides of stereophonic sound can be integrated into one signal.

This decision will not be made for another three or four years for

sound radio, and goodness knows how many years before it is added to television, plus colour television. By that time, it will be almost as expensive as buying a house.

### Montreux Festival 1964

Gold, silver and copper "Roses" have been duly awarded at this year's Montreux Television Festival, and prints of the winning entries have been booked and shown on BBC or ITV programmes.

I must say that I was surprised at the "Copper" award being made to the American CBS comedy feature *The Jackie Gleason Show*, which, though it was mildly amusing to most British viewers, was obviously uproariously funny to the live audience which participated in the transmission and whose roars of laughter were precipitated at the least provocation. Jackie Gleason is a good comedian who is at his best in miming sketches, such as the one where he plays the part of a magnificently uniformed trainer of a troupe of performing fleas in a circus.

The dialogue in the double acts was inclined to be stilted and dated, but maybe the American sense of humour is not quite the same as British—or perhaps the sound mixer turned up his "audience" microphone too eagerly.

One of the best supporting acts in this show was a lively banjo act by Gene Sheldon, a comedian with a dead-pan face that reminded one of Buster Keaton, and also reminded me of some of the music hall performers in the BBC's *The Good Old Days*, which was another entry at Montreux. This show, video recorded at the City Varieties Music Hall at Leeds is inclined to vary in quality week by week, but its best examples were, I thought, far ahead of *The Jackie Gleason Show*.

The music hall chairman, played by Leonard Sachs, is a splendid link-man between the acts, and the Edwardian-costumed audience are excellent foils. Jugglers, broad comics, sopranos and odd musical instruments add to the variety that is the spice of life. Gene Sheldon and his marvellous banjo would have fitted into the BBC's *The Good Old Days* very well.

### Dated Instruments

Banjos are not seen or heard very often on TV, but were all the rage in the days before sound radio commenced. Some of the musical gimmicks of yesteryear come over very well by way of a change, and call to mind the ukelele, banjolele, jews harp, swanee whistle, one-string phono-fiddle, concertina, musical glasses, clavioline and kazoo.

In this day and age, the electric guitar has superseded the accordion as an instrumental best seller amongst the younger generation who have an urge to express themselves musically.

Vocally, traditional techniques of operatic voice production are at a discount when the microphone can reinforce *sotto voce* into gargantuan virtuosity, with all the tricks of artificial reverberation, vibrato, flutter-echo and other gimmicks available at the touch of a switch. Some of the effects, I admit, *are* effective. Others are rather hard on the ears!

### Berlin Festival

These TV and Film Festivals seem to multiply year by year. The Berlin Festival covered TV documentary features and, with little variety of appeal, added up to a lengthy endurance test with critics dropping off to sleep.

A more lively festival at Venice covered a wide range of TV and cinema commercials, and a large number of after-show parties and entertainments. Television commercials are not easy to make or, for that matter, to watch unless they have originality.

The hard-sell zooming up to "pack shots" are out of popularity for the moment. So are the loud, strident sales talk voices which sound like side-show barkers.

### Equestrian Appeal

It has been said that horses are as important as stars in the contribution they make to the success of television and technicolor. On colour film, they look marvellous. On television, they provide plenty of activity, movement and excitement, whether at the races, on show jumping or in cowboy films.

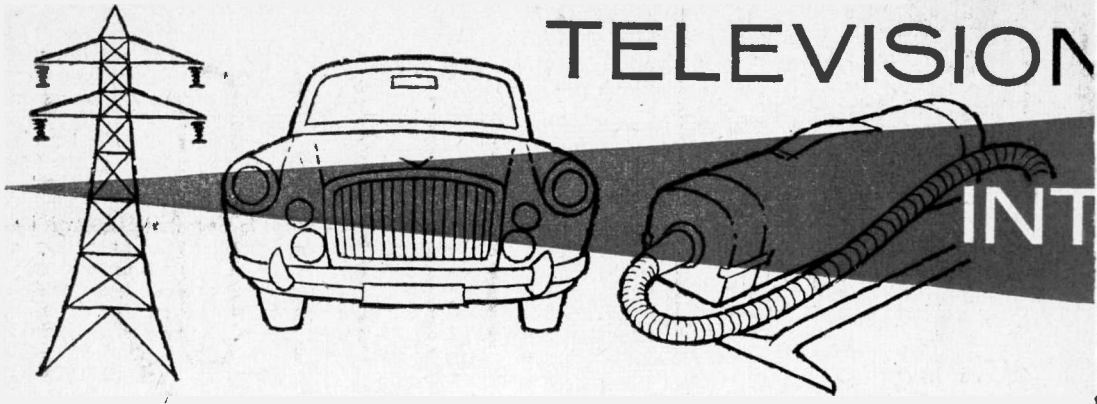
The BBC's outside broadcast of the competitions at the *Royal Highland Show* near Edinburgh was one of the best examples of television techniques, with no over-emphasis on zooming and restless cutting from camera set-up to set-up, which is sometimes hard on the eyes. The superimposition of the names of riders and horses was stylishly done, and the commentary by Dorian Williams first-rate.

Horses appeared, too, in the edition of *Eye on the World*, which gave viewers every possible angle and opinion on fox hunting as carried out by the Quorn hunt. Excellent camera work and editing with rapidly moving shots taken from cars, and, one presumes, by a horse-riding cameraman, followed the hounds in full cry.

There was plenty of excitement and activity from the spectators, too, some of them (including the commentator) against fox hunting. I might even agree with some of these odd remarks, were it not a fact that I have a number of chickens in a run in my garden which are regularly maimed or killed by foxes. This film was a second viewing of a feature from *Tonight*, directed by Jack Gold, splendidly photographed by Peter Hall, and expertly edited by Peter Moseley.

### Rudyard Kipling

I would not be at all surprised if the BBC's presentation of Rudyard Kipling's short stories leads to new editions being printed and appearing on the bookstalls. The plots are short magazine stories that really are short, and the producer decided to join two stories together under one title, *The Bank Fraud* for the first episode. With excellent casting of Joss Ackland in the part of a kindly and relaxed newspaper editor, who is fooled by Alfred Burke as an Indian hootch dealer from one of the stories, and becomes involved himself in helping Ralph Michael (bank manager) to fool his directors in a little soft-hearted deception, the two stories tie up very smoothly in the TV adaptation by John Maynard.




SINCE the early days of radio and television it has been the aim of engineers to minimise the effects of interference. Although complete suppression at the source is virtually impossible, the level of the radiated interfering signal can, nevertheless, be substantially reduced at this end by special treatment, and with the great rise in the use of electrical machinery—both commercial and household—the Post Office has made it law that such items of equipment, including car ignition systems, be reasonably suppressed at both radio and television frequencies. At the receiving end of the chain such interference cannot be properly suppressed, for once it is picked up by the set it "looks" to that as a radio signal—which, of course, is what it is—and a method which may be successful in deleting the unwanted signal may have an adverse effect on the wanted signal.

There are so many electrical devices now in everyday use that can cause serious interference, that the Post Office maintains a special department to deal with complaints of radio and television interference from licence holders. This department, in fact, has been operating for many years and it has done much useful work not only in the day-to-day suppression of interference and in its location, but also in terms of designs for suppression equipment and in advice offered to users of electrical equipment which is causing interference.

## Responsibilities

It should be made perfectly clear at the outset, however, that it is fundamentally the responsibility of the user of electrical equipment to ensure that it is working in such a way as not to cause interference to radio and television. Reciprocally, it is the responsibility of listeners and viewers to ensure that their receivers and aerials are installed efficiently so that they fail to respond to residual interference which is present almost everywhere these days.

A television or radio receiver which is in a poor condition and/or working with an inferior aerial and earth system will almost certainly display or produce the effects of the prevailing interference. In such cases there is no point in trying to locate the interfering source or sources, for as soon as particular attention is given to one source another source will as quickly appear. This is because an installation of this kind is highly acceptable to interfering signals.

Thus, before complaining about interference the viewer or listener should take special pains to make sure that his set, aerial and earth are beyond reproach. The type of aerial system required will depend to a large degree on the local strength of the radio or television signal. A strong wanted signal will not need such an elaborate aerial as a weak wanted signal, but even a strong wanted signal in an area where the interfering signal level is high may need a special aerial to provide the maximum discrimination against the interference.

## Signal/Interference Ratio

The whole exercise in the suppression of interference is to maintain the greatest possible ratio between the levels of the wanted signal and the interfering signal. This ratio is kept high (a) by reducing the level of the interference radiation at the source and (b) by increasing the level of the wanted signal—relative to the interfering signal—at the receiver.

Only in those cases of good installation and set where troublesome interference is experienced should the Post Office be called in. Here the trouble is mostly caused by nearby electrical equipment producing an interfering signal of greater level than permissible (due to lack of suppression of a fault condition), by a weak aerial signal (due to the use of an adequate aerial system for the area) or by a combination of both.

The Post Office engineers carry equipment which is capable of detecting and locating the interfering equipment, and once the source is located steps are taken by them to recommend methods of suppression. It is then the responsibility of the owner of the equipment to have necessary repairs and/or suppression carried out before putting the equipment back into use. In certain cases, the Post Office engineers may themselves undertake the suppression of the equipment, but this should not be considered as a part of their work.

In fringe areas where the received signal is relatively weak compared with the prevailing interference, it may be impossible completely to delete all traces of interference. Such conditions may exist for example, in small, isolated pockets of population

# TERFERENCE

BY GORDON J. KING

where local screening severely attenuates the signals from one or both stations. Here, then, interference from, say, overhead electricity cables or domestic electrical appliances may well outweigh the required signal level actually conveyed to the set from the aerial. About the only solution to this sort of interference problem is to set the aerial up on a hill above the screening and interference. In that way the wanted signal at the aerial can be kept high compared with the level of the interfering signal and the effects are neither seen nor heard. For the interference to be pushed well into the background, the wanted signal must be at least 100 times stronger than the interfering signal. That is 100-1 (or 40dB) signal/interference ratio.

Such an exercise often means that the coaxial lead from the hill-mounted aerial to the set needs to be extra long, and since a long cable can considerably reduce the strength of the signal by the time it arrives at the set end, some form of signal amplification is often desirable. This may be necessary on both BBC and ITA channels, or on just the ITA channel, as the signal is attenuated more rapidly at Band III frequencies than Band I frequencies.

## Near to Aerial

The best idea is to locate the amplifier as near as possible to the aerial because this ensures that the *noise* generated by the set and the amplifier is kept low compared with the signal itself. Note that *noise* in this respect does not refer to interference as we have considered it above. Noise is a signal

***—continued overleaf***

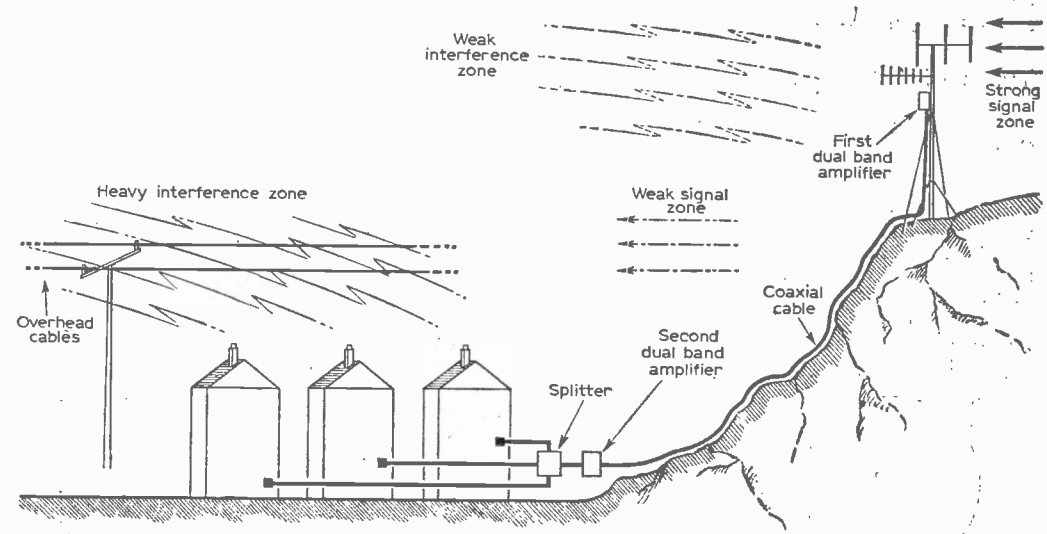



*Fig. 1—Example of a hill-mounted aerial to improve the signal/interference ratio. By the use of amplifiers and a splitter a number of viewers may be fed from the one aerial, thereby reducing costs. The masthead amplifier could be powered from a small unit at the set end of the coaxial cable, using the cable to feed power to the amplifier as well as to feed signal to the sets.*

produced by the set and/or amplifier resulting from its normal function of amplification.

As it may be difficult to power an amplifier remotely sited near the aerial, it is possible to use the coaxial downlead to feed power up to an aerial amplifier without detracting from its primary job of carrying the signal to the set. Coaxial-powered aerial amplifiers are readily available commercially (valve and transistor models), both single and dual band models.

An extra amplifier at the receiving end of the downlead could allow the one aerial to feed a number or group of viewers, by feeding a splitter with the required number of outlets, as shown in Fig. 1. Such splitters are available commercially or can easily be constructed.

## Increase Ratio

Thus, we have seen that to win the battle against interference we must enlarge the ratio between the wanted signal and the interfering signal either by improving the aerial system or by suppressing the interfering signal at source (or both). This philosophy applies no matter the type of interference experienced, and there are several types, as we shall see.

At this juncture it is worth noting that the type of aerial itself can do a great deal to discriminate between wanted signal and interfering signal. A single dipole, for example, is omnidirectional. That means that it picks up signals equally at all angles round it. An aerial with a reflector and directors, on the other hand, is responsive mainly to signals arriving within a limited angle at the front. This allows the aerial to be turned so as to provide the greatest discrimination between the signal and interference (see Fig. 2). All the time, it will be realised, we are endeavouring to maintain the highest possible signal/interference ratio.

## Types of Interference

There are three primary types of interference. One is the interference generated by all kinds of electrical machinery and plant, two is radio-frequency interference actually produced by radio signals and three is so-called multipath interference, which arises from the reflection of the television signal from a hill or large structure, the set then receiving the direct signal and a very small fraction of a second later the reflected signals.

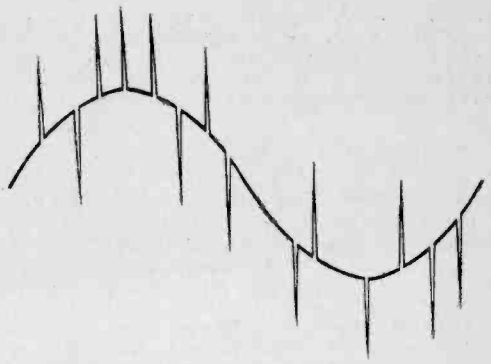


*Fig. 3—Showing spikes of impulsive interference superimposed upon a signal waveform.*

Electrical interference is the most common and its effects are well known in that on sound it produces sharp, staccato bursts from the speaker and on vision white blobs and dashes on the screen on 405 lines and grey ones on 625 lines. This is the sort of interference which emanates from car ignition systems and from electrical equipment, such as motors, thermostats, welders and the like. In view of its effect, it is sometimes called "impulsive interference". It takes the form of steep, sharp pulses superimposed upon the wanted signal, as shown in Fig. 3.

It thus amplitude modulates the carrier, and after detection it appears to the audio stages as a.f. transient signals, and is reproduced as such. Likewise in the vision channel. Impulsive interference has considerably less effect on the FM sound channel of the 625-line TV system, and owing to the negative vision modulation of that standard it appears as grey, instead of white, blobs on the picture.

## Typical Display

A typical display of interference due to an electric motor in a vacuum cleaner is shown in Fig. 4. This picture was taken on a blank raster (without a wanted signal) so that it would show up better than on an actual picture.

Impulsive interference is suppressed at source by the use of small suppression chokes wound on dust-iron cores for TV and larger chokes and capacitors for radio, depending upon the type of equipment

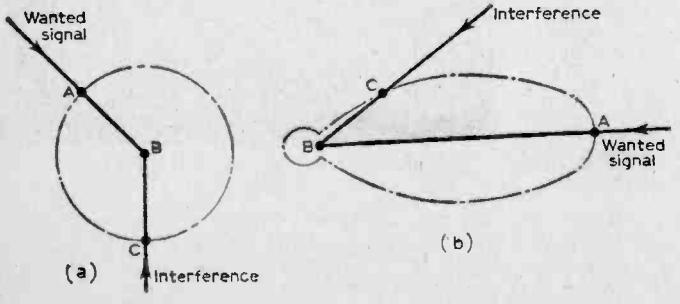



*Fig. 2—An omnidirectional aerial at (a) gives response to interference equal to that of the required signal. B-C equals B-A. A directional aerial, however, can be orientated for the best ratio between the signal and the interference. Here the response B-A is greater than the response B-C.*

causing it. Car ignition interference is mainly suppressed by the use of resistive suppressors fitted to each plug and/or distributor or (more recently) by the use of an e.h.t. cable from the distributor to each plug featuring a resistive conductor.

## Interference Propagation

At this stage it should be made clear that interfering signals can be propagated either through the ether, as ordinary radio signals, or through the mains system and cables. Moreover, it is sometimes picked up by cables and then re-radiated by them at some other location.

Generally speaking, however, impulsive interference which affects television reception is rarely, if ever, mains borne, since to v.h.f. signals the losses in the mains cables are very high and any high-frequency component of the interference is speedily attenuated.

TV interference, then, is mainly propagated through the ether in the ordinary radio manner. Medium-frequency radio interference, on the other hand, is often mains borne and mains filters and suppressors can be used here to alleviate the effect —but not on television so much.

R.f. interference is the kind that causes patterns on the picture and whistles on the sound, and a typical display on the picture is revealed in Fig. 5. The r.f. causing this effect was modulated a little at mains frequency (50c/s), which is the reason why the interference effect is most intense at the top of the picture, gradually tailing off in intensity towards the bottom.

Any radio signal which can get into the TV set along with the wanted signal and beat with either the carrier or the intermediate-frequency signal so as to produce a difference-frequency within the receiver's video passband (up to about 3·5Mc/s) will create patterns. Whistles will be caused on sound when the difference-frequency in the sound channel is below about 15kc/s. Mains modulation on the signal in the sound channel will also cause a hum, this being typical of certain interference produced by r.f. medical equipment.

Again, r.f. interference is propagated through the ether and rarely through the mains system, and suppression is essential at source.

## Co-channel Interference

Pattern effects are also caused during the spring and summer months particularly on the Band I channels as the result of co-channel interference. This is when two or more stations are simultaneously receivable on the same channel. Normally, of course, the range of TV signals is considerably limited and at distances in excess of a hundred or so miles the signal is so small as not to be troublesome. During settled weather conditions, however, v.h.f. signals undergo a "ducting" effect in the troposphere and can then travel over many hundreds (sometimes a thousand or so miles) of miles at fairly high level.

The trouble arises when the distant station so propagated is on the same channel as the local station. The set then receives two (or more) signals. The strongest one produces a picture while the weakest one gives rise to patterns as shown in Fig. 6. When the two (or more) signals are almost matched in strength a second picture is sometimes

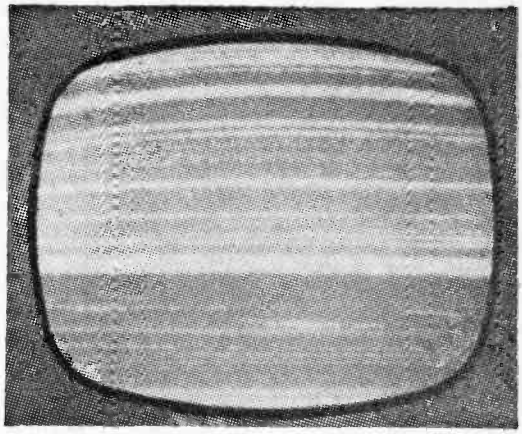


*Fig. 4—Impulsive interference from an electric motor as displayed on a TV screen.*

*Fig. 5—The display of r.f. interference modulated at 50c/s, see text.*

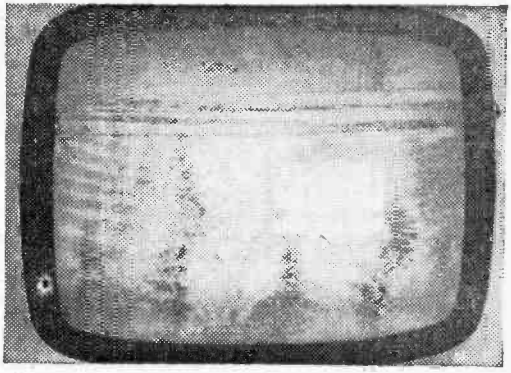


*Fig. 6—Excessive pattern effects caused by co-channel interference.*

seen drifting from side to side across the picture to which the set has locked.

Another effect of co-channel interference is the production of dark, horizontal lines, as shown in Fig. 7.

Unfortunately, there is very little that can be done to alleviate the effects of co-channel interference and when it is troublesome the TV authority makes periodic announcements to avoid viewers from calling in their dealers, thinking that something has gone wrong with their sets.

Co-channel interference is less troublesome on the Band III channels, and is not very often reported on the u.h.f. channels of Bands IV and V.

## Multipath Interference

As already intimated, multipath interference is caused by the set first picking up the direct signal and then a reflection of the same signal a fraction of a second later. The ordinary main picture is produced followed by a second or "ghost" picture displaced a little to the right of the main picture. The displacement between the two pictures is a measure of the delay of the reflected signal.

This sort of interference can be reduced considerably by paying careful attention to the aerial system and its orientation. A good directional aerial should be used and this should be rotated to give the greatest discrimination between the direct and reflected signals (see Fig. 2(b)).

If, when the aerial is orientated for the maximum ghost rejection, the main picture is too weak, an amplifier should be used to restore the level of the wanted signal. This it will do without impairing the high signal/interference ratio achieved by aerial orientation. One of the low-noise transistor amplifiers is useful for this application.

## Fluorescent Light Interference

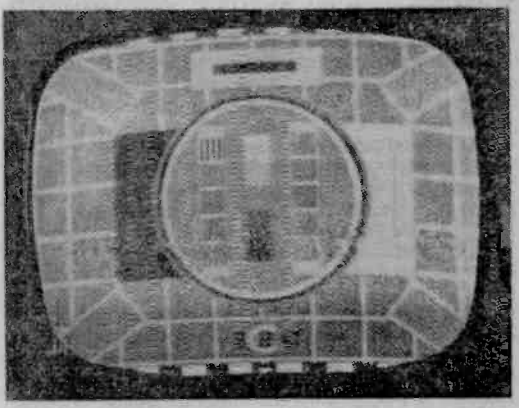
An interference effect which results from a combination of impulsive and r.f. signals is that caused by fluorescent lights, the effect of which is shown in Fig. 8. Here two wide, horizontal bands of small dots and patterns develop across the picture.

The waveform responsible for this sort of interference is shown in Fig. 9. This was obtained by winding a couple of turns of wire round a radiating fluorescent tube and connecting the end of the wire to the Y amplifier of an oscilloscope with the timebase locked at 50c/s.

Fluorescent light interference is unpredictable and difficult to clear permanently. Worn fluorescent tubes suffer most from the trouble. The makers of the lights supply suppressing equipment, but while this may appear to effect a cure initially, the interference has a habit of returning without warning. Reversing the tube so that the ends are interchanged may clear the trouble for a while, and should the interference re-occur changing the tube back again may be all that is necessary to keep the picture clear. Earthing the metal case of the assembly is another exercise worth attempting.

By far the best idea, though, is to re-position the aerial well out of the way of the interfering field, for in that way not only is the strength of the interfering signal weakened but the strength of the wanted signal is enhanced, thereby giving the condition that is essential for the deletion of any type of interference—a high signal/interference ratio. ■

*7—Another form of co-channel interference.*



*8—This photograph shows how fluorescent light interference affects the picture.*

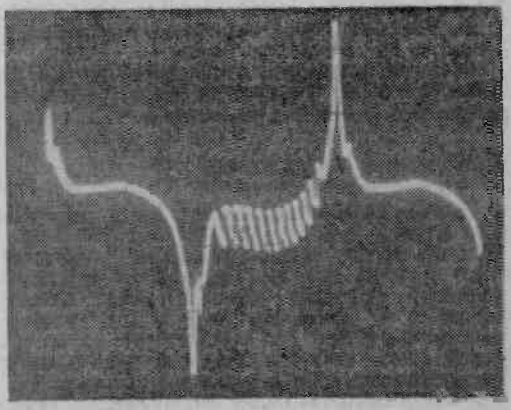


*Fig. 9—The radiated signal responsible for fluorescent light interference—see text.*

# DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

By Charles Rafarel

THE Sporadic E opening that started on May 18th proved to be one of the best ever and afforded daily unbroken reception until the end of the first week in July, when a "break" occurred. However, there seems to be signs that the good reception conditions are returning as I write these lines at mid-July. It might be profitable at this stage to compare this year's results with those of preceding years.

The main point that I have noted from my own results and by studying readers' reports is that in earlier years reception has been approximately equal from stations lying north/south of the British Isles and those lying to the east. but this year the best reception seems to be along the north/south axis.

The "star" performers have been Spain, Portugal, Italy, Norway and Sweden, whereas those stations to the east such as U.S.S.R., Poland, East Germany, Hungary, Czecho-Slovakia, etc., have been much less in evidence during reception in this area. This does not mean that good reception from East Europe may not have been achieved by other DX-ers in other parts of the country.

## READERS' REPORT

**W. C. Gordon,** of Glasgow, has received R.T.F. France on channel F4. The signal most probably originated from the Carcassonne transmitter in Southern France., **D. Davies,** of Towyn. Wales, has also received this station, and this seems to again show the north/south pattern that I have mentioned, and I suggest that other DX-ers (particularly those in northern parts of the country) should be on the "look-out" for twin split French positive image pictures, even if they only have "unconverted" 405-line receivers. Why not keep a look-out near channels 2 and 5 on your set?

Another DX viewer, **Mr. Whillance,** of Durham, tells us that a friend of his has had a French R.T.F. picture on channel F2, and this could well be either Caen, Troyes or Limoges, most probably the latter.

**Leonard Allsopp,** of Cardiff, reports reception of T.V.E. Spain on various channels, and he has also had Sweden on the north/south axis. He, however, mentions reception from Poland, Hungary and Czecho-Slovakia, so his area has been suitable for reception from the east, which seems less common.

**Mr. Deaves,** of Middlesbrough, is a similar case. He has had R.T.P. Coimbra, Portugal, on E3, and Skovde, Sweden, on the same channel, and he, too, has had Warsaw, Poland, and Budapest.

The latter station, M.T. Budapest, Hungary, has proved to be one of the "mysteries" of 1964! In previous years its test card "C" type with the outer white circle and the word "Budapest" below the inner circle was very much in evidence, but this year as far as I know this card has not been received and it seemed that in spite of good openings Hungary was missing, although Grunten, Jauerling and Ostrava were coming in at times at approximately the same skip distance.

We now have the answer to the mystery thanks to **Albert Davies,** of Gillingham, Kent. Budapest has now changed its test card and is now using one identical to that used by Poland except that there is no lettering or words on it.

This card has in fact been seen on a number of occasions and I think that most of us imagined that it originated from Bydgoszcz, Poland. Over the last three years Poland has used at least three types of test card and this appeared to be a slight variation of the 1963 version. However, if you see this type of card with *no* letters on it it is our old friend Budapest still with us.

## GENERAL DX NEWS

The power of Lille-Bouvigny u.h.f. on channel 27 is reported to be 500kW and reports of reception in South-Eastern and Southern England continue to arrive.

As I write, tropospheric reception is still poor and Continental DX-ers are also complaining. There does seem to be a slight improvement at present but it has a long way to go before reception becomes normal and worth while, so I suggest that you concentrate on Sporadic E at present. If, however, we get a long period of settled weather I feel that the tropospherics will improve.

The "new" test pattern mentioned in last month's article (the test grid with two shaded horizontal bars in the centre) is most probably West German from Kreuzberg on E3. This pattern has been reported as being seen from West Germany in Band III. Still no news, however, as to the origin of the checkboard pattern on E4.

I recently spoke of the possibilities of Band II reception of TV signals and suggested ways of becoming operational on this band and I stated that I myself had modified a receiver to cover 75-100Mc/s. I am pleased to report a small success here, confirming that DX-TV is possible on this band.

On July 7th, 1964, at 10·00 onwards the R.A.I. (Italy) Band I stations were coming in at exceptional strength, so an attempt was made on Band II. Sure enough the R.A.I. Milan station on channel Ic (82·25Mc/s) was received, and though the signal was weak it was on the screen, which is cause for optimism regarding other stations on Band II. It is worth noting that the reception conforms to the suggested north/south pattern.

# SERVICING TELEVISION RECEIVERS

## No. 105: PAM 120A, PYE V700 and INVICTA 941

By L. Lawry-Johns

CONTINUED FROM PAGE 514 OF THE AUGUST ISSUE

THE line timebase consists of the B section of V14 (ECC82), which functions as a line oscillator, the PL36 line output, the PY800 efficiency diode and the EY86 e.h.t. rectifier.

When the line hold R100 (150kΩ) is found to be at the end of its travel or when its setting requires frequent attention, although there is a margin of tolerance within this setting, check the ECC82 by replacement, also R99 and R95 if necessary.

The hold control itself sometimes changes value and it should also be remembered that the PL36 output valve is also part oscillator with feedback via C72 and C75.

### Lack of Width

This is usually due to a failing PL36, sometimes aggravated by a low ECC82, and both should be checked; also the PY800 if necessary. Check the

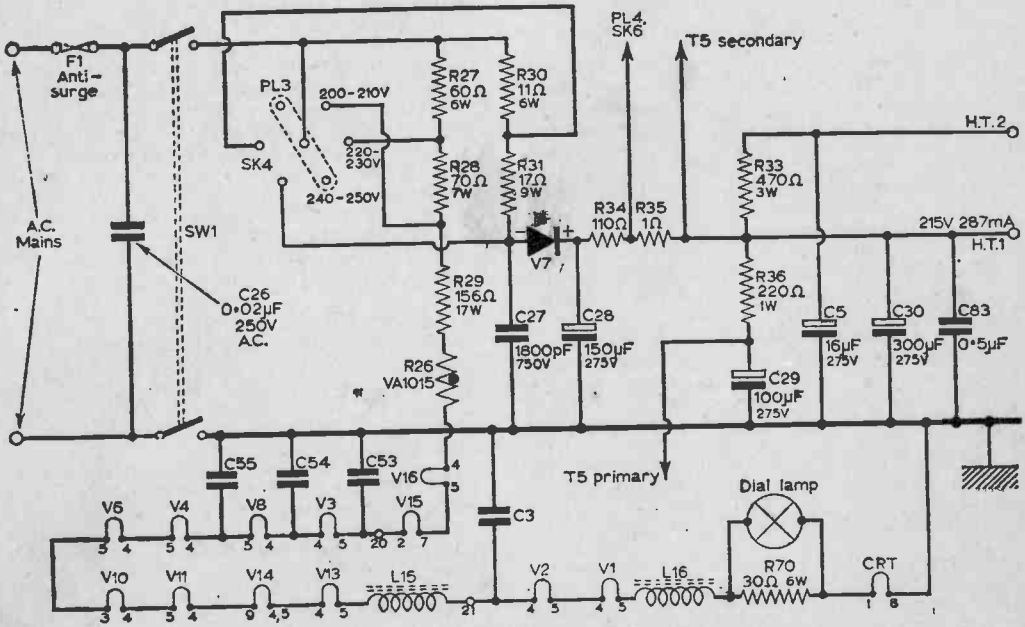



*Fig. 4—The power supplies.*

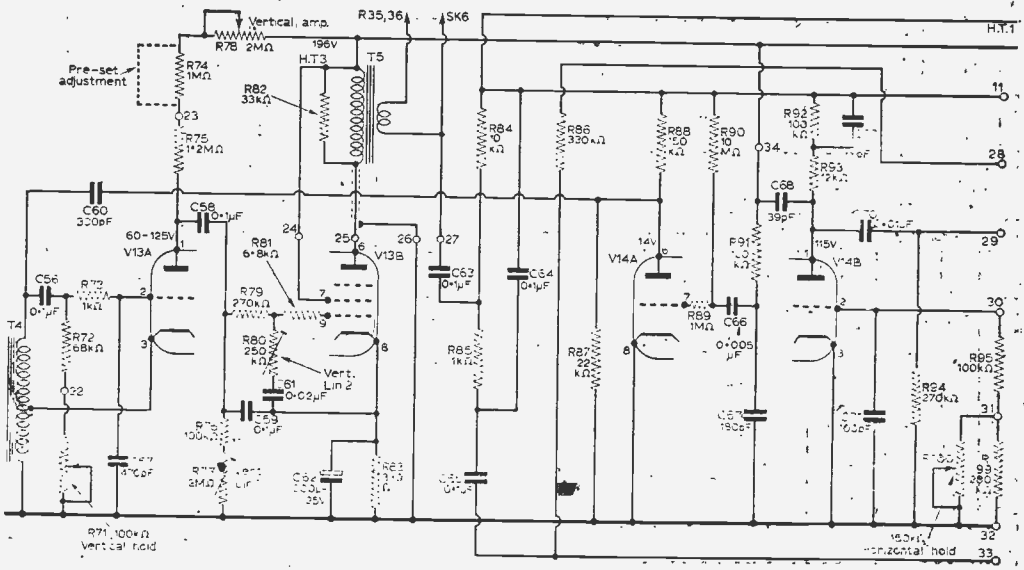



*Fig. 5—Frame oscillator/output stage and line oscillator.*

h.t. voltage, which at the output of the rectifier or at the reservoir capacitor C28 should not fall below 200V.

### *No E.H.T.*

If the sound is normal but there is no picture or raster when the brilliance is advanced it is likely that there is no e.h.t. at the side of the tube. If tests show that this is so, remove the lower section of the centre screened section and check at the top of the EY86.

If a normal pulse voltage is evident here or if the line whistle is healthy try a replacement EY86, which probably has an open-circuited heater. If, however, the line whistle is subdued or absent, note whether the PL36 presents a normal appearance.

If it is overheated check the ECC82 and components. If it is not overheated check this valve (PL36), the PY800 and the boost line capacitor C79 (0·1μF).

An ominous, distorted or varying whistle accompanied by sounds of discharge apparently from the line output transformer is often due to the actual discharge taking place in the PY800.

It is as well, however, to note the effect of removing the e.h.t. clip from the side of the tube as similar symptoms can be caused by a short in the EY86 and sometimes by a discharge in the PL36.

It is also as well to note the effect of moving the four-pin strip from the deflector coils socket. A breakdown of insulation in the deflector coils is a possibility which should not be ignored.

### *The Frame Timebase*

This consists of the V13 stages, the PCL85 being the frame oscillator output valve with the A section of the ECC82 (V14) serving as a frame sync clipper. The frame hold control itself R71 and the resistors R72 and R73 do not usually give much trouble except where the control itself becomes partially o.c. or erratic.

A more common trouble is that an even reduction of height occurs due to R75 (1·2mΩ) going high. By even reduction of height we mean that the top and bottom of the picture show gaps without distortion in the lower part more than the top.

Where the bottom is compressed more than the top, attention is directed to V13 itself. R83 330Ω bias resistor, which the writer has in fact never found changed significantly in value, it being sensibly a 1W resistor, and C62 (200μF 25V). This latter component is likely to dry up and lose capacity.

A distinct foldover may be caused by V13 running into grid current, C58 being leaky or a faulty C59 or C61. Faulty controls may cause fluctuations in height and linearity.

### *Weak Frame Sync*

If the line hold is quite solid but the frame persists in wandering up or down check the components associated with V14A, in particular R88 and R90.

### *White Horizontal Line*

This denotes a complete break in the frame timebase and we have frequently found that C80 (0·1μF) shorts to chassis. As this boost line also feeds the c.r.t. first anode (pin 3) a quick checkpoint is available here.

It may be thought that the absence of first anode voltage would cut the beam current of the tube off completely; and this is so with some tubes; however, the concentration of the beam across the

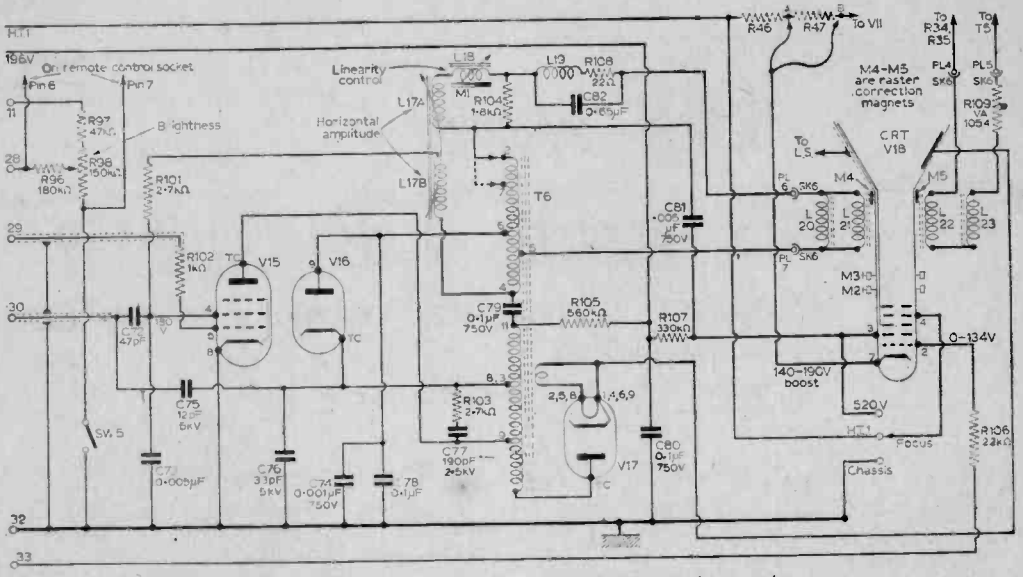



*Fig. 6—Line output stage, e.h.t. rectifier and cathode ray tube.*

centre is often sufficient to show quite a bright line. This, of course, means that no supply is being made to the height control.

If the first anode shows a normal 500V or more check on the other side of the height control (R74 usually linked across). If a fair voltage is at R74 and one end of R75 but not at the anode of V13A check C58, although when this capacitor is a dead short there will be more of a band across the screen with a thicker white line at the bottom. If the V13A voltage is normal at between 60—130V check at the anode of V13B (185V).

If this voltage is absent check the continuity of T5 primary. The voltage will not at first be entirely absent owing to the presence of R82 33kΩ, but this resistor is likely to overheat and fail.

Check R36 and C29 100μF (275V) if T5 is intact.

### *Poor Contrast*

If the brilliance functions normally but the picture lacks contrast and the sync is weak check V11, R46 and V9 (CG64) vision detector diode, which is inside the T3 coil can.

On meter it should have a high resistance with the leads connected or applied one way and a comparatively low resistance when the leads are reversed.

Quite often the diode may be found "high" in both directions or "low" in both directions, either condition producing a very weak signal at the video grid (TP3).

This condition should not be confused with a "noisy" picture with excessive grain and ragged outlines. This latter condition should direct attention to the aerial, input circuit V1 (PCC89), V2 (PCF86) and the operating conditions of these valves and V3 (EF85).

### *No Sound*

The audio output PCL83 (V6) is nearly always responsible for sudden or intermittent loss of sound. Where the loss of sound is intermittent, tapping the PCL83 will often provide conclusive proof of its guilt.

If, however, there is a slight hum in the loudspeaker and the volume control varies the response, check C15 (0·001μF) from pin 8 of V4 to chassis. Check CG64 (V5) if necessary.

Distorted sound can also be caused by a faulty PCL83 and R19 should always be checked when it has been necessary to replace this valve (R19—470Ω).

### *Electrolytic Capacitors*

Faulty electrolytic capacitors can cause a variety of symptoms from hum and uneven illumination of the screen, sound on vision, poor sync and low h.t. voltage (C28 is the reservoir capacitor of the rectifier V7).

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# BUSINESS OF SERVICE

*—continued from page 542*

of staff have been discussed as it is considered that these aspects of servicing are of first importance. Since the finest engineer cannot work without tools the very vital question of choosing test equipment will next be examined.

In the first case the minimum amount of test equipment required for starting up will be discussed, followed by suggestions for equipping the workshops with a full range of test instruments. Only the fortunate few have sufficient capital when starting up to fully equip a workshop and it is the general practice to build up as the business progresses. ■

PART 2

# Optical Systems for Amateur Closed Circuit TV

## ADAPTING AMATEUR EQUIPMENT FOR CCTV MICROSCOPY

BY M. L. MICHAELIS

THE specimen can easily be positioned as desired between two simple spring clips as shown in Fig. 1. The position of the stage in relation to the condenser has been made adjustable by means of an attached angle-piece sliding in a U-profile rail on the underside of the lamp tube. The specimen stage can be locked in any position with the help of a wing nut.

The purpose of this longitudinal stage adjustment is to permit optimum approach to the condenser for the various thicknesses of specimen carriers. Adjustment is not necessary for every slight difference in thickness of ordinary microscope slides but it is required when inserting the type of slide carrying a thick U-trough for examining organisms under live conditions in a small quantity of pond water.

### *Focusing*

Coarse focusing is always performed by racking the lamp and stage assembly relative to the stationary lens. Fine focusing is performed during open projection by adjusting the normal focus ring on the lens and during closed CCTV operation (system closed, lens inaccessible) by racking the vidicon carriage within the CCTV camera. Fine focusing adjustments will normally not be required, the lamp-and-stage-assembly rack already providing sufficient focus control precision.

The lens carrier junction ring is a composite item turned on the lathe from a single piece of aluminium. It serves the dual purpose of assembling the constituents of the entire unit and of mounting the lens in reverse, i.e. with the front end pointing at the CCTV camera. This reversal is necessary for two reasons:

Firstly, the optical correction of the lens is calculated for the microscopic conjugal point in the rear focal plane (just as in normal use when televising ordinary scenes where the tiny image on the vidicon target is again in the rear focal plane). The performance is poorer as far as resolution is concerned if this point is not observed.

Secondly, the front focal plane is in fact too close to the front lens surface so that the design would also not be possible on mere considerations of physical dimensions if the lens were to be mounted the other way round.

It is strongly recommended when intending to build this unit with a different lens than the one specified nevertheless to keep to a lens originally intended for 16mm cine film photography and also to keep to about the same focal length of 25mm. The reason is that the conditions demanded by 16mm cinematography and those demanded by microscopy are, basically, rather similar. Due to the exceedingly tiny film image on such cine films compared to the large dimensions of the filmed scene the conditions are clearly ones of high (reciprocal) magnification. for which a good-quality cine lens may be relied upon to have been trimmed by the makers for optimum performance.

Physically inverted, as in our micro-objective, we can expect the same high direct magnification at good resolution under conditions of microscopy as the prototype has thoroughly confirmed in practice.

The smaller the aperture set on a lens the less the blurring due to image aberration (optical lens errors), but the greater the blurring due to diffraction—and vice versa. Thus, due to the interplay of these opposing effects, optimum definition is given by any particular lens at some intermediate aperture which is characteristic of its design and intended application.

Now the resolution under conditions of microscopy is inherently the greater, the greater the lens aperture used because it is primarily a function of the diffraction effects. A lens which is suitable for high-resolution microscopy is consequently one which is so designed as to place the optimum stop number at a much greater aperture than for normal photography, i.e. one with low optical aberration right down to large apertures.

The realisation that exactly the same requirements are placed upon a lens intended for cinematography, and that such lenses are for the same reasons required for normal scene televising with amateur CCTV equipment (tiny vidicon target image), prompted the author to reach the theoretical conclusion that the *same lens*, in a properly designed micro-objective, should lead to a high standard of performance. These theoretical considerations were fully confirmed.

### Open Projection

A high standard of performance is obtained with the unit as a "pocket" projection microscope. With the unit on an ordinary photographic tripod, and the tube "3" and ring "1" removed, a brilliant picture is obtained on an ordinary lantern slide projection screen at a range of about 3yd, giving a magnification of about 120 diameters on the screen.

In a darkened room much greater magnifications are obtainable by projecting from a greater distance. For ranges up to 3yd it is not even necessary to fully darken the room. The brilliance of the projected images, especially in a fully darkened room, approaches that of modern lantern-slide (diapositive) projectors. The sharpness of focus is quite remarkable. If one goes right up to the screen the images are razor sharp down to the last detail. This is all the more surprising considering that only a 6V 15W lamp is used—proving the efficiency of a properly adjusted point source of light.

The CCTV application of open projection lies in the available duality which, with the help of a trick, can be used simultaneously. If a small hole is cut in the projection screen, and the hole of the lens carrier of the CCTV camera (without lens) is placed immediately behind this screen hole, then one can view a specimen at low magnification, but in entirety, on the projection screen directly and can steer any small part of interest on to the hole, this part then appearing blown up in much greater magnification on the screen of the TV set.)

This method of working is extremely comfortable and versatile, certainly when first selecting and getting accustomed to unknown specimens.

When working in this manner it is convenient to project at a range of some 4ft on to the canvas screen, giving a primary magnification of some 50 diameters there. The power supply to the lamp should be reduced to 4V as the vidicon target will otherwise be overloaded under these conditions.

The image on the canvas screen is then still bright enough for clear viewing in a room with strongly subdued ambient lighting. The image on the TV receiver screen then represents a magnification of about two thousand diameters, i.e. it definitely shows up the maximum resolution which the entire system is capable of giving.

### Electrical Supply for the Lamp

The power supply for the lamp uses a heater transformer rated at 6·3V 2·5A and tapped at 4V. When using the unit in the closed CCTV set-up, with the recommended 10cm tube giving a magnification of about 300 diameters on the TV receiver screen, the lamp voltage must be reduced to 2·3V. Otherwise the vidicon target is severely overloaded, as manifest by the fact that signal current from the target then rises to saturation as soon as the target voltage control is advanced only a very small way from zero.

The lamp filament merely glows dimly at 2·3V (obtained between the 4V and 6·3V tappings on the heater transformer), but this leads to just the right illumination intensity with the highly efficient condenser system and provides ample reserves in the ability to use higher lamp voltages if dark or thick specimens are encountered.

The 4V lamp supply is normally required when using open projection into the CCTV camera at short range and the full 6·3V are required for open projection at greater range and for brilliant projection on to a canvas screen without a CCTV link.

### Straightforward Micro-photography with the Unit

The purpose of tube "3" and ring "1" being separate items which screw together was to make this connecting screw-thread the same as that employed for the lenses of the author's Leica photographic camera. This enables the entire micro-objective unit, except ring "1", to be screwed into the author's Leica in the same manner as any of the "ordinary" photographic lenses and, conversely, enables the lenses of that camera, with the simple interposition of the ring "1" alone, to be used in the CCTV camera.

We do not here intend to go into details of ordinary photography with the micro objective but it may be said that the image brilliance is ample in this arrangement to allow the use of the fastest shutter speeds available on the camera. leading to sharp photographs (in colour if desired) even of moving live pond-water organisms in a trough slide. It is not necessary to use films faster than normal for this purpose.

If colour transparencies are to be taken use reversal film which is balanced for artificial light and briefly run the lamp at 8V during the exposure (suitable extra tapping on the transformer) to achieve the correct colour temperature of the filament. The coloured lantern slides will subsequently appear on the canvas screen at about 500 diameters overall magnification under normal conditions of projection.

Alternatively, using monochrome film, small contact prints may be made and televised in the "macro" arrangement for CCTV to be described below. This may be the best method of display for entertaining friends with CCTV microscopy as a novelty without having to get live pond-water specimens to do the wanted thing at the right moment.

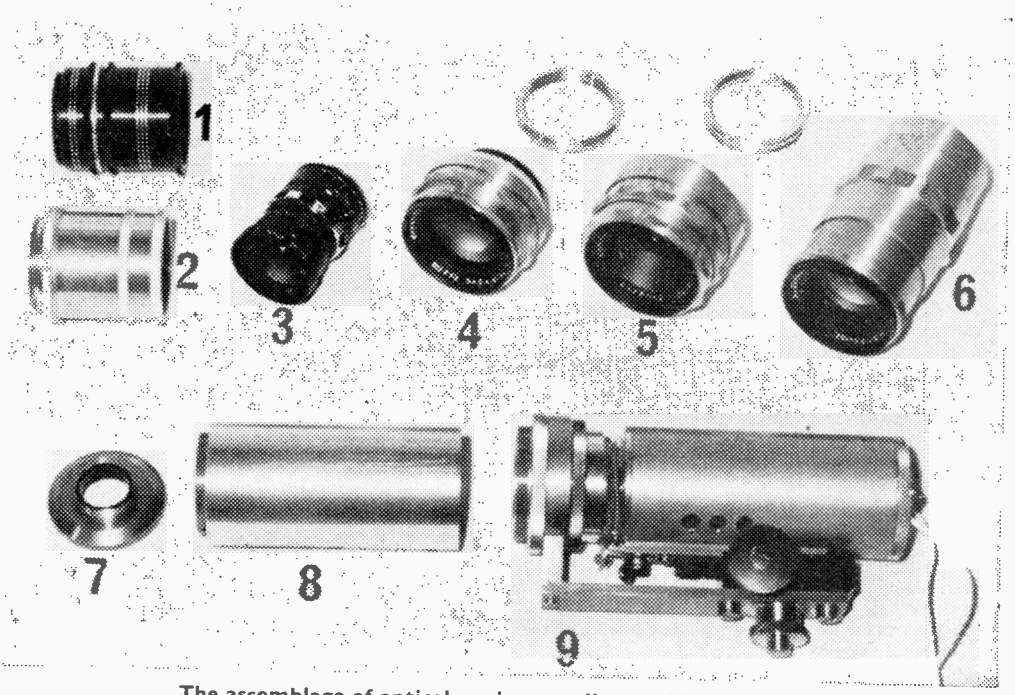
### Use of an Ordinary Microscope for CCTV

Any ordinary microscope is usable as a form of projection microscope, i.e. for projecting a magnified real image out at the eyepiece end, which can in principle be caught on the vidicon target.

The separation between the top end of the microscope tube and the vidicon target should normally be about 2 to 6in. for best results and so it is merely necessary to turn a suitable collar for the microscope tube fitted with a thread maching the CCTV camera lens plate.

If the microscope is of good professional quality the performance of this arrangement on CCTV is as good as the microscope, particularly if this is fitted with a properly focused condenser system. But comparable results are obtainable with the normal lens of the CCTV camera in our micro-objective design.

If the microscope is of lower quality, such as the cheap toy microscopes widely available, trouble may be experienced. The magnification and resolution as such are in fact quite good even with these cheap instruments. The chief trouble lies




**The assemblage of optical equipment discussed in this article.**
1, 2—camera extension rings. 3—normal lens for CCTV camera. 4 (wide angle), 5 (normal), 6 (telephoto)—35mm photo camera lenses and combination rings. 7—CCTV camera ring. 8—tube "3". 9—Micro-objective system assembled.

in the chromatic aberration (several differently coloured partially overlapping images) at high magnifications and in getting proper illumination without rather clumsy set-ups.

The performance of such a CCTV micro system using a toy microscope will, at the best, approach that of the system described. The contrast is generally somewhat poorer with a rather washy picture. This is again a function of the lighting used.

Readers nevertheless wishing to use a toy microscope with simple adaptor collar for the CCTV camera should not be fundamentally discouraged; the performance is certainly usable. In case of difficulty a monochromatic colour filter can be used in front of the lamp to reduce chromatic aberration; the best colour should be found by trial and error in a given case. For experimental purposes small glass cells with water-colour solutions can be used.

### *Use of Leica-type Camera Lenses*

A Leica-type camera employs perforated 35mm film of the same kind used for professional cinema films. Good 35mm cameras possess exchangeable lenses, the most common focal lengths being 35mm (wide-angle panorama shots), 50mm (normal shots) and 135mm (telephoto shots).

These respectively named "effects" refer to use with the particular film size. If the same lenses are used for a "film" of smaller size, such as is represented by the vidicon target window, the optical effects will all be shifted in the direction of telephoto appearances.

A lens gives a "normal" image impression if its focal length is roughly equal to the image target diagonal, which is about 16mm in the case of the vidicon. Smaller focal lengths give a correspondingly intense wide-angle panorama effect, whereas longer focal lengths give a correspondingly powerful telephoto effect.

For television and film purposes in general a very mild telephoto (portrait) effect is desirable, which is the reason why the normal lens for the CCTV camera has a focal length of 25mm, one and a-half times the target frame diagonal.

Now consider the standard "trio" of 35mm camera lenses. The wide-angle lens of 35mm focal length represents a telephoto factor of just over two for the CCTV camera (focal length just over twice the target frame diagonal), which is a good value for head and shoulder televising of single persons.

The normal lens of 50mm focal length has a telephoto factor of three for the CCTV camera, giving about the same telephoto intensity as the real telephoto lens does with the 35mm camera!

Using the real telephoto lens in the CCTV camera its effect is consequently three times more powerful there with a factor of nine. This is slightly more powerful than the popular type of standard 8 x 30 field binoculars with respect to the human eye.

In other words, the "ordinary trio" of 35mm

camera photographic lenses open up various shades of telephoto operations for the CCTV camera without the need for purchasing any specific extra telephoto lenses. It is merely necessary to turn the ring 1 (Fig. 1, August issue) on the lathe to adapt the CCTV camera lens thread to that of the particular 35mm system camera. The lenses should otherwise be used in the normal manner, racking the vidicon carriage inside the CCTV camera to the correct focal plane.

If using a different CCTV camera than the one being described which does not permit movement of the vidicon within the camera by actuating an external control (a most useful but unfortunately still rather rare feature) the adapter ring 1 will have to be turned to exact longitudinal dimensions to match the focal planes of the 35mm camera lenses to that of the normal lens of the CCTV camera.

It will, of course, not be necessary to make more than one such precision ring since the three 35mm camera lenses will themseves necessarily be matched by virtue of their exchangeability in the 35mm film camera.

The power of the 135mm telephoto lens is still inadequate for CCTV astronomy. It forms an image of the moon, for example, 4/3mm in diameter. The vidicon target frame is 9 x 12mm, so that the display on the TV receiver screen would be such that some seven rows of nine such moons could be accommodated on the screen. It is clear that other heavenly bodies would not be discernible.

The system is thus confined to long-distance shots of a landscape nature or for candid portraits of single persons at long ranges (head and shoulders at more than 6yd). Under no circumstances point the camera at the sun, whatever the optical system in use, as this could lead to immediate burn-out of the vidicon target.

### *CCTV Astronomy*

There is no simple way of achieving really satisfactory performance with an amateur CCTV astronomical system apart from purchasing properly designed professional telescope equipment. Even then the low luminous intensity of most heavenly bodies presents a serious problem. One is virtually limited to studies of the moon, whose brilliance is quite adequate for work at apertures as small as f/11, which are achieved even by relatively simple telescopes.

Work on the sun should be avoided unless one is quite sure of using a light-absorption filter of sufficient density to avoid damage to the vidicon. Readers are warned that any such damage is virtually immediate and irreparable, manifesting itself in dead spots or areas on the target, i.e. subsequent holes in the televised pictures. However, a properly designed system can provide interesting means for studying sunspots and eclipses.

Studies of other heavenly bodies are largely beyond the reach of the amateur CCTV enthusiast on account of their low brilliance which would demand drastic modifications of the scanning system. However, professional use of such arrangements has been made, scanning one frame in anything up to several hours, making use of the very long intervening charge storage time and of special recording and display devices. It has been claimed that, in conjunction with the best modern telescopes, a sensitivity and resolution surpassing that of most photographic films used for astronomical purposes has thereby been achieved.

The author has experimented with a combination of the 35mm film camera lenses. If the wide-angle lens (f=35mm) is used to project a magnified real image on to the vidicon target from a primary image formed in front of it by the telephoto lens (f=135mm) one can achieve a telephoto factor three times greater than that obtained with the telephoto lens alone whilst still maintaining the minimum effective aperture necessary for CCTV observations of the moon.

For this arrangement the adapter ring 1 is first of all screwed into the CCTV camera, followed by a 10cm extension tube and then the wide-angle lens. This is followed by another adapter ring turned on the lathe to fit the normal lens into the front end of the wide-angle lens. Another such adapter ring finally fits the telephoto lens into the front end of the normal lens. This arrangement, in fact, corresponds to a conventional astronomical telescope with the telephoto lens as objective, the normal lens in the middle as field lens and the wide-angle lens as eyepiece.

The moon comes out at nearly half the frame height on the television receiver screen with this arrangement—still rather poor from an astronomical point of view, but the performance for televising long-distance landscape shots is quite pleasing. For example, a church will fill the receiver screen at a range of about a mile.

### *Macro-CCTV*

Between the televising of normal indoor and outdoor scenes and the field of true microscopy lies the interesting range of macroscopy, which is concerned with small objects which are nevertheless not too small to be familiar to the naked eye as well. Particular items of interest in this class include photographic snapshots, postage stamps, small flowers and insects and numerous similar objects.

The normal range of macroscopy extends from reproductions of objects about natural size to about ten times natural size, although there is no hard and fast boundary line either way.

As far as the published basic CCTV camera design is concerned (October, 1963-February, 1964) the travelling vidicon carriage fully caters for all macro-CCTV applications with the camera as it stands without any alterations or change of lenses. It is merely necessary to bring the object to be televised correspondingly close to the lens (only about 1in. away in the extreme case) and then to rack the vidicon carriage back until the image on the TV receiver is well in focus.

In the limiting setting, with the vidicon carriage driven back as far as it will go, an ordinary postage stamp will come out at least four times the size of the television receiver screen. In the other direction the range of available settings is continuous right back to those for normal scene televising.

If intending to do macro-CCTV displays with other CCTV cameras, which usually have a fixed

vidicon but removable lens, suitable intermediary rings must be machined to achieve the same necessary increased separation between lens and vidicon target. Several rings covering a range of about 25mm displacement are required.

If the CCTV camera not only has a fixed vidicon but also a non-removable lens a certain amount of close-up work is still possible by making use of proximity lenses slipped over the front end of the main lens. But the scope of such measures is rather limited so that cameras which do not permit removal of the lens for interposing intermediary rings are largely unsuitable for macro-CCTV. The movable vidicon carriage here remains the best solution as it permits continuous control in a simple manner instead of the discrete steps and awkward changes involved with rings.

These considerations were taken into account at an early stage in the design of our CCTV camera and have led to the incorporation of the movable vidicon carriage, which also vastly simplifies the problems of accurate lens positioning for normal use in an amateur design, since slight errors can immediately be corrected with the carriage drive.

So far as the use of macro-CCTV for entertainment purposes is concerned the televising of small photographic prints probably ranks at the top of the list. The author has created much pleasure at parties by inviting guests to submit snapshots out of their wallets for macro-televising, each guest giving a personal commentary to his pictures when they appeared on the television receiver screen.

Lighting is surprisingly uncritical in this arrangement—an ordinary reading lamp stood somewhere in the vicinity on the table is generally perfectly adequate, and there is no need to undertake any measures to direct or even out the light, nor to darken the room in any way apart from drawing the curtains if powerful beams of sunlight are entering. ■

# U.H.F. PREAMP

*—continued from page 534*

reasonable match to the aerial cable and better matching is hardly worth while. The base circuit is rearranged so that the collector circuit is all "d.c. earthy". This simplifies the amplifier. The output is tapped directly into the tuned cavity and its position is not critical. Moving the tap towards the transistor increases the stability and bandwidth but reduces the gain.

A small choke consisting of five turns of enamelled wire wound on a ¼in. former may be fitted across the input of the amplifier to prevent the application of large and possibly destructive pulse voltages to the transistor. It serves no useful purpose so far as tuning is concerned.

### *Operation and Performance*

For best results the amplifier should be mounted close to the aerial as amplified signal and amplifier "noise" are then attenuated by the cable, whereas if the amplifier is at the set end of the cable only the signal is attenuated. For low loss cable runs the difference is small.

The optimum operating current for this transistor is 2mA, and although the voltage supply is nominally 9V the amplifier works well even when the supply voltage is below 5V. Physical dimensions of the amplifier are shown in Fig. 2.

Laboratory measurements have shown a gain of better than 18dB (x 8), a noise factor of 7dB and a bandwidth in excess of 35Mc/s.

In a typical installation about 20 miles from the Crystal Palace where the received picture was noticeably grainy, fitting such an amplifier reduced the noise to a barely visible level and improved the picture quality considerably. ■

# BOOK REVIEW

**TELEVISION SERVICING HANDBOOK**

**By Gordon J. King, Assoc. Brit. I.R.E.; published by Odhams Books Ltd. 352 pages, 8¾" × 5½", stiff cover. Price 35s.0d.**

READERS of PRACTICAL TELEVISION will need no introduction to the author of this book and, in a way will need little comment on the material in this book other than an outline of the coverage. Indeed, quite a few readers will not even need this, for the volume under review is the Second Edition of a work which first appeared in 1958 and, no doubt has found a place on many enthusiasts' bookshelves.

This new edition is completely revised and enlarged and makes a very real effort to be as completely up-to-date as possible. It is a little unfortunate that the BBC and ITA introduced their new Test Cards only a few weeks before this book was published, so that the only Test Card information given is that for the defunct type C. However, this is a very minor point indeed and only goes to illustrate the virtual impossibility of producing a book with every recent development.

Three entirely new sections have been introduced. One of these deals effectively with television in the u.h.f. bands and included in the information is a complete table of u.h.f. channels and their allocations. Another new section covers dual-standard receivers; this is a very useful chapter and takes the reader through the principles and circuitry of the 625-line u.h.f. system and the problems involved in 405/625 receivers.

The third section has one eye on the future. It discusses transistor TV receivers and takes the reader stage-by-stage through the practical circuitry of such a set. All these new chapters are preferred reading for anyone seriously interested in any aspect of servicing TV receivers.

The bulk of the book concerns itself with more "conventional" matters and, briefly, consists of separate chapters for each section of a receiver, describing typical circuitry and analysing fault symptoms and remedies. The book is essentially practical in approach and never delves too deeply into design aspects or detailed theory. Servicing and repair is the theme and this is kept to in a most informative, lucid and practical manner. For readers with a basic knowledge of theory who want to take up servicing, this book is highly recommended.—*W.N.S.*


***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.*

### TUBELESS COLOUR TELEVISION

SIR,—Whilst looking through some past copies of PRACTICAL TELEVISION recently I was intrigued by a reference to a "new" colour television system proposed by a Mr. Charlton (January, 1953, issue).

I can find no subsequent reference to this equipment in any other issue, although the system is somewhat similar to the one devised recently by Crump (Proc. C.T.S., May, 1964). This latter system makes use of a slightly higher frequency, colour splitting being obtained by the use of a negative biased anti-phased pair of magnetrons. The bias is modulated by the incoming rectified signal, the amount of bias controlling the colour range. It will be obvious that easier colour mixing is obtainable provided the variable bias does not overrun the scanning signal.

As with Mr. Charlton's system the c.r.t. is dispensed with, the viewing area consisting of a luminous matrix fed from a high potential electrostatic source.

I should be pleased to learn how Mr. Charlton progressed with his system and whether any worthwhile results were obtained.—K. NIRK (Rotherham, Yorkshire).

(Have any readers information on this matter?—Ed.)

### LIFELONG CUSTOMERS NOT ENOUGH

SIR,—I would like to point out to your correspondent, Mr. A. E. Morgan (June P.T.) that Mr. Ford in his article on part-time Servicemen, suggested that the "kitchen table brigade" bought spares wholesale and thus increased *their* profits (at the expense of local component retailers), the "realistic" (or unrealistic?) price paid by the customer being just the same.

There are some wholesalers who are prepared to supply both the trade and the KTBs. There are few who would supply the KTB only and to see how much turnover could be expected from such a source one certain wholesaler (evidently fishing for such business) enquired whether my component purchases would exceed £20 *per year*. Despite the fact that I work in a small way my *monthly* accounts average £20 with *each of three* wholesalers, most of whom realise that they need more than "lifelong customers" to stay in business.

I think your other correspondent, Mr. Hurrell, would agree that insurance stamps would come under allowances—aged aunt, wife and six kids, etc.—rather than expenses—rent, electricity, etc.

Mr. Ford's article has been misleading in more ways than one but before anybody thinks that I have horns I would point out that as a professional serviceman I spend many unpaid hours tracing faults in do-it-yourself sets made by local beginners and many are the diagrams drawn for the fabulous profit on a couple of condensers!—D. BUSHELL (Leeds 6).

### IMPROVING TV SOUND

SIR,—I suppose many other readers have thought of the uses an extension speaker has in conjunction with a television receiver. Many of the television sets on the market today have their speakers in the side of the cabinets so that if in a small living room, with the receiver situated in one corner, much of the sound is muffled by the close proximity of the walls, and an extension speaker placed so that it faces the viewer would make all the difference to one's enjoyment of the programmes.

People who feel they are not getting the full amount of reproduction from their TV receivers should try cutting out the internal 6in. (or even less) loudspeaker and connecting up a good quality 12in. speaker in a bass reflex cabinet. Many of the sounds will be greatly improved with the wider frequency response so that a violin playing ceases to sound like a child's toy, and drums no longer resemble the refuse collectors kicking your dustbin lid on a Friday morning.

One friend of mine has even gone so far as to completely cut out the final audio stages of his TV set and link up a hi-fi amplifier. This same amplifier is also used for his tape recorder, record player, and radio tuner and each piece of equipment is switched by a single multiple switch into the amplifier with the result that everything, especially the TV receiver, sounds really good.—S. MILTON (Wanstead, E.11).

### TWO REQUESTS

SIR,—I would be extremely pleased to hear from any reader who owns a Kerr or Baird Grid cell, as used in the pre-1936 Baird 30-line television receivers as I am anxious to obtain one. I would also like to buy or loan copies of PRACTICAL TELEVISION containing the articles on "A closed circuit colour TV system" by R. W. Wells (excluding the first one, i.e. July 1959).—STEWART DAVIDSON, School House, School Road, North Berwick.

### SERVICE!

SIR,—There must be many readers contemplating setting up on their own in business, even on a small scale, in radio and TV servicing. How about some articles on these lines?—H. LIONEL (Palmers Green, London).

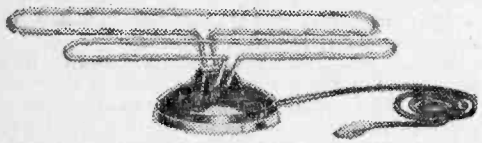
*(See page 540, this issue—Editor)*

# TRADE NEWS • TRADE NEWS • TRADE NEWS TRADE NEWS • TRADE NEWS • TRADE NEWS

### Set-top U.H.F. Aerial

ANTIFERENCE announce the introduction of the *Vantenna 625*, a set-top aerial for u.h.f. It incorporates a folded dipole and reflector and has a wide bandwidth giving coverage of Band IV channels 21-34. Like other Antiference set-top aerials it is capacity coupled for safety. The finish is in cream and gold and it retails at 25s. complete with plug and lead.

Antiference also announce price reductions in their range of u.h.f. outdoor and loft aerials (indoor aerial prices remain unchanged). Typical examples are the 3-element window mounting *Winner* reduced from 32s. 6d. to 25s. and the *Broadside Explorer* 18-element array from 180s. to 125s. *Antiference Limited, Bicester Road, Aylesbury, Bucks.*



*The "Vantenna 625" set-top aerial made by Antiference.*

### King Telebooster

WE have been asked to point out that these boosters are now handled exclusively by *Transistor Devices Ltd., New Road, Brixham, Devon*, and not by Gordon J. King (Enterprises) Ltd., as stated in the June issue.

### Reduced Aerial Prices

THROUGH the introduction of improved manufacturing techniques, Labgear Limited have been able to announce considerable price reductions throughout their range of u.h.f. aerials. These reductions will apply to all orders placed from August 1st onwards this year. *Labgear Limited, Cromwell Road, Cambridge.*

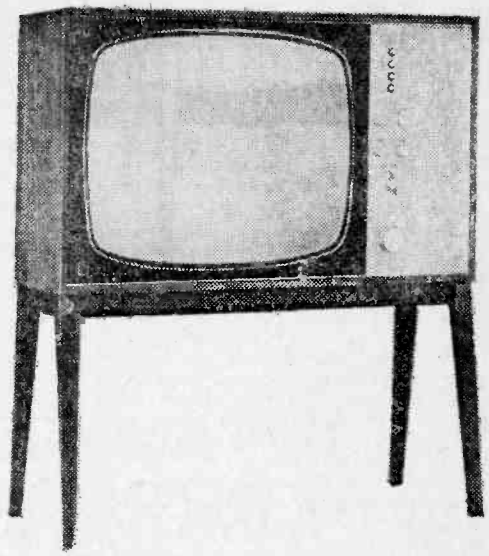
### 405/625-line Receivers

FERGUSON have recently introduced two new receivers, both featuring their new "cool-running" chassis, which by use of an auto-transformer in place of the ordinary ballast resistor, gives some 30W less heat dissipation.

This chassis is also noteworthy for its one-piece construction, a single printed circuit board taking the majority of components. By removing only two screws, this chassis can be swung out through as much as 90° for inspection purposes.

Ferguson's have reduced the number of valves in their circuit to 13 by the use of the latest multiple types. Changing from 405 to 625 lines and vice versa is a one-switch operation, after which Band I and III programme selection is accomplished by push-button switches and u.h.f. tuning accomplished by a two-speed rotary control.

The two receivers are the models 3623 and 3626 which are 23in. and 19in. screen sets respectively. Both are finished in sapele veneer with a fully burnished polyester lacquer. *Ferguson Radio Corporation Ltd., Thorn House, Upper St. Martin's Lane, London, W.C.2.*



*One of Ferguson's new receivers—the 19in. model 3626.*

### Component Catalogue

MESSRS. Henry's Radio have recently published a new 1964 edition of their comprehensive catalogue. It comprises 86 pages and is fully illustrated, covering a very wide range of electronic components.

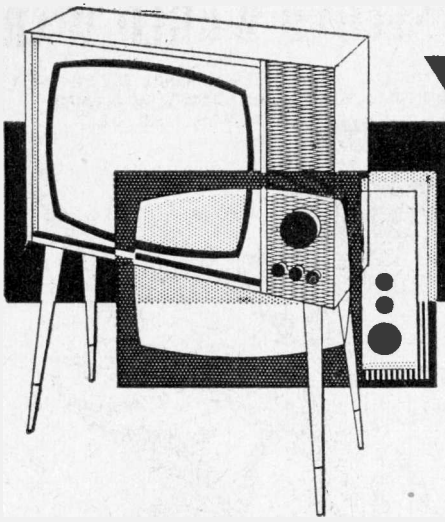
Cadmium sun-cells, crystal ovens, dosimeters, deccatrons, printed circuit etching kits, ferrite pot cores, geiger tubes, gamma probes and mercury cells, are but a few of the items listed.

A wide range of transistors and associated components are included, plus a transistor equivalent chart and connection details.

It is a well-produced book and much thought obviously has been given to its preparation. The price is 2s. 6d. post free and copies may be obtained from *Messrs. Henry's Radio Ltd., 303 Edgware Road, London, W.2.*

## TRANSISTOR TV CAMERA

IN the circuit diagram of this unit (Fig. 1, page 458, July issue), a 0·1μF 150V isolating capacitor should be connected between the lead from the line scancoils carrying the line blanking (connection 6) and pin 2 on the vidicon. This is to isolate the grid volts from C31 and C32, which are not rated for the voltage which can be present on the grid.



# 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. 572 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.*

### *BUSH TV53*

**On ITA channel 9, there is slight sound on vision accompanied by a " silky " patterning with slight white overshoot and black after white. On BBC channel 2 there is also sound on vision and the picture has an overall blurred effect with fluctuating brightness on the black parts of the picture.**

**The i.f. stages have been checked and found to be tuned correctly. The sensitivity switch is in the local position, but on certain band 3 frequencies the tuner becomes rather microphonic.—M. Ward —(Cheadle, Cheshire).**

The fault is apparently due to inadequate de-coupling and all the 0·001$\mu$f capacitors should be checked by bridging each with a known good component.

We have known the effect to be caused by a faulty valve and the i.f. EF80's and the tuner unit valves should be checked by substitution.

### *PHILIPS 1748U*

**Every now and then the picture goes out of focus and then disappears completely. Turning the brightness down however, seems to bring the picture back. On watching the EY51 rectifier, it was noticed that the heater went out and the picture disappeared whenever the brightness control was advanced.**

**The EY51, PL81 and PY81 were replaced but the same fault persisted. When the picture does come on it is perfect.—P. W. Chipman (Wood-End, Nr Atherstone, Warwickshire).**

The 1·5k$\Omega$ 3W resistor wired from h.t. to the line oscillator does not often change value but it may have done in the receiver in question. Check this, also the h.t. voltage and PY82 rectifiers if necessary. Check the position of the ion trap magnet on the rear neck of the tube (against maximum brilliance).

### *FERRANTI 17SK4*

**The V3 valve, EF80 overheats and has been replaced several times. Then for no apparent reason this fault rectifies itself and the set works perfectly.**

**When the valve is in the overheated condition, there is practically no picture and it can only be viewed in a darkened room.—J. Ferguson (Belfast 13. N.I.).**

This fault is due to the a.g.c. line to V3 control grid becoming positive. Check this by shorting the line to chassis.

### *REGENTONE 17T*

**Apparently the sound band is infringing into the vision strip, and there is sound on vision present on both channels. The cores of the oscillator coils in the tuner and the sound rejector have been adjusted, but this has made no difference. There is no microphony present, the h.t. is normal and the timebases are working correctly.—A. J. Phillips (Swansea, S. Wales).**

We would advise you to check the 16$\mu$F electrolytic capacitor which decouples the frame shift h.t. line (C78 in the makers' manual).

### *ARGOSY M17K40*

**The switch on this receiver broke and shorted the mains. After fitting a replacement switch, I was unable to get a picture until I reduced the brilliance control, then it was negative. The sound is also rather distorted.—W. H. Smith (Welling, Kent).**

It would appear that there is insufficient heater current (300mA is correct), the h.t. voltage is low (check rectifier) or you have displaced the ion trap magnet on the tube neck and the sound distortion is due to a separate fault—check output valve and noise limiter resistors.

### SOBELL T21

**When first switched on the picture has a very small black edge at the top of the screen, followed by about ½in. of thin outstanding white lines. After the set has been on for about 10 to 15 minutes, the black and the white lines vanish from the top of the screen, but reappear at the bottom of the screen. The black edge being about 1in. and the bright white lines being about 2in. deep. The height control only makes the screen appear longer. It does rid the screen of the black edge, but it is a far from satisfactory picture.—D. Cowley (Liverpool 13).**

We would advise you to check the PCL82 frame output valve by replacement (rear centre). Check the associated components. It is easier to remove the tube before trying to dismantle the deflection coils.

### SOBELL T172

**There is sound on vision on both channels. The frame area moves over the screen approximately ¼in. and then returns when the set warms up. Also, when first switched on, there is quite a loud mains hum, but this disappears after a while.—S. Milton (Woodford Bridge, Essex).**

This fault appears to be due to defective electrolytic capacitors, and whilst the main 100+200μF capacitor is likely to be at fault, the 16μF sub h.t. should not be overlooked.

### BUSH TV85

**Definition of faces and things of a white nature, tends to become a white blurr on this set, except when the subject is very close up. This fault is also noticeable when white letters are being shown, the top halves of the top line of letters merging together into a blurred white band.—E. Quinn (Amagh, Co. Tyrone, N.I.).**

The symptoms that you describe suggest that the tube is failing and may need replacement. You should check the video amplifier and its associated components.

### REGENTONE TEN 17

**I am having trouble with the width of my picture. There is a gap of about 2in. each side of the screen.—T. McGowan (Glasgow, S.W.2).**

We would advise you to check the 2·2kΩ resistor to pin 8 of the PL81, the PL81 itself and the h.t. voltage, if necessary replacing the existing rectifiers with a BY100 silicon rectifier.

### ALBA 866T

**After a short period, the sound develops what can only be called a " gurgling ". I have changed the i.f. amplifier panel completely and substituted new valves throughout, but the trouble still persists.—G. Huxley (London, N.19).**

We would advise you to check the capacitors C56 (50μF) and C77 (0·1μF). The loudspeaker could be at fault, but this is less likely.

### FYE FV2C

**This set has a faulty 16in. MW41-1 tube. Can I replace tne original tube with a 21in. tube—assuming that I can surmount the mechanical difficult.es—w.th, say, an MW52-20?—J. W. Bassett (Gloucestershire).**

We do not know of a 21in. tube that could be conveniently run from the FV2C chassis. An MW43/69 17in. tube should work, but we doubt if the e.h.t. available is sufficient to give a sharp picture on a 21in. screen.

### MURPHY V320K

**The fault is a cogwheel effect on the picture, affecting the uprights and edges of the images on the screen. It is more noticeable on BBC.—L. Trotman (Cinderford, Gloucestershire).**

The symptoms you describe could be due to an aerial fault, or to poor i.f. coupling or misalignment.

### PYE CONTINENTAL 17T

**After being switched on for 30 minutes double images appear, there is also slight sound distortion. I have changed the PCL83 without success.—A. Mellor (Newton, Nr. Barrow-in-Furness).**

Check the PCF80 line oscillator valve at the back of the set for your picture fault. Slight distortion of sound usually denotes a faulty capacitor in the interference limiter stage.

### PYE V700LBA

**Some time ago, I had trouble with the picture rolling and now I have lost the picture although the screen lights up and the sound is normal. The stations appear to come in between the numbers on the dial.—J. Greenaway (Airdrie, Lanarkshire).**

We advise you to treat the PCL84 video amplifier V11, as suspect. The other alternative is a defective vision detector diode which is fitted inside the last i.f. transformer T3.

### BUSH TV56

**Please would you tell me what is the cause of the picture on this set being about 2in. short top and bottom.—J. Thornton (Sale, Cheshire).**

A compression of two inches at the top and bottom of the picture is usually due to low emission PCL83 valve under the tube on the front left side of the right hand chassis as viewed from the rear. Ensure that the trouble is not due to incorrect picture shift adjustment. The adjustment lever protrudes from the side of the focus assembly and is capable of movement in all directions.

### PHILCO A1497

**I can only get BBC sound. There is nothing from ITA, but there is a fairly good raster present. On this raster, there appears to be symptoms of either sound on vision or of lack of fine tuning, though I am fairly certain it is the latter, as there are " frame jumps " depending on the incoming sound level. Please would you let me know how**

**to adjust this, as I am not too sure of the position of the coils.—B. J. Woods (Belfast 6).**

You should realign the oscillator coil cores from the side with the channel selector knob turned to the desired channel and removed, the fine tuner knob set mid-way and removed. Insert a screwdriver-shaped long trimming tool into the hole to the right of the spindle and tune the recessed core for maximum sound. Check both tuner unit valves and the 4·7kΩ resistor to pin 1 of the PCF80 if necessary.

### *GEC BT2747A*

**Would you please inform me how to change the tube and the e.h.t. rectifier in the above set. Is it necessary to replace the can over the rectifier again after it has been changed?**

**Would you also enlighten me how to get rid of the picture and sound on channel 8.—R. Hollingworth (Gorton, Manchester 18).**

The shroud over the U45 or EY51 should be refitted when this valve is changed. The tube in this receiver is a GEC7401A, and to change it, remove the rear cover and front control knobs. Detach the cabinet internal screening lead and unplug the speaker leads. Remove the two screws located at each bottom corner of the wooden baseboard. The chassis can then be withdrawn. Remove the e.h.t. connection and the c.r.t. base socket. Remove the screws from the two "U" clips, then remove the metal band passing round the tube. Hold the deflection coils steady and withdraw the tube.

Retune oscillator coil core of the channel 8 coil biscuit to remove picture and sound.

### *BUSH TV 67*

**On switching on, the picture and sound are excellent for about half an hour, then, suddenly the picture goes off leaving a series of vertical dots in the centre of the screen. After a short time the dots disappear and sometimes the picture returns. If the set is switched off then on again, the picture returns, but only for about half an hour as described above. The EY86 and PL81 valves have both been changed, but this has made no difference.—F. C. H. Walker (Fishponds, Bristol).**

Remove the screen over the line output section and note whether the PY81 overheats when the fault occurs. If it does, change the 0·1μF boost line capacitor. If the PY81 does not overheat, check the connections to and from the line scanning coils.

# TEST CASE -22

*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.*

? *On this receiver both the frame and line locks held solidly when the set was first switched on. After an hour or so, however, the line lock gradually began to weaken, causing tearing at the top of the picture which necessitated constant readjustment to the line hold control.*

*A test was made on the frame lock after the line lock had badly weakened. The frame was still "solid". Nevertheless the sync separator valve and line timebase valves were checked by substitution, but the trouble persisted. Voltages in the timebase and sync circuits were in accordance with those indicated in the service manual. What was the most likely cause of this symptom?*

See next month's PRACTICAL TELEVISION for the solution to this Test Case and for another problem.

## SOLUTION TO TEST CASE 21

### *(Page 524, last month)*

The fact that a small frame scan remained even with the frame output valve removed meant that 50c/s current must have been flowing through the frame scanning coils from some source. The excessive non-linearity, with extreme cramping at the top of the picture and compression at the bottom, also meant that the scanning waveform was far from sawtooth and probably had sine-wave characteristics.

Testing with an oscilloscope at the "live" wire of the secondary of the frame output transformer proved this point, the trace revealing almost true sine waveform at that point.

The circuit from the secondary of the transformer to the frame scanning coils contained a thermistor and resistor in series for compensation due to temperature rise. Tracing with the "probe" of the oscilloscope indicated that the 50c/s waveform was strongest at the junction of this thermistor/resistor combination and it was then seen that the insulation on the printed board at that point had charred slightly, giving a carbon track from the mains dropper to the scanning coil circuit, and it was through that track that the spurious scanning current was flowing—from the mains supply!



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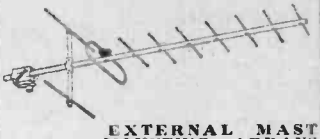

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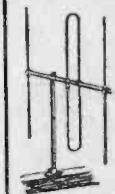

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