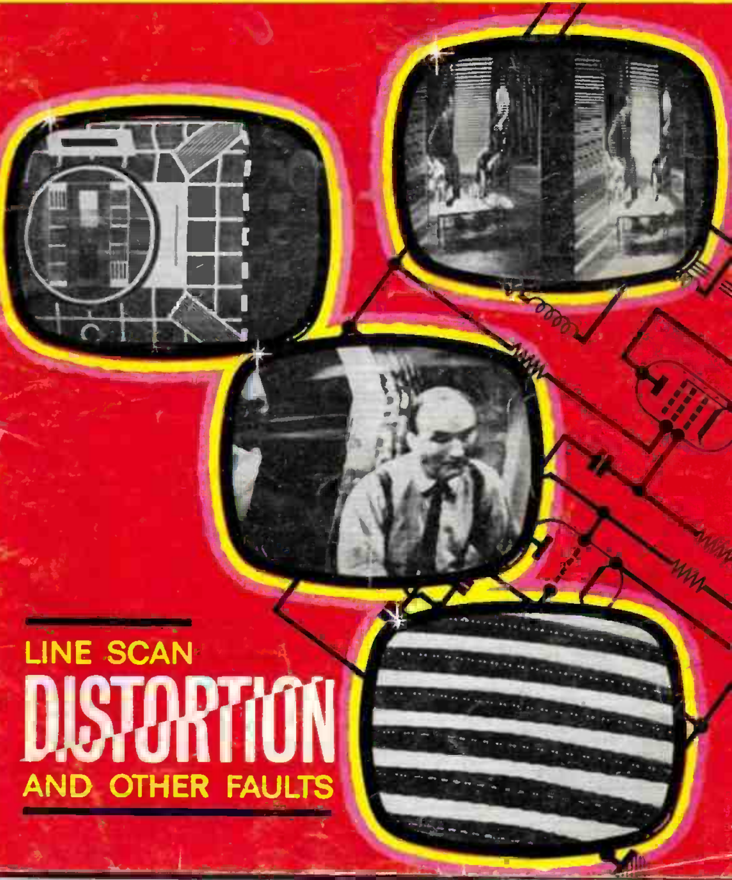
Practical TELEVISION

JULY 1966 GEC BT455-6 2/-



LINE SCAN

DISTORTION

AND OTHER FAULTS

a reduction in h.t., caused by a failing PY32. Replacement by a PY33 is advisable—you will not get more h.t., than from a PY32 but this valve is more reliable.

OUTPUT STAGE TROUBLE

Usually, the first symptoms of output stage failure, either the cathode bypass resistor first mentioned, or the valve itself, is a shrinking at the bottom of the picture—more evident as the set gets hotter.

A failure of C97, altering the feedback conditions, can also cause this fault, and a complete open-circuit of this loop will give quite a drastic foldover.

Remember also that any conditions upsetting the feedback will have the effect of impairing linearity, and note also that C94 has been known to develop a leak, putting unwanted voltage from the triode anode onto the pentode grid, giving a foldover that is usually variable as the field hold is moved slightly.

In any power output stage, the screen grid conditions are vital for good operation, and in this case the screen is fed direct from h.t. This means, however, that a partial breakdown of the output transformer primary, a leak to core, for example, will give the same effect, and we have had to change several output transformers for no other reason than lack of height and perhaps a bit of difficulty in getting good linearity.

The design of the mask of these models makes the linearity control very important, as owners will have noticed, sinking into their deep armchairs!

SCREEN RESISTOR

Before going to the extent of replacing the output transformer, it might be an idea to try the effect of different values of screen feed resistor in place of an h.t. direct feed, starting at about 22kΩ and working upwards, decoupling with a 0·25μF capacitor.

Where cramping at the bottom is still persistent, yet all other factors seem in order, try reducing the value of C98 from its correct 0·1μF to 0·05μF and re-adjusting the control. The opposite state of affairs, i.e., stretching at the bottom of the raster, is not a usual fault on this group of models, but is common to many other sets, such as the earlier 306, and the Cossor 948 series, etc.

The usual cause is a leak, or sometimes a severe reduction in value, in the feedback capacitor of the linearity loop to the grid, i.e., the 'Top' adjustment.

On the same model, the 306, which uses a PCF80 as pentode sync separator and triode half multivibrator, and a very similar circuit in its general design, foldover at the top of the raster which varies with signal conditions can cause a bit of trouble, and attention should be directed to the cathode bias resistor of the PCF80 triode section.

Stretching at the top of the field, increasing as the set warms up, may be due to failure of the 0·01μF capacitor that is used for flyback blanking, between a resistor network across the field output transformer secondary and the brilliance control line to the grid of the c.r.t.

This is situated on the field output transformer tag strip, where other components in this circuit will be found, and where also the elusive top linearity control is hidden.

THORN 850

Still on the subject of field faults, and still concerning ourselves with the Ferguson range, as the circuitry is in many respects similar to that of Fig. 1, let us conclude this section with some reference to the Thorn 850 chassis.

By the time this came out, with many ideas then new—and some since improved upon—the Thorn Group had taken in Marconiphone, H.M.V. and Ultra, as well as the original Ferguson brand name.

No confidences are being broken by my revealing that the basic 850 chassis was used in the Ferguson 3617, 3618, 3619, 3620, 3621 and 3622, the Marconiphone 4609 and 4610, the H.M.V. 2614, 2616, 2618, and 2619, and the Ultra 6618, 6619, 6620, 6621 and 6622.

The field circuit is shown in Fig. 3, and from this it is evident that the basic 'shape' is very similar to the previous design, but there are a number of small differences, some required by the greater drive needed, and some by the 'convertibility' which was the great selling point at the time.

This meant a different line oscillator valve was used, and, in fact, half the ECC804 is used as field oscillator, and the improved PCL85 was employed as field output valve.

VDR's

In addition, to stabilise the circuit under the conditions that would occur when standards were changed (405 to 625-line), several voltage dependent resistors have been used, one being fitted across the boost line feed to the field oscillator.

In later versions, the 900 and 950 circuits, more of these devices come into play, including one across the primary of the field output transformer. There are many other 950 features that might interest us, including the 'single-panel' chassis layout, but for the moment let us concentrate on the common field faults that may be encountered on the 850 series of sets.

One of the obvious faults again, is lack of field drive, and here the ECC804 may be the culprit, but before jumping to too many conclusions, check the 22kΩ anode load resistor, tucked away behind the valve. The clue is that the cramping and shrinking may happen when the set is first switched on—the picture gradually filling to normal as the set warms up.

The reduced drive is caused by R138 going low in value. This has been noted a number of times. Replacement should be by a 1 watt component, for safety.

PCL85 TROUBLE

Another odd one—persistent field failure—may be caused by over-running the field output valve. The PCL85 does not take too kindly to an excess of h.t., so don't be tempted to alter the voltage tapping as a quick method of overcoming faults.

Again, unusual, but fairly obvious when one stops to think about it, is an oversized field. This can be caused by *low* boost voltage, and on this model may be the result of incorrect system switching or—much more rarely—component failure, of the portion of the circuit used to switch the line output

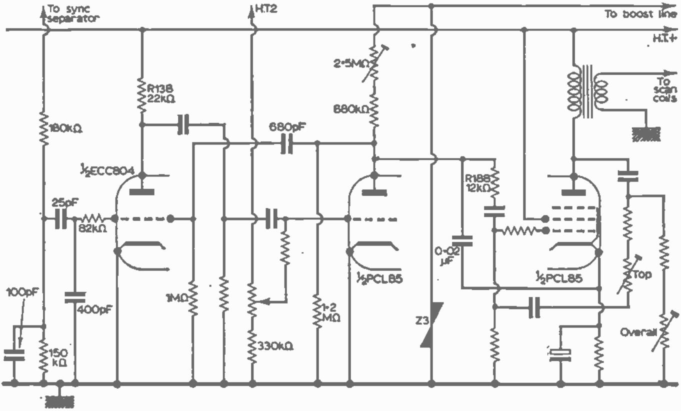


Fig. 3—Variation on the theme of Fig. 1, used in a wide range of Thorn receivers, under the Ferguson, Marconi, H.M.V and Ultra trade marks. Differences are discussed in the text.

transformer to different harmonic tuning for 405 and 625-line operation.

It has probably been noted, on many sets, that deterioration of the smoothing capacitors can cause timebase troubles, often long before the obvious symptoms of hum and a visible hum bar become apparent. Touchy field hold on some of the older Decca models is a case in point.

In the chassis we are considering at the moment, the main electrolytic is a four-part component, for main and subsidiary filter circuits, and should be checked for variations on different signal levels, or field-on-sound symptoms.

FIRST CHOICE FACTORS

From the foregoing, it can be seen that there are several 'first choice factors' to be looked at when investigating some faults. The practising service engineer works mainly by experience.

He would never get through his day's work in time if he followed the text-book method checking each stage of a circuit and eliminating possibilities, working from back-to-front, so to speak. He says to himself: *'Ah, foldover at the bottom—that's usually the 250µF on this joker'.*

And, nine times out of ten, it is!

This is not to disparage the text-book method, for there will always be the odd occasion when experience lets you down, and the tenth shot will be a miss. Then, it is vital to be able to make the right tests, the right way, and with the right application of logic—which is all that television receiver fault-finding turns out to be, in the end.

In the next section, we shall consider a few of the stock field faults in other types of receiver and dwell a little more on these 'logical tests' that may help us when the trouble turns out to be something a bit deeper than a 'Stock Fault'.

Continued next month

OHMMETER FOR LOW RESISTANCE MEASUREMENTS

By H. Webster

TO determine the serviceability of transformers, coils and other components, it is often necessary to measure the d.c. resistance of the various windings. Often the resistances to be measured are extremely small and cannot be measured on the run-of-the-mill instruments, which are not normally readable below a few ohms. With the meter described in this article it is possible to measure resistances down to 0·1Ω with a reasonable accuracy. Two ranges are provided, one covering 0·1 to 90Ω and the other 1 to 900Ω.

Theory of Operation

A simple ohmmeter consisting of a meter, battery and a potentiometer is shown in Fig. 1. The battery potential is developed across the meter and the potentiometer, which permits adjustment to the current level in the circuit loop. Normally the potentiometer is adjusted to give full-scale deflection with the terminals A and B open-circuited. Any resistance path across the terminals such as through a component under test will shunt the meter and cause the meter pointer to fall towards zero. The amount of movement will depend upon the resistance across the terminals A and B. The lower it is, the more current it will pass and the further the meter pointer will travel towards the zero mark.

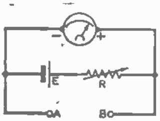


Fig. 1—Simplest type of ohmmeter.

Components

Almost any meter can be utilised for an ohmmeter. The author's was built around a meter having an internal resistance of 100Ω and a full scale sensitivity of 1mA. A circuit including this meter movement is shown in Fig. 2. This circuit differs from the first in as much as the supply is drawn from a potential divider across the battery, and shunt (R1) is included to enable the range of the instrument to be widened.

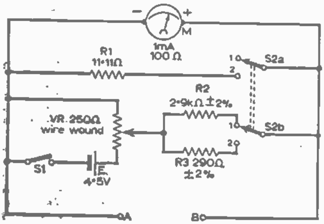


Fig. 2—Circuit of the author's ohmmeter. All component values are given on the circuit.

With the range switch (S2) in the 1 position, the coverage of the instrument is from 1 to 900Ω. In the other, the shunt resistor is placed across the meter to reduce its sensitivity from 1mA to 10mA at full scale deflection. This, reduces the overall sensitivity of the instrument (by the same factor) so that the meter can indicate resistance from 0·1 to 90Ω.

Calculating the Meter Shunt

The meter shunt resistor R1 will vary according to the internal resistance and the sensitivity of the meter movement to be used. The value of the resistor R1 can be derived from the following formula:

$$R1 = \frac{Rm}{\frac{I}{Im} - 1}$$

where I is the maximum current in the meter circuit (including that which will go through the shunt), Rm is the internal resistance of the meter and Im is the current through the meter for full scale deflection.

Thus in the author's case, the shunt resistor was calculated as follows:

$$R1 = \frac{100}{\frac{10}{1} - 1} = \frac{100}{9} = 11{\cdot}11\,\Omega$$

Constructing the Meter Shunt

A simple way of making-up the meter shunt is to wind several feet of 32 s.w.g. manganin d.r.c. resistance wire on to a piece of paxolin sheet; cut to the dimensions given in Fig. 3. It is best to

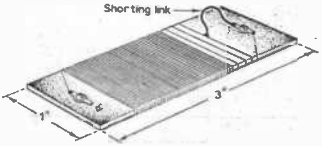


Fig. 3—Shunt construction details.

strip-off about six inches of the covering of this wire, which has a resistivity of about 2Ω per foot, so that a few turns can be shorted to obtain the correct resistance value at a later stage.

Final adjustment of the shunt should be done with the meter hooked-up in the circuit arrangement given in Fig. 4. With the meter shunt out of circuit, the variable resistor in the Fig. 4 arrangement should be adjusted until the meter reads exactly 1mA. Then place the shunt across the meter, which will back-off the reading to about 0·1mA (one-tenth of full-scale deflection). Adjust the shorting link on the shunt resistor until the meter reads exactly 0·1mA, then solder it into position. This method is not the most accurate but is satisfactory for practical purposes.

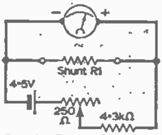


Fig. 4—Circuit for adjusting the shunt.

Calculating the Series Resistors

To calculate the value of the series resistors R2 and R3, one should use the following formula:

$$R_s+R_m=\frac{I}{E}$$

where R_s is the value required for the series resistor, Rm is the meter resistance, I the current in the meter circuit and E the voltage on the wiper arm of the potentiometer.

The author chose three volts as the potential, as the correct value resistors were at hand. He suggests, however, that a constructor should consider three volts as minimum as the measuring accuracy increases with voltage—the reason for this is explained in the appendix.

As the author decided on a potential of 3V, his calculations were as follows using the formula:

$$R_s+R_m=\frac{I}{E}$$

His calculations were thus:

$$R2+100=\frac{\frac{1}{1000}}{3} \qquad R3+100=\frac{\frac{10}{1000}}{3}$$

$\therefore R2=2900\Omega$ $\qquad$ $\therefore R3=290\Omega$

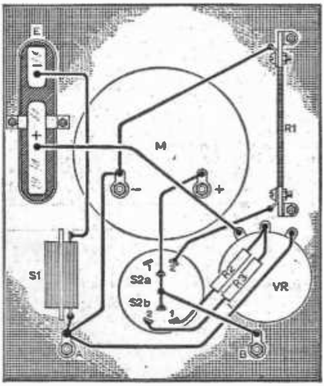


Fig. 5—Component layout diagram.

Assembly

Since the instrument is quite simple to construct, no hard and fast rules are necessary. The author's unit was built on a small paxolin panel and the layout used is shown in Fig 5. The battery is held in position with a piece of aluminium strip secured by two 6BA bolts. The leads to the battery are soldered directly to the terminals.

Calibration

Although it is possible to dismantle the meter and calibrate the scale directly, the risk of damage is great unless the constructor has had experience of this type of work. The author recommends the use of a separate graph or chart, from which the resistance corresponding to any particular current reading can be read. As a general guide to the constructor a specimen of the author's calibration chart is given in Fig 6.

Meter reading mA	Range 1 Ω	Range 2 Ω
1·0	∞	∞
0·9	900	90
0·8	400	40
0·7	230	23
0·6	150	15
0·5	100	10
0·4	67	6·7
0·3	43	4·3
0·2	25	2·5
0·1	11	1·1
0·08	9	0·9
0·06	6	0·6
0·04	4	0·4
0·02	2	0·2
0·01	1	0·1

Fig. 6—Specimen calibration chart.

Operation of Meter

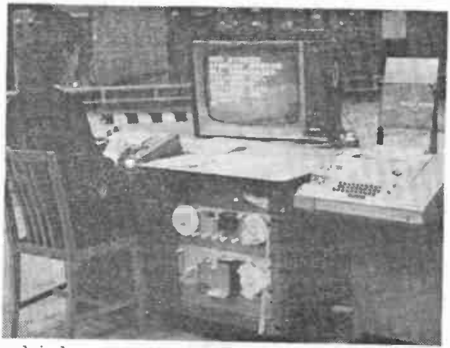
Before making any resistance measurements, it is necessary to "zero" the meter. Ensure that the test leads are not touching and, after operating S1 to bring the battery into circuit, adjust VR until the meter reads exactly 1mA. The unknown resistance can then be connected across the test leads and the resistance value read either directly from the scale or from the prepared calibration graph. Switch S1 off after each reading to minimise battery drain.

Appendix

The formula for calculating the resistances assumes that the current in the circuit is constant. In fact, the total resistance varies according to the resistance in the component under test as this is across the meter and battery and thus shunts the meter circuit. To achieve a greater accuracy this resistance must be taken into account in the calculations.

Also it is worth pointing out that the accuracy of the instrument will increase as the driving voltage is raised. This is due to the fact that the series resistor needed to limit the current through the meter has to be larger and thus, the shunting effect of components under test is not so noticeable.

TELEVISION CAPTIONS STRAIGHT FROM THE TYPEWRITER



This display system, which converts digital information into a video picture suitable for feeding into 525- and 625-line TV systems, was demonstrated to the BBC recently.

A SYSTEM for putting printed matter on to a television signal without having to go through the laborious task of preparing captions and tying-up another television camera has been developed by the Canadian RCA Victor Company. With this system, which is known as DIVCON (DIgital to Video CONversion), a typist sitting at a control console can put messages straight on to the screen. The machine the typist uses has all the facilities found on an electric typwriter, such as space, shift and backspace, etc. It is even possible to electronically underline words or make them flash, to give emphasis. Also one can have the wording moving across the screen.

Full erasing facilities are provided so that an odd character, words or complete lines can be erased. It is not necessary to completely retype passages, as words that have to be altered can be replaced.

Built-in Memory

The DIVCON system has an electronic memory which can store information ready for later use. Logic interface circuits are also provided so that various inputs can be catered for, such as punched paper tape and magnetic tape, and inputs from teleprinters or data processing systems.

Several Already in Use

There are several DIVCON systems in service on the North American Continent. One of these is used by 300 firms in the Montreal area to receive up-to-date information from Canada's Stock Exchange. In this particular application, Brokers get continuous information on selling, share indices and trends over an eight-channel network, which includes a straight-from-the-teleprinter and a statistics channel.

Air Canada is another organization using this RCA Victor process; for screening arrival and departure information.

Applications in which these systems could be used are numerous, particularly in the television broadcast field for sporting events and the like. A DIVCON system was, in fact, in use in the BBC's main studio on election night along with other digital tabular display equipment.

Technical Notes

Solid state circuitry is used throughout the DIVCON system, which features a multi-bit random access core memory. The first six bits can contain up to 64 character symbols. The seventh can provide additional symbols or special functions such as underlining or flashing, while the eighth can be used for parity checking—a logic coding system to minimise errors.

The actual size of the memory depends upon the number of individual characters required and the number of separate output video channels needed. Signals can be fed to any number of monitors over any distance.

Electrical pulses from the typewriter, the memory or any of the other input devices, are put through a digital video generator which provides outputs suitable for 525- or 625-line transmissions. This processed signal can be fed into a live or closed circuit television network in exactly the same way as the output from a conventional caption camera set-up. ■

HT Supply Systems

S. George

A DISCUSSION ON METHODS OF OBTAINING THE HT VOLTAGE IN TV SETS

FOR effective time-base operation, sync separation and video amplification, it is essential for the h.t. supply to be as smooth as possible, while to prevent unwanted stage inter-coupling the internal resistance of the supply must be as low as practicable.

Further, the delivered h.t. voltage must be as high as possible for the requirements of the line output stage in particular.

The transformerless technique, now almost universal, necessitates a low value series impedance in the filter and very high value capacitors, unless the h.t. output is branched so that those stages requiring maximum h.t. but only moderate smoothing can be separated from those stages where freedom from ripple is more important than optimum voltage.

DEMANDS ON RECTIFIER

In practice, both such methods are in use today (a) the simple π filter using a choke of high inductance but low d.c. resistance in conjunction with a reservoir and smoothing capacitor in the 150-350μF range, and (b) the multi output type using both choke and resistor series impedances with a number of capacitors of rather smaller value to filter the individual branches.

In all instances, voltage supply adjustment varies the surge limiting resistance to both equalise the rectified voltage on all tappings and keep initial switch-on currents within permissible limits.

It is not always appreciated how rigorous are the demands made upon all types of d.c. rectifier in the modern set. For instance, the Thorn 850 series of receivers takes approximately 300mA at 243V from the 100μF reservoir capacitor fed by a BY100 rectifier.

As 1 Amp flowing steadily for 1 second equals 1 Coulomb, this d.c. current of 0·3A each full cycle of 1/50th of a second (It)=0·3x0·02=0·006 Coulomb or 6,000 microcoulombs.

As the reservoir capacitance is 100μF, and without any further input, this drain of 6,000μC over one complete cycle would lower its voltage by

$$V = \frac{Q}{C} = \frac{6{,}000}{100} \text{ or 60 volts.}$$

The rectifier must replace this 6,000μC loss each full cycle to maintain the average voltage, but as it can only conduct during the positive half-cycle and when its anode voltage exceeds its cathode voltage, obviously it must pass a much heavier current than the 0·3A constant drain.

Assuming then that the rectifier can only conduct during a quarter of the full cycle or $\frac{0{\cdot}02}{0{\cdot}25}$ secs (i.e., 0·005 sec) the charging current must average $I = \frac{Q}{t} = \frac{0{\cdot}006}{0{\cdot}005} = 1{\cdot}2$ amp and rise to about double this at the peak of the positive half-cycle.

Again at switch-on, when the reservoir capacitor has no charge or terminal voltage, the current is

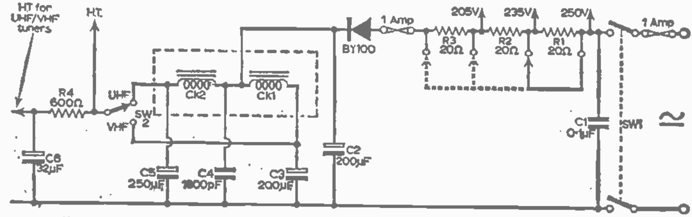


Fig. 1—H.T. smoothing and supply system used in Decca DR 101 to 606 range of receivers. Operation of system switch SW2 passes h.t. current through Ck1 on v.h.f. and Ck2 on u.h.f. These then magnetically pull over the multi-contact change-over switch to the appropriate position. R4 and C6 comprise additional smoothing for the v.h.f./u.h.f. tuners.

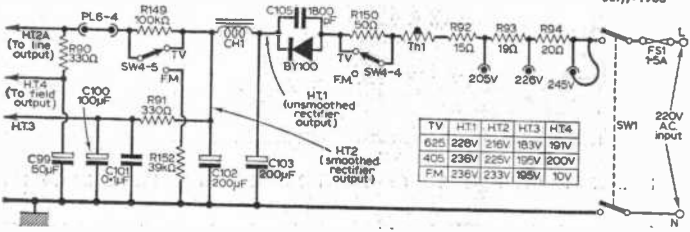


Fig. 2—Triple output h.t. smoothing and supply system used in many GEC/Sobell v.h.f./u.h.f./f.m. receivers. Note voltage variations on 625, 405 and f.m. and additional surge limiter in circuit on f.m. to reduce voltage.

really only limited by the surge limiting resistor and the forward resistance of the rectifier.

As the latter is always kept as small as possible to avoid undue voltage drop and internal temperature rise, it is not surprising that repeated switching on and off imposes a heavy strain on all types of rectifier, and causes sparking over in thermionic types.

TRANSIENT IMPULSES

While silicon rectifiers are free of this disadvantage they are susceptible to short duration high amplitude transient impulses from the mains supply, and to absorb or at least limit these impulses a 0·01μF capacitor is paralleled across them.

As most electrolytic capacitors have appreciable inductance, it is standard practice to parallel them with a mica or ceramic capacitor. Fig. 1 illustrates the unique Decca twin solenoid system, in which a 1,800pF capacitor shunts the 200μF reservoir.

The twin solenoids in this circuit fulfil the dual roles of operating the multi-contact system change-over switch and providing series inductive choking for the h.t. smoothing arrangement.

They are brought into circuit by a small pilot switch linked to the v.h.f. tuner, so that when the latter is turned to the u.h.f. position, it automatically energises the particular solenoid which moves the system switch to the 625 setting.

SURGE LIMITER

Another very interesting but necessarily complicated h.t. smoothing and supply system is that used in many Sobell dual-standard/FM radio models, and shown in Fig 2. To equalise the voltage on f.m., an additional 50Ω surge limiter is switched in on change-over, while simultaneously a 100kΩ resistor is put in series with the HT2A and HT4 branches.

This resistor, in conjunction with a 39kΩ bleed resistor switched across these branches and chassis, then reduces the voltage of these two feeds to 10V.

These two branches feed the line output stage and field output pentode respectively, so that while they are then unable to operate, they will not be subject to cathodic poisoning, as of course the heaters will still be in circuit.

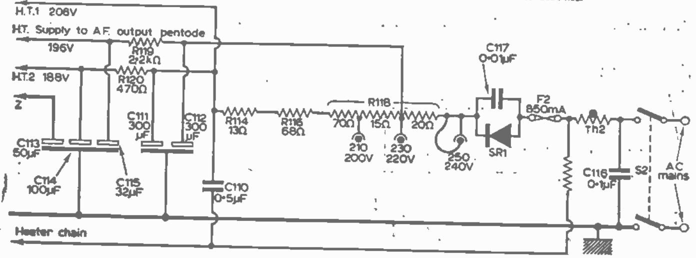


Fig. 3—Complex h.t. smoothing and supply system as used in many dual standard bush receivers. The 208V h.t. feed supplies the receiver strip while the lower voltage, but still further decoupled HT2 feed supplies the timebases and sync separator. C110 connected from the heater chain to HT1 supply feeds a small anti-phase a.c. voltage for residual hum cancellation.

THERMISTOR

As a further refinement to prevent undue switching surges on changing from f.m. to TV or vice versa, a miniature thermistor is included in the anode feed to the BY100 power rectifier.

Many Bush dual-standard models use an h.t. supply system giving three separate outputs, and a typical example is shown in Fig 3. The highest voltage output (208) of HT1 mainly feeds the receiver strip, while the lower voltage (188) but further smoothed HT2 supply mainly feeds the timebase circuits and the sync separator. The third output is purely for the a.f. output pentode.

The unique feature in this design is the inclusion of a 0·5µF capacitor from a point on the heater chain to HT1, and designed to remove the last trace of ripple by feeding into the branch a slight out-of-phase a.c. current.

STANDARD FILTER

Finally, the conventional π h.t. smoothing filter now tending to become standard design practice is shown in Fig. 4 and is taken from the KB/Regentone/RGD range of receivers. Due to the very low d.c. resistance of the smoothing choke (24Ω) there is very little voltage drop across it, and no less than 235V is available at the smoothing capacitor for feeding the entire receiver.

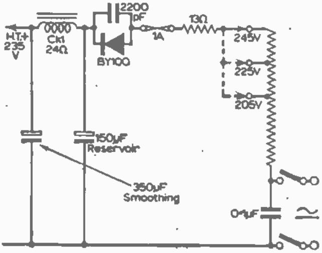


Fig. 4—Conventional h.t. smoothing filter as used in most current TV designs. (Example from KB, Regentone, RGD range). High value smoothing capacitor plus choke Ck1 gives extremely low hum level with high output voltage.

While the voltage variation or ripple at the reservoir capacitor is determined purely by the constant current drain and the reservoir value, the percentage of ripple across the smoothing capacitor is determined by the ratio of its own reactance to the reactance of the smoothing choke.

In practice it is quite an easy matter to determine just what the voltage ripple will be across the smoother once the voltage variation across the reservoir has been established. It is simply:

$$V_S = V_R \times \frac{X_C}{X_L - X_C}$$ where V_R equals the reservoir ripple and V_S equals the ripple at the smoothing capacitor.

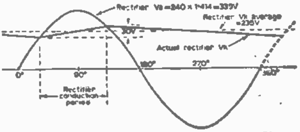


Fig. 5—An average dual-standard television receiver will require about 300 mA at 245V d.c., but as rectifier conduction occurs only during the positive half-cycle and then only when its anode voltage Va exceeds its cathode voltage Vk, the d.c. feed to the reservoir capacitor takes the form of short heavy pulses during the brief conducting periods as indicated.

The two reactances are subtracted because they are 180° out of phase, but should a resistor be employed as the series impedance instead of a choke the formula becomes:

$$V_S = V_R \times \frac{X_C}{\sqrt{R^2 + X_C^2}}$$

To give an example: If a 5H choke is used, and ignoring its d.c. resistance, its reactance will be $2\pi fL$ or $2 \times \pi \times 50 \times 5 = 1{,}570\Omega$.

Assuming the use of 350µF smoothing capacitor, a popular value, its reactance $\frac{1}{\omega C}$ to the ripple frequency will be $\frac{1{,}000{,}000}{2 \times \pi \times f \times C(\mu F)}$ or very closely 9Ω.

The total impedance of this choke/capacitor combination then will be $1{,}570 - 9 = 1{,}561\Omega$.

Taking the voltage ripple at the reservoir capacitor to be say 20V r.m.s., the ripple at the smoothing capacitor will be only $20 \times \frac{9}{1{,}561} = \frac{180}{1{,}561}$ or slightly more than 0·11V.

RIPPLE CONTENT

In conclusion, the ripple content and internal resistance of the h.t. supply in a television receiver must be much lower than in a radio receiver, and many puzzling instances of complete loss of field sync have been purely caused by reduced value electrolytics even though the speaker hum level seemed quite up to standard.

Then again, reduced value smoothing capacitors virtually increase the load of the video amplifier to the lower video frequencies, by having a reactance comparable with that of the series impedance, whether choke or resistance, and over-amplification of these frequencies occurs with disastrous effects on picture quality.

In all instances where the electrolytics exhibit signs of deterioration or drying-up, that is, swelling sealing caps or deposits of dried chemical around the soldering tags, replace them automatically.

In cases of obscure hum level, the possibility of the two positive leads of the dual capacitor having a low value leak between them, and thus shorting out the impedance of the series choke or resistor must not be overlooked, while shorted turns on the choke will similarly provoke a high ripple level. ■

SERVICING THE UNFAMILIAR RECEIVER

by

V. D. Capel

OCCASIONALLY, the amateur enthusiast whose interest is well known among his circle of acquaintances, gets called in to have a look at the set of a relative or friend. More often than not it will be a set that he has not seen before and for which he has no circuit or other service information. Not only can much time be wasted in trying to identify the various stages and components but some loss of face may result as one searches uncertainly for the appropriate parts with the owner peering over one's shoulder.

While it is true that different makes and models of TV receivers vary widely from each other, it is also true that there are many basic similarities and clues to help make a positive identification of the function of the particular stage.

Starting with the front end of the set, no difficulty should be experienced in locating the r.f. and oscillator valves as these will be on the tuner unit, which is easily recognisable. Sometimes though, the tuner may be mounted in a particularly inaccessible position. With the screening cans in position it is not possible to distinguish between the r.f. and the mixer stage. If one of these has to be changed, it often happens that one is withdrawn with some difficulty only to find that it is the wrong one. It then has to be replaced with even greater difficulty and its partner removed and replaced.

To identify which is which before removal, check to see whether the fine tuner is at the front of the unit or the back. The nearest valve will be the mixer. If it is not possible to see the fine tuner, then look for the i.f. output coil usually on the top of the tuner. This also will be nearest to the mixer.

Should this too be uncertain, then trace the aerial lead back from the co-ax socket to where it enters the tuner. It will, of course, enter near the r.f. valve and thus identify it.

Vision and Sound I.F.

Next, we have to identify the sound and vision i.f. valves. This is not always easy as in many chassis there seems to be just a jumble of coil cans and valves with little apparent system in the layout. This makes it difficult to distinguish between the two channels.

As it is essential to keep the leads between one stage and the next as short as possible, both sound and vision channels take the form of chains of alternate valves and i.f. coils, although like a chain, it is not always in a straight line. Coil cans which appear to be off the main line of the chain, being mounted to one side of either a valve or i.f. coil, are usually rejector circuits. The actual configuration of the chain varies between models. Some, the easiest to follow, are in two parallel lines. Others form a V with the common i.f. at the apex. Another

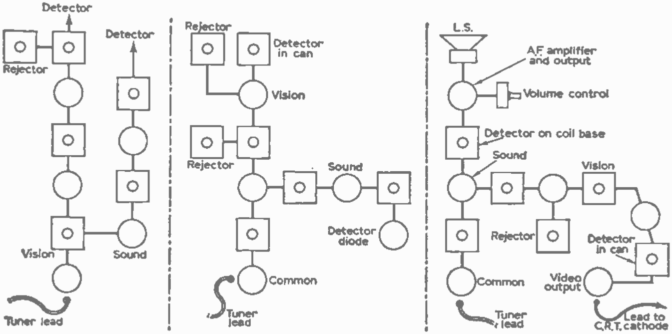


Fig. 1—Various i.f. layouts showing how sound and vision chains can be traced.

common layout is that of a T, with the common i.f. valve and coil comprising one arm and the sound and vision circuits the other. One receiver had the sound i.f.s running on in a straight line from the common, but the vision channel curled around in a circle so that the video output valve was quite near the r.f. and mixer stages (it was an old single band receiver) giving a Q shaped layout.

One must then, first locate the common i.f. if there is one, and then trace the two chains out from there. To find the common is quite easy, just trace the screened output lead from the tuner to its point of connection of the i.f. strip.

Now, we must discover which is sound and which is vision out of the two chains. There is one simple way of doing this which works in most cases. That is to gently rock one of the valves in its holder. Over a period, oxide and other deposits form on the valve pins and sockets. Any movement between the two will usually give rise to disturbances. This will take the form of crackling in the sound channel and white spots on the screen if it is in the vision chain. Care must be taken not to be misled here, as oxide on an h.t pin can produce both sound and vision disturbance. One, however, should be much more pronounced than the other, if in doubt rock a valve in the other chain and compare the results.

It may be found that the valveholders are noise free, and no disturbance is produced. In this case, access must be obtained to the underside of the chassis or printed panel. A screwdriver blade held on the grid pin (usually pin 2 of most r.f. pentodes of the 9-pin base type) will detune the circuit to produce a marked drop in either sound or vision signal level and thereby identify to which channel the valve belongs. Another way of identifying the vision channel is the presence of the rejector coils already mentioned, these not being used in the sound circuits.

Vision and Sound Detector

Next comes the detectors. These are at, or toward the end of each chain. Sometimes the chain is terminated by the output stage and sometimes by the detector, the output stage being located elsewhere.

The appearance of a double diode valve near the end of the chain can sometimes mislead one into assuming that this is the detector. This is not always the case as some makers tuck the detector away inside the last i.f. coil can in the form of a germanium diode, the valves diode being used for a limiter. The general tendency now is to use a semi-conductor for both detection and limiting, in which case there is a further identification problem. The easiest way is to check for h.t. voltage on the diode. There should be none on the detector but some on the limiter, although this may be only a small amount due to the presence of high value resistors, depending on the circuit used. There should be no signal input for this test as a rectified carrier voltage appearing at the detector could mislead. If a meter is not available, the diodes can be identified by means of a capacitor, the value being unimportant. Connect one side of the capacitor to chassis and then connect the other side to each terminal of the diode in turn. Connection to either side of the detector will result in the signal disappearing, but it will be affected by connection to only one side of the limiter, if it is not defective and the limiter control is in the off position.

Video

The video output stage, if not located at the end of the vision strip can still be quite quickly found. This is done by tracing the cathode lead from the cathode ray tube. Most tubes are cathode modulated and so in order to keep stray capacitances to a minimum which would restrict the high frequency response, this lead is always run separately from the other leads to the tube base which are frequently run together in a sleeve or twist. Should the tube be grid modulated, which is less frequently encountered, the same thing applies, that is, the grid lead is run apart from the others. In either case the lead which is separated from the others will lead to the video output stage.

If one is trying to locate the video stage from underneath the chassis or printed panel, then it can be identified by means of the small video chokes usually found in the grid and anode circuits. These are normally wound on resistor formers and so are easy to recognise. In some cases a video amplifier is used as well as the video output. The two sections are almost always contained in the same envelope, one of the multiple valves being used for the purpose. Generally, the output section is the triode which is used as a cathode follower. If though, a multiple valve is found in the video position do not too readily assume that both sections are video, the other could be the the sync. separator or even the line oscillator.

Sound Output and Sync

The sound output stage is best located by tracing the speaker wires back to the sound output transformer. As the sound output valve is not always near to the transformer it may in some cases be necessary to follow the primary wires back to the valve anode pin. An a.f. amplifying stage is often though not always used, and like the video stage is usually in the same envelope as the output section. If there is any doubt about this, the best way is to follow the wiper lead from the volume control which should end up in the grid circuit of the a.f. amplifier.

To locate the sync. separator is perhaps one of the more difficult tasks. Its position on the chassis can be almost anywhere. It can be a single valve or one of the multiple types. The line oscillator, video output frame generator and even sound detector have all shared envelopes with the sync. valve in various receivers as well as the more-to-be-expected line sync. clipper. The valve rocking technique will not be much help here, as any transient disturbance produced will be suppressed along with the unwanted video signal.

About the only way to identify it other than by tracing the coupling circuit from the anode of the video output stage to the sync. grid circuit, is to select a few possible valves and then to short the grid of each to chassis and observe the effect. It is probably safer to do this via a large value capacitor in case an h.t. pin is accidentally touched. Turn the brightness down too, in case a frame valve is involved and a frame collapse is brought about and a line burnt across the tube face. When the grid of the sync. valve is shorted it will result in loss of both line and frame sync. The absence

of only one will indicate that the valve involved is a clipper and that the separator is elsewhere.

Line deflection valves are usually quite easy to locate. The line output and boost diode being together near the line output transformer. As with the tuner valves, it may be necessary to replace one of these, and if both are in a difficult position, the wrong one may be removed. Some line output valves were made quite large physically, such as the PL36 and the 6BG6 whereas the boost diode has always been of more moderate dimensions. If then, one valve is larger than the other, it will be the line output. Where the more usual PL81/PY81 combination is used there is no difference in size. Look for the characteristic long white insulators inside the PL81. Another clue which can be helpful where the internal structure is not readily visible is that in some models an anode stopper is used with the PL81. This usually takes the form of a resistor—about 47Ω wired directly to the top cap of the valve. The boost diode often has a small choke going to its top cap.

The line oscillator is not aways positioned near the output valve and is often combined with another stage in a multiple. Rocking the likely valves can be tried and will in most cases identify the oscillator by affecting the line scan. A gentle tap is perhaps the most positive method as even good valves are sufficiently microphonic to produce some line disturbance when treated in this way. It must not be forgotten, however, that the multivibrator is the most commonly used type of generator, and this needs two valves. While in many cases both sections will be contained within the same multiple valve, often they will be separated so both halves will need to be located when fault finding in this stage. Frequently too, the output valve is used as the second half of the multivibrator and faults there will affect the line speed. In such cases there can be inductive coupling from the line output transformer to the first valve, or capacity coupling from the screen.

Field Scan

When dealing with the frame circuit in an unfamiliar receiver it is as well to remember that while some sets employ a single multiple valve with the generator and output stages being in the same envelope, others use two and even three valves, with the output and two sections of a multivibrator being all in separate envelopes. As with the line oscillator, rocking or tapping will produce frame disturbance by causing the lines to bunch. This will not, of course, distinguish between the generator and output sections. Where valves such as the PL82 or PCL82 are used, the output section will be obvious, but in such valves as the ECL80 or similar types further examination will be needed as the pentode section could be used in another stage. The easiest way to find the output stage when in doubt is to locate the frame output transformer and then trace the primary connections back from there. While many makers skimp on the size of the sound output transformer, they cannot do so with the frame transformer without seriously affecting the linearity, so this can be easily distinguished from the former by its size.

By then applying a few simple rules and watching for the basic identifying features, a completely unfamiliar receiver with no service data will not be quite so baffling as it at first may seem. ■

ADVANCE IN TV LIGHTING TECHNIQUES

—On-line data processing techniques coupled with s.c.r. power control units

A new approach to television lighting control is apparent in the recently announced Thorn Electronics system, which makes use of on-line data processing techniques to control hundreds of s.c.r. (silicon controlled rectifier) dimmer units. Although previous systems have made use of data processing and s.c.r. dimmers, this advanced system enables lighting directors to obtain complex lighting effects, through cross fading, that were previously unobtainable by conventional methods.

In addition to this, it is possible to automatically programme up to one hundred different lighting plots—each using multiple lighting channels—and later recall any lighting arrangement, in any sequence, simply by operating push-button switches on the control desk.

MAGNETIC CORE STORES

Adjustment and storage of dimmer settings for up to 390 individual lighting channels, each of which can have multiple lamps, can be made from the central control desk. The control desk shown in the illustration above has provision for 200 channels. Complete lighting plots using some or all of these channels may, by simple push-button operation, be recorded in any one of the system's 100 "files" or memories. Master dimmer settings and the actual times for cross fades can also be stored in the "files" which are, in fact, magnetic core stores.

Any channel or "file" may be instantly recalled for modification, should the studio lighting director wish to make major or minor changes to his original plan of action.

SETTING-UP

During the development of a lighting plot for a particular scene, the lights to be used and their intensity levels are automatically recorded in either the "studio" or the "pre-set" store; the choice of which is under the control of the operator.

The main difference between the two stores is that the "studio" store directly controls the dimmers whereas the "pre-set" does not and thus, does not interfere with other people during rehearsals. Information in either store is subsequently transferred to one of the 100 "files." Once this has been done, the particular store can be wiped clean ready for the next plot to be developed.

MIMIC DISPLAYS

Two mimic displays are contained on the control desk. One is associated with the "studio" and "pre-set" stores and the other is for the "files."

The store display has a white and red lamp under each of the lighting channel numbers. When a channel is selected for the "studio" store, the associated white lamp comes on at a brightness level corresponding roughly to the level of that lighting channel. Selection through the other store brings up a corresponding red lamp, but at a fixed intensity.

The mimic display for the "file" numbers also has a red and a white lamp for each number, and simply indicates which "file" is in use and from which store the information was taken.

INFORMATION RETRIEVAL AND STORE MIXING

The recall of data to a store does not lose the "filed" information and the contents of the store can, therefore, be modified without losing details of the original plot. If a modified plot should be required to replace an original "file," it may be separately recorded in another "file" and the original wiped clean.

Facilities are also provided for mixing the two stores so that the lighting scenes can be changed at any time: even when "on-the-air." Safety precautions have, however, been included to prevent accidental blackouts by an operator.

CROSS FADES

All the lighting patterns for a full scale production can be pre-programmed during rehearsals. Even complicated fades can be programmed—the maximum time to complete a cross fade being seven minutes. This is considered to be sufficient time for the transposition from a day to night scene or vice versa.

A pair of master dimmers are included and provide control of all the channels selected in each store on a proportional basis, independently of individual starting levels.

DIMMER UNITS

The standard dimmer units are suitable for controlling lighting channels with up to 5 and 10 kW of power. All of the dimmers are of the silicon controlled rectifier type, have no moving parts and have an efficiency rating of 98%.

A large smoothing choke, which occupies almost as much room as the control elements, is fitted to each of the dimmer units. These chokes have been included to minimise spurious radiation from the lighting cables. Radiation from lighting cables can cause noises in the studio's microphone circuits.

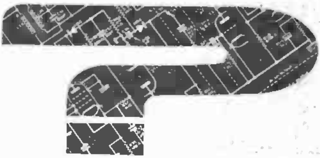
COST

The cost of this Thorn system is higher than the more conventional systems, but is much simpler to use, has more facilities—which should lead to better television—and is suitable for colour work. Cost of a control installation for a television studio is in excess of £20,000.

Although the cost of this system is far too high for the amateur television operator to consider purchasing one, it will probably help the ideas man to improve his own lighting arrangements. Silicon controlled rectifiers are comparatively new in this country (outside the professional and industrial fields) and are gaining ground rapidly.

Our sister journal, *Practical Electronics*, recently carried an introductory article on s.c.r's (or thyristors as they are sometimes referred to) in the June issue.

TV TERMS AND DEFINITIONS EXPLAINED



Gordon J. King

Part IV Feeders

Feeders

In the television world a feeder is used to convey signal abstracted from a radio wave by the aerial to the set with the minimum loss of signal. To satisfy this condition the impedances of the aerial, the feeder and the set input must match, and an impedance value around 70 ohms has been chosen because this is the impedance at the centre of a half-wave dipole and also because 70-ohm feeder is reasonably dimensioned in its cross-section, for the sectional dimensions of feeder are a direct function of their impedance, among other things.

Feeder can be either "balanced" or "unbalanced". Unbalanced feeder is typified by the well-known coaxial cable which is used in Great Britain for all (or the very great majority) v.h.f. and u.h.f. aerial systems of the domestic kind.

Balanced feeder has a pair of side-by-side conductors which may or may not be enclosed in a flexible, braided covering. If they are so enclosed, the feeder is called "balanced screened" or "screened twin". In the early days of television, balanced aerial inputs were featured almost as much as unbalanced inputs, but this state of affairs has been stabilised now.

Twin feeder has certain advantages over coaxial but greater practical disadvantages. Provided the whole system from aerial to set is perfectly balanced, demanding a critically balanced and designed aerial input circuit at the set, then the feeder works well indeed, since the two halves of a half-wave dipole represent a balanced circuit, anyway.

However, in practice optimum balance all the time and under all conditions is nigh impossible, since other aerials nearby can unbalance the aerial and to secure good balance at the set critically adjusted bridge circuits would be needed. Now, if a balanced feeder is unbalanced it tends to pick up interference and the losses rise; but with unbalanced cable this is not so, provided the unbalance is retained—and this is not difficult.

At u.h.f., however, some authorities advocate the use of a small transformer at the aerial—called a "balun"—to make the dipole itself "look" unbalanced to the feeder, rather than balanced.

The amount of attenuation to which the signal is subjected during its passage through a feeder is a function of the frequency. The greater the frequency, the greater the attenuation or losses. The attenuation approximately doubles each time the signal frequency is squared. Thus, in a given feeder, Band III signals are attenuated about twice as much as Band I signals and the u.h.f. signals are attenuated about twice as much (or more in practice) as the Band III signals.

For this reason super low-loss cable (which has a larger diameter than "standard loss" cable) should always be used for the u.h.f. (BBC2) signals in areas where the signal field at the aerial is not particularly high.

Filters

A filter often signifies a circuit network which allows the passage of a group or band of frequencies while offering a high attention to signals of other frequencies. The network may be composed of combinations of inductance and capacitance in a configuration that patterns the filter characteristics.

For instance, a *high-pass* filter allows the passage of high-frequency signals while attenuating signals of lower frequency relative to a "critical frequency". A *low-pass* filter similarly passes all frequencies below a critical frequency. In addition to these two prime filters used in television, we have *band-pass* and *band-elimination* filters, passing respectively all signals between *two* critical frequencies and all frequencies outside *two* critical frequencies. Examples of high-pass, low-pass and band-elimination filter circuits are given in Fig. 15 at (a), (b), (c) and (d).

A television diplexer consists of a high- and low-pass filter connected respectively to Band III and Band I aerial systems, allowing such signals to be directed to a common feeder without interaction at the aerials. A triplexer is similar but has a band-pass section in addition.

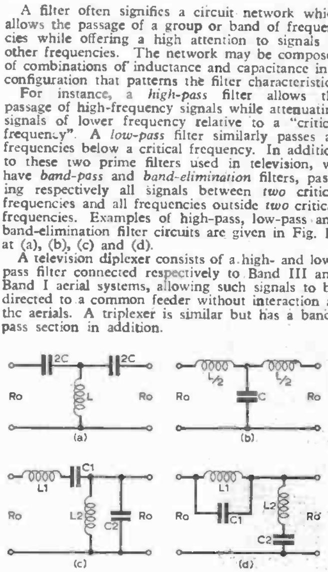


Fig. 15—(a) High-pass T-type filter. (b) Low-pass filter. (c) Band-pass filter. (d) Band-elimination filter.

First anode voltage

This signifies the potential applied to the first anode of a picture tube, as distinct from the e.h.t. voltage applied to the "final anode". A typical first anode potential is 300 volts. This is often derived from the boosted h.t. supply in the line output stage, and before being applied to the anode is filtered through a fairly high value resistor in conjunction with a capacitor between the anode and h.t. negative (or chassis).

If the filter resistor increases in value or the capacitor develops impaired insulation, the first anode voltage would reduce. This shows up as poor focus and lack of brightness.

Flashover

This term describes an electrical discharge that manifests as a spark or flash. Flashover often occurs due to poor insulation (sometimes precipitated by dampness) between the windings of a transformer, especially the line output transformer which is subjected to high amplitude pulse voltages. Another vulnerable component is the metal h.t. rectifier of the selenium variety. Flashover can occur between the metal discs of this component.

The symptom is also not uncommon between the electrodes of valves and between the electrodes of the electron-gun assembly of a picture tube. Poor vacuum in such devices tends to aggravate the trouble, as also does the collapse of the cathode material, which occurs with age.

Some brand new power-type valves may produce an internal flashover when first put into service (especially line output valves), but this does not necessarily indicate that the valve is defective. However, in sets with line output stage fuse protection, a flashover of this nature can blow the fuse and render the stage inoperative.

Flyback

The forward strokes of the line and field timebases move the scanning spot horizontally and vertically on the picture tube screen to trace out the raster of scanning lines. At the finish of the forward strokes, the timebases create a very rapid change in scanning coil current, the effect of which speedily causes the scanning spot to move to its forward-stroke starting point again. This "retrace" is called the flyback.

To render the flyback invisible on the picture, the pulse of voltage that its action produces in the inductive components of the circuits is fed back as a negative-going blanking signal to the grid of the picture tube. Thus, when the flyback occurs the tube beam current is muted (and illumination extinguished) by the pulse giving the tube an instantaneous beam current cut-off action. This technique is always adopted on the field circuits, and less frequently on the line circuits. Fig. 16 shows the basic circuit of field flyback blanking.

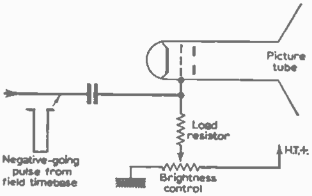


Fig. 16—Basic circuit of field flyback blanking.

Owing to the greater rate of line flyback, compared with that of the field, the line flyback pulse has greater amplitude than the field flyback pulse. In fact, these high amplitude line flyback pulses are further stepped up by the action of the line output transformer and then rectified by the e.h.t. rectifier to provide the tube final anode voltage.

Controlled "ringing" in the line output transformer and line scanning coils improves the efficiency of this action and also provides a boosted h.t. potential of 300 to 500 volts which is used to supply the c.r.t. first anode. It is also used in some sets to power the field timebase oscillator as a means of facilitating scan linearity and of applying some degrees of automatic scan amplitude control.

The boost diode works in conjunction with the line output stage, and it arranges for the "ringing energy" delivered by the line circuit inductive elements to supply the energy for almost the first half of the line scan, at which point the line output valve switches "on" to supply energy for the remainder of the scan. It is across the reservoir capacitor of the boost diode that the boosted h.t. voltage is developed. This is generally added to the ordinary h.t. line voltage.

Flywheel-controlled line sync

There are two basic schemes in current use for synchronising or "locking" the line timebase. One is called "direct sync" in which the line sync pulses are processed so that they "trigger" the line timebase oscillator and thus instigate each line scan. In that way the line trace at the set is held in accurate step with that at the camera.

This arrangement works quite well in practise but does suffer the slight disadvantage of being affected by spurious signals which may "look" to the line timebase rather like a line sync pulse. The timebase is thus likely to "fire" on a spurious signal slightly earlier or later than the correct time dictated by the line sync pulse proper.

Such spurious signals may consist of random or impulsive electrical interference and "noise" developed by the signal stages in the receiver. Dual-standard sets adjusted for the 625-line standard are more prone to the trouble than ordinary 405-line-only sets. This is because the sync pulses on the 625-line standard are positive-going and thus rise in the same direction on the picture waveform as interference pulses (see Fig. 17). This makes it more difficult for the set to decide whether it is receiving a sync pulse or pulse derived from a spurious signal in the system.

On 405 lines, the picture signal is positive-going (the sync pulses negative-going). Here the picture proper is more affected than the sync by pulses of spurious signal. As we know, impulsive effects show as white spots on the picture, while on 625 lines they show as black spots.

The second method is arranged to combat these troubles (sync-wise). The problem is solved by not feeding the line sync pulses direct to the line timebase generator. Instead, the *frequency* of the

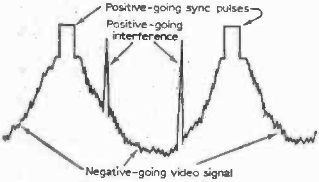


Fig. 17—Showing how interference pulses rise of a 625-line picture waveform.

generator is held constant by a *control potential* devised from a discriminator. The discriminator is fed with processed line sync pulses and processed pulses from the line timebase itself and the circuit is adjusted so that when these two inputs are exactly in step there is no output from the discriminator.

However, should the timebase tend to run out of step with the sync pulses, the discriminator compares the time or phase difference with the sync pulses and produces a positive or negative output, or control potential, which is fed to the line timebase generator. This potential is of the correct polarity and potential so as to alter the frequency of the timebase by just the right amount to bring it back in step again with the sync pulses.

In that way the sync pulses proper are isolated from the timebase generator and any interference on them fails to affect the "firing" of the timebase. However, slight phase differences can occur on the sync pulses due to interfering effects, and to overcome this the control circuit from the discriminator to the generator is given a long time-constant. This means that distortion of the sync pulses or even their failure over a few lines will not greatly affect the line timebase synchronising.

The long time-constant is often given by a largish value capacitor in conjunction with a highish value resistor, but the same effect is provided sometimes by the use of a tuned circuit adjusted to the line repetition frequency.

Field (or Frame) bounce

This is a picture sympton whereby the whole picture sets up a vertical judder or bounce. The frequency of the bounce may be very low (one or two times a second) or up to fifteen or twenty times per second. It is sometimes possible to stabilise the field by very careful adjustment of the vertical hold control, but even this adjustment may not correct it. It may, however, be discovered that the symptom can be stopped by reducing the picture height or by vertical linearity control adjustment. Though it may start again at any time.

Most usually the trouble is caused by a defect in the field timebase valve. If a triode-pentode valve is adopted, this should be tested by changing with one known to be in good order.

Frame-grid valves

Frame-grid construction facilitates an extremely small grid-cathode spacing, resulting in a valve of dramatic mutual-conductance or "slope" increase. This is highly desirable for television amplifiers, for it marks a significant improvement in "figure-of-merit", which is the bandwidth/gain function of an amplifier.

A typical conventional valve like the Mullard EF80, for instance, has a grid-cathode spacing in the order of 100 microns, while the frame-grid EF184 has a spacing of only 50 microns. The slope of the EF80 is 7·4mA/V and of the EF184 15mA/V.

Close spacings cannot ordinarily be achieved since the backbone of the grid assembly cannot be made sufficiently rigid nor its dimensions controlled accurately enough to maintain the required close tolerances. However, the frame-grid technique makes the necessary strength, rigidity and dimensional control possible because the grid is formed of a backbone of stiff molybdenum rods held at a predetermined distance apart by spacing bars.

Tolerances are fantastically small. The support rods, for instance, are drawn to ± 5 microns and

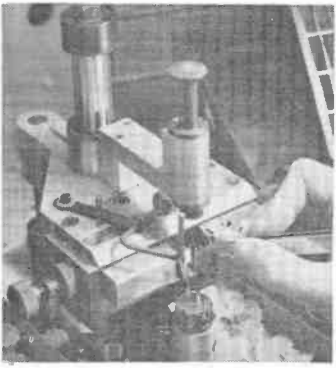


Fig. 18—Showing the frame grids being assembled in a double-triode valve. Acknowledgements to Mullard Limited.

the grid wire itself to $\pm 0{\cdot}2$ microns, which is less than half the wavelength of sodium light!

Some v.h.f. and u.h.f. tuners feature frame-grid triode valve amplifiers and in v.h.f. application a single frame-grid triode is able to provide almost the same gain as possible from a pair of triodes in a cascode circuit. Moreover, triodes have improved noise performance at v.h.f. and u.h.f. over pentodes and similar valve stages. A typical frame-grid triode is the Mullard PC97.

Pentode frame-grid valves such as the EF183 and EF184 are employed in the i.f. amplifier stages of modern sets because noise here is less important than in the tuner. The photograph in Fig. 18 shows the two frame-grids of the double-triode Mullard PCC89 being positioned over the cathodes.

Free running

This term describes a timebase which is not under any external control. For instance, if the sync pulse feed to, say, the field timebase generator were removed, the timebase would be free running and would, of course, fail to lock to the field sync pulses.

It may be possible by very delicate adjustment to the vertical hold control to hold the field steady for a very short period of time, but the picture would quickly roll upwards or downwards as soon as the manual control is removed.

This is the kind of symptom that results from a fault in the field sync pulse feed to the field timebase generator. Similar effects are observed in the line timebases but here the picture breaks up horizontally and, owing to the greater repetition frequency, it is virtually impossible to hold the picture in lock "by hand".

Frequency gratings

These are sets of vertical lines within the circle of a test card, their purpose being to judge the horizontal definition of the vision channel of a receiver. On test card "D", for instance, the six frequency gratings, reading from left to right and from top to bottom, correspond to 1·0, 1·5, 2·0, 2·5, 2·75 and 3·0Mc/s, while on test card "C" for 625 lines there are two vertical sets of five gratings each, corresponding to 1·5, 2·5, 3·75, 4·5 and 5·25Mc/s reading in that order on the left-hand set from top to bottom and from bottom to top on the right-hand set.

Most 405-line sets in correct alignment will resolve the 2·75Mc/s gratings (and to some extent the 3·0Mc/s gratings) on test card "D", while a correctly aligned 625-line set should define the 4·5Mc/s gratings of the 625-line test card "C".

If the h.f. response of the set is impaired due to misalignment, video amplifier or detector fault, etc., the higher frequency gratings will resolve as blurred rectangles instead of properly defined thin, vertical lines, which is their real composition on the test card shown to the camera.

"Ringing" in the vision stages of the set is shown as "image flares" from the right-hand side of the higher order frequency gratings and sometimes as white lines "ghosting" the vertical black lines of a frequency grating. The fine tuning control should be carefully adjusted to the point of optimum frequency grating definition, but if it is taken beyond that point the sound signal will tend to break into the picture, causing the picture to "vibrate" or jump in sympathy with the sound signal.

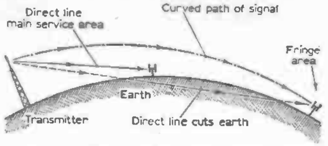


Fig. 19—Showing how the signal curves round the earth in the fringe area. This bending is influenced by the tropo-sphere or earth's atmosphere, the conditions of which are affected by the local weather. Thus, fringe area reception can be disturbed by the weather conditions.

Fig. 20—When the state of the troposphere encourages fringe area reception, distant stations sharing the channel of the wanted signal are often received. This causes co-channel interference, the effect of which is shown here.

Should this happen the fine tuning control should be turned back until this sound-on-vision effect is just deleted. This position should then be the best for definition, assuming that the set is correctly aligned.

Fringe area reception

The transmitting authorities publish "signal contour" maps relative to their stations. These reveal the signal field strength in the "primary service area", where reception can be almost guaranteed, and the signal field strength at more distant locations from the transmitter. These locations are in the "secondary service area", where reception is fairly reasonable provided the receiving aerial is suitable.

Generally speaking the fringe area starts where the line-of-sight distance between the transmitting and receiving aerials is exceeded. This distance, of course, is influenced by the height above sea level of the transmitting and receiving aerials.

Assuming a smooth, spherical earth, fringe area signals are thus obliged to bend round the curvature of the earth to reach the receiving aerial (see Fig. 19). The bending effect is a function of the atmosphere directly above the earth's surface called the "troposphere". If the characteristics of the troposphere alter, so the fringe area signals are altered because they are propagated into the fringe area, as it were, by the troposphere.

The troposphere is in fact affected by local weather conditions and this is one of the reasons why fringe area reception can vary from time to time or, indeed, quite often during periods of high pressure. Moreover, more distant, same channel, signals are propagated into the fringe area, thus causing interference on the wanted signal. This causes "co-channel" disturbances, a typical example of which is shown in Fig. 20.

LINE SCAN

FAULT symptoms as displayed on the picture tube can go far towards speedy fault diagnosis. This article deals particularly with symptoms associated with line troubles. The pictures were photographed by the author directly from the screens of faulty and maladjusted receivers.

Future articles along similar lines will depict and describe faults in other sections, such as the field timebase, sync circuits, video circuits, r.f. and i.f. circuits and so forth.

PULSE AND BAR

Transmitting authorities sometimes transmit a vision test signal consisting of a pulse and bar, the waveform of which is shown in Fig. 1. The pulse is useful for determining the h.f. performance of links and transmission circuits, while the bar has other uses, including l.f. response checking.

The parameters of the transmitted signal are maintained at high accuracy so that any deviations

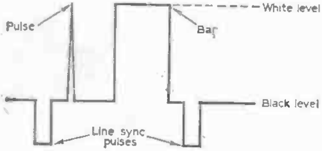


Fig. 1—Pulse and bar signal with line sync pulses.

at the receiving end of the link can be interpreted in terms of link impairment. During testing periods, this signal may be seen on the screens of our sets, and it appears as shown in Fig. 2.

The display here was photographed from a brand new set, and within the limits of domestic set tolerances it can be considered as "perfect". The pulse of the waveform is responsible for the vertical line at the left-hand side, while the bar, of course, produces the area of illumination on the right-hand side. Slight bending of the pulse display and the edges of the bar will be seen. This is caused by slight imperfections of the receiver and is rarely completely avoided in popularly-priced sets. The well-defined pulse implies that the set has good h.f. response and noise-free sync. Lack of flaring from the bar implies a fair l.f. response.

Of course, this signal is not meant specifically for receiver display tests, it being of main value to transmission engineers viewing the received waveform on an oscilloscope and comparing it with the original signal applied at the sending end. Nevertheless, it is instructive to know something about it and, in addition to what has been said already, the pulse is useful for detecting multipath interference (i.e., "ghosting") and "ringing" in the vision stages at the set end.

Ordinary test cards, of course, should be used for assessing the general goodness of receivers proper.

LINE BREAK-UP

Figs. 3 and 4 show symptoms of line-break-up on the pulse and bar signal. The effect would be similar on any other signal, but an interesting aspect is the series of dots between the wide, bright slightly diagonal lines. These result from the pulse, while the wide lines from the bar of the signal.

These are common symptoms. A normal set should lock the line over 10 deg. or more rotation of the "line hold" control, and either side of the locking range the line will break, producing the symptoms shown. However, an ageing line oscillator valve, a defective time-constant capacitor or change in value of a time-constant resistor or resistor connected in series with the line hold control can upset this balance and often make it necessary to turn the control hard clockwise or counter-clockwise to secure line lock.

Even then the lock may be towards the end of its range, so that eventually the picture will break-

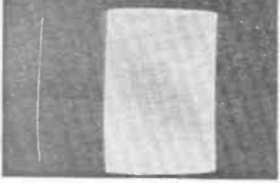


Fig. 2—Pulse and bar display on ordinary television set.

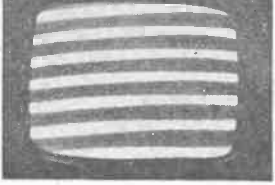


Fig. 3—Line timebase running slow on pulse and bar signal.

Fig. 4—Line timebase run... bar s...

distortion

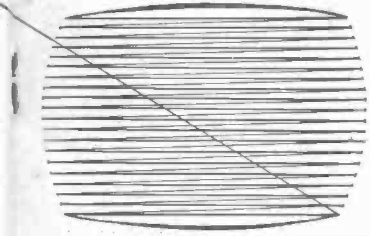
EXTREME DRIFT

Sometimes an extreme drift or component value or characteristic change occurs, putting the hold control very severely out of adjustment. When this happens it may be possible to lock the line on a multiple or sub-multiple of its correct frequency. Fig. 6 shows the effect at running at half correct line speed, two pictures side-by-side, while Fig. 7 shows how an incorrect lock might be obtained with the timebase running too fast.

Incidentally, these effects may be caused on dual-standard sets if the appropriate line preset is incorrectly adjusted. The adjustment to the 625-line and 405-line (if fitted) preset should be made in each case with the main line hold control set to range centre, the preset of the appropriate standard then being set for the best line lock.

The symptom in Fig. 6 might be obtained when a Continental transmission is received on a British 405-line set. The pictures, however, would probably be of negative appearance owing to the negative-going picture signal. Incidentally, Fig. 6 reveals considerable line non-linearity by the width of the picture on the right being narrower than that on the left.

By K. ROYAL



up with the control at one of its stops. Rotating the other way will only worsen the effect. Fig. 3 indicates that the line timebase is running too slowly, while Fig. 4 indicates fast running. These are indicated by the slight diagonal tilt to the left and the right of the screen respectively.

Fig. 4 may be caused by an ageing line timebase valve or by a change in value of a resistor or time-constant capacitor, while Fig. 3 should firstly lead to a check of the resistor in series with the line hold control. This is often of fairly high value, and thus is prone to value change.

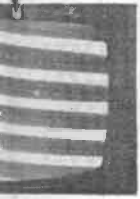
It often happens that the line may lock towards the end of the line hold control when the set is first switched on, but that a drift occurs towards the stop end of the control as the set warms up, giving the symptom in Fig. 4. This effect is nearly always cleared by changing the line oscillator valve.

Fig. 5 shows the "fast-running" symptom on ordinary picture modulation and fairly weak signal. This was actually taken from a faulty set whose line hold control was at the end of its range. Valve replacement restored balance of the hold circuit and, of course, cleared the symptom.

On a full picture this non-linearity would barely be visible, it being considerably emphasised by the fault symptom. However, it may lead to a check of the linearity control adjustment if fitted, but may not warrant attention to the linearity correcting sleeve within the scanning coils (between the coils and the tube neck) of modern receivers.

PRESENCE OF HUM

It sometimes happens that the line lock performance of a receiver is somewhat impaired by the presence of excessive hum in the sync separator, line timebase or video circuits. Normally, the hum is heard from the speaker and seen as a shaded, horizontal band across the picture. This is a fair indication that the electrolytic smoothing capacitors need looking at, as one or more may be low in value or there may be a poor connection between the metal (negative) case of such a component and the metal chassis (or capacitor clip).



...nning fast on pulse and ...gnal.

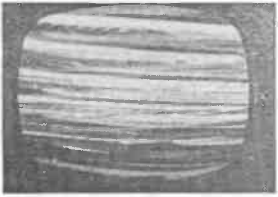


Fig. 5—Line timebase running fast on picture signal.

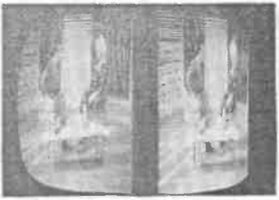


Fig. 6—Line timebase running at half speed.

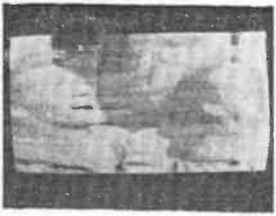


Fig. 7—Line timebase synchronised to multiple frequency.

Fig. 8—False line lock, showing a little hum.

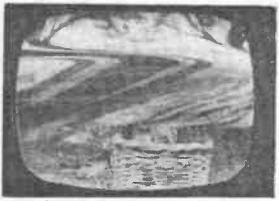


Fig. 9—Hum in video stages.

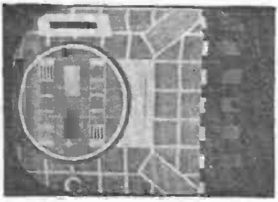


Fig. 10—Incorrect phasing on test card.

There are times, however, when the hum barely troubles the sound, yet can upset the timebases. Fig. 8 shows a little hum in the line circuits in the form of bending of the vertical parts of the picture when the line hold control is adjusted just to the point of line break-up. Careful adjustment of the control around that point will secure a "false line lock", as shown in Fig. 8.

The trouble here, which was having an adverse effect on the line (and field) lock, was cleared by changing the main electrolytic smoothing capacitor. Poor heater/cathode insulation in one of the line timebase valves can also cause a similar symptom, as also can increase in value of the resistor on the line output valve's control grid.

A rather peculiar effect can occur if the hum enters the picture channel at the video amplifier or picture tube cathode. Fig. 9 shows a typical symptom. Here the video amplifier valve was at fault, it having a bad heater/cathode leak. Similar trouble, however, can arise from the tube cathode lead picking up excessive hum and from hum entering the sync separator stage, due either to a valve defect or circuit/component fault.

So far, the line faults considered are those associated with directly synchronised line timebase oscillators. Some sets have fly-wheel controlled line oscillators or "indirect sync" systems. Symptoms arising from these can differ a little from those already shown.

FLYWHEEL-CONTROLLED SYNC

Flywheel-controlled line sync systems sometimes work by virtue of a discriminator comparing the "phase" of the sync pulses with pulses derived from the timebase proper. Should the two signals go out of step, then the discriminator produces a control voltage which pulls the oscillator back into step with the sync pulses.

It is possible for the discriminator to produce a "locking potential" while being a little out of phase, as it were. When this happens the line locks but the picture shifts horizontally in full form *within* the raster. The effect is rather like that of the horizontal shift being out of adjustment, but it is essentially different in that when the shift is responsible the raster complete with picture are displaced, while when the phasing of a flywheel system is wrong only the picture is displaced, the raster remaining in its correct position.

Fig. 10 shows the effect. Note the "flaring"

Fig. 11—Incorrect phasing on picture.

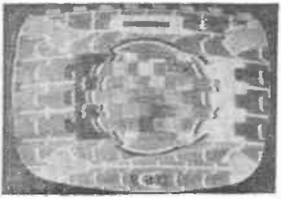


Fig. 12—Cog-wheel effect

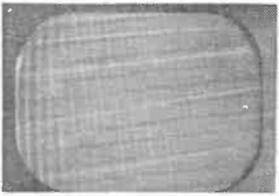


Fig. 13—Bad ringing in line output stage.

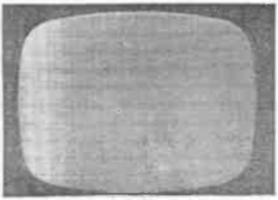


Fig. 14—Corona display on unmodulated raster.

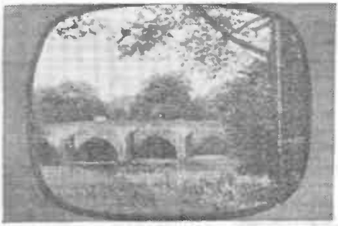


Fig. 15—B-K or "switching" interference in the line output stage.

from whites on the right of the screen. This shows that a raster is, in fact, present here in spite of the picture being seriously displaced to the left of the screen. The symptom can occur if the "line lock" control is incorrectly adjusted, but then the line is not properly "locked".

The best way to test this is to adjust the "line lock" control for the best hold, determined by the position when the picture immediately jumps into line lock after removing the aerial plug and replacing it again, and then, if the picture is displaced in the raster, as explained, to carefully adjust the "phasing control" (sometimes a preset capacitor or core in the line oscillator coil) until the picture is correctly balanced in the raster.

If it is attempted to balance the picture in the raster by the "line lock" control alone, any burst of interference or irregularity in the transmission would be likely to cause immediate line break-up, similar to that in Fig 5. Fig. 11 shows what the out-of-phase symptom looks like on a picture signal, in which the flaring from whites is clearly seen.

COGGING

Another symptom which affects the line action of a picture is shown in Fig. 12. This is often called "cogging" for obvious reasons. The effect is that horizontal bands of the picture are displaced where they terminate in white picture signal. If they are displaced to the left, excessive picture signal at the output of the sync separator stage is a possibility. In this event, careful attention should be given to the sync separator components, especially the anode, screen and control grid components.

If the displacement is to the right, poor h.f. response in the video circuits should be suspected. In Fig. 12 the test card shows very poor h.f. response, so firstly the video circuits should be checked. Poor h.f. response can be encouraged by leakage at the cathode of the picture tube, alteration in value of a component in the video amplifier stage and, of course, misalignment of the vision i.f. stages and the sound rejectors therein.

LINE RINGING

Fig. 13 shows serious "ringing" in the line output stage, this being responsible for the alternate dark and light vertical lines at the left of the screen. This trouble is common in older style sets due to various shortcomings but, fortunately, is now less of a problem. Older sets have damping components across inductors in the line output stage. For instance, a resistor and capacitor network across a width or line linearity inductor sometimes acts as a damping system to suppress such rings. If one of these components fails, then, of course, the symptom becomes serious as in Fig 13.

Another symptom associated with the line output stage is shown in Fig. 14. The vertical

—continued on page 473

UNDERNEATH

THE DIPOLE

FORTY years ago—and still going strongly on the screen! Nineteen twenty-six was the year that the unique film double-act, Stan Laurel and Oliver Hardy teamed up in film comedies made at the Hal Roach Studios, Hollywood. That was in the days of silent films; talkies started about three years later.

Mr. Laurel and Mr. Hardy

Laurel and Hardy made about 20 silent films together, and then carried on with nearly 100 sound films, many of which have appeared — and continue to appear—on television. These two comics have now passed on, but their differing styles of clowning were so complementary to one another, built up over the years, that their films have become real classics, regularly repeated on television.

Laurel and Hardy were not always pleased to see their comedies on American television, with their names and their films being used interspersed with numerous commercials advertising deodorants, beer, brilliantine and floor polish. It was particularly galling to them that they received no payment for the television showings, or the usage of their names, but a legal battle by the cowboy film star, Roy Rogers, on the same subject, had failed.

In Britain, Laurel and Hardy films are seen on BBC, and on ITV and the intrusion of commercials is handled with much more discretion and care than on American TV networks.

Film Prints at 4d. Per Foot

Old films (and even the not-so-old films) are the copyright of the film producing companies who bought the original scenarios or the film rights of books or stage plays. In the early days of the silent film, prints were sold on an "open market" at 4d. per foot! Having bought a print, the purchaser could make a duplicate negative from it and manufacture a further number of "pirate" prints for sale. At that time such piracy was legally prevented by the simple expedient of fixing the producing company's trade mark on not-too-conspicuous positions on the furnishings of scenes or the scenery itself. You could't copy the trade mark, even if, at that time, you could copy a dramatic scene.

Repeats—Repeats—Rep . . . !

Coming to the productions made for television on videotape or on film today, the copyright position is covered for original or for subsequent replays of those which are popular enough to justify a second, third or even fourth showing, and may be worth preserving and storing for years to come.

Take *Robin Hood*, for instance, a highly successful film series specifically made for television at the now defunct Walton-on-Thames film studio, or the VTR series of *Steptoe and Son* and *The Best of Hancock* (some of which were electronically transferred from tape to film for exporting) are all series which are worth repeating. The BBC are at an advantage in presenting almost immediate repeats of subjects which have been successful on BBC 1. Viewers who missed the first transmission and have read enthusiastic press notices can sometimes see a second performance on BBC 2—if their sets can receive the channel.

In this respect they have an advantage over the ITV companies. There are a number of plays of great merit, such as ATV's *Nelson*, by Terence Rattigan, which were missed by a good many viewers, but, following the "smash hit" press reports would have been more widely viewed if ITV had an ITV 2 channel available for showing an immediate repeat. Writers and actors are not averse to repeat showings of modern taped productions; their contracts usually call for additional financial rewards, unlike the reissues of the old "open market" films of yesteryear.

TV Exports

Those of us who are able to take a look at television abroad must become aware of the untapped goldmine of television programmes of international interest which exists in Britain and is suitable for export. I am not just thinking of the peak-time programmes of the BBC or of the major ITV companies, but of every one of the commercial organisations, from Rediffusion (11,187,000 possible viewers) to Channel Islands (89,000 possible viewers). These statistics refer to the number of sets able to receive both channels at the end of 1965, and not including the growing number which can pick up BBC 2.

All stations, however parochial the programmes might be at first sight, contribute something which is of value in the vast world market of television material. The problems of exports are not simple. Indeed, they are complicated by the different languages, the different line standards, the different gauges of film, and whether videotape versions are required. Further complications will arise—in fact, have already arisen with colour TV. Peak-times on American major networks are almost exclusively devoted to programmes filmed in colour, using 35mm prints.

This is probably the most valuable export item from

British television, a fact which has been noted by Lew Grade, of ATV, who has already put in hand colour television series on 35mm film. Nevertheless, black-and-white programmes are exported in various forms by ITA and BBC to Australia, New Zealand, Canada, Rhodesia, Sierra Leone, Sweden, Holland, Finland and others. Many of them are accepted in the English language, some with translated sub-titles and some with new voices in the appropriate languages.

Translation For Viewers

Putting new local language voices on foreign films is a tricky and expensive process, but seems to be worth while in West Germany, France and Italy. It is a method of presentation which has long been in use for the cinemas in those countries, and vice versa, in Britain. It is a specialised and complicated operation which is worth while for TV series which have an international appeal.

In Britain, the De Lane Lea organisation has specialised in dubbing English voices on foreign films successfully, though their activities are at present mainly concerned with films for the cinema. Exports of television productions are important for the economy of this country and both BBC and ITV companies are playing their part. The promoters of series on film or on tape will await with interest the decisions at Oslo in July on the international standards for interchange.

So far as colour is concerned, film prints on 35mm are likely to be the principal medium for the Common Market, with 16mm film reduction prints for the smaller stations. In the meantime ABC—TV's *The Avengers* and ATV's *Danger Man* are being made in colour for export, but seen here in black-and-white.

A Question Of Taste

Television series are aimed at large "popular" audiences, carefully planned, written and cast and subject to revision, recasting (or even being abandoned) after the first "pilot" episode has been seen by the "front office" executives. BBC's

Vision mixer at console controlling three motion picture cameras (Mitchell system 35) shooting "Stop The World I Want To Get Off" on colour film.

Dr. Finlay's Casebook went through many ups and downs before the right ingredients were found.

Another Category

Full length TV plays are in another category. Unless the viewer has read something about the play in the appropriate TV programme journal and knows what to expect, the first ten minutes are critical and he may reach forward to switch off or switch over. This is what happened when I switched on to a BBC—TV play, *Final Demand*, by Hugh Whitemore, in which Kenneth More played a bewildered hero who gives up his job, his wife and his responsibilities, and, when I switched off, looked as though he was going to be a hermit in his own home.

Its aimlessness reminded me of Pinter's *The Caretaker*, Wesker's *Roots* and, I am told, follows the plotless shape of Beckett's *Waiting For Godot*. Ionesco's *The Bald Prima Donna* and Frisch's *The Fire Raisers*, all of which are on the ABC—TV programme. It's all a matter of acquiring an off-beat taste!

At the other extreme comes the new series, *Mrs. Thursday*, which tops the TAM ratings in most ITV regions. This is yet another version of the *Cinderella* success story, with Kathleen Harrison as the char who receives a legacy of millions of pounds and subsequently becomes involved in a multiplicity of sub-plots. Lord Willis, who designed the series and is one of the most successful TV script writers, is also one of the few writers who put women in the top leading parts in many of his scripts for films or TV.

Woman in a Dressing Gown, *Hot Summer Night* and *The Eyes of Youth* were all subjects with women in the most important parts, a trend which is not followed by other writers, such as the brilliant partnership of Simpson and Galton, Muir and Nordern, Hills and Green, all teams which produce a prodigious amount of comedy writing.

Budding writers in the television script field should be warned to avoid clichés.

The would-be script writer might well emulate the dialogue he will create for his inevitable inventor:

"*Do you realise what this means? Why, with this knowledge, we can alter the destiny of mankind.*" To this well-worn cliché, he could add: "*I wish I'd written that!*" To which you could answer, "*You will! You will!*"

Iconos

IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part II

THE test waveform generator (Fig. 4) supplies either a sawtooth or a variable lift waveform. (Note that unless otherwise mentioned the pulses referred to are from the fully interlaced and critically timed pulse generator, but any important difference due to the use of a simple pulse generator will be mentioned.) When the switch S1 is in the sawtooth position (Fig. 4) the capacitor (C) is charged through Tr1. The rate of charge depends on the bias on the base of the transistor; this controls amplitude of the sawtooth. Blanking pulses (the same as syncs with a simple pulse generator) are applied to Tr2 and cause it to conduct heavily and so discharge the capacitor (C). Thus we have the sawtooth waveform as in Fig. 5b. It is mixed with syncs (Fig. 5c) in the common load of Tr3 and 4, the result being shown in Fig. 5d. The sync amplitude is controlled by a potentiometer in the base circuit of Tr4. In the lift position blanking pulses are amplified and the amplitude set by the position of the lift potentiometer. Then syncs are added as before (Fig. 5e). This design uses OC170s where shown, but as these are being driven fairly hard one should always increase the sawtooth and sync amps from zero (the sawtooth zero amplitude is with the slider at the negative supply end of its travel) until the required amplitude is reached. Otherwise one might easily destroy the transistors. MAT101s have been used with success and are more robust but more expensive.

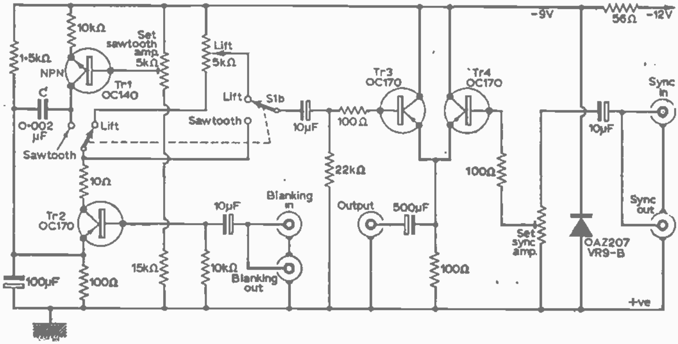


Fig. 4—Test waveform generator supplying sawtooth or variable lift waveform.

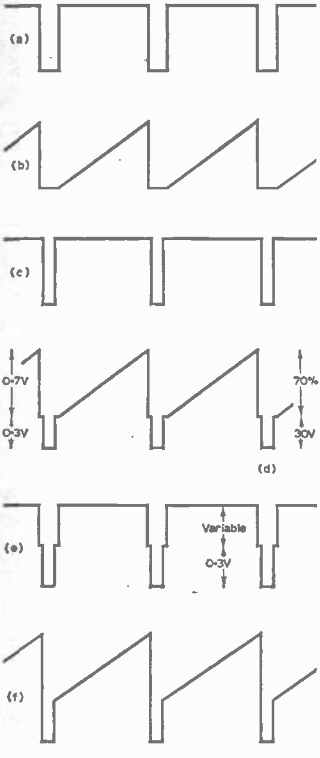


Fig. 5—(a) Blanking pulses (field pulses not shown);
(b) Sawtooth derived from the blanking pulses;
(c) Sync pulses;
(d) Sawtooth and sync pulses combined;
(e) Blanking and sync pulses, i.e. lift output;
(f) Sawtooth output when monitored from simple pulse generator.

These (a to e) refer to the waveforms found in the test waveform generator when driven by the fully interlaced sync pulse generator.

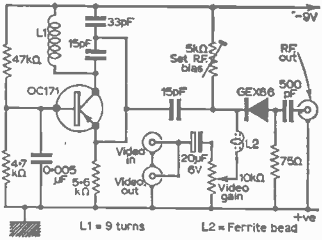


Fig. 6—Circuit of the r.f. modulator.

Here again no constructional or layout problems have been encountered and Veroboard and a medium size metal box are very suitable.

Note that on all equipment the video or pulses are "looped through" as shown; this allows one to feed a signal on to the next piece of equipment. The final piece in the chain of equipment is "terminated" by a 75Ω resistor across the "out" input socket. The reasons for this will be discussed later on.

Radio Frequency Modulator

The radio frequency modulator is merely a low-powered transmitter which allows one to feed a string of ordinary television sets tuned to an unused channel with video input. The unit feeds a coaxial cable, so is not used as a transmitter source, so no licence is required.

This circuit (Fig. 6) is a variation of an early American circuit. The radio frequency oscillator is a Colpitts oscillator which is an OC171 working in a common base configuration. The coil (L1) is nine turns of 30 s.w.g. on a ¼in. diameter form with a slug for tuning.

The r.f. signal is fed through the diode (GEX66), which is normally biased off but is switched on again on any increase of video level. This bias is adjusted (set r.f. bias control) to give minimum output when no video is being applied. The bias should be set so that the syncs are not clipped or limited. with the depth of modulation at a maximum The ferrite bead (L2) is an r.f. choke and isolates the video sockets from r.f.

As the bias and gain are rather interdependent the circuit is best set up with a sawtooth being fed into the modulator and the result observed on an ordinary television set. A good place to check with the 'scope is the detector of the set. Syncs and sawtooth peak should just not limit.

A 9V supply is specified as it is more convenient to run off a small battery and the complete modulator with battery and switch can be built into the small metal box. It is essential that the circuit is well screened: the metal box serves this purpose admirably. If it is likely that two modulators are to be used on different channels, high-quality capacitors should be used for the oscillator output; this allows one to select a vision source with the channel switch.

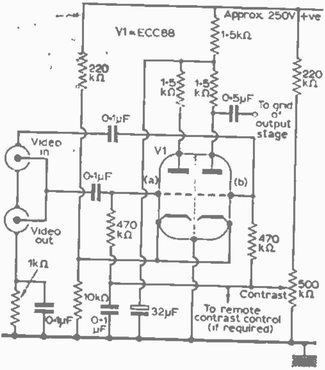
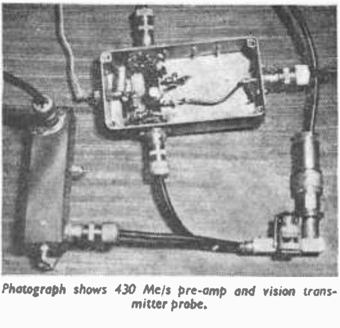


Fig. 7—Circuit of double-triode cathode coupled video amplifier.

We will now deal with details of an r.f. modulator to convert a video signal to a suitable r.f. signal for display on an ordinary television set. Why, then, convert a set to a monitor? There are several reasons but principally it is much simpler to apply the vision signal to a video amplifier and hence to the tube than to apply the video to an r.f. modulator, frequency change in the tuner, amplify at i.f., demodulate and then amplify in a video stage before driving the tube. Naturally the bandwidth is less predictable and is usually reduced as well as more distortion occurring with the latter system. An additional video amplifier stage is required, and it is essential that the TV chassis is isolated from the mains by means of a double-wound transformer.



Photograph shows 430 Mc/s pre-amp and vision transmitter probe.

Choosing a Suitable TV Set

Most television dealers take old television sets in part exchange for new models and, as there is little or no market for television sets of the 14in. size, many of these merely clutter up valuable storage space. Most dealers welcome the chance to get rid of a few of these and good working models can usually be obtained for a few shillings. The following points should be checked if a picture can be seen:

1. Condition of the tube, any ion burn, poor focusing at any part of the picture, low contrast.
2. Conditions of the scan circuits, range of control of the vertical and horizontal hold, geometry and linearity of the scans.

The width and height controls should have enough range to allow the corners of the pictures to be seen within the tube mask. When a picture cannot be seen, then check for those points that can be observed with a raster alone.

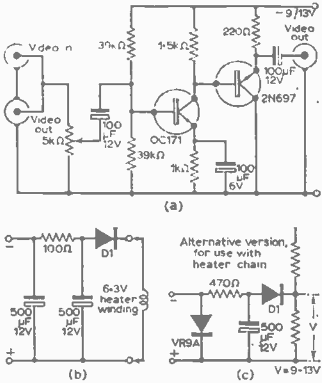
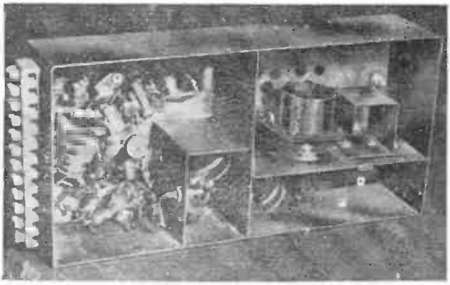


Fig. 8—(a) Transistor video amplifier (b) D.C. power supply from parallel heater chain and (c) series heater chain.

If one can obtain a circuit of the proposed set this can be helpful, e.g. it is generally better to use a set with a simple "hard lock" sync circuit than one with a flywheel sync circuit. The dealer might well be able to assist with a circuit diagram. If any sets with badly damaged cabinets are available then these can be considered for rebuilding on to a suitable chassis for use as a viewfinder.

The set as obtained needs modifying by adding an amplifier stage (Fig. 7) to increase the input signal to the 5V and 10V amplitude needed to drive the vision output stage. Fig. 7 is rather complicated but is commonly used in many commercial monitor circuits. This circuit is a double triode used as a cathode-coupled amplifier. The video is applied to a grid of V1a. This acts as a cathode follower and drives the cathode of V1b by the common load. The grid of V1b is at a constant potential and the signal at the anode is positive going video of the required amplitude. The grid of V1b is in fact connected to the outer of the coaxial so that the actual signal at the output is the difference between the signal on the inner and the signal on the outer of the coaxial, hence any hum or interference induced in a long video cable is removed. If it is impossible not to earth the outer then the 1kΩ resistor and the 0·1μF capacitor are, of course, omitted. However, the grid 0·1μF capacitor must not be omitted and is earthed at one end. Incidentally a video signal injected at this grid appears as a negative image superimposed on the main signal, a useful test point. The contrast control carries d.c. only and can be removed if required.



Underside view of 430 Mc/s 10 watt vision transmitter.

If a transistor circuit is preferred then Fig 8a is a suitable one. It derives its power supply from the heater chain as shown (Fig. 8b). This can be built on to a piece of Veroboard and put in a small metal box and placed as near to the video detector as possible.

Part III Next Month

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 such apparatus.

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

TRANSISTORISED TV

SIR,—Some time ago you published constructional details for a transistorised TV receiver. I missed this and I understand that the relevant back issues are now out of print. Is it possible for you to publish another circuit like this? I feel sure that many people would be interested.—J. BRODY (Stratford).

[*We are unable to commit ourselves on the question of publishing a new transistor TV design. Back issues for the Olympic II can be seen at many local libraries. The issues which covered the series were April to October, 1965.* —Editor.]

SERVICING TV RECEIVERS

SIR,—In view of the great number of "Servicing Television Receivers" articles which appear regularly in PRACTICAL TELEVISION is it possible to publish a list of all those covered so far?—R. MIDDLEJOHN (Exeter).

[*We cannot publish a full list of receivers covered in this series but indices are available from our Information Bureau.*—Editor.]

SPARES AVAILABLE

SIR,—I am one of the writers mentioned by Mr. Roden in the May issue. I have quite a number of spares available and I am very willing to send them to any reader who sends postage. They are mainly 17in. sets dating from 1958 to 1961.—G. WEYMOUTH (245 Milligan Road, Leicester).

ISSUES WANTED

SIR,—I require the April, May and June, 1961, issues of PRACTICAL TELEVISION. I am willing to pay a good price for them or would exchange issues which I have. Can any other reader please help me?—G. F. BROOKS (11 Shakespeare Crescent, Eccles, Manchester).

TIMEBASES

SIR,—I may be able to help your correspondent, E. W. Morton, of Deal, Kent, whose letter appears in the June issue. His full address is not given, so if he would write to me direct I have a copy of "Timebases" by O. S. Puckle which I am willing to sell.—J. FLYNN (Hill House, 59 Weoley Park Road, Selly Oak, Birmingham 29).

MISLEADING SYMPTOMS

by G. R. Wilding

AT one time it was considered that diagnosing television receiver faults was simpler and quicker than diagnosing radio receiver faults, since the symptoms were displayed on the screen.

However, with the increasing inter-connection of stages and circuits in modern designs, this no longer holds good for defects in one stage can produce symptoms normally only associated with another.

For instance, as a simple but quite common example, many of the slim-line sets Philips made (just before the introduction of the dual-standard types) used to develop insufficient height, which could not be cured by valve or the usual electrolitic bias capacitor replacement.

This fault, which showed up only in the *field* circuit, was caused by a defective component in the *line/focus* circuitry. In these particular receivers, as in many others, the h.t. for the field oscillator is taken from the boost h.t. rail to secure a more linear scan—but so also is the feed to the c.r.t. focus electrode via a miniature "slide" potentiometer connected from this point to chassis.

Reduced in Value

This component, mounted on the tube base, often reduced in value after some years of service and, imposing a heavier than normal drain on the boost h.t. rail, pulled down the available voltage and thus also the voltage to the field oscillator, resulting in reduced vertical scan.

Again, in current designs, the a.g.c. voltage is invariably obtained from the grid of the sync separator, so obviously if the sync pulses are at low amplitude so also is the a.g.c. and overloading can develop—a fault which normally could only be due to incorrect value cathode bias resistors and their immediate circuitry.

A classic example of the widespread effects that a fault in one section of a television receiver can have on many others was recently experienced by the author.

The receiver was a very modern convertible Ferguson, which had an over-contrasty picture impossible to graduate, slight symptoms of sound-on-vision and extreme pulling on whites. It was impossible to lock horizontally or vertically on ITA, barely possible on BBC, while the picture gradation on the Test Card made the three darkest squares all appear about the same tone and could not be separated.

Valves all OK

After checking all relevant valves without the least trace of improvement, we were beginning to form the impression that either some of the tuning slugs had been maladjusted or that a component failure in the tuning strip had broken down causing an excessive narrowing of the i.f. frequency response.

However, on locking the picture for a few moments on the Test Card we noted that the 3Mc/s gratings were well reproduced, so this ruled out the mis-tuning idea.

The inability to separate the three darkest squares on the Test Card decided us to first concentrate on the video stage and very soon we found an excessive

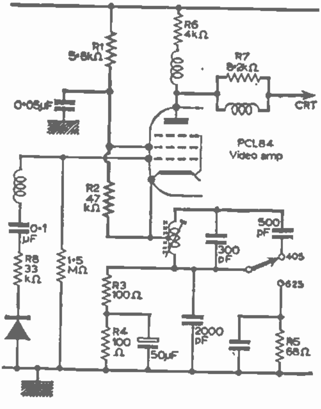


Fig. 1—Basic Ferguson dual-standard video amplifier. When R1 and R2 reduced in value thus increasing voltage drop across R3 and R4 and over-biassed the video amplifier, symptoms were (a) practically zero sync lock, (b) low a.g.c. voltage, (c) i.f. overloading and (d) poor picture tonal gradation.

cathode voltage and therefore also excessive grid bias.

The cathode resistors were about normal in value, but the two resistors from the h.t. line that fed the video amplifier screen and also augmented the voltage developed across the cathode resistors were considerably reduced in value and were thus the basic cause of the symptoms.

Lack of Sync

As the video pentode was over-biassed the low amplitude sync pulses were unable to lift the valve off the flat tail of its characteristic and received little or no amplification. Hence the reason for the lack of sync and also for the overloading and the slight sound-on-vision due to their being virtually no a.g.c. voltage being applied to the i.f. valves.

Similarly the excessive bias working the video valve on the flattest part of its curve made it practically impossible to separate the lowest amplitude (darkest) Test Card squares. Replacement of the two resistors in question completely restored normal contrast range, sync lock, picture tone and freedom from sound-on-vision.

Four separate circuit faults from two reduced value resistors!

This is by no means a freak fault, but indicative of the inter-relation of what were once regarded as separate clear-cut stages. The purpose of these bleeder resistors connected from the h.t. rail to the video cathode is both to stabilise the bias voltage and reduce the value of cathode resistor required for any specified bias, thus reducing negative feedback.

In many earlier Philips receivers the cathode of the video amplifier was tied to the cathode of the second vision i.f. amplifier.

The current through the cathode resistor of the latter valve (Fig. 2), also includes that of the video pentode so that a degree of mean level a.g.c. is introduced into the circuit.

An increase in mean picture level produces an increase in video anode current and thus a greater voltage across its cathode resistor. This in turn increases the bias on the vision i.f. amplifier and reduces its gain.

Of course, abnormal current in either valve will effect the biassing of both so in receivers incorporating this system, incorrect video circuit operation could be caused by a faulty second i.f. amplifier or supplies and vice versa.

Boost H.T. Rail Feed

Another unusual innovation in this series of models is the feeding of the triode section of the PCL83 audio valve from the boost h.t. rail. This means in practice that should the PY81 fail (a common occurrence in these models), there will be complete loss of sound as well as e.h.t.

Such a combination of faults would normally direct suspicion to a complete lack of h.t. caused by an o/c surge limiter, h.t. fuse or rectifier fault—but certainly not the reclaim rectifier.

This arrangement is used because the triode a.f. amplifier also acts as the interference limiter, and its anode is fed via a 2·7MΩ resistor. By feeding this resistor from the boost rail of 450V instead of the 192V h.t. rail it is still possible to supply the anode with an adequate voltage.

As previously mentioned, the boost h.t. rail is invariably used in modern designs for supplying the field oscillator valve but where VDR height stabilising systems are used, a fault here can produce lack of width as well as lack of height thus giving the incorrect impression that the general h.t. supply voltage is down.

Similarly, in many dual-standard Thorn chassis a 1·5MΩ resistor is switched from the boost h.t. rail to chassis on 625 to reduce its voltage marginally and thus maintain height constant on switch-over from 405.

Again if this resistor depreciates in value or a leak develops across the system switch, the reduction in boost voltage will affect width as well as height.

In fact in some models where there is ample vertical amplitude available but only adequate width, a lowering of boost voltage caused by such defects in the field circuit can be most evident by insufficient width or poor horizontal linearity.

In all modern circuits where stages are interconnected great care must be exercised before condemning any stage as being the cause of its own shortcomings.

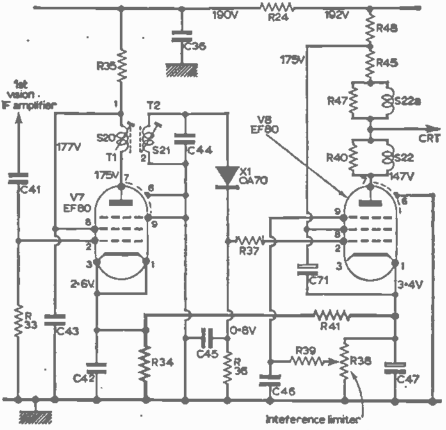


Fig. 2—Video biassing system used in many Philips models. Cathode bias resistor of second vision i.f. amplifier is common to video amplifier. As mean picture level rises so does video anode current and also voltage developed across common resistor to bias back the i.f. stage, giving a degree of a.g.c.

DX-TV

A MONTHLY FEATURE
FOR DX ENTHUSIASTS

by Charles Rafarel

AS I write these words "glorious" May is with us, and at last Sporadic E DX has begun to show some activity, and my predictions of last month have proved right.

For myself, the period mid-April to mid-May was rather mixed with the latter part better than the first. Ten days enforced stay in hospital was not very conducive to serious DX, although some effort was made with a converted 14 in. set and a telescopic car radio aerial poked out the window when Matron was not looking! Little or no Sporadic E activity was evident, and this was confirmed by other DX/TV friends' reports.

Two good things came out of my spell "inside". The hospital room was permitted to become a DX/TV office, and my wife was able to cope with some of the back-log of correspondence. Apologies for some delays in early April.

Secondly, now that I am faced with several weeks at home, this is being put to good account by a considerable increase in DX viewing hours, and this may be in part reflected in my impression that the first part of May has been more profitable for DX.

Reception in Bournemouth Area:—

20/4/66 E2a Jauerling Austria.
22/4/66 E2a Jauerling Austria.
23/4/66-2/5/66 Away!
5, 6, 7, 8, 9, 10 and 11/5/66 E2 Hörby Sweden, and Grünten W. Germany.
8/5/66 E2a Jauerling Austria.
10/5/66 R1 Bydgoszcz Poland, or Budapest Hungary.
12/5/66 E2 B. R. Grünten W. Germany.
12/5/66 E2 S. R. Hörby Sweden.
13/5/66 E2 S. R. Horby Sweden.
14/5/66 E2 S. R. Hörby, and B. R. Grünten.
15/5/66 E2 S. R. Hörby Sweden.
15/5/66 E2 B. R. T. Ruiselede Belgium.
(Very rare Tropospheric in my area.)

The pattern of this reception is of some interest, with the very long run of Swedish and West German reception. In fact, Sweden is comparatively rarely received in this area, and the usual stations to the south like T.V.E. Spain have been completely absent to date.

Tropospheric reception here has been erratic and entirely dependent on prevailing weather conditions, although it has had its good days.

NEW STATIONS

Here are some new ones now in operation on u.h.f.:—

Spain: TVE Madrid Ch24 Power 1,500kW (just possible here).

France: ORTF2 Mezières Ch23 power 500kW; Nancy Ch29 power 500kW; Rheims Ch46 power 500kW; Bordeaux Ch57 power 1,000kW.

Holland: NTS Markelo Ch54 power 300 kW.

Sweden: S. R. Hörby Ch43 power 500kW.

The following Band I/III transmitters have now increased power: *Norway:* Hemnes Ch E3 now up to 12kW. *France:* ORTF1 Bordeaux Ch F10 now up to 50kW.

EBU LIST

The new EBU TV station list No. 11 is now available from The European Broadcasting Union, Technical Centre, 32 Avenue Albert Lancaster, Brussels 18, Belgium.

Subscriptions are now due, but the price has been increased to 125 Belgian Francs, ie. approx. one pound sterling. A map of European TV stations is now included. This information comes from R. Bunney.

AERIAL PREAMPLIFIERS

Notwithstanding all that I have said in the past about the advantages of mast-head preamplifiers, I have recently been doing some re-thinking on the subject.

With the poor conditions prevailing so far this year, I have often felt that the mast-head preamplifiers here may have been "packing-up", and as they are over 30 ft. up it is impossible to check without major dismantling operations on the mast itself.

There seems to me now to be another objection to mast-head use. Once fitted it is impossible to adjust the coils for maximum gain on any one channel, without dismantling, and one has to resort to making the preamplifier "broad-band" by loading the coil with parallel resistance, with consequent loss of gain.

In my own case this particularly applies to a Band III broad-band Belgian array that I use. If I could, for example, peak the coil to Ch F10 for ORTF Rouen I would get increased selectivity which would help a lot in rejecting local ITA on B11, but with the flat response of the present set-up I get no help at all in this way.

So in the near future I plan to re-organize all the aerial arrays, with the possible exception of u.h.f., and bring the associated preamplifiers down to ground level, where they can be checked and/or re-adjusted as and when required.

The co-axial down leads in my case are about some 45 ft. long and are all of super low-loss cable, so I have a feeling that I shall gain more

TEST CARD DATA (11) R.T.P. PORTUGAL

(courtesy M. Aisberg)

Test Card: as per photo.

Channels

Portugal operates on one channel only in Band I.

Channel E3. Coimbra-Louza 60kW horizontal, often very well received here. This is your only chance for Sporadic E reception, as all other transmitters are in Band III and too far distant for Tropospheric reception.

Test Card and Programme times: Regret no precise information, but usually on Test Card from early afternoon, and Programmes from about 1800-1900 hours.

Watch for this station when Spain TVE is being well received, as it often comes in then.

Late News

It has been noted that on 19/5/66 the Coimbra transmitter was radiating Test Card "D" as BBC/ITA, but with the letters "R.T.P." in black at the bottom. This may be an alternative to the photograph shown above or it may be that it will be used in the future. (Information from Mr. A. Davies of Crawley).

on the swings than I lose on the roundabouts!

So if your co-ax leads are relatively short I suggest that you consider this aspect. The basic transistor preamplifier design I published some time ago in PRACTICAL TELEVISION is equally happy at either the aerial or the set end of the down-lead, so if you omit the 2·2kΩ damping resistance and arrange for the coils to be tuned through each band by means of parallel capacitance it may well be worth the trouble.

READERS' REPORTS

Very few this month due to poor conditions, but one good one however:—

D. Boniface (Ripon) did well in April, so it seems that conditions were better further north. He broke into the u.h.f. field with, Holland (Lopik Ch27 Roermond Ch31 and Goes Ch32), West Germany with Aachen Ch24, Aachen Ch36, and Hamburg Ch36.

Band III yielded Holland, Smilde Ch E6. Sporadic E reception covers Switzerland (Utliberg Ch E3), Denmark (Fyn E3), Spain and Sweden E3, Yugoslavia (Kapaonik E3), and West Germany (Kreuzberg-Rhön E3).

The RSGB through reader Boniface have asked DXers to co-operate with them in reporting any Sporadic E TV reception over 100Mc/s frequency, and this means Ch E6. So, if you do see any, please report either to Martin Harrison G3USF at 367 Parrs Wood Road, Manchester 20, to me or to Mr. Boniface. The frequencies required seem to be higher than Ch R3 and 4, and Ic which have been received here at times, and the chances seem "slim" but look out please, nevertheless.

TRADE NEWS • TRADE NEWS • TRADE NEWS TRADE NEWS • TRADE NEWS • TRADE NEWS

RENTASET WIN CONTRACT

A CONTRACT worth £750,000, to wire Dawley New Town has been awarded to Rentaset Wired Services Division. The programmes to be relayed at present are BBC-1 and two ITV programmes (Lichfield and Emley Moor) and the radio programmes will be BBC Home, Light, Third and Luxembourg.

The service will be a v.h.f. system to enable normal domestic TV receivers to be used. Cables will be laid together with other public utilities as the development proceeds.

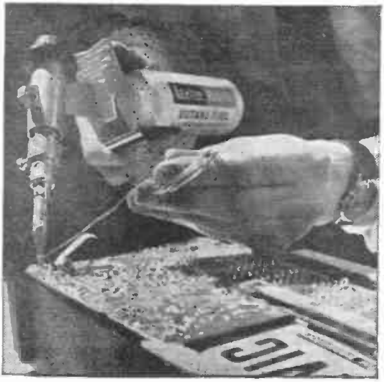
The receiving installation will eventually consist of very elaborate aerial arrays to receive all the programmes available in the vicinity. The station will be provided with an automatic start standby generator in case of power failure.

RONSON BLOWTORCH

FROM Ronson Products Ltd., comes the Ronson Varaflame Blowtorch, a compact appliance which works from an ordinary Ronson gas Multi-Fill. The Blowtorch is assembled in two or three seconds simply by clipping the torch attachment on to the Multi-Fill which then serves as an easy-to-grip handle. It then has only to be ignited to be ready for use.

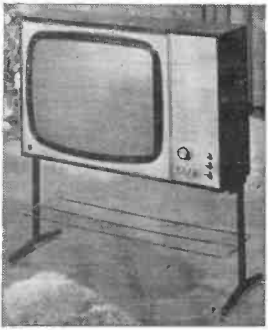
Also available is a Blowtorch kit, packed in a metal box. This consists of the standard Blowtorch, described above, plus three attachments. These attachments are: a copper soldering tip designed for use in precision soldering; a blowtorch head which provides an extra large diffused flame, and a flame spreader which gives a wide fan-shaped flame of fairly low heat intensity. The price of the Blowtorch Kit, which includes a giant-size gas Multi-Fill is 79s. 6d.

The photograph shows the copper soldering tip attachment for jobs where special precision is needed.



PHILIPS "76" TV RECEIVERS

TWO newcomers to the Philips Style 70 range of TV receivers are the 9176 and 3176, 19in. and 23in. models respectively. Both have similar slim, modern styled cabinets veneered in sapele with satin polyester finish. Simplification of operation has been increased so that switching to BBC-2 is effected simply by pressing that control knob, rather than having to first of all change the line systems. A metal stand with magazine rack is available for both models.



AVO INSTRUMENT SALES DIVISION MOVES

AVO (MI Group) instrument sales division has moved to new premises at Avocet House, Archcliffe Road, Dover, Kent.

The Instrument Service and Spares departments and the Coil Winding Division remain at 92-96 Vauxhall Bridge Road, London, S.W.1.

PYE OF CAMBRIDGE LTD.

PYE of Cambridge Limited announce that in the light of the unusually depressed state of the radio and television market it has become necessary in the interests of cost saving and efficiency to concentrate the main part of their radio and television set making at their factories at Lowestoft and Malmesbury.

Specialist production of Dynatron high quality products will continue at Maidenhead.

Servicing TELEVISION Receivers

No. 124 The G.E.C. BT455 and BT456 continued

By L. Lawry-Johns

Vision on Sound

There is another electrolytic capacitor in the video amplifier circuit, this being C51 32μF. It decouples the h.t. supply to the screen (pin 9) of the PCL84 V5 and also the h.t. to the audio stage V8 (PCL84) triode. The effect of this capacitor becoming open circuit is more severe on the sound than it is on the vision. It appears in the form of a buzz, which is present all the time the vision signal is being received, the fine tuner not having any worthwhile effect.

A quick check is to short out R45. If this removes the buzz, C51 is almost certainly at fault.

Quick Checks

No results—receiver dead

Check fuse FS1. If intact and mains voltage is present at this point, check at dropper. If absent here, the on/off switch or the connecting leads must be checked.

Valves not lighting

Ensure mains voltage is present at all dropper sections and at both ends of R99, then check through heater chain, starting at V14 PY800, continuing through to the tube heater pins 1 and 8. Pin 1 connects to chassis.

Valves lighting

Check dropper left side sections to TH1, thence to BY100, h.t. output of which should be about 240V d.c.

Sound in order—no light on screen

Advance brilliance. If no raster is displayed, check operation of line timebase. On 405 standard the 10kc/s whistle should be heard. If present, and a neon lights when brought into the vicinity of the line output stage check the DY86 (V15). If e.h.t. is present at the tube, which it almost certainly will be if the DY86 lights, check the tube base voltages. If there is no voltage at the grid pins 1 and 6, check brilliance network, particularly C146 (0·1μF) and C145 (0·02μF).

Raster present—no picture

Still assuming the sound is in order, a blank but illuminated screen, fully controlled by the brilliance, indicates a fault between the common i.f. stage and the cathode of the tube. The most likely offender is the video amplifier V5 PCL84. Therefore check V5 and associated voltages, then V4 similarly. If these two stages are in order, check the OA70 vision detector diode, and the small chokes between this and the video amplifier. The OA70 is inside the T3 coil can.

No sound or vision signals

If the raster can be displayed on the screen when advancing the brilliance control and there is some evidence of noise from the loudspeaker and on the screen, check the aerial input. If in order, check the tuner unit valves by substitution. Check tuner unit voltages, and resistors for correct value, cable terminations and common i.f. stage V3 if necessary.

The usual type of tuner unit fitted is quite acces-

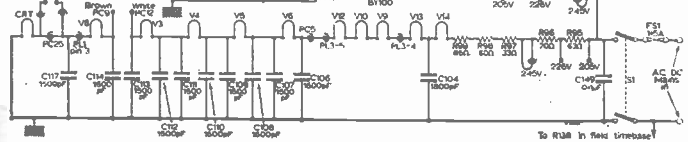


Fig. 4—Arrangement of heater and d.c. supplies.

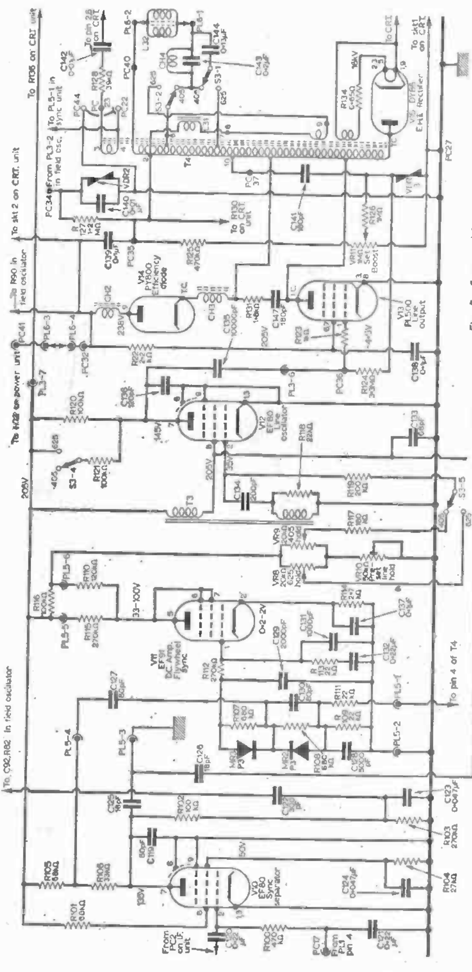


Fig. 5—Sync and line scan stages.

sible, but where the press button type of tuner is encountered, access to components is not always easy, and a certain amount of patience is necessary to effect certain replacements. The alternative is to return the tuner to the makers.

No sound, vision normal

Check V8 PCL84, h.t. voltages to pins 2, 6 and 9, bias voltage at pin 7. If the audio stage is in order, as evidenced by a hum when the OA81 limiter is touched, check the OA81, the V6 EF80 and voltages and the OA79 inside the T4 coil can.

Distorted sound

If the sound has a choked quality, worse on strong signals, check R67 (4·7MΩ), associated components to the OA81 and the load resistor R68 (220KΩ) of V8 pin 2. If the output valve V8 overheats as the volume is advanced, check C85 (0·01μF).

Weak signals

Check aerial input. If in order check V1 PCC189 on tuner unit. Then check V2 PCF801, R12 and R15, tuner unit voltages and common i.f. stage EF183.

Improper operation of channel selector

Clean and lubricate surface contacts, disc studs, etc., in tuner. It is unnecessary to strip the tuner, merely remove the cover and rotate the selector to expose studs in turn. Check smooth movement and return spring of fine tuner.

Oscillator adjustment

If optimum signals are not obtained with the fine tuner somewhere around the mid-position, set it midway, which brings the hole in the pulley in line with the aperture where the required oscillator coil core will present itself, and adjust the core for maximum sound with a suitable non-metallic tool.

Poor sync

Inability to lock the field timebase, as referred to above, implies that the control is at the end of its travel. When this is not the case, i.e. the picture can

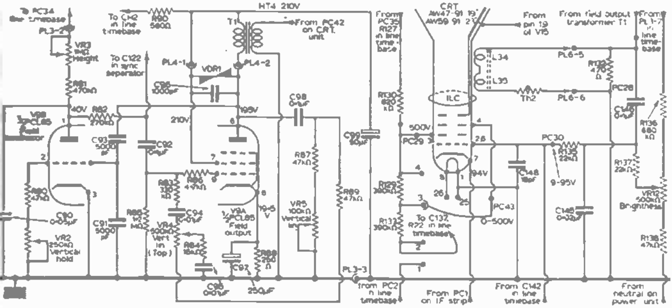


Fig. 6—Field scan and c.r.t. network.

be made to roll both up and down, but will not remain stationary, the trouble is lack of synchronising pulses. These pulses are fed to the timebase via C122 300pF, through a filter R102 R103 C123. C123 is a ·047μF capacitor which can and sometimes does short to chassis, causing a complete loss of field locking. When the pulses are present, but weak, the trouble is not necessarily in the sync separator stage at all. The video amplifier cathode bias circuit has a 100μF electrolytic across one of the 120Ω resistors. This capacitor can become open circuit, causing slight loss of contrast, which may not be noticed, but the effect on the low frequency field sync pulses is more drastic. The possibility of this capacitor being at fault is not always realised when a fault of weak sync is being chased.

LINE SCAN DISTORTION

—continued from page 459

column of short, irregular white lines at the left of the screen is caused by corona or flashover often in the line output transformer during the line retrace period. When the symptom is mild, it can best be seen on an unmodulated raster, as shown in Fig. 14.

When the line output transformer is responsible, its replacement is usually demanded completely to clear the symptom; but it should be noted that the effect is aggravated by incorrectly fitted shields and screens around the line output transformer and e.h.t. section and by a weak aerial signal. Sometimes it shows up more on a BBC channel than an ITV one—or vice versa, depending on the relative signal strengths.

CORONA EFFECTS

The flashover results from poor insulation in the windings of the line output transformer, for instance, but poor insulation in any component associated with the pulses generated in the line output stage during the line retrace can cause the effect. On some sets wet or damp weather encourages the effect, it almost disappearing during the summer months. A set running from an indoor or set-top aerial could produce the symptom, yet it could disappear altogether by using a good outside aerial on the same set!

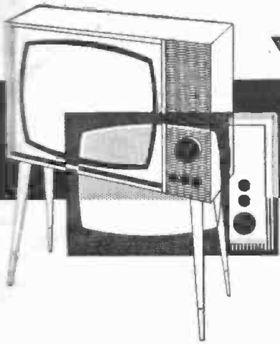
Fig. 15 shows a symptom that is not all that easy to photograph, and yet one that causes quite a bit of trouble. It takes the form of the thin, watery-looking, vertical line towards the left of the screen. Again, it has its origin in the line output stage, and is usually caused by a very short-duration burst of r.f. interference from the line timebase when it "switches" from the booster diode to the line output valve.

Change of line output valve is one way of curing the effect in obstinate cases. Others may demand the inclusion of a small r.f. choke in series with the anode of the line output valve (top cap) and, may be, also in series with the cathode (top cap) of the booster diode.

Again, the effect is invariably aggravated by a weak aerial signal and by running an aerial close to the set. It can also appear after a servicing operation due to badly refitted screens and shields around the line output transformer and e.h.t. rectifier.

WINDSCREEN WIPER EFFECT

Note that the symptom can be radiated from or to a neighbour's receiver. If the symptom is caused by an interfering neighbour's set it often flits to and fro horizontally across the screen, giving the impression of windscreen wiper action, if the interfering set happens to be receiving a different channel to the affected set. For obvious reasons, the effect, when radiated is called "windscreen (or windshield) wiper interference". ■



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 477 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

ECKO T356

The U191 glows blue when the set is switched on and by the time the picture and sound appear loud cracking and arcing appear in this valve. I have tried changing the valve, also 30P4 and U26, but the trouble persists.—H. G. Smith (Malmesbury, Wiltshire).

We suggest you check the line linearity choke on your receiver. This is on the rear wall of the e.h.t. compartment and the core of the choke frequently slides down its former to short to chassis.

HMV 1846

When first switched on I get a very dull and out-of-focus picture, but after the picture has been on about three minutes the picture clears up and I have a black strip about 1in. from the bottom. Also if I increase the brightness control up past the position where I get a good picture it increases the height and then the picture goes off and a blue glow in the neck of the c.r.t. appears.—P. Johnson (Chesterfield, Derbyshire).

The main trouble in your case is a faulty picture tube. It would seem that this has poor vacuum. The other symptoms could be aggravated by (a) low h.t. voltage due to a worn h.t. rectifier, (b) low emission e.h.t. rectifier, booster diode and/or line output valve and (c) a worn field output valve.

FERGUSON 3602

This set was converted to 625 in April, 1964, and has been working satisfactorily. I now find that on 625 the best positions for sound and vision do not occur at the same setting of the u.h.f. fine tuner. When tuned for best picture the sound is very distorted but can be brought back to normal for a few minutes by switching on a light or other electrical appliance.—P. Sparks (Reigate, Surrey).

You should check both the valves on the u.h.f. tuner unit by replacement and, if the fault persists, check the components and rectifiers in the discriminator circuit (these are W9 and W10 on most panels).

SOBELL TS17

This set has lost some of its sound on channels 10 and 5. I have changed the valves in the sound section and the channel 10 sound is OK but the BBC sound is weaker and there is a mains hum present (on BBC only).

The picture is good on both channels. I have removed the biscuit from C5 in the tuner and changed the 1kΩ resistor but the hum is still there.—H. A. Lloyd (Aberdare, Glamorgan).

You do not say whether or not you have retuned the channel 5 oscillator coil core. This, of course, must be done to clear the hum.

Then check the electrolytic capacitors associated with the PCL83, the 100μF 12V cathode capacitor and the h.t. decoupling capacitor 24+8μF 350V.

FERGUSON 204T

Can you let me know how to remove the line output transformer from this set?

It appears that the chassis is *not* made to be removed from the cabinet. Have you any comments on this?—W. C. Wilsher (London, N.4).

We do not understand why you are having difficulty in removing the chassis. Once the front knobs and the side panels are removed the two rear edge screws are released, the LS leads unplugged and the chassis is withdrawn complete with tube. The L.O.T. is removed from below being secured by four PK screws.

AERIALS

I wish to make a skeleton slot aerial for channel 5, BBC. Please tell me height and width.—Ian Grewar (Dundee, Angus).

There is little point in using a skeleton slot by itself. J-beam aerials use the arrangement in an integrated aerial design which then facilitates matching. However, the slot should have an overall length of 7ft 1in. and a width of about 6in. Matching can be by stubs clamped at the centre of the slot and "v-ing" in to about 1in.

PYE VT17

This set has a picture which is cramped at the bottom and extended at the top. I have changed all the relative valves without avail. The voltages appear to check with the service sheet.—D. Byrne (Peterborough, Northants).

We advise you to check the 200μF cathode bias bypass decoupling capacitor and the 16μF screen grid decoupling capacitor on the PL83 frame output valve.

DECCA DM17

On this set the e.h.t. has disappeared. I have replaced the line output transformer and put in a new EY86 but there is still no whistle and no spark from the anode or heater of the EY86. I have substituted several components but still the fault persists.—R. V. Bailey (Coventry).

You should check the line drive to pin 2 of the PL81. If this is absent the PL81 should overheat. If it doesn't, replace the PL81 and the ECL80. Check all components associated with the width and linearity circuits.

PYE 31UF

After switching on the picture is very dark but during the first ten minutes becomes brighter until even with the brightness control turned right down it is still too bright.—J. Williams (Staffs.).

Your symptoms suggest either a faulty c.r.t., a defective PFL200 video amplifier valve or trouble in the transistorised circuitry. If you suspect the latter we would advise you that the makers do a complete advance replacement tuner/i.f. strip via your local dealer.

BUSH TV93

Could you please enlighten me on the cause of speech being slurred and unclear; the picture is OK?—R. Macfarlane (Liverpool 6, Lancs.).

You should check the PCL82 audio output valve. If this is not at fault check the associated components and the 1MΩ resistor to pin 7 of the EB91. Check ECC82 valves.

EKCO TC369

This set has run trouble-free for five years until recently, when the picture became indistinct with severe sound on vision and buzzing on the sound.

I replaced the 100+200μF smoother and inserted a set of new valves. I also replaced the sound rejection circuit capacitor 47pF prior to the vision i.f. stage and also replaced the 0·001μF decoupling capacitors for the vision i.f. valves 6F26 and 6F23.

The picture and sound are now perfect but I am still getting sound on vision in spite of attempts at retuning.—S. C. Noble (Cottingham, E. Yorks.).

We advise you to suspect defective secondary smoothing, namely the 16+16μF capacitor towards the top of the i.f. strip adjacent to the sound output valve.

PYE C17

Twin white lines show at the top of the picture. Manipulation of the vertical hold and fine tuner will move them above the picture but this then becomes unstable. If this is due to slow field retrace how does one speed it up?—J. C. Basham (Darlington).

Slow field retrace causes the "pulse and bar" test signal to be displayed. To put this right halve the value of the 4·7kΩ cathode resistor on the ECC82 field generator by fitting another 4·7kΩ across it (i.e. spigot to chassis).

K-B RV IMPERIAL

There is a reasonable picture but the top is elongated with the lines wide apart. Adjusting the height control leaves a black border on top and can you tell me the type of metal rect'fier on this set and if it could be replaced with a BY100 type?—A. J. Astell (Bristol 3).

You should check the field output valve and its cathode circuit electrolytic capacitor.

A BY100 diode can be used in series with a 25Ω wire-wound resistot.

BUSH VT85

Please could you tell me what type of tube is fitted in this set? The tube is burnt out and the label off the tube has been destroyed. I have your volumes of TV and Radio Servicing but the only model near to it is the TV75, which has similar circuit valves, etc.—William Ward (Brierley Hill, Staffordshire).

The c.r.t. in the Bush TV85 is an AW43/80.

FERGUSON 306T

The front glass and face of the tube are getting very dirty.

I should be very pleased if you could inform me how to unbox this set and allow me to clean the front.—B. Beharell (Leigh).

Remove channel selector knob and fine tuner. Remove side panel and disconnect loudspeaker leads. Remove lower rear screw on the inside each side of the cabinet. Push cabinet forward an inch or so and lift off base plate and chassis, i.e. take the cabinet off.

PYE VT7

This set shows a white line across the screen about the level of an object's eye level. It looks as if one or two of the lines are missed but looking closer the line or lines can be seen at times and for periods the screen becomes normal with all lines very even. When the white line appears the lines above it seem a bit thicker than the ones below.—P. L. Guppy (Sherborne, Dorset).

Your symptoms indicate Barkhausen oscillations in the PL82 frame output valve. This is normally due to a defective valve but can also be caused by inefficient decoupling capacitors in the associated stages.

K-B HV40

This set should have a C14BM triode picture tube. It now has an unmarked tetrode tube, the emission of which is failing rapidly.

Could you please suggest what type of tube I should get to replace it or would it be better to replace it with a C14BM. The set works very well in all other respects.—P. H. Priest (Chesham, Buckinghamshire).

It is essential to check the heater voltage across pins 1 and 12. If this is 6·3V you can use an MW36-24 (ion trap magnet required) tetrode tube for replacement or, if you wish, a C14BM. If the voltage is 12·6V across the heater, use a C14FM.

FERGUSON 306T

The picture width is reduced. The linearity control will not increase the picture to fill the frame. The picture is flat at the bottom and open at the top.

R103, the frame linearity control is not working, and R33, the contrast control is not working. On channel 1, the picture is faint and on channel 9, the picture is either overdefined or sooty.

Increasing the input voltage by plugging the lowest voltage tapping only slightly improves performance.

I have changed V1 (PCC84) which has had a long life, but both V1 and V2 seem critical and perhaps need matching.—R. Collis (Hounslow Middlesex).

Check the h.t. voltage. If this is low, replace the PY32 (PY33) rectifier. If the h.t. is normal check the PL81, PY81 and PCL83 valves. Check the a.g.c. circuit for shorts and the tuner unit coil biscuits and contacts.

QUERIES COUPON

This coupon is available until JULY 21st, 1966 and must accompany all Queries sent in accordance with the notice on page 475.

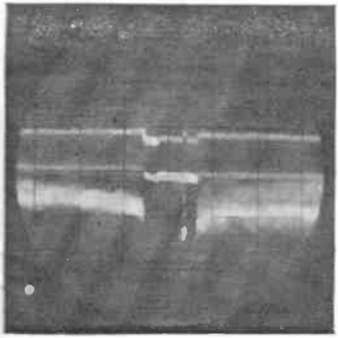
PRACTICAL TELEVISION, JULY, 1966

TEST CASE -44

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.

? *Having acquired an oscilloscope, an experimenter proceeded to secure traces of the picture signal waveform from the anode of the video output valve. He set the timebase sweep so that several waveforms of line signal were nicely displayed; he then reduced the sweep in an endeavour to obtain a field period display. This he found quite possible and a reasonable display on the ITV transmission was achieved.*

The experimenter later reproduced the exercise, but this time on the BBC transmission. He then obtained a field period display as shown below. This was identical to that from the ITV transmission, but on BBC he discovered a pulse on the display that was not present on ITV. This can be seen on the accompanying oscillogram, during the field blanking period.



What is the explanation of this pulse? See next month's PRACTICAL TELEVISION for the answer to this and for another item in the Test Case series.

SOLUTION TO TEST CASE 43
Page 429 (last month)

The slightly high heater chain current indicated that for some reason or other the heater chain voltage, across each element, must be out of balance.

The next move would have been for the enthusiast to measure the a.c. voltage across each valve heater in turn. The character in our drama, in fact, did just that. He found that the voltage on all the first valves he checked was some few per cent higher than the rated value. However, when he came to the heater of the PY33, he found the voltage here was 19 instead of the rated 29!

Now, in a series-connected heater chain, the voltage across any heater or element in the circuit is a direct function of the resistance of the element. In the case of the PY33, the heater resistance had fallen (or the valve could have had an abnormally low heater resistance from new) and thus less than the correct or rated voltage was developed across it. This meant that the missing voltage was spread over the heaters of the remaining valve, resulting in their over-running and consequent premature failure.

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(continued on next page)

Practical Television

STOCK FAULTS

A TELEVISION receiver incorporates some score valves and semiconductors, hundreds of resistors and capacitors, many inductors, and any of these may at some time become faulty. If we add to this the possibility of broken fly leads, defective plugs and sockets, dry joints and other mechanical faults, we arrive at a theoretical permutation of trouble running into the sort of figures that make football pool forecasting child's play!

Fortunately for our sanity, these are theoretical possibilities. Many components seldom go wrong. Others frequently do so. And more often than not, faults are confined to the boundaries of associated sections of the whole receiver.

Fortunately, too, fault symptoms often display indications of the area most likely to yield to investigation. A good grounding in basic circuit theory is the first, and most important, weapon in the armoury of the TV fault finder. An intelligent application and interpretation of test procedures is another.

Experience plays a large part, too; its application underlines the art of discriminating between the *possible* and the *probable*. And herein lies the essence of placing servicing on an economic basis. It is of little benefit to customer or technician to contemplate the theoretical possibilities when experience should show the way to a short cut.

For the majority of faults encountered in domestic TV receivers are peculiar to a particular type of circuit or receiver. Many of these stock faults are conveniently common to most models and makes of receiver and by knowledge of such probabilities the professional service engineer can achieve a quick turnover of jobs and save time for the sticky ones.

But for the amateur repairer, or the professional without sufficient stored knowledge, a "stock fault" can be simply a "once-ouly" job. In this case, it is "back to the drawing board"—a routine of prime causes, diagnosis and investigation.

It was with these thoughts in mind that we published an article in August 1963, designed to guide the lesser experienced repairer into some of the aspects of stock faults. This proved so popular that the author was commissioned to write a complete series on this subject, and these articles appeared in the May-December 1964 issues.

With this issue, following many requests for more, we are pleased to announce the start of another instalment of Stock Faults. We hope that the material will result in many hours saved in TV servicing.

JULY 1966
VOL. 16 No. 190

THIS MONTH

OUR NEXT ISSUE DATED AUGUST WILL BE PUBLISHED ON JULY 21st

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(continued)

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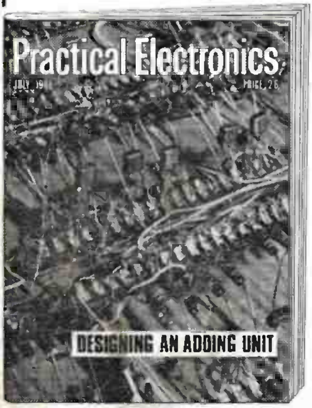

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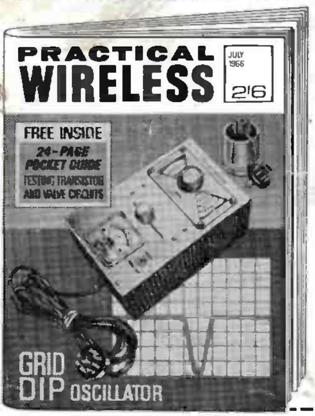

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TELETOPICS

No more Plessey sets?

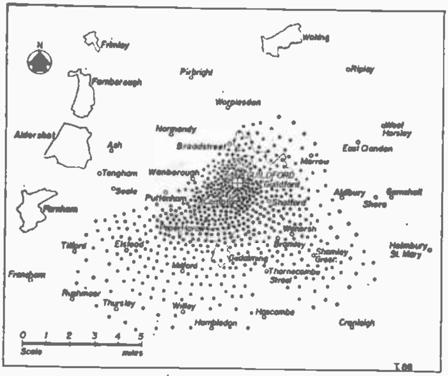
THE Plessey Company, of Ilford, have closed down their radio and television production lines and development laboratories. This follows their break with the Co-operative Wholesale Society, with whom they have been associated for a little over thirty years.

Writing in the current issue of the Defiant sales and service bulletin, the editor commenting on the Plessey break states: "It was with very great regret that we did this, as there is no doubt that the high reputation currently enjoyed by Defiant is in no small measure due to their high standard of design and engineering. Our contract with them is not being completely severed, and many Plessey components will continue to be used in future Defiant receivers."

The Defiant range of television receivers will in future be produced by the Rank-Bush-Murphy organisation.

Plessey will continue to manufacture the wide range of components for the radio and television industry, and will probably re-enter the domestic field when colour has established itself.

BBC-2 Service for Guildford



THIS is the estimated service area map for the Guildford BBC-2 television channel 46 vertical polarization. The vision frequency is 671·25Mc/s and the sound, 677·25Mc/s.

Reception is easiest where the dots are most dense, but in hilly districts there are, inevitably, pockets of poor reception which cannot be indicated on this map.

Radio Rentals acquires Vista

THE Chairman of Radio Rentals Ltd., Mr. J. W. C. Robinson, M.B.E., M.A., announced recently that the company has acquired a majority shareholding in Vista TV Rentals, but it is not intended to alter the independent and separate character of the Vista concern, or merge the management with that of Radio Rentals or Rentaset.

IMPROVED ITA FOR EAST ENGLAND

THE Independent Television Authority's new transmitting station at Belmont, Lincolnshire, began transmitting a full programme service on May 16.

The Belmont mast (1265 feet) is one of the new generation of three very tall, tubular masts designed for the joint use of ITA and BBC. The mast at Winter Hill, Lancashire (1015 feet) went into full service at the end of February, and the third, at Emley Moor, Yorkshire (1265 feet) is nearing completion.

BBC-1 TV Stations at Sandale and Moel-y-Parc

FOR many years channel 6 has been used in this country for radio astronomy observations and, to enable an important part of this work to be completed, it was necessary for TV stations using this channel to share it on a time basis with the radio astronomers. This restricted the times of operation of the BBC-1 stations at Sandale and Moel-y-Parc to the period midday to midnight.

From Monday, 2 May, this restriction has been withdrawn and the stations operate during normal hours. They operate from the start of trade test transmissions at 09.00 or from the start of programmes if earlier.

NEW RANGE OF SILICON PLANAR TRANSISTORS

MULLARD Ltd. announce the BC107 and BC108 silicon planar transistors for use in TV receivers. The BC107 is a "TVistor" rated for a collector voltage of 45V and is especially suitable for use in TV timebase and oscillator stages. Its low bottoming characteristic and high voltage rating lend themselves admirably to driver applications.

The BC108 is a high gain and high impedance unit and is ideal for a.g.c. amplifiers, video output drivers and sync separator stages of TV receivers. The audio applications include the preamplifier stages of radio receivers and record players.

Barnstaple Station opened

THE BBC's TV and v.h.f. sound relay station near Barnstaple came into service on May 16. It transmits BBC-1 TV on channel 3 with horizontal polarization. The three sound services on v.h.f. are on the following frequencies: West Home Service, 92·9Mc/s; Light Programme, 88·5Mc/s and the Third, 90·7Mc/s.

For satisfactory reception of the TV transmissions from the Barnstaple relay station, it is important that viewers use horizontal aerials designed for channel 3.

SYMPOSIUM ON RADIO AND TV MAINTENANCE

THE Society of Electronic and Radio Technicians and the Wolverhampton College of Technology jointly organised a three-day symposium on Radio and Television Maintenance. It was held at the College of Technology on June 14th, 15th and 16th. Topics discussed were Education and Training of Radio Servicemen, Television Picture Quality, Maintenance Problems, Test Equipment, Colour Television and Programme Distribution Systems.

BATH RELAY STATION

THE BBC has placed a contract with the Cornubian Construction Co. Limited, for the design, supply and erection of a 150ft. aerial tower for Bath TV and v.h.f. sound relay station which is planned to go into operation early in 1967. It is to be erected on Bathampton Down and will serve an area covering some 85,000 people.

Silent Power widens scope of TV outside broadcasts

REDIFFUSION Television has speeded up the time taken between receiving a news assignment call and getting a programme on the air by using an Auto Diesels' 20kVA Silent Generator for outside broadcasts in the London area. The new unit, mounted inside a Commer van, is so quiet that sound equipment, cameras and generator can operate within a few yards of each other. Previously, when using generator power, the unit needed to be up to a quarter of a mile away from the microphones to overcome the noise problem.

New Mazda valve data booklet

THE 1966 edition of the *Mazda Valve Data* booklet has just been released.

The booklet contains 160 pages giving abridged data selected for maintenance work on 264 current and obsolescent valves and picture tubes. A complete list of obsolete Mazda valves is given for reference. The equivalents list contains 1250 fully cross-indexed types.

The *Mazda Valve Data* booklet is distributed to dealers by Mazda Valve representatives and Mazda wholesalers, but further copies may be obtained free on request from Thorn-AEI Radio Valves and Tubes Ltd., Publicity Department, 7 Soho Square, London, W.1.

Philips win top TV Engineering Award

THE Television Society's top technical award—the Geoffrey Parr award—goes this year to the Philips Research Laboratories to mark the work they have done on the development of the Plumbicon Television Camera Tube. The secret of the success of the tube, which has marked a big advance over previous types of TV cameras, especially when applied to colour TV, is in the layer of lead oxide in the tube. A higher degree of sensitivity of the layers of lead oxide gives improved colour definition and also enables the cameras to operate efficiently at much lower light levels.

To date some 25 Philips Plumbicon Studio colour cameras have been ordered in Britain, largely for TV studio use, and more than 250 cameras have been ordered or are already in use in the USA. One of these cameras was used by the BBC for their colour transmissions of the General Election programme over Early Bird to the United States, when the pictures were described as being of the same quality as colour pictures reproduced in some of the better class colour magazines.

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

START OF NEW SERIES

PART 1: Some Field Faults

IN the previous series of articles on this subject, some points of interest were raised. Readers suggested that it was not sufficient merely to state that R45 caused rolling on the Super-7 Slimline—we must also say just where on the chassis that recalcitrant component was located.

The point is taken, and in the following notes on common faults encountered during the daily round, the author will endeavour, wherever space allows, to give an exact location of the offending part.

Next—we were told that the system of dividing faults into broad categories—i.e., Field, Line, Video, etc., caused a certain amount of overlapping. This is to some extent unavoidable. Faults, by their very nature, tend either to be once-only types that are the result of component or valve failure, or fall into the category in which we are interested—and their symptoms may then overlap.

For example, a video fault can drastically affect field and line sync, either or both, and occasionally neither. A field fault might also affect line conditions, and a line fault, in modern circuits, can sometimes upset the contrast and resolution, while not giving obvious clues to its source. Poor smoothing will often affect practically everything.

The answer seems to be to concentrate on certain groups of the more popular circuits, and outline the principal troubles that experience has shown to beset them. But, in addition, to deal with some of the faults that readers have queried since the last series of articles on this subject appeared in print.

FIELD FAULTS

By far the greatest section of questions has been about faults in and around the field (frame) circuits. (Although most readers seem to prefer the term "frame", we are now falling in line with industry generally and will use the more technically correct term "field"). Faults in field circuits divide into four main sections: No lock, false lock or similar symptoms such as jitter, poor linearity and little or no height.

Often, the symptoms overlap and the causes are common. It helps to know what kind of field circuit is in use when making a preliminary diagnosis, so for the first section we shall describe a couple of popular and widely used circuits and pinpoint some of the faults that have arisen.

However, it must be stressed, in sheer self-defence, that this does not mean that the particular circuits being described are those most prone to failure.

Fig. 1, shows the complete field oscillator and output circuit of the Ferguson 506T, 508T and 546T ranges, in all of the various A, B and C versions. The differences, which were in tube fitting and line output circuitry, do not concern us here, although we shall undoubtedly have to return to them at a later date.

The circuit shows a typical multivibrator, with two triode sections as the operating valves, and a pentode output stage. But the first triode is actually half the valve used also as line oscillator, and a fault here is sometimes overlooked until the circuit is inspected, especially as this valve is tucked away at the back of the lower panel, beneath the deflection coils.

The other triode of the multivibrator is part of the PCL82—and, in answer to many queries from readers, the 30PL13 is not the direct equivalent of this valve, although it takes its place very effectively, giving a little more output. But the answer to a lack of height (field output) is not a more powerful valve, however great the temptation.

Especially with a multivibrator circuit, it is necessary to trace the cause of the defect. A blocking oscillator circuit has rather different conditions, and does not concern us at this stage.

OSCILLATOR CONTROL

Points to note about the circuit are that the field oscillator frequency is controlled by a variation of grid voltage of the second half of the triode pair, whereas height control is effected by change of anode voltage. This supply is from the boost line, not the main h.t. line, in accordance with current practice.

The linearity feedback network is split into two paths, from anode of the output stage to chassis, and from the same point back to the grid. At the same time, a single feedback path from the cathode of the output stage to the anode of the multivibrator helps preserve the exact waveform of the circuit—and, in this case, the timing.

Each of the main feedback paths has its variable preset control, one for top R126, and one for overall linearity R128.

Another interesting point about this circuit is the cancellation line from the tapping on the field output transformer to a tapping on the cathode potentiometer of the sound output valve.

A fault in the sound output stage can, in these conditions, have the peculiar effect of a loud buzz, variable as the field hold control is rotated. If this happens, check the lower resistor of the two cathode components of the sound output stage.

Any increase will cause field pulses to have quite

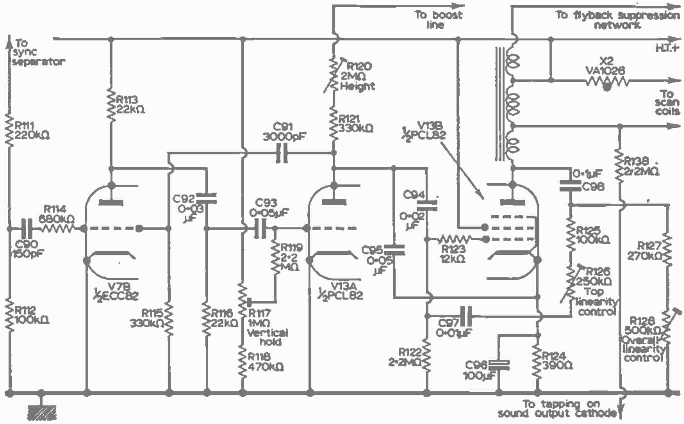


Fig. 1—Typical field oscillator and output circuit, as used by several models in the Ferguson range.

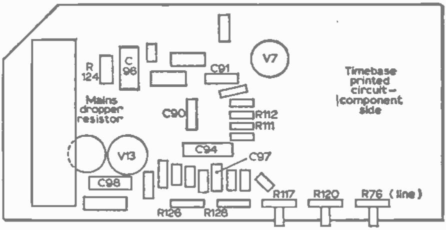


Fig. 2—Layout of components shown in Fig. 1 and mentioned in text. View of component side of timebase printed circuit board.

the opposite effect to that intended, and cause field buzz instead of cancelling it!

At this point, we should perhaps revert to our four main fault sections, and look at common causes of, first, lack of field hold.

FIELD HOLD FAILURE

The prime cause is obvious, open circuiting of the feed from the sync separator, for example, C90. But a further look at the circuit shows that this feed enters the field circuit at the junction of a potentiometer across the h.t. line, consisting of the sync separator anode load, part of the integrator circuit, R111, and the return resistor R112.

If lock is just touchy, check these two last mentioned resistors. Often, R111 will be found to have gone high. When replacing, it is wise to use a 1 watt resistor in this position, to avoid a possible repetition of the fault.

A slow slip, or an occasional false lock (our second point) can be caused by C91 becoming intermittent. This 3nF capacitor should have a rating of 400V d.c. working and anything less may lead to further trouble.

Finally, an obscure cause of field slip on this range, which has nevertheless been noted several times, is a leak in the electrolytic which bypasses the field output cathode section, C96. Obscure, because it does not at first show the expected symptom of field cramping at the bottom, which failure of this component might be expected to produce. Although this usually happens later, if the fault is not cured by substitution right away.

There must have been many cases of 'touchy field' persisting until the service mechanic had cause to tackle the 'lack of height and cramping' trouble, and found he had killed two birds with one stone!

Poor linearity and lack of height often go hand in hand. With this type of circuit, reduction in the overall height, with good linearity, may simply be