Practical TELEVISION

MARCH 1967

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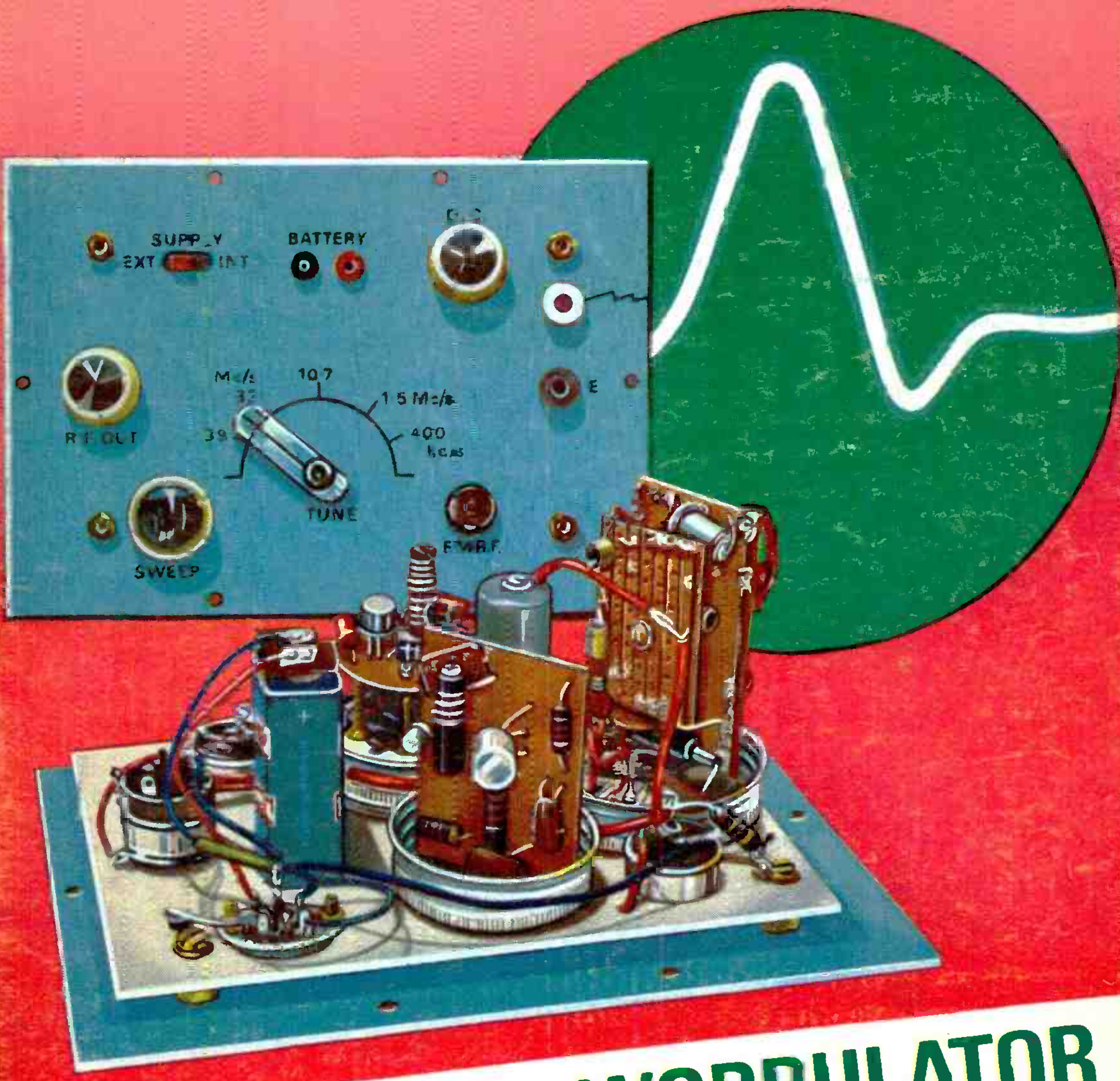

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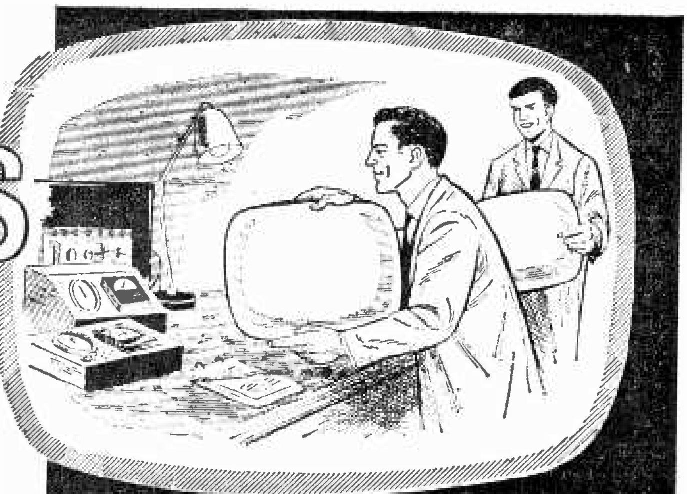

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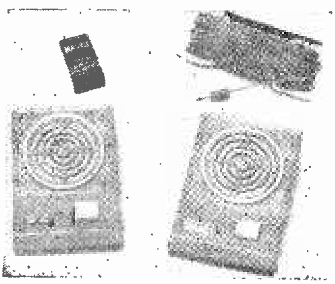

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Practical Television

MARCH 1967
VOL. 17 No. 6
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TV AND THE YOUNG

TELEVISION already influences the attitudes, thinking and behaviour patterns of many viewers and it is now gaining a foothold, by way of CCTV, in the school rooms. The advantages are not disputed—a central control room can do the work of several teachers and a carefully prepared and well illustrated lesson by CCTV seems a great advance on the blackboard-and-chalk days.

However, there is an inherent danger. The solo teacher cannot compete in the more spectacular aspects of presentation but a CCTV system cannot establish the same personal rapport and project the same individual personality as a flesh and blood teacher directly involved with the pupils.

Teaching by CCTV is obviously attractive but as the techniques advance and applications grow, as they surely will, then we must be prepared for the ultimate situation—arrived at in evolutionary stages—of a standard curriculum on video tape pumped out to a chain of state comprehensive schools. This would be around 1984!

In all directions we are perceptibly drifting towards conformity. The choice of schooling is being progressively eroded and the ad-mass attitudes of state and industry is gradually reducing us to a race of battery hens. *Touché!*

A recent ITA survey shows that series and serials are "for most people the staple diet of TV viewing". Plays must be "easy to understand", the plot must become clear in the first few minutes and the viewer must be able to foresee a consistent denouement. Otherwise he will switch off, presumably to another channel in search of something easier to comprehend. The mass TV audience looks for undemanding material—and usually gets it.

The receptive minds of young people are consequently exposed to mass-appeal programmes more than others, as they are to offerings which cause viewers to wax indignant about being "offensive and corrupting to children who may be viewing"—and who are seemingly so befuddled by compulsive viewing or so lacking in parental control that they have forgotten where the on-off switch is located.

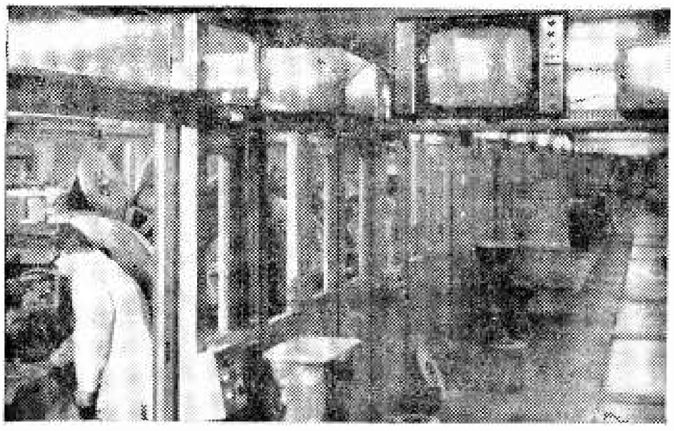
Perhaps most people are resigned to the grand theory of "levelling" to the lowest common denominator. And maybe this is the inevitable outcome of science and technology. But it is a pity that television could be, maybe inadvertently, not only lending itself to, but playing a major role in, the march towards the anthill society. W. N. STEVENS—*Editor.*

THIS MONTH

OUR NEXT ISSUE DATED APRIL WILL BE PUBLISHED ON MARCH 23

TELETOPICS

CCTV aids manufacture of cables



CLOSED circuit television is utilised in order to overcome the long distances between machine operators and assistants during the paper lapping process in the manufacture of super-tension cables at the BICC factory at Belvedere, Kent. By the strategic placing of Rank Organisation equipment, consisting of TV cameras and a 19in. central monitor the machine operator can observe, from the control position at the input end of the machine, the coiling-on process which is situated some 70 yards away at the output end. In addition, on two 14in. Pye monitors, he can observe the passage on the far side of the machine.

East Berlin giant Television mast still growing

THE 1,180 ft. television tower, which is to dominate one of East Berlin's main squares, the Alexanderplatz, has now reached a height of 400 ft. and construction on the second third of the project is well under way. The giant mast due for completion in 1968, will be the tallest building in Europe.

The seven-storey tower, in addition to transmitting and other technical installations, will house a café with accommodation for 200 persons and be equipped with an observation platform at a height of 600 ft.

The top of the tower is designed as a steel sphere with a radius of 52·5ft. This upper structure consists of 140 segments, each of them weighing eight tons. The project provides for the installation of an air conditioning system since all windows and portholes of the tower will be hermetically sealed.

The proposed height of the East Berlin TV tower compares with a total height of 620ft. for the GPO tower of London (including 40ft. for television aerials) and with a total height of 1,033ft. (including 15ft. for transmitter installations) of the Eiffel Tower of Paris.

TELECINE FOR HONG KONG

EMI Electronics have recently been awarded a contract for the supply of four telecine chains to Rediffusion Hong Kong, the contractors who supply the wired **television service** for the Colony. These are based on EMI Vidicon Camera type 201 and include the latest Philips 16mm projector. Facilities for separate magnetic replay on 35mm and 16mm are provided, and common magnetic on 16mm.

EMI TELEVISION GEAR FOR NEW ZEALAND

EMI Electronics will be supplying video equipment for the New Zealand Broadcasting Corporation's latest News Studio in Hamilton, North Island.

The installation includes two Vidicon Cameras type 201 fitted with Angenieux zoom lenses, a complete production vision mixer and solid-state monitors. Installation will be carried out by NZBC's own engineers and the Studio will be operational late this year.

ABC Television broadcast from cathedral crypt

ON Sunday, December 11th at 11.00 a.m., ABC Television's Outside Broadcast cameras were positioned in the Crypt of Liverpool's new Metropolitan Cathedral to broadcast Pontificial High Mass. The Service, screened on the ITV network, was the first ever to be televised from this famous new Cathedral which is now nearing completion.

ENGINEERING CAREERS EXHIBITION A SUCCESS

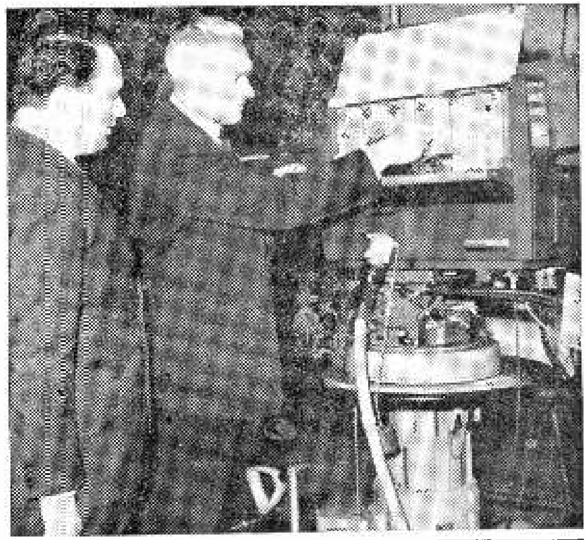
ATTENDANCE at "The Engineers' Day" Exhibition at the Science Museum, London, well passed the 175,000 mark.

This government-sponsored exhibition, designed to encourage young people to consider professional engineering as a career, was a graphic answer to the question "what does an engineer actually do?"

Over 500 school parties from London and the southern half of England visited the exhibition since it opened in November last year.

A spokesman for the government departments and public bodies taking part in the exhibition said recently: "the response to the exhibition was most e. couraging; obviously there is no shortage of interest among young people in this valuable and rewarding type of career".

Russian TV Experts Visit Britain



DR. S. Novakovsky, Director of the Scientific Research Institute on Television in Moscow, and three colleagues visited Britain recently, and at the invitation of The Marconi Company, made extensive tours of the Company's laboratories. One of the main reasons for their visit was to see the new Marconi Mark VII colour camera and in the photograph, Dr. Novakovsky (right) is shown examining the camera with Mr. Tom Mayer, Manager of Marconi's Broadcasting Division.

Colour TV Servicing Exam

The City and Guilds of London Institute, in conjunction with the Radio Trades Examination Board, has introduced an examination in colour television servicing principles as a part of subject 48. There will be a three-hour paper and the first exam will be held in June.

The syllabus is a slightly modified version of the 1963 one and candidates will normally be expected to have passed the final in radio and television servicing.

Colour from Belmont

BELMONT (Channel 28) now carries experimental colour transmissions as follows:
Monday and Tuesday 14.00–14.15 Black and white test card; 14.15–14.25 Colour bars; 14.25–15.00 Colour slide; 15.00–18.00 As for 14.00–15.00, repeated; 18.00–18.30 Black level and syncs; 18.30–18.35 Colour bars; 18.35–19.15 Colour slides; Wednesday, Thursday and Friday 14.00–18.35 As Monday and Tuesday; 18.35–19.15 Colour slide followed by colour film.

On Wednesday, Thursday and Friday a colour film may be transmitted during the period 16.00–17.00.

NEW RECEIVING AERIAL FOR BELMONT AREA

BELLING-LEE Aerials have produced a new aerial-type 5U10/4A for use in the area of the new Belmont transmitter.

The new aerial is a combined v.h.f./u.h.f. model with 5 elements covering the whole of Band III, Channels 6 to 13, and 10 elements on Band IV, Channels 21 to 34. Two fully coupled folded dipoles provide band width and high gain and correct impedance matching to standard cables on Band III.

More information is available from Belling-Lee Aerials Ltd., Heysham Road, Netherton, Bootle 10, Lancashire.

Practical Television Filmshow

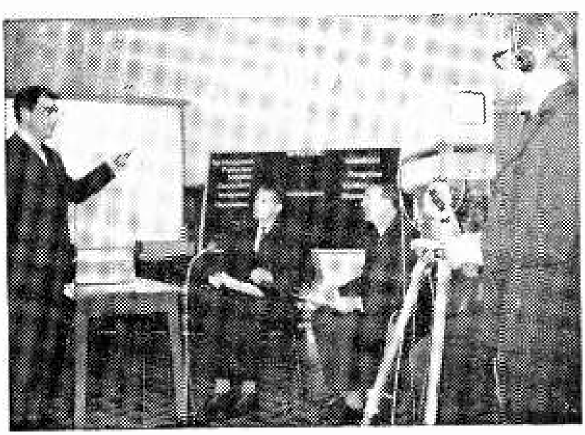
THE annual filmshow, organised jointly with Mullard Ltd., and Practical Wireless and Practical Television magazines is to be held as usual at the Caxton Hall, Westminster.

The date is Friday, April 14th and the show will start at 7.30 p.m. prompt.

The programme will include a film "Electrons in Harness" and a topical talk on "Transistors and Television".

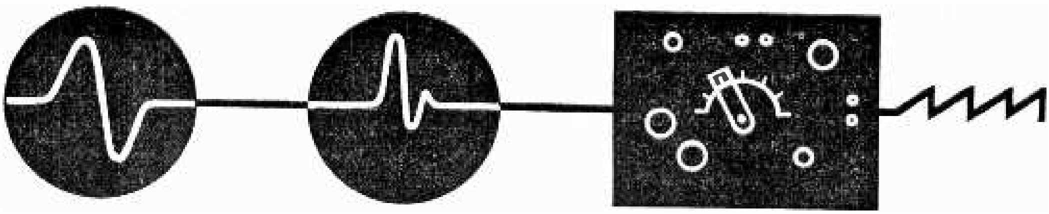
Refreshments will be served in the interval. For further details of the filmshow, please see the next issue.

as seen by others



LINK 51 Limited, the international storage and materials handling consortium, have introduced closed-circuit television as a visual training aid for their technical storage representatives in Britain.

"Few people", said Mr. J. F. Suriano, Group Training Officer, "really appreciate the visual impact they make on others, and this medium of closed-circuit television can reveal both strengths and weaknesses in communication. It is not enough for our technical representatives to possess the necessary knowledge to solve industrial storage problems, they must be seen to possess it by those with whom they are negotiating. A televised feedback of a discussion between a manager and a colleague acting the role of an industrialist enables the former to analyse his presentation and also provides an opportunity for group discussion". The first of these televised training courses was produced by Zoom TV. Slough, for the Erecto slotted angle company, a member company of Link 51 Limited, at their Hayes, Middlesex, headquarters.



WIDE-RANGE WOBBULATOR

D.R. BOWMAN B.Sc. A.M.I.E.R.E.

MANY readers of PRACTICAL TELEVISION will have experience in the construction and operation of wide-band intermediate-frequency amplifiers necessary for the proper reception of vision signals These experimenters may have also found that the correct alignment of the vision i.f. amplifier has presented problems. The development of a new circuit always involves the consideration of stage gain, unwanted feedback, overall bandwidth, layout and so on. Some will do it the easy way by beginning with the mathematics, some from inclination or necessity will rely upon experience and experiment alone. Eventually however, the i.f. amplifier is built and switched on, and the moment of truth has arrived: does it give the expected results?

A few years ago it was possible to get by, because vacuum tubes were simpler devices to use than transistors. The experimenter who uses valves still is better off in this respect than those who are more "with it" and are "going solid-state"; they are not handicapped by huge input capacitances, low input resistances and feedback capacitances that by pentode standards are of astronomical size.

Semi-conductor tuners and i.f. strips are appearing publicly, and the v.h.f. transistor receiver is now well established. Design and development for the amateur are going to be more difficult in the future, if more rewarding in their results.

Frequency Sweep Methods

The device to be described is an all-transistor swept-frequency generator—or "wobbulator" which, correctly used with an oscilloscope, is capable of displaying the receiver response curve visually at a glance. Adjustments to the receiver r.f. and i.f. stages cause changes in this response curve, and these show up at once. If a wobbulator is not available the whole response curve has to be traced out laboriously with a signal generator each time a tuning core is rotated, and this can multiply the development time by a hundred without difficulty!

There are several methods of generating a swept-frequency signal, the easiest being to tune a signal generator rapidly through the pass-band of the amplifier under test, while displaying the amplifier output on the face of a cathode-ray tube. If the time base generator is set to a slow speed, say one sweep per second, a rough idea of the response can be obtained from the signal trace displayed—if it happens to fall somewhere near the centre of the screen. In default of all else this helps. The next development along this line is to drive the tuning knob of the signal generator by means of a motor running in synchronism with the time base trace. Some very successful wobbulators have been designed for mechanical drive in this way. However, the system is not elegant, some would maintain that it is barbaric, and even if this is discounted there are some big disadvantages in the method, among them the fact that continuous tuning is hard to achieve, while intended variations in frequency sweep are not easy to arrange except by using detachable variable-capacitor vanes or similar artifices.

Variable Reactance Devices

The reactance-valve, or its equivalent the reactance-transistor, represents a useful and popular way of going about it. This method has the advantage of being voltage-controlled or current-controlled and with no inertia or wear to worry about. While only relatively small frequency sweeps were required—from 5kc/s to 2Mc/s for example—it was, and probably is, the best method to use, especially in vacuum-tube circuits. There are ways of obtaining large frequency sweeps using variable-reactance devices, in any case, and no doubt a number of amateurs possess and use such instruments with every satisfaction.

The present design utilises a variable-reactance device as the frequency-sweeping element, but in this case the simple variable-capacitance diode is used. Readers will be aware that a semi-conductor diode is non-conducting when reverse voltage is applied because current carriers are attracted away from the p-n junction by the applied e.m.f.; the larger the reverse voltage the greater the attraction and the thicker the depletion layer becomes. Hence the junction capacitance falls with increased reverse voltage. Typical diodes of this type, useful at relatively high frequencies, may have depletion layer capacitances varying from about 3pF at about 20 volts reverse e.m.f. to about 10pF at about 1 volt reverse e.m.f.

Consideration of the conditions existing where such a diode is used to tune a circuit of oscillator frequency, say 34-37Mc/s is rewarding. Clearly, the best frequency sweep is obtained when stray circuit capacitances are small, so it will be assumed that a suitable coil has been wound which when tuned only with "strays" resonates at 37Mc/s. In a typical transistor curcuit the OC171 might be used. The collector capacitance would be about 6pF, coil and wiring capacitance 1·5pF, and the minimum diode capacitance 3pF, making 10·5pF in all. At minimum reverse e.m.f. the variable reactance diode would add another 7pF, making 17·5pF in all.

Now frequency is inversely proportional to the square root of capacitance, so if these conditions prevailed the lowest frequency the oscillator could operate at would be $37 \times \sqrt{\frac{10 \cdot 5}{17 \cdot 5}}$Mc/s or 29Mc/s, giving a frequency sweep of 8Mc/s. This would suffice for testing the i.f. strip response of any TV receiver on the 405 or 625 lines standards. The chances are of course that rather less would be achieved—probably about 6Mc/s in all, which although satisfactory from a frequency point of view would be rather pushing one's luck.

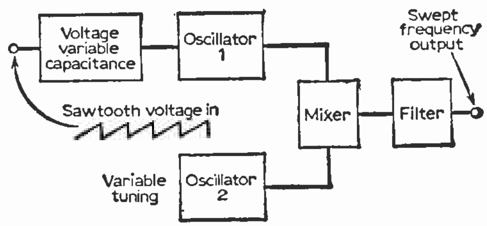


Fig. 1: Schematic diagram of the unit.

frequency. When the generated signal is applied to an amplifier, there is therefore a built-in non-linearity, which will tend to "skew" a response curve as far as the display is concerned; the amplifier will appear to give more amplification at the higher frequencies. Alternatively, an amplifier badly affected by Miller feedback, having a response curve with a large hump at the lower end of the pass-band, may appear to be relatively flat. Nobody will worry until the displayed picture in the completed receiver is horribly affected by "ringing", or turns out to be verging on instability.

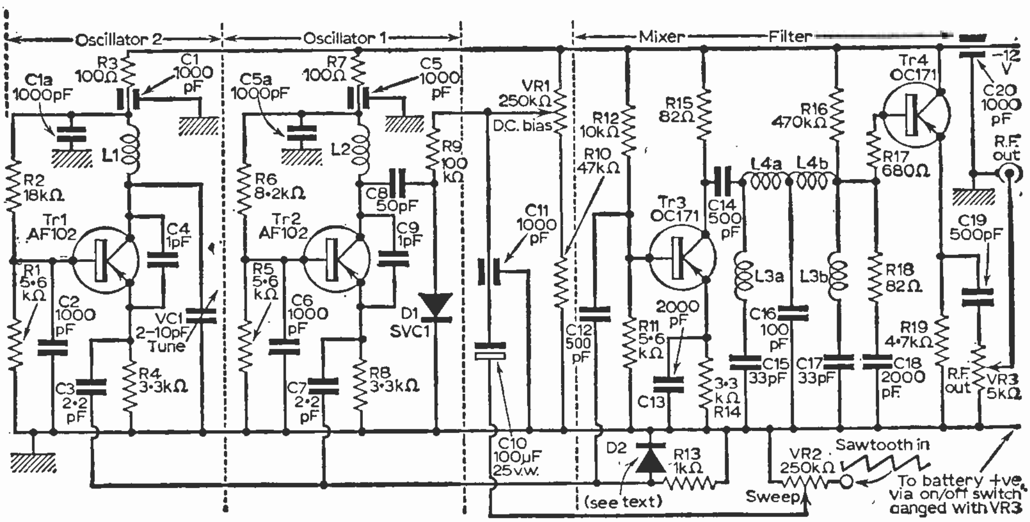


Fig. 2: Complete circuit diagram of the wide range wobbulator.

At the same time the variations in load on the tuned circuit have to be considered, and when this is done the picture is not so gaily coloured. At considerable reverse e.m.f. the capacitance across the tuned circuit is small. The semiconductor material of the diode depletion layer carries a small r.f. current and losses in the equivalent series resistance of the diode are small; the oscillator output tends to be high. When the reverse e.m.f. is small the depletion layer capacitance is large, three or four times the r.f. current flows in the equivalent series resistance and losses are high; the output from the oscillator diminishes accordingly. Hence the output varies markedly with

Add to the above the fact that in transistor circuits, 12V is all there is available as a rule, and that the total capacitance range of the diode cannot be achieved, and it will be apparent that some further thought needs to be devoted to the design.

One approach to the problem arises from the observation that if small capacitance variations only are permitted, and these about some low value appertaining to a considerable reverse e.m.f., oscillator output is sensibly constant. Consider the situation existing if the frequency of oscillation is raised to 250Mc/s. Suppose a capacitance variation of 3pF can be tolerated, over this range the oscillator output being sensibly constant. Then the frequency sweep will be 250 x $\sqrt{10{\cdot}15/13{\cdot}5}$Mc/s to 250Mc/s, or about 30Mc/s. This is highly satisfactory; in fact, it would be possible for most applications to use only a capacitance variation of 1pF, equalising oscillator output more effectively still; this would give a frequency swing of 16Mc/s.

The OC171 would hardly be usable practically in such a circuit, since its cut-off frequency is of the order of 75Mc/s and its transition frequency (at which gain = 1) is about 120Mc/s. This is also above its maximum frequency of oscillation. The AF102 is highly satisfactory for this application, and its output capacitance is of the order of 2pF thus reducing "strays" still further. Using this transistor, the oscillation frequency can be reduced to 150-160Mc/s, in between Band II and Band III, with ample frequency swing for constant output. The reason for this will be apparent later.

The only remaining problem is to convert the 150Mc/s frequency to the desired intermediate frequency and this is a relatively simple matter if normal frequency changing methods are employed.

Difference Frequency

Fig. 1 shows the block diagram relating to the instrument. Oscillator 1 is the variable-frequency oscillator already discussed; its basic frequency is fixed, but because of the reactance-diode across the tuned circuit a sawtooth voltage input will sweep the frequency between limits dependent on the sawtooth voltage input and the residual capacitance in the circuit.

Oscillator 2 is so arranged that the tuned circuit associated with it can be tuned by a variable capacitor. When the vanes of this capacitor are fully meshed it tunes to nearly the same frequency as oscillator 1, and when the variable capacitance is reduced the frequency rises to some 50Mc/s above that of oscillator 1. Thus the difference frequency, which is detected in the mixer, varies between about 0·1 to 1Mc/s and 50Mc/s. This difference frequency is fed to the output terminal through a filter designed to attenuate frequencies above about 45Mc/s, thus minimising the escape of the waves generated directly in the oscillators.

The design of the mixer and filter will be discussed in due course.

Fig. 2 shows the complete circuit diagram for the instrument, and a number of circuit points may be mentioned at once. In the first place each oscillator is contained within a small aluminium can, the negative battery lead being taken through a lead-through capacitor for decoupling purposes. The sweep oscillator is supplied with its sawtooth input through a similar capacitor; this has negligible effect on the sawtooth at sweep frequencies of interest, but prevents the escape of radiation. The filter unit is similarly enclosed inside a can, which necessarily has to be of somewhat ampler proportions.

Secondly, the filter—whose inductors are L3 and L4 (two of each)—is associated with two transistors. The first provides a little gain, with the average transistor, but this is not its function; the real purpose of this transistor is to effect an impedance-match with the filter. It will be realised that a filter of this type is working near the practicable limits for "lumped" circuits when dealing with frequencies near those of television receivers, and to obtain reproducible results it is necessary to use reasonable values of circuit component. It would be pointless to aim at a circuit using for example 1 or 2pF capacitors of low tolerance, so a compromise has to be reached between the tolerances of capacitors and the accuracy with which small coils can be wound. The output is also obtained from an emitter-follower transistor, and a glance at the circuit will reveal that the termination of the filter is such that a very nearly constant resistance is presented to the filter whatever the setting of the output control.

Diode Mixer

Output from the oscillators is taken at the emitter through a small capacitor (2·2pF) which feeds the signal into the diode mixer. This arrangement imposes less capacitive load on the tuned circuits, and represents a relatively low source impedance for the mixer. Less "pulling" between the oscillator results from this arrangement; it has been found quite practicable for the oscillators to operate at frequencies no more thas 100kc/s apart, and 465kc/s can readily be generated if desired. However, a certain amount of jitter is bound to occur in even these stable oscillators, and if only 0·01%—negligible at 150Mc/s — this represents a random frequency inaccuracy of 20kc/s which is hardly tolerable at 465kc/s as it is some 4%. At 10·7Mc/s the same jitter is 0·2%, and this can barely be seen on a 6in. oscilloscope, so the instrument can be used very effectively to generate 10·7Mc/s for the alignment of v.h.f. receivers.

R.F. current from the fixed-frequency oscillator (oscillator 1) is arranged to be much larger than

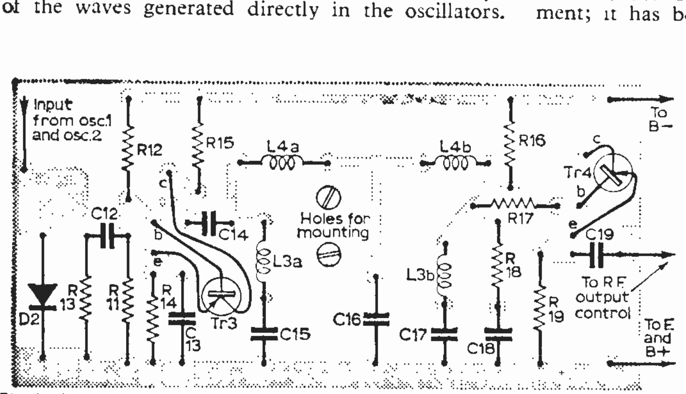


Fig. 3: Etched circuit board for the filter unit. Note: Layout of this unit is fairly critical, the filter operating at new Television frequencies

COMPONENTS LIST

Resistors:

R1	5·6kΩ	R11	5·6kΩ
R2	18kΩ	R12	10kΩ
R3	100Ω	R13	1kΩ
R4	3·3kΩ	R14	3·3kΩ
R5	5·6kΩ	R15	82Ω
R6	8·2kΩ	R16	470kΩ
R7	100Ω	R17	680Ω
R8	3·3kΩ	R18	82Ω
R9	100kΩ	R19	4·7kΩ
R10	47kΩ		

All 10% $\frac{1}{4}$W miniature

VR1 250kΩ VR2 250kΩ }carbon
VR3 5kΩ with switch

Capacitors:

C1 1000pF lead through
C1a 1000pF
C2 1000pF
C3 2·2pF
C4 1pF
C5 1000pF lead through
C5a 1000pF
C6 1000pF
C7 2·2pF
C8 50pF
C9 1pF
C10 100μF 25V electrolytic
C11 1000pF lead through
C12 500pF
C13 2000pF
C14 500pF
C15 33pF 2% silver mica
C16 100pF 2% silver mica
C17 33pF 2% silver mica
C18 2000pF
C19 500pF
C20 1000pF lead through
All 20% ceramics unless otherwise stated
VC1 2–10pF air spaced variable

Semiconductors:

Tr1 AF102, Tr2 AF102, Tr3 OC171, Tr4 OC171, D1 SVC1, D2 microwave silicon diode (see text)

Inductors:

L1 $2\frac{1}{2}$ turns 18 s.w.g. enam. wire
L2 3 turns 18 s.w.g. enam. wire
L3/L3a 11 turns 26 s.w.g. enam. wire
L4/L4a 15 turns 26 s.w.g. enam. wire
See text for further details

Miscellaneous:

Aluminium sheet, Veroboard, copper laminate, knobs, screening cans, two-pole two-way slide switch, coaxial socket, nuts, bolts etc.

that from the variable-tuning oscillator (2) and this is reflected in the differing values of base bias provided. Even so, the mixer diode is not being used as a highly efficient mixer, as the r.f. voltage does not swing the working-point far into the linear part of the characteristic curve. However, there is sufficient non-linearity to produce a respectable i.f. and a few microvolts output is in general all that is required for alignment purposes. If desired, the 680Ω resistor in the base lead of the final transistor may be omitted; or, better still, a "high-output" lead taken from the filter termination direct for preliminary alignment purposes or for testing individual stages of an i.f. amplifier. The termination will be approximately correct for a 75Ω coaxial cable.

Low Pass Filter

The mixer diode used in the prototype is a microwave silicon diode, which has to operate at 150—200Mc/s, so the usual OA70 will not be very suitable. The microwave diodes available are frequently of the "coaxial" type, and small clips will have to be fabricated from strip brass (such as can be got from a spent cycle battery) to obtain good electrical contacts with mechanical rigidity.

The filter is designed as a low-pass filter cutting off sharply at 45Mc/s, with a characteristic impedance of 80Ω. It consists of a centre section of "constant-k" type, with two half-sections of the same impedance as input and output terminations, each of "m-derived" type. This classical type of filter suffices to keep most of the v.h.f. away from the output terminal, and in fact works better than was expected! Much depends on the care taken in constructing the filter, and some constructional points will next be mentioned.

The filter, with the mixer diode and the two associated transistors, is in the prototype, built on a small piece of copper-clad laminate, appropriately etched, which fits into an aluminium can 2in. diameter and $3\frac{1}{2}$in. long. Such cans can often be obtained—empty, of course, from one's local chemist. The paint is best removed with a paint stripping solvent such as Polystrip or Nitromors. The laminate is cut to size $2\frac{3}{4}$in. by $1\frac{3}{8}$, and the circuit etched as shown in Fig. 3.

The inductors are wound on a 11/64in. drill shank with No. 26 s.w.g. enamelled copper wire, close-wound. The wire is put on by hand, taking great care that the turns are lying closely side by side, with no gaps. For L3 inductors about 11 turns will be put on first, and for L4 inductors about 15 turns. The wire is then allowed to spring back, and the loose coil will then be 3/16in. inside diameter and will fit with a very slight push on to the shank of a 3/16in. drill. The end turn is removed leaving $9\frac{1}{2}$ turns for L3 inductors and 13 turns for L4 inductors.

The ends are carefully trimmed to lie at right angles to the coil, and are cut to length of $\frac{1}{4}$in. The end $\frac{1}{8}$in. is cleaned and tinned, unless the wire is of the self-fluxing variety.

To be continued

"LOCKED OSCILLATOR" F. M. DISCRIMINATOR

by S. George

WHILE the conventional radio detector is used in many dual-standard TV receivers, there is now a growing tendency to use the EH90 "Locked Oscillator Discriminator" as the f.m. detector, on four main points. (1) It is more economical in design than the conventional ratio detector, since the expensive r.f. transformer is replaced by one simple tuned circuit, while the matched duo-diodes and triodes are eliminated. (2) The circuit has very good amplitude-limiting characteristics. (3) It gives an extremely high a.c. output so that in most commercial designs, the EH90 output directly feeds the sound output pentode, while on 405 it can act as an a.f. amplifier to boost the output from the 405 a.m. detector. (4) The output for a given f.m. deviation is constant irrespective of signal strength.

Simplified discriminators

Pentodes were used in a simplified form of such discriminators in American receivers, but the present day heptode circuit is the outcome of considerable development by the Mullard Research Laboratories to improve the function of this type of discriminator, and we are indebted to them for much information contained in this article.

All such f.m discriminators function by virtue of the fact that the anode current of the detector is a function of the phase relationship between two similar frequency sine waves applied to two different grids. Also when an a.c. voltage is applied to the control grid, the electron stream passing through the suppressor grid to the anode, induces a facsimile voltage on the suppressor but lagging by 90°. Such coupling is known as "space charge" coupling and if G3 is returned to cathode via a parallel tuned circuit, the valve becomes analogous to a tuned-grid-tuned-anode oscillator. Over a fairly restricted frequency range, the oscillation produced at the suppressor grid "locks" to the applied input signal the "lock-in" range increasing with increased signal input. Outside this range however, the oscillator fails to synchronise with the input and beats occur. Inside the "lock-in" range, when the f.m. signal deviates slightly from the tuned circuits resonant frequency in accordance with the modulation, the phase difference between the two r.f. signals is no longer 90° but increases or decreases according to the direction of the frequency shift. Anode current being a function of the two signals phase relationship an a.f. output representing the difference between them is developed across the anode load resistor.

Space charge coupling

For most effective operation, the valve used should have high "space charge coupling". This implies that the electron stream should have a large effect on Suppressor grid potential or in other words that the gm (G3-A) will be high. The EH90 heptode is particularly suitable in this respect, and superior to a conventional pentode.

Discriminator circuit

Figure 1 shows the basic EH90 discriminator circuit with L2 being the "quadrature" coil damped by the 39kΩ resistor for optimum gain and "lock-in" range. The G2/4 screen is fed via a low resistance fixed potentiometer network to prevent variation of f.m. output with signal level, while omission of the cathode bypass capacitor compensates for valve input capacitance change with voltage and assists limiting action by negative feedback.

Figure 2 shows an EH90 dual-standard sound circuit (GEC/SOBELL) in which the valve functions as an a.f. amplifier on 405 (sound output stage is not shown). Such discriminator circuits give little trouble, are relatively insensitive to component tolerances, and only the resistors in the screen grid fixed potentiometer network and the cathode lead need be of 10% tolerance. Valves in this mode are very free from microphony and valve replacement has

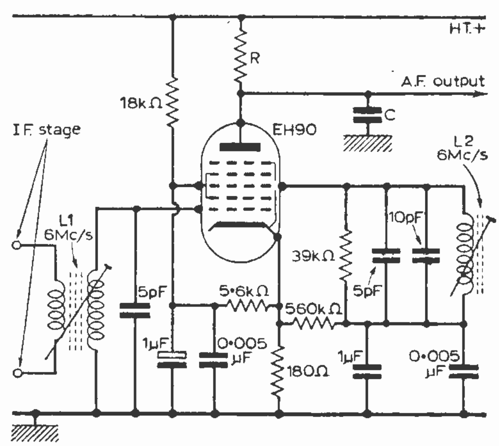


Fig. 1: Basic EH90 'Locked Oscillator' f.m. discriminator. Space charge coupling between G1 and G3 induces a replica of the input frequency on the latter but lagging by 90°. F.M. variations of the input signal then produce slight variations of this phase disparity to produce an a.f. signal across the anode load resistor.

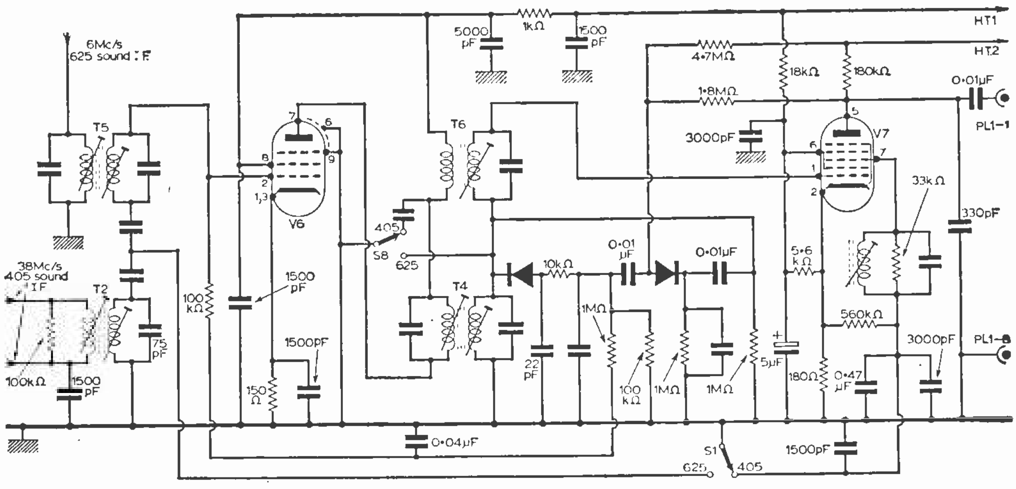


Fig. 2: Typical EH90 dual-standard sound system. On 625 it functions as a "locked oscillator" f.m. detector and on 405 as an a.f. amplifier. (G.E.C./Sobell/McMichael series).

negligible effect on operation and tuning. Indeed a five-fold increase in Cgl-G3 results in only a slight reduction in the "lock-in" range and reduction of a.m. suppression ratio. Warm-up drift due to capacitive changes in the valve is negligible after the first 5 minutes, but it is worth noting that the Mullard Engineers observed—"It was found most important to lock the cores of the inductors with a good quality locking compound. If rubber string was used, the core unscrewed slightly during each temperature cycle. Ten such cycles produced a final frequency error of 12kc/s whereas when the cores were sealed with locking compound the error was less than 50c/s".

Due to the reduction in components compared with the conventional f.m. detector, and the absence of the duo-diodes, servicing presents few problems. The most likely sources of trouble apart from variations in the value of resistors effecting the operational function of the valve are—(1) Partial or complete loss of capacity in the fixed trimming capacitors associated with the quadrature coil. In extreme cases this could tune the coil right out of the "locking range" limits. (2) Short circuited fixed trimming capacitors which would thus also short circuit the coil. (3) Open circuited or dry-jointed coil damping resistor which would thus increase the "Q" of the quadrature coil above optimum and decrease the discriminator "lock-in" range. (4) Open circuit or reduced capacity G2/4 capacitor which could cause instability and varying output with varying signal level. ■

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

NEW SERIES

PART 9: Tuner Units

IN and around the tuner unit, more care is needed, because of the higher frequencies involved, where the length of component lead-out wires is a significant inductive and self-capacitative factor, and where component placing and the siting of connecting wires can drastically affect the tuning. Often it is worth spending a little more time diagnosing the fault, making proving tests and eliminating possibilities, before probing about vainly in the electronic undergrowth.

Far and away the most prevalent is the breakdown of a current-carrying resistor: usually the common h.t. feed, or the resistor in series with the oscillator anode, where valved tuner units are employed. We are so used to this fault now, on many different units, that the preliminary proving tests are almost habitual among the servicing fraternity. First, are there faint clicks through from the aerial, and perhaps small flashes on the raster? Do we get clicks and crashes as we rotate the turret or press the buttons and keys? If so, it is a fair bet that h.t. is reaching the tuner and, if absent, is being lost where it divides to feed different parts of the circuit.

If the tuner is 'lively' yet the correct signals cannot be tuned in, the next point to suspect is the oscillator, and again, the most likely trouble (apart from some tuning problems we shall come to later) is lack of h.t. voltages. Often, quite small resistors are used in these h.t. feed circuits, and it needs only a small flashover to burn them out. More likely than this is deterioration through constant use—hot and cold cycles of daily wear causing 'ageing'. When this occurs, though there may still be h.t. present, it may not be enough to sustain oscillation.

TUNER H.T.

Testing for h.t. with a meter is straightforward enough, the drawback being the near impossibility of getting the average probe to the exact position one needs for the test. Without a meter, it may be necessary to make a 'spark test'. Highly unofficial, this! A screwdriver blade touched quickly between a high tension carrying point and chassis should provide a small spark. For the brief moment of the test, the short-circuit will not damage resistors or blow fuses, but there can be a real danger of burning out the fine wire of some coils.

A glance at Fig. 43 reveals that the popular method of supplying h.t. to the tuner unit is by divided and separately decoupled paths from the main h.t. line of the receiver. This source point may itself be filtered, and if there is no h.t. at all reaching the tuner, the filter circuit and its decoupling capacitor should be checked. Note that the h.t. feed to the triode oscillator section of the PCF806 is via a 12kΩ resistor, but that the pentode mixer section has a series feed circuit with decoupling from the junction. This is partly because of the value of resistor needed and the power dissipation, partly to provide the correct frequency-conscious circuit dependent on the physical placing of the components.

H.T. to the r.f. triode is via a parallel pair, in practice a single tapped component, whose position is as shown in Fig 44, adjacent to the valve base. In this model, the components are fairly easy to reach and replace; other units seem designed to defeat such an exercise. This type of permeability-tuned unit is found in the Bush TV135 and 138 range, and the Murphy V923 and 929. Known as the A490, it has four push-buttons which can be arranged to select any combination of Band I and Band III stations by altering the switch actuating tab which is secured to the rocker bar by a rub screw.

To remove the unit, take out one hexagon-headed bolt and withdraw from the rear. It is easier to disconnect the plugs (power and i.f.) from the main panel. The cover can be removed by a slight pressure on the blunt end, raising a bit, then disengaging the other end.

Having chosen whether the appropriate button has to tune BBC or ITV, slacken the grub screw, reposition the tab (downwards for Band III, upwards for Band I) and refit the base. Then, all that is necessary is to press in the button, which operates the bandswitch shown in Fig. 43, pull it gently out until its flange is felt to engage the tuning spindle, and turn till sound and picture tune in, and slide the button clear of the spindle. Selection of another button neutralises the engaged one. This is a streamlining of a common Bush principle, and is very similar to other types of tuner.

An earlier type of Bush tuner, such as used in the TV125 series, also had four push buttons, but was intended to be set for two stations on each band, and altering to receive one Band III and three Band I channels, quite a common requirement, is a bit more difficult. The button to 'doctor' is the inside Band III button, whose switch actuating block should be set upward normally, and can be altered to a downward position for BBC reception. An adjustable core stop which is usually employed to set the neutral return positions of the Band I buttons can be set to tune to the position

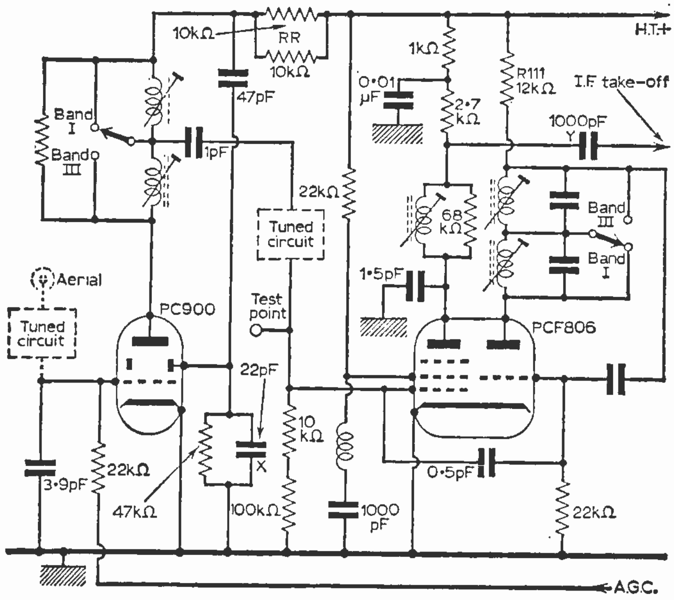


Fig. 43: Permeability tuner for Bands I and III.

capacitors carrying the h.t. line into the tuner unit. One of the common symptoms is an apparent high h.t. current drain, which makes one suspect a valve fault. The valves are replaced and the trouble persists. But switching between channels momentarily regains h.t. voltage at the external feed point. In these cases, suspect a leak across the silvering of one of the feed-through capacitors, or perhaps cracked ceramic of its tube. There is no real solution, but an effective cure is to remove the capacitor altogether, rewire the h.t. line through the hole, make a joint as near the hole as possible, but insulated safely, and connect a 1,000pF bypass, soldered to the body of the tuner as near the original point as possible (see Fig. 45).

Where BBC-2 signals are in order and v.h.f. does not come through, there are two possibilities. First is the r.f. valve, which is not used on u.h.f., second the oscillator of the v.h.f. mixer-osc. If the trouble is not h.t., and valves are in order, check the system switching, especially the a.g.c. line, which is altered externally, usually on the main slider switch section on the i.f. panel.

Patterning on odd channels is not an unfamiliar fault, and may often be caused by a breakdown in decoupling, generally between the r.f. and mixer stages. In Fig. 43, where a triode r.f. valve in earthed cathode mode is used, the 22pF capacitor marked "X" is part of the neutralising circuit and open-circuiting will cause a severe herringbone pattern in certain parts of the country.

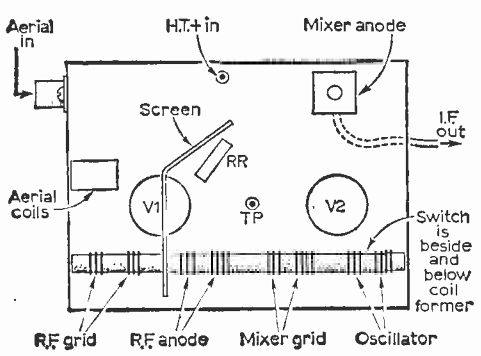
Leaky coupling from the tuner unit is another problem that can cause peculiar symptoms. Where the leak puts h.t. on the grid of the succeeding common i.f. valve, or upsets the a.g.c. line (the voltage limited by intervening components) symptoms of overloading may be found. This can often be checked by operating the system switch, when the fault may temporarily clear. Check the feed-out capacitors in such cases: Y in Fig. 43 is an example.

taken up by the outside BBC button and then selected by the second button, by first tuning the signal, then slackening the Philips screw on the stop (available through the bottom of the cabinet).

Although we cannot spend too much time on the obvious stock fault of poor h.t., it may be as well to mention that several manufacturers recognise the vulnerability of these resistors and helpfully mount them outside the body of the tuner. (Of course, they have an ulterior motive; heat dissipation). Others, such as the Plessey push-button tuner and the Bird tuner used in Defiant receivers, had their h.t. resistors hidden away in the intestines of the unit, while some of the Philips designs are of particular awkwardness.

CAPACITOR BREAKDOWN

A fault with similar effect but more confusing to trace is breakdown of one of the feed-through



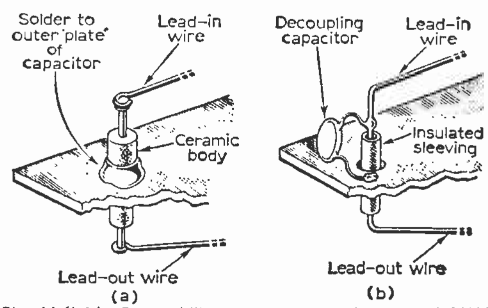


Fig. 44 (left): Permeability type tuner used in the Bush TV135 and 138 series.

Fig. 45 (above): Two methods of replacing faulty lead-through capacitors.

MIXER GRID

The grid of the mixer stage of the v.h.f. tuner is a notorious trouble spot, and fault symptoms vary between an intermittent hum and weakness more apparent on one band or even on one channel.

The tuner units that Philips have employed in various models differ in small constructional points but have enough similar features for us to concentrate on the simplified circuit of Fig. 46, which is that used in the Cossor CT1964A and the Peto Scott 960. Choice is determined by the large number of these sets distributed by multiple stores and rental outlets.

We can again note the different h.t. feed lines with vulnerable resistors shown in the diagram, and here we can also see the mixer grid network. The trouble usually shows itself at v.h.f., and is probably intermittent. Check the 10kΩ resistor and look for broken connections at the mounting of the 18pF capacitor, situated at the front of the switch unit on top of the main body of the tuner, shown in Fig. 47.

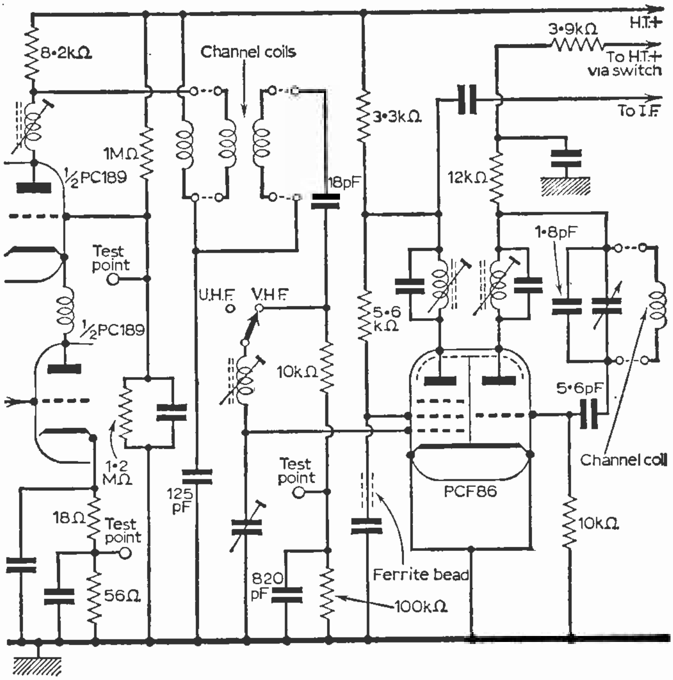


Fig. 46: Simplified circuit of the Philips tuner used in the Cossor CT1964A.

The setting up of the oscillator on these tuners can be perplexing at first, Fig. 47 shows the main adjustment points. When the channel is selected, the appropriate coil biscuit (printed circuit type) is turned to engage small spring blades. These blades, and the contacts on the biscuit, tend to get 'coked up' after some time and will not usually respond to the brute force method of an application of switch-cleaner. In fact, the best cleaner here is a drop of methylated spirit, on a clean rag wrapped around a screwdriver blade.

Much patience is needed, and the practice of resetting the stator to tighten spring blade action by small adjustment of the grub screws at the end of the tuner body can solve many intermittent switch problems. The watchword should be: "Easy does it". Never try to force switches against their "natural" spring. All that results is a permanent bending of contacts and what seems to be a loss of elasticity. Similarly, the practice of bending these springs with pliers to facilitate better contact is to be deplored. At best, it is a temporary solution.

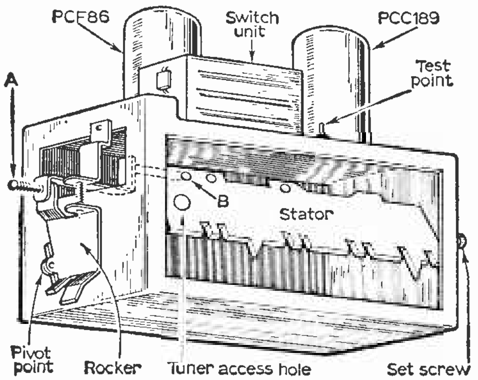


Fig. 47: Philips tuner, the circuit shown in Fig. 46 (above).

COIL PLATES

If it is necessary to remove coil plates, i.e. printed circuit boards, there are two types that need attention. The type shown in Fig. 47 is removed by first taking off the plate on the roller side of the tuner, turning the rotor to a convenient position, then easing out the coil insert from the rear end. Incidentally, in case the 'gremlins' have mixed up the coil sequence, when replacing, the rotor lug sits between coils 12 and 13. For reasons that need not bother us here, the sequence of coils in the rotor should be retained, even when there seems to be a tendency on the part of the maker to require maximum rotation of the selector knob between stations.

The old practice of putting adjacent coil biscuits to suit the local channels is prevented by the v.h.f./u.h.f. switching, among other things. In any case, switches benefit from regular use and have a certain self-cleaning action that channel selection helps.

To return to our adjustment, Fig. 47 shows two main variables. Screw A is used to set the movement of the cam that selects the position of the plunger in capacitor C (see Fig. 46). Each channel has an adjustment screw that determines the movement of the rocker, this depresses a nylon cap on the end of a metal pin (shoulder end goes to the tube side of the capacitor, when replacing, losing the pin is the usual dismantling penalty!) and the plastic tube has the nylon end inwards.

The cam setting is regulated on Band I, adjusting screw A to the mid-position for the channel to be received, having turned the fine tuner knob (depressed to locate the screw) to mid-position. After this, turn to the local Band III channel and tune the grub screw B for best picture and sound. When tuning these modern units, often it is better to set the receiver up slightly toward the sound carrier, i.e. for best sound. Any variation to obtain best picture can be made with the fine tuner knob. A word of warning, too. There are, as we have implied, two main types of tuner. The type discussed has coils with a prefix GB, has an internally mounted i.f. coil and screening skirts to the valveholders. The valves are PCC189 and PCF86. In other sets, coils with GP prefix are used and though these appear similar, they are not interchangeable. In these tuners, the rotor lug comes between channels 2 and 3, and PCC89 and PCF80 valves are employed.

The tuner slug operated by a cam is used on tuners by K-B and GEC as well as Philips, though in a slightly different circuit formation. In these, breaking of the slug can cause queer symptoms, the usual being that one channel appears to drift and another to tune up perfectly until the rotor is turned, when a lot of jiggling is necessary to get the signal back.

Although it may be a poor solution to turn the set on its side each time we change channels, this is the only alternative to repairing the broken slug! However, do not despair, the slug can generally be pushed right through the tube with an orange stick, and can sometimes be repaired with that indispensable aid, Araldite.

On earlier Philips types, if the core is tight in the former, application of a small amount of heat from a soldering iron held near the former can assist removal. Tightening a slider type slug in a former may need the addition of a sliver of elastic. A justifiable remedy, even if the makers do frown on it!

AERIAL CONNECTION

On some Pye tuners, a prevalent fault was the breaking of connections of the aerial coil at the rear of the rotor. This usually led to poor Band I reception, and the cure was to resolder the tail end and gently reposition the coil. Where incremental tuners are used, as popularised by Pye in earlier days, care must be taken not to alter positioning of coils. The same stricture applies to many of the later units, very different physically, but electrically similar in technique.

NEXT MONTH

It was intended to end this series with the present article. But tuners offer us much scope for discussion and we need to take a look at transistorised tuners, methods of u.h.f. coupling and mechanical tuning drives and, space permitting, some aerial troubles and their cures. These subjects will be dealt with in our concluding article, next month.

HUM IN TELEVISION RECEIVERS

V. D. Capel

WHEN hum manifests itself in a television receiver, first suspicions are usually directed to the smoothing circuits, especially the smoothing capacitor. There can, however, be many causes of hum in a TV receiver and its effect can be detected in many different ways. Let us consider the smoothing circuits first.

The first leg of the smoothing circuit is provided by the smoothing choke, which is an iron-cored inductor designed to possess the maximum inductance possible for its size. The impedance offered by any inductor to a current flowing through it depends mainly upon the frequency of that current. The impedance is less as the frequency decreases and is almost zero for d.c., the only opposition then offered being that due to its ohmic resistance. Hence while the d.c. h.t. current flows through the smoothing choke with little opposition, a fair impedance is offered to the 50-cycle a.c. ripple current. With most television receivers half-wave rectification is employed, hence the ripple will be 50c/s. Where the rectification is full wave the ripple will be 100c/s and so twice the impedance will be presented by the smoothing choke, hence the smoothing circuit will be more efficient.

SMOOTHING HUM

The smoothing capacitor has exactly the opposite effect to the choke, this offers a very high opposition to d.c. current but presents a low impedance to alternating currents. Hence whereas the smoothing choke is connected in series with the h.t. supply line, the smoothing capacitor is shunted across it. Less impedance will be offered to a frequency of 100c/s than to one of 50c/s, so, as with the smoothing choke, the capacitor will be more effective with full-wave systems.

Theoretically, ineffective smoothing could be due to either of these components being defective but in practice it is nearly always the capacitor which gives rise to trouble. If the smoothing choke goes open circuit, the result will be no reception at all as the h.t. supply will be interrupted. Failure of the smoothing capacitor, on the other hand, will result in an a.c. ripple being passed along the h.t. line to all circuits of the receiver. The result will be that the sound circuits will be modulated with the familiar hum, also vision, sync and time base circuits will be affected to some degree, varying with different receivers. For example, it is sometimes found that the vision exhibits a black hum bar across the screen whereas the hum on sound is only slight. In other cases it may be that the hum bar is only slight and the main effect on the vision is poor line sync. If the hum is manifested in several circuits, then it is fairly safe to say that the smoothing capacitor is the cause of the trouble.

Receivers are sometimes found with their smoothing capacitors bridged by another one. Presumably the original became defective and a repair was effected by connecting the replacement across it. It is bad practice to leave a defective capacitor in circuit since the original may be passing a high leakage current which could result in an unnecessary load being placed on the h.t. line, and the capacitor may become heated or even explode. The writer has seen cases where this has happened.

The smoothing capacitor is commonly combined in the same can with the reservoir capacitor. If the smoothing capacitor has become defective then it is likely that the reservoir also will soon show a defect even if this is not the case already. While it may be more expensive, it is prudent to replace the complete unit if any section should be faulty. Even if this is not done the defective capacitor should be completely disconnected and a replacement fitted to a separate tag connection.

Another possibility which can prove quite baffling to the uninitiated is a leakage between the smoothing and reservoir capacitors within a common can. Such a leakage in effect shorts out the smoothing choke and hum in all circuits will result just as if the smoothing capacitor had gone open-circuit. The normal practice of bridging the suspected capacitor with a test one will hence not produce any results. The leakage between the sections will not normally be measurable with an ohm-meter due to the low d.c. resistance of the smoothing choke connected between them. If smoothing is suspected because several circuits of the receiver are affected with hum, and if temporarily bridging the smoothing capacitor gives no improvement, then this possibility of leakage between sections must be investigated. The way to do this is to disconnect one section and to temporarily wire in a substitute. The most

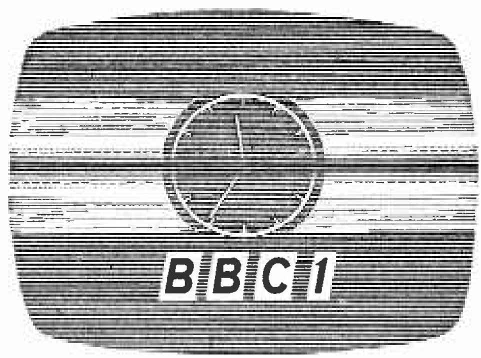


Fig. 1: Hum on vision.

convenient one to disconnect will generally be the reservoir capacitor as usually there are only two wires connected to it, one to the rectifier and the other to the smoothing choke, whereas the smoothing capacitor may have a number of feeds to various h.t. circuits.

WIREWOUND RESISTORS

Many receivers use wire wound resistors in place of smoothing chokes. Circuit operation is different in principle from the smoothing choke as now it becomes a simple decoupling arrangement such as commonly used in other parts of the receiver. It is not so effective as the choke, as a high value of resistance should be used to achieve sufficient decoupling at 50c/s and this value will, of course, cause a loss of h.t. potential across it and so restrict the h.t. voltage to the receiver. Furthermore, heat will be generated in the resistor to add to that present from the various other sources. Cheapness, size and weight makes this a popular alternative with many set manufacturers. Although the principle of operation will, as we have said, be different, our remarks on fault finding with smoothing choke circuits still apply to those using smoothing resistors.

HEATER/CATHODE LEAKAGE

A further major source of hum is that of leakages between valve cathodes and heaters. Most valve heaters are fed from raw a.c. by being connected in series across the supply mains through a suitable value dropping resistor. Some receivers use a rectifier in place of the dropping resistor and omit a reservoir capacitor so that a suitable reduction in voltage can be obtained. This arrangement has the advantage of cooler running for the receiver due to the absence of heat from the main dropper. Because there is no reservoir and smoothing circuit for this d.c. supplied heater chain, there will be a.c. ripple on it. Hence any heater/cathode leakage within a valve will put a.c. potential on the cathode. While some cathodes, such as those used in output circuits, are generally bypassed by high value capacitors, this is not always the case and any a.c. on the cathode will, as a result, modulate the valve anode current and produce hum in the circuit.

Hum from this source will usually affect only one circuit and so can be easily identified by this manner. If there is hum on sound and yet the picture betrays no trace of hum whatsoever, it can be assumed that the hum is originating in the sound circuits and most likely will be due to a heater/cathode leakage in one of the sound valves. Any of the valves could be responsible, from the first sound i.f. valve to the sound output. Generally though, hum originating from before the detector possesses a different character sound to that coming in at a later point. This is due to the fact that the fundamental 50c/s rarely gets past the detector circuit without undergoing considerable modification to its wave-form. This means that harmonics will be generated and will predominate in the resulting signal. If the hum is harsh with more the characteristics of a buzz, then it is probable that its origin is before the detector stage; on the other hand, should the hum be pure and deep in tone then most likely the fault is in the audio circuits.

HUM ON VISION

Another common manifestation of hum is in the vision circuits. Usually this takes the form of a black band near the centre of the screen. If the hum frequency is the same as the field frequency then there will be one band, but if a full wave system were used then the frequency of the hum would be 100c/s and two horizontal bands would be in evidence. The fault will most likely be a leakage in the video valve or in one of the i.f. valves. First, carefully examine the picture to see that the band really is due to modulation of the video signal and not to a wider spacing of the scanning lines. The two effects are very similar when viewed casually, as the areas where the lines are spaced wide apart will have a lower overall illumination than where they are normal. Any such variation in line spacing can also be attributable to hum but in this case the hum will be in the field circuit. When checking these valves by substitution, remember that in many receivers there are three valves or parts of valves which are involved. Some models use a multi-vibrator consisting of two triodes. These may be the triode parts of triode-pentode valves, the pentode section of which are used for other purposes such as sync or video output. Either of these plus the output section are, of course, suspect. As multiple valves normally use separate cathodes then only one section will

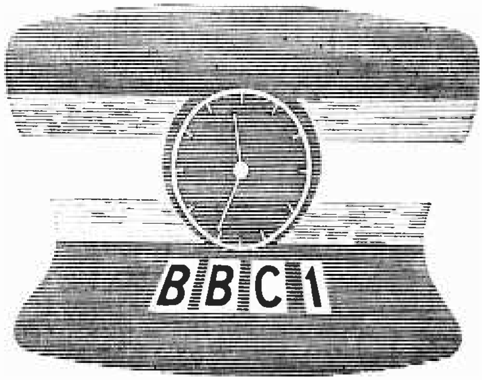


Fig. 2: Hum on line.

be affected by any heater/cathode leak. An exception to this rule is the ECL80 valve which has a common cathode for both sections, hence any leak between the heater and the cathode will affect both circuits alike.

When hum appears in the line circuits, the effect is unmistakable. The vertical edges of the raster become shaped like the letter S. The precise effect will depend a lot upon the circuit. For example, output stages that have their cathodes taken directly to chassis, the bias being provided by the negative drive on the grid, will not exhibit any hum effects at all. In such cases any cathode leakage will effectively bypass the heater current from the rest of the heater chain, and as the line output valve is normally connected in the top half of the chain, it will mean that it and the valve above it, normally the boost diode, will glow very brightly and the rest of the valves only dimly. If the leak is severe then excess current will flow and the fuse will blow. When hum modulation effects of the line are evident, most professional engineers will change each of the valves in the line circuit in turn until the defective one is located. The amateur repairer may not have a wide selection of valves at his disposal and may have to obtain valves specially, in which case he will not want to get the wrong ones. In such a case it would be wise to check if the cathode of the line output valve is taken directly to chassis. If this is so then the hum cannot be due to this stage and will most likely be found in the line generator. If, on the other hand, there is a low value cathode resistor as fitted by many makers (this being done in order to limit the anode current in the event of a failure of the line oscillator to provide sufficient negative drive on the grid), then the line output valve could be the cause of the hum modulation. If the trouble is, in fact, due to the line output valve, and the resistor is momentarily shorted out, the hum modulation should disappear. If it does not then one of the other line valves should be checked. Should the hum modulation of the line be very pronounced it would be unwise to short the line output cathode resistor in this way as this would indicate that the leakage was heavy and shorting the resistor would immediately draw a heavy heater current through the valve with the possibility of further damage.

SYNC HUM

An effect of hum perhaps not so obvious is when it affects the synchronising circuits. A heater/cathode leak in the sync separator valve will cause lack of synchronising in both line and field circuits. Again the precise effect will vary from model to model, in some cases one timebase will be affected more than in another, and in a few cases one timebase may seem to be hardly affected at all. Synchronising can also be affected by heater/cathode leaks in the video circuits. Here it will also be accompanied with the bar on the picture. There have been cases where such leaks in the video circuit have produced very little shading of the picture and yet have seriously affected the synchronising. Where sync faults are experienced then, it would be as well to change video valves as well as the sync separator.

LEAKAGE—TUNER AND I.F.

Another effect that can be obtained by a heater/cathode leakage is the one produced by a leakage in either of the tuner valves or in the common i.f. As these circuits are common to both sound and vision any leakage in one of these valves will produce hum on sound and vision. For this reason it is easy to confuse this effect with that produced by a defective smoothing capacitor. There is one difference which should be looked for before a definite diagnosis is made. When the smoothing capacitor is at fault not only are sound and vision circuits affected but also some trace of hum will most likely be found in the timebases. These, however, will not be present if the fault is in the tuner or common i.f. The rule is then, when investigating a set that has hum on sound and vision, to make a close examination of the edge of the raster. This may be done by reducing the width control or by moving the picture over by means of the picture shift until the edge becomes visible. Any sign of curvature will indicate smoothing troubles, whereas if the edge is perfectly straight then the fault will probably be as described in the tuner. As a further check an examination of the lines themselves can be made to see if they are all equidistant or whether there is any compression and expansion over the raster. When doing this be careful not to mistake poor field linearity for hum.

VISION ON SOUND

Another easily recognised source of hum is vision on sound. This is not really hum at all but takes the form of a harsh buzz. Its source is not due to any a.c. component reaching the sound circuits from the mains, but as its name implies, is due to the vision signal finding its way into the sound circuits. Misalignment of the i.f.'s will produce this trouble, but before attempting to alter the alignment of the i.f. coils it is prudent to check one or two other details.

A common cause of this trouble is overloading due to too strong a signal. If the set has a sensitivity control then try turning it down. If there is no such control then it may be necessary to fit an attenuator in the aerial lead. If the set had been working satisfactorily in that location without alteration to the aerial then it is unlikely that the signal strength would suddenly increase to cause overloading in this way. It is possible, if a sensitivity control is fitted, that this may have been turned up accidentally by the user. If a new aerial has been fitted or a new set installed then the signal strength may be too great and need the attenuation as described. The a.g.c. system on most modern sets has a sufficient range to take care of all except the very highest signal levels, so the more likely explanation in such a case would be a fault in the a.g.c. system itself. As the contrast control is often tied up closely with the a.g.c. system, it can be checked by operating the control to see whether the picture can be turned right down. If the contrast control makes little difference to the picture then a fault in the a.g.c. system would be indicated.

A similar fault to this is sync on sound, caused by synchronising pulses, particularly the field pulses, getting into the sound stages. Normally this can only be caused by some components or valves that are common to both circuits. Some early Philips receivers employed an ECL80 triode pentode with the pentode as the sync separator and the triode connected as a diode sound detector. Interaction between these two sections led to sync pulses being injected into the sound detector circuit. Often several new valves had to be tried before one was found that would be free from the trouble, so a modification was used whereby a germanium diode was used

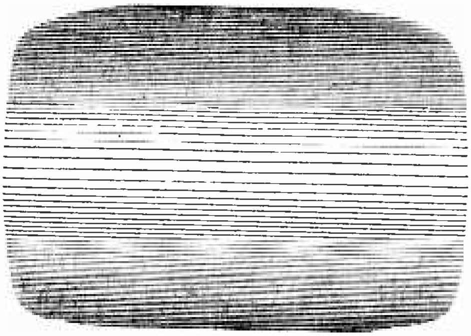


Fig 3: Hum on field.

in place of the triode. Sometimes sound and sync circuits may have a common decoupling capacitor which, if it goes open circuit, will lead to unwanted coupling between the two.

A fault which has a very similar sound is that caused when the sound is modulated by field pulses. It can very easily be distinguished from vision on sound or sync on sound by altering the field speed control. If the buzz is due to the field circuit the pitch of the note will alter immediately. Most likely cause of this trouble is open circuit h.t. decoupling.

GRID HUM

Yet another type of hum is that known as grid hum. This is due to there being no d.c. path between the grid and cathode leaving the grid "up in the air". This means that the impedance of the grid circuit is now infinity and under these conditions will be very sensitive to any stray hum fields that are about. Open circuit grid leaks are mainly responsible, although anything that is open circuit in the grid path, including dry soldered joints, will give this same effect. Hum from this source tends to be more harsh than normal although not so much of a buzz as that caused by sync, vision or field pulses reaching the sound circuit as described earlier. Grid hum can also appear in both vision and sound circuits and will give very similar symptoms to that already described.

It can be seen that there is far more to curing hum than just changing the smoothing capacitor. If the circuits affected are carefully observed then a speedy diagnosis and cure should result. ■

AERIAL RIGGERS' INTERCOM

December issue 1966

There is an error in Fig. 1 on page 120. The battery connections to tags 5 and 6 are shown inadvertently interchanged. This may be corrected by swopping over the two battery leads, also the tag numbers 5 and 6 at the connections to the printed circuit board.

Book Reviews

COLOUR TV TROUBLE CLUES
By the PF Reporter Editorial Staff. Published by Foulsham-Sams Technical Books Ltd. 128 pages, 8½in. x 5½in. Price 18s.

THIS book is written entirely from the practising serviceman's angle, citing actual cases of colour-TV troubles, including some really tricky ones, describing the symptoms, the tests made, the instruments that make them, and the clues to particular faults.

It is a painless method of instilling knowledge and to be recommended, provided the British reader always bears in mind that the eventual system on this side of the water will differ in some respects from the trans-Atlantic model.

Even if one has no intention of touching a colour-TV set—at least until familiarity has taken the edge off apprehension — the technique of imparting knowledge by passing hints and off-beat tips that this experienced group of writers has adopted should be of benefit to any television enthusiast.

Long live George, Herb and John, who appear to be blokes just like us, not some strange race of colour-gifted super-servicemen.—*MAQ*.

SERVICING TRANSISTOR TV
By Robert G. Middleton.
Published by Foulsham-Sams Technical Books Ltd. 223 pages, 8½in. x 5½in. Hard covers. Price 30s.

THIS book, despite its translantic origin, has the advantage of topicality. A growing number of receivers are employing transistors and the wholly transistorised TV will be the norm as certainly as the solid-state set has ousted the valved radio from its pride of place. Most of the TV circuitry is applicable to UK designs, and the servicing advice that Mr. Middleton gives is universal.

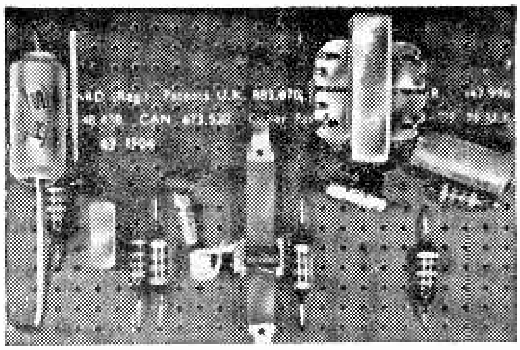
After one chapter on general considerations, i.e. typical circuitry, transistor circuit testing, expected voltages, Test Card analysis and a look at the special cathode ray tubes employed, he goes systematically through the transistor TV circuit, from tuner to power supply in ten well-written chapters.

Each chapter begins with a section describing the stage of the receiver under the spotlight, then enters into a general discussion of its peculiarities, proceeding to describe fault symptoms and tests in commendable detail, and concluding with a short questionnaire on the whole chapter.

This method is maintained throughout, helped by the generous amount of circuits, waveforms and picture symptom photographs that we have come to expect from this author.

The book is thus a useful reference volume as well as an easily-read text for the television engineer or spare-time enthusiast who has not yet had the opportunity of handling these quite different circuits—but knows he most certainly will.

Forewarned is forearmed, and this volume is as good as any we have seen to help build up one's stock of specialised knowledge.—*MAQ*



TELEVISION PRE-AMP

BABY ALARM

By A. Thomas

THE circuit described has been in constant use, with germanium transistors, for the past four years. Now that silicon transistors are easily obtainable and are relatively inexpensive, the author recommends that use is made of them. The original circuit has, in fact, been modified to accommodate them on a piece of Veroboard, which can be mounted almost anywhere on the television chassis. One should, however, be careful to keep the preamplifier away from components working at high temperature.

CIRCUIT DESCRIPTION

Figure 1 shows the final circuit. As it can be seen, the microphone input is fed via a miniature transformer which isolates the microphone from the television chassis. In some instances the TV chassis may be at mains voltage. If this is the case the L and N leads should be reversed. The microphone used by the author was a low impedance balanced armature type (a telephone ear-piece, but any low impedance microphone with a reasonable output may be used). One can use a high impedance microphone if the circuit is modified; bv including an emitter follower in the input to carry out impedance matching, as shown in Fig. 2.

The first stage employs a common emitter low current amplifier as does the second stage which has a potentiometer as a volume control in its collector. Output from the final stage, also a common emitter, is fed via a d.c. blocking capacitor and a high value resistor to a suitable audio point on the television set. The high value resistor

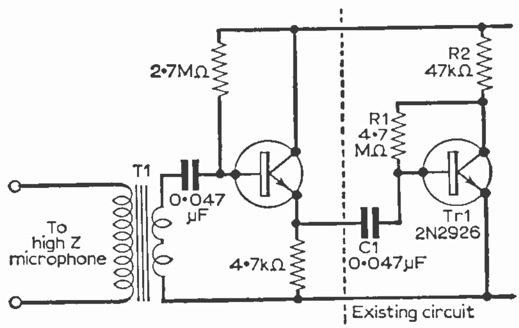
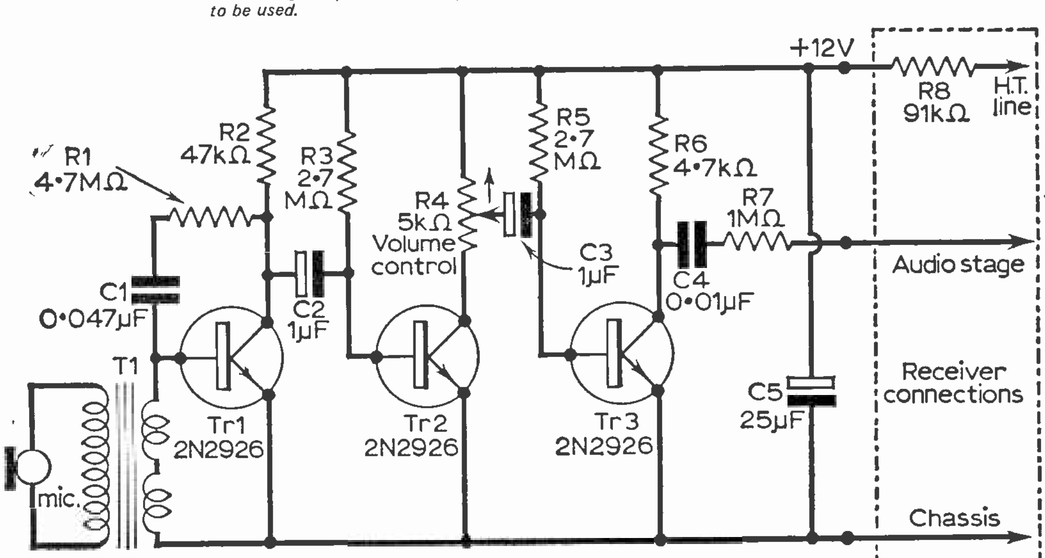


Fig. 1 (below): Circuit diagram of pre-amplifier.

Fig. 2 (right): Impedance matching unit that can be added to the standard circuit to enable a high impedance microphone to be used.



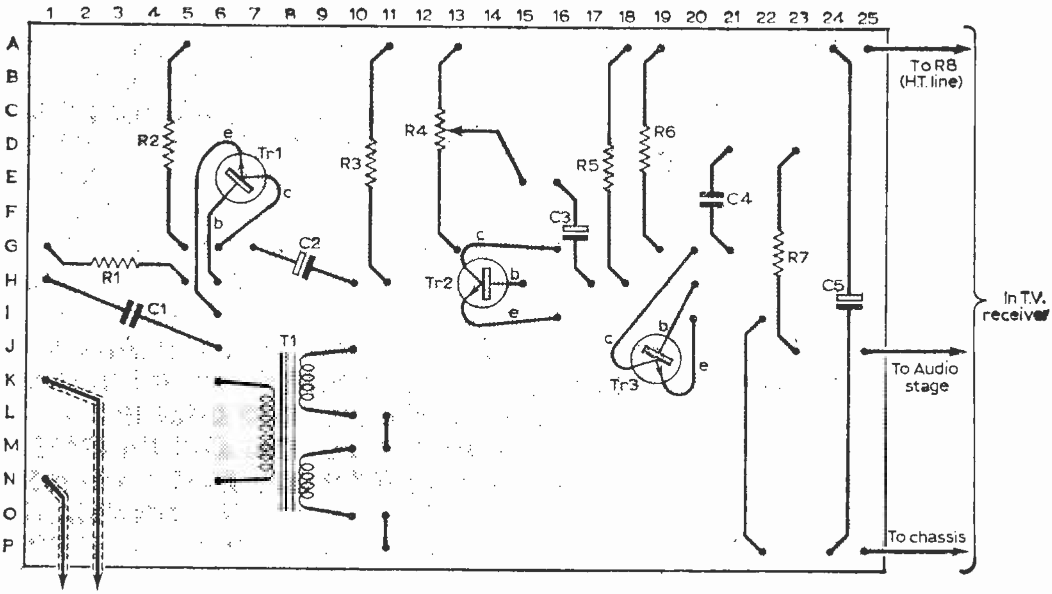


Fig. 3: Suggested component layout of the standard circuit using Veroboard

prevents the transistor amplifier from loading the normal television sound signal, but because of it a greater output voltage is required from the amplifier than would otherwise be the case.

On the author's set, a KB SV30FM, the most convenient point to inject the signal is on the wiper of the sound volume control. A general ruling cannot be given on the best place to inject the amplifier output, but the grid of the output stage is a good starting point on an unknown set. If a circuit diagram is available then the place may be chosen with ease. The signal connection from the amplifier to the set must be screened to prevent spurious signals being fed to the output stage.

The power to feed the amplifier can be taken from the main h.t. line of the set and fed via a dropping resistor to a decoupling capacitor. The drain from the h.t. line will be in the order of 2·5mA and will not adversely affect the television receiver. The h.t. may be tapped at any convenient point, the main smoothing capacitor often being the most suitable since one could go onto the boosted h.t. line by mistake. For the sake of safety, the dropping resistor R8 should be inserted at the h.t. end to ensure that high voltages do not appear on the Veroboard.

A 12V Zener diode may be used as a voltage regulator but is not thought necessary as the regulation of the transistor line voltage will not adversely affect the amplifier or the transistors.

If the Light programme or Home Service is heard in the output, this is due to it being picked up by the long microphone lead; it may be removed by putting a 0·01μF capacitor between the base and emitter of the first transistor.

COMPONENTS LIST

Resistors:

R1	4·7MΩ	R5	2·7MΩ
R2	47kΩ	R6	4·7kΩ
R3	2·7MΩ	R7	1MΩ
R4	5kΩ (preset, slider)	R8	91kΩ

Capacitors:

C1 0·047μF, 400VW
C2 1μF, 15VW
C3 1μF, 15VW
C4 0·01μF, 250VW
C5 25μF, 25VW

Transistors:

Trl-Tr3 2N296 (Green Spot)

Miscellaneous:

Radiospares transformer type T/T3, microphone (see text), Veroboard, screen lead, etc.

CONSTRUCTION

As previously mentioned, the amplifier is constructed on a piece of Veroboard as shown in Fig. 3. No difficulty should be encountered as there are only sixteen components.

The microphone input lead may be terminated in a coaxial plug, with a coaxial socket be mounted on the back cover of the TV. This can then be disconnected when not required. An on/off switch may be wired into the 12V power supply, but this was not thought necessary by the author. ■

THE WORLD OF SERVICE

Part 3: THE SPECIALIST ENGINEER

By G. R. Wilding

BECOMING a service specialist represents the easiest way for the competent service engineer to branch out on his own, for in the radio and television business it is becoming increasingly difficult for the small man with limited capital to compete with the national companies as a "selling" dealer. To the utter disbelief of the general public, no one makes a mint from pure service work, or at least no one the writer knows after lifetime of experience. It is easy, of course, for the layman to form that idea, and although (as in all trades) over-charging *does* occur, the customer is apt to overlook that additional to the time spent by the service engineer in his home attending to his set, there are the overheads of shop or workshop premises, van or car running costs, time travelling to and from the service call, phone bills and instrument upkeep. Conversely I know many "company" outside service engineers making up to 15 calls a day who think on the lines of *"If only I made a clear pound from each call, that would add up to £75 a week for five days' work"*.

The problem with this presumption is that to get an average of 15 paying calls per day, due to the high incidence of TV rental, one would require a bigger area of coverage than the average shop has. Furthermore, most receivers owned by possible clients are far from new, since most dealers offer two years' free maintainance with new sets: neither are set owners prepared—nor indeed is it good economics—to spend much time and money on sets whose life expectancy is limited.

Most set owners only want minimum servicing to keep the set working "till they get a new one". The slogan used to be "till the new lines come out," but now as TV is losing its grip and BBC-2 holds little attraction, in many instances, customers who don't like renting, consider that the general level of programmes fails to merit buying a new set. Also many sets are owned by pensioners and other people in the "lower income groups", to whom one is compelled to charge what may well be considered uneconomic rates.

There is no false charity about this work. If after being called to see a TV, and finding it old and in need of extensive repairs, circumstances sometimes compel one to make a nominal charge to cover whatever replacements and service work is unavoidable to produce acceptable results. The alternative is to waste the time and expense involved making the call at the house. It is far better to accept each individual case on its merits—at least cover working costs and leave the set owner well disposed. At the other extreme, exorbitant charges are the surest way of losing goodwill, no matter how high the income group of the customer.

While service work on average will produce a satisfactory income, *the cream comes from the sale of new receivers to those customers who over a period of time have found you to give good and attentive service.* You will be expected to take their old receiver in part exchange, but there is seldom any real objection to this as there is always a ready market for good used models, especially to your own clients happy to accept your personal assurances.

RECONDITIONING

The most lucrative part of being a service specialist is reconditioning used television receivers. As the number of service calls varies constantly, to keep fully occupied one must always have sets in the workshop awaiting attention. So at regular intervals you go around all the larger Rental Companies and buy their part-exchange stock, usually *en masse* and at what might seem ridiculously low prices, i.e. £5 for a complete car or van load. Many sets will be fit only for scrap, but as it can be quite a problem disposing of old receivers, most companies are prepared to sell you a bulk lot very cheaply so long as you *do* take the lot. There will always be some very good buys among them, and the beauty of reconditioning receivers is that once you know the types that give little trouble, you get the equivalent of the selling price for repairing it, since individually they cost no more than £1 when bought in bulk.

By spending some time on a known good type and possibly changing several valves plus, say, the rectifier, a few capacitors, any doubtful sections on the breakdown resistor and possibly a few pre-set controls, one can obtain up to £15 for them easily. It never pays to transfer seemingly tolerable valves from scrap sets to those you are about to recondition. Unless valves are obviously new and have been fitted by the set owner in a last minute attempt to solve the defects, discard them. Putting a new replacement in a reconditioned model where required will save a subsequent journey to the customer's home and having to change it there, apart from eliminating the customer's complaint.

There are many service engineers who say that they never seem to make any worth while money out of reconditioned receivers, but I have always found them to be the best part of the business.

Some independent service engineers run their own maintenance schemes, generally averaging about 3s. 6d. a week for 17in. or 19in. receivers following a complete overhaul at owner's expense. Possibly the most characteristic factor about TV service is that whoever wants it, and for whatever reason, wants it right away. If you mention car repairs or even servicing to a garage proprietor, they invariably murmur something about being free to look at it next Thurday or Friday. This is not so with TV repairs. Any request for TV service carries the unspoken assumption that it will be that day, and that you have been waiting their call to jump into action: so much so that if you don't advertise " Same Day Service " or " Radio Controlled Vans ", you won't get much business.

MOBILE WORKSHOP

The " ABC Mobile Workshop " type of approach which more or less guarantees to do any TV repair " on the spot " finds considerable favour. *"After all"*, argue set owners, *"if rental customers can get same day, on the spot attention—why not private set owners?"* Many set owners accept some pretty low reception standards, undoubtedly caused by the insidious nature of many set faults. For instance, after replacing a line circuit valve and restoring vision, you will possibly find vertical linearity way out, a badly contacting channel selector, maladjusted fine tuner or sensitivity control, focus off optimum and considerable variation in gain as the coaxial lead is moved about or the cabinet is knocked. On drawing the owner's attention to these faults, the reply usually takes the form of *"we never noticed"* or *"we thought the set was getting worn out"*. I have seen wooden chips jammed under channel selector knobs to improve ITA reception, rasters that take up to half an hour to fill the screen, EY86's so low in emission that scene changes constantly changed picture size and focus, intolerable sound-on-vision and vision-on-sound and focus so poor it was impossible to distinguish the individual lines.

All these faults and many more like them are tolerated by the owners for long periods, but ultimately lead to the set going off altogether. In the vast majority of cases, far from the set being " worn out ", an hour or so of quite simple servicing will completely restore the set.

TOP OVERHALL

This is where (to borrow a phrase from the motor industry) the "top overhaul" comes in. This means cleaning and adjusting the channel selector, setting the fine tuner where fitted so that both stations are received with the same knob setting, changing (probably) the field output pentode, r.f. amplifier, video pentode or sync separator where tests so indicate, cleaning the volume control and the pins of all valves which produce picture or sound variations when " rocked ", adjusting for optimum focus, balancing Band I/III reception, checking leads and plugs, setting subsidiary gain controls for best sensitivity with freedom from inter-modulation of sound and vision, and finally setting up on Test-Card " C ".

The price charged need not amount to more than a few pounds, depending on the number of valves used, but on seeing the transformation that such basically simple work produces, the owner will often assure you of his continued patronage and consider you a TV genius: so long as it doesn't go off again!

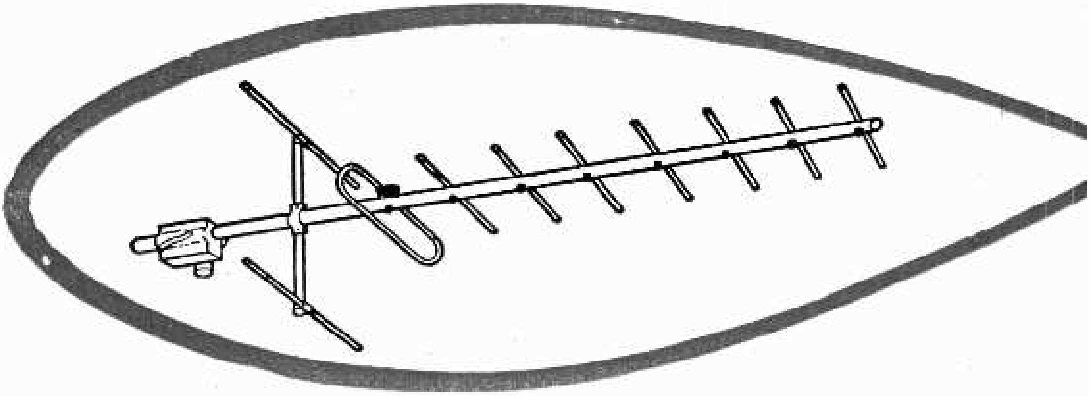
Unfortunately customers have the idea that once a service has been performed it automatically invalidates any further failures for at least six months. Change a video pentode and a subsequent fuse-blowing PY33 will be deemed your personal responsibility and in some way entirely entirely your fault. *"After all—I paid you 35/- the other week"*. Often a customer's idea of a week in this respect is about a month, a month equates to six calendar months, and " some time ago " is undoubtedly a couple of years.

NEW VALVES

Quite often when called to service a set, you will notice one or two gleaming new valves, and it usually transpires that the owner took all the valves to the nearest radio shop for testing. Obviously in any receiver after some years of use, every valve will have depreciated in emission to some extent. Many valves, such as those in the sound section, can reduce to 50% efficiency and still give adequate output, but set owners optimistically believe that any valve indicated by the testing machine as being below par will automatically cure whatever complaint the set has. Attempts by the shop assistant to clarify the indication are often regarded as pure guile. Try and convince a customer that replacement of a low emission PLC82 will fail to make any difference to poor BBC reception !

Similarly, customers buy new valves because the suspects run " too hot " or " too cold " or quite honestly for reasons I am never able to discover. I would say that on average, seven out of ten valves bought over the counter by the layman are completely unnecessary and inapplicable to the curing of the complaint.

In America hardly 1% of television receivers are rented, giving the TV repairman the whole field open to his services. However in this country the situation is almost reversed and the larger the city, the higher the incidence of rental customers.



THERE are more than three times as many usable channels in the u.h.f television bands than there are in the v.h.f. television bands. Each local reception area will eventually have a group of four u.h.f. channels: these groups have already been established. To start with, only one of the u.h.f. channels in these groups is used for BBC-2. Later the other three allotted channels will be put into use, probably to radiate colour-TV, ITV-2 and educational-TV (ETV).

If an aerial for each u.h.f. channel were needed, each household would at some time in the future require four u.h.f. aerials plus the ordinary v.h.f. aerials. Fortunately, this impossible situation will never arise because the majority of groups of four channels will run from co-sited stations and the u.h.f. aerial should have sufficiently wide bandwidth to embrace the frequency spectrum of the group of four channels as a whole.

Grouping of the u.h.f. channels has been arranged so that in most areas the four channels come within an 11-channel grouping, thus the aerial requires a maximum bandwidth of 88Mc/s. In a few areas of the country it has been impossible to maintain this ideal pattern, and in these places of special channel allocations there is a *wider* frequency span.

Table I

ELEMENT LENGTH AND SPACING DATA IN INCHES	FORMULA, WHERE f IS FREQUENCY IN Mc/s
Dipole	5616/f
Reflector	5976/f
First Director	5400/f
Subsequent Directors	Progressive 2·5% red.
Reflector/Dipole Spacing	3052/f
Director/Dipole Spacing	1546/f
Director/Director Spacing	1546/f

It has been agreed among makers of u.h.f. aerials that the u.h.f. spectrum be divided into three groups of channels. These channel groups are lettered "A", "B" and "C" and colour-coded

Table II

U.H.F. TELEVISION CHANNELS, FREQUENCIES IN Mc/s

Group "A"			Group "B"			Group "C"		
Channel	Sound	Vision	Channel	Sound	Vision	Channel	Sound	Vision
21	477·25	471·25	39	621·25	615·25	52	725·25	719·25
22	485·25	479·25	40	629·25	623·25	53	733·25	727·25
23	493·25	487·25	41	637·25	631·25	54	741·25	735·25
24	501·25	495·25	42	645·25	639·25	55	749·25	743·25
25	509·25	503·25	43	653·25	647·25	56	757·25	751·25
26	517·25	511·25	44	661·25	655·25	57	765·25	759·25
27	525·25	519·25	45	669·25	663·25	58	773·25	767·25
28	533·25	527·25	46	677·25	671·25	59	781·25	775·25
29	541·25	535·25	47	685·25	679·25	60	789·25	783·25
30	549·25	543·25	48	693·25	687·25	61	797·25	791·25
31	557·25	551·25	49	701·25	695·25	62	805·25	799·25
32	565·25	559·25	50	709·25	703·25	63	813·25	807·25
33	573·25	567·25	51	717·25	711·25	64	821·25	815·25
34	581·25	575·25				65	829·25	823·25
						66	837·25	831·25
						67	845·25	839·25
						68	853·25	847·25

by K.ROYAL

POINTS ABOUT U.H.F. AERIALS

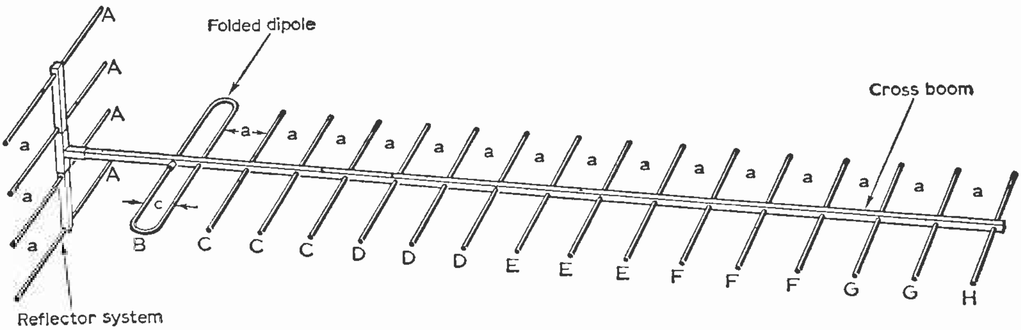


Fig. 1: Eighteen-element 'in-line' Yagi. From the dimensions given in Table III, it is a simple matter to construct a 'Group' aerial for u.h.f. reception.

Table III

DIMENSIONS IN INCHES											
CHANNEL GROUPS	A	B	C	D	E	F	G	H	a	b	c
"A"	10·9	10·8	9·5	9·0	8·9	8·3	8·0	7·8	4·45	4·45	0·7
"B"	10·4	8·45	7·4	7·1	7·0	6·5	6·3	6·1	3·5	3·5	0·7
"C"	9·15	7·15	6·25	6·0	5·9	5·5	5·2	4·8	2.95	2·95	0·7

red, yellow and green respectively. Group "A" takes in all the channels of Band IV (channels 21 to 34), while Groups "B" and "C" together cater for all the channels in Band V (channels 39 to 51 and channels 52 to 68 respectively). This grouping of channels means that an aerial or aerial amplifier purchased for the reception of BBC-2 in any given reception area will also respond to the other channels of that area's group when they become active. Some early u.h.f. aerials and amplifiers were 'peaked' to the first channel to go on the air (carrying BBC-2), and this applies especially to home-made equipment.

WIDEBAND AERIALS

Wideband aerials do not rapidly fall away to zero response outside their designed spectrum so it is possible that a fairly powerful signal outside the group would be received reasonably well on the originally installed aerial. In areas such as these, and there are not very many, aerial manufacturers will probably design units with bandwidth in excess of the normal channel groups. Already it is possible to get aerials with a wider bandwidth than the normal channel group.

Enthusiasts will always want to try for reception of distant u.h.f. channels, and already this is happening in places distant from the u.h.f. stations at present on the air. The author, for instance, has been receiving Channel 24 from the Isle of Wight over a distance of 100 miles. This cannot be considered as 'normal' reception, for a u.h.f. station does not consistently 'illuminate' an area extending much more than about 30/35 miles. Nevertheless, u.h.f. DX activities are likely to become popular as more and more u.h.f. stations go on the air and for this a 'peaked' or single channel aerial is best.

Most constructors, in fact, design their own aerials for a specific frequency, and formulae for determining the optimum lengths for the elements and spacings are given in Table I. To assist with the construction of such aerials, Table II gives the sound and vision frequencies of all the u.h.f. channels. Note: channels 35, 36, 37 and 38 are not yet allocated for television broadcasting in the United Kingdom.

Wideband aerials are far more difficult to design than single-channel units, as one has to achieve consistent matching, polar response, gain and so forth over the spectrum. It is not just the matter of working out element lengths and spacings. Much more is involved during basic development work dealing with tests of directivity, polar response and matching while the actual aerial is being 'tailored'. There are no 'standard' formulae available for determining these parameters and a considerable amount of trial-and-error work is involved.

A wideband u.h.f. aerial has to be developed as a complete unit, with a little added to the reflector, for instance, and a little taken from the directors as the practical development progresses until the end product satisfies all the various factors mentioned. There is more than one way of achieving the requirements, and it is for this reason that element lengths, spacings and so on of aerials of different manufacturers and home-designs rarely seem to be consistent.

The elements may differ a little in length and the spacings may not be the same; some makers may stipulate a balun in the aerial between the dipole and coaxial downlead and others may not; some makers may adopt specially-shaped dipoles while others stick to the conventional design seen in v.h.f. arrays.

As more and more u.h.f. channels become active, the possibility of co-channel interference will become very real. Protection from this interference is possible only at the aerial, and the front-to-back pickup ratio of the aerial will become important. The Post Office recommendation to manufacturers is for a front-to-back ratio of at least 16dB.

EXPERIMENTAL ARRAY

While u.h.f. aerials are not unduly expensive, enthusiasts will almost certainly want to make one. Table III gives experimental statistics for wideband arrays in Groups "A", "B" and "C" relative to the eighteen-element 'in-line' Yagi shown diagrammatically in Fig. 1.

The aerial has one reflector system, folded dipole and fifteen directors. The reflector system can be made up of four spaced elements, as shown in Fig. 1, or of a piece of metal mesh whose square is equal to the dimensions given in column "A" of Table III.

It is not intended here to detail actual methods of aerial construction since these have been given on numerous occasions. The aerial can be made for either outdoor or attic mounting, ½-in. diameter aluminium or alloy tubing being highly suitable in either case. The reflector and directors are not connected to anything electrically, though their centre points may be in contact with a metal boom. Similarly, the unbroken side of the folded dipole may be connected to a metal boom at its centre, but, of course, the two ends across which the feeder is connected must be insulated from each other and from the metal cross boom.

This sort of aerial will have a relatively high gain, a good front-to-back ratio and will be highly directional. This latter factor makes it necessary to orientate the aerial very carefully on a transmission for maximum signal pickup.

If this is done on a receiver, the line hold control on 625 lines should be carefully adjusted so that the picture is just slipping out of line lock. The aerial should then be rotated first one way and then the other for the maximum pickup, indicated by the picture pulling into line lock.

It is not usually possible to orientate on picture strength proper, as this is ironed out by the set's a.g.c. systems. One could probably orientate for minium picture grain, but small variations in grain (i.e., picture noise) are not easily discernible. ■

LETTERS TO THE EDITOR

CAN ANYONE REMEMBER?

SIR,—I wonder if any of your readers could cast their minds back to the days of medium wave television using the original Baird system and, in the light of their experience, help me to obtain some data I require to assist in the building of a photographic type of facsimile recorder for use with the American weather satellites, Essa II and Nimbus II. At present I am using a direct recording process which, though simple and convenient, cannot reproduce the finer gradations of the picture.

The information I require is (a) the type of lens system used to project a minute spot of light at a distance of some few inches and (b) details of a device which I believe was called a "Kerr Cell" which was used to modulate a fixed source of light with the picture information.

Although only a schoolboy when the 30-line TV system was in use I can remember some of the details, but I have really no idea where to start making inquiries.—J. B. TUKE, GM3BST ("Torbank", McMasters Road, Stranraer, Scotland).

VIEWMASTER COILS

SIR,—Can any reader of this journal supply me with details of Channel 1 coils for a Viewmaster TV? The original coils were made by Wright and Wearie Ltd., London and South Shields, and were Wearite iron-cored coils (Channel 3). I want to change to Channel 1.—ALEX CAMPBELL (1 Lochaber Road, Kinlochleven, Argyll).

ISSUES REQUIRED

SIR,—Could any readers sell or lend me a copy of the December, 1964, edition of PRACTICAL TELEVISION or the article containing details of the P.T. Videoscope from that issue?

I am willing to pay the full price of the issue plus any postage expenses that may be incurred. —R. M. DUNKLEY (80 Third Avenue, Dagenham, Essex).

SIR,—I would like to buy or borrow some copies of PRACTICAL TELEVISION so that I may get them photostatted. They are January, 1964 (I have February, 1964) and any of the following issues which contained the articles on the Flying Spot Transparency Scanner, also December, 1964, and any issues containing articles dealing with the Olympic II Transistor TV Receiver.—B. CAMERON (84 Pownall Street, Masterton, New Zealand).

The Editor does not necessarily agree with any of the opinnsio expressed by his correspondents.

Servicing TELEVISION Receivers

No. 132 - REGENTONE 195 and associated models—continued

by L. Lawry-Johns

No picture

If the sound is in order and is quite normal, it can be initially assumed that the h.t. is in order. If advancing the brilliance fails to produce any sort of raster, listen for the line timebase whistle (405 working). If there is no whistle check V8 (PL36) which is most likely to be at fault. It is possible that the glass may be cracked.

If the heater appears to be quite normal the valve may still be at fault. It may be found that some line whistle is audible and that V8 is not at fault but is still not passing current as evidenced by a high screen grid (pin 4) voltage, which should be 170V, although R556 (2·2kΩ) is correct. The answer to this one is that the drive to the control grid is biasing back the control grid of V8 due to a resistor (probably R559) going very high.

Another " no picture " condition occurs when C568 (0·25μF) shorts. This results in a strained line whistle which changes to a finer pitch with some e.h.t. when the top cap of the V9 (PY800) is removed which, of course, should result in complete cessation in timebase operation. This fault has often lead readers to write in querying why this should be so. The answer is, of course, that the shorted boost line capacitor allows the h.t. to pass through it, thus permitting the stage to function without the efficiency diode operating, to supply the first half of the scanning stroke. Therefore, if the stage continues to function with the top cap of the PY800 removed, immediately check C568.

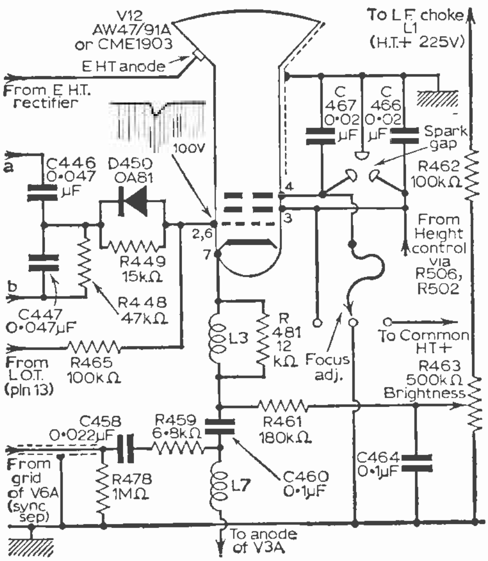


Fig. 4: Cathode-ray tube circuitry.

Shorted e.h.t. rectifier

An internally shorted DY86 (V11) e.h.t. rectifier (note: not EY86!) will also produce a strained line whistle which will return to normal when either its top cap is removed or the e.h.t. lead to the c.r.t. is removed. A completely normal line timebase whistle with evidence of high voltage at V11 top cap should again direct attention to this valve, this time because of an open circuited heater i.e., no heater glow.

E.H.T. in order but no picture

Quite often a condition of "no raster" can result, although the e.h.t. is quite in order. A voltage check on the c.r.t. base will probably reveal that the supply to pin 3 (A1) is absent. This can be due to R506 (3·3MΩ) being open circuit—and this is quite common, C466 being shorted (0·02μF) or C467 being shorted if the focus adjustment is joined with pin 3. A very dark picture results when C477 (0·25μF) shorts—which it often does, but this allows at least 200V to be applied to pin 3 and so permits the passage of some beam current. Do not expect to find any control voltage at grid pins 2 and 6 as the brilliance control is in the cathode circuit, pin 7, where minimum voltage represents maximum brilliance.

Sound with a blank raster

This implies that the sound is quite normal and that the screen can be fully illuminated with

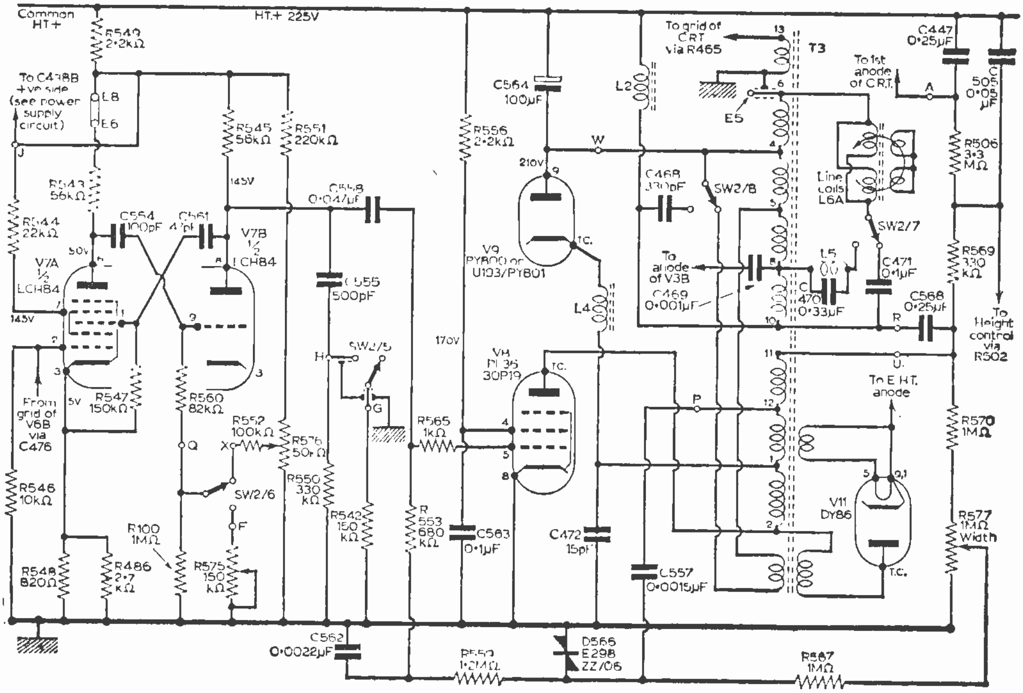


Fig. 5: Circuit of the line timebase

the brilliance control but that there is no picture modulation. The first suspect here is the video amplifier V3 (PCL84). Even though this valve may be defective a replacement will not always restore normal conditions if the faulty valve had an inter-electrode short. The diode (OA70) contained in IFTV3 may be damaged as a result. Secondary casualties may be resistors R123 and R152. Check all others for correct value, R115, R109, R122, R124 (18kΩ) can change, causing incorrect operating conditions for V3, resulting in poor sync and incorrect contrast. Damage may occur to 122 etc., with a virtual h.t. short once R123 2·2kΩ can no longer tolerate the heavy current flow, and itself changes value.

The field timebase

V10 (PCL85) is the field oscillator-output valve. A horizontal straight line across the centre could well mean that the valve has failed altogether, but if the valve is not at fault, voltage readings should be taken at pins 1 and 6 to ensure that these are present. Low or no voltage at pin 6 should direct attention to the field output transformer primary. Absence at pin 1 indicates the necessity to check R503 (680kΩ). and height control, R502 (470kΩ). C505 (0·05µF) could be shorted, thus dropping the available voltage not only to the height control but also to the c.r.t. 1st anode (pin 3) where the low voltage would still be sufficient to resolve a fairly bright straight line.

Bottom compression

This is a fairly frequent fault which can usually be attributed to a failing PCL85 or an open circuited capacitor C501 (500µF).

However, it is sometimes the case that neither is at fault, and when this is so, capacitor C511 0·0022µF should be checked, together with other linearity circuit components. The bottom compression may be accompanied by actual fold-over showing that the PCL85 is being driven into grid current. In this case check the PCL85 then capacitors C507 (0·003µF) and C511 (0·0022µF) for leakage.

Weak sync

Where it is difficult to lock both holds i.e., the picture tends to roll up or down and be erratic in a horizontal direction, attention should be directed first to V6 (ECH84) and associated components, particularly resistor R531 (680kΩ). Check video stage resistors if necessary. If only the vertical hold is affected check V6 pin 8 and pin 9 components and the interlace diode OA79 (D526).

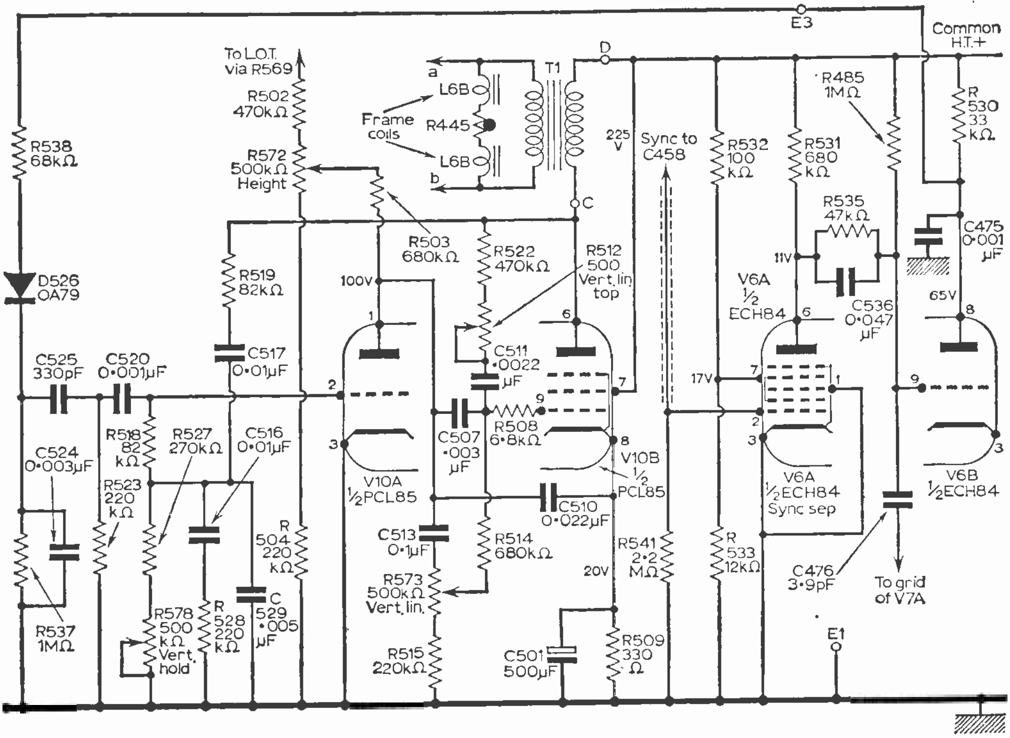
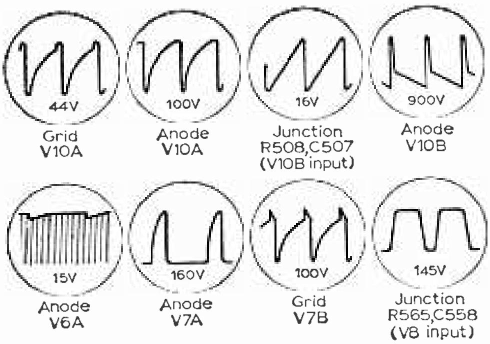


Fig. 6 (above): Field timebase circuitry.

Fig. 7 (below): Waveforms at various points in the field timebase circuitry.



The sound stages

On the 405-line standard the sound i.f. amplifier is V4 EF184 (or 6F30). While this is also an i.f. amplifier on the 625 standard it should be remembered that both V1 (EF183) and V2 (EF80) function as common vision and sound amplifiers, the sound then being picked off at the video amplifier. V5, PCL82 (or 30PL12) is the audio-output valve. Check this stage if no sound at all can be heard when the picture is normal. The output transformer primary (T2) can go open circuit resulting in no h.t. at pin 6 of V5.

Distorted sound

If all signals are distorted, check V5 and capacitor C106 (0·01μF). If only 405 signals are affected particularly on a strong signal, the effect minimised as contrast is reduced, check resistor R150 (5·6MΩ) which can "go high".

The a.g.c. system

The triode section of V3 is a pulsed a.g.c. amplifier which samples the video signal either from V3A anode (on 405) or V3A cathode (625), dependent upon the setting of SW1. Control of contrast is achieved by variation of V3B grid voltage, while balance of contrast between the two standards is achieved by means of the preset control R117 (5kΩ), adjustment being made on 405 line operation at low level of contrast (20V peak-to-peak). A.G.C. relay is obtained by the delay diode M3 (D135) and the 10MΩ resistor R132 connected to the contrast control slider.

Loss of height

If the lack of field scan is even top and bottom, check the height circuit resistors R502 (470kΩ), R503 (680kΩ), and R569 (330kΩ) (boost line).

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

THE period 20/12/66 to 22/1/67 has run true to form for Sporadic E reception under winter conditions, with long periods of inactivity enlivened by some brighter spells in January.

The earlier part of the period was poor for tropospheric reception as well, but showed remarkable improvement on all bands from 28/12/66 onwards, including some good u.h.f. results.

I believe that Boxing Day also provided reasonable openings according to my more temperate DX pals, but I must confess that I was a bit too involved at that particular moment!

At New Year I spent three days with L. C. Styles, an old DX friend, at Ingatestone, Essex. He is now exclusively a u.h.f. DXer, and it was a great pleasure for me to see N.T.S. Holland via Lopik, Goes, and Roermond u.h.f once again, after many months. Even in his favourable location conditions were far from good, but at least I returned home realizing that it was not necessary to tear my own gear apart to look for low-gain faults.

The brightest spot for Sporadic E was the 6, 7, and 8th January, with openings to T.V.E. Spain on E2, E3, and E4; the E3 on the 8th was first class and of long duration.

The tropospherics, including u.h.f., really opened up from 12th January onwards and I hope you have all done well since then.

NEWS

Rumania has been received via Bacau on Ch R1 (now 3·0kW up from 600 watts as originally used). Reception reported by F. Smales of Pontefract, and Cpl. Maden of Cyprus.

Cpl. Maden reports reception on 4/12/66 at 14.30 to 15.00 test card as per Data Sheet No. 7, and 15.30 to 16.00 GMT test card as per Data Panel No. 15. The transmission opened at 16.00 GMT, with clock and "Bucuresti" caption and this could well be a new one for most of us when the coming SPE/DX season opens.

France: O.R.T.F. has now commenced regular colour test transmissions as from 21/11/66 on u.h.f. bands 2nd chain all transmitters. Times as follows for Monday, Tuesday and Wednesday each week:—

16.45 to 17.30 (French time) Test cards etc.

17.30 to 18.00 (French time) Films and still photos in colour.

There is a colour transmitter now operating at the Paris Buttes Chaumont TV studios on Ch 28, at the following times:—

09.30 to 18.00 (French time) on Monday, Tuesday, Wednesday, and Thursday with Test cards, test patterns, and films or stills in colour.

Power details of this station are not yet known, but it is probably fairly low, as the service area is destined for the Paris region only, but there is always a chance! I myself have a tentative reception of this one already on 16/1/67.

Holland Colour transmissions also scheduled to commence in the Autumn of 1967.

METEOR SHOWER REFLECTED SIGNALS

As a follow-up to last month's notes on F2 layer reflections, I think that some notes on meteor shower (M.S.) reflections may be of interest. We have mentioned this previously in connection with the fairly recent Leonid and Geminid showers, but we will now deal with the subject in a little more detail.

When meteors travel through the E layer they are capable of leaving an ionized trail in a similar manner to the action of the sun's rays, the main difference being that the duration of the ionization is much shorter.

It is, however, often of sufficient intensity to enable a TV signal to be reflected back to the earth's surface from heights of 60 to 70 miles up, but it must be remembered that meteors are often of very small dimensions (like grains of sand), and the majority will not produce sufficient ionization for reflection to take place.

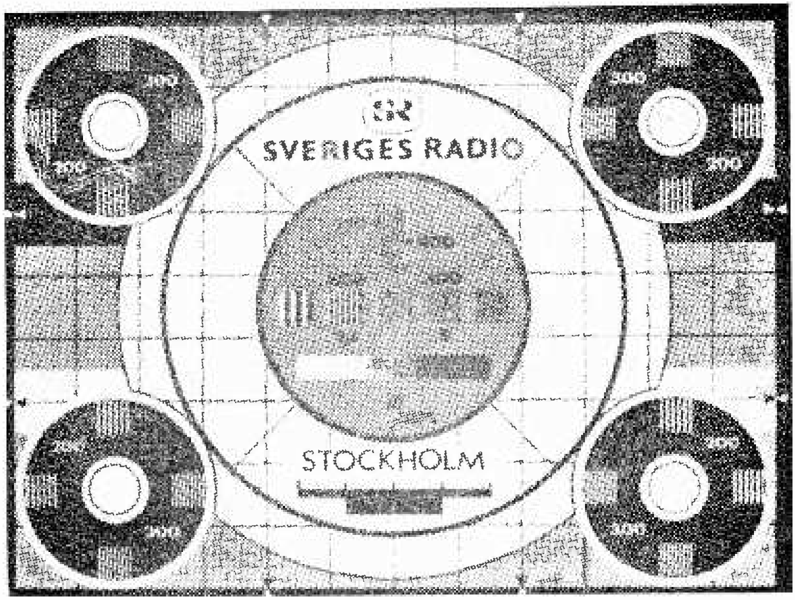
These random meteors fall throughout the 24 hour period at all times of the year, but it is usually only when they fall in showers that reflection is possible.

These meteor showers are predictable, and those falling in the Northern Hemisphere arrive at the following approximate dates:—

Quantarids	early Jan.	Perseids	mid August
Lyrids	mid April	Giacobinids	early October
May Aquarids	early May	Orionids	mid-late Oct.
Cetids	mid May	Leonids	mid-late Nov.
Delta Aquarids	end July	Geminids	early-mid Dec.

DATA PANEL-19

SVERIGES RADIO (S.R.)



Test Card: As photo (see notes below). There are some variations to the above test card in use.

(1) Some versions have a crown with arrows at the top of the inner circle.

(2) At times there is a rectangle containing a written caption across the lower part of the inner circle, the wording can be in various languages including English, and is in fact the title of the music accompanying the test card.

(3) At times (only too rarely!) the lower half of the card carries the name of the actual transmitter, ie, Vännäs. Boden, or Orebro, etc.

Channels:

Band 1: E2, Hörby, Vännäs, Orebro; E3, Skovda, and Sveg; E4, Stockholm, Boden, and Ostersund. All well received in the U.K.

Band III: Sweden is also occasionally received by tropospheric propagation in the North of the British Isles.

U.H.F: U.H.F. Hörby has been received in East Anglia by one DXer.

Reflections of TV signals are generally possible in Band I only, and are better towards the l.f. end of the band. Yes! I know that our radio amateur friends get reception on 144Mc/s by this method, but remember that the bandwidth is very small in comparison with TV standards. The distances over which reception is possible is about the same as short-medium Sporadic E, i.e. 500 to 1,100 miles.

There are certain clearly defined characteristics to be noted with M.S. reception. The signals received are of very short duration, or subject to very rapid changes in strength over several seconds, multi-path propagation with subsequent "smearing" of the image is also often present.

There is, of course, a problem here for short duration erratic signals are also characteristic of Sporadic E reception under certain conditions, and it can be very difficult to distinguish between this and M.S. reception. There is no hard and fast rule and I can only suggest that if during meteor shower periods we get sudden "flash-ups" of signals of about one second or less duration, these are probably M.S. reflections.

READERS' REPORTS

Still not much activity here; not surprising in view of recent poor conditions, but things appear to be better now, so we are awaiting news of your current successes, and will see what we can find for the Post Bag next month.

UNDERNEATH THE DIPOLE

BBC-ITV collaboration

CHRISTMAS viewers were unanimous in their preference for BBC-1 programmes, according to TAM and other audience measurement ratings which normally show ITV as the leaders. Perhaps the best single effort, from many points of view, was the joint ITV and BBC production "The Royal Palaces of Britain". This documentary was a fine example of collaboration artistically and technically, having an engrossing commentary by Sir Kenneth Clark and magnificent editing by Roy Fry of superb shots and background music. Thanks also to David Windlesham and Anthony de Lotbiniere: it was a delightful presentation of history as well as of bricks and mortar.

The 'whiter-than-white' paper

It is not surprising that the cheerful faces of executives of the television industry have become worried during the past few weeks — in fact, since the Government's White Paper on Broadcasting was published. "It takes a worried man to sing a worried song" might well be the musical background to an epitaph for a would-be progressive industry.

The Government's terms of reference have turned out to have the same theme as the Pilkington - Hoggart Committee's report; as down-beat and discouraging to independent broadcasting as it was (and still is) to independent television.

Competition is essential in show business. "Give the public what it wants—within reason" say the successful showmen. To give the BBC a monopoly for colour television for at least three years has caused dismay in many quarters (including some in the BBC) and especially among the manufacturers of television receivers.

Many people looked forward to a whiter-than-white Government White Paper; as bright as a barrage of rockets. Instead, it turns out to be a nine-page damp squib. The BBC will soldier on against fearful odds, hedged in on u.h.f. by mountains of skyscrapers, gas - holders and pylons. Nevertheless, when every lamp-post in the land is fitted with a miniature satellite u.h.f. transmitter, every man, woman and child in the land will be able to watch colour television—that will be really good!!! If the Greater London area already needs 34 u.h.f. transmitters of varying power to satisfy BBC-2 viewers in the black spots, how many transmitters will they have to install in the Lake District, Scotland or other hilly areas? Lamp - posts still have to be erected in some villages!

TV backroom melodrama

Old-fashioned melodrama faded from the theatrical stage generations ago, when the brothers Melville and Walter Howard presented "The Bad Girl of the Family", "The Midnight Wedding" and "The Female Swindler". Those were the days when the heroes were heroes (cheers! white spotlights) and villains were villains (hisses, supported by green limes). In this sophisticated day and mass-produced age every character seems to be villainous, down-beat and offensive. Of course, they are not all like that. Nevertheless, melodrama persists even in the modern idiom of theatrical plays, cinema films and TV technical areas.

"The Sins of Brema" is not, as you may think, a Restoration period play. It might well be an evangelical approach to the charms of d.c. restoration or Mothersole circuitry in television receivers, performed annually by representatives of the British Radio Equipment Manufacturers' Association (BREMA) before the Engineering Committees of the ITA, ITCA and BBC.

BSC & BREMA

The British Society of Cinematographers, that rather exclusive body of technicians generally referred to as Lighting Cameramen in film studios, who are responsible for the photography of large and small feature films for the cinema or for television, is not a large society. Its membership is limited (by invitation) to fully-qualified technicians. These gentlemen are aghast at the poor quality of the reproduction of their photography on the average domestic television receiver. They are mollified somewhat when they view their films on a television studio monitor on which the picture quality black-and-white (and sometimes in colour) is quite satisfactory. Because of this they refer to today's TV sets as having "beautiful reproduction easily made awful", the initials of which coincide, by mere chance, with those of the BREMA!

The British Society of Cinematographers refuses to be put off with the excuses *there is no demand for quality in television sets. The most important thing is the cabinet. The public will not buy sets which may require knob-twiddling. The viewers cannot tell good quality when they see it so why waste the money? The carpets and curtains are more important than the television set which should match them.* They are appalled to see the faces of their artists turn from light to dark skins rapidly according to the background behind them and many other of the horrors of "losing the mood" and making darkness into fog, etc. The BSC's idea of giving an award or medal to those sets which pass the test of giving reasonably good picture quality is a very good one and they are actively engaged in persuading members of BREMA to take notice.

Laugh, please laugh!

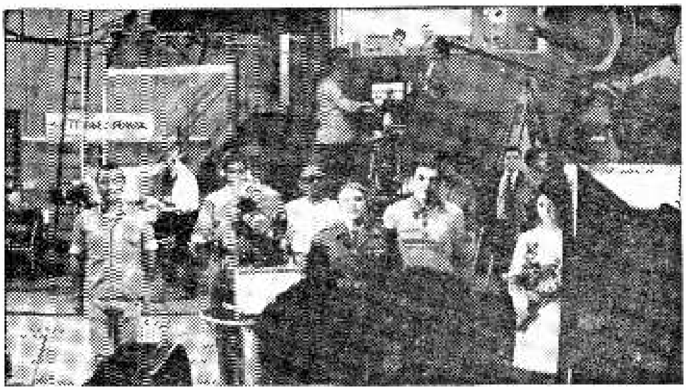
It is not easy for a solo comedian to be funny. He stands there alone with an audience waiting for him to be funny. How he waits! And sometimes still waits—for the slightest sign of approval or a chuckle, a giggle, or bless his heart, a big laugh! More difficult still is it for him to put on the same act in a sound broadcasting studio or a television studio, minus the audience. No reassuring chuckles encourage him and if the studio acoustics are lacking in reverberation like the first BBC "padded cell" at Savoy Hill, he may take fright and rush for the exit. A responsive audience in a studio is a valuable stimulant for just one laugh from just one of them can be contagious. If he tailors his funny gags to the laughter created by the previous wisecrack by accurate timing he can build up the comic atmosphere.

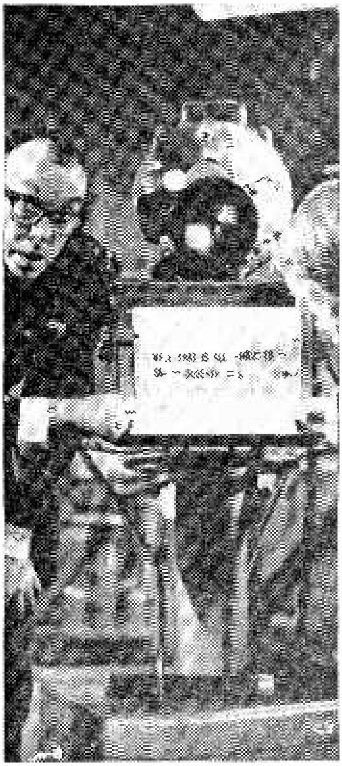
Double acts

Some of the most successful have been double comic acts. The classic combination of a "straight" man feeding a comedian goes back to characters in Shakespeare, to the first minstrels and to Evans' Supper Rooms. We remember affectionately Burns and Allen, Laurel and Hardy and more recently, Flanagan and Allen. Who will forget the splendid Tony Hancock and Sidney James team, who have never been singly quite so funny as they were in their classic double act situation comedy series. Equally successful were Steptoe and Son, whose character names are better known than their own; Wilfred Brambel and Harry H. Corbett.

Probably the most successful double act on television during 1966 has been Morecambe and Wise, whose split-second timing of well-written gags, physical as well as verbal, promotes laughter with the greatest of ease.

In this case, both are funny men who act as feed for the other, though Eric Morecambe inevitably seems to be the butt, whether in a television sketch or in a full-length feature film. In *The Magnificent Two*, a feature film production being made at Pinewood Studios, a television studio setting was built, complete with image orthicon cameras, video tape monitors and control





Attention for Parazuellian National Anthem! Ernie Wise, camera men and crew watch their president Eric Morecambe, make his presidential address.

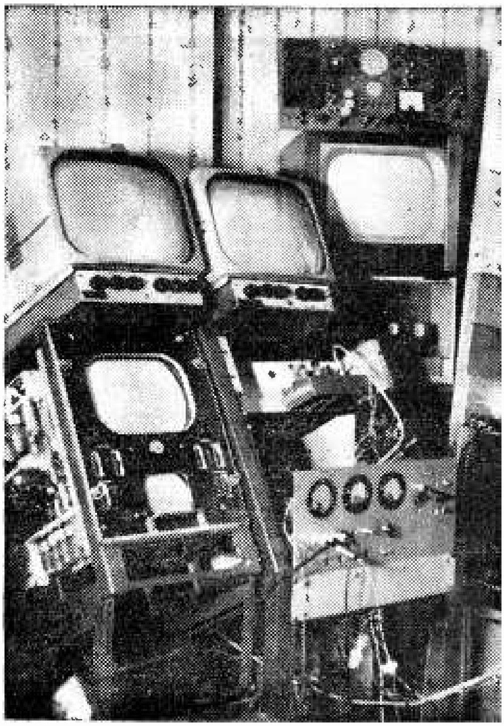
Left: Eric and Ernie playing about with one of the Teleprompters.

rooms. It represented the new President of a South American republic, Parazuellia, which was played by Eric Morecambe, making a speech to "his people". This television studio was actually a reproduction of the Westward Studio at Plymouth. Plenty of slapstick fun was made with the aid of Teleprompter, pedestals, cameras, microphone booms and other equipment as props, aided by a vociferous "Parazuellian" technical crew.

Many new technical complications are now arising during the production of feature films for the cinema, especially if they involve a mixture of film cameras, television cameras, monitors and lighting for colour. For the television studio scenes in *The Magnificent Two* the motion picture cameras had to be run at 25 frames per second (instead of the usual 24) so that they could be synchronised with the pictures on television monitors in the scenes. By using a motion picture camera with a mirror-shutter at that speed, the camera operator can observe the "hum bar" (which looks like the frame-line between each picture on a film). This enables him to check the synchronisation and phasing, and ensures that one of the interlace fields is (almost) completely photographed. Also he has to balance the intensity of the monitor picture with the rest of the scene. Further complications arise when video tape is played off and reproduced by monitors in a scene.

Morecambe and Wise have no difficulty in maintaining their pace and timing perfectly without needing laughs from an audience. But they are well aware of the difficulty the technical crews have in stifling their laughs during the shooting of many of the scenes.

Iconos



IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part IX

LAST month we were discussing cut amplifiers and a further circuit for inter-field cutting is shown below.

A very compact layout of cut amplifiers has been achieved by using the plastic "buttons" used to protect B9A valve pins on new valves. The small components are mounted between "pins". These are "wires" that are fitted through the holes in these buttons. The whole assembly can then be plugged into a valve base. Numbers on Fig. 51 (last month) refer to the pin connections used. The partially completed bank of cut amplifiers are mounted on a 19in. rack panel; two fade amplifiers and a stabilising amplifier are also mounted to form the complete vision mixer controlled from a remote panel.

In order to fade vision, a potentiometer could be used but it would need to be integrated with an amplifier, as if co-ax cables were used to remote it, the potentiometer would not match the impedance of these cables. A constant impedance potentiometer system is commonly used and these are called faders. The quadrant fader used has a 75 ohm input and output impedance. This means it can be used with coaxial cables to feed the video to and from the mixer control panel. Faders are, unfortunately, expensive to buy as they are high quality stud contact switches with two rows of about 30 studs connected to high stability resistors in a bridged "T" configuration. Capacitors are also used to improve the high frequency response. The B.A.T.C. might be able to assist in obtaining second-hand faders, but they are in great demand. As with all other mechanical devices, flashing due to dirt on the fader contacts is a considerable problem.

Fortunately, simple transistor circuits have been developed which vary their gain in response to d.c. applied from a potentiometer. Instead of obtaining the bias from the usual rotary potentiometer, a linearly operated potentiometer could be used. These potentiometers have only recently been introduced into this country and are remarkably cheap. Their linear movement makes them ideal for use in sound and vision mixers where swift operation is required. The neat appearance of these is also an asset. They are obtainable from F. W. O. Bauch, Holbrook House, Cockfosters, Herts, at about 15/- each, by quoting Type No. 62ZW. In the range of potentiometers available, are log and linear

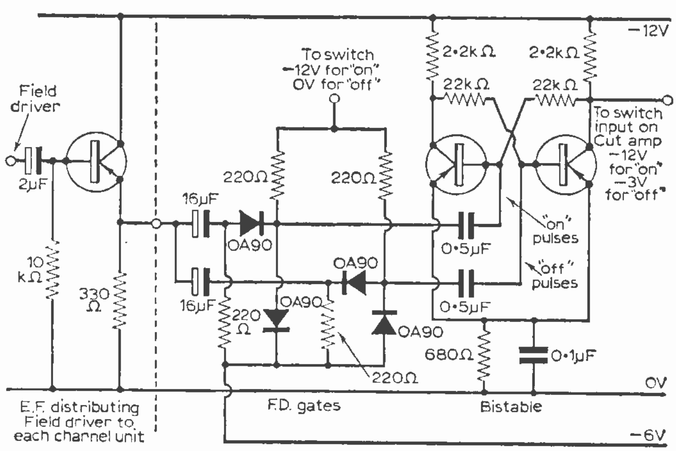


Fig. 52: Additional circuitry for inter-field cutting.

types in a wide variety of values; however, the potentiometer used here is a 10kΩ linear type.

The bias from this potentiometer is fed to the bases of a long tailed pair of 2N711's. Varying the bias alters the gain, and most of the non-linearity inherent with this process is eliminated by the difference amplier action of this circuit. This circuit (Fig. 53) can be used as a cut amplifier by switching the bias to it. A maximum gain of about 10 is obtained and so the input must be about 0·1 volts of video. The losses in the cut amplifier conveniently compensate for most of this gain.

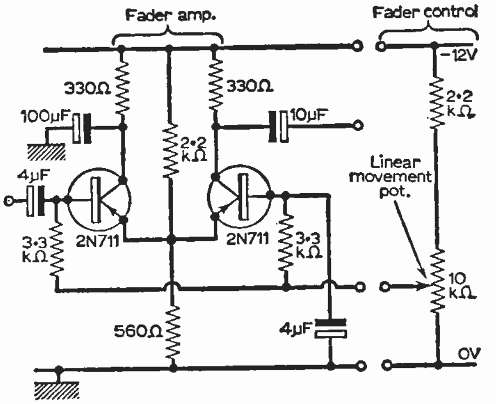


Fig. 53: Circuit of the fader amplifier.

VISION MIXERS

Two types of vision mixers using these cut and fade amlifiers are shown in Figs. 54 and 55. Many other types of vision mixers are used, mostly consisting of combinations of these two basic types. Figure 54 shows A/B mixer with two banks of cut buttons, the output of each bank feeds a video fader. Each source appears on both banks so if Camera 1 is selected on the A bank, Camera 2 can be selected by cutting, simply by depressing its button on the A bank, or can be mixed to by selecting it on B bank and fading A bank down and B bank up. Obviously, by this means, any source can be cut to or mixed to any other (providing they are both synchronous). For convenience the potentiometers controlling A bank and B bank faders are wired in an opposite sense so movement of the two potentiometers together effects a mix. The output of the fader amplifiers are combined and feed a stabilising amplifier where syncs. are re-inserted, as the syncs. through the fader amplifier will vary in amplitude along with the vision. This circuit will be dealt with later.

Unfortunately, non-sync. sources, i.e. those from another pulse generator, which have not been genlocked to, cannot be treated in this way as their syncs. will not coincide. Neither can two sources not in exact synchronism be mixed one with the other or even faded down (without sync. separation, re-generation and re-insertion!). Non-sync, sources, then, are selected after the output of the stabilising amplifier by cut ampliers and these cut amplifiers, along with the sync. source cut amplifier, are combined to feed an output amplifier. There is absolutely no point in using inter-frame cutting for these ampliers as field drives are unlikely to occur during the field

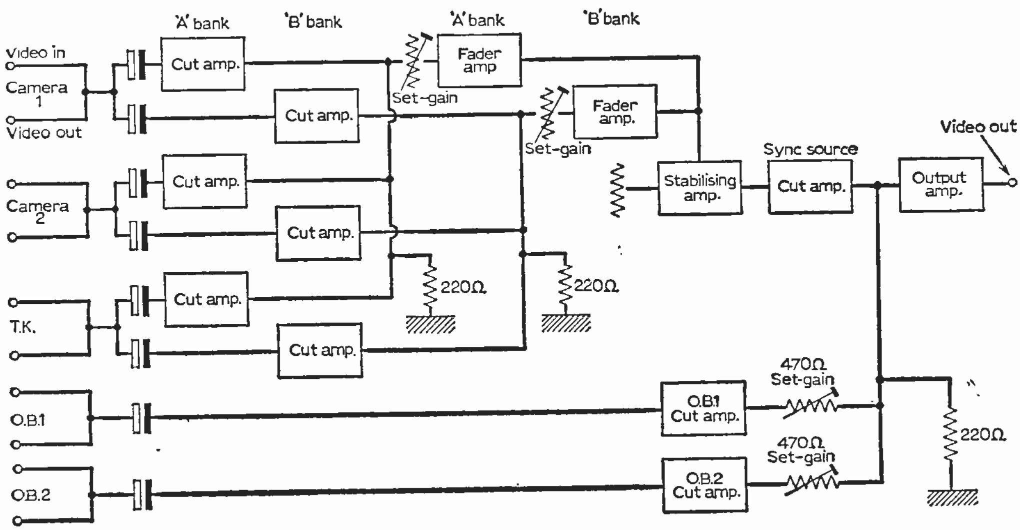


Fig. 54: A/B vision mixer chain.

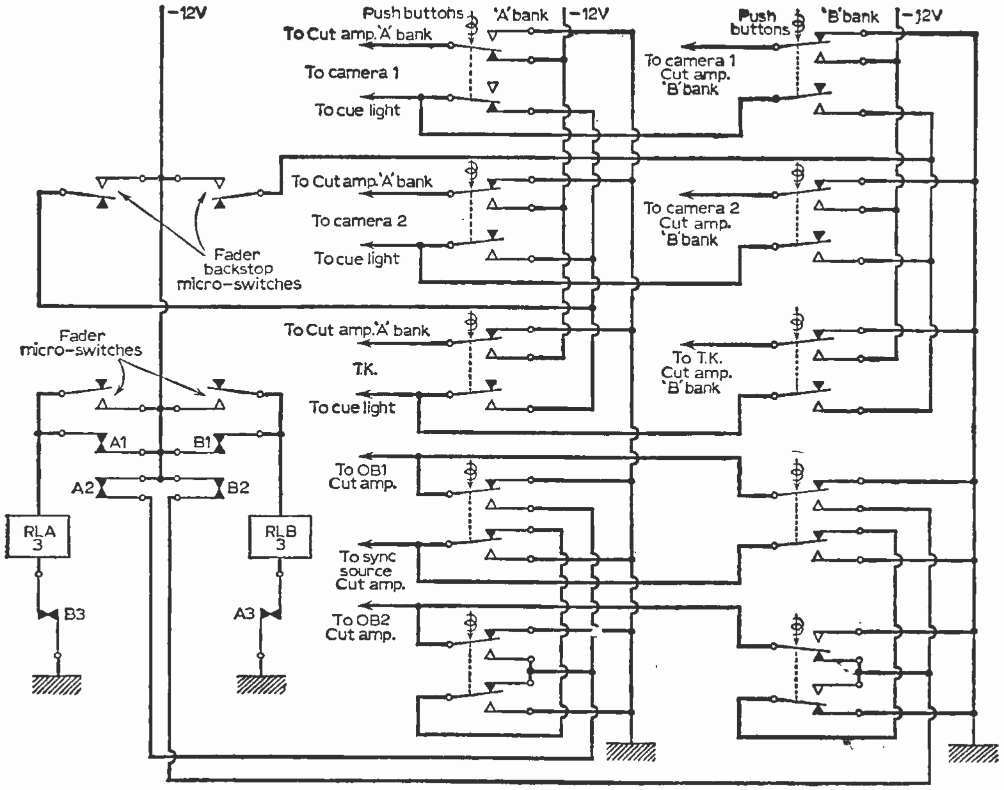


Fig. 55: A/B mixer d.c. switching.

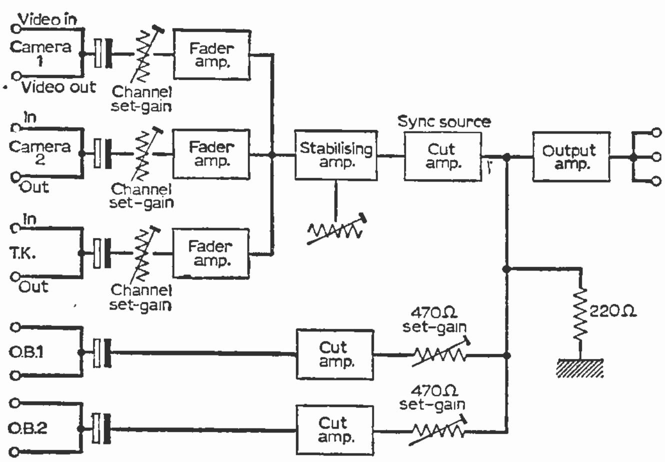


Fig. 56: Vision schematic for cut/fade vision mixer.

period of the remote syncs., and in many cases a scan disturbance is unavoidable when cutting to non-sync. sources.

The d.c. control circuitry for the A/B mixer is shown in Fig. 55. Micro-switches operated at the fader full up position energise a latched relay which in turn energises non-sync. source buttons on the bank corresponding to that fader. Latching is interrupted by the other fader so that the non-sync. source button of which ever bank is faded up are operative. A second set of micro-switches on the faded down position on each fader feed cue lights via the push buttons. On fading up either bank the micro-switches operate and feed the cue lights of the camera selected. The two non-sync. sources are usually referred to as O.B.'s., and labelled O.B.1, O.B.2, etc. Although cue lights are not usually fed to O.B.'s., it is common practice to arrange an indication of the source selected either by an illuminated sign adjacent to the transmission monitor or on the vision mixer control panel or both. If this is required, the feed to the

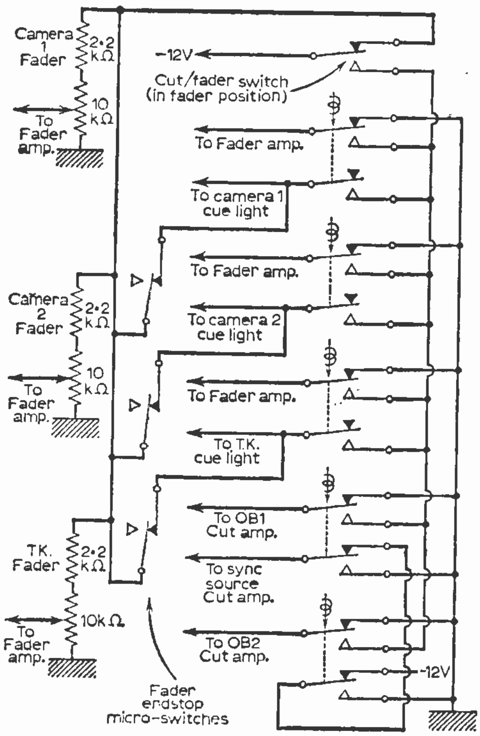


Fig. 57: D.C. control of cut/fade vision mixer

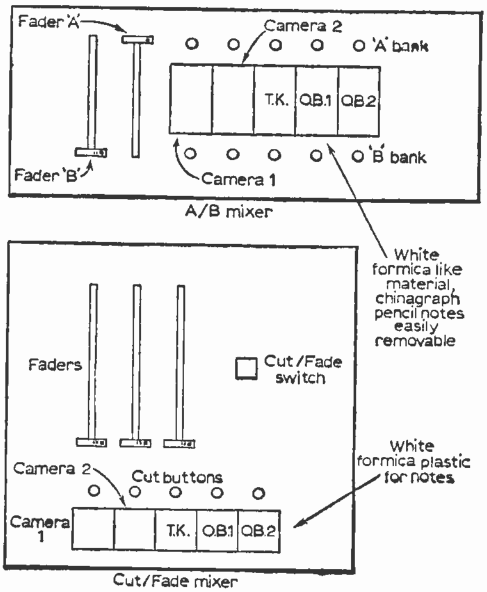


Fig. 58: Layout of mixer control panels.

O.B. cut amplifier can be used to control a relay operating these lights.

Potentiometers (1kΩ) are used to adjust the balance between the two banks and a 470Ω series potentiometer sets the gain of each non-sync channel in respect to the sync. source output. The approximate gain of a fader amplifier is a maximum of 10, so about 0·1 of a volt video should appear at the input. This is set exactly with the amplifier faded up by adjusting the set gain to exactly 1 volt at the output of each amplifier. The non-sync. channels are also set to give a similar amplitude sync. sources at the output of the cut amplifiers. Sawtooth is used for lining these channels up. A suitable layout for the control panel is shown in Fig. 58, along with the other type of mixer, known as the cut/fade mixer (Fig. 56). The layout is very important as the method of operation should be obvious to the operator. Both these control panel layouts are commonly used in professional equipment and hence are proved. Temporary notes can be made with a chinagraph pencil on a white formica type plastic placed near or below the rows of cut buttons, allowing a special identification of sources. The vision control panel should be mounted at least 9in. from the near edge of the desk to enable scripts or notes to be placed on the control desk without obstructing the controls.

With this type of mixer each sync. channel has a fader control and cut button. Non-sync. sources cannot easily be faded, as mentioned previously, so that only cut button selection is provided. The sync. sources are fed to a fader amplifier which is controlled by bias from the cut buttons or from the faders depending on the position of the cut/fade switch. This is followed by a stabilising amplifier then the sync. source cut amplifier. This cut amplifier and the non-sync. source cut amplifiers select sync. or non-sync. sources and feed it to the output amplifier. As before, the set gains of the sync. channels are adjusted to give 1 volt of video at the output of each fader amplifier when faded fully up. Non-sync. channels are adjusted as before. The d.c. control circuitry which is considerably simpler than for the A/B mixer is shown in Fig. 57.

Although for simplicity both mixers are shown as having three sync. and two non-sync. channels, it is advisable to build a more complicated mixer, say 6 sync. inputs and 4 non-sync. inputs, although not all of these channels need be constructed until required. This large capacity allows for use in exhibitions with cameras belonging to other amateurs, as well as other facilities to be decribed, such as Inlay.

The A/B mixer only allows two sources to be superimposed simultaneously and may appear more complex, but it has the advantage of being very convenient to use with Inlay equipment, to be described. Cut/Fade mixers allow the superimposition of any number of sync. sources. Professional equipment often features a combination of both types of mixer, for example, many BBC studios use an 8 channel cut/fade mixer as each bank of an A/B mixer, with facilities for cutting between either bank. Many other types exist, and it is for the constructor to decide on the type and complexity of the mixer he may wish to use.

TO BE CONTINUED

Gas in valves and tubes

by K. T. Wilson

THE home experimenter encounters the gassy valve usually in the form of a blue glow in the sound output valve, sometimes accompanied by severe audio distortion and ending up in fuse blowing. To the professional valve-maker, gas is a subject of great concern, signifying a faulty pump system, in which case several pump-loads of valves may have to be rejected; worse, it may mean faulty seals in a batch of several thousand valves and subsequent mass scrapping.

The gas, of course, is usually ordinary air, for the valve-maker calls gas anything which isn't solid, liquid or vacuum. In the case of a newly pumped valve at the factory, the gas, or lack of vacuum, may be due to factors outside the valve, such as a leak in the pump system. In the case of a valve which has passed factory tests and gone out to the customer, the gas must be due either to leaks in the valve itself or to gas generation inside the valve.

GLASS-TO-METAL SEAL

The leak is the most common fault. The modern valve has a number of glass-to-metal seals forming the electrical leads into the valve. These seals consist of metal and glass which are carefully chosen so that they expand and contract at the same rate; if it were otherwise the seal, which is formed at a temperature at which the glass is molten, would crack and be useless as it cooled.

During the heating process in which the glass is melted round the metal pins to form the seal, the metal oxidises, and the oxide which forms dissolves in the molten glass, causing a distinctive colouration. An expert can judge the goodness of any glass-to-metal seal by looking at the colour of the dissolved oxide.

There are some things which the most expert eye cannot see, however. If there should be a minute scratch down the pin before sealing, the glass will not penetrate to this portion, and a path will be left along which air can trickle into the finished valve.

If this leak is large, it will be detected by the processes to be described later; if it is very small, it will probably pass undetected, to cause a "gas" failure later on in the life of the tube. As fate would have it, this often happens just outside the guarantee time!

PINS

The remedy for this sort of thing is very great care with the pins at all stages. Valve-makers insist that the material of the pins be tested for purity, that it should be machined only in certain ways (for example, by centreless grinding), that it should be finished to a very high degree of surface smoothness that it must not touch anything which might corrode it (even the oils used during machining must be special non-corrosive types), and that the finished pins must be carefully inspected, and accepted only if less than a very small percentage of a sample is found defective.

With continual care, then, the valve-maker tries to keep down the number of leaks. Some will always get past, for he cannot afford to inspect and test everything; besides, he has no way of testing for very small leaks and must rely on the care which he takes in the selection of his materials.

GENERATION OF GAS

So much for leaks; what of internal generation of gas? Internal gas can come from any part of the valve, and can be caused by either incomplete outgassing of the components or poor cathode processing. Let me explain what these phrases mean.

As far as the amounts of gas which worry the valve-maker are concerned, all materials are to some extent spongy. Most of this sponginess is just at the surface of the metal or glass or ceramic, though it goes in layers in mica. All the parts of a valve have therefore soaked up gas in quantities enough to cause trouble, and something must be done about this before the valve can be assembled and pumped.

In the case of the metal parts, this "something" is hydrogen furnacing. The metal is heated to a very high temperature, often 800—1,000 degrees Centigrade, in a furnace filled with hydrogen. Providing that the metal has been thoroughly cleaned before the furnacing, this has a remarkable cleaning effect, removing stains and oxidation, and, more important for our purpose, replacing the various gases which have soaked into the metal by pure hydrogen.

It may seem a bit pointless, heating up the metal to remove the mixture of gases it has absorbed, and then letting it soak up hydrogen as it cools down, but there is sound reasoning behind it all. If the metal were heated in a vacuum to remove the mixture of gases, it would simply soak up the gas again during the assembly of the valve, which cannot be done in vacuum. If, on the other hand, it is allowed to saturate itself with hydrogen then very little of any other gas will be absorbed during the time that the parts are exposed to the air.

Furthermore, hydrogen is the lightest of all gases, and we can easily extract all the hydrogen from the metal parts by giving them a break during the time when the valve is being pumped out. This break will also remove the water vapour from the glass of the valve, another source of gas. To make sure of complete gas removal from the metal parts, they are often heated to a dull red heat by induction heating from outside the valve during pumping.

ACTIVATION OF CATHODE

The activation of the cathode is what turns an assembly of parts in a vacuum into a working valve. The cathode of most of the valves commonly encountered consists of metal oxides, those of the metals barium, strontium, and sometimes calcium coated on a nickel cylinder inside which the heater wire is inserted. The trouble is that the oxides cannot be put on the cathode cylinder beforehand, they must not be exposed to air if they are to emit electrons properly; they are therefore formed within the valve.

To do this, the carbonates of the metals are coated on to the cathode cylinder, and these are converted to the oxides, while the valve is pumping, by applying volts to the heater. The carbonates are then converted to the oxides and the gas, carbon dioxide, is liberated in the reaction known to all schoolboy chemists as the burning of lime.

This process releases an enormous amount of gas, which must be pumped completely away before the valve can be sealed up and removed from the pump.

THE GETTER

It can be seen that there are many sources of gas inside a valve, and these would make valves useless if we did not use a getter. The getter is a film of a highly absorbent metal which can soak up thousands of times its own volume of gas.

Since the getter is not heated by the heater or struck by electrons, it does not heat up to any great extent and releases this gas, and valvemakers are careful to place the getter, which is released inside the valve by induction heating after the valve is sealed, in a cool part of the valve.

The getter will soak up gas in a valve until it is exhausted, after which the valve will be useless. This is usually what happens in the case of a slow leak. If the gas comes from inside the valve, however, as often happens when a valve is used after a long period of disuse, the gas which is released rapidly will be steadily mopped up by the getter.

It is this effect which is the cause of so many puzzling failures. The equipment is switched on, and the heating of the large cathode of an output valve, always the worst offender, releases some gas, This, as will be shown later, produces excessive current in the valve, causing overheating, which releases more gas, until the excessive current blows a fuse or causes some other breakdown.

Once the rush of gas is over, though, the getter can cope with the job of mopping up, and by the time the puzzled owner of the equipment has removed the valve and tested for gas, the valve seems perfectly sound. This can happen several times until substitution of a new valve proves that hot gassing is the cause.

ELECTRON BEHAVIOUR

So much for the causes of gas in the valves. The effects are better known, though the reasons for them are not. The root of the trouble is that electrons in valves travel in vacuum. Large, slow moving particles of gas constitute an obstruction to the small fast electrons and reduce their average speed.

In the presence of gas particles, electrons in a valve or c.r.t. travel from one collision to another on their way from cathode to anode, and each of these collisions mean that the electrons must start accelerating all over again.

Physicists have a term, "Mean Free Path", which means the average distance which an electron can travel before colliding with a gas particle (or molecule), and as you would expect, this Mean Free Path is longer as the vacuum is better, since there will be fewer gas molecules to collide with.

The importance of this idea can be seen by comparing a c.r.t., where the electrons have to travel many inches on their way from cathode to screen, and a u.h.f. triode, where the distance from cathode to anode is measured in thousandths of an inch.

The collisions of electrons and gas molecules have consequences even more serious than the lengthening of the means free path. Each time an electron strikes a gas molecule at high speed, it breaks it up, first into atoms, then further into ions and more electrons.

The ions, being positively charged and heavy, drift lazily toward the cathode, but the electrons are accelerated toward the anode like any other electrons Each of these electrons can in turn strike a gas molecule and cause further breaking-up, or ionisation, as it is called.

When large numbers of extra electrons are created in this way, the current flowing to the anode is no longer controlled by the grid, and can reach destructive proportions, unless it is limited by external impedances, as is the case in circuits designed for gas-filled valves.

Even if the ionisation does not proceed to the point of complete breakdown, the cathode of the valve can be destroyed by the bombardment of the positive ions which are attracted to it; such cathodes usually show a brown discolouration.

ION BURNS

Negative ions can be produced also; they are of little consequence in valves, but can lead to rapid discolouration and loss of brightness of the screen, since they are attracted to the positive element. Being heavy, negative ions are not so readily deflected by the scans as electrons, so the ion burn in a c.r.t. usually consists of a brown spot or blob in the centre of the screen.

We have known for a long time how to avoid this affect, either by aluminising the screen (aluminium being fairly porous to fast electrons but opaque to the large slow ions) or by tilting the electron gun and straightening up the electron beam by means of a magnet. In this case the ions are not deflected and strike the walls of the tube harmlessly.

The formation of the positive ions in a valve also accounts for another feature of a gassy tube. On their way to the cathode, the ions encounter electrons, and if they encounter electrons which are not travelling too fast, they may recombine to form atoms of gas again. Energy had to be absorbed to ionise the atoms in the first place, and the same amount of energy must therefore be given up when recombination takes place.

This energy is given out as light, and the amount of energy determines the colour of the light, usually blue. This is the explanation of the well-known blue glow in gassy valves.

ION GAUGES

The formation of positive ions in a gassy valve has a very practical use, however, apart from deliberately gas-filled valves, for it enables us to measure the pressure of the gas which is causing the bother; and in the pumping of valves, the ion current may be used as the measure of the vacuum of the system.

Special valves, known as ion gauges, are made for this purpose, and used when a very high degree of vacuum has to be measured with precision. These gauges are of a simple construction (see Fig. 1.) and consists of a hairpin-shaped filament, a spiral of thin wire around it to act as a collector grid, and a pin or another hairpin filament to act as anode.

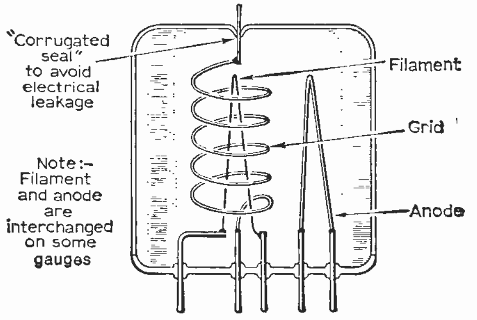


Fig. 1: Electrode structure of an ion gauge.

Arrangements are often made for all the elements of the gauge to be heated red hot by passing current through them; this drives off any gas which may be absorbed in the metal of the gauge, as it would be pointless to try to measure the vacuum in a pumping system if the gauge were giving off more gas than the rest of the system.

The wire used is usually Tungsten or Molybdenum. In either case it has a very high melting point and can stand high temperatures. In use, the anode hairpin is put at about 100V positive and the grid at a few hundred volts negative.

The filament is then heated until electrons are emitted and a fixed anode current, say of 25 milliamps, is reached. The negative current at the grid then consists entirely of positive ions (discounting leakage resistance) and can be directly measured, usually in microamps or less. The gauges are usually calibrated against other types of gauge of known accuracy. (See circuit, Fig. 2.)

In a form of this gauge, known as the Philips Gauge, no hot filament is used. Instead, the cathode is of pure metal, and a grid at a potential of a thousand volts or so is placed very close to it.

The electron emission from such a system is very small, and so a magnet is used to make the path of the electrons into a long spiral where their chance of knocking into several gas atoms is greatly increased.

ION PUMP

A development of the ion gauge is the Ion Pump. We have seen that the negative current at the grid consisted of negative ions, but what happens to them when they reach the grid?

First of all, they must give up their negative charge to the grid; they then become single atoms. In their normal state, however, these gases are molecules, two atoms linked together, and when they are in the single atom state they desperately want to combine with something else.

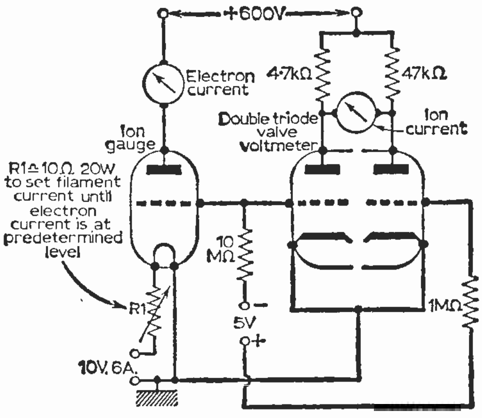


Fig. 2: Method of setting up ion gauge.

The nearest thing available is the metal of the grid, and combination with this takes the atoms out of the gaseous state. They can be recovered only by heating, which is why we heat up the electrodes of the gauge before allowing it to start its work.

In one form of this ion pump, the ions are gathered on a freshly prepared getter surface, the favourite material being Titanium; this form is known as the Getter-Ion Pump.

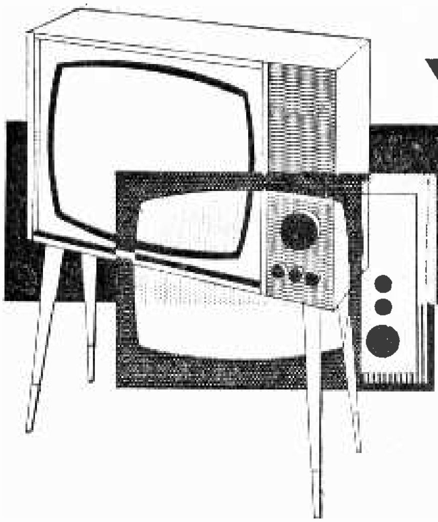
Every valve testing meter incorporates a test for gas, and the same method is used. In this case, of course, we cannot attach an ion gauge to the valve, and we have to use the valves own electrodes as the electrodes of the ion gauge.

Some testers pass current by making the grid positive and the anode negative, just as if the valve were an ion gauge; the more usual method is to run the valve with a very high grid resistor and measure the grid current.

This grid current will be made up of both electrons and ions, but for a given anode current, the grid current is roughly proportional to the ion current and hence to the gas.

This phenomenon is the reason for the warning in the valve manuals about the maximum grid resistor which may be used, especially in the case of power valves where positive ions landing on the grid and not being discharged to earth by a fairly low value resistor may charge the grid positive and cause excessive anode current.

Gas, then, is one of the valve and c.r.t. manufacturers greatest headaches. It is very much a tribute to his methods of dealing with it that it is not a major problem to the users of valves. ■



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 page 284 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

FERGUSON 407

The boost diode failed. I changed this and the vision returned. Shortly after, a smear appeared on the picture and in the background there were vertical bars shaded black and white extending to about the centre of the picture.—K. Colwill (Torrington, Devon).

Check V17 and V18 (EF80 and ECC81) also the 0·01μF capacitors associated with the oscillator-sync transformer. Check also the 1·5kΩ resistor wired across the width coil.

VIEWMASTER

I have just put in a new metal rectifier and whilst the picture and sound are good, there is a clicking noise from some part of the set, which I am unable to trace.—W. H. Jarvis (Barnet, Hertfordshire).

We would suggest you check the e.h.t. section for signs of arcing, resulting from poor soldering, protruding wire ends, dust etc.

MURPHY V879U

The following symptoms developed over a period of three weeks. The sound was normal throughout. (1) After switching on, the picture shrank slightly about 1in. in from the screen edges. (2) Later the centre of the picture took longer to appear than the rest. Eventually, the whole picture took about 7 minutes to appear and was very dim. (3) On increasing the brightness control, the picture enlarged, grew dimmer and then disappeared. This last symptom apparently indicated low emission of the e.h.t. rectifier.

Before I obtained the replacement valve, the symptom had become a vertical white line only down the centre of the screen. Subsequent replacement of the e.h.t. rectifier produced no change.

The line whistle is clearly audible. The PY88 and the PL36 appear to be overheating.—J. W. Gilbert (Whitefield, Lancashire).

The PL36 is likely to be at fault. Check the valve and associated components: line drive to the control grid etc.

BUSH TV145U

Can you suggest how to connect a meter so as to compare signal strengths in order to adjust the aerial and its siting?—J. D. Akroyd (Weymouth, Dorset).

If you wish to meter the signal strength at the receiver itself, it is a comparatively simple job to connect a voltmeter across the a.g.c. line and adjust for maximum negative voltage. Any other means of reading, say at the diode with a voltmeter or milliameter, will necessitate shorting the a.g.c. line to chassis.

The best reception is not always obtained at the point of maximum signal particularly where ghosting is experienced.

PYE V830A-16W

This set gives no picture—just full brightness without any sound. Adjusting the contrast does not make any difference to the brightness of the screen. Adjustment of the horizontal hold darkens the picture and reduces the screen top and bottom but the full brightness remains and no picture appears. The vertical hold diminishes the screen to 6in. in depth.—W. Prescott (Wirral, Cheshire).

There appears to be a fault on the tuner. Common causes of the symptoms you describe are: broken coils on the tuner rotor, a faulty local oscillator valve, or low h.t. due to a defective h.t. rectifier.

ULTRA 1980C

The trouble is cramping at the top of the picture.

Can you please tell me if the safety glass can be removed to clean the tube face without withdrawing the chassis.—W. Fraser (Herne Bay, Kent).

You should check the 30PL14 field output valve and the components associated with pin 6 to the vertical form circuit.

The chassis must be removed from the cabinet for cleaning purposes.

BUSH 138RU

This set is troubled by some form of interference on BBC-2. There appears to be a band of light about 3 to 4in. wide, which travels up the screen and makes the picture sway as if it were affected by a light breeze.

The u.h.f. tuner is transistorised, although the maker's instruction book quotes the tuner as being a valve one.

I have an inside aerial and the picture is quite good. The form of interference I get does not affect 405-line pictures.—G. Barnett (Leeds, 8).

This effect could well be caused by some defective fluorescent lighting or other type of tube, gas filled, lighting operating nearby. We do not recognise the fault as originating in the receiver.

PETO-SCOTT 733

The line hold drifts after the set has been working for about an hour. The plug adjustment is set for fringe working at the moment. When this control is set to normal, the picture verticals are ragged.

The sync separator, line output valve and oscillator valve have been checked for emission, and the set was found to have a good 3Mc/s response on both channels 1 and 9. There is no evidence of 50c/s hum or interference on the raster and the frame hold is functioning perfectly. —L. R. Whieldon (Elstead, Surrey).

While the emission of the line generator valve may check normal, it is possible that a drift in its characteristics takes place when it increases in temperature. This valve should be checked by substitution with this kind of symptom. If the valve is OK, check by substitution, the components in the time-constant circuits of the line oscillator and the resistor(s) in the line hold control circuit.

EKCO TC268

The fault is a very loud buzzing on both ITV and BBC. The valves in the tuner unit have been changed and so have the coils for both channels. The fine tuner affects the noise very little.

The trouble seemed to coincide with the changing of the line output transformer.—G. Metcalf (Halifax, Yorkshire).

You should check the smaller 16μF electrolytic capacitors associated with the i.f. strip.

SOBELL ST282

The valve V6 (PCL84) burned out—it had a short from cathode to filament. After replacing this valve with a new one, the picture was pale and delayed. I then changed over PCL84 (V10) with PCL84 (V6). The sound was then delayed and when it did appear it was very crackly.—T. Edwards (Swansea, South Wales).

It seems as though the new PCL84 is faulty. However we would suggest that you check the resistors which are associated with the originally faulty PCL84—particularly the cathode bias resistor.

MURPHY V929U

The field hold is critical, particularly on 625. Also the top of the picture is elongated but this is not accompanied by cramping at the bottom. The field linearity control will not reduce the top of the picture, even at the end of its range. The interlace control is also at the end of its range and any increase in either direction here also stretches the top of the picture.

I have renewed the diodes in the flywheel circuit because out-of-phase with manual control. The picture was not correctly on raster then. This line trouble was caused by the renewal of these diodes but the field trouble started long after this repair.—J. F. Grindley (Oswestry, Salop).

We would advise you to try the interlace diodes, which are similar rectifiers to the ones which you have already replaced. In the circuit these are designated 3MR3 and 3MR4.

EKCO T345

The picture has slowly faded away over the last year and I have purchased a new CME 1703 c.r.t. I have some basic electronic knowledge and would appreciate some notes about the installation of the new tube.—E. L. Thomas (Marham, Norfolk).

Once the chassis is out of its cabinet, there is little left to be done. Remove the tube base socket and the neck clamps etc. Remove the e.h.t. lead from the side of the tube. Then slacken the front clamping band and remove the tube.

FERGUSON 305

This set has three faults: (1) The picture rolls for five minutes when first switched on, but can be stopped by adjusting the horizontal hold. After a few minutes the picture is gradually displaced to one side but can be centred by re-adjusting the horizontal hold to its original position. (2) The picture gradually creeps up from the bottom of the screen. (3) The contrast control makes no difference to the picture whatsoever.

It may help you to know that this set, although used very little, has been stored for several years, probably in damp conditions.—G. Tawn (Wisbech, Cambridgeshire).

You should check V17 (EF80) and V18 (ECC81) by replacement. Also check V16 (PCL82). Testing these valves proves very little.

Check 0·5μF a.g.c. line capacitor, also V11 (PCF80).

FERGUSON 546T

The left half of the screen is much more brilliant than the right. The scan is good with the exception that after approximaely one hour there is a foldup of approximately ¾in. at the bottom.—A. Hills (Haslington, Crewe).

There is a 0·25μF capacitor which decouples the "A" supply to pin 3 of the c.r.t. base. Check this capacitor (C112) preferably by replacement. Also check the lower PCL82 and the 0·01μF capacitor C97.

COSSOR 950

The sound on this set is OK. There is a bright line across the screen. Recently the PL84 and ECC82 have been changed but no improvement was obtained.—A. D. Burge (Highfields, Leicester).

If the effect is a collapse of raster to a bright horizontal line, as distinct from the line being present actually on the raster, then the field time-base has failed. If the field timebase valves are in order, a systematic check of the associated components should be made, along with voltage tests to check the goodness of the resistors, coils and transformer windings. It is possible that the primary of the field output transformer has failed or even that the connections have broken between the secondary of this transformer and the field scanning coils.

PHILIPS U.H.F. TUNER

I have purchased a Philips u.h.f. tuner and i.f. panel for adapting Philips and associated TV receivers for BBC-2. The type number is Mk. 84006. I would appreciate some information as to the type numbers of the sets for which this particular tuner and i.f. panel are suitable.— E. M. A. Barrell (Holland-on-Sea, Essex).

The conversion kit is intended for use with the Philips models 19TG142A—9142, 23TG121A—3121, 9121, 9122, 9123 and 9125. Stella models are: ST1049A, ST1089A, ST1043A. The Peto-Scott model is TV945.

EKCO T345

The screen has a black band top, bottom and sides which is about ½in. wide.—W. H. Goodman (Allestree, Derby).

It would appear that the h.t. rectifier is failing. This is the large valve situated above the width settings. Try a new PY33.

EKCO T371

Please could you inform me how to remove old tube and fit a new one, advising on adjustments and precautions.—G. O'Neill (Belfast, N. Ireland).

Remove the rear cover. Rotate the fine tuner and expose channel switch knob shank grub screws. Loosen these and remove the knobs. Remove panel screw and pass control panel into cabinet. Pull off loudspeaker leads and remove the four bottom chassis fixing screws. The chassis should now come out if the front of the tube is not stuck too fast to the front mask. Some force may have to be used to break this adhesion. Remove the tube base socket and clamp etc. Remove e.h.t. lead from the side of the tube. Slacken the front clamps and remove the tube.

TEST CASE -52

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.

? *After a repair in the power supply input circuit, an experimenter was presented with a single-standard receiver exhibiting severe hum bars on the picture. Although the residual hum on sound did not appear to be abnormally high, shunt tests were made with electrolytic capacitors across the main reservoir and smoothing capacitors in the set, but this had no effect whatever on the symptom.*

The vision valves were tested for heater/cathode insulation and eventually tested by substitution, but the trouble was not to be found here. Short-circuiting the control grid of the video amplifier valve left the hum bars as before, but a slight decrease in intensity was noted by connecting the tube control grid to chassis through an 0·1µF capacitor.

What was a likely cause of this symptom? The answer will be given in next month's PRACTICAL TELEVISION *along with a further item in the Test Case series.*

SOLUTION TO TEST CASE 51
Page 237 (last month)

If the experimenter had adjusted the cores in the sound i.f. transformers with the fine tuning control adjusted for the best possible picture he would probably have found that the tuning was very peaky and probably towards the end of the travel of the cores. This would have indicated positive feedback in the sound i.f. stages of sufficient magnitude to peak the response yet insufficient to promote real instability and oscillation. The most likely cause of this trouble is open-circuit of a screen grid decoupling capacitor. Apart from inducing mild positive feedback, depending on the circuit design, trouble of this kind can also detune the stages, giving the symptom fully described last month.

The enthusiast shunted each screen decoupling capacitor in turn with a similar value capacitor, using the shortest possible lead-outs. On shunting the faulty capacitor the sound returned to normal with no apparent peaking of the i.f. tuning.

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EF80	2/6	ECC82	4/–	EF85	5/–
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30F5	5/–	30PL1	5/–	20P4	7/6
PL36	7/6	PCC84	4/–	PL82	4/–
PCL83	5/–	PCF80	4/–	PL83	4/–
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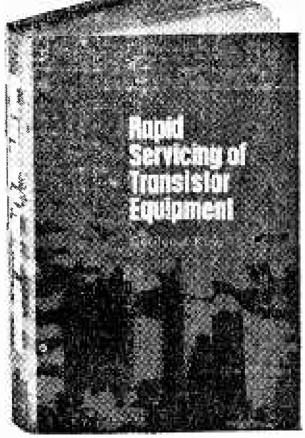

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