REGENTONE, TV402, 404, 501, 502,

Practical TELEVISION

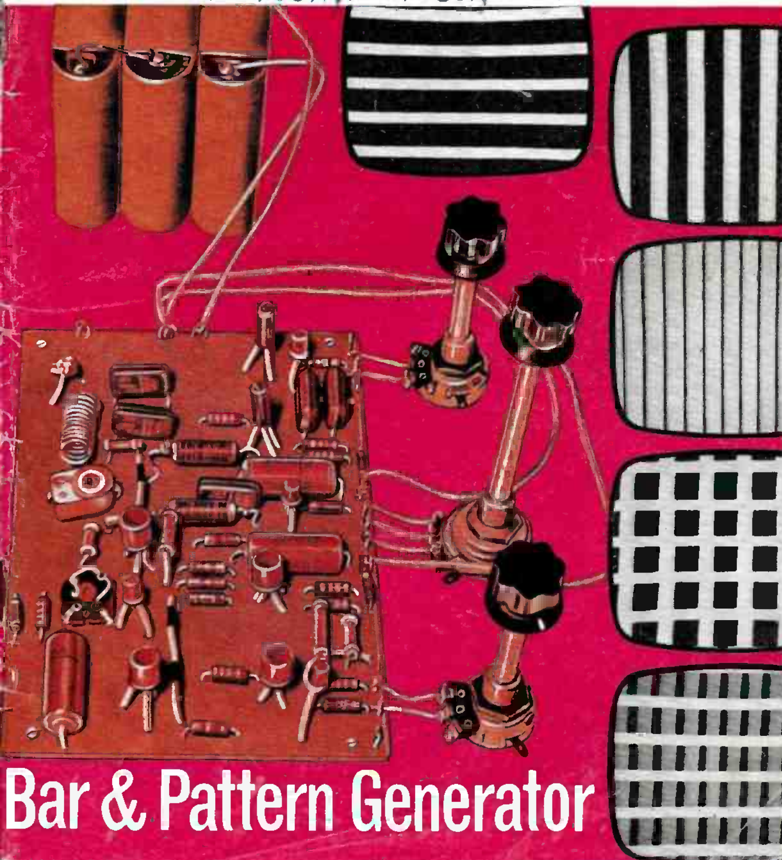
S.T.C. VC2 VC3

RGD RV202, RV302, 627,

K-B XV60 WV90, KV001, KV101, KV002

NOVEMBER 1966 2/-

KV400A. KT405A.



Bar & Pattern Generator

of these values affects field sync first. The symptoms can cause some fruitless searching in the wrong circuits.

One is reminded of Gordon King's dictum: "*see what you are doing*", and tempted to recommend servicing video and timebase circuits with an oscilloscope.

However, we can do quite a lot without it—and in the video section such a lot of trouble is caused by over-running, either due to excessive drive or by lack of adequate bias. In this case, the valve is the first thing to suffer, and the easiest to check. But the bias resistors tend to alter in value when an excess of current passes for any length of time.

In the first place, they are always carbon components—wirewound resistors, because of their self-inductance, should not be used—and in the second place, even the 1 watt resistors that some makers employ are not capable of taking much of an overload.

There would seem to be a case for some sort of protection—in the way the sound stage is fed from the boost line in some circuits previously noted, giving immediate "dead set" warning to switch off and prevent over-drive.

Provided the whole set is not too inundated with dirt, a quick inspection for discoloured components may help us make an early diagnosis. The screen and cathode resistors are the first to suffer, and the first to show signs of overheating. The "chain effect fault" where the video amplifier over-runs, these resistors burn and change value, and because of the grid current and the resultant positive voltage, the detector also passes excess current and breaks down—this is the sort of fault that causes much nail-biting.

CHECK EVERYTHING

The mistake is to change only the obvious offender—the burned resistor, the over-run valve, the "blown" electrolytic—and to overlook the other links in the chain. Most especially, the damaged detector, often tucked away in the last intermediate frequency transformer screened can, is neglected, and the repair only results in a weak and under-contrasted picture.

In its early stages, this fault can have the opposite effect of an over-contrasted picture with touchy synchronisation. The Ferguson 3605 (see the similar 506 circuit) is a particular offender. Look for signs of overheated resistors. But as a precaution, change the PCL84, and check the detector diode. The Ekco 345 was another "dog" with poor sync symptoms when the 27kΩ upper leg of the potential divider overheated.

Another common practice that leads to a common fault is the fitting of a small preset resistor in a current-carrying position. Some of these are in the cathode circuit of the video stage, giving a fine control of bias, and usually labelled "Quality Control".

Typical sets are the HMV 1921 and Marconi 4602—the usual fault being cogging on strong signals. The Decca DR41 has a 100Ω preset that goes high much too readily, and the Pye 11U employs separate contrast controls for 405 and 625 lines— between h.t. and chassis.

The picture limits badly when these protest at being over-worked.

OTHER FAULTS

Poor coupling to and from the video stage was previously mentioned. Examples are the 0·1μF sync coupler from video anode of the earlier Decca (35/45) models. The tube coupling of the GEC 455DT (leaky 0·22μF, causing lack of brilliance); Ultra 6601 (0·5μF—smeared picture), and the 17-81 and 19-80 models in the later range.

In this case (see Fig. 23), the 0·05μF coupling from video anode to a.g.c. rectifier develops a leak and kills the video altogether. The 17-81 often exhibits sound-on-vision symptoms and an apparent reversal of the action of the contrast control.

Note also that in this circuit, and other similar models, there is a 16μF bypassing the vision interference limiter. In the 21-80 range, a negative picture results from its failure. Why identical circuits should have different stock faults it is difficult to say, but it certainly does happen, and you are welcome to your theory.

The valve itself should never be overlooked. The PCF80 of the Bush TV128, Ultra 6601, Murphy V800 and many Regentone and RGD models, the PFL200 in the Pye 40, Ferranti 1136, and others; the PL83 which has made a comeback in Philips models, sometimes having the peculiar effect of working happily on 405 and protesting with hum and instability on 625, the PCL84 of the RGD 619 . . . and so on.

Everything depends on the individual circuits. The illustrations show some of the most popular variations.

To be continued

electron beams at work

K. T. WILSON

THE techniques of focussing and deflecting an electron beam, the same techniques which are the mainstay of television, have recently assumed an importance which will extend well outside the realms of television, but which also may be the cause of important changes in our TV receivers.

The reason is that the electron beam is now an important new tool in the art of microelectronics, and already microcircuits are finding their way into the new American TV sets—in fact in one set, the whole sound channel from the i.f. pickoff point to the output driver consists of one microcircuit.

BEAM ENERGY

The key to the usefulness of electron beams in this rapidly advancing technology is the high energy density of a focussed electron beam. Consider the beam energy of a typical c.r.t. At a final e.h.t. of 15kV and a peak white current of one milliamp, the total dissipation is fifteen watts.

Not an exceptional amount, perhaps, but it is being spread over the whole area of the c.r.t. If the diagonal is 19in., the frame scan extends over about 11½in. 405 lines in this space means a line width of about 0·029in. if the lines are just touching each other, as they almost certainly will at such a beam current.

This means that if the scan were stopped, the whole energy of the beam, the fifteen watts, would be concentrated on a circle only 0·029in. in diameter. Since this is about 0·003 square inches, the power density of the beam is the terrifying figure of 5 kilowatts per square inch.

Power of this sort is sufficient to vapourise any known substance, and, in fact, the electron beam is sometimes used to evaporate materials which are quite unaffected by any ordinary means of heat. Carbon, for example, can be evaporated, as can silica and zirconia, and thin films of these substances can be made with great ease.

All this can also be done by the laser, but the electron beam has one great advantage over the laser; it can be deflected with great accuracy, and the deflection can be electronically controlled, and, if necessary, programmed by a computer.

The main operations for which electron beam methods are now so valuable are welding, shaping and trimming.

WELDING

Electron beam welding is by now a well-established process which is used for purposes other than microcircuit work, and high power welders with a beam energy of several kilowatts (pulsed) are now available.

A schematic diagram of such a welder is shown in Fig. 1. For convenience, the welder is divided into two compartments; one, kept at a very high vacuum, contains the electron gun and its focussing electrodes; the other is used to contain the work.

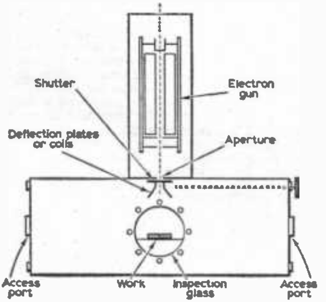
The aperture which connects the two compartments is closed, when the work chamber is being loaded, by means of a sliding shutter; in this way, the gun compartment can be kept at high vacuum. When the work has been loaded in, the work chamber is sealed up, and a second pumping system evacuates it.

The vacuum in the work chamber need not be so good as that in the gun tube (where the electrons are focussed), and the pumping system of the gun tube can cope with the small leak caused by the aperture when the shutter-plate is drawn back. This double compartment system may seem clumsy, but it can cut down the required pumping time by a factor of 5—10 times, which is of great importance when considering the use of electron beam welding for production purposes.

Such welders are being used where it is necessary to preserve a very high standard of purity in the metals being welded, for ordinary welding is a dirty process which introduces all sorts of impurity into the joint, flux, oxidation, etc.

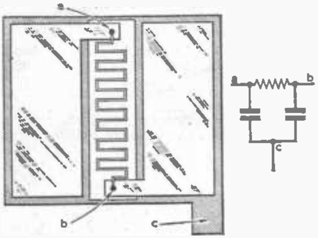
Electron beam welding, being carried out in a vacuum with nothing other than the metals being joined present is the cleanest imaginable welding process. A typical cross-section of a weld is sketched in Fig. 2.

As far as microcircuits are concerned, the high



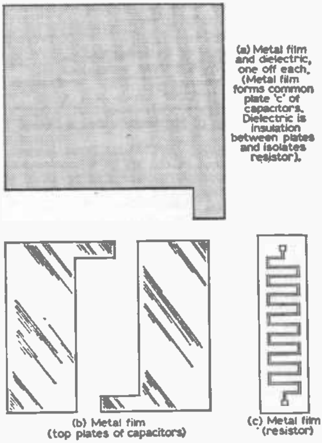
◀Fig. 1—Schematic diagram of an electron beam welder.

Fig. 2—Typical cross-section of a weld. ▼



▲ *Fig. 3—Thin film circuit.*

Fig 4—Masks required to manufacture the thin film circuit in Fig. 3. ▶



power of the electron beam is not so important; in fact it is rather an embarrassment and the power must be very carefully controlled if the whole circuit is not to be completely evaporated.

The important points here are that the beam can be finely focussed, down to a fraction of a thousandth of an inch, and precisely deflected over the microcircuit, so that interconnections, always the most difficult and least reliable part of any miniature circuitry work, can be made with greater certainty than can be achieved in any other way.

SHAPING

The shaping operation is probably the most fascinating of the jobs for which the electron beam is so well suited. Both thin film circuits and solid-silicon microcircuits depend on operations being carried out on selected parts of the circuit at any given time. With the thin film circuit, these operations may be evaporations of metal when conductors and resistors are being made, and of alternate insulator and metal when capacitors are being made. With the solid microcircuits, the processes might be all the above plus impurity diffusion and the formation of oxide layers.

All these processes demand that some sort of masking be carried out so that each process can affect only the portions of the film or silicon slice which is intended. Up till now, these masks have been made by photoetching, where a large drawing of the mask is made, photographically reduced, and printed on to the masking material exactly as if a printed circuit were being made.

The masking material, usually metal, is coated with a photosensitive material which is acid-resistant; where this material is exposed to light it hardens and becomes insoluble in water. The remainder can be washed off, and the metal will be attacked by acid where the coating has been washed off.

This method has been refined to the point where it is usable for microcircuits, but it contributes largely to the high price of starting a production run of microcircuits, as the cost of all the accurate design and drawing of the masks is very high. The use of electron beams promises to eliminate this and opens up the probability of designing microcircuits directly by computer.

Consider the thin-film circuit of Fig. 3, which is a simple low-pass filter. The masks required for this are shown in Fig. 4. These masks could easily be formed by cutting the metal directly with an electron beam, and they would require only simple X and Y deflection. It is not hard to imagine the deflection being carried out as a series of digital steps.

The next stage of this process is to control the movements of the cutting beam by means of a punched paper tape. Obviously the beam should not cut too fast, otherwise there might be insufficient time for penetration of the metal, just as the face of a c.r.t. is not punctured because a stationary, focussed, high-intensity beam is not allowed to form.

Control by paper tape means working at suitable speeds which are limited by the speed of the tape reader, which is a mechanical device.

The next obvious step is to produce the paper tape directly from a computer. It is a comparatively easy task to produce a computer programme to punch out instructions for cutting masks when the input information is worked out from the basic drawing in the form of the required resistors and capacitors; but the thing which makes this method of preparation of masks exciting is the possibility of using the computer to work out the entire layout, simply feeding in information on the circuit, and having the translation to the

continued on page 85

DUAL-STANDARD VISION DETECTORS

by G. R. Wilding

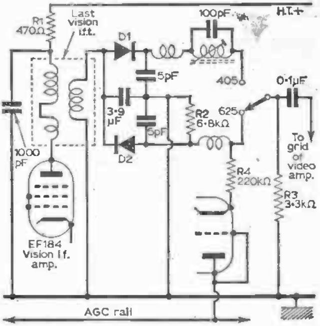


Fig. 2—Dual-standard vision detector employing 2 diodes. (Alba) D1 and D2 (OA79's) are the 405 and 625 detectors respectively, with R4 3·3 kΩ resistor as common detector load but virtually shunted on 625 by R2 to increase bandwidth to accommodate 6Mc/s inter-carrier sound. Diode connected PCL84 triode functions as overload diode on 625. A.C. coupling to video amplifier valve eliminates need for bias change on system change-over.

DUE to the non-linearity of the diode detector, any unwanted frequencies picked up in this stage can produce the usual quota of harmonics and cause background patterning. Similarly, as the voltage level at the vision detector is quite high, care must be taken to ensure that no radiation from detector stage components is allowed to reach earlier stages in the vision or sound sections of the receiver. Detector stage screening must, therefore, be good and it is for this reason that the germanium diodes usually employed are mounted inside the last i.f.t. can.

Half-wave rectifiers

The majority of detectors for demodulating a.m. signals are simple half-wave rectifiers. There are, of course, variations in component values to meet the different bandwidth demands. For instance, on 405 the detector must handle modulation frequencies up to 3Mc/s.

The associated load resistor can be either shunted across or placed in series with the detector diode; the latter being universally used in current designs.

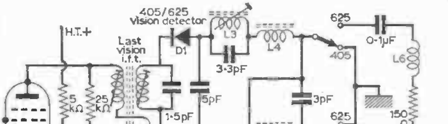


Fig. 1—Dual-standard vision detector circuit using 1 diode (Ferguson). L1 and L2 are compensation chokes for 625 and 405 respectively. L3 is a harmonic suppression filter, L4 and L5 are i.f. filter chokes. L6 is 625 video grid compensation choke while L7 is the 3·5 Mc/s "dot" rejector circuit used on 405 only. Overload diode D2 functions only on 625 to supplement normal a.g.c. bias with d.c. component from D1 detector on dark scenes and prevents "lock-out" on the sudden application of a strong signal similarly mainly dark in picture content.

To obtain maximum efficiency the resistance or impedance of the detector load should be much greater than the forward resistance or impedance of the diode, otherwise much of the signal will be lost across the diode. So far as the modulated signal is concerned, the detector load comprises the actual load resistor plus the combined reactance of all the various capacitances in parallel with it. Despite design care, the capacity across the load resistor (from its "live" end to chassis), plus the capacity of the associated wiring, filtering components and the input capacity to the next stage, cannot be reduced much below about 15pF.

The reactance of the load can be found as follows:

$$X_c = \frac{1}{2\pi fc} = \frac{1}{\omega C}$$

Thus $X_c =$

$$\frac{1}{2\pi \times (3\times10^6)\times(15\times10^{-12})}$$

$$= \frac{10^{12}}{6{\cdot}28\times(3\times10^6)\times15}$$

$$\therefore\ X_c \doteqdot 3{\cdot}3\text{k}\Omega$$

Thus, to preserve a fairly linear response from zero to 3 Mc/s there is no point in having a load resistor much in excess of this figure. Another factor one must consider is the time constant

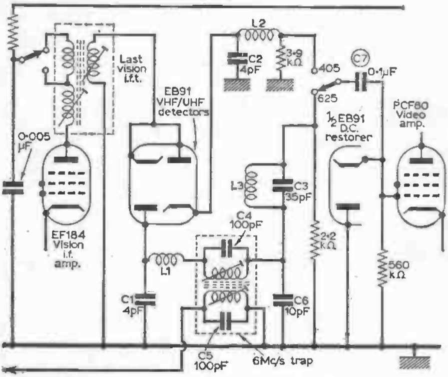


Fig. 3—Dual-standard vision detector circuit (Decca). L1/2/3 are i.f. filter chokes with R1 and R2 respectively being 405 and 625 detector diode loads. A.C. grid coupling V1a, C7 to video amplifier grid has d.c. restoration by EB91 diode. Unusually, the 6Mc/s inter-carrier sound i.f. is taken from the detector instead of from the video amplifier valve.

of the RC detector circuit which must be small; hence a low value resistive section is necessary if the combination is to be able to follow the higher video frequencies. Also the forward resistance of the diode must be very much lower than this figure (3·3kΩ) to preserve good detector efficiency. This consideration is usually obtained by using a germanium rather than a thermionic diode. A load resistor must be fitted, since otherwise the combined capacitance would just charge up to the peak value of the applied signal and prevent further rectification.

Filtering

Another problem in detector design is filtering the unwanted i.f. carrier from the modulating

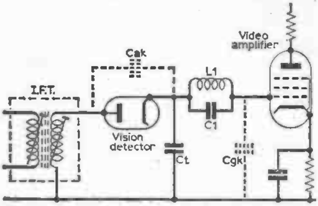


Fig. 4—The importance of small capacitances in the television detector stage. Due to Cak being comparable with Ct a large i.f. content is present in the rectified signal. On 405, filter choke L1 is often designed to tune with C1 as a rejector to the i.f. frequency and with the input capacity Cgk of the video pentode at 2·5-3Mc/s to boost top end response.

signal. In conventional radio receivers the ratio between i.f. (460kc/s) and the top audio frequency is so great that r.f. decoupling presents no problems, but even on 405 lines with a vision i.f. at 34Mc/s the 3Mc/s top video frequency represents a ratio of only about 11/1. Thus i.f. filtering has to be done with great care to avoid further attenuation of the higher video scale. In practice this is usually accomplished by using parallel capacitors and series r.f. chokes of very precise value, which are normally tuned to the i.f.

Often the input capacity of the video valve is used by the designer for r.f. filtering, and, in conjunction with the series choke and the associated decoupler, forms a conventional π (pi) filter. Sometimes these chokes can serve a dual purpose, by resonating just below 3Mc/s to boost the upper frequencies.

While all these factors necessitate a compromise between opposing demands, the introduction of 625 and the necessity to provide a switchable positive or negative-going output, plus a rectified frequency response up to 6Mc/s to accommodate the inter-carrier sound, further complicate the issue. The problem of providing the alternate positive or negative output has been resolved in two ways by different manufacturers—(a) by transposing the anode and cathode connections to the one diode on changeover, and (b) by using separate diodes for u.h.f. and v.h.f. (See Figs. 1 and 2.)

Detector stage alteration at system changeover is not merely confined to changing output polarity and increasing bandwidth on 625, since it is necessary to feed the a.c. signal to the video amplifier grid instead of varying the d.c. signal as on 405.

Some models use a.c. video grid coupling on both systems and either ignore the d.c. level, or "fake" it with a separate d.c. restorer diode as in many Decca models. Also it is necessary to reduce the value of the diode load resistor on 625, either by the use of separate resistors or the switching-in of a further resistor in parallel to the existing load on 405. This latter practice is used in the Alba model illustrated in Fig. 2.

Overload diode

It is also current practice to switch in an "overload" diode on 625 in series with a limiting resistor (connected with its cathode to the negative-going output from the detector diode and its anode coupled to the a.g.c. rail). Normally a.g.c. voltage is in excess of the rectified 625 video output and the diode remains non-conductive. When the a.g.c. rail voltage drops below that of the rectified d.c. component, this additional or "overload" diode conducts and augments the a.g.c. voltage to re-adjust the contrast level. Without this, the predominantly dark scenes would be made almost black since there is little a.g.c. produced under these conditions. The diode, although usually a germanium type, is sometimes replaced by the triode of a multiple valve whose grid and anode is strapped together to form a diode. This diode is not switched-out on 405 in some circuits, since it merely remains totally non-conductive; the 405 detector output being positive at all times.

Possibly the most noticeable feature of dual-standard 405 detector design, as compared to 405-only receiver circuits, is the occasional inclusion of the 3·5Mc/s "Dot" rejector between the diode and grid of the video pentode instead of in its traditional place in the cathode lead of the video amplifier. This is done to reduce switching action in receivers that use a.c. video coupling on both systems, there is no need to change the standing bias. Consequently if the "dot" rejector was included in the video cathode lead it would need to be shorted out on 625.

6 Mc/s sound signal

Usually the 6Mc/s inter-carrier sound signal is tapped off from the video amplifier but in one Decca series of receivers it is tapped off directly from the 625 detector output. (See Fig. 3.) This circuit is interesting also for its use of the duo-diode EB91 detector at v.h.f. and u.h.f., for its a.c. coupling on both systems, and the use of a further EB91 shunted directly across the input to the PCF80 video amplifier.

As with other dual-standard detectors, the diode load is reduced on change-over, and in this instance the respective values are 3·9kΩ and 2·2kΩ.

Detector stages give little trouble. Patterning or instability can be caused by faulty decoupling or filter capacitors. ■

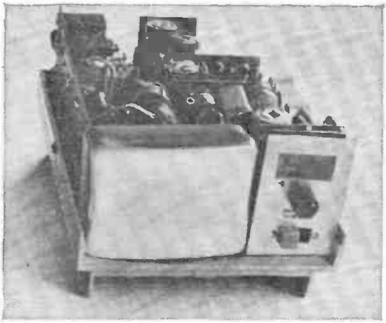
Up-to-date List of BBC-1 and BBC Wales Television Transmitting Stations

Location	Channel and Polarization	Maximum Vision E.R.P.
† Abergavenny (BBC—Wales)		
† Aldeburgh	5V	25W*
† Ambleside		
† Ammanford (BBC—Wales)		
Ashkirk	1V	18kW*
† Ayr	2H	50W*
Ballachulish	2V	100W*
† Ballater		
† Ballycastle	4H	50W*
Barnstaple	3H	200W*
† Bath	6H	250W*
† Bedford	10H	500W*
† Belmont	13V	20kW*
† Betws-y-Coed (BBC—Wales)		
Bexhill	3H	150W*
Blaen-plwyf (BBC—Wales)	3H	3kW*
Bodmin	5H	10W*
Bressay	3V	6kW*
† Bridlington		
Brighton	2V	400W*
Brougher Mountain	5V	7kW*
† Bude	4V	100W*
Cambridge	2H	100W*
† Campbeltown		
Canterbury	5V	30W*
† Cardigan (BBC—Wales)	2H	45W*
Carmarthen (BBC—Wales)	1V	20W*
Churchdown Hill	1H	250W*
Crystal Palace	1V	200kW
Divis	1H	12kW
† Dolgellau (BBC—Wales)	5V	25W*
Douglas	5V	3kW*
Dundee Law	2V	10W*
Eastbourne	5V	50W*
† Ffestiniog (BBC—Wales)		
Folkestone	4H	40W*
Forfar	5V	5kW*
Fort William	5H	1.5kW
† Girvan	4V	20W*
Grantown	1H	400W*
Hastings	4H	15W*
Haverfordwest (BBC—Wales)	4H	10kW*
† Helensburgh		
Hereford	2H	50W*
Holme Moss	2V	100kW
Holyhead (BBC—Wales)	4H	10W*
† Hungerford		
† Jamestown		
Kendal	1H	25W*
† Kilkeel	3H	25W*
† Kingussie	5H	35W*
Kinlochleven	1V	5W*
Kirk o'Shotts	3V	100kW
Larne	3H	50W*
Les Platons	4H	1kW
† Limpley Stoke		
Llanddona (BBC—Wales)	1V	6kW*
Llandrindod Wells (BBC—Wales)	1H	1.5kW
† Llanelli (BBC—Wales)		
† Llangollen (BBC—Wales)	1H	
† Llanidloes (BBC—Wales)	13H	20W*
† Lochgilphead		
Londonderry	2H	1.5kW*
Machynlleth (BBC—Wales)	5H	50W*
† Maddybenny More (Portrush)	5H	20W*
Manningtree	4H	5kW*
† Marlborough		
Meldrum	4H	17kW*
Melvaig	4V	25kW*
Moel-y-Parc (BBC—Wales)	6V	20kW*
Morecambe Bay	3H	5kW*
† Neath (BBC-Wales)		
Newry	4V	30W*
† Northampton	3V	90W*
North Hessary Tor	2V	15kW*
Oban	4V	3kW*
Okehampton	4V	40W*
Orkney	5V	15kW*
Oxford	2H	650W*
Penifiler	1H	25W*
Perth	4V	25W*
Peterborough	5H	1kW
Pitlochry	1H	200W*
Pontop Pike	5H	17kW
† Port Ellen		
Redruth	1H	10kW*
† Richmond (Yorkshire)		
Rosemarkie	2H	20kW*
Rowridge	3V	100kW*
† Rye		
Sandale (North)	4H	30kW*
(Scotland)	6H	70kW*
Scarborough	1H	500W*
† Scilly Isles		
† Seaford		
Sheffield	1H	50W
† Sidmouth		
Skegness	1H	60W
Skriaig	3H	12kW*
Swindon	3H	200W*
Swingate	2V	1.5kW*
Sutton Coldfield	4V	100kW
Tacolneston	3H	45kW*
Thrumster	1V	7kW*
Toward	5V	250W*
Ventnor	6H	10W*
Weardale	1H	150W*
† Wensleydale/Swaledale		
Wenvoe (BBC-1)	5V	100kW
(BBC—Wales)	13V	200kW*
† Weymouth		
† Whitby	4V	40W*
Winter Hill	12V	125kW*

* Directional aerial.

† Station not in service at date of issue of this list; where Channel and E.R.P. are not shown, these are not finalised.

MICROVISION

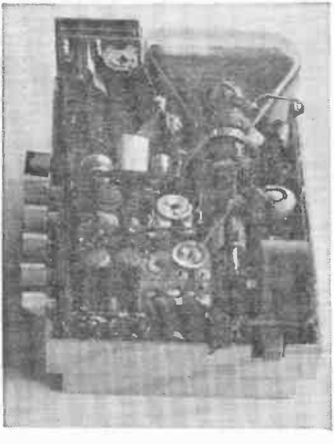


This receiver is said to be the smallest in the world

It measures 4″ x 2½″ x 2″

CLIVE SINCLAIR, designer of this miniature television receiver and chairman of the Cambridge design company Sinclair Radionics, told *Practical Television* in a recent interview that he is still unable to disclose many technical details, as the patents have not yet been granted. These were applied for in January of this year. He did, however, permit us to photograph the inside of the receiver, but was not prepared to give us a block schematic or a circuit diagram of the complete receiver.

In fact, Mr. Sinclair would only give us the briefest of details. The tuner, he told us, was of his own design and featured a novel form of automatic frequency control; he would not, however, elaborate on this point.



The tuner employs two Texas germanium epitaxial transistors and is much smaller than the usual run-of-the-mill types. It is permeability tuned and covers in one range Channels 1 to 13. Continuous tuning, he told us, will enable the receivers to be used overseas and was a good selling point.

Little was learned about the amplifiers that follow the tuner, except that a form of intercarrier is used. If this follows the method adopted by manufacturers of 625-line receivers, it would appear that the intercarrier frequency is 3.5Mc/s. Direct coupling is employed in nearly all the circuits, and from the brief look at the components it would appear that all the intercarrier amplifiers fall into this category.

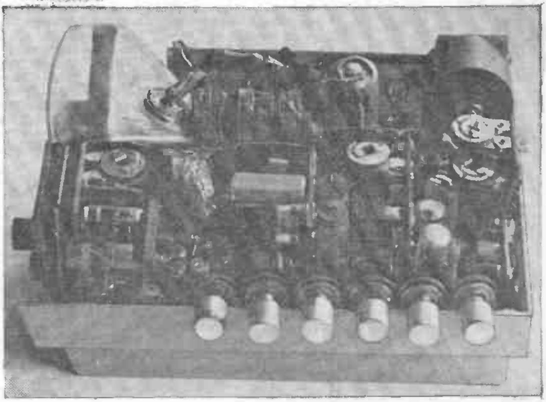
The gain-bandwidth product of this type of amplifier is not all that high and since a sensitivity of 5μV is quoted for the receiver, it is doubtful if the bandwidth is anywhere near as broad as in conventional circuitry; although Mr. Sinclair claims that it is.

We have seen two models, so far, neither of these could resolve more than the 1MC/s bars. In fact on both of the receivers we have seen, it has been difficult to read the BBC-1 caption which appears at the bottom of the Corporation's Test Card. Mr. Sinclair informs us that this is due to the focus magnets and with another type, the picture improves. This we have not yet seen.

The picture tube used in this receiver has a rectangular face plate with an aspect ratio of 3:4 and a diagonal measurement of just over two inches. The deflection angle is 70° and the overall length is just over three inches. The reduction in length, when compared to similar tubes, has been achieved by using a quarter-inch neck. This tube was specially made by 20th Century for the receiver; heater consumption is less than 100mW. The e.h.t. requirement is 1400 volts.

To obviate the need for some of the transformers in the timebase circuits, a number of circuit deviations have been made. For example, a Class B, push-pull output stage eliminates the usual field output

A variety of views of the Sinclair "Microvision" pocket-sized television receiver. The one on the right is life size. The illustration at the foot of this page shows the piezo electric loudspeaker, which is housed in the top cover of the receiver.



transformer. Multivibrator oscillators are used in both timebases. Boosted h.t. and e.h.t. is provided in the usual way from the line timebase output stage.

A transformerless push-pull output stage is also used in the audio section. Two silicon transistors operating from an 80 volt line, in fact, provide the output. The high voltage is required to drive the piezo electric loudspeaker, which is much shallower than the normal p.m. type and is claimed to be more efficient. The audio output is 50mW and the quiescent consumption is only 80μA.

Component packaging is rather good, considering it is only in prototype form. Some of the capacitors seem to be rather large compared with the other items, but it all fits into the 4 x 2½ x 2 inch package with room to spare.

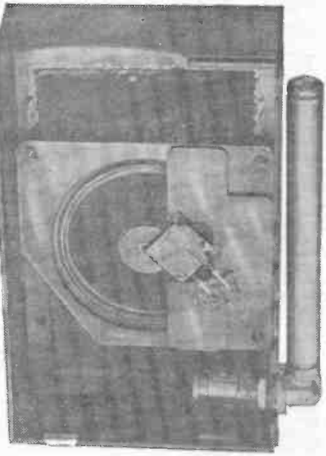
As you can see from the illustrations, the tuner assembly lies alongside the tube at the front of the receiver. The printed circuit panel immediately behind the tuner carries the components for the field timebase circuits. The other two circuit boards on the same side of the receiver contain some of the line timebase and audio components.

The remaining board, which lies on the other side of the picture tube, carries the d.c. converter, the line output transformer and e.h.t. circuits.

The d.c. to d.c. converter drops the 9 volts from the six "Penlite" batteries (housed beneath the main chassis) to 4 volts, to feed the transistors. The converter thus holds the supply constant to the thirty transistors it feeds throughout the life of the batteries, which is claimed to be in the order of 15 hours viewing time. Consumption is quoted as 450mW.

A lot of interest has been shown in this receiver in this country and overseas. The television organisations, for example, are thinking of using them to improve the communications link between producer and his staff. Industrial concerns are interested in their applications for monitoring.

Mr. Sinclair has not yet signed a contract with a manufacturer, but anticipates that these tiny receivers will be in the shops early next year; at 49 gns. The tooling and the production planning has been completed. ■



UNDERNEATH THE DIPOLE

IT usually takes a month or so to get over the gimmicks of the Radio Exhibition. That was how it used to be, when this show was open to all, with enormous crowds queuing for live TV shows, gawping at the scientific miracle of television, clutching at glossy leaflets, pleading for TV personality autographs, staggering home with hot hands and tired feet.

Those were the days! They always were—even before television, when the triode valve superseded the crystal and the loud speaker replaced the headphones. But this year was different—a trade show in the real sense of the word. Nevertheless, it seemed to be possible for many amateurs with technical backgrounds, such as the readers of this journal, to obtain tickets and see the latest offerings in television, radio, tape recording, radiograms and miscellaneous gadgets.

They joined the studious throng of radio retailers, television engineers, maintenance men and aerial fixers who appraised the 'swinging' equipment on show. Swing it was too, with television sets in dazzling styles worthy of the flashy mod buttons of Carnaby Street—sharp, slick and with-it. The sets might just as well have been an extra-mural side-show of the versatile and famous Mary Quant, whose designs girdle the world, or of Captain Teddy Tinling who gave a new look to tennis. Nothing very new to shout about beneath the veneers, however.

Picture qualities bore little resemblance to the pictures seen by television directors on their studio monitors, especially on low-key scenes. There wasn't a single television set which included the long-lost qualities of d.c. restoration, black-level clamp and Mothersole circuitry. Actors' faces turned black, grey or white, governed by the tones of the background. No wonder television producers moan about the 'fraudulent reproduction' of their pictures on modern television sets.

Donkey Shots

Happy holiday snaps are exciting to photograph but are usually boring to look at, especially if you haven't taken them yourself. Whether the pictures are shot for 8mm. movies, slide transparencies or paper prints, wide angle lenses are nearly always used. This results in what is sometimes known as the amateur's 'donkey shot', because of the extraordinary distortion of the big full face of that long-suffering animal, behind which can be seen its shrinking and receding hindquarters.

Wide-angle lenses for movies distort the movements of mice and men, the false perspective effect in long shot giving them the wide-screen strides of seven-league boots, and in close-up the long noses of a platoon of Cyrano de Bergeracs.

False Perspectives

False perspective characteristics are sometimes designed into stage, screen or TV settings to give added depth and spaciousness to moderate sized sets. It is easy enough to give the impression that an office has the dimensions of a skating rink and a bedroom the size of a huge auditorium. This has become quite a fashionable trend, zooming into absurdity, in both BBC and ITV features. Even that beautifully directed Anglia presentation: *You'll Know me by the Stars in my Eyes*, with Nigel Patrick, Phyllis Calvert, Michael Johnson, Jane Asher and Marie Lohr, fell neatly into the wide angle trap.

Here was a long, but interesting play, with interiors mainly shot in Anglia's not overlarge studio stages in Norwich. Nevertheless, the apparent immensity of the setting looked worthy of the huge Stage 5 at Rediffusion, Wembley.

Who's a Good Boy Then? —I am

Long titles are now in the groove, both on BBC and on ITV. It used to be said that play title length should be limited to the space available on the canopy over the front entrance of a theatre. More important, however, is the amount of space available for the names of the stars in the play and whether they are worthy of such billing.

Thora Hird and Ron Moody are well known in film, theatre, radio and television worlds and should attract a large viewing audience. Their excellent performances in a trivial and untidy play may have held the viewers for seventy-five minutes, but I doubt it. This was an example of really professional actors being able to keep a straight face when delivering futile dialogue. It was the epitome of 'dead-pan'. The dialogue jolted along with fatuous interjections ["That's my favourite!"], like the clanking of an old railway truck, ["Do you like sausages for tea?"] with occasional counterpoints on the rail junctions ["What's happened to Cavan O'Connor?"].

Goodness gracious! What *has* happened ["That's my favourite!"] to the BBC Drama Department? ["What about a nice cuppa tea?"] This kaleidophone of disconnected words went on and on, without the advantage of commercial breaks which is the heritage of ITV.

'One man went to Blow'

Music on TV comes in so many guises — symphonic workshops with voluble conductors who can explain why Schubert never finished it; music for dancing with its 1940's air of haircream and tulle; and tracking shots into shiny grand pianos with the maker's name discreetly taped over.

For photographic impact allied

with musical integrity and a minimum of padded-out announcements, my vote goes to *Jazz 625* on BBC-2. My outlook has differed somewhat since I have had to erect a 36 foot mast (on high ground) with a lengthy lead to my television set. This, by the way, will be the eighth time I have moved my BBC-2 aerial to try to achieve (at 22 miles from Crystal Palace) a picture at least equal to BBC-1!

Jazz 625 is a programme that brings real jazz to everyone—the many faces of true jazz are presented, and the style of presentation with the 'cutting to tempo' type of camera work makes the music entertaining for the jazz fan and the layman. *Jazz 625* presents small brand jazz and jazz vocalists—Anita O'Day is a particular example of the jazz vocalist supreme.

Iconos's musical taste are pretty catholic, with jazz knowledge gleaned from his son's record collection which leans greatly towards the 'New Orleans' style and the blues. Last year's *Tempo* programmes on the barnstorming tour by the veteran Blues singers such as Lonnie Johnson, Memphis Slim and the late Sonny Boy Williamson showed how far Tin Pan Alley 'Blues' were from the original sources. A far cry too, from that cherished recording of the Original Dixieland Jazz Band spinning at 78 r.p.m. on the horn gramophone.

The Interviewers

Someone once said that the reason journalists had so often a high opinion of themselves was because they knew the door on the Pearly Gates had a button bearing the name 'Press'! One recalls Peter Sellers' impression of '*Face to Face*' when the 'victim' is reduced to impotent moans beneath the blistering invective of the interviewer with his final 'Thank you— Mr. Harrison'.

TV interviews seem to follow a very strict pattern—unlike a footballer, the interviewer always plays 'at home'; except the filmlet style with Joe Soap showing off his grouse moor and Holbeins. In ones' minds' eye on pictures the film unit tramping over the acres and for interiors finding that Joe Soap's electricity is a very strange voltage. The interviewers here are gentleman with faultless suits, classless accents, and encyclopaedic minds.

Other interviewers adopt variations of what could be called the 'Dragnet' technique—high speed cutting from mouthed loaded question to lip moistening victim. The format of '*Late Night Lineup*' on BBC-2 is more informal—though let's face it, no television appearance is informal—but the criticism here is that so often the same people pop up here as they do on the radio quiz programmes. The 'casts' of these programmes are all permutations of two or three dozen professional chatterers.

The Levin-Kee interviews complete with harpsichord are of the exotic variety—the dinner jackets are a nice touch—shades of Savoy Hill when announcers always wore dinner jackets for broadcasts and the emergency lighting was a shaded candle, with box of matches at-the-ready. People like to know about people—and as the number of 'characters' in public life continues to diminish—so the interviewer's skill is put to greater use. After all, Joe Soap can't help telling us about his grouse moor—and we must know!

'Play School'

One of BBC-2's most consistently excellent shows has been their half hour morning programme for children at home—*Play School*. Young actors and actresses with names like Colin and Miranda, in a nursery setting straight out of '*House and Garden*' (with plenty of rag dolls, and functional furniture), really do something. They mime, build, sketch and sing rather tunelessly except for Rick who plays the guitar.

One wonders how the Coronation Streets take to it, because it is all rather '*Hampstead*'. Its secret is that it never talks down to the tots—the programme instructs and entertains.

British Telecine

One side of British television which has surpassed the American efforts is the teleciné, which is particularly difficult when dealing with film shot at the normal 24 frames per second being dissected and transmitted with 60 fields. Britain has the advantage of being able to run films shot at 24 frames merely by speeding them up to 25 frames—slight difference in pitch being unnoticeable.

The BBC seems to be ahead of ITV as regards quality of film reproduction, a fact which is mainly due to their preference for the flying-spot type of teleciné playoff as compared with the use of a ciné projector pointing at a vidicon camera. It is strange to relate that the finest quality film transmissions are made by BBC at Lime Grove on two of the oldest Cintel twin-lens flying-spot machines, affectionately known as 'the battleships'.

There has been a return to this type of teleciné, with highly satisfactory results for colour film, on tests by both BBC and ABC-TV. The ABC-TV studio at Teddington has made great progress in colour television and its demonstrations of what can be achieved on 405 lines have astonished the whole industry.

Iconos

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

CONDITIONS

The notes on conditions are somewhat briefer than usual due to holidays. The period 9/8/66 to 7/9/66, like last month, was somewhat erratic, with some extremely good days but periods of three and four days with no Sporadic E propagation at all. And, again, rain in the South has made Tropospheric reception difficult, too.

A number of readers have asked how this year's Sporadic E season compares with earlier years. Remembering that the season is not yet over, I must confess that it has not been one of the better ones. There are theories that towards sunspot maximum, Sporadic E tends to drop off a little, and as we are now well over half way to the next maximum in 1968/9, this reduction could apply again next year.

However, I feel that most of us would willingly put up with poor Sporadic E, if the compensation was extreme DX by F2 reflections at or near sunspot maximum!

Here are this period's best days:

21/8/66=Spain, Czech, Sweden.
22/8/66=Nil.
23/8/66=E. Germany, Poland, Hungary.
24-26/6/66=Nil.
27/8/66=Italy, Norway, Sweden.
28/8/66=Italy.
29/8/66=Nil
30/8/66=Czechoslovakia.
31/8/66=U.S.S.R.
1/9/66=U.S.S.R., Czech.
2/9/66=Czech.
3/9/66 and 4/9/66=U.S.S.R., Czech.
5/9/66=W. Germany.
6/9/66=Nil.

The Tropospherics have had their moments too, even N.T.S. Lopik Holland E4 has been in here at times (always an event in my area!). It was seen radiating the new electronic Test Card mentioned last month.

NEWS

From R. Bunney we hear that there are two Czech transmitters operating on Ch R1, and three on R2, and it is possible to distinguish between them at times as the Test Cards carry distinguishing lettering as below:

(1) R1 Prague 30kW marked "Stredni Cechy Praha" in small black lettering below the contrast wedge.
(2) R1 Ostrava (Severni Morava) 10kW, no markings.
(3) R2 Jizni (Southern Bohemia) 10kW marked "TV Jizni Cechy" in small white letters at the very bottom of the card.
(4) R2 Budejovice (Ceske Budejovice) 100kW. No markings.
(5) R2 Bratislava (Zapadni Slovensko) 10kW. No markings.

So at least we can sort out items (1) and (3) and, if we have "floaters" with them, (2), (4) and (5) as well.

There is a new Finnish transmitter at Kajaani Ch E4 15kW Horizontal, and an outlet at Helsinki Ch 24 with 25kW for optimists!

Iceland is shortly opening a new TV service. No details as yet, but even if it is in Band III only, it could be a possible in the north of the British Isles.

READERS' REPORTS

Paul C. Marston of Harrogate has now received USSR, Yugoslavia, Spain, Portugal, Italy, Poland, Austria, France, Czechoslovakia, Belgium, W. Germany, Sweden and Finland, and that is about 80% of the possible countries already received in the current season.

P. Wright of Andover has logged USSR, Hungary and Spain and comments that TVE was received "on a screwdriver, mounted horizontally, of course"!

J. Readings of Cowley has sent us a very attractive set of Test Card photographs, proving his reception of Poland / Hungary, Portugal, W. Germany, Czechoslovakia, Norway and France.

B. Williamson of Yell, Shetland, has been active again this year, and his recent log covers Yugoslavia, W. Germany, USSR, Czechoslovakia, Poland and Sweden An interesting item from him is the reception of N.R.K. Bergen Norway in Band III, Tropospheric.

E. Sheehan of Brierley Hill has had Finland, Spain, Portugal, Italy, USSR, Sweden, Switzerland and Yugoslavia. Welcome! We seldom get DX reports from the Midlands, and would like to hear from more of you!

P. Hocking of Redruth once again turns in a fine log with Liege Belgium E3 as a short-skip Sporadic E signal, also Czechoslovakia, Raichberg, W. Germany E4 (fairly rare), Switzerland, Austria, Italy, Spain, Portugal, Yugoslavia and USSR. Conditions seem to have been pretty good in the South-west.

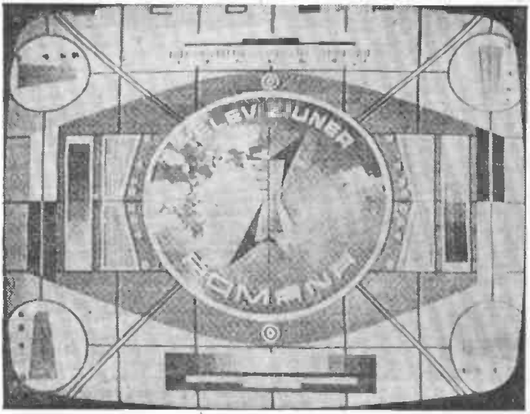
STOP PRESS NEWS

It has happened again! Another of our list of "exotics" has been received, this time by our old friend G. J. Deaves of Hitchen, who reports:

"On 26/8/66 at 19.30 on E2, I was receiving weak pictures that I thought were from TVE

DATA PANEL 15
(Supplementary to Data Panel 7)

RUMANIAN TV
("Televiziuner Romana")



(courtesy D. F. Browne, Hove)

Test Card: The Test Card depicted above is a new one and appears to be an alternative to that shown on Data Panel 7 in the March 1966 issue. The original Test Card is also apparently still in use at times.

All other information remains as before, frequencies in use being Bucharest R2 in Band I and Oradia R3 in Band II.

Spain. Then I could make out a coloured announcer, followed by 'Sports News' and after this a caption marked E.N.TV. Channel 2".

"I think that there is no doubt that this was the Enugu transmitter of the East Nigerian TV Service. Reception continued at reduced strength until about 20·15. I am writing to E.N. TV for confirmation."

I feel sure that Mr. Deaves will get his confirmation, and our highest praise to him for this spectacular reception.

PRACTICAL TELEVISION INDEX

The index to Volume 15 of PRACTICAL TELEVISION is obtainable from the Post Sales Department, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. The price is 1s. 6d. inclusive of postage.

IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part VI

AT demonstrations of amateur television it has often been found that the simplest way of providing entertainment is by film, as it needs only one person to operate the equipment. Hence, films are often used to fill in between interviews and other live items. The amateur often needs a caption for station identification or a test card for lining-up and general testing. These signals can be provided by a caption scanner which may be combined with a telecine channel.

There are two basic types of telecine and slide scanners, those using vidicon tubes and those using the "flying spot" principle. The flying spot system comprises a cathode ray tube which displays a raster locked to the station sync pulses, an image of which is projected on to the slide or the film by a lens system.

As the density of the slide or film varies, more or less light from this spot is transmitted to a photo-cell. Thus the density of any particular point scanned by the spot is indicated by the output of the photo-cell, which is amplified, blanked and sync added to give a standard output.

This system works extremely well when used as a slide scanner but when film is involved the time taken for the spot to flyback to the top of the picture (the field flyback period) does not allow the film to be pulled down and the next frame exposed. This leads to an image of a shutter appearing on the picture and a great deal of flicker is apparent.

There are various methods of overcoming these problems, but they involve electronic control of the motor or sophisticated mechanical methods. This is rather beyond the amateur, so that the flying spot system can only be recommended for a caption scanner.

A Flying Spot Slide Scanner

One successful system based on an ordinary slide projector uses a photo multiplier (type 931A) in the original position of the bulb. The projector is pointed at the tube displaying a raster and focused on this so that the image of the raster falls on the slide (layout as in Fig. 30). This is the reverse of the usual system where the image of the slide appears on the screen.

Probably the simplest modification is to obtain a spare top plate for the projector and fix the photo-cell to this. The photo multiplier should be placed so that the cathode, which can be seen in the centre surrounded by the dynodes, faces the condenser lens, which is in approximately the same position as the original lamp filament. The special base for the photo-cell is mounted on the inside of the top plate and feeds through it to a head amplifier mounted in an Eddystone box fixed to the top.

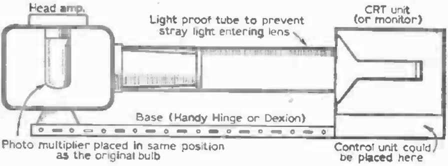


Fig. 30—Layout of flying spot scanner.

A suitable head amplifier circuit is shown in Fig. 31; the high voltage for the photo multiplier is derived from a power supply such as that used on the vidicon camera. Before removing the lamp from the projector, the correct alignment for the screen and the projector can be determined by projecting a detailed slide (preferably a test card slide) on to the face of

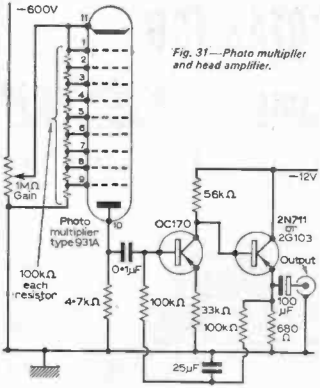


Fig. 31—Photo multiplier and head amplifier.

the cathode ray tube. When the picture size, position and focus have been set, the cathode ray tube and projector can be fixed to a suitable base.

The head amplifier feeds a control unit (Fig. 34) which is basically a processing amplifier as used for the vidicon channel, with the addition of a phase inverter to deal with both positive and negative slides (negative slides are sometimes used by amateurs to save the cost of printing a positive copy of a home-made slide) and a gamma corrector which "stretches" the darker parts of the picture in order to correct for film and cathode ray tube characteristics.

The "set gamma" potentiometers should be adjusted to give the most faithful reproduction of the darker parts of the picture. An afterglow correction circuit (Fig. 32) may be incorporated, since it is of 75Ω impedance it can be inserted between the head amplifier and the processing amplifier.

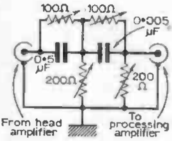


Fig. 32—Basic afterglow correction circuit.

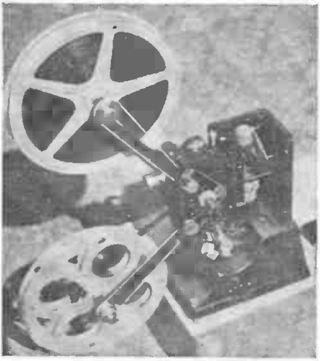
The display cathode ray tube can be a monitor fed by mixed syncs. or a special tube such as the 5FP7. The afterglow correction depends on the phosphor and so the correction should be set up by sticking strips of paper of varying lengths horizontally on the tube and then viewing the resulting signals. Adjust the shunt resistor for minimum streaking and the series resistor for minimum high frequency loss. The first section controls long term streaking and should be set first. When set, the circuit could well be re-made with fixed components.

This system produces good pictures from slides but is not as flexible as the vidicon system to be described.

Vidicon Telecine

Here a vidicon camera views the output of a film projector or a slide scanner. The film projector is normally focused on to the tube face but a small mirror can be swung into the light path which then deflects the light from the slide scanner into the camera. If a half-silvered mirror is available then this mirror can be fixed in position and the film projector shined through it on to the tube.

The output of the vidicon channels could then be controlled by switching on the lamps. A scan reversal switch to correct for lateral inversion in the mirror should be operated when the mirror is in position or the slide projector lamp is on. This is naturally a better system but it requires a half-silvered mirror, which may be difficult to obtain. Both types of mirror must be adjustable for angle and tilt and if a movable mirror is used its slide must locate accurately; a simple movement could be made up from Meccano or similar construction material.



The Specto without covers showing lamp and drive mechanisms.

The mirrors and light paths from the projectors to the vidicon may need to be enclosed in a light-proof tube to exclude extraneous light. The whole assembly is fixed on a base made from angle, such as *Dexion* or *Handy Angle*.

The projector should be selected with care and the following points should be borne in mind. Although it is possible for a skilled amateur to add a sound drum and photo-cell to a silent projector, it is far simpler to obtain a projector ready equipped for sound. The resulting sound should be of reasonable quality, and free from wow and flutter.

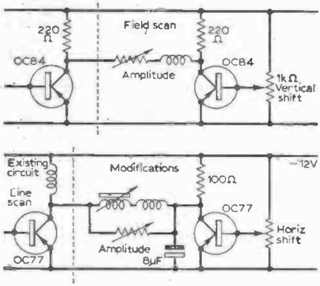


Fig. 33—Modifications to scan chassis to move shift control.

Film speeds of 16 and 24 frames per second are an advantage for showing silent films; variable motor speed allows the operator to adjust the motor speed to be the same as the television field speed and thus minimising flicker. A racking system, preferably by racking pad, is necessary to compensate for variations of frame position relative to the perforations and thence relative to the film gate.

A rear take-up spool is an advantage, as the front lower spools found on some models tend to get in the way of mirror and camera.

The following projectors are possibly suitable and average prices to be expected are mentioned:

1. Philips EL5000	Ideal, but pricey	£50+
2. Siemens Bauer	Good, but pricey	£60+
3. RCA Victor	Satisfactory, at about	£30
4. B.T.H.	Satisfactory at about	£30
5. Bell & Howell Filmosound	„ „	£30
6. G.B.L. 512	Pricey spares, but easy to obtain	£20—£30
7. Specto	Needs modifications, but proved in use ...	£30+

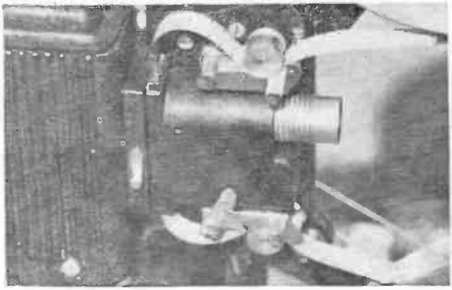
In order to protect the film from damage or scratches a complete overhaul is to be recommended even if it costs almost as much as the projector.

Investigation of the Specto projector mentioned above showed that the following points required alteration and it is hoped that they may be of use with other types of projector.

To produce the correct size image on the tube face, the lens must be brought forward. As the 16mm frame dimensions are similar to the scanned area of the vidicon tube the lens must be about half way between the film and the vidicon. If a long light path is required to accommodate the mirror system then a longer focal length lens should be used (a 5in. lens gives a total light path of 10in.). However, the lens must still be positioned about midway between the film and the tube and special mounting is required to avoid vibration of the lens, ruining definition.

In the case of the Specto, the lens was at the gate end of the lens tube so the front rim of the lens tube was carefully turned off in a lathe. This allowed it to be inserted with the lens at the front. This gave an image of the correct size, about 4in. in front of the film gate. Arrangements have been made for the take-up pulley to be placed at the rear of the projector fixed to the main baseplate.

The camera circuits require some modifications, which are also shown in Fig. 34· the gamma corrector and phase splitter perform the same functions as in the flying spot scanner. As the frame position varies slightly it is useful to be able to shift the scanned area of the film as well as its amplitude.



Film lace-up of the Specto.

The shift circuits shown in Fig. 33 are added to the scan circuit board. The shift and the amplitude controls should be mounted near to the main target and lift controls, as are the motor run switch, motor reverse switch, lamp on switch, lamp dim/bright switch, positive/negative switch and sound controls. The C.C.U. could well be combined with the camera and all controls mounted on the left side of the case (most projectors are right hand loading) and this arrangement means that all controls on the projector and the camera are then on the same side.

In order to extend the range of the target control the lamp brightness could well be switched. The lamp should be run at about one-half of its designed voltage to avoid over-

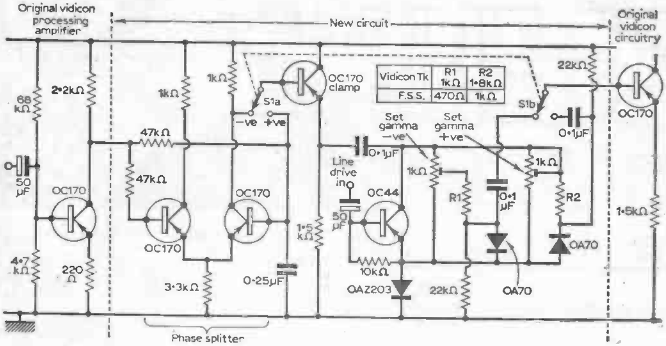


Fig. 34—Modifications to vidicon processing amplifier for use with TK screens.

heating the film when stationary in the gate. A voltage dropping resistor should be used to reduce the lamp voltage and by switching the value of the dropper the lamp brightness can be altered. When showing negative film the effect of the lift and target controls are interchanged but this condition is not often encountered by amateurs.

The separate mesh vidicons have been available for about two years and the slight increase in price of these is offset by the increased definition, particularly in the corners, obtained from these tubes. By connecting the field mesh, which is placed across the end of the wall anode, to a base pin rather than an internal connection to the wall anode, the mesh can be maintained at a different voltage from the wall anode. This results in a smaller beam diameter and hence sharper pictures.

The Specto showing gate and pull-down mechanism.

The separate mesh (pin 3) is connected to the slider of a 1MΩ potentiometer one end of which is connected to the highest potential available (the second smoothing capacitor in the high voltage power supply), the other end is connected via the 1MΩ resistor to earth. The potentiometer is set for best definition with minimum shading of the picture. With a separate mesh tube the heaters draw 95mA at 6·3 volts so they could well be run off the 12 volt d.c. supply via a 62Ω ½ watt resistor.

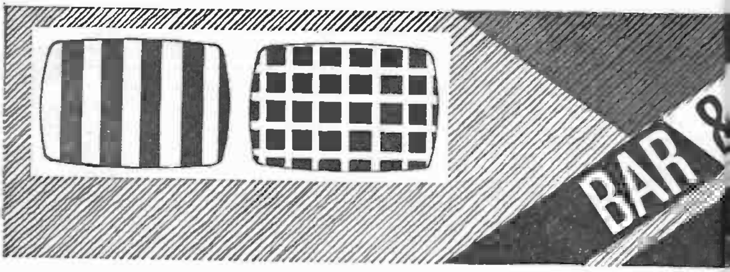
The usual sound system used with 16mm film is called Comopt (COMbined OPTical sound track) and most sound projectors have facilities for Comopt only. If sound on home-made films is a possible requirement then it is usually quite easy to mount a magnetic record/replay head against the sound drum, a distance of two frames past the optical slit position.

This can then feed an ordinary tape recorder amplifier circuit and allows the reproduction of high quality commag (COMbined MAGnetic sound track) which is now coming into use with release prints, as well as the ability to add sound to amateur efforts. There are several other synchronised sound systems available but these are rather beyond the scope of these articles.

Film should always be handled with great care as it is easily damaged by scratching or breaking. Film breaks can be repaired in an editing block (some 8mm editors will handle 16mm film as well). A rewind/editing bench with winders, viewer and editing block fixed to a board is a great assistance when cutting a film or simply splicing several short pieces of film into one reel.

Inexperienced operators should refer to the photograph which shows the correct lace-up of the projector and which prevents damage to film.

Part VII next month



IT is easy to produce some form of visible pattern on the screen of a television receiver. Any amplitude modulated r.f. carrier, whose fundamental frequency or one of its harmonics falls within the channel to which the television receiver is tuned suffices for the purpose. Thus a conventional signal generator with internal modulation, tuned to an appropriate frequency, will produce a pattern when connected to the aerial terminals of a television receiver. However, it will not be possible in the general case to *lock* this pattern. It will take the form of horizontal or vertical lines or bars, with critical adjustment of the signal generator tuning or television receiver hold controls. The synchronisation circuits in the receiver cannot function correctly, because the input signal does not conform sufficiently closely to the standard television wave form. The pattern generator r.f. carrier must be modulated accurately in a manner sufficiently similar to a standard television signal to enable the synchronising circuits of the television receiver to function normally. Only then can the pattern be locked rigidly whilst using it for making adjustments to the picture geometry or for a number of other useful purposes which will be discussed later.

Modulation Waveform

The required modulation waveform would, on first thoughts, appear to be different according to the television standard to be adopted. Thus the 405-line system, using positive modulation with a low-carrier-level black level below which the sync pulses lie, calls for deep modulation (almost 100%) of the carrier with a pulsed waveform. On the other hand, the 625-line system, using negative modulation with some high carrier level as black level, above which the sync pulses rise to peak carrier level, would appear to call for low but sharply pulsed modulation depth on that part of the signal intended for the receiver sync circuits. However, a closer look at these apparently contradictory requirements shows that an *asymmetric squarewave* satisfies *both*, provided it is used to produce 100% modulation of the carrier wave, i.e. to switch it sharply on and off. Sharp excursions are then present both below the 405 black level and above the 625 black level, so that whatever pattern is produced can be locked on either type of receiver without calling for any form of changeover switching whatsoever.

Since the square wave modulation is 'switching' the carrier on and off, it will take the picture between peak white and full black, on either type of receiver, so that the condition of maximum pattern contrast is satisfied.

It remains to decide upon the best frequency and symmetry ratio of the squarewave. If the frequency lies between the line and frame frequencies of the particular television standard, the duration of each black/white cycle is many lines but less than a frame. There will consequently be a tendency to produce horizontal black and white bars. If the frequency of the squarewave is higher than the line frequency of the particular television standard, then there will be several black/white transitions along each line, tending to produce vertical black and white bars. An ideal arrangement should therefore employ two squarewave generators, one running at a multiple of the frame frequency (but well below the line frequency) and the other running at a multiple of the line frequency. The modulator arrangement should be such that the carrier can be chopped with either one of these squarewave generators alone, or with both simultaneously. In the latter case we will obtain crossed vertical and horizontal bars, i.e. some form of check pattern.

Modulation Frequency

The respective bars will appear locked on the television receiver in their basic form when the generators are running at an exact multiple of the respective receiver timebase frequencies, or, to be strictly accurate, the bars lock whenever the bar generator frequency divided by some *whole number* gives a sub-harmonic frequency falling within the pull-in range of the television receiver timebase. The whole number divisor applicable in this sense is then equal to the number of stationary bars appearing across the picture. Manual controls for varying the bar generator frequencies are thus called for. In the first place, this is essential for the vertical bar generator because the 405 and 625 standards use different line frequencies. The ratio is about 2 : 3 and represents a fully adequate tuning range for the vertical bar generator. The required number of vertical bars across the picture for adequate assessment of line linearity on the television receiver lies between 6 and 10. The tuning range of the vertical bar generator should thus extend from 10 times the '405' line frequency to 10 times the '625' line frequency, i.e. roughly from 100kc/s to 150kc/s.

Since both standards employ a 50c/s frame frequency, one might think that a fixed-tuned horizontal bar generator would suffice. However, this would forfeit at least one useful application

PATTERN GENERATOR

by M.L. Michaelis MA

of the pattern generator, namely the facility for adjusting the aspect ratio (ratio of height to width of picture) on a television receiver. This application will be discussed later, since it goes a little beyond the general introductory considerations. It suffices here to point out that the horizontal bar generator must also be given a 2 : 3 ratio tuning range, the most suitable figures being 200c/s to 300c/s, allowing 4, 5 or 6 horizontal bars to be set.

Symmetry Factor

The symmetry factor of a squarewave is the ratio of the durations of the positive and negative portions of each cycle. This ratio may take any desired value in the general rectangular wave, for a given sum of the two sections representing a particular frequency. A symmetrical squarewave is one in which the positive and negative sections are of equal duration, each taking up one half of every cycle. When used in a bar generator, such a squarewave will produce alternate black and white bands which are all and mutually of equal width. This is not, however, the optimum arrangement for a simple pattern generator where the *same* waveform is to produce sync and intensity modulation, because the sync separators of many television receivers are designed to operate preferentially on sync pulses (i.e. excursions below black level) of definite width. It is thus most desirable to make one half-cycle of the squarewave of *constant* duration approximately equal to the optimum sync pulse width, and to control the frequency by varying the length of the other half-cycle.

Here we run into the first real contradiction of requirements, for the one half-cycle is the sync pulse on 405, but the other half-cycle is the sync pulse on 625. So we have got to make a simple choice, since no compromise is possible. Experience shows that synchronisation on the 405 standard is inherently more critical than on the 625 standard; numerous fault conditions which lead to complete loss of sync on a 405 receiver still maintain reasonable sync on a 625 receiver. Our choice is thus clear. We must keep that half-cycle constant which is the sync pulse for 405 standards operation, and rely on the 625 receiver being tolerant of this measure whose justification is fully borne out in practice. In other words, that half-cycle of each bar generator which cuts off the carrier wave is kept constant and of optimum duration, whilst the other half-cycle, which turns on the full carrier wave amplitude, is made of variable width. This means that, on a 405 receiver, all black bars are of *fixed* width, whilst the width of the white bars is adjustable. On the 625 receiver, it will be the white bars which are fixed and the black bars which are variable.

Carrier Wave Oscillator

In principle, the bar generator squarewaves could be injected directly at some point in the video circuits of the television receiver, ahead of the sync separators. However, this is an inconvenient procedure in many applications and thus the modulation of an r.f. carrier wave with the squarewaves is essential so the bar generator may be connected to the television receiver aerial terminals. The test signal should thus be of a form accepted by this input and since it then has to pass through all stages of the receiver, its display on the screen verifies correct functioning of all stages.

The carrier wave oscillator of the pattern generator need operate only on any one channel frequency provided on the tuner of the television receiver. However, it is useful to have at least one channel in each Band, in order to permit provisional checks of the tuners in the television receiver. Now this does not mean that the pattern generator must contain an oscillator operating in Band III or even in the u.h.f. range. It is much simpler, from the constructional point of view, to choose a fundamental frequency in Band I. If Channel 2 is chosen, strong harmonics will inevitably fall into at least two channels in Band III. If any commercial or home-built u.h.f. aerial preamplifier is fed from the oscillator, *via a point-contact diode* (e.g. type OA81, polarity immaterial) in series with a 2pF capacitor, then the arrangement functions as frequency multiplier into the u.h.f. band. It is advisable to use a tuned u.h.f. preamplifier set to the desired band. The carrier wave oscillator requires a manual fine tuning control with a range encompassing only Channel 2 in Band I. The corresponding tuning swing on the harmonics in Band III will be greater, so that at last two different channels can be tuned in. Due to the even greater frequency multiplication for u.h.f., several channels can be tuned in via the diode and preamplifier connected as mentioned above.

Circuit Design

It is important to point out that many of the design factors described above are valid only when looking for the simplest possible circuit of adequate performance. If circuit complexity were no limiting factor, many additional refinements would be possible and any compromise avoided. Many commercial units employ separate waveform generato. for sync pulses and intensity modulation, with appropriate switching for the various television standards. Such units are heavy and bulky, as well as expensive, and their place is on the shelf in well-equipped laboratories and workshops. The design presented in this article may be built pocket-size complete with batteries, cheap to build, and surprisingly simple whilst meeting the basic requirements discussed previously. It may thus be used in the field as well as in the workshop, and especially in the homes of customers when installing television receivers or making provisional checks for deciding whether a faulty set should be transported to the workshop or repaired in the customer's home.

Circuit Stages

Figure 1 shows the complete theoretical circuit. The first stage is the vertical bar generator, which is a multivibrator using two transistors Tr1 and Tr2. the second stage comprising Tr3 and Tr4 is the horizontal bar generator, another multivibrator. The third stage is the modulator, Tr5 and Tr6 with associated voltage delay diodes D4 and D5. The fourth and last stage is the v.h.f. carrier wave oscillator, Tr7.

The entire circuit is critical regarding tansistor types. Thus, whilst it has been well tried with the specified types and may be relied upon to function correctly, indiscriminate substitution of other transistor types which happen to be available will most likely lead to failure. Nevertheless, experienced readers may certainly make judicious substitutions and some mention of important points to watch thereby will be given in the description of each individual stage.

Vertical Bar Generator

Transistors Tr1 and Tr2 operate as a conventional multivibrator. Frequency variation is obtained by means of VR3 connected as part of the base leak for Tr1, to adjust the time for which Tr1 remains cut off during each cycle. If unsuitable transistors are used in either or both positions in this stage, it will refuse to oscillate. This stage is called upon to provide squarewaves at frequencies up to 150kc/s. The edges of the squarewaves generated by this stage however, are considerably rounded, but this defect can be corrected at source by inserting emitter follower coupling or other stock refinements into the multivibrator circuit, or, alternatively, the subsequent modulator can be designed to produce a true square wave. The latter measure was found to be the simpler one and its principle will be discussed when describing the modulator stage.

V.H.F. transistors have been employed, in the vertical bar oscillator. The circuit will not oscillate at all with OC72's, AC126's or with a number of other audio and medium-wave r.f. types which were tried. Two *different* transistors, which greatly enhances the *initiation* of oscillation upon switch-on, have been selected. The AF115 (Tr2) is rated for higher maximum frequencies than the AF116 (Tr1) and has thus been used in the section which is cut off for the briefer time. D2 stabilises the collector supply voltage for the vertical bar generator. This is essential for assuring stable frequency calibration in conjunction with applications that are described later.

Horizontal Bar Generator

The circuit of this stage is similar to that of the vertical bar generator. It is another simple multivibrator using OC72 transistors (Tr3 Tr4). Since the operating frequency is low, conditions are less critical and an excellent waveform is obtained. Types AF116 or AF115 may be used as alternatives, whereby the choice can be made on a basis of availability and price compared to OC72's. The frequency is varied by VR4, which is in the base circuit of Tr4. This controls the time for which Tr4 is cut off in every cycle. D3 provides a stabilised rail supply to this multivibrator.

Pattern Modulator

This stage serves the purpose of switching the carrier oscillator Tr7 right off whenever the fixed cut-off duration section of either bar generator is cut off, i.e. when either Tr2 or Tr3 is cut off for a duration determined by C2 R4 or C5 R9 respectively. Under these circumstances the collector voltage of Tr2 or Tr3 rests at the negative supply voltage provided by D2 or D3 respectively, so that either Tr5 or Tr6 of the modulator stage receive heavy cut-on bias via R6 D4 or R13 D5 respectively, and thus conduct to saturation, thereby shorting out a sufficient portion of the base bias of the carrier oscillator in order to silence the latter. VR1 should be adjusted so that the remaining base bias with one or both modulator transistors conducting just brings the carrier oscillator Tr7 to the threshold of oscillation (but still not oscillating). The adjustment is made as follows. Disconnect either Tr2 collector or Tr3 collector, so as to make one modulator transistor conduct permanently. Starting with VR1 slider *remote* from the collectors of the modulator transistors, then adjust VR1 until oscillation of the carrier oscillator *just ceases*, as evidenced by disappearance of the white screen (405) or black screen (625) and appearance of random noise characteristic of absence of any r.f. signal on a channel to which a television receiver is tuned. If VR1 is turned too near the modulator collectors, maximum carrier amplitude will be reduced unnecessarily. This will in particular reduce the harmonics, making u.h.f. responses disappear. If VR1 is turned up too far towards R16, the minimum carrier level will be rather high and may lead to loss of sync on 405 receivers, although 625 receivers will probably show no deteriorated response. Correct adjustment of VR1 is thus particularly important when intending to use the pattern generator for 405-standard receivers.

In the terminology of logical circuit modules, this pattern modulator stage is a NOR-Gate. "NOR" means "NOT A OR B". The output, i.e. the carrier wave, is present when "not A or B" is present, i.e. when neither the vertical nor the horizontal bar generator are providing a blanking pulse.

Bar Shaping

It was mentioned in the section dealing with the vertical bar generator, that the squarewave output of the latter is by no means truly square, it being left to the modulator stage to improve this waveform, i.e. to reconstitute a reasonable sudden switching of the carrier oscillator to give sharp black/white transitions and good line sync response on the television receiver.

The principle of the adopted method is quite

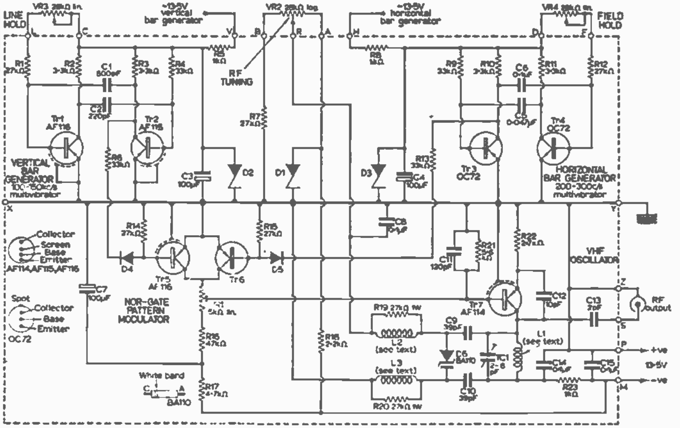


Fig. 1—Complete circuit of the bar and pattern test generator.

simple. D.C. coupling is employed via a resistor and a diode (R6 D4 and R13 D5 respectively) from each bar generator collector to modulator base. The 'switch on' and the return of carrier oscillation, is rapid because of the low collector to emitter resistance through the conducting transistor. The cut-off of the respective bar generator transistors and therefore the carrier wave is, without correction, much slower because the stray collector capacitances have to charge up through R4 or R9 respectively. The modulator conducts heavily as soon as the *first small portion* of the gate generator collector drop to the negative supply line is completed, so that the carrier oscillator is turned off very much more rapidly than the edge duration of the vertical bar generator squarewave. When the carrier oscillator is running (considering only the vertical bar generator; the function is quite analogous for the horizontal bar generator), Tr2 collector is virtually at chassis potential because Tr2 is conducting heavily. The residual emitter to collector voltage of Tr2 is prevented from opening the modulator transistor Tr5, due to the interposition of the voltage delay diode D4. This is an ordinary silicon switch diode whose normal silicon threshold of about 400mV must be exceeded before any negative voltage can reach Tr5 base. Now consider the moment when Tr2 commences to cut off on its rather slow edge. We require the carrier oscillator to be switched off as quickly as possible on this edge. Now Tr2 collector is aiming to drop from chassis to —7V. But as soon as it has completed a mere 400mV, D4 conducts and after a further drop of a few hundred millivolts drives Tr5 to maximum conduction. The *initial part* of the bar generator collector drop, which is the steepest part of the exponential, thus suffices to turn off the carrier oscillator completely.

Choice of Modulator Transistors

Various factors play a role in the choice of satisfactory modulator transistors. R16 must be made high (47kΩ) so that a very small level of base voltage of either modulator transistor below the respective conduction level of the associated diode already bottoms the modulator collector voltage, i.e. turns the carrier oscillator right off. If R16 is made too high, a considerable voltage-drop will occur across it due to the collector leakage current of some types of germanium transistors. In that case the carrier oscillator Tr7 will refuse to operate at all, or will result in erratic modulation. The adoption of silicon transistors in the modulator stage would overcome the difficulty. However, to avoid the need for an additional positive collector supply for the more usual n-p-n-types found among silicon transistors, it would be necessary to select suitable types from among the rarer p-n-p silicon transistors. These unfortunately have severely limited frequency ranges, i.e. relatively long switching times. Nevertheless, a type OC449 was found to be completely satisfactory for the horizontal bar modulator Tr6 which has to contend only with quite low switching frequencies. It has negligible leakage current. An OC449, was selected for Tr5, the vertical bar modulator position but, performed erratically. The performance was as shown in A or B in Fig. 3, with the vertical bar waveform not being able to switch off the carrier completely. This is tolerable on 625 receivers, merely leading to weaker contrast in the vertical bars without loss of line sync. On 405-standard receivers, however, line hold is weak or lost completely under these conditions. It is thus necessary to use a germanium type in Tr5 position. A large variety of possible candidates were tried, and it wa*

Practical Television

IMMEDIACY

WHEN TV was a bright and innocent young thing, its champions cheerfully enthused on the many delights to be enjoyed by the avid public. The greatest attraction, we were assured, was that of "immediacy."

Can we be pardoned for asking what happened to immediacy—for this is surely one of the most neglected aspects of TV. Unique events such as the World Cup Series demonstrate that TV has an ace up its sleeve but is apparently reluctant to play the card too often!

For what else can TV do better than other media? Precious little, it seems. A glance through the programmes in a typical week of offerings all too often shows a sterile hotchpotch of regurgitated material.

Those "panel games" (now fortunately on the wane) and discussion programmes (too often too scripted and attenuated) are borrowed from steam radio which did the same sort of thing at a much brisker pace. Many of the soap opera serials appear to be borrowed from comic strips or "story" adverts. We have plenty of old films, of course. And, most astonishing of all, both channels still persist in running pretentious "variety shows" complete with "star" artists using their oldest material and fronting a rag bag of amateurish turns and even the occasional acrobat. Some of the shows put on recently would have got the bird right back in the music hall days. These were abandoned years ago by sound radio! So much for progress by the most promising entertainment medium.

We have plays, of course, and some are very good. But too many bear the touch of writers and producers who seem more intent on pandering to their own *avante-garde* tastes than to entertaining the viewers. TV has a voracious appetite for material, and in the realm of TV drama this is even more obvious than in some of the "comedy" shows and Amateur-Night-at-the-Hippodrome variety productions.

Can it be said, then, that television alone of the mass entertainment media has really failed to come up with something uniquely its own? So far little has been done except to copy, adapt and (sometimes) improve on what has been done before. Except, of course, in the realms of our old friend immediacy.

More on-the-spot coverage not only of sport but of everyday events might inject a little more life and purpose to television.

W. N. STEVENS—*Editor*

NOVEMBER 1966
VOL. 17 No. 2
issue 194

THIS MONTH

OUR NEXT ISSUE DATED DECEMBER WILL BE PUBLISHED ON NOVEMBER 24

finally established that type AF116 gives the best compromise between sharp switching and deep modulation at the vertical bar frequency.

V.H.F. Oscillator

The basic circuit around Tr7 is a conventional grounded base arrangement with the tuned circuit in the collector line and positive feedback via C12 to an aperiodic emitter load R22. However, there are some special features involved here. This type of circuit will oscillate only if the base is grounded at the carrier frequency. This is satisfied with the help of C11. On the other hand, C11 must be as small as possible, since its time constant in conjunction with R21 VR1 and the modulator transistors, determines the switching time on the modulation waveform, edges which must be as short as possible in order to give sharp bars. After many experiments, an AF114 was selected for Tr7 position with a value of 120pF for C11. This combination gives sharp vertical bar modulation.

The tank coil L1 should be wound exactly given specification and mounted with the spacing shown on the printed circuit board drilling diagram, Fig. 4. It is also important to maintain the shapes of the copper conductor areas, also shown in Fig. 4, since these are part of the distributed inductance and capacitance of the oscillator circuit. Arbitrary changes, if undertaken here, could make the oscillator frequency fall outside the television bands, or even make the oscillator refuse to oscillate at all.

Tuning Arrangements

It was decided to adopt fine tuning with the help of a varicap diode rather than with a small tuning capacitor. A varicap diode (D6), is a semiconductor device which may be treated electrically as a diode biassed in the cut-off sense and which thereupon behaves as a capacitance whose value varies according to the applied inverse bias voltage. This bias voltage is stabilised by D1 (to make calibration of VR2 independent of battery or mains voltage), varied with VR2 and applied to the varicap diode via the v.h.f. choke combinations L2/L3/R19/R20. The r.f. tuning potentiometer VR2 may be mounted at any convenient position in the final unit, since only d.c. potentials are handled by it. The connections to the bar generator tuning potentiometers VR3 and VR4 should be kept short, since they carry pulse voltages.

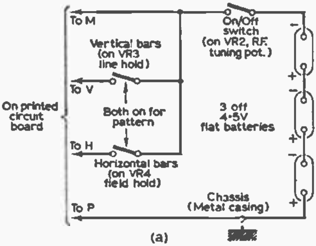
The specified component values and layout in the v.h.f. oscillator circuit provide a swing of about one channel width at the fundamental Band I frequency with D6 and again with TC1. The oscillator can thus be tuned through two Band I channels. Channel 2 will normally be found to lie most closely to the centre of the tuning range. For alignment, set VR2 to its mid-way position and then adjust TC1 with a non-metallic trimming tool to bring Channel 2 (Band I) sharply into tune, with a television receiver connected to the output via a short length of coaxial feeder. Direct coupling to the oscillator collector, via C13, has been used instead of the more usual pi-filter output found in closed circuit TV, in order to facilitate maximum output of harmonics, since they provide the Band III and u.h.f. signals. However, with this form of output coupling, the tuning is *slightly* affected by the length of feeder to the receiver and by the nature of the receiver input circuits.

Power Supplies

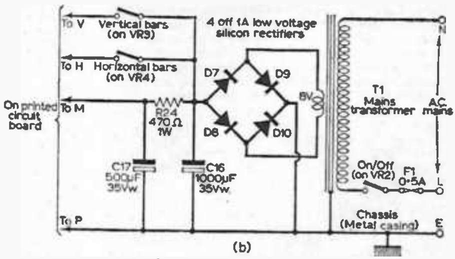
Figure 2 shows suitable supplies, (a) for battery operation and (b) for mains operation. It is necessary to use *three* 4·5v batteries in order to maintain at least 9 volts up to the end of their useful life, so that the stabilisers D1, D2 and D3 in turn maintain their respective *constant* voltages, losing control only when the batteries are completely exhausted and not at some earlier stage. It is essential that these constant supply voltages are maintained, so that calibration of the manual controls remains constant (see under applications). The suggested arrangement of switching shown in Fig. 2 should be adopted when building this unit alone into a small case. It avoids increasing the number of manual controls beyond three. The battery or mains on/off switch is combined with the r.f. tuning potentiometer VR2, and the respective bar generators have their individual on/off switches combined with their tuning potentiometers VR3 and VR4.

Using the Pattern Generator

The applications of this pattern generator are much more versatile than merely checking line and frame linearity on television receivers, although these conventional uses will be considered first.



(a)



(b)

Fig. 2—Power supplies for the test generator; (a) is for battery operation and (b) for mains operation.

Receiver Scan Linearity

The bar generators run at a definite frequency, so that the bars should be spaced strictly equidistant. Any departure from this condition as far as the display on the television receiver is concerned *must* be due to nonlinearity of the *receiver* scan, and the linearity controls can be adjusted accordingly until the bars are spaced as uniformly as possible over the entire picture width or height. These observations and adjustments should be made with only one bar generator running, and the other one switched off. It is thereby advisable to adjust the line linearity first. Figures 6 and 7 show the appearance of the bars with the receiver linearity controls adjusted to within generally accepted tolerance limits.

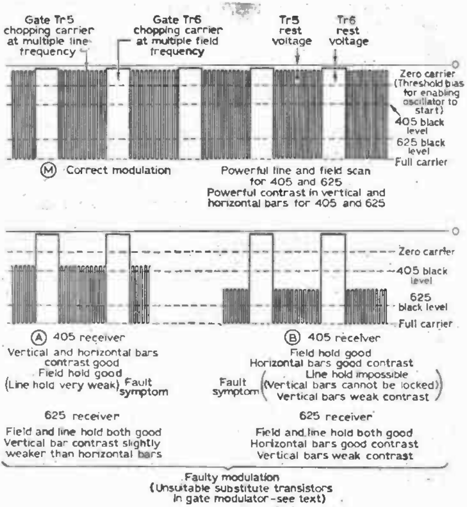


Fig. 3—Pattern modulator principles (waveforms at the slider of VR1).

Aspect Ratio

The second use of the pattern generator is to check and adjust the aspect ratio, i.e. the ratio of picture height to width, on a television receiver. The correct aspect ratio is 3 : 4 Now this does *not* mean that the number of horizontal bars and the number of vertical bars must be in the ratio 3 : 4 or some multiple thereof to produce a "square" pattern on which the receiver is to be adjusted to produce it square. We must remember that we are using asymmetric squarewaves for the bars, and also the flyback must be taken into account. First of all, adjust a television receiver for correct aspect ratio and linearity on a test card transmission. Then connect the pattern generator and switch on both bar generators to produce a cross-grid pattern as shown in Fig. 9, selecting respective bar generator frequency settings making the black squares as nearly square as possible on the correctly adjusted receiver. Then select a value for C2 or slightly modify the value of R4 such that the display consists of accurate squares. They will be black on a 625 receiver, or white on a 405 receiver—that makes no difference to the application. The specified component values for C2 and R4 should normally give some satisfactory setting for both 625 and 405 receivers without further adjustment. These settings should be marked clearly against the bar frequency controls VR3 and VR4. Each will thus obtain two marks, "405 aspect" and "625 aspect". The stabilisation of the collector supplies will then maintain these settings irrespective of the state of the batteries.

In use, the procedure is then as follows. Set the bar frequency controls to the marks corresponding to the television standard of the receiver to be adjusted. If the pattern is not locked immediately, *slightly* displace the controls until lock is obtained. Then adjust the picture width on the receiver so as to just cover the mask width. Finally adjust the height control until the black or white squares are as square as possible.

Raster Distortion

The type of raster distortion known as "pin cushion" distortion (elongated picture corners) or "barrel" distortion (compressed picture corners) is corrected with the help of magnets. These are usually mounted on the scan yoke, or elsewhere on the neck of the picture tube, and they may become displaced and require readjustment—certainly after repairs and replacements to the scan yoke or when fitting a new picture tube. The type of pattern which is most suitable for making these adjustments to a receiver calls for a much closer mesh than is achievable in the fundamental settings of the bar generator frequency controls. Nevertheless, suitable patterns are available with this generator. It will be found that there are numerous intermediate settings in between the main ones giving patterns of the kind shown in the screen photograph five. Here the vertical bar generator frequency bears a simple but non-integer ratio to the line frequency. For example, suppose that 11 times the line frequency is equal to twice the vertical bat generator frequency. There will thus be 5·5 bars per line, i.e. alternate lines will yield a sync. pulse and this normally suffices to lock the pattern. The result will be two sets of 5·5 bars interlaced on alternate lines, giving the appearance of 11 bar across the picture. This type of intermediate setting is not usable on the horizontal bars, since it would lead to flicker.

Hum on Line Timebase

Figure 8 shows an interlace setting with the vertical bar generator running alone. This pattern is in fact an interchange of black and white sections on alternate lines, giving black (625) or white (405) thin bands whose width is equal to the difference between the normal black and white bar widths. A setting can be found where the vertical bands are very narrow and this setting is quite sensitive to hum on the television receiver line sync circuits. If this receiver fault is present, the vertical bands will "wriggle".

Checking Receiver Timebase Pull-in Range

Rough quantitative checks can be made here by establishing locked bars and noting the extent to which the bar generator frequency controls may be displaced to either side before the receiver timebase loses hold and the bars break up. One may go as far as making comparisons on a few average receivers whose lock circuits are known to be in working order, and marking small sectors against the scales of the bar generator frequency controls to locate the normal ranges of lock around each principal setting. Any receiver tested subsequently and found to give a much restricted lock range should be further examined (incorrect sync separator gating level, a.g.c. fault leading to overloading and sync pulse distortion, or a host of other possible faults).

COIL WINDING DETAILS

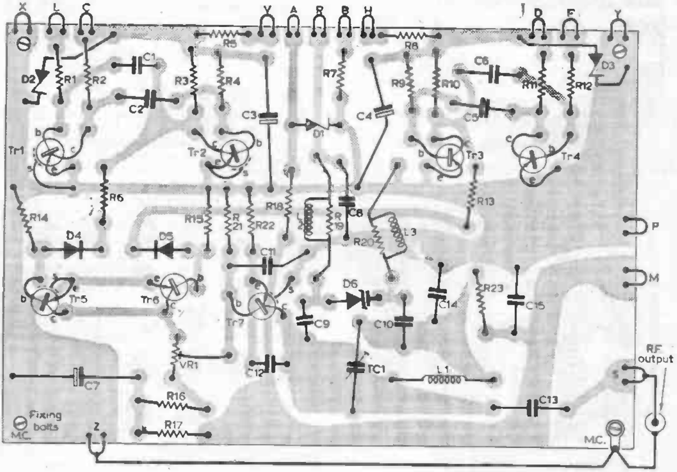
L1	12 turns 18 s.w.g. tinned or enamelled copper wire. Wound on 8mm former (pencil), subsequently removed. Coil then stretched uniformly to have exactly the length equal to the spacing between mounting holes on printed circuit board. (Inductance=0·7μH) (tank coil, v.h.f. oscillator)
L2, L3	40 turns 28 s.w.g. enamelled copper wire, close-wound single layer on 27kΩ 1W carbon resistor as former and connected in parallel.

Observations should here always be made in the bar setting, *not* in the pattern setting, i.e. with only the vertical bar generator running for checking receiver line lock range, or only the horizontal bar generator running for checking receiver frame lock range. This is because in the simplified pattern waveform used here, line sync pulses are missing during frame sync pulses, causing a lock response which is not truly representative of behaviour to be expected in response to a broadcast television waveform.

Checking Automatic Line Lock Circuits

Many modern television receivers employ a 'memory' type automatic line lock circuit which makes a manual line hold control superfluous.

Fig. 4—Layout of the printed circuit board.



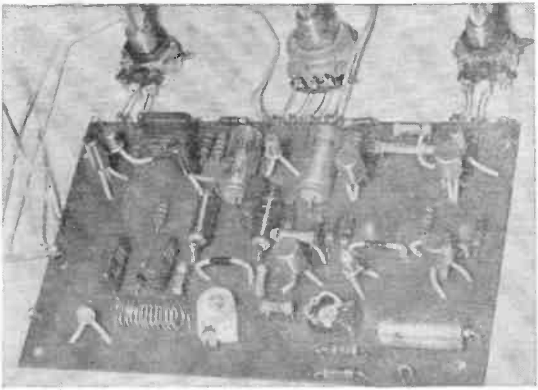


Fig. 5—General view of the complete test generator.

The principle is to use a sinewave oscillator for the line oscillator stage, controlling its frequency via a reactance tube whose d.c. control voltage is developed by a discriminator comparing the frequency and phasing of the line flyback pulses and the sync pulses. The d.c. control voltage from the discriminator acts in a sense such as to correct the frequency and phase of the line oscillator. This control voltage is stored in memory capacitors, which are quickly charged to the new value if the sync pulse rate should change, but which maintain their charge for long periods if

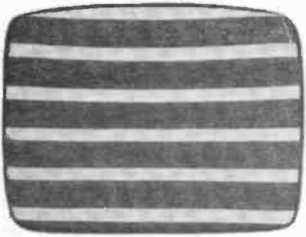


Fig. 6—Horizontal bar generator running at an exact multiple of the field frequency. (Useful for checking field linearity).

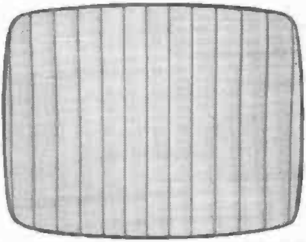


Fig. 8—Vertical bar generator running at a non-integer ratio to the line frequency. (Useful for checking if hum is present on the line timebase.)

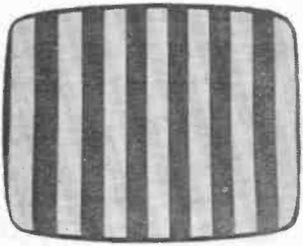


Fig. 7—Vertical bar generator running at an exact multiple of the line frequency. (Useful for checking line linearity.)

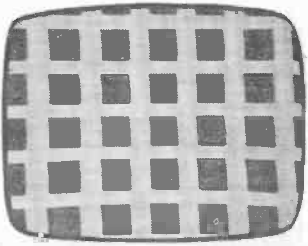


Fig. 9—Standard pattern: horizontal and vertical bar generator running at exact multiples of the field and line frequencies. (Useful for checking picture aspect ratio.)

★ components list

Resistors:

R1	27kΩ	R13	33kΩ
R2	3·3kΩ	R14	27kΩ
R3	3·3kΩ	R15	27kΩ
R4	33kΩ	R16	47kΩ
R5	1kΩ	R17	4·7kΩ
R6	33kΩ	R18	2·2kΩ
R7	2·7kΩ	R19	27kΩ 1W
R8	1kΩ	R20	27kΩ 1W
R9	33kΩ	R21	5·6kΩ
R10	3·3kΩ	R22	2·7kΩ
R11	3·3kΩ	R23	1kΩ
R12	27kΩ	R24	470Ω 1W

(Carbon, ±10%, ½W unless otherwise stated)

Capacitors:

C1	500pF C	C10	39pF C
C2	220pF C	C11	120pF C
C3	100μF E	C12	10pF C
C4	100μF E	C13	2pF C
C5	0·047μF MF	C14	0·1μF MF
C6	0·1μF MF	C15	0·1μF MF
C7	100μF E	C16	1000μF E
C8	0·1μF MF	C17	500μF E
C9	39pF C		

C=Ceramic, 500V, E=Electrolytic, 35V, MF=Micro-foil 250V.
TC1=Ceramic Trimmer 2–8pF

Potentiometers:

VR1 5kΩ lin preset
VR2 25kΩ log } each with
VR3 25kΩ lin } single-pole
VR4 25kΩ lin } switch

Semiconductors:

Tr1 AF116 }
Tr2 AF115 }
Tr3 OC72 } (Mullard)
Tr4 OC72 }
Tr5 AF116 }
Tr6 OC449 (Intermetall) OC202 (Mullard)
Tr7 AF114 (Mullard)
D1 ZB6·8 (S.T.C.) BZY88/C6V8 (Mullard)
D2, D3 ZB8·2 (S.T.C.) BZY88/C8V2 (Mullard)
D4, D5 BAY20 (Intermetall) BAY38 (Mullard)
D6 BA110 8–14pF Varicap Diode (S.T.C.)
D7 }
D8 } 1A low-voltage silicon rectifiers
D9 } (100 p.i.v.) (any make)
D10 }

Miscellaneous:

T1 Small Bell Transformer 8V 1A
F1 Fuse assembly, ½A
Mains connector, casing, printed circuit materials, etc. 3 knobs.

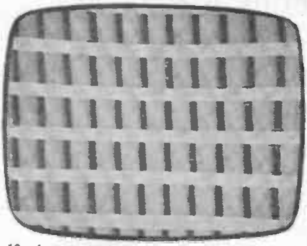


Fig. 10—An example of one of the numerous interlace patterns which will lock rigid upon slight misplacement of VR3. (Useful for checking geometry faults.)

isolated or even whole batches of sync pulses are missing. In a properly adjusted circuit of this kind the line timebase continues to run at the correct frequency even if the line sync pulses are suddenly missing for most of a whole frame. The efficiency of the circuit is best tested by applying a waveform in which batches of line sync pulses are regularly missing. This is provided in the basic pattern setting as shown in Figure 9. If the automatic line hold circuit is correctly adjusted, the squares should show only slight jitter, if any. If the jitter is confined to the top part of each square and is the same for each square, then the free-running frequency of the line oscillator is probably too far off the correct value, calling for too great a control voltage from the discriminator. Correct by realigning according to the service sheet for the particular receiver. If the jitter extends over the entire height of each square and is not in phase for all squares over the whole screen, then there is probably some circuit fault present which is producing incorrect damping of the charge-up and memory system (defective discriminator diodes, faulty resistors or capacitors).

Summing up, it may be said that the pattern generator permits two important groups of checks and adjustments to be made on television receivers. The first group includes all geometry factors (scan linearity, aspect ratio, raster distortion correction), and the second group comprises checks of the receiver sync circuits. The range of lock can be determined and assessed as being adequate or inadequate *without disturbing controls on the receiver!* Only if the lock range is found to be inadequate is it necessary to disturb the preset controls, so that a correctly adjusted receiver need not be misadjusted to find out whether it was previously correctly adjusted. More important, if a receiver fails to lock a broadcast picture within the range of the manual hold controls, the pattern generator will quickly reveal whether normal range of lock is obtained at some grossly displaced position, or whether no lock is possible under any circumstances. In the former case, a preset control may merely need resetting (although a circuit fault may be present), whereas in the latter case a circuit fault is definitely present. One soon becomes adept in the art of diagnosing numerous stock faults and misadjustments of television receivers simply by noting if and how the faulty receiver locks the respective bars and a pattern. This check need only take a half minute or so. ■

Beginners' Guide

C. Rafarel

LONG DISTANCE TV RECEPTION

FINAL PART OF A SHORT SERIES OF ARTICLES DEALING WITH THE BASIC ASPECTS OF DX-TV RECEPTION

THIS is the final article in the Beginners' Guide series, and here are the further modifications promised last month:—

(1) **Line Speed:** If the existing line hold control will not reach 625/819 lines, then proceed as follows: The usual Line hold control is in the form of a network of 3 resistors, the middle one variable, i.e. the control, and the lower one with the bottom end connected to chassis, if the value of the latter is increased by 25%–50%, this will usually give us sufficient control.

(2) **Picture width:** Lack of picture width coupled with low e.h.t. at 625/819 lines can be off-set as follows:—

(a) Drive the line output stage harder by means of adjustment to any line drive control if fitted. (b) Increase the screen voltage on the line output valve by halving the value of the screen resistance. (c) Low e.h.t. can be improved by overwinding the EY51/EY86 heater winding on the line-output transformer, this is often 5–6 turns of fairly thick wire, and by using the inner insulated conductor of a piece of co-axial cable we can add a further 2 turns to this winding. If you do this be careful about insulation, and ensure that any soldered joints are free from sharp points, which can cause "brushing".

A word of warning here, at 405 lines the EY51/EY86 valve will tend to overrun, and old valves may prove to be "expendable", but if we wish to avoid "dim" pictures the above suggestions are well worthwhile.

(3) **Field oscillator anode feed:** Normal practice is to feed the field oscillator valve anode from the h.t. boost rail, there are technical reasons for this, but for our purposes, when receiving fast fading Sporadic E signals causing rapid changes in brilliancy on the c.r.t., and hence the current drawn by it, the voltage regulation of the boost rail is far from adequate to ensure a constant voltage at the field oscillator anode, and a stable field hold control, the result is that the field either rolls up or down depending on whether the boost rail volts rise or fall.

I suggest that you check the anode voltage on a steady signal, then disconnect the feed from the boost rail, and arrange an alternate h.t. supply from the main h.t. rail of the set ensuring that the anode voltage is the same, by means of a suitable resistor and decoupling capacitor.

(4) **Video amplifier valve bias,** when handling negative going 625-line images:— A reduction in bias is required here, and this can be easily achieved by shunting the existing cathode bias resistor on the video amplifier valve with a second resistor of the same value, if the TV is required for positive image reception as well this resistor can be switched-in for 625-line negative reception by means of a pair of additional contacts on the Pos/Neg Yaxley switch mentioned in last month's article.

(5) **Increased gain in Tuner and i.f. stages:** This can be realized by changing a PCC84 in the tuner to 30L15, and by changing one or more of the usual EF80 valves in the i.f. stages to EF183 or EF184, some alteration to bias resistors will be required to conform with the makers specification on bias voltages, and some re-peaking is needed on the associated i.f. transformers and this should be done systematically and carefully, unless you are experienced and have the use of a signal generator available.

If you want any further advice on your own TV and its possible conversion, send the service sheet to me on loan as previously advised, and I will be very pleased to give you all the help that I can. ■

BBC RELAY STATION CONTRACTS

The BBC has placed a contract with J. L. Eve Construction Company to erect a 150-foot aerial tower for the television and v.h.f. sound relay station which is being built at Aughrim Hill, some three miles north-west of Kilkeel. This station is one of a number the Corporation is building to improve its coverage in Northern Ireland. The station is scheduled to come into service early next year.

Another contract to put up an aerial has been placed with the Cornubian Construction Company. This is for a 125-foot job for the television and v.h.f. sound relay station to be built at Ardrishaig; about 2 miles south-west of Lochgilphead. The station is expected to be on-the-air next spring, transmitting BBC-1 on Channel 1; vertical polarization.

Messrs. B. G. Davies Son have received a contract to erect the buildings for the new television relay station at Pantygrwndy Farm, two miles south-west of Cardigan. This station is being built to improve the coverage of the BBC-Wales television service. It is expected to come into service later this year, transmitting on Channel 2 with horizontal polarization.

CURING LOW SENSITIVITY FAULTS

V. D. Capel

A WEAK watery looking picture with the line tearing and lots of grain in the background is the familiar symptom of low sensitivity. Unlike most other faults which can be pin-pointed quite quickly to one particular stage, even though localising the faulty component may thereafter take some time, this fault can be due to almost any part of the circuit from the aerial socket to the video output stage.

There are other factors which can further complicate matters. If one is investigating a set other than one's own in perhaps another district, the signal strength there will be an unknown quantity. This can vary from street to street in some areas, and at least some of the trouble may be attributable to poor signal. Another possibility outside the set is the aerial and downlead, which may be defective.

Aerial Plug

The first objective is to eliminate all outside possible causes. The co-axial aerial plug is often the culprit especially if it has been fitted to the cable without soldering. The centre conductor is sometimes just pushed inside the centre plug-pin and in time oxidises and makes poor contact. Even some professional aerial erectors do this, and trouble results later. The conductor should be soldered for trouble-free service. If soldering facilities are not available a good connection can be made by feeding the centre conductor into the plug-pin and then squeezing the base of the pin with a pair of side cutters. This will crush the base of the pin together with the conductor inside, without flattening or deforming the end of the pin which has to make contact with the socket on the receiver.

Another fault encountered with badly fitted plugs is stray whiskers of wire from the outer braiding making intermittent contact with the centre conductor, thereby creating a short-circuit. The socket, too, can provide its share of trouble with the centre contacts becoming enlarged or forced apart with continued insertion of the aerial plug. The remedy is to squeeze it together with a pair of long-nosed pliers. (See Fig. 1.)

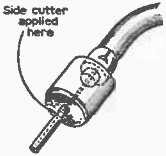


Fig. 1—Method for fitting plug without soldering.

Aerial and Feeder

Next check the aerial itself and the feeder. A rough way of doing this is to touch a screwdriver blade into the centre conductor of the receiver co-axial socket and then touch the outer of the aerial plug to the blade. In most cases, in areas of average signal strength, a picture will be produced. This can now be compared with the results when the aerial plug is plugged in properly. If the aerial is good, there should be a large increase in signal. If there is no difference, or the improvement is only marginal, then the aerial or its feeder must be at fault.

General Inspection

Having eliminated exterior causes we now turn our attention to the receiver itself.

A weak picture which is completely free from noise or grain with which there is normal sound, would indicate a fault at or near the output end of the circuit, such as the video output stage or the detector (See Fig. 2). A slight amount of noise with normal sound would indicate a fault in one of the vision i.f. stages. Noise, grain and perhaps some patterning together with low sound output would point to a fault in the common i.f. stage or the tuner. One must be careful, however, not to be misled on the matter of low sound. In many cases the sound may seem normal but is actually down on what it should be. The a.v.c. can also disguise low-sound symptoms by allowing the sound i.f.'s to work at maximum gain, whereas normally they are biased back by it. Low sound is often more easily recognised by a higher-than-normal noise level than by low volume. Sometimes one fault develops which cuts down the gain, but the user can still get a passable picture by turning up the contrast control. The set may be operating like this for some time and then another fault occurs which also affects the sensitivity. As there is now no reserve of gain left, outside advice is then sought.

Ageing Valves

One common cause of poor sensitivity is an ageing valve, especially the twin triode r.f. valve in the tuner unit. This should be the first suspect. The mixer is the next most likely one, followed by the i.f. and video valves. Professional servicemen often find that cases of low sensitivity are due

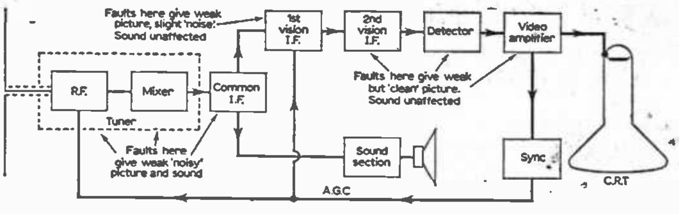


Fig. 2—Block schematic showing the sections of a 405-line receiver prone to sensitivity faults.

to several, sometimes nearly all the valves being down a little in performance. Replacing any one valve will improve the performance slightly but not enough to say the gain is sufficient. The user rarely appreciates the need for paying for five or six valves just because the picture is "a bit weak." He may feel that he is being "had", and professional servicemen have frequently been charged with sharp practice because of such cases.

Usually it is possible to reach something of a compromise by replacing two or perhaps three valves which effect the biggest improvement. How can these be determined? Taking the valves to a dealer to test is really not the answer. Some valves that show low emission on the tester sometimes give only slightly inferior results to new ones, while others that show a good reading give decidedly poor results. The reason for this is that there are many factors other than the emission of a valve as measured by a tester, that can affect its gain.

Substitution is the simplest way, but this may pose a difficulty for the amateur as he will need to have the replacement valves to try. Assuming that these are available, there is one very simple method of comparing the relative gain of a replacement valve. With all the old valves in the set, the picture brilliance is adjusted so that the peak whites are just visible with the contrast control at maximum and the fine tuner set to give maximum picture. A suspected valve is now replaced and the receiver switched on again. Under these conditions the amount of improvement, if any, should now be quite obvious. If only a little more of the picture becomes visible, then it is doubtful whether it is worth changing the valve. If on the other hand, should a good deal more of the picture comes into view, then a replacement should be made. Proceeding in this way through the suspected valves will indicate the best ones to replace for maximum improvement. When testing in this way with a replacement mixer/oscillator valve, be sure to re-tune the fine tuner for maximum picture, as the tuning point of the new valve may differ from the old one.

A.G.C. Circuits

Having dealt with the valves, we must investigate further if low gain persists. Before becoming too involved in the tuner or the i.f. strip, make sure that the trouble is not due to excessive control voltage from the vision a.g.c. circuit. Depending on the type of circuit used, a number of faults could occur which would cause this. The control voltage is usually applied to several stages; the r.f. stage as well as one or more i.f., so it would be very easy to be confused when looking for low-gain causes when the a.g.c. system is responsible. When measuring the a.g.c. voltage remember that there are usually high value resistors in series with it, so a low impedance meter will only give a fraction of the true voltage. The easiest check here, is to simply short the a.g.c. line to chassis. (See Fig 3.) With low signal strength there should be very little negative a.g.c. voltage, hence shorting the line would give only a slight increase in gain. If the picture gain jumps up to its normal level, then clearly excessive control voltage is being developed for some reason.

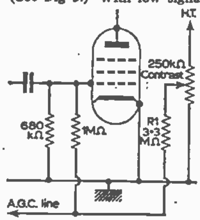


Fig. 3—Typical a.g.c. line.

One possibility is the resistor which connects the a.g.c. line to the wiper of the contrast control where the latter is a potential divider across the h.t. line to chassis. In this type of circuit, a positive voltage, dependent upon the setting of the contrast control is applied to partially cancel the negative voltage derived in many cases from the grid circuit of the sync separator. If this resistor has gone "high" in value, the negative voltage will increase and low gain will result.

Localising Faults

If the a.g.c. line is in order, then the fault must be localised to the particular stage responsible. We can divide the receiver into three sections for our purpose: the video output stage and detector; the i.f. stages; and the tuner. By carefully observing the symptoms mentioned earlier we can determine in which of these sections the fault lies. The next step is to take voltage measurements in the suspected section. Special attention should be paid to the cathode voltages of the i.f. stages. As the d.c. resistance of the i.f. transformer primaries is so low, no measurable voltage drop can be read across them, hence little idea of whether the valve is conducting can be obtained from this. The cathode voltage is the only certain indication.

Video Output Stage

When taking voltage readings in the video output stage it is easy to be misled, especially with the anode voltage. The video anode load is usually quite low in value, just a few thousand ohms, but sometimes, because of the high wattage dissipated in this component, it heats up, and where a carbon resistor is used, this often decreases in value. This has little effect on the anode voltage except for a slight increase, depending on the amount the resistor has deviated from its original value, but can have an appreciable effect on the gain of the video stage. When checking for faults in this region do not rely solely on the voltage reading, check the resistance as well.

If the trouble seems to be at this end of the receiver, yet the video stage is in order, do not overlook the diode vision detector. This can be checked by measuring with an ohmeter, first in one direction, and then with the leads in the opposite direction. One way the reading will be high (some cheaper meters with limited range on the ohms setting will show infinity or an open circuit) but the other way quite a low reading will be obtained. To avoid a misleading reading due to a parallel resistive path in the circuit, one end of the diode should be disconnected before the reading is taken if this is possible.

Faulty Decoupling Capacitor

An unexpected cause of low gain can be an open-circuit decoupling capacitor in the anode or screen circuits of the i.f. stages. (See Fig. 4.) This gives rise to the familiar instability and patterning symptoms which results from positive feedback through the affected circuit. Sometimes the feedback may be negative in polarity, thus causing a gain reduction, or instability may result which has no visible effect on the picture, but which generates a large a.g.c. voltage that cuts back the gain of the controlled stages.

A small gadget that many professional servicemen use for checking decoupling capacitors is illustrated in Fig. 5. The snag with substituting a capacitor in the normal way is that if it is held across the suspected one by hand, the presence of the hand might actually introduce instability. If a new capacitor is soldered in as a check, the long wires could also cause instability; and if the wires are cut to size, then the capacitor may be useless for further use because the wires are too short.

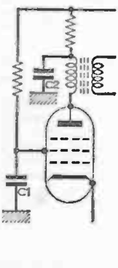


Fig. 4—C1 and C2 are typical decoupling capacitors.

The gadget consists simply of a piece of tag strip on which the pair of tags have been filed or cut to a point. Across these is soldered a 1,000pF capacitor with the leads as short as possible. This is then mounted on the end of a plastic or wooden rod. A slot cut in the end will, in most cases, be a convenient method of fixing. The pointed tags are then touched across the suspected capacitor, holding the device well up the handle.

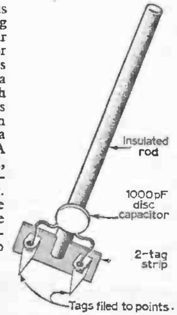


Fig. 5—Home-made in-circuit capacitor tester.

Using a Generator

If it is difficult to determine exactly in which stage the loss is taking place, then stage gain measurements will have to be taken. These need not be very accurate as a serious loss would be necessary to produce a noticeable lack of gain, and such a loss could easily be detected with approximate comparative measurements. For these a signal generator will be necessary that has a calibrated output voltage level. The c.r.t. itself can be used as an output indicator in the same manner as that described for valve checking. A modulated signal at i.f. frequency is fed into the grid circuit of the last i.f. stage and the brilliance and contrast controls set so that the peak white portions of the pattern on the screen are just visible. The output voltage of the generator is then noted. Next, the signal is fed into the preceding stage and the output of the generator reduced until again the peak whites are just visible. The output voltage setting of the generator is noted and compared with the previous one. The ratio between the two levels will give some idea of the stage gain. This process is repeated over preceding stages until one is discovered that has low gain. Often it will be found that the offending stage has a gain of less than unity. Variations of gain from one stage to another do not necessarily indicate a fault, as many factors such as the adjustment of the tuned circuits, the impedance of the grid circuit compared to that of the generator, and capacitance of the generator leads, will all affect the reading. The common i.f. stage, if there is one, will show a lower gain normally than the others as it is broadly tuned to accept the vision bandwidth as well as the sound. In some cases, however, high gain valves are used in this position to equal or even exceed the gain of the others. Suspect a circuit then, only if its gain is very low compared to the others.

The last i.f. stage can be checked by comparing the injected generator voltage at the grid with that needed to give the same c.r.t. indication when injected into the r.f. side of the vision detector. There may be widely differing impedances in the two circuits which will affect the results, even so, a fair gain should be noted.

If nothing wrong in the video circuits or the i.f.'s can be found, then look to the tuner. As mentioned earlier, a faulty tuner can often be quickly identified by noise or grain in the picture which is due to the i.f.s working full out with little signal input to cover the normal valve noise. The best approach is to check the tuner gain in the same way as the i.f. stages but with different frequencies. This can be done by injecting a signal of the appropriate frequency at the aerial socket with the tuner switched to the channel covered by that frequency. The signal level wanted can be compared with that needed to give the same output when fed into the common i.f. grid circuit.

Owing to the bandwidth involved and the possibly restricted range of the fine tuner, more accurate results can be obtained by using the sound channel for this test with a meter connected to the output stage in the usual manner. The test can be done on Bands I and III. Often it will be found that the gain on Band I is the greater.

Tuner Sensitivity

Sensitivity checks were made on a number of popular tuners and the results recorded. Measurements were made on Band I and Band III using Channels 5 and 10. New valves were fitted for the purposes of taking the measurements. These are as follows:

Fireball tuner (using PCC84): *Band I*, gain of 180; *Band III*, gain of 40. *Fireball tuner (using PCC89)*: *Band I*, gain of 400; *Band III*, gain of 250. *Ekco tuner (as used in 346 series)*: *Band I*, gain of 850; *Band III*, gain of 600. *Pye HDF tuner*: *Band I*, gain of 250; *Band III*, gain of 65. *Philips tuner (as used in the TG200 series)*: *Band I*, gain of 400; *Band III*, gain of 85.

It can be seen that there are wide differences between various types, but these seem to depend mainly on the type of r.f. valve used. The same tuner with a different r.f. valve gives different gains, but different makes of tuner with the same valve have similar figures. This does not mean that a higher gain valve can be exchanged for one of the lower gain type, the circuit is designed for the specific type used. It should be noted here that the figures given were not "spread" over several tuners to get an average reading, hence they may have been taken on a unit that was either better or worse than the average, and others may give different readings. The receivers were working in each case up to the normally expected standard, so a large deviation from these figures would not be expected.

If the gain of the tuner is indeed found to be below that expected, it will be necessary to determine whether the trouble is in the r.f. stage or in the mixer/oscillator. Most tuners provide a convenient test point where injection of a test signal can be made into the grid circuit of the mixer. If a signal of the appropriate channel frequency is injected here, as it was at the aerial socket, and the level compared with that fed into the common i.f. at i.f. frequency to give the same deviation on the output meter, it will be found that the mixer stage has a gain of less than unity—its function being to convert the r.f. signal to the i.f. frequency. A surprising fact in view of overall gain figures quoted above where the Band I reading is always greater, is that over the mixer, the band III gain is greater (or more accurately the Band III loss is less).

It is well to remember this, as otherwise much wasted effort could result looking for a fault in the mixer that did not exist.

Some examples are: *Fireball tuner: Band I*, gain of 0·15; *Band III*, gain of 0·8. *Philips tuner: Band I*, gain of 0·05; *Band III*, gain of 0·3.

Should the tuner prove to be at fault, then the most likely causes, other than valves which should be tried first, are dirty switch contacts; increase in value of the oscillator anode resistor; loose trimmers or cores. Also check the grid decoupling capacitor of the second r.f. triode. ■

ELECTRON BEAMS AT WORK

—continued from page 58

micro-min layout, and hence to the required masks, done completely by the computer.

The programming for this kind of "instant" micro-min design is very complex, and at the moment requires a considerable amount of try-and-see steps. There is every sign that it will develop to the stage where production of micro-min or thin-film circuits will be possible by feeding details of the functional requirements of the circuit (gain, frequency and phase response, input and output impedances, etc., in the case of an amplifier) to a computer linked to the mask-cutting equipment which will then create the tools with which the circuits can be put into production.

When we reach this stage, it will be almost as economic to produce the optimum circuit for each application as it would be to make a large quantity run of standard circuits and adapt the applications to use them.

The third use of electron beam heating in circuitry is in trimming. Thin film resistors cannot at the moment be produced to very fine tolerances, and, if the circuit requires the use of close tolerance resistors, as, for example, a d.c. amplifier, the resistors must be made oversize (*low* resistance) and cut down until the resistance measures exactly as planned.

This is hardly a task which can be performed by a razor blade, but it has been done in the past by a very similar technique, using a blade rigidly held and carefully guided, the whole operation being viewed under a microscope.

The electron beam is a much better trimmer. It can be precisely guided, its effects can be controlled by varying beam current and focus, and, once again, the fact that the deflection of the beam can be programmed on tape or otherwise recorded, means that a large number of circuits can have their resistors trimmed, more than one resistor to a circuit, to match with standards which form part of the test equipment.

It would be most amusing if the familiar television c.r.t. were to be supplanted by a solid-state panel device which had to be produced by electron beam cutting! ■

TELETOPICS

EXPERIMENTAL COLOUR TV TRANSMISSIONS
LATEST TIME SCHEDULES

THE experimental colour transmissions using the PAL system from Crystal Palace, Channel 33, are continuing according to the following schedule: Monday, 1400-1415, Test Card in black and white; 1415-1425, colour bars; 1425-1500, colour slide; 1500-1700, programme as for 1400-1500, repeated. Tuesday, 1400-1700, as Monday. Wednesday, 1400-1700, as Monday; 1810-1900, moving pictures may be included in this period, together with colour slide and colour bars. Thursday, 1400-1700, as Monday; 1810-1900, as Wednesday. Friday, 1400-1700, as Monday; 1810-1900, as Wednesday.

The colour transmissions are also radiated from the u.h.f. relay stations at Hertford (Channel 64) and Tunbridge Wells (Channel 44).

At the times given above, the colour transmissions replace the scheduled BBC-2 trade test transmissions, but they are subject to the reductions in power and interruptions caused by work on the BBC-2 aerial at Crystal Palace.

START OF BBC-1 SERVICE FROM BODMIN RELAY STATION

THE new BBC-1 relay station near Bodmin was brought into service on September 19. It transmits BBC-1 on Channel 5 with horizontal polarisation.

For satisfactory reception it is important that viewers use horizontal aerials designed for Channel 5.

The station will make available improved reception of BBC-1 to some 6,000 people.

New Equipment Unveiled by Rentaset

RENTASET Wired Services Division's latest modular console closed circuit TV studio recently demonstrated at the National Audio Visual Aids Exhibition.

Picture shows A. S. Whitenstall, Executive Director of Rentaset Wired Services Division (far right) with an Education Officer. R. D. Efford, London Sales Executive for the Company operates the console unit with D. White controlling one of the cameras.

TELEVISION AT LEIPZIG AUTUMN FAIR

LATEST developments in the field of East German television include a fully transistorised television set due to go into serial production next year. The set, fitted with an 11in. screen and weighing 18¾lb., is manufactured by VVB Rundfunk und Fernsehen and claims to include substantial improvements on models of international standard as well as better performance data in some respects.

THORN EQUIPMENT FOR BBC COLOUR TV STUDIO

THORN ELECTRONICS LTD. have been awarded a major contract for the provision of a comprehensive electronic lighting control system in the new BBC Studio 8 under construction at the TV Centre, White City, which is designed specifically for colour TV transmissions.

The installation will control over 500 studio lighting outlets which will be fed from Thyristor type dimmers. These will be controlled by a special purpose computer which processes and stores information enabling dimmer settings to be automatically "filed" during rehearsal and recalled for use by a simple push button operation.

Closed Circuit Television Applications Book

DURING the last few years a large number of applications for closed circuit television have been published. Beulah Electronics Ltd., 126 Hamilton Road, West Norwood, London, S.E.27, have combined fifty-three case histories, many of which have not been published before, in one booklet.

BBC ORDER AUTOMATIC HIGH-POWER U.H.F. TRANSMITTERS

THE BBC has placed an order for three 40kW u.h.f. transmitters with the Marconi Company. They are due to be installed in 1968 at Caradon Hill in Cornwall, Sandy Heath, in Bedfordshire, and at an unknown site in North Yorkshire.

Servicing TELEVISION Receivers

No. 128. S.T.C. VC2 and VC3 chassis, K-B XV60, WV90, WV90, KV001 KV101, KV002, KV400A and KT405A; RGD RV202, RV302, and 627. Regentone TV402, 404, 501 and 502 continued.

By L. Lawry-Johns

No H.T.

The next fault to consider is that of NO RESULTS although the heaters all glow (except the DY86). These symptoms indicate lack of h.t.

Once again commence testing with a meter or neon at the dropper R169 junction R170, 1A fuse (or R165-VC2) then R165 to the BY100. If we are alright up to this point the d.c. output at the BY100 will almost certainly be present and normally as far as the VC2 is concerned the fault will by now have been located in an o.c. resistor (R165?) or fuse. As the VC3 uses further resistors one of these could be o.c., R167 or R168. Now having located the break a little time should be spent considering the manner in which the fault has occurred. Examine the fuse if this has failed. If it has completely disintegrated (obviously blown) look for the cause. Check the BY100 with a two way resistance reading; it should be low one way, high when the leads are reversed. If the BY100 is not at fault (disconnected from circuit for test) check C144 (2,200pF 2kV), the electrolytics C145, C143, C141, C83 (check R101) and C62 (check R56).

No Picture, E.H.T. in Order

A voltage check on the tube base should reveal the cause if the raster is absent. For example, the voltage at the first anode should be slightly in excess of 500V. A low voltage here, at pin 3, will probably mean an upset in the balance between R156 680kΩ and R157 2MΩ. The latter is the focus control and this can change value dropping the pin 3 voltage enough first to make the picture dark and then out altogether. These same symptoms obtain when C137 0·05μF 1·5kV leaks or shorts to chassis. Quite often the pin 3 voltage is found normal but the pin 7 voltage higher than its maximum of 160V. This happens when the balance of R58 470kΩ and R61 390kΩ is disturbed.

This happens when R61 goes high. If both pin 3 and pin 7 seem to be in order it may be found that the pin 2 voltage is too low even with the brilliance fully advanced. This normally happens due to a leaky or shorted capacitor, C85 0·022μF,

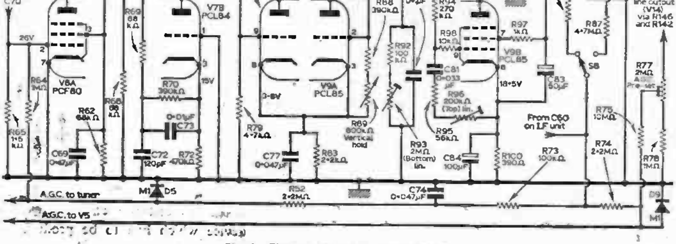


Fig 4—Field oscillator and output circuits.

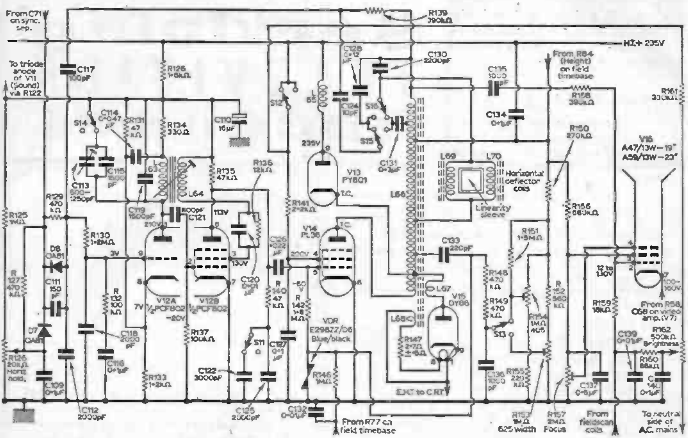


Fig. 5—Line timebase and c.r.t. circuitry.

C140 0·1μF and C139 0·01μF should be checked. R161 can change value and this is another possibility which should be checked.

Raster Normal—No Picture

When this condition prevails and the sound on BBC-1 and ITV is normal, it is quite in order to go straight to the V7 PCL84 which is more often than not the cause. If it is not, check through S5-S6, L44, D6 (GD12), V6 EF184 and associated voltages. It is just as well to check the continuity of L46-47-48 in the PCL84 anode circuit. If the drive to pin 8 of the PCL84 is excessive (much more than 5V) check C54 by connecting a test decoupler of about 0·001μF from pin 8 of V6 to chassis.

No Sound, Vision O.K.

A sharp tap on the PCL86 (V11) often reveals the fault straight away and a new valve will then restore normal conditions. If the PCL86 is not at fault check the response from the loudspeaker. If a faint hum is heard it can be assumed that the output transformer and the loudspeaker are in order. If no response is heard check the loudspeaker connections and the voltage at pin 6 on the PCL86. If this voltage (about 200V) is absent L61 the sound output transformer is probably open

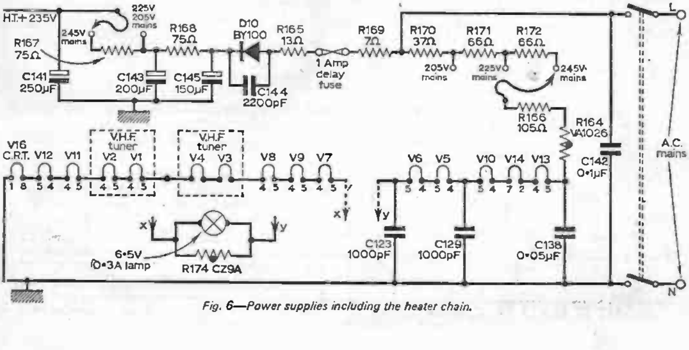


Fig. 6—Power supplies including the heater chain.

circuited. If a hum is heard check the pin 9 voltage (just over 100V) and for audio hum from the volume control and S4, through D4, D3, V10 and associated voltages.

Timebase Troubles

The line output stage has been lightly touched upon but there are many possible faults which can occur which are outside the scope of this short article. A few, however, can be briefly outlined.

LINE HOLD: It will be found very difficult to lock the line timebase if the core of L63-64 has been disturbed. This should be set up on 625 and C113 adjusted for correct 405 working (hold control set midway). Do not make these adjustments until V12 has been proved by replacement. Check R125 R130 C116 and both OA81's if difficulty is experienced.

WIDTH: Adjust R154 on the 405 line standard and R153 on 625 for correct width. The line linearity control is a closed loop sleeve on the neck of the tube. Adjustment to this will necessitate readjustment of the above presets to regain width.

FIELD TIMEBASE: Bottom compression is probably the most common complaint. This should direct attention to V9 PCL85, to C84 100μF and C82. If the hold control is at the end of its travel, check V8 and V9 if necessary, then check R88 and C77.

LACK OF HEIGHT: If there is an even gap top and bottom check R85 1·5MΩ. In earlier models a 100kΩ resistor and 0·1μF capacitor was used in the boost line feed to the height control. If these are fitted the 0·1μF capacitor should be checked for leaks, particularly if the 100kΩ overheats.

STANDARDS SWITCH: Erratic operation of the 405-625 switch contacts can cause all sorts of troubles but these can usually be identified by working the switch. Cleaning and slight adjustment is all that is normally required and these remarks also apply to the v.h.f. tuner, be it rotary or push button.

The troubles which beset these tuners have been repeatedly dealt with in past issues.

HUM ON 625 STANDARD: The hum referred to is picture hum where the screen is of uneven illumination—light top, dark bottom, etc., and poor sync is experienced. This effect may not be noticed on the 405 standard. A replacement PCL84 will nearly always restore normal working. The reason why it is not noticed so much on the 405 standard is because the increased bias of R55 tends to mask the effect. This video amplifier defect is not confined to these receivers by any means and is even more commonly encountered when a PL83 is used in the video stage and the bias is reduced for 625 working.

LETTERS TO THE EDITOR

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

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

MANY THANKS

SIR,—With reference to the 1960—1964 issues of PRACTICAL TELEVISION, asked for in the May issue of PRACTICAL TELEVISION.

May I express my sincere thanks to all those 60 readers who offered to help me. A local reader gave me 90% of the copies I required. Thanks once again for such a bumper response—C. WOODS (Stretford, Manchester).

INFORMATION WANTED

SIR,—Can anyone loan hire or sell me the Instruction Book as issued by the manufac- scope using c.r.t. VCR97, which I believe was published in PRACTICAL TELEVISION some years ago?—C. A. D. BARNETT (53 Westbourne Grove, Selby, Yorkshire).

CAN ANYONE PLEASE HELP?

SIR,—Can anyone loan, hire or sell me the Instruction Book as issued by the manufacturers, for the Pye 17in. model VT17? All expenses will be paid for same.—H. A. F. PERKINS ("Monks Walk", 48 Highbury Park, Warminster, Wiltshire).

ADVICE OFFERED?

SIR,—I would like to give a bit of assistance in "Your Problems Solved." Re a Mr. Wilson's 4610 Marconi (850 series) TV, in the May issue of PRACTICAL TELEVISION, where he complains of loss of field hold on 625-lines.

I have found that the PCL84 video output valve is faulty owing to R24 changing value. A 2W component for replacement is essential. Also, C23 should be changed from 0·03μF to 200pF and R138 should be checked by substitution; once again, 22kΩ to a 2W rating gain.

Another tip on this series for 625: If the signal is locking out at video amp., is to transfer the green wire from tag 7 to the other side of R27 (1MΩ). This usually results in a better control of contrast on 625.

One more suggestion I have is for a Mr. Huxley of London, who has an Alba T866 which shows the flyback (pulse and bar) on BBC-1.

He should check R54, the 5·1MΩ resistor in the anode circuit of the PCL85. This resistor goes low and causes the above fault.

I hope that these tips may be of some help to fellow readers of an excellent magazine.—M. WALLWORTH (Altrincham, Cheshire).

INCORRECT INFORMATION

SIR,—May I draw your attention to the incorrect information given to R. J. Evans (Flintshire) in the September issue.

Mr. Evans inquired about tuning his TV receiver to receive BBC Wales and the Welsh ITV (TWW) and was told that the signals would be poor being received from Wenvoe and St. Hillary, near Cardiff.

BBC Wales is in fact transmitted by five high power and five low power transmitters, the nearest to Mr. Evans being Moel-Y-Parc in Flintshire (Channel 6 vertical polarisation, 21kW e.r.p.).

The Welsh "Teledu Cymri" service of TWW is transmitted by four high/medium power transmitters serving S.E., S.W., N.W. and N.E. Wales. Moel-Y-Parc transmits "Teledu Cymri" on channel 11 vertical polarisation.

The channel 9 aerial used for Winter Hill is normally satisfactory in Mold (6 miles) if rotated towards the transmitter but a broad-band aerial gives far better results, especially on channel 6. A portable set or a set-top aerial is quite sufficient on high land around the town which is situated in a valley.—JOHN P. BLYTHIN (Mold, Flintshire).

AN OFFER TO P.T. READERS

SIR,—Having spent forty years in radio and television engineering, I have accumulated thousands of valves, motors, capacitors, etc. which I am disposing of to anyone who will send enough carriage to cover delivery. I propose sending in boxes of about 20 lb. in weight, but will send less in cases of certain wants. I also have about 1,000 A.M.'s, P.W.'s, and A.W.'s, going back to 1932.—J. GOULDING (3 Larch Grove, Marsh Est., Lancaster C).

ISSUES WANTED

SIR,—Could any reader please supply me with the April, May and June, 1961, issues of PRACTICAL TELEVISION, which carried the "Servicing Television Receivers" articles covering the Decca DM45?—G. F. BROOKS (11 Shakespeare Crescent, Eccles, Manchester).

STOCK FAULTS

SIR,—I am very glad to see that "Stock Faults" are back with us again. I would like to take this opportunity of congratulating Mr. H. W. Hellyer on his last excellent series and wish him equal success with this series of "Stock Faults".—A. READ (Walthamstow).

LAWSON BRAND NEW CATHODE RAY TUBES

The rapidly increasing demand for a complete range of new tubes of the very highest quality is now being met by the new Lawson "CENTURY 99" range of television tubes.

SPECIFICATION:

The new "Century 99" range of C.R.T.s are the products of Britain's premier C.R.T. manufacturers. All types are exact replacements, manufactured to the original specification but incorporating the very latest design improvements to give superb performance, coupled with maximum reliability and very long life.

"Century 99" C.R.T.s, available as direct replacements for the following makes and types

MULLARD

MW43/69, MW43/64, MW36/24, MW31/74, MW31/16, MW43/80, MW36/44, MW53/80, MW53/20, MW43/43, AW59-91, AW59-90, AW53-89, AW53-88, AW53-80, AW47-91, AW47-90, AW43-89, AW43-88, AW43-80, AW36-80, AW36-21

Twin Panel Types: A47-13W, A59-16W, A59-13W

MAZDA

CRM121, CRM123, CRM122, CRM124, CRM141, CRM142, CRM143, CRM144, CRM153, CRM171, CRM172, CRM173, CRM211, CRM212, CME141, CME1402, CME1702, CME1703, CME1705, CME1706, CME1901, CME1902, CME1903, CME2101, CME2104, CME2301, CME2302, CME2303

Twin Panel Types: CME1906, CME2306

BRIMAR

C12FM, C14FM, C14GM, C14HM, C14JM, C14LM, C14PM, C171A, C174A, C175A, C177A, C17AA, C17AF, C17BM, C17FM, C17GM, C17HM, C17JM, C17LM, C17PM, C17SM, C19/7A, C19/16A, C19/10AD, C19AH, C19AK, C21/1A, C217A, C21AA, C21HM, C21KM, C21NM, C21SM, C21TM, C23-7A, C23-TA, C23AG, C23AK

EMISCOPE & EMITRON

4/14, 4/15, 4/15G, 5/2, 5/2T, 5/3, 5/3T, 14KP4, 17ARP4, 17ASP4, 17AYP4, 21CJP4, SE14/70, SE17/70

GEC and COSSOR Also ENGLISH ELECTRIC

141K, 171K, 172K, 173K, 212K, 7102A, 7201A, 7203A, 7204A, 7205A, 7401A, 7405A, 7406A, 7501A, 7502A, 7503A, 7504A, 7601A, 7701A

12" ..	£4.10.0
14" ..	£5.10.0
17" ..	£5.19.0
19" ..	£6.19.0
21" ..	£7.15.0

Terms: C.W.O. Carr. and Ins. 10/-

2 YEARS' FULL REPLACEMENT GUARANTEE

Complete fitting instructions supplied

LAWSON TUBES
STATION ESTATE, MALVERN.
Offices
18 CHURCHDOWN ROAD, MALVERN. MALVERN 2100

FREE TO AMBITIOUS ENGINEERS

— THE LATEST EDITION OF ENGINEERING OPPORTUNITIES

Have you sent for your copy?

ENGINEERING OPPORTUNITIES is a highly informative 156-page guide to the best paid engineering posts. It tells you how you can quickly prepare at home for a recognised engineering qualification and outlines a wonderful range of modern Home Study Courses in all branches of Engineering. This unique book also gives full details of the Practical Radio & Electronic Courses, administered by our Specialist Electronics Training Division—the *B.I.E.T. School of Electronics*, explains the benefits of our Employment Dept. and shows you how to qualify for five years promotion in one year.

SATISFACTION OR REFUND OF FEE

Whatever your age or experience, you cannot afford to miss reading this famous book. If you are earning less than £30 a week, send for your copy of "ENGINEERING OPPORTUNITIES" today—FREE.

WHICH IS YOUR PET SUBJECT

Mechanical Eng., Electrical Eng., Civil Engineering, Radio Engineering, Automobile Eng., Aeronautical Eng., Production Eng., Building, Plastics, Draughtsmanship, Television, etc.

GET SOME LETTERS AFTER YOUR NAME

A.M.I.Mech.E.
A.M.I.C.E.
A.M.Prod.E.
A.M.I.M.I.
A.I.O.B.
B.Sc.
A.M.I.E.R.E.
City & Guilds
Gen. Cert. of Education
etc., etc.

PRACTICAL EQUIPMENT

Basic Practical and Theoretical Courses for beginners in Radio, T.V., Electronics Etc., A.M.I.E.R.E., City & Guilds
Radio Amateur's Exam.
R.T.E.B. Certificate
P.M.G. Certificate
Practical Radio
Radio & Television Servicing
Practical Electronics
Electronics Engineering
Automation

INCLUDING TOOLS!

The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details

B.I.E.T. SCHOOL OF ELECTRONICS

POST COUPON NOW!

Please send me your FREE 156-page "ENGINEERING OPPORTUNITIES"
(Write if you prefer not to cut page)

NAME ....

ADDRESS ....

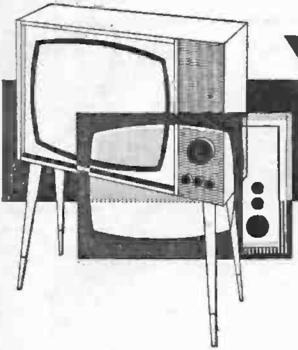
....

....

SUBJECT OR EXAM THAT INTERESTS ME 301B

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
(Dept. 301B), Aldermaston Court, Aldermaston, Berkshire

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD



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

PAM 752DL

The contrast when turned either way has no effect but the brilliance still works perfectly. The picture was fair for a few weeks and suddenly the whole lot disappeared—sound O.K. Have replaced EY86, PY81 and PL81. I can get a reading on the top caps of these valves but I am unable to get any e.h.t.—W. Innison (Maidenhead, Berks.).

Check the h.t. Voltage. If low, check the h.t. metal rectifier and electrolytic capacitors. If the h.t. is in order note whether the PL81 tends to overheat. If it does check the screen feed resistor and PCF80 line oscillator. Check boost line capacitor and line output transformer. Also check the a.g.c. diodes and capacitors.

TV ALIGNMENT

I should like to enquire if it is possible to line up a TV receiver wihout any test gear, if so what would be the best way to adjust the sound traps? Also, could a loft aerial be made that would give high gain on all channels instead of the usual yagi arrangement directed at two stations.—J. C. Blanch (Southend-on-Sea, Essex).

It is possible to align television sets without instruments with some degree of success, depending on experience. For absolute correct alignment however, test instruments are essential, even for the highly experienced.

An article on this subject was published in the September 1963 issue of PRACTICAL TELEVISION, but this is no longer in print. You may be able to see a copy at a reference library.

Sound rejectors alone can be adjusted on a test card transmission with a tone sound accompaniment, by adjusting them simply for minimum picture disturbance with the set otherwise adjusted for the best picture.

A wide-band, high gain aerial system embracing all channels is not a practical proposition owing to the difference in signal polarisation and direction of the stations from the receiving site, among other more technical factors.

HMV 1843

The sound is normal. There is no raster, no line whistle no e.h.t. and the PL81 glows red hot. I have changed over V7 with V9 (PCF80's) but this has made no difference. Twice the line whistle and a raster appeared for a few seconds only. I have partially cleared the grease from the line transformer to observe the U151 but I cannot see any signs that this is lit up. Do you suspect the LOT or are there any other suspect components that I may check first before replacing this?—E. Thompson (Sheffield, 6).

This fault is in the line oscillator stage or in the coupling to the PL81 control grid. Check the PCF80 components (oscillator transformer etc.) including the coupling capacitor to the PL81.

FERGUSON 3624

On BBC and ITA I get a good picture, but on switching to BBC-2 the picture starts off all right but gets brighter as the set warms up until there is a faint picture which goes up and down and there is tearing at the top of the picture. I changed the PFL200 which cured the fault and gave me a good picture, but about a week after, the same fault appeared. Changing valves, the fusible resistor has blown; could you give me the rating, or could it be replaced with another fuse?—G. Webber (Cheltenham, Gloucestershire).

The fusible resistor has a value of 14Ω. This can be reset quite simply or replaced by a 500mA fuse.

Check the PFL200 cathode resistors and the 300μF electrolytic capacitor. The PFL200 is practically unbiased if this capacitor is shorted.

MURPHY V240

When the set is switched on ITV is perfect, but the BBC has spasmodic lines (as in sound on vision) jumping horizontally across the picture. I am unable to correct this by adjustment of the controls. The volume control does not in any way affect this and after 25 minutes or so the effect disappears and the picture appears normal.—H. J. Rowlanes (Croydon, Surrey).

It would seem that the local oscillator in the tuner is slightly out of adjustment on the BBC channel. This should be adjusted for maximum sound consistent with minimum sound on vision.

FERGUSON (900 chassis)

After switching on, when the timebase becomes operative, flashover occurs in the EY86 rectifier and a small corona discharge appears on the screen for a half-minute afterwards. The set then behaves perfectly for the rest of the evening.—L. Raymond (Wembley, Middlesex).

The EY86 rectifier is almost certainly the only cause of the effect.

BUSH TV105

Can you tell me whether or not this set can be made to receive BBC-2.—H. Woodrow (Mitcham, Surrey).

The TV105 can be made to receive BBC-2 (see page 532 September 1966 issue) but it is extremely difficult to convert it for dual-band working.

BUSH TV43

This set was giving an excellent picture on a reactivated tube, when there was a crackle from the speaker and the picture collapsed sideways to form a fading vertical line. Now there is no raster. The sound is all right and there is a line whistle present. The EY51 is not alight and no spark can be drawn from its top cap.—A. Smith (Farnham, Surrey).

Check the continuity of the EY51 heater. Change this valve if in doubt. The manner of the line collapse did not suggest EY51 trouble however and we would have thought the PL81 or a boost line capacitor would have been more likely to have been at fault.

FERGUSON 306T

Both sound and vision break down together on both channels. Perhaps the set will remain off for quite a while and then reappear for a fraction of a second.

E.H.T. appears to be normal also the brilliance and contrast controls work normally.—C. Benham (Wolverhampton).

This fault is almost certainly in the tuner unit.

Check the tuner valves, valve base contacts, spring contacts (to studs) and resistor continuity.

Check also simple things like aerial connections and coaxial leads etc., and the check the common i.f. stage if necessary.

DER V22206

This set was given to me and I found that the thermister was broken and behind the mains socket a 100Ω resistor was c/c. I replaced these components and found that all the valves lit up. I still could get nothing from the set. I changed the two PY82's and EY51, then I had sound on ITA. I tried the final anode to chassis and got a long blue spark. The line whistle is audible but I can get no raster or picture.—A. Duxbury (London, S.W.6).

The lack of raster is probably due to low emission of the tube or to a misplaced ion trap magnet on the tube neck. The lack of BBC reception should direct your attention to the rear right side section which is used for BBC reception only (V1 EF80 and V2 ECC81).

COSSOR CT1935A/77

The sound is perfect but the picture is very faint. If the brightness is turned up, the picture blows up and disappears. I have to turn the brightness down and then slowly turn the knob to get a faint picture. The e.h.t. rectifier, EY86, PL36 and PY81 are in perfect working order and the tuner valves are brand new.—D. Steemson (Mansfield Woodhouse, Nottinghamshire).

The fault is in the EY86 circuit. Either this valve is at fault or its associated power supplies are incorrect. First observe if the EY86 heater glows normally. If it does not, go back to the PL36 and the line drive etc. checking voltages and line drive.

PYE VT4

The picture is normal but very faint even with brilliance, contrast and vision sensitivity fully advanced. Contrast is slightly better when the brilliance is cut back a little way. The focus lever has to be at the lowest position to retain the picture. Line hold and vertical hold function normally and the sound is normal.

What type is the overload crystal diode?—C. Carrell (Reading, Berkshire).

The symptoms you describe suggest a low emission cathode ray tube. The overload crystal is type CG5E.

STELLA ST8617U

The picture has been reduced by two inches at the bottom of the screen. The height control has no effect. By adjusting the line and frame hold a picture comes that has a thick black line in the centre with double vision and is reduced at the bottom of the screen. I have fitted a new PCL82 frame oscillator and output valve, also sync sep. and frame oscillator ECL80 which has no effect.—G. Dixon (Boston, Lincolnshire).

Since the height control has no effect, check the control for element continuity and resistance and check the resistor connected between its top tag and h.t. positive line. This component could have increased substantially in value.

COSSOR 932

This set is fitted with a Stella ST1600-01 turret tuner. After switching on, a dim picture appeared and the volume was considerably reduced. No picture could be obtained on the ITV channels. after finding the envelope of the PCC84 cracked, a replacement was fitted and the sound and vision returned to normal but the gain control was inoperative. The contrast control works normally. The volume is still very poor when the set is switched to ITV and light bands appear to to rise up the screen.—J. Best (Co. Durham).

Your trouble appears to be in the tuner. We would advise you particularly to suspect the new PCC84 which you have fitted, as this could easily be faulty. There are normally adjustments which can be made to optimise ITA reception on any particular tuner, but it is difficult to say what they should be on an adaptation such as yours.

GEC BT2748

The trouble is very weak sound with no distortion. The picture is quite good.—H. Galwin (Solihull, Warwickshire).

This symptom could be caused by lack of sensitivity in the sound channel and a fault almost anywhere in the whole of the section could be responsible. First have the sound channel valves checked and sound i.f. alignment. Also check that the aerial is delivering balanced sound and vision signals.

QUERIES COUPON

This coupon is available until NOVEMBER 24th, 1966, and must accompany all Queries sent in accordance with the notice on page 91.

PRACTICAL TELEVISION, NOVEMBER, 1966

TEST CASE -48

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.

? *The symptom was that of an inverted picture accompanied by arcing in the field timebase valve (ECL80). Vertical hold was good and solid, but it was found that the height control had very little influence on the picture. Changing the ECL80 failed to alter the conditions, and arcing in the replacement valve was still intermittently present during the warming-up period.*

Checks were made of the smaller components in the field amplifier stage and as a last resort the field output transformer was tested by substitution, but the fault persisted.

Indeed, in desperation the enthusiast changed almost everything in the field circuits to no avail. What could be one item that was overlooked and responsible for the trouble?

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 47
Page 44 (last month)

Many new houses now feature fluorescent lighting either diffused in the lounge or in the kitchen in the form of a "halo" type of light. Unfortunately, fluorescent lights generate a form of r.f. interference which disturbs television, mostly on the lower Band I (BBC) frequencies. This interference was shown last month.

On new tubes and fluorescent lighting systems the interference level is usually so small that it has virtually no effect on television reception provided the aerial is correctly installed and the signal levels reasonably high. However, where an attic-type aerial is employed, interference pickup from the supply cables is greatly increased, and this is further aggravated if the signals are a little weak—as they often are from any indoor aerial.

The result is that the signal/interference ratio is impaired and even though the interference radiated by the fluorescent circuits is very small, it can under these conditions cause the interference illustrated. Band I channels are more responsive to interference of this kind than Band III and the u.h.f. bands.

One solution to the problem is to raise the aerial signal pickup and move the aerial outside the major interference field, but this often means fitting an outdoor aerial. Another possible solution is to improve the radiation at v.h.f., and this can often be done by wiring small 1-ampere TV suppression chokes in series with each feed at the ends of the tube, one choke in each lead as close as possible to the tube.

Both solutions are based on increasing the signal/interference ratio, the first by raising the signal strength and the second by reducing the level of interference signal.

Published on or about the 22nd of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2, and printed in England by WATMOUGHS LIMITED, Idle, Bradford; and London. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia) LTD. Subscription rate including postage for one year: To any part of the World, £1.9.0.

MISCELLANEOUS

CONVERT ANY TV SET into an Oscilloscope. Instructions and diagrams 12/6. REDMOND, 42 Dean Close, Portslade, Sussex.

SERVICE SHEETS

RADIO 2/-. TV 3/-. Manuals 5/-. C.W.O. S.A.E. Model No. HOPKINS, 44 Dale Valley, Poole.

SERVICE SHEETS, Radio, TV, 5,000 models. List 1/-. S.A.E. enquiries. TELRAY, 11 Maudland Bk., Preston.

SERVICE SHEETS (75,000) 4/- each. Callers welcome. ALWAYS OPEN. 5 South Street, Oakenshaw, Bradford.

SERVICE SHEETS

For all makes of Radio, Television, Tape Recorders, 1925-1966. Prices from 1/-. Catalogue of 6,000 models, 2/6.

Free fault-finding guide with all Service Sheets.

Please send Stamped Addressed Envelope with all orders and enquiries.

HAMILTON RADIO
Western Road, St. Leonards, Sussex

SERVICE SHEETS

4/- each, plus postage

We have the largest supply of Service Sheets for all makes and types of Radios and Televisions, etc. in the country (speedy service).

To obtain the Service Sheet you require please complete the attached coupon:

Name: ....

Address: ....

....

....

To: **S.P. DISTRIBUTORS**
30 Baker Street, London, W.1

Please supply Service Sheets for the following:

Make: ....
Model No. .... Radio/TV

Make: ....
Model No. .... Radio/TV

Make: ....
Model No. .... Radio/TV

I also require new 1966 List of Service Sheets at 1/6 plus postage.

(please delete items not applicable)

I enclose remittance of ....
(which includes postage)

MAIL ORDERS ONLY (Nov. PT.)

RATES: 4/- per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Television", Tower House, Southampton Street, London W.C.2.

SETS & COMPONENTS

"HEATHKITS" can now be seen in London and purchased on H.P. Free brochure. DIRECT TV REPLACEMENTS LTD., 126 Hamilton Road, West Norwood, S.E.27. GIPsy Hill 6166.

STOP

FULLY GUARANTEED L.O.P.T. REWINDING SERVICE

A few of the types are listed below:—
BUSH TV 53-66. TV 79.115R, etc.
K.B.P.V.P.20 etc.
PHILIPS 1768U, 17TG100U, etc. All at 50/-

NEW FROM STOCK

U25 Type EKCO, state model.
FERGUSON 306-308. All at 45/-
F.O.P.T. REWINDS 30/-.
We manufacture all types of transformers.
S.A.E. Enquiries *P. & P. 4/-, C.O.D. 6/-*

WITWORTH TRANSFORMERS Ltd.
26 All Saints Road, North Kensington
W.11 *Telephone:* BAY 9071

TV SPARES, fully guaranteed. Makers' Parts. Telephone orders sent same day C.O.D. Line O.P. Trans: Murphy V270/280 99/6, Ekco T311, 330, 221, 231, 327 series and Pye VT4 etc., all 62/6. Most types stocked. Send S.A.E. for quote. Add 4/- p.p. Ekco/Ferr. Plastic Hsgs, 15/-. KINGS (ORPINGTON) LTD. 8 Cray Parade, Main Road, St. Paul's Cray, Kent. Orpington 30566.

TUBES, AERIALS, VALVES

U.H.F. aerials. Bands I, II & III aerials. U.H.F. transistorised boosters. I.T.V. boosters, Regunned T.V. tubes. Valves, etc. New and second-hand T.V. sets, Transistor Radios and all types of Electrical Appliances. Quotations without obligation. Coaxial cable, fluorescent light fittings, all at special prices to the trade and Home Engineers. S.A.E. for list.

G. A. STRANGE

BROADFIELD, NORTH WRAXHALL, nr. Chippenham, Wilts. Tel. Marshfield 236

A.1 POST FREE BARGAIN
Guaranteed reclaimed valves

6A7	6/6	EBF80	2/9	PL83	4/3
6F1	1/-	EF42	5/-	PY31	1/-
6F13	4/-	EF50	1/3	PY33	5/-
6F14	4/-	EF80	1/-	PY80	2/-
6H6	2/-	EF85	4/6	PY81	1/6
6J5	2/-	EF91	1/3	PY82	1/3
6J7	5/-	EF184	6/-	PY800	4/9
6P25	3/-	ECC82	2/6	PZ30	4/3
6P28	4/-	ECL80	1/6	SP41	1/6
6U4G	4/-	EY86	3/9	SP61	1/6
10C2	4/-	KT61	3/-	T41	3/6
10F1	1/-	KT33C	2/-	U31	2/9
20D1	1/9	L63	2/-	U191	4/6
20F2	4/3	PCC84	2/3	U251	4/9
20L1	4/-	PCF80	2/-	U301	5/-
20P1	3/6	PCF86	6/6	U329	4/9
20P3	4/-	PCL82	4/-	U801	7/-
30F5	4/6	PCL84	3/3	UB41	5/-
30P4	6/-	N37	3/-	UF42	4/-
30P12	4/3	N339	11/3	W729	7/3
B36	3/9	PL33	4/-	Z66	4/-
EB41	3/6	PL36	4/9	6L1	5/-
EB91	1/-	PL82	3/-	6L18	4/6

10% Reduction on orders for 6 or more.

A.1 RADIO COMPONENTS
14 The Borough, Canterbury, Kent

TELEVISION TUBE SHOP

THE
NEW TUBE Specialists

A47-13W	£10.10.0
A59-13W	£13.10.0
AW36-20, 21	£5.12.6
AW36-80	£5. 7.6
AW43-80	£6. 7.6
AW43-88, 43-89	£6.12.6
AW47-90, 91	£7.10.0
AW53-80	£7.12.6
AW53-88, 53-89	£7.17.6
AW59-90, 59-91	£9.10.0
C14BM, FM	£5.15.0
C17BM, FM, HM	£6. 7.6
C17LM, PM, SM	£6.12.6
C21HM, SM, TM	£7.17.6
CME1402	£5.17.6
CME1702, 1703	£6.12.6
CME1705	£7. 7.0
CME1901, 1903	£7.10.0
CME2101, 2104	£8. 7.6
CME2306	£13.10.0
CRM93	£5.10.0
CRM124	£5.10.0
CRM141, 2, 3, 4	£5.17.6
CRM152	£5. 0.0
CRM153	£3.19.6
CRM171, 2, 3	£6. 7.6
CRM211, 212	£7.17.6
MW6-2	£6.17.2
MW22-16	£5. 2.6
MW31-16, 74	£5.12.6
MW36-24, 44	£5. 2.6
MW43-64, 69	£6. 7.6
MW43-80	£6. 7.6
MW53-20	£7.12.6
MW53-80	£7.12.6
14KP4A, 141K	£5.12.6
171K, 172K, 173K	£6. 7.6
7201A, 7230A	£5.12.6
7240A	£5.10.0
7401A	£6. 7.6
7405A	£6.12.6

Manufacturers' Reprocessed Tubes available at £1 each less than the above prices.

All tubes tested before despatch and guaranteed for 12 months.

CARRIAGE 10/-, via B.R.S. or 15/- via passenger train. Add 2/6 for Comprehensive Insurance.

TERMS £2 down (plus carriage) balance £1 per month.

Midland Stockists:—
Amateur Electronics Co.,
240 Lichfield Road, Aston,
Birmingham.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD
LONDON S.W.11. BAT 6859

JUST SOUTH OF THE BRIDGE
OPEN SATURDAY UNTIL 4 p.m.

SETS & COMPONENTS
(continued)

FOR SALE

FOR SALE
(continued)

WANTED

SITUATIONS VACANT

(continued on next page)

BBC-2 CRYSTAL PALACE & SUTTON COLDFIELD SERVICE AREAS

The top map shows the service area (indicated by dotted band) of the Crystal Palace BBC-2 transmitter on Channel 33. Polarisation is horizontal, the vision frequency is 567·25Mc/s and the sound frequency is 573·25Mc/s.

The map on the left shows the service area of the Sutton Coldfield BBC-2 transmitter on Channel 40. Polarisation is horizontal, vision frequency is 623·25Mc/s and the sound frequency 629·25Mc/s.

The dotted bands must not be interpreted as rigid boundaries as reception may be possible at many places outside them.

TELEVISION SERVICE IN THE HOLY LAND

AN order for television equipment for two transmitting stations and a production studio has been placed with The Marconi Company by the Ministry of Information of the Hashemite Kingdom of Jordan. The stations will be on the air next year.

One transmitting station, broadcasting in Band III, will be located in Jerusalem. The other will be on the outskirts of Amman, and will broadcast in Band I. The studios will be in the city of Amman.

The order includes the supply of 10kW transmitters and associated equipment for the two transmitting stations.

TECHNICAL TRAINING

CITY & GUILDS (electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, T.V., automation, etc., send for 132 page handbook—FREE. B.I.E.T. (Dept. 173K) Aldermaston Court, Aldermaston, Berks.

EDUCATIONAL

A.M.I.E.R.E., A.M.I.Mech.E., City & Guilds, G.C.E., etc. Become a technician or technologist for high pay and security. Thousands of passes. For details of exams and courses in all branches of Engineering, Building, Electronics, etc., write for 132 page book—FREE. B.I.E.T. (171K) Aldermaston Court, Aldermaston, Berks.

AERIALS

TV AERIALS

Band I. H. Mast Fitting	£1 15 0
Band III. 5 Ele Mast Fitting	£1 10 0
Band I/III. S/D and 4-Array	£1 15 0
Band IV. 9 Ele Array	£1 10 0
Band IV. 18 Ele Array	£2 18 0

Lashing Kits from 10/-; Poles, Co-ax 8d., Grade "A" 1/4. Plugs 6d.

P. & P. 4/6. C.W.O., S.A.E. for list.

TELEINDUSTRIES LTD.
BREAKSPEAR ROAD, RUISLIP, Middlesex

FIRST-CLASS RADIO AND T/V COURSES...
GET A CERTIFICATE!

After brief, intensely interesting study —undertaken at home in your spare time— **YOU** can secure a recognised qualification or extend your knowledge of Radio and TV. Let us show you how.

FREE GUIDE

The New Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. Chambers College provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & G. Telecoms., A.M.I.E.R.E. Guide also gives details of range of diploma courses in Radio/TV Servicing, Electronics and other branches of engineering, together with particulars of our remarkable terms of

Satisfaction or refund of fee

Write now for your copy of this invaluable publication. It may well prove to be the turning point in your career.

FOUNDED 1885—OVER 150,000 SUCCESSES

CHAMBERS COLLEGE
(Incorp. National Inst. of Engineering)
(Dept. 884V), 148 HOLBORN
LONDON, E.C.1

PADGETTS RADIO STORE
OLD TOWN HALL
LIVERSEDGE, YORKSHIRE

Telephone: Cleckheaton 2866

Reclaimed Tubes. Six months' guarantee. AW43/80, 30/-. MW43/80, 30/-. MW43/69, 30/-. CRM172, 30/-. CRM142, 17/-. 12in. Tubes 10/-, 17in. Tubes perfect but without guarantee. 17/- each. Carriage on any tube in G.B., 10/-.
Specially Selected Nearly New Valves with 6 months' guarantee. Single valves. Post 7d.

PY33	6/-	807	5/-	EF91	2/-
PCC84	5/6	ARP12	1/6	6K7	1/9
PCF80	5/6	ECL80	3/6	6K8	2/-
PL36	6/-	ECC83	5/-	6V6	1/9
PL81	5/6	ECC82	4/3		

VALVE LIST

Ex. Equipment, 3 month's guarantee. Single Valves, Post 7d.

EF80	1/6	KT36	5/-	6F14	5/-
ECL80	1/6	PCF80	2/-	10C2	5/-
EF91	9d.	PC84	2/-	10P13	2/6
EB91	9d.	PCL82	4/-	10P14	5/-
EBF80	3/-	PCL83	3/-	20D1	2/-
ECC81	3/-	PCL84	3/-	20L1	5/-
ECC82	3/-	PCL85	3/-	20P1	4/-
ECC83	4/-	PZ30	5/-	20P4	8/6
EL84	5/-	PY81	1/6	U801	8/6
EY51	2/6	PY82	1/6	U329	5/-
EF50	1/-	PL81	4/-	U301	5/-
EY86	5/-	PL36	5/-	U191	5/-
6K25	5/-	PY33	5/-	U281	5/-
6U4	5/-	6B8	1/6	U282	5/-
6P25	5/-	6F1	1/-	U25	5/-

Special Offer. Bush TV56 17in. 13-channel TV Sets in good working order fitted with good tube. Cabinet condition fair. £8. Carriage 10/-.
Untested 17in. TV Sets, complete, fitted with all BBC and ITV coils, 50/-. Carriage 10/-.
New Jap Earpieces complete with lead and plug, 8 ohms, 3 or 5 mm., 1/11 or 20/- per doz. Post Free.
Perfect Speakers removed from TV sets. Round 8in., 6/-. Rola 6 x 4, 3/-. Goodmans 7 x 4, 5/-. 6in. Round, 3/-. Philips 5in. Round, 3/-. Plus Post on any Speaker 2/9. 6 x 4, 6in. and 5in. Round Speakers, 6 for 20/-. Post Paid.
Motors. Single Phase. 240v., quarter H.P. 26/-. 1400 revs. Fully guaranteed, ex washing machines. Carriage 8/6.
Breaking up Giant Computer for Spares. 3000 Type Relays 1/9, P.P. 1/9. Doz. 22/-. Post paid. Toggle Switches, 6d., P.P. 9d. Doz. 6/-. Post paid. Special Long Life Valves. ECC82 3/6, EB91 1/3, EF91 2/-, 6CH6 2/6. P.P. 7d. per valve.
Breaking up 19 Sets. Receiver section complete with valves. Parts removed. 500 micro-amp meter. All transmitter parts. Relay and 807 valve. Condition Fair, no dry rot, 10/-. Carriage 10/-.
New Boxed Valves. 185TB 8/6, LP2 2/-, EL38 6/-, 10L1 5/-, 1L4 2/6, U24 4/-, KT36 8/6, IF2 2/6, UU8 6/-, PL38 8/6, 6J7 2/6, EM85 5/-, 27SU 5/-. Post 9d. per valve.

Just published—the standard reference book by J. P. Hawker

OUTLINE OF RADIO and TELEVISION

This introductory book starts with clear explanations of electric currents, radio and audio waves and electronic components, and continues through to the most advanced items of equipment such as u.h.f. television tuners, multiplex stereo systems and colour television receiver techniques.

408 data filled pages
over 300 diagrams
including many circuits

30s. from booksellers or 32s. by post.

GEORGE NEWNES LTD.
Tower House, Southampton St., W.C.2

NEW RANGE U.H.F. AERIALS FOR BBC 2 (625) line transmissions

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.
Loft Mounting Arrays, 7 element, 35/-. 11 element, 42/6. 14 element, 50/-. 18 element, 57/6. **Wall Mounting with Cranked Arm,** 7 element, 60/-. 11 element, 67/-. 14 element, 75/-. 18 element, 82/6. **Mast Mounting** with 2in. clamp. 7 element, 42/6; 11 element, 55/-; 14 element, 62/-; 18 element, 70/-. **Chimney Mounting Arrays, Complete,** 7 element, 72/6; 11 element, 80/-; 14 element, 87/6; 18 element, 95/-. Complete assembly instructions with every unit. **Low Loss Cable,** 1/6 yd. **U.H.F. Preamps,** from 75/-. State clearly channel number required on all orders

BBC · ITV · F.M. AERIALS

BBC (Band 1.) Telescopic loft, 21/-. External S/D, 30/-. "H" £2.10.0.
ITV (Band 3). 3 Element loft array, 25/-. 5 element, 35/-. Wall mounting, 3 element, 35/-. 5 element, 45/-.
Combined BBC/ITV. Loft 1+3, 41/3; 1+5, 48/9; Wall mounting 1+3, 56/3; 1+5, 63/9; Chimney 1+3, 63/9; 1+5, 71/3.
VHF transistor pre-amps, 75/-.
F.M. (Band) 2. Loft S/D, 12/6. "H", 30/-. 3 element, 52/6. External units available. Co-ax cable, 8d. yd. Co-ax plugs, 1/3. Outlet boxes, 4/6. Diplexer Crossover Boxes, 12/6. C.W.O. or C.O.D. P. & P. 4/6. Send 6d. stamps for illustrated lists.
Quotations for special arrays available on request

K.V.A. ELECTRONICS (Dept. P/T)
27 Central Parade, New Addington
Surrey
LOD 2266

NEW VALVES
Guaranteed Set Tested
24 HOUR SERVICE

1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94. SET OF 4. 14/9.
DAF96, DF96, DK96, DL96. SET OF 4. 23/6.

1R5	4/-	DY87	6/9	PCL82	6/3
1S5	3/9	EABC80	5/6	PCL83	8/9
1T4	2/9	EAF42	7/-	PCL84	7/3
3S4	4/3	EBC41	6/6	PCL85	7/9
3V4	5/-	EBF80	5/9	PL36	9/3
5Y3GT	4/6	EBF89	5/9	PL81	6/6
6F1	6/3	ECC81	3/3	PL82	5/-
6K7G	1/3	ECC82	4/6	PL83	5/11
6K8G	3/3	ECC83	4/6	PL84	6/-
6L18	7/3	ECC85	5/3	PY32	8/9
6V6G	3/-	ECH35	5/9	PY33	8/9
10C2	11/-	ECH42	8/-	PY81	5/-
10F1	9/6	ECH81	5/6	PY82	4/9
10P13	8/3	ECL80	5/9	PY83	5/3
20F2	8/9	ECL82	6/3	PY800	5/11
20L1	13/9	ECL86	7/6	R19	6/6
20P1	8/9	EF39	3/6	U25	8/3
20P3	8/9	EF41	5/9	U26	8/6
20P4	12/6	EF80	4/3	U191	10/-
30F5	7/-	EF85	5/-	U301	11/6
30P4	11/6	EF86	6/6	U801	15/6
30P19	11/6	EF89	4/9	UABC80	5/-
DAC32	6/9	EL33	6/3	UAF42	6/11
DAF91	3/9	EL41	8/-	UBC41	6/6
DAF96	5/11	EL84	4/3	UBF80	5/6
DF33	7/6	EY51	5/11	UBF89	5/9
DF91	2/9	EY86	5/3	UCC85	6/-
DF96	5/11	EZ40	5/6	UCH42	8/6
DK32	7/-	EZ80	3/6	UCH81	6/-
DK91	4/-	EZ81	4/-	UCL82	7/-
DK96	6/3	KT61	6/3	UCL83	8/6
DL33	6/6	N78	14/6	UF41	7/9
DL35	4/9	PCC84	5/3	UF89	5/6
DL92	4/3	PCC89	9/9	UL41	7/9
DL94	5/-	PCF80	6/3	UL84	5/3
DL96	5/11	PCF82	5/9	UY41	4/9
DY86	6/3	PCF805	8/-	UY85	4/9

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any parcel insured against damage in transit 6d. extra.
Office address, no callers.

GERALD BERNARD
83 OSBALDESTON ROAD
STOKE NEWINGTON
LONDON N.16

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

NEW SERIES

PART 5. Video Amplifiers

THE vital video amplifier has received a fair share of attention during the past few months. In particular, the articles by G. R. Wilding in the June, August and September issues are to be recommended as homework for the aspiring troubleshooter.

In this article, we are not so much concerned with the whys and wherefores of video amplification as with the effect of certain common faults, but to discuss these properly it is useful to look briefly at the basic video circuit of Fig. 20, and consider what the stage is doing.

First, this is a voltage amplifier, required to handle frequencies between zero (d.c.) and 5Mc/s. (This is on 625-line standard, the upper frequency limit on 405-lines extending only to 3Mc/s in theory and, all too often, 2·5Mc/s in practice.)

BANDWIDTH

Because of the bandwidth to be handled, a high resistive value of anode load is impractical—much of the upper range of frequencies would be lost through stray shunt capacitances. Moreover, the amplifier gain decreases as the frequency rises, also due to shunt capacitances, both in the valve itself and in the external circuits.

One way of compensating for these inevitable losses is to add inductance in the anode circuit as part of the combined load. (See L in Fig. 20, put in series with R2, with stage isolation provided by R3, decoupled by C2.) In some circuits, notably the Philips range of receivers, a whole chain of tuned circuits will be found in the anode load of the video amplifier.

Although the inductor shown in Fig. 20 appears untuned, it is, in fact, tuned by the stray capacitances, and is carefully designed to maintain as straight a response curve over the video amplifier as possible. To prevent it resonating at the tuned frequency and thus imposing a "peak" of distortion, the coil is often damped with a parallel resistor and will frequently be wound upon the resistor itself—thus the value of this resistor is also fairly important, though not critical. It is not chosen for mere physical convenience!

Peaking networks will also be found in the cathode circuits. One purpose of this type of wave-trap design is to prevent the video amplifier having too wide a response—limiting, in fact, the frequencies above 3Mc/s. This is to prevent the amplifier passing the 3·5Mc/s frequency, which is the same on the 405-line standard as the beat frequency between sound and vision frequencies, and which would result in patterning.

STAGE GAIN

To increase stage gain at the higher frequencies and again compensate for losses, the cathode bypass capacitor is carefully chosen. A low value reduces negative feedback, the reactance of the capacitor C1 being less to high frequencies than the resistance of R1. in Fig. 20. Thus it can be seen that any alteration in component values affects not only the gain of the stage but also its response curve, resulting either in restricted handling of sync pulses or loss in reproduction.

One point very often overlooked is that the "normal" decoupling, i.e. R3, C2, is part of the video amplifier load circuit. R3 comes into play at lower frequencies because C2 is so chosen (in combination with circuit strays, etc.) that high and middle frequencies are shunted. But at low frequencies, C2 may well offer a greater impedance than R3 and thus stage gain is increased.

Once more, the hidden values of stray capacitance, valve characteristics, wiring inductance and so on, have been allowed for by the designer, and should be altered as little as possible. To "slap another electrolytic in" may well bring about new faults by altering the responsive curve.

Again, even where these decoupling components may not be obvious, they exist in the main h.t. decoupling circuits of the receiver—which is why a failing "main" electrolytic may first show signs of ageing by causing "touchy sync".

"VARYING D.C."

The video signal can be regarded as a "varying d.c." rather than an a.c. The d.c. level of the video signal is necessary to convey the information as to black or white content of the signal and gradations between, whereas the a.c. content gives information as to the fine detail. (This is a simplified explanation—which I trust forgivable in a practical article of this nature?)

Capacitor coupling between detector and video amplifier and from video amplifier to cathode

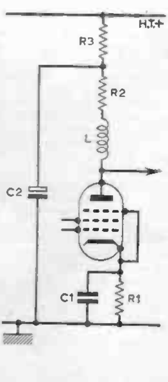


Fig. 20—Basic video circuit.

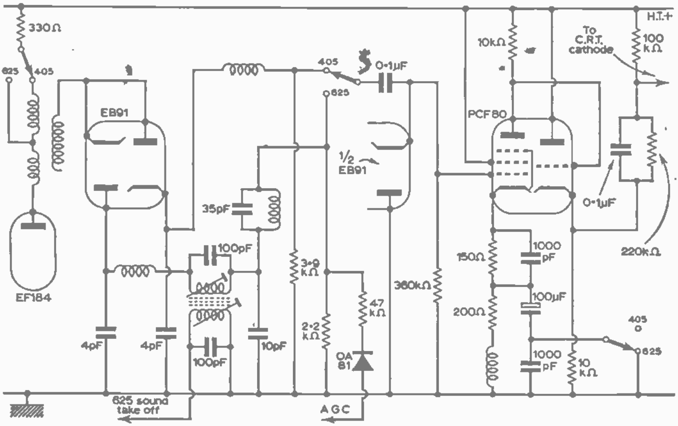


Fig. 21—An example of modern cathode follower video amplifier and output stages is given by the Decca circuit. This has many common features, but also one or two quite individual tricks of design and is worth studying.

ray tube, was thus considered taboo by many purists, and many a controversy raged in the trade and technical press over the early years of television, on the subject of d.c. restoration.

DUAL STANDARD

Unfortunately, many arguments in its favour fall down when the a.g.c. system is also taken into consideration. The use of a mean-level a.g.c. system precludes what advantage a purely d.c. coupled video circuit gives, and various "compromise" circuits have evolved—almost as many variations as there are models, and quite beyond the scope of this series to debate.

Dual-standard receivers brought the old bogy to the forefront again. It is necessary to present to the video amplifier a waveform of the same polarity, and, if possible, to keep the conditions all the way from the detector to the tube as constant as possible.

This can be done by extensive switching, and was done in this way by earlier designers. But recent models have changed over to a.c. coupling, with the necessary d.c. conditions at the tube base determined by voltage tappings on fixed and variable potentiometers.

A lot of switching is saved and so is the rather involved design problem of maintaining a constant bias and avoiding resetting of controls when the standards change is carried out.

Some makers use direct coupling for 405-line systems, Sobell/McMichael, for example, and many of the Thorn Group models, and others employ a.c. coupling, with some d.c. restoration provided by a diode across the video amplifier input (Decca).

Bush tend to favour a cathode follower input to the tube, and this is also seen in the Decca circuit of Fig. 21. Here, it can be seen that the pentode of the PCF80 is coupled to the detector, with the diode across the grid/cathode to preserve the d.c. level, and is directly coupled to the triode, which acts as a cathode follower.

From the 10kΩ cathode load, the signal is taken to the tube by a low-frequency attenuator network. The 220kΩ resistor of this network is also part of the potential divider which determines the c.r.t. cathode voltage.

The other diode in this circuit, the OA81, is an "anti-lockout" device, which conducts on 625-lines, to give additional a.g.c. voltage when a strong signal is picked up.

VARIATION OF GAIN

All of which is merely an excuse to pin-point the circuit features that, by their failure, will give us certain identifiable symptoms. First, gain which varies at different frequencies gives us changes in picture quality.

Detector and video load resistors which carry h.t. current can increase in value with age, and the low and mid-frequencies will be increased at the expense of the higher frequencies.

This will give a weak resolution of fine detail, and resetting the contrast level merely boosts the low frequencies more, because the high frequencies are dependent on circuit stray capacitances and resonating impedances of peaking networks, where-

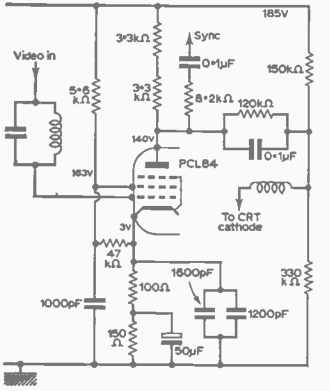


Fig. 22—Video amplifier from Ferguson 506T. Note the use of two series anode load resistors.

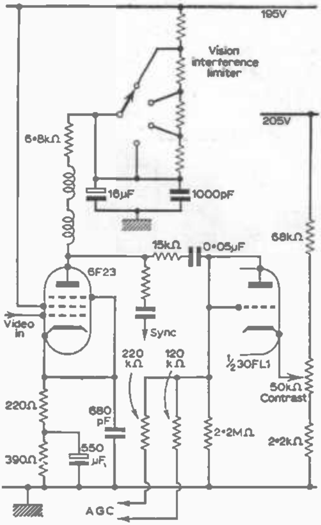


Fig. 23 (right)—Unusual vision limiter circuit and a.g.c. rectifier coupling of several Ultra models is often a fault source.

as the lower frequencies, at the "black" end of the range, depend almost wholly on the resistive load.

BIAS CONDITIONS

Secondly, bias conditions are important, to retain the sync pulses, which are nearest the cut-off end of the Ia/Vg curve of the valve. In particular, the screen-grid voltage and the cathode voltage, where this is fixed by a potentiometer circuit of which the screen grid dropper resistor is part, must be within fairly critical limits.

An increase in a cathode bias resistor, or a decrease in the feed resistor regulating this voltage, will cause poor synchronisation and an over-accentuation of the "blacks" in the picture. Adjusting the controls to compensate for this poor tonal gradation merely gives a milky sort of picture. The cathode bypass capacitor is a frequent offender.

LEAKY CAPACITORS

Our third point must be the impairment of both low and high frequencies when the electrolytic or small-value fixed capacitors respectively develop leaks or fail altogether.

In Fig. 21, it will be noted that the cathode bias is in three parts, the lower section modified by switching during 625-line operation. The larger capacitor has most effect on the negative feedback at middle and low frequencies, while the 1,000pF across the upper leg of the bias network removes the negative feedback at the upper end. This gives a form of "top lift" as negative feedback is progressively applied as the frequency falls.

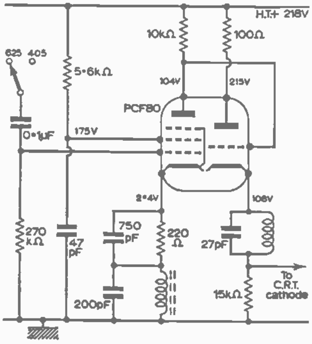
C.R.T. COUPLING

The fourth point concerns the coupling to the tube, usually a resistor shunted by a small capacitor. Failure of this capacitor is a common cause of trouble affecting low frequency gain. The capacitor shunts the resistor at higher frequencies and the voltage "lost" across this network is small, whereas at lower frequencies the reactance of the capacitor becomes significant, producing negative feedback.

These points will be brought out more clearly as we go on to consider actual faults most commonly encountered. The preliminary discussion should have enabled us to outline symptoms, causes and cures without delving too deeply into the philosophy behind each circuit.

DOUBLE-FEEDBACK BIAS

Taking the cathode bias of the video amplifier first—perhaps the most important single factor in the receiver for both good synchronisation and correct resolution.



ig. 24—Cathode-follower circuit used in many Bush models.

Fig. 22 shows a typical arrangement, using the "double feedback" method, and also the regulator circuit from the h.t. line, in combination with the screen grid dropper and decoupling circuit. This circuit is very similar to the later HMV and Ultra models, and has a definite kinship with the earlier Ferguson 406.

When the 50μF fails, a cogwheel effect is noticeable first.

POOR CONTRAST

A different set of conditions exists when either of the two "picofarad" bypass capacitors fails. Usually it is the 1200pF that develops a leak in this Ferguson 506 range and associated models. The picture looks "flat", but as the contrast control is advanced, modulation may disappear altogether.

Brilliance seems to operate normally. A test will show little or no cathode voltage when the fault is really severe.

Poor contrast is another common fault that should be mentioned here, though it looks similar to the above fault. It has its origin, usually, at the input to the video amplifier, where a dry joint—yes, even after years of trouble-free use!—on the ends of the video choke will rob the stage of some gain, getting progressively worse at lower frequencies.

The Ultra 6604 had this trouble as well as the 506. But the effect of these faults differs according to the bias conditions. On the Sobell 192, a similar trouble will give an over-contrasted picture and is often quite a teaser to track down.

POOR SYNC

Poor synchronisation can result from bad bias conditions, as we have seen, and the GEC BT448 was one model that evinced this symptom when the 100μF bypassing the 270Ω lower resistor of the bias network dried out. The upper, 100Ω, resistor of this chain is not bypassed and an experimental addition of a few picofarads may improve resolution somewhat to make up for other ageing components and valves.

Incidentally, an improvement to synchronising conditions can be obtained in circuits such as Fig. 23, by increasing the bypass capacitor of the screen grid dropper. The cogging effect, where this is not caused by the 50μF cathode bypass, may be reduced or eliminated by increasing the 1,000pF screen decoupling to as much as 0·05μF.

On the later, Thorn 850 chassis, used in a number of models with minor variations*, field synchronisation can be greatly improved by increasing the 0·03μF screen decoupling to as much as 200μF! But before going this far, check that the trouble is not being caused by coupling leakage.

SCREEN GRID CIRCUIT

Having reached the screen grid section of our video circuit, let's stay with it awhile. Screen grid decoupling of the Bush TV135R is a 1μF capacitor with a 47,000pF across it, and alteration

** Ferguson 3617, 3618, 3619, 3620, 3621; HMV 2614, 2616, 2618 2619; Marconi 4609, 4610; and Ultra 6618 6619, 6620, 6621, 6622.*

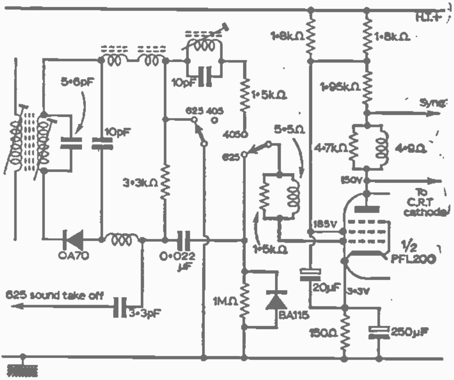


Fig. 25—Method of coupling dual-standard signals to the video amplifier (Philips detector and video circuit).