Practical TELEVISION

SEPTEMBER 1965

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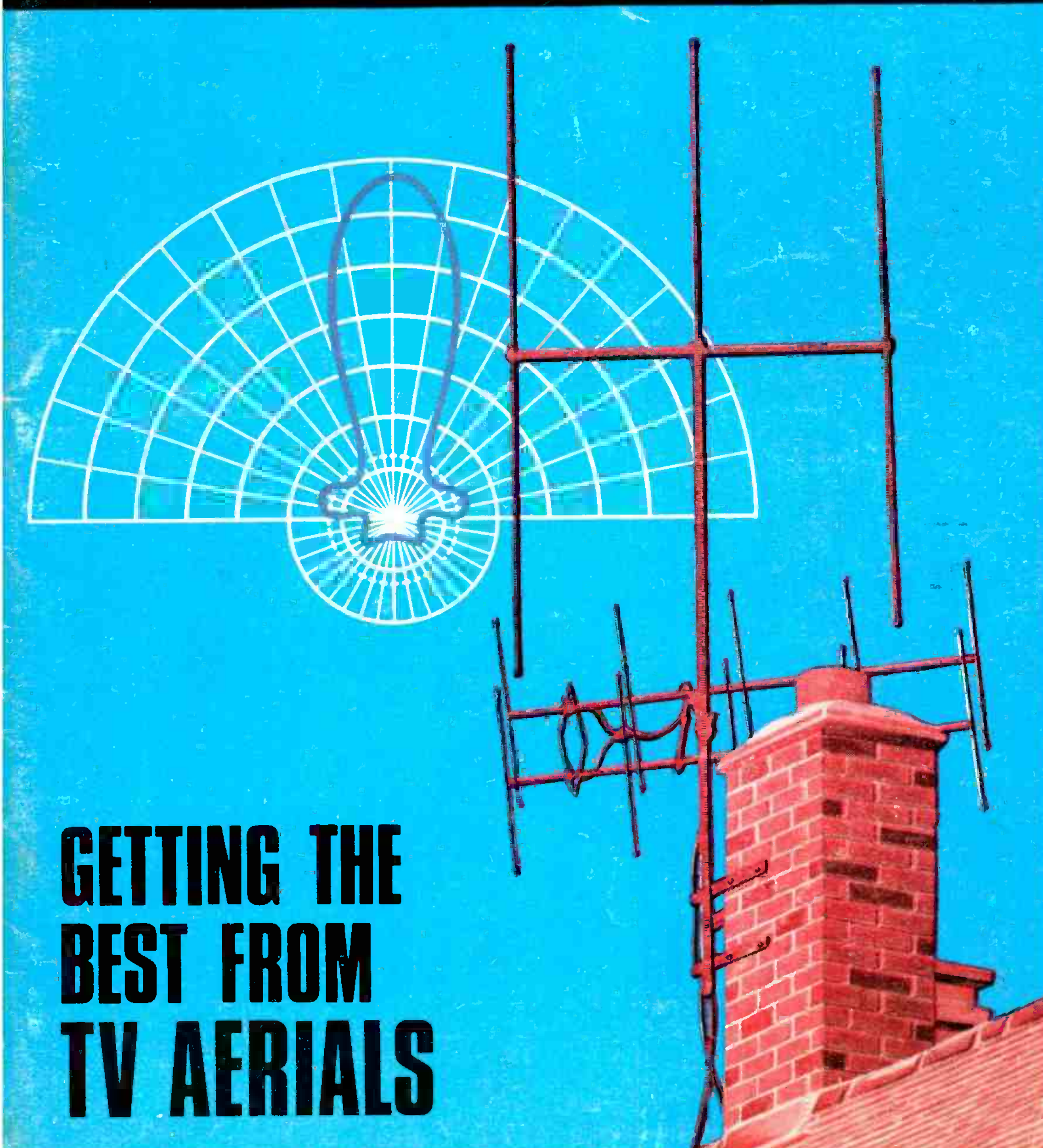

GETTING THE BEST FROM TV AERIALS

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VOL. 15 No. 180

QUANTITY versus QUALITY

BEFORE the start of regular TV broadcasting, optimistic speculations were voiced as to the development of the wondrous, nebulous new medium. Many of these hopes are way off beam as viewed in terms of TV 1965.

Technically, impressive advances have been made—improved receivers, cameras, lighting, transmitter coverage, studio facilities, video tape, etc.—though many an old timer would be astonished to know that we had not yet advanced to colour and stereoscopy.

But the rosy dreams of yesteryear, as applied to programme content and quality, have been sadly mauled. There *are* some good programmes but in the main we are plagued by mediocre mass-audience mulch churned out as though by some inexhaustible electronic sausage machine. And many "commercials" are so puerile and pathetic that one shudders to think they are apparently so commercially successful. On top of that; the high audience ratings achieved by some programmes of an intelligence level that makes Listen With Mother a positive intellectual feast.

On the other hand, a complete turnaround would be equally morbid, for if some had their way, the TV channels would be bogged down in arty crafty vacuity and waffle which would be even worse.

We have, then, the apparent impasse of quantity versus quality. There are more pop fans than Beethoven lovers; more Western addicts than students of Etruscan art. So what do we do? Give the (majority of) viewers the escapist sop they seem to want, or provide what they ought to want? But who decides what is debased or elevating? What is the average intelligence level and should programmes be aimed at this, or below or above it? And should TV entertain, instruct or both?

Everyone must agree that there should be a good leavening of light entertainment. But surely it ought to rise above the current level of tired and juvenile jokes, creaking situations, hammy acting, mechanical and platitudinous dialogue and repetitive gimmickry.

If not, and the trend continues, we might anticipate in a few more generations hence, a race of vegetable-like viewers, their tastes reduced to the lowest common denominator, absorbing a daily ration of "background" viewing requiring absolutely no mental effort to similate.

THIS MONTH

OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPT. 23rd

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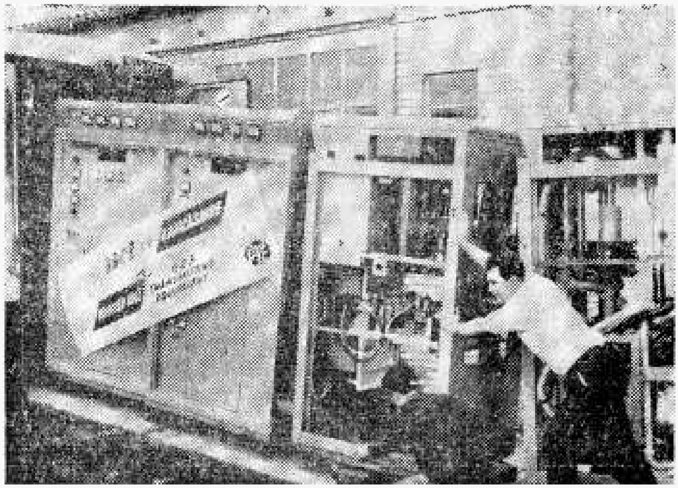
TELETOPICS

BBC–2 GOES NORTH



TRANSMITTING equipment that will bring BBC-2 to 4½ million Lancashire viewers on 17th October this year, is seen leaving the Cambridge factory of Pye TVT Limited.

This 625-line u.h.f. transmitter, to be installed at Winter Hill, near Bolton, will cover 26 major towns in Lancashire and parts of Cheshire.

BBC-2 FOR THE SOUTH-WEST

ON 12th September BBC-2 transmissions begin in parts of North Somerset and South Wales. The u.h.f. station at Wenvoe will serve Cardiff, Barry, Bridgend, Bridgwater, Burnham-on-Sea, Caerphilly, Minehead, Newport and Weston-super-Mare.

This is the first of six new u.h.f. transmitting stations to be brought into operation before the end of the year. The others will be at Sutton Coldfield, Winter Hill and Emley Moor, Rowridge and Black Hill.

ABC Television enter for Tokyo TV Contest

ABC Television's entry for The Japan Prize in the Adult Education category of the International Educational Programme Contest, to be held in Tokyo in October this year, will be "The Power of the Prime Minister", featuring the Rt. Hon. Harold Wilson, O.B.E., M.P., which was screened on 10th January, 1965, as the first programme in ABC Television's Adult Education series "Power in Britain".

Bermuda Buys British TV

BERMUDA now has a second commercial television programme. The new station, ZFBTV, went on the air in July and gives viewers 42 hours extra television each week.

Pye TVT Limited of Cambridge, England, have been awarded a contract through Thomson Television (International) Ltd., to supply the complete station. This includes a 3kW 525-line band 3 transmitter, together with associated mast and aerial equipment. The studio centre will be provided with vidicon cameras and telecine units.

GERMANY PLANS TO START COLOUR TV BY 1965

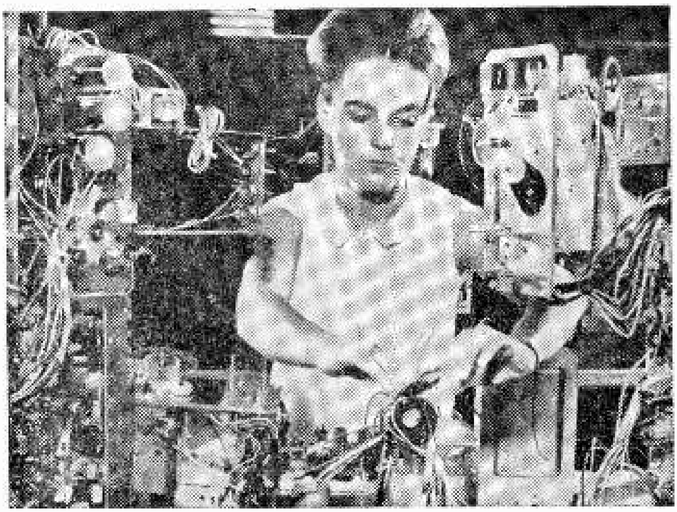
PLANS are going ahead in Germany for the introduction of colour television using the PAL system in 1967.

The West German government has come to this decision following the failure of other European Countries to agree on the adoption of a common colour TV system, although it is of the opinion that such an agreement would be desirable if it could be achieved.

It has been suggested that a further round table conference should be called to make another attempt to reach an agreement.

CAR TV FOR U.S.A.

PHILCO Corporation of the U.S.A. are to introduce a car TV receiver with a 9 inch screen. A portable receiver for use in cars was marketed in the U.K. some years ago by EKCO but later dropped.



DEMANDS FOR COLOUR FLOOD TV INDUSTRY

BECAUSE of unprecedented demands for colour television receivers in the US, the Radio Corporation of America plan to employ thousands of additional employees to help double present output. They will also spend a record 50 million dollars on expansion.

Official estimates state that this year 25% of all TV receiver sales in America will be for colour sets.

The scene here is part of the production line of colour receivers at RCA's Bloomington, Indiana, factory.

BBC TELEVISION CENTRE NEW STUDIO IN SERVICE

STUDIO 7, the latest to be completed at the BBC Television Centre, Wood Lane, London, was brought into service on 4th July —the opening programme being "Time Out" (BBC-2) on 8th July. This is the sixth main production studio to be completed. The present plans for the Television Centre include a total of eight main production studios with provision for future extensions.

Studio 7 is identical in size with studios 2 and 5, measuring 70ft. by 50ft., with a height of 25ft. to the lighting grid. It has four Marconi Mark IV 4½in. image orthicon cameras and can operate on 405, 525 and 625-line standards.

Major innovations associated with the new studio are the use of a Vision Apparatus Room which will also be common to Studios 6 and 8 (now under construction), and the use of common caption scanning equipment for the three studios, resulting in the more efficient use of the technical facilities.

Marconi Cameras for Education

OVER 450 of the new transistorised CCTV cameras designed by the Marconi Company for education purposes are to be exported to the United States, Australia and Canada. On top of this, fifteen educational establishments in the UK have ordered cameras.

There are two versions of the new camera. The more sophisticated incorporates, in addition to the basic unit, an integral viewfinder and special facilities. Both versions feature the minimum of controls—on/off switch, focus and iris adjustment. Automatic control takes over once the camera has been set up and maintains a stable picture over large changes in light level.

Mast Contract for New BBC-2 TV Station

THE BBC has placed a contract with British Insulated Callender's Construction Co. Ltd., for the design, supply and erection of a 1.000ft. mast to carry the aerials at the u.h.f. television transmitting station for BBC-2 which is to be built near Waltham-on-the-Wolds, Leicestershire. This station, hitherto identified in preliminary announcements as the Nottinghamshire station and which the BBC hopes to bring into operation during the winter of 1966/67, will extend the BBC-2 service to much of Nottinghamshire and parts of Lincolnshire and Derbyshire.

TV HIGHLIGHTS AT MONTREAL CONFERENCE

NEW concepts in television and an important display of new TV equipment, will bring TV engineers from all parts of the world to the 98th SMPTE Technical Conference and Equipment Exhibit at the Queen Elizabeth Hotel, Montreal, 31st October—5th November.

In the transmission field, reports will be presented on colour TV in Europe before and since the CCIR Conference in Vienna, new u.h.f. transmitter design, and on cable distribution of u.h.f. signals.

CFTF-TV will describe their operational experience with multiple fixed Marconi 321 vidicon cameras, and other equipment papers from six other countries will include new cameras, electron beam recorders, monitors, colour slide scanners, up to complete mobile units and new studio designs.

EXPERIMENTAL COLOUR TRANSMISSIONS

COLOUR transmissions by the BBC on channel 33 between 10.00 and 13.00 will be discontinued but there will be late-night live studio and colour film transmissions after the closedown of BBC-2, on Monday to Friday inclusive.

The transmission characteristics of the PAL colour system are as previously issued, but a field indentification signal may be added later.

GETTING THE BEST FROM TV AERIALS

by Gordon J. King

THE receiving aerial is often the weakest link in the chain between the television transmitter and the set. In the majority of installations the performance of the set depends entirely on how well the aerial picks up the required signals and rejects unwanted signals and interference.

The television aerial is thus required to do more than simply pick up sound and vision signals of the local channels. It is called upon also to reject unwanted and interfering signals. This rejection aspect can sometimes be more important than the picking up of the wanted signals.

Often Neglected

In spite of the fact that television aerials are more likely to suffer from wear and tear than any other part of the installation, they are often sadly neglected and left year in and year out in their exposed positions eventually to decay and literally fall to pieces.

The drop in performance of a television set due to a decaying aerial system is generally so gradual that it is not noticed to anywhere near the same extent as a set fault which may occur much more speedily.

Some television aerials have now been exposed to all weathers for a decade without attention—some longer. Indeed, the author knows of some BBC aerials still in use which were erected when television started again after the war!

Around the coast in particular, one can regularly see aerials which have received virtually no maintenance from the day that they were erected years past. Some of these have wobbling or missing elements and others are mere skeletons of the original array. It is really amazing how some of these wind-mutilated dangling pieces of metal capture even the weakest of signals.

Last to be Checked

The aerial, curiously, always seems to be the last item of the installation to be suspected in the event of a fault. The set itself is often examined in great detail to no avail, and it is only as a last resort that the aerial system is looked at. For some symptoms it is best to work the other way round.

Lack of sensitivity effects, for instance, especially when related only to the weakest channel, is a typical system of aerial trouble. The aerial system as a whole, of course, must be considered. This includes the coaxial downlead, the diplexer or triplexer (if used) and the plugs and sockets.

If the aerial has been in use for a number of years with the minimum of attention and the general performance of the set seems to be below standard (there will come a time due to aerial trouble when this is appreciated), the time has come for the aerial system to be examined.

The big question is—how can the aerial be tested? Sadly, this is a problem. Even television dealers are troubled with it, which is probably why aerials are left to the last.

How to Test an Aerial

Conclusive evidence that the aerial is not right is given only by a signal strength test on a Test Card and only when the signal originally delivered by the aerial system is known.

Some dealers and aerial erectors save testing time and problems by checking the aerial signal strength on all channels after installing or repairing an aerial. The figures are recorded on a " history card " and a comparison is then available for future use.

The majority of dealers, unfortunately, fail to do this. And most experimenters and enthusiasts do not possess signal strength testing equipment.

An aerial which is bady out of condition stands out because of the poor reception that it gives compared with an aerial of similar type in use by a neighbour. Direct comparisons of this kind, however, include the set and can be misleading.

If the picture is particularly poor and noisy while a neighbour's picture is good and noise-free using the same type of aerial, the aerial is definitely a suspect. Proof can be had by trying the neighbour's set on the suspect aerial.

Another symptom resulting from a troubled aerial system is co-channel interference. This manifests as horizontal, dark lines across the picture, and sometimes on Band III a ghost picture of an entirely different programme can be seen floating in the background of the local programme.

Co-channel interference is caused by the aerial picking up not only the signals of the local station but also signals of a more distant station sharing the same channel number. On Band I, of course, there is essentially only the one BBC programme, but on Band III a different programme is generally transmitted by each ITV station. Hence the reason for the ghost picture of different programme when co-channel interference is experienced on Band III.

Directional Effect

Television aerials of more than just the single element of the dipole (even this when mounted horizontally) are directional. That is, they are sensitive to the pickup of signals more in one direction (the forward direction) than in the others. This directivity effect is revealed by a "polar diagram".

The polar diagram related to a very directive aerial is shown in Fig. 1. The extent of the of the directivity is revealed by the narrowness of the "response curve" marked on the graph. In the diagram it will be seen that maximum response occurs on the zero deg. axis. This is the forward direction.

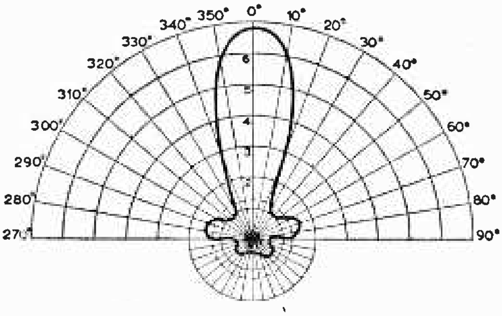


Fig. 1—Polar diagram of directional television aerial. This shows that maximum signal pick-up occurs at 0° in the forward direction and that the pick-up rapidly falls as the aerial is turned off direction. The circuits indicate the relative pick-up sensitivity of the aerial.

As the aerial is turned either side of maximum, the response falls. At 20 deg., for instance, the response is down to the third circle (from the centre) of the graph. At 40 deg. the response is down to the first circle. This means that the aerial picks up very little signal when it is pointing 40 deg. away from the direction of the transmitter.

When an aerial is first erected, particularly in poor signal and high interference areas, it is carefully orientated for the maximum signal/interference ratio. This does not necessarily mean that the aerial is directed for maximum pick-up of the wanted transmission, though, of course, with an aerial of high directivity it cannot be turned too far off beam.

The exercise has been (or should have been) to secure the maximum difference between the response to the wanted signal and the response to interfering signals which may be arriving towards the side of the aerial. Clearly to secure this condition the aerial may have had to be turned a few degrees away from the direction of the transmission.

Off-beam Aerial

Now, after a high wind, poor reception or the display of more interference than usual may well signify that the aerial has shifted from its original optimum position. If the aerial is highly directional, such as with a polar diagram illustrated in Fig. 1, it could have turned sufficiently during a very high wind to cause a drop in signal strength at the end of the downlead of several times.

While this may not effect the overall brightness of the picture it would almost certainly increase the background grain and give the picture a "snowy" appearance. In "noisy" reception areas, such as main road sites, interference would also become more troublesome than hitherto.

The picture brightness is not affected by a decrease in signal strength on modern sets because of the high efficiency of current vision automatic gain-control systems. All that happens, as explained, is that the picture grain becomes more prominent.

This means that a wind-gotten aerial cannot be reorientated for an increase in picture brightness. Nor, for that matter, for an increase in sound level, for this, too, is held substantially constant over a wide range of aerial signal levels by the sound a.g.c. system.

If one is after maximum aerial signal, some kind of signal indicating device should be used. Aerial erectors and those in business servicing television sets would be well advised to acquire such a device —known generally as a "signal strength meter".

These are available in various forms for the measurement of signal voltage (in microvolts and millivolts) in Bands I, II, III, IV and V. There are battery—and mains—operated models. The very latest ones are transistorised.

How to Adjust the Aerial

The enthusiast, however, will not feel inclined to rush out and buy a £30 instrument just to reset his aerial! How, then, can the enthusiast solve the problem?

There are two ways. One is to work out a compass bearing on the station on a large-scale Ordnance Survey map and set the aerial accordingly (alternatively, check the bearing of a close neighbour's aerial which is performing well and set the maladjusted aerial to this bearing).

The other is to turn the aerial for a picture of least grain and the best signal/interference ratio.

The latter method is not easy, however, for the man on the roof cannot see himself what is happening to the picture as he is turning the aerial. Indeed, most of his attention (unless he is highly experienced) is taken up by maintaining personal stability!

If it is decided to have a go, then a field telephone, a pair of earpieces or two pairs of headphones should be used to provide telephonic communication between the man on the roof and the man watching the picture.

Other ways of conveying messages from the TV-watcher to the aerial turner are possible, but not all that successful—as proved by experience. One way is to employ a third person positioned to see both operators. He can then give predetermined indications as to what is happening to the picture as the aerial is turned.

Even then, it is not all that easy to decide the aerial position giving the least grain. This is virtually impossible when watching a moving picture. Such adjustments should thus be performed only on a fixed transmission, such as during the transmission of a Test Card.

Fringe area type aerials are often secured by U-clamps to a 2in. alloy pole. The pole itself is also held tight (or should be) by similar, though larger, clamps on the chimney or wall brackets. Large rubber grommets are employed to kill vibration.

Even though the aerial pole was originally clamped very tight via the grommets, constant exposure to all weathers weakens the rubber and the grip to the pole becomes progressively impaired. The aerial then has a tendency to turn in the wind.

Weathercock Effect

Some aerials behave like a "weather-cock". They turn and change direction each time the wind changes. Unknowledgeable viewers swear blind that their reception is affected by the weather. It is, of course, but not the way they think.

An inadequately clamped aerial pole is soon located once up on the roof by the chimney—or wherever the aerial may be. Sometimes it is possible to turn the complete aerial by a normal hand grip round the pole.

When reorientating, care should be taken to avoid loosening the clamp nuts too much, as this will cause the aerial-carrying pole to drop down through the grommets and assistance may be required to lift it up again. The nuts should be released just enough to allow the pole to be turned by a tight hand grip.

After reorientation, of course, the nuts should be really tightened by the leverage imparted by normal strength plus a 6in. spanner.

Mutual Interference

Examples of various aerials employed in fringe areas are shown in the photograph of Fig. 2. This picture also reveals some of the clamping methods. A more detailed view of an aerial mix-up is given in Fig. 3. Here each viewer has on his common chimney stack two ITV aerials and one BBC aerial, giving six aerials in all.

It is interesting to note here that should one aerial of this complex configuration develop an element fault, the trouble may well reflect into the neighbour's viewing due to mutual coupling between the two sets of aerials.

For this reason, it is not a good idea to locate such large amounts of metal work close together. In addition to a fault in one aerial system being coupled to another aerial system, the impedance of the aerials themselves is affected due to the nearness of unconnected metal items. This applies particularly to the new u.h.f. bands.

Loose Elements

Another common fault with television aerials is the loosening of an element. The elements are locked to the cross boom by self-tapping screws or wing-nuts and bolts, and while the securing device may not fail completely it may loosen, thereby causing the element to wobble in the wind.

Curiously, this rarely causes crackles on sound and white flashes on the picture, as one may expect.

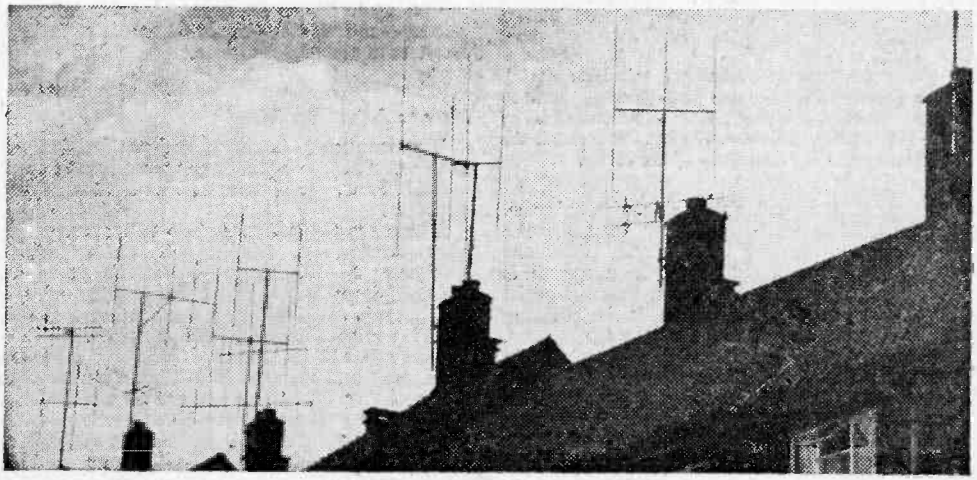


Fig. 2—This picture shows the various types of aerials and fixing methods.

The symptoms are generally those of intermittent "rumbling" on sound and dark, horizontal bands on the picture in time with the movement of the loose element. There may be variations in picture brightness and background grain and slight changes in sound level as well.

This trouble is not difficult to prove, for it appears only during windy weather. Observing the aerial on a windy day one would probably discern a slight, independent movement of one of the elements.

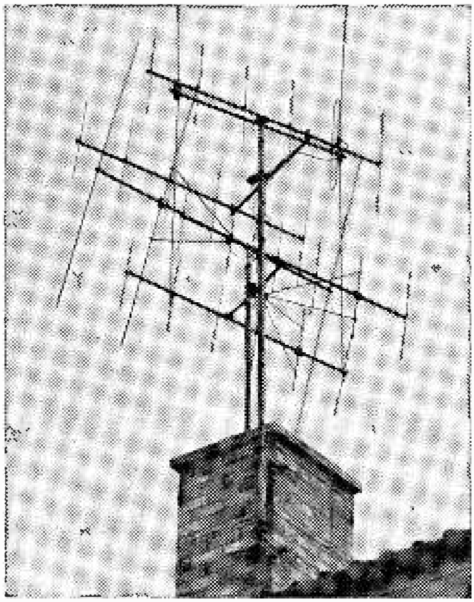


Fig. 3—Here is seen the fixings at the chimney stack at the aerials in greater detail. There are two sets of aerials on a common chimney stack, and the nearness of the two systems means that a fault in one system will be reflected into the other system.

Lost Elements

When an element falls off the set will not stop working. Indeed, one may not at first notice a great deal of difference in the reception and then conclude that such a complicated aerial was not really necessary in the first place.

Of course, there is a signal reduction when an array sheds an element but in many cases this will be ironed out by the set's a.g.c. systems. More important, is the way in which the polar response is impaired. If the aerial was originally installed for the best signal/interference ratio, then the missing element will almost certainly let in more electrical and co-channel interference than hitherto.

The increase in co-channel interference may not be noticed until there is a spell of the weather that favours this kind of interference. However, main road viewers will probably experience an increase in car ignition interference immediately after an element falls off.

Other causes of poor and intermittent reception include loose coaxial cable connections at the aerial terminals, at the diplexer or triplexer (this may be fitted on the aerial mast or somewhere near the set end of the coaxial downlead), at the coaxial plug to the set or at the coaxial outlet socket. The flylead between the outlet socket and the set aerial socket should also receive attention.

All these factors should come under regular attention whether or not the set is playing up. A yearly summer or spring maintenance exercise on the aerial system as a whole is well warranted.

Coaxial Cable Troubles

Continuous abrasion of the coaxial downlead against the guttering, for example, will eventually wear away the p.v.c. outer cover and possibly the outer braid conductor. Even though the outer conductor may not sever completely, water will probably get into the insulating dielectric and greatly increase the attenuation factor of the cable. This is another cause of weak signal from an aerial system.

Certain kinds of coaxial cable used in fringe areas have a cellular polythene or polythene air-cell dielectric. The former is a soft material and does not normally absorb moisture. The latter, however, virtually represents a tube throughout the whole length of the cable. This can fill with water due to incorrect fitting at the aerial or a break in the outer covering of the cable.

In a case of poor aerial signal investigated by the author water could literally be poured out of the cable. The loss due to the water was almost 9dB about three times. Thus, only about a third of the available aerial signal was getting to the set.

U.H.F. Aerials

Just a word about the mounting of u.h.f. aerials. These really need as much height as possible and should be mounted well clear of the existing v.h.f. aerials. They should also be supported firmly so that the wind wobble is minimised. It is best to mount them on the top of the main aerial pole if this is possible, but extra special care must be taken to ensure that the pole is not overloaded.

If too much weight is put at the top of a slender pole one may be in for a shock after a windy night. Some idea of what can happen in this respect is shown in Fig. 4.

Maintenance

Yearly maintenance should, theoretically, include removing the aerial from its mountings and going over all the element fixing devices and coaxial connections. Although modern aerials are heavily plated with zinc and passivated by the dichromite method, the plating may suffer damage during erection and this leads to eventual corrosion of the metal parts.

Any areas which have suffered plating damage, therefore, are best covered with a bitumastic paint. The paint must, however, be kept off the insulator and coaxial connecting box or diplexer (triplexer), etc.

The feeder should be checked for continuity and short-circuits with an ohmmeter or battery and bulb. Note that some aerials have a short-circuit to d.c. across the dipole (as also do some diplexers and

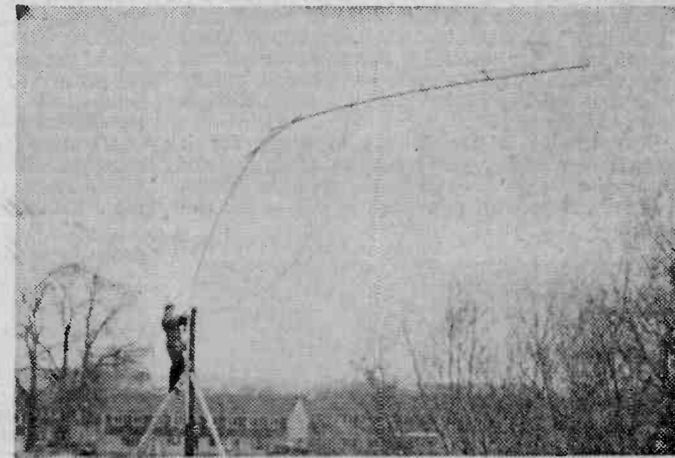


Fig. 4 (top)—Too great a weight at the top of an aerial pole will result in a mishap such as this picture shows.

Fig. 5 (centre)—The correct way to remove or install a television aerial on the chimney stack. Two operators are required, one at the chimney and the other on the ladder.

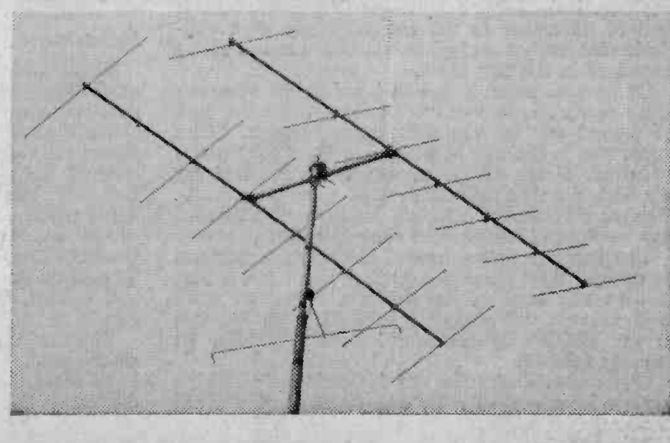


Fig. 6 (bottom)—Here is shown a wind-damaged aerial. While even an aerial in this sad state may capture some signal, the reception will be well below standard. Regular aerial maintenance avoids such troubles.

triplexers), a short across the feeder would thus be correct with the aerial connected. The inner conductor to the dipole should be disconnected to check for a feeder short.

However, knowing that there is a d.c. short actually across the dipole is useful for checking feeder continuity without dismantling the aerial. All that is necessary is to connect a battery and bulb or ohmmeter across the set end of the cable with diplexers, etc., disconnected. This test, of course, will not reveal a feeder short-circuit.

Whether one attempts the journey up to the aerial depends upon one's skill at roof work. This task is not easy (so far as the author is concerned!) by any means and is best put over to a builder, window cleaner or other versed in the arts!

Two people are really needed to dismantle and reinstall a television aerial. Two ladders are also needed. One up to the guttering and the other on the roof. On no account be tempted to walk directly on tiles or slates. The ladders should be secured by rope to the guttering brackets (select one which is really tight).

One man can then take up position by the chimney stack and the other can handle the aerial, eventually passing it on to the man by the chimney as the picture in Fig. 5 shows.

Remember that upon the aerial's efficiency depends to a very large extent the quality of reception—both sound and vision. Regular yearly aerial maintenance will ensure the best from the aerials and will most certainly avoid the horror shown in Fig. 6 and the consequent impairment of television enjoyment. ■

FIRST TIME TESTS

PART I

H. W. Hellyer

POWER SUPPLY CIRCUITS

"... and suddenly the screen went dark, so I knew it must be the picture tube"

The professional engineer is accustomed to such statements. Occasionally, to his shame, he may take advantage of the credulity of his customer. But generally he just gets on with the job of diagnosis and test.

Faced with a similar catastrophe—the blank screen and a breathless family—the reader of *Practical Television* should not have to take a pessimistic view. With a minimum of tools and test gear and the knowledge acquired by diligent study he can tackle most faults with confidence.

Dead Set

Take, for example, the "dead" receiver. No sound, no vision, no sign of life. A few quick tests with a neon screwdriver will eliminate or prove most of the obvious causes, even when the design is completely unfamiliar.

Any television receiver less than five years old is likely to have a series circuit fundamentally as shown in Fig. 1. The mains input, either directly from the flexible lead or via a plug and socket, is taken to the on/off switch, through the fuses, and thence across the circuit, the chassis being employed as a return line.

Variations may be the use of a single anti-surge

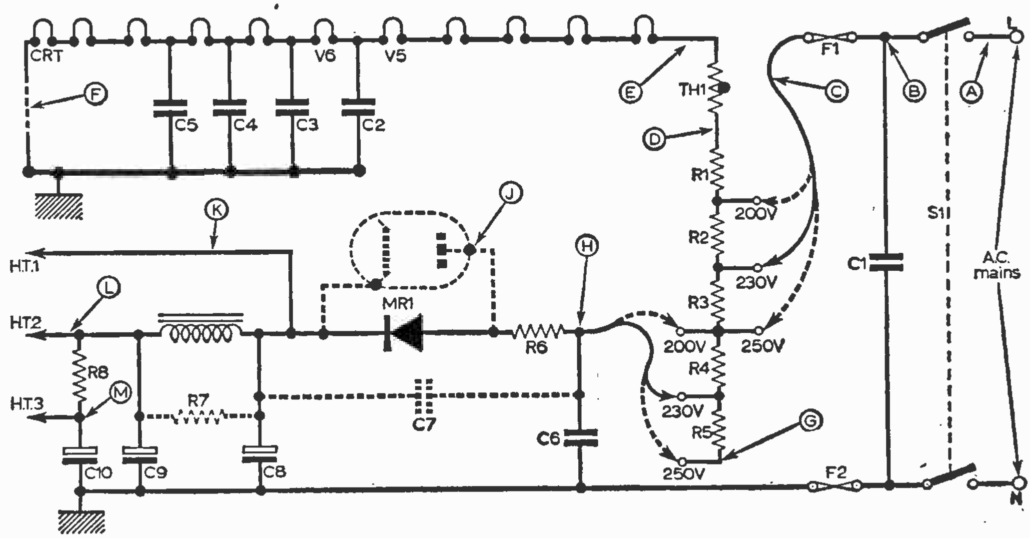


Fig. 1—Series heater chain and h.t. supply circuitry of typical TV set.

fuse in the "live" line or the fuses wired in the circuit prior to the switch as illustrated in the layout diagram of Fig. 2.

Thus if the "dead" set is inspected visually and it is seen that no valves light up there is obviously a break somewhere in this series circuit. First thing to establish is the presence of mains voltage. The neon tester can be used—with the customary precautions: one hand only in action, the other tucked away safely from the chassis or other possible return path.

It should be remembered that an indication on the neon tester when this is applied to the live terminal of the mains socket does not necessarily indicate that all is well. There could possibly be an open-circuited neutral line.

Live Indication

In this case a glow would be obtained at both line and neutral terminals when the receiver plug is inserted. This means that the receiver circuit completes the path back to the neutral terminal, giving, in effect, a "live" indication. Obvious method of making sure is to try some other appliance known to be in working order in the doubtful socket.

Assuming that the mains socket is in order the next test point is the nearest convenient "live" point on the receiver layout when the back is removed. This is generally a fuse. The tester should glow at points B and C on the layout of Fig. 2 (where the fuses are prior to the switch). If a glow is obtained at one end and not at the other the fuse is open-circuited.

This is generally a quicker method of test than removing the fuse (after disconnecting the plug to make sure no inadvertent "bridge" of hand to chassis is made while fiddling with the fuseholder).

Faulty On/Off Switch

No neon indication at either fuse is usually an indication that the on/off switch is faulty. Where only one fuse is fitted remember to try the chassis also for a neon indication in case there is a reversal of input wiring. The chassis should, of course, be connected to the neutral pole.

Where the fuses come after the switch and a neon glow is obtained at both fuses, suspect one pole of the switch of being inactive.

Similarly no indication may indicate the "live" pole of the switch being o/c and it is often quicker to reverse the mains input plug temporarily and test for a glow at the neutral chassis connection than to upend the set, remove the base and test on the switch itself.

If only one pole of the switch refuses to function it may be advisable to rewire the circuit so that an external switch can be employed. In many cases the on/off switch is ganged to one of the main controls, perhaps to a dual-concentric control, and the expense of replacing the whole component is not justified. A double-pole single-throw (DPST) toggle switch costs little and is easily fitted in an unobtrusive place. Remember to use a correctly rated component.

Mains Droppers

Reverting to our tests, we can next apply the neon screwdriver to the mains dropping resistor. There are many variations and a number of systems use double droppers with carousel tappings, etc., but the principle remains the same.

A glow should be obtained at each point from the input at point C, through the series resistors R3, R2 and R1, to point D for the heater line, and similarly through R4, R5 to point G for the h.t. feed.

More about this later; at present we assume there are no heaters lighting.

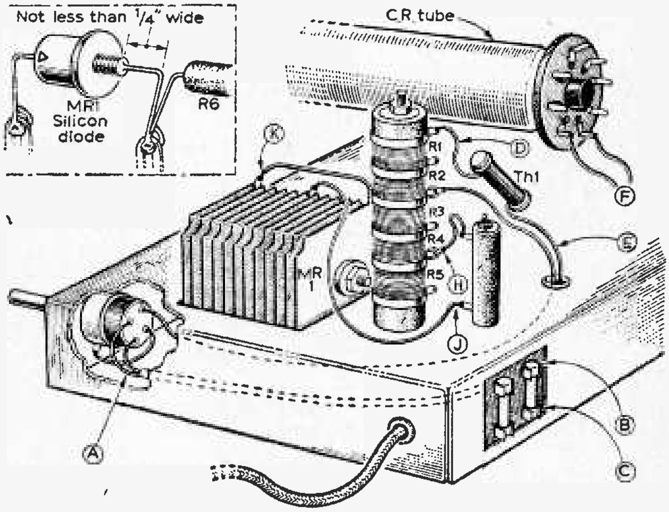


Fig. 2—Common type of layout of TV power supply section.

Thermistors

The next point is the thermal resistor TH1, whose purpose is to prevent large current surges through the heater chain because of their relatively low resistance when cold.

The thermistor has a high resistance when cold, limiting heater current until the set attains its working temperature. It is sometimes shunted by a low-value resistor, the actual value being computed to allow a compromise between heating time and current carrying capacity.

If the thermistor open-circuits under these conditions some current may pass and the valves glow dimly. The thermistor can be temporarily short-circuited to prove this kind of fault but should be replaced before the repair is considered complete.

Some fairly recent models had a heavy duty thermistor which regulated both heater and h.t. current and which was prone to overheat and arc at the terminal wires. A suitable modification was the fitting of a 0·3A thermistor such as the CZ1 *Brimistor* or TH1 equivalent for the heater line alone, while the h.t. is fed separately from the a.c. end through an additional 21Ω resistor.

Heater Chain

If the neon indication is normal at each end of the thermistor and still no heaters light the break must be in the heater chain. Again it is wise to make a couple of quick tests before ripping the set to bits.

First check the heater pins of the tube base. It is usual practice to wire the tube heater as shown in Fig. 1 electrically nearest the chassis. A glow at one side of the tube heater and not at the other is the most unwelcome sign of a faulty tube.

To go back to our earlier input continuity tests this point F is a convenient one at which to break the return circuit and test for neon glow when a neutral pole open-circuiting of the on/off switch is suspected.

Another convenient test point on many sets is the heater wiring to the tuner unit. Here there may be a tag strip or a series of feed-through inlets. One point giving a neon indication and another with no indication immediately gives the clue that one of the tuner unit valves is the culprit.

Circuit Tracing

At this stage, still with no heaters alight but a neon indication at the thermistor and none at either tuner or tube base, we must resign ourselves to circuit tracing.

Fortunately the heater circuit need not be traced out in detail. It is only necessary to tap quickly with the neon tester on the heater pins of each valve in turn in any order, simply taking note where the neon lights and where there is no reaction.

A light at one side of a heater and not at the other (at pin 4 and not pin 5, for example) immediately pinpoints the cause.

The difficulty occurs when the heaters themselves are intact but where the break occurs either in printed circuitry or in some jumper lead or panel connection. Patient tracing is the only answer if the actual circuit is not known.

H.K. Shorts

Heater-cathode short-circuits which cause all valves on the "hot" side of the fault to glow brightly and the rest to stay unlit can be difficult for two reasons. First, it is undesirable to leave the fault condition any length of time for fear of over-running the lit valves. Second the short-circuit may not show up unless the current is applied.

Knowledge of the heater chain sequence is an advantage, making it necessary only to remove the "first" of the unlit valves to prove whether the short is in this (in which case the others will go out) or in the "last" of the lit ones (in which case they will stay alight until this one is removed).

Take, for example, a heater-cathode short-circuit in V6, causing the first five to light brightly. Removing V6 will open the circuit and they will go out. If the short is at the "hot" side of the heater V6 itself will not light, but if at the "cold" side of the heater, adjacent to V7, then V6 will also light brightly.

S/C Capacitors

A further possibility that should not be overlooked is a short-circuit of the heater decoupling capacitors. In the case given above a faulty C2 could give the same symptoms.

Remember also that these notes refer to the series circuit and do not apply completely to some earlier receivers where series-parallel heater circuits were employed.

Assuming that the heaters are all alight (except the e.h.t. rectifier, which will only light when the line timebase begins to operate), and there is still no sound or picture, we next turn our attention to the h.t. circuits.

H.T. Circuits

From the mains input the circuit is through the dropper and its voltage tapping variations, then through a surge limiting resistor to the rectifier anode. The surge limiting resistor may be a large type as R6 of Fig. 2, mounted on the chassis, or may be a simple wire-wound type suspended in the wiring, mounted on a tag strip or directly to the valve base.

A neon indication should be obtained right up to the rectifier anode. No indication should lead one straight to the open-circuit resistor section.

Mains dropping resistors have a habit of going open-circuit because of expansion and contraction of their wires beneath the enamel caused by heating and cooling.

There need be no electrical fault and indeed an excess of current causing open-circuiting will usually cause discoloration. However, the open circuit must be remedied and it is not good practice to link across and obtain a permanent short-circuit.

The exact value of resistor, even if not known, should not be difficult to calculate. To be on the safe side take the maximum rated current of the rectifier and divide it into the voltage to be dropped to calculate the resistance. The wattage can be calculated either from the formula I^2R or EI. In each case it is advisable to err on the high side.

Surge Limiters

For a surge limiter, which is the most frequent cause of breakdown—this being, after all, its function to protect against surges—a 100Ω 12W component may be used. Often a 50Ω component of smaller wattage is fitted.

Where a double diode rectifier valve or two separate valves are employed separate surge limiters are needed. This is one possible cause of breakdown, an open-circuiting of one limiter causing the partner valve to work harder, straining it to the point of flashover, when the second limiter burns out. Again tests should be made at both anodes for complete assurance.

The D.C. Side

After the a.c. input of the rectifier we are dealing with a different set of conditions. Our neon tester may not be the better type which gives a clear d.c. indication. But most types will glow if the d.c. circuit is completed.

In this case the experienced man will complete the circuit by touching the chassis firmly with the same hand as holds the tester—not with the other hand—in case a shock is experienced, the current flow across the whole body being the most dangerous case.

A slight tingle may be felt when making and breaking the circuit if h.t. is present. To be quite correct a meter should be used for this and subsequent tests at point K, L and M, the various h.t. feed lines.

It will, in any case, be needed if the h.t., though present, is inadequate. Such a condition is quite usual with an ageing selenium rectifier in an older set.

Silicon Diodes

The silicon diode rectifier can be used as a very convenient substitute for either valve or metal rectifier. But its greater efficiency must be taken into account.

Additional surge limiting is needed and the inclusion of a protective capacitor shown dotted at C7 in Fig. 1. The surge limiter should not be less than 12Ω and a value of 21Ω 5W is a good general guide easily obtained.

It can be mounted before or after the rectifier as shown in the inset to Fig. 2 but should be stood off with a firm tag strip connection so that the full length of its leads and the diode leads can be employed to aid in keeping its temperature down.

The capacitor C7 may be connected as shown, in which case it should be rated at 1kV and a value of $0{\cdot}005\mu F$ is recommended. An alternative method of connection is from the cathode of the diode to chassis (i.e. across C8), in which case it need only be rated at 400V working and a value of $0{\cdot}01\mu F$ is suitable.

Reservoir Capacitors

Similar symptoms can arise from a faulty reservoir capacitor and it is an advantage to use a standby capacitor both to tap across the existing one and prove the h.t. by the discharge spark when the connection is removed and short-circuited and to prove the possibility of open-circuited C8, C9 or C10 by the temporary shunting.

It is not good practice to shunt the reservoir capacitor before switching on as the capacitative load presents a virtual short-circuit to the rectifier at the moment of switching on and may cause more damage than we are trying to cure.

Also it is not advisable to shunt existing components, leaving them in circuit, as the break-down can still develop, inter-sectional leaks of electrolytics or sectional short-circuits of rectifiers causing later failures.

Do the job properly once these first-time tests have pinpointed the cause of that domestic tragedy —the "dead" TV.

PART TWO NEXT MONTH

VALVES and their habits

PART 2

H. PETERS

PCF82

Another mixer with 0·3A heater, the PCF82 has the same basing as the PCF80 and can be used on higher working voltages than the normal 180V line. Its characteristics (mainly the triode) are slightly different from the PCF80 but it may be used in its place (sometimes with improvement) in mixer and sync separator stages.

PCF86

The standard frame grid v.h.f. mixer valve. Has largely replaced the PCF80 in this function but has a different base and will not interchange.

PCF800, PCF801, PCF802, PCF805, PCF806

A group of new v.h.f. triode pentodes, all with different basings and characteristics. The days when tuners were designed around available valves appear to be over.

PC182

A triode output pentode with 3·5W output, this valve is used predominantly as a frame oscillator/amplifier.

Its fault symptoms — usually low-emission pentode—are cramping at the bottom of the picture, sometimes with foldover. This condition may correct itself slowly as the valve warms up. For repeated failures of this kind check that the screen grid feed resistor has not changed in value.

Sometimes encountered as a sound output stage, where it gives little trouble. Check feedback capacitors for leakage if distortion is present.

PCL83

A smaller version of the PCL82 with different basing. Used in a variety of circuits but mainly in the sound output stage or frame timebase. As a sound output valve it commonly becomes microphonic and will probably cut off completely if tapped.

It should also be suspected if hum is present after the interference limiter stage. In an emergency a 30PL1 may be fitted in its place and will give greater output.

PCL84

A video output pentode-with-triode having the same base connections as the PCL82. This valve incorporates a pentode with a higher slope but slightly less power output and a lower impedance triode.

PCL85

Modern frame output valve with slightly larger triode than the PCL82 and with a different base. Has the same general faults as the PCL82.

PCL86

300mA version of the ECL86 audio valve. It is especially intended to provide good-quality sound output of adequate power in dual-standard sets.

PFL200

A double pentode. The first issue in the ten-pin B10B base to be found in receivers incorporating the new Thorn 900 *Cool Chassis*. Its output section has the phenomenal mutual conductance of 21mA per volt.

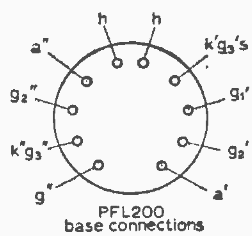


Fig. 6—Base connections of the PFL200. The amplifier half (a", g", etc.) uses pins 1 to 4, and the output half (a', g2', etc.) uses pins 7 to 10.

PL36

A line output valve on an octal base for 90° c.r. tubes. Suitable to replace the PL38 and 30P4 in an emergency.

PL38

An early octal base line output valve. Fault symptoms are softness, when the valve glows bright purple, not blue, which is apparently normal, and grid sag, which usually burns up the cathode resistor. This latter symptom is more often met when the valve is mounted upside down or horizontally.

PL81

This is a 0·3A heater, B9A based line output valve. The symptoms of low emission are usually a narrow, dim, defocused picture possibly cramped on the right-hand side. This does not apply to 110° sets using a desaturated transformer where the valve can age considerably before a deterioration is noticed.

A red-hot grid denotes excessive screen grid current due to a change in value of the screen dropping resistor or insufficient drive. Heater cathode leakage can produce a "wasp-waisted" effect and internal shorts are usually marked by bright flashes inside the valve.

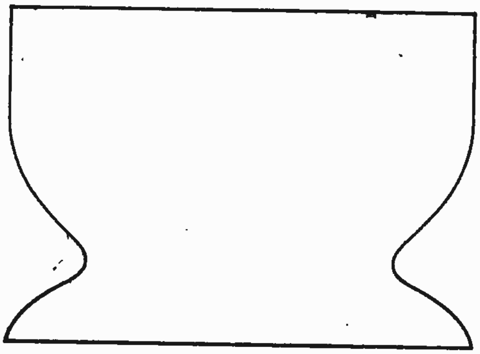


Fig. 7—Heater-cathode leakage in a PL81 can make the raster take on this shape.

An alternative valve type is the 21B6, which is slightly fatter and may now be obtained and fitted as a direct replacement for the PL81. It is claimed to be more reliable.

Parasitic oscillation sometimes produces a bright line on the left of the screen on Band III channels and in many cases can be removed by fitting a ferrite bead at the anode or a magnet around the "waist".

PL82 (30P16)

Generally employed as a frame output pentode, the common symptoms of failure are a slow stretching out of the height for a good while after warming up, eventually producing cramping at the bottom of the picture, possibly with foldover.

This valve may be exchanged with a 30P12 in an emergency, but the difference in bias may prevent correct linearity from being obtained.

PL83

Designed as a video amplifier, in which stage it seldom gives trouble, but often used as a frame amplifier, where it exhibits the same symptoms as the PL82 after a while.

It frequently develops heater cathode leakage, in which case a "judder" is imparted to the picture, giving the effect of two flickering pictures, one half an inch or so above the other. If these symptoms are combined with foldover the grid coupling capacitor should be checked for leakage.

PL84

A frame output valve with the same base, connections and heater current as the PL82. Intended for the extra power required by 110° tubes, its chief failing to date has been the production of Barkhausen-Kurz (parasitic) oscillations.

These take the form of a series of bunched scanning lines similar to telegraph wires which move slowly up and down in the middle of the screen (30P18 equivalent).

PL302

See 30P19.

PL820

An improved version of the PL81 for 110° scanning. Has the same base and similar characteristics as the PL81 but handles slightly higher peak voltages. Will substitute for the PL81 but the reserve gives short life.

PY80 AND PY82

These early 0·3A efficiency diode and h.t. rectifiers have the same base connections and in an emergency are interchangeable. The PY80 has better heater/cathode insulation but lower h.t. current rating than the PY82.

PY81

A popular efficiency diode, this valve seldom goes low but may flash over internally due to flaky cathode. A red-hot anode can denote an h.t. short in the line output stage or a heater/cathode short in the valve itself.

Lift the top cap (cathode) lead from the valve and if the glowing ceases suspect the circuit, but if it persists suspect the valve. (See U251.)

PY800

An improved version of the PY81 for 110° scanning. Has the same base and similar characteristics as the PY81 but can cope with higher flyback voltages. Will substitute for the PY81 but the reverse does not always last long.

PY32

These formed the current h.t. rectifier for many TV receivers. The early form had a shaped envelope and two separate anodes connected to pins 3 and 5. Later versions have a straight-sided envelope and a single long anode and when this type is used it should be checked that pins 3 and 5 are joined on the valveholder.

Fault symptoms are those of weak h.t., namely a dim, small, defocused picture and weak sound, all of which take longer to appear than normal. Superseded by PY33.

PY33

An improved version of the PY32, giving longer life and about 10V more h.t. To be used in place of the PY32, which is being withdrawn.

PZ30

The early h.t. rectifier, comprising two separate rectifier sections in the same envelope. This led to several manufacturers using one half as efficiency diode and the other as the h.t. rectifier, but the trouble that this arrangement caused at first has now largely been overcome.

SP41/61

These two are early r.f. pentodes of similar design but having respectively 4V and 6V heaters.

These valves were used widely in early post-war receivers because of their availability from surplus Government stock.

Apart from low emission the major faults are mostly physical, namely intermittent metallising due to the valve becoming loose in its base, a dry joint top cap causing noisy operation and erratic synchronising, weak heater valveholder contacts due to the heavy current drawn.

The offending valveholder pins may usually be taken out and tightened without replacing the entire holder.

T41 AND 6K25

These are thyratrons. The T41 has 4V heaters and Mazda octal base and the 6K25 6·3V heaters and international octal base. Apart from this they are identical.

Widely used in early post-war receivers as line and frame generators but subsequently abandoned due to their non-linearity, comparatively low linear output, and unsuitability for a.c./d.c. techniques.

Commonest symptom is frame judder or dither, usually presenting two complete pictures, one half an inch above the other, both flickering.

U22

This valve is an e.h.t. rectifier with 2V 2A heater and Mazda octal base. It was used exclusively on mains e.h.t. units in vintage receivers. The usual signs of failure are a bright purple glow inside the entire envelope and/or bright white sparks flying from the top and bottom of the heater. The maximum e.h.t. is 5kV.

U24

Also an e.h.t. rectifier with 2V 0·15A heater and international octal base, used in early receivers with flyback e.h.t. If it is difficult to obtain, change the base and use a U26 or wire in a U25. The maximum e.h.t. is 7kV.

U25

The U25 is a wired-in e.h.t. rectifier with 2V 0·2A heater. Fault symptoms are low emission (a picture which expands rapidly with increased brilliance) and a flaking cathode (ragged edge with width variations and defocusing).

If no gettering can be seen around the top of the bell the valve is becoming "soft" or if filaments repeatedly blow, wire a 15Ω ¼W resistor across the heater pins.

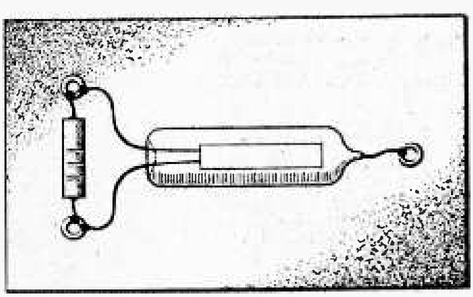


Fig. 8—How a 15Ω resistor is wired across a U25 to absorb surplus heater current.

If U25s fail, due to internal shorts, check the efficiency diode, which often fails shortly afterwards.

U26

This is the plug-in version of the U25 with a much higher working voltage. Fault symptoms are the same as those of a U25, for which it may be substituted in an emergency, taking 150mA greater heater current. This makes it an ideal replacement for the U25 in cases where repeated failures occur in lieu of the 15Ω shunt mentioned in the U25 section.

U191

The U191 is a current efficiency diode with 19V 0·3A heater and octal base. Earlier versions marked "QS" were very susceptible to cathode flaking but the later version marked "NL" is free from this defect (see U25).

U193

An efficiency diode for use with the 110° tubes. Very similar to the PY800 and the PY81, with which it will interchange. A sign of failure is a gradual increase in width during the warm-up period.

U251

A nine-pin efficiency diode which is equivalent to the U329. It usually fails due to a heater fault. A PY81 may be fitted as an emergency replacement without alteration.

U282

This is an octal-based efficiency diode which is found in receivers in the immediate pre-ITA era. Seldom fails but can be destroyed by insulation breakdown of the heater winding on the mains transformer.

Should this occur the cheapest cure is to earth the heater winding via a 100Ω resistor and rewire the stage to accept the U301.

U301

An efficiency diode with similar characteristics to the U282 but different basing, this valve is the 200mA heater equivalent of the U191 and has as its main faulty symptoms cathode flaking, causing bright flashes during warming up, and a short-circuited heater (see U25).

U801

An early 200mA 80V h.t. rectifier which has four separate anodes and two separate cathodes. Fault symptoms are purple flashes, open heaters and fuse blowing.

Signs of age are loose white power in bottom of envelope and a metallic patch on the glass above each anode. It is commonly used with 50Ω or 100Ω surge limiters in the anode circuits.

These surge limiters should all be checked at the same time as the valve is replaced to ensure that current is taken evenly by all sections. It is now more economic to use two BY100 diodes.

UU8

A 4V h.t. rectifier used in early TV receivers. Although spells of trouble with this valve were experienced, many failures were not due to the valve itself.

Condensation between the valve and its holder is a frequent cause of trouble, especially in console models where the power unit is near ground level. 50Ω surge limiters fitted in each anode leak will often prolong the life of the valve.

6F12

See EF85.

6F19

See EF91.

6F23

A 6·3V high-gain pentode which may be used as an emergency replacement for a 30F5 and EF80 in series circuits.

6F24 AND 6F25

The modern frame grid i.f. valves. The 6F24 is the high-gain version of the "straight" 6F23 and the 6F25 is its variable-mu counterpart.

6F26

A variable-mu pentode with similar characteristics to the 6F19/EF85, with which it will interchange.

6K25

See T41.

6/30L2

This valve is a general purpose 6·3V 0·3A double triode. Gives most trouble in timebase circuits where synchronism may take a while if the valve is slow heating. Faulty valves usually produce a higher timebase speed than normal and also give rise to variable contrast symptoms when faulty in a.g.c. circuits.

For versatility the triodes are equal to each other and also have the same characteristics as the triode sections of the 30FL1, 30PL1, 30PL13.

6L18

A 200mA triode used as a frame amplifier in five-channel sets. Symptoms of low emission in frame timebase are foldover at the bottom of the screen and a short picture. It may often be exchanged with the less important "spot wobble" valve where fitted.

6P25

The 6P25 is an early sound and frame output valve. Common faults are open-circuit filament and frame foldover at the bottom of the screen. Valves suffering from the latter trouble may be changed over with the sound output valve if of the same type. Emergency equivalents are 6P1, EL33 or 6V6.

6U4

This 6V efficiency diode frequently develops an open-circuit heater.

10C2

A 28V 100mA triode pentode whose commonest fault is that the heater blows soon after switching on. Check the heater voltage if repeatedly troublesome and fit a small resistor across the heaters if necessary to absorb surplus.

10P13

A 40V 100mA output tetrode used as a frame and sound amplifier. It has the normal fault symptoms of a frame output stage, i.e. varies when tapped, the bottom of the picture becomes cramped and Barkhausen-Kurz (parasitic) oscillations producing "telegraph wires" across the centre of the picture.

When withdrawing old 10P13s make sure that the glass envelope does not pull out of the metal base. Should it do so the heater pins are those adjacent to the keyway.

10P14

This 40V 100mA output pentode is the octal-based version of the 10P13. Used in one receiver as the frame and sound output pentodes in which it is common to find that if one valve fails the other may shortly follow suit.

20D1

The 20D1 is the 9·5V 200mA version of the 6D2 (see EB91 for fault symptoms). A 6D2 may be used as an emergency replacement but it will take longer to heat up.

20F2

An 11V 200mA r.f. pentode used mainly as a sync separator. It seldom gives trouble except in the frame output stage of one certain receiver. If the valve fails in the sync separator stage a 6F15 may be used as an emergency replacement.

20L1

This 12·6V 200mA double triode is most troublesome in flywheel sync/line oscillator stages where the symptom of a low-emission valve is high-line frequency.

Frequently valves of some age are slow heating and involve constant adjustment of the line hold control during the first half-hour. If the verticals are bent suspect heater cathode leakage.

20P1

A 38V 0·2A line output valve whose low-emission fault symptoms are lack of width with the picture cramped on the right. The emergency replacement is the 20P4, although this may give excessive width and e.h.t.

20P3

This 20V 0·2A output tetrode is the 200mA version of the 10P14. It gives the normal low emission symptoms in the frame timebase, i.e. cramped bottom of screen (see 10P14).

20P4

The 20P4 is a 38V 0·2A line output valve. A smaller and more economic version of the 20P1. In certain receivers with self-oscillating line output stage a specially tested valve coded "GP" should be used.

20P5

The 20V 0·2A version of the 10P13 is comparatively trouble free (see 10P13).

30C1

See PCF80.

30C15

The high-gain version of the 30C1 which cannot be interchanged due to different basing.

30C17

A variable-mu frame grid v.h.f. mixer similar to the 30C15 and with the same basing. Will interchange in an emergency.

30C18

Another frame grid variable-mu mixer. Characteristics are similar to the 30C17 but the basing is entirely different.

30F5

This is a 7·3V 0·3A r.f. pentode. Its high gain occasionally produces an unstable i.f. stage unless the decoupling is perfect. An EF80 or 6F23 may be used as emergency replacement in series heater circuits.

30FL1

This 9·4V 0·3A beam tetrode/triode is a general purpose valve with various applications. Works hardest as an a.f. amplifier/sound output valve judging by the frequent replacements for low gain.

Commonest faults are open-circuited heater and heater/cathode breakdown. The latter may produce perplexing symptoms in v.h.f./TV combined receivers where the offending valve is in the part of the set which is out of circuit on radio. (See also 6/30L2.)

30L1

See PCC84 and 30L15.

30L15

The high-gain version of the 30L1 with almost double the gain on ITV. This valve has the same basing and heaters as the 30L1 and has successfully been fitted as its replacement despite the fact that it is not an equivalent.

The present r.f. trimmers on the turret tuner normally have to be readjusted (usually unscrewed about three turns) but no other alteration appears necessary and the stage does not overheat.

At odd times the substitution of the 30L15 for the 30L1 has produced beat patterns due to self-oscillation on certain channels, but the sensitivity of the receiver in such cases has usually been found sufficient to make the change of types unnecessary. The PCC89 has not been found to interchange well with the 30L15.

30L17

The frame grid version of the 30L15 with the same base as it and the PCC89. Interchangeability depends upon circuit design but it is worth trying in an emergency.

30P4

This 25V 0·3A line output valve is the 300mA version of the 20P4. Like the 20P4 it has a few special batches which have been tested to meet certain requirements. It is interchangeable in an emergency with the PL36.

The 30P4 has the habit of producing spurious oscillations on Band III, especially in timebases designed for wide-angle scanning. These take the form of ragged vertical lines on the left of the picture and may be cured by substitution or by fitting ferrite beads in the anode lead. (See also 30P19.)

30P12

This 12·6V 0·3A tetrode is the 0·3A equivalent of the 20P5. It suffers the usual troubles of a frame output valve, namely microphony and cramped picture at the top and bottom.

Sometimes it exhibits bright flashes when tapped. It is interchangeable in an emergency with a 30P16 (PL82), preferably with adjustment of bias.

30P16

See PL82.

30P18

See PL84.

30P19

The 110° version of the 30P4, which it supersedes in every case except the single valve Murphy V310 series, where a 30P4 MR must be used.

30PL1

This 13V 0·3A triode beam tetrode is a useful sound amplifier/output valve with 5W output and widely used in frame timebases up to 90° scanning angle.

The triode section seldom gives trouble but the tetrode suffers the normal symptoms in frame timebases, i.e. the picture takes a long time to reach full height, is cramped at the top and bottom, and the picture jumps when the valve is tapped.

It will replace the PCL83 in an emergency but the reverse does not always apply.

30PL13

A 16V 0·3A triode beam tetrode which is the 110° scanning angle version of the 30PL1. It exhibits the same fault symptoms, plus the vertical "judder", which may not occur until an hour or so from switch-on and is preceded by lack of interlace.

R.F. PENTODE SUBSTITUTION NOTES

Readers ask "What happens if I substitute a variable-mu pentode for a "straight" pentode or a frame grid valve for an ordinary one?" As most r.f. pentodes have the same base and heater consumption there is no objection to trying and little harm can be done.

Generally speaking the stages have been designed to squeeze the last ounce out of the valve selected and the substitution of a wrong type can give less gain rather than more.

Fitting a straight pentode in a variable-mu stage usually gives an abrupt action to the contrast control, whilst a variable-mu valve in a straight stage should lower the gain.

By replacing a valve with its frame grid equivalent an improvement in gain can usually be obtained. A little realignment and bias adjustment is often necessary. Sometimes the different characteristics outweigh the extra gain and no improvement results. Sometimes the gain is so greatly improved that the stage becomes unstable and oscillates. ■

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

ONCE again good news. July was another good month for Sporadic E and here is the list of the best dates and the countries received, which should help in checking your logs and clearing up any queries.

24/6/65: Czechoslovakia, Finland, Sweden, USSR, Roumania and Poland.
27/6/65: Spain, USSR and Hungary.
28/6/65: Czechoslovakia, USSR, Spain, Finland, Sweden and Roumania.
29/6/65: Spain, Poland and Hungary.
30/6/65: Spain and Poland.
3/7/65: Czechoslovakia and Hungary.
4/7/65: Czechoslovakia, Hungary, Italy and Sweden.
7/7/65: Czechoslovakia, USSR, East Germany, Sweden and Roumania.
9/7/65: Czechoslovakia, USSR and Poland.
11/7/65: Czechoslovakia, USSR, West Germany and East Germany.
12/7/65: Norway and Poland.
14/7/65: Austria, Spain and Czechoslovakia.
18/7/65: Czechoslovakia, Poland and Hungary.

From this brief summary I would deduce that the most prevalent openings were from the East and North-East (with Czechoslovakia easily the most regular) rather than from the South (Spain and Italy) as applied last year. In my area, for no apparent reason, Italy has become "rare" this year. I suppose this is only what we can expect from Sporadic E!

MYSTERIES

One new mystery this month and this appears to be "a poor thing but my own" as inquiries amongst DX friends seem to show that it was not seen by them and I myself saw it for a few seconds only. If any other reader has seen it I will be delighted to hear from him.

Date 14/6/65, at 1446 on channel R1, a weak test card appeared consisting of the usual rectangle with four corner circles but with a large white cross in the centre on the grey background. In the middle of this cross, which occupied about a quarter of the screen area, there was a fairly small centre circle not unlike the USSR test card in design.

This was not USSR as it was seen as a "floater" with the USSR test card, nor was it Czechoslovakia as Ostrava was on test grid at this time. Has anyone any ideas?

We have had many readers asking where the "DTV" caption comes from. This is of Polish origin and stands for "Dziennik TV", i.e. "Daily TV", a type of "Today" programme.

YUGOSLAVIA AND FINLAND

I. C. Beckett, of Twyford (Bucks), gives us the following details on these countries:

Yugoslavia—The following transmitters are at present in operation: Ch. E3, Kapaonik; Ch. E4, Labistica. Both at times show captions marked "Studio Beograd, Studio Zagreb and Studio Ljubliana" and at least two different types of test card are in use: (a) the Polish/Hungarian/BRT type of card with "RTV" at the top or a written caption, or (b) Marconi Resolution Chart No. 1, i.e. like that used by Telefis Eireann on their 625-line service. Other patterns in use are: (c) a test grid like TVE and (d) a black and white horizontal rectangle with gradation bars below it.

As yet there is apparently no station operating on Ch. E2 but there may well be a second station on Ch. E4.

Finland.—This is a most interesting case, the position as far as we know being as follows:

Firstly there would appear to be two networks now in service in Finland, TV1 and TV2. Mr. Beckett gives this Band I information:

Tampere. — Yle 2. Location 23E54.61N24. Power, 10kW. Vertical polarisation, Ch. E2.

Tervola. — Yle 1. Location 24E42.66N07. Power, 20kW. Horizontal polarisation, Ch. E3.

Taivalkoski.—Yle 1. Location 28E20.65N33. Power, 15kW. Vertical polarisation, Ch. E2.

These stations at present use test card "G" (like test card "C" but with an outer white circle) which is marked "Yleisradio TV1 or Yleisradio TV2 at the bottom of the centre circle.

Two points to be noted: (a) It seems that the two TV services in Finland are the "old" TES with its "cogged" wheel type test card and the "newer" YES service. The last time I saw the "cogged" card was January, an exceptionally strong signal on a vertical domestic TV aerial indicating a vertically polarised transmitter. This agrees with Tampere E2 vertical, now apparently using test card "G" marked TV2.

(b) Reports of test card "G" carrying numbers TV1 and TV2 on Ch. E2 are correct as this channel seems to carry two transmitters, one at Taivalkoski TV1 and one at Tampere TV2, thus the confusion over the TV1 and TV2 captions.

Two of the three stations are vertically polarised, both on Ch. E2, so try for these with a correctly polarised aerial.

READERS' REPORTS

The most interesting news this month is of Sporadic E results in Band II. **George Le Couteur,** of Torteval (Guernsey), received the Roumanian transmitter on Ch. R3 at Oradia on 4/7/65 with the usual Roumanian test card marked Bucuresti. Excellent DX.

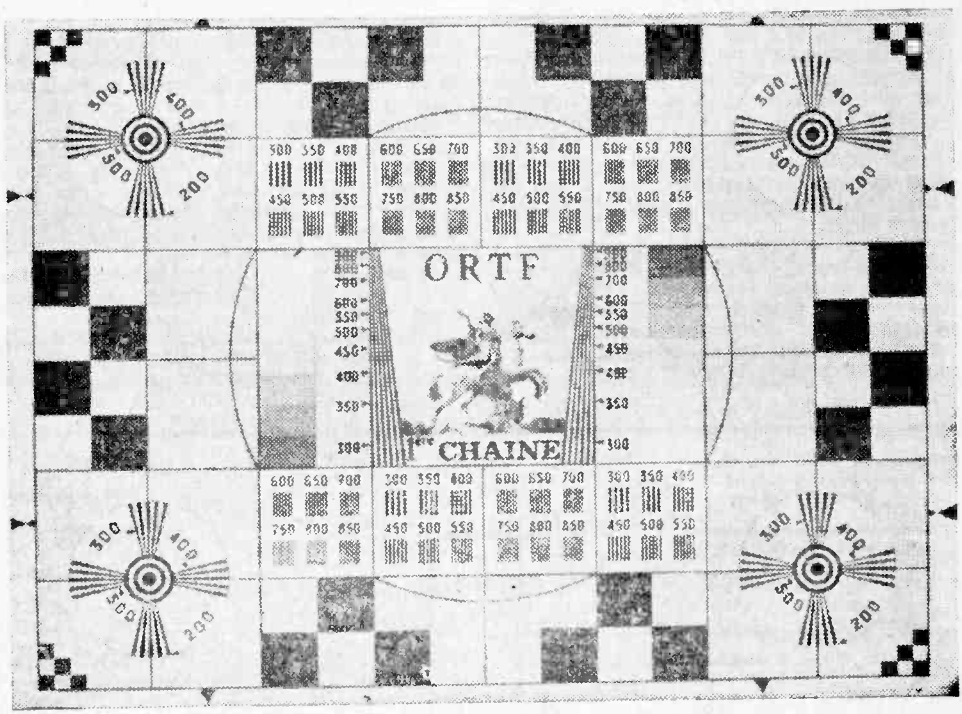
I. C. Beckett also had excellent results and reports USSR test cards on channels R3 and R4. The R3 is either Riga or Kichinev and the R4 either Kalingrad or Vilnius. He also reports the Polish/Hungarian type test card on Ch. R3; this could be Gdansk (Poland) or even Tokaj (Hungary), so it is certainly possible to receive DX in Band II!

M. Vango, of Walthamstow, London, has improved his log with Fyn (Denmark) on Ch. E3, very short skip for the London area. **J. J. Whittingham,** of Bloxwich, Staffs, has joined the ranks of DX-ers with reception of Sweden and Spain

B. Williamson, of Yell, Shetland Islands, has started DX/TV with Spain E2 and Switzerland E3. Sporadic E interference is spoiling BBC pictures in Shetland. Several correspondents have complained of this, so we suggest "if you can't beat them join them" as Mr. Williamson has done.

M. Davison, of Hartlepool, has turned in a good log including Czechoslovakia, Poland, Spain, Portugal, Holland, West Germany and France via Sporadic E propagation, all on an unconverted set. Signals must have been strong!

DATA PANEL—I O.R.T.F.



Test Card (*a*) as photo, or (*b*) Test Grid, or (*c*) Black and White Rectangles.

1st Chain 1. 30 minutes before start of programme.
2. At all times from 12.00 until end of evening programme, when no programme is actually on.

Note—1st Chain has "1 ieme Chaine" on test card; 2nd Chain has "2 ieme Chaine" on test card.

2nd Chain U.H.F. Daily except Sunday and Monday from 14.00 until start of evening programme.

Programmes (1st Chain)

Daily (during term time) 09.00—10.00 approx (Schools).
Daily 12.30—13.30 (Programme and News at 13.00). 16.30—23.30 approx., except when special events are televised.

Programmes (2nd Chain)

Daily 20.00—23.00 approx. (Monday to Saturday), Sunday 14.45—23.00 approx.

Times are BST: France does not alter its clocks and an adjustment of one hour must be made for GMT in Winter here.

For station frequencies refer to previous articles in the DX TV series. Programme times are subject to alteration for special transmissions.

PATTERNING ELIMINATION

by G. R. Wilding

FEW defects can so utterly ruin TV reception as self-generated patterning. And few defects can be so difficult to locate and cure! Only rarely is this fault caused by simple misalignment; more often the replacement of miniature hard-of-access components is called for.

Where misalignment is the sole cause of background patterning it would need to be so far from optimum that the inferior picture quality and not the patterning would be the principal consideration. In case of doubt, if the test card gratings are well reproduced without undue ringing, and if there is no sound-on-vision or vision-on-sound, it can be safely assumed that alignment is pretty well within the maker's limits.

This fault can be caused by a variety of reasons, even including any of the EF80 or EF85 valves in the r.f. strip, or more probably the PCF80-type frequency-changer, producing excessive harmonics or sub-frequencies. Before proceeding further then check all relevant valves and ensure that all valve covers are fitted and properly earthed.

Next check that all sub-circuit screens and covers are bonded to chassis, paying particular attention to those associated with the detector and video input stages, which, of course, are susceptible to all frequencies from zero to 3Mc/s.

Finally, before actually getting down to component checking, ensure that all coaxial leads have an earthed braid. This is best done by temporarily shorting the outer to chassis with a screwdriver blade or capacitor and noting results.

Special attention should be paid to the outer of the i.f. feed coaxial from the tuner to the first common i.f.t., for very often, due to constant bending when changing valves, cleaning contacts or on chassis removal, it develops a far from perfect bonding to chassis.

Having tested all these simpler probables, the next step is to check decoupling components and these are as follows:

(a) Anode, G2 and, more important still, the *heater* circuit decoupling capacitors. The latter are especially liable to produce

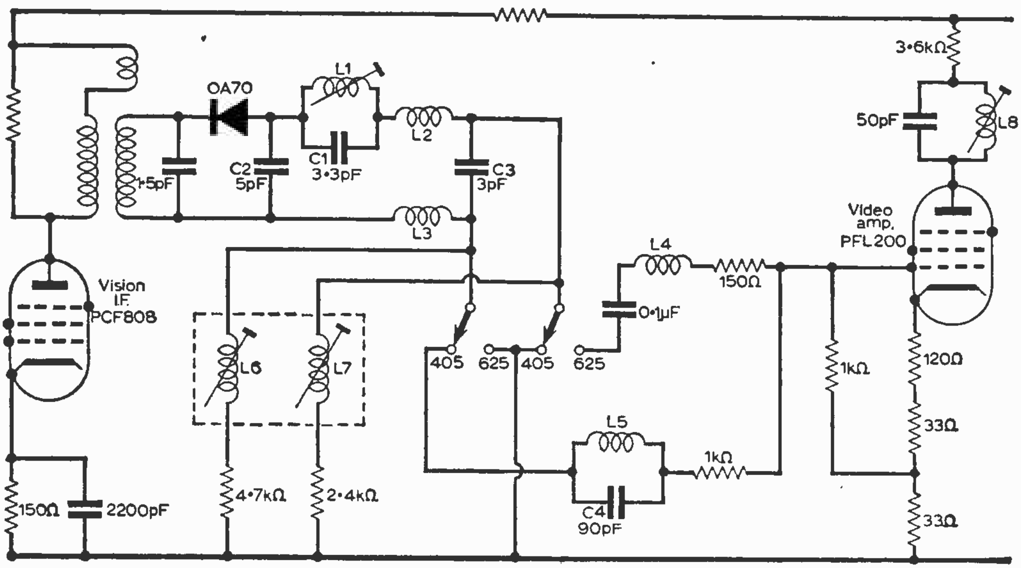


Fig. 1—Detector circuit of typical dual-standard receiver. Only L2 L3 and C2/C3 need be investigated when patterning caused by i.f. breakthrough is experienced.

patterning if o/c or dry jointed as their main purpose is to prevent unwanted inter-valve coupling via the heater wiring.
(b) Filter capacitors in the detector and video input circuits.
(c) Short-circuited r.f. chokes similarly positioned.
(d) Broken core of tuned filter, omitted Ferroxcube beads or misplaced pre-video circuit wiring.

To take probability (a) first. Not all valves have their heaters decoupled to chassis, and some have both sides decoupled, but in all instances the best way of checking is to shunt a good replacement across each suspect in turn and note results. Typical values are from 1,000pF to 4,500pF and with a working voltage of at least 350V a.c.

As regards probability (b) the filtering circuits employed in modern receivers vary considerably in design and complexity, ranging from particularly simple arrangements such as that used in many 405-line Philips receivers, where only one shunted filter capacitor of 8·2pF is utilised, to that employed in some of the latest dual-standard models like the Thorn 900 series, where many filter capacitors, filter chokes and more than one tuned circuit are incorporated.

The primary function of all post-detector circuitry is to filter out the i.f. component, any residual signal frequency and all extraneous waveforms other than that of the picture video signal as transmitted, but in most of these dual-standard receivers will be found 405 compensation chokes, 625 compensation chokes and harmonic suppression coils as well as the normal plain i.f. filters, so that before delving into this section of the receiver it is vital to have a service manual to hand to identify and outline the function of each component.

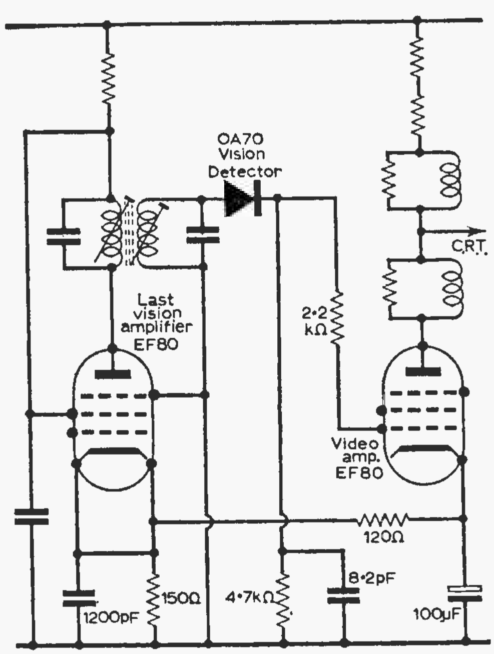


Fig. 2—Detector circuit of typical 405-line receiver showing simplest possible i.f. filtering.

For instance, in the Thorn models previously referred to there is incorporated a rejector circuit tuneable to 194Mc/s or 209Mc/s. When tuned to the former frequency it suppresses the fifth harmonic of the 625 vision i.f. which could cause interference on receivers which are in close proximity and tuned to channel 9. Alternatively when tuned to the latter it suppresses any self-generated harmonic interference obtained on channel 12.

Thus such tuned circuits are quite separate from the vision i.f. filters, 5pF and 3pF shunted across the detector output. When any such low-value capacitors are suspect it is vital to keep to the exact specification as even the slightest increase in value will attenuate the higher video frequencies and blur fine detail.

Probably the only way to determine the efficacy of such extremely small capacitors is to completely replace them, since shunting an equivalent across them (the usual procedure) can swamp the circuit capacitively and lead to false deductions.

As a general rule, however, when no service manual is available i.f. filter capacitors can be recognised by being of very small value, often non-standard, and shunted across the video detector load, while i.f. chokes (if incorporated) will be untuned (without paralleled capacitor) and connected in series with the feed from the vision detector to the grid of the video amplifier.

One further form of patterning, although not always recognised as such since it does not produce the usual moire background, is the 3·5Mc/s sound and vision beat frequency getting through to the video amplifier.

As is well known, on both Bands I and III the vision carrier is always 3·5Mc/s above the sound carrier, so that if the high-frequency resolution of the video stage is good enough any resulting difference beat frequency produced can chop up the raster lines into a succession of dots similar to that produced by the 3·5Mc/s test card grating, hence the term "dot interference".

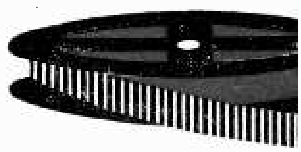
To prevent this possibility practically all receivers incorporate a rejector tuned circuit at this frequency in one of three positions: (a) Between the detector diode and video amplifier grid, (b) in the cathode lead of the video amplifier valve, or (c) in series with the lead from video amplifier anode to the tube cathode.

These simple tuned circuits rarely give trouble and if dot interference is apparent it is more likely to be due to maladjustment of the slug by being mistaken for a sound-on-vision rejector than any fault in the coil or associated capacitor.

However, in the case of those rejectors placed in the cathode lead of the video amplifier, if this valve develops an internal s/c it could well overheat and damage the inductor.

Once it becomes established that maladjustment has occurred, or that the paralleled capacitor must be replaced, the best way to realign is to inject a 3·5Mc/s signal into the video stage and then adjust for minimum picture interference. ■

THERMOPLA



BEFORE videotape recording became a practical proposition the only feasible method of recording a television programme was by using film. This was a highly unsatisfactory method, however, as the use of film requires an optical input (from a monitor) and an optical output (telecine) and there is considerable degradation of the signal both in resolution and in signal-to-noise ratio in these two conversions.

The introduction of videotape was the answer to the producer's prayer as this recording method used an electrical input and an electrical output and gave results so good as to be indistinguishable from the original.

Video to Visual

There is, however, a third method of video recording, *thermoplastic recording*, which has some peculiar advantages of its own but is hardly known and little used. Thermoplastic recording uses an electrical input signal, in some cases a modulated r.f. signal, and gives a visual signal out. Thus this method converts from video signal to a form of film.

In principle thermoplastic recording is extremely simple, simpler than film (with the complications of its chemical processing) or videotape (with the complexity of rotating recording heads added to the problems of tape recording).

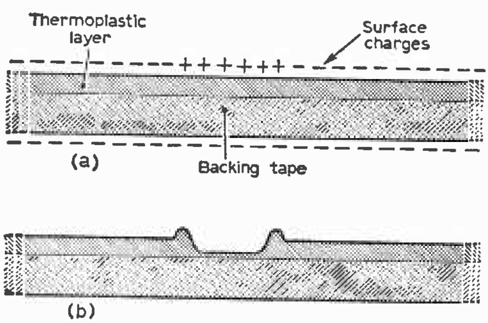


Fig. 1—Section of tape with charged thermoplastic layer (positive). The rest of the tape on both sides being negative.

The recording material consists of a transparent tape made of a plastics material of high melting point covered with a layer, also transparent, of a thermoplastic material of low melting point.

Thermoplastic Principle

Thermoplastic is the name applied to the class of plastics which soften on heating and return to their normal condition on cooling—the process can be performed as often as is desired. Thermosetting materials are usually fairly soft until they are baked, when they harden and stay hard.

The top layer of thermoplastic tape is a good insulator and if it is electrostatically charged the charge will persist for some considerable time, several days at least. Imagine a section of this tape on which a piece of the thermoplastic layer has been charged positive by an electrostatic signal, the rest of the tape on both sides being negative (see Fig. 1).

If the whole tape is now heated to the melting point of the thermoplastic layer the electrostatic forces present will distort the surface. The positively charged portion will be pulled down towards the negatively charged backing and will also form "humps" at the boundaries with negatively charged portions surrounding it.

If we now reduce the temperature rapidly this pattern will be "frozen" on to the tape. In this way a pattern of charges is converted to a pattern of ripples on the tape.

Recording Method

The practical method of using this simple principle is highly ingenious and is due to W. E. Glenn, of General Electric, of U.S.A. The recording principle is shown in Fig. 2. The tape is contained in or passed through a type of cathode ray tube in which the moving tape takes the place of the screen and the electron beam scans the tape from side to side and is modulated by the video signal.

When the electron beam strikes the tape it knocks off more electrons than it deposits and the tape charges positively and not negatively as might be

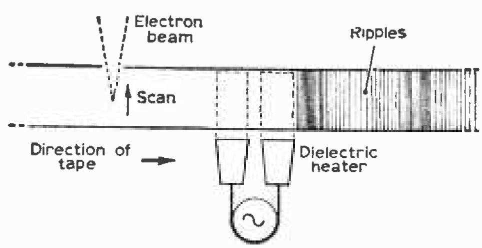


Fig. 2—The practical method of using the thermoplastic principle.

STIC VIDEO RECORDING

K. T. WILSON

expected. This is for a beam whose cathode is about 2·5kV. negative to the tape surface.

At high negative cathode potentials (and also at very low potentials of the order of a few volts) the electrons stay on the tape and the surface charges negative.

Let us assume, however, that we are using a moderate cathode potential and the tape is charging positively according to the modulation of the beam (i.e. the video signal). If we now heat the tape strongly but locally by passing it through a strong electrostatic r.f. field which generates heat because of the dielectric losses in the tape the electrostatic signals will be developed on the tape in the form of ripples which will become permanent as the tape cools.

Usually the thermoplastic layer has much higher dielectric losses than the backing tape, with the result that only the thermoplastic layer is heated in the r.f. field and the cool backing layer absorbs the heat rapidly whenever the tape passes out of the field, which may be localised to a width of only a few thousandths of an inch.

This overcomes the difficulty of cooling anything in a vacuum. Of course the film need not be heat developed immediately—the charges will persist for several days at least—but it is highly convenient to develop at the time of recording in order to monitor the result.

Picture on Tape

The result is a picture which is visible on the tape but which cannot be projected by normal means since the tape is completely transparent. The reason for the pictures being visible to the eye is that we can view them by reflecting light from the tape.

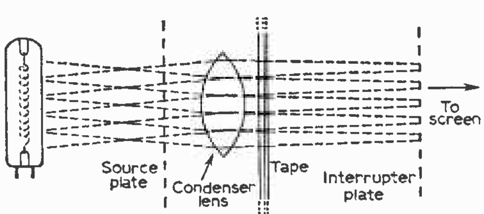


Fig. 3—Principle of a thermoplastic projector using Schlieren optics.

When we do this the tops and shallow sides appear bright as they reflect light to the eye and the lower parts and steep sides of the ripples appear dark as they reflect light away.

The degree of light and dark corresponds to the ripple height and depth and thus to the amounts of charge causing the ripple. As the charge corresponds in turn to the video modulation of the electron beam the electrical input signal has been converted to an optical output signal.

The resolution of the system is very high and a bandwidth of over 50Mc/s is possible. Like videotape and unlike photographic film the thermoplastic tape can be erased. This is done simply by heating the film strongly until the thermoplastic becomes slightly conducting. The charges then neutralise each other and the whole surface of the tape becomes smooth again.

Projection

Projection of thermoplastic images is done by using Schlieren optics. This is a method of converting variations in refraction into variations in optical density and is the method used to show up such phenomena as convection currents or shock waves in air or other liquids.

The principle of the thermoplastic projector is shown in Fig. 3. Light comes from a large number of sources and passes through the condenser lens and the thermoplastic tape, here shown unrecorded, to strike an apertured plate.

For a video recording scanned in the normal way it is convenient to make both the "light source" and the "interruptor plate" a pair of identical slotted plates, the light source plate being uniformly illuminated by a projector lamp and separate condenser lens system.

The plates are so arranged that when the thermoplastic tape is unmodulated none of the light passing through the condenser lens and the film will pass through the interrupter plate as each slit on the light source plate is opposite a solid bar on the interruptor plate.

The presence of a ripple on the thermoplastic tape alters all this. The ripple bends the light beam and allows more or less of it to pass through the slits of the interruptor plate according to the height of the ripple.

In this way the brightness of the projected beam is proportional to the ripple height, which is, in turn, as we have already seen, proportional to the original video signal.

Pictures obtained by this method of projection are not as bright as those which would be obtained from film using the same projector lamp. The reason for this is the loss of light in both the light source plate and at the interruptor plate.

It is, however, very much easier than then reading off the video signal from magnetic tape and converting it to optical form.

There is no way of recovering the electrical signal from the thermoplastic tape directly and a flying-spot scanner must be used together with the Schlieren optical system if a video signal is required.

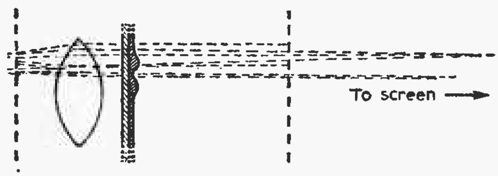


Fig. 4—Showing how ripple bends the light beam and allows more or less of it to pass through the slits of the interruptor plate according to the height of the ripple.

Radar Application

One of the first announced uses of a thermoplastic tape system was in connection with the development in U.S.A. of a "sideways looking" radar system. This type of radar scans the ground under an aircraft and the output signal is therefore a map of the "view" from the aircraft.

If the radar signals are recorded on thermoplastic tape the resulting pictures resemble very closely an aerial map but with rather better definition than is usually possible with photographic mapping, since the radar beam is not affected by atmospheric conditions.

Another use of the system is to obtain a permanent optical record of a TV broadcast. There is no risk that the thermoplastic recording will be accidentally erased, as can so easily happen with a magnetic tape, and the contents of the tape can be checked simply by looking at it.

Projection TV

One interesting use for thermoplastic recording which has been proposed is the application to projection television. If a loop of thermoplastic tape is used with an erasing step permanently included the tape can be used to record video signals, project them and be erased, all this happening within one vacuum envelope. This method of projection is very much less complex than existing methods.

Thermoplastic recording might well be the recording method of the future as far as domestic uses are concerned as it has the great advantage of allowing very high information density (so that only small reels of tape are required for even a lengthy programme) and also of permitting an optical readout so that a modified 8mm projector might be used.

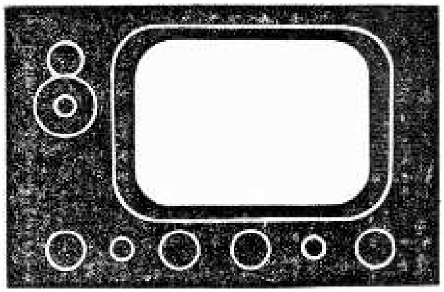
The snag here is the requirement that the tape be run past the scanning electron beam in vacuum. This requires fairly elaborate vacuum pumping equipment which could hardly form part of a domestic recorder.

Special C.R.T.

Perhaps the answer to this problem may lie in the development of a tube made by Litton Industries, of U.S.A. This resembles a normal cathode ray tube in which the phosphor screen is replaced by a mosaic of fine wires.

These wires are embedded in the glass of the faceplate and pass right through it so that the wires virtually form an extension of the electron beam, and anything in contact with the wires will behave as if it were in contact with the electron beam. This is, of course, a sealed-off tube, so there is no complication with vacuum systems.

Whether such a tube could be made at a price which would make the whole system competitive with others using purely magnetic recording is another matter; this would depend on the potential market for such a system. ■



THE OLYMPIC II Transistor TV

by D. R. Bowman

Part Six: Sync and C.R.T. Control Unit

THE remaining units required for the completion of the receiver are the sync control unit, the flyback blanking unit and the linearity control of line scan. The first includes the device responsible for sync separation, the production of field (frame) sync pulses, and a phase-connecting line sync circuit which gives a d.c. output suitable for controlling the line oscillator. The second comprises the network which provides the requisite direct voltage for the first anode of the cathode ray tube, an adjustable voltage for the focus anode, and brightness control.

The flyback blanking unit hardly deserves the name of "unit" as it comprises a few resistors and capacitors which feed a pulse to the c.r.t. grid to blank out the flyback lines which might otherwise be seen on the tube face.

Sync Control Unit

The theoretical circuit is shown in Fig. 33. Tr22 (oc44) is operateed with a base bias supply which sets it at its correct working point. The transistor cuts off when the video signal arrives, at the base, while passing current only as the sync pulse train occurs in the opposite polarity to the video signal. Across R94 (3·3kΩ) the collector load resistor there appear just the sync pulses, at considerable voltage. The field sync pulses are separated by a conventional "interlace diode"—in fact two diodes (D15, 16 OA81) contribute to the function, as seen. The bias on this pair of diodes is so arranged as to cut off the line sync pulses but to pass the much larger field sync pulse which is produced by the action of the "time-constant" circuit R95 (3·9kΩ) and C97 (0·01μF). From this circuit the field sync pulses pass, via C98 0·005μF, to the sync input terminal of the field generator.

The line sync pulses are derived also from the video signal and appear in a positive-going sense, limited in amplitude, at the collector of Tr23 (OC44). These are rectified across circuit "A" in the diagram, and the bias across D17 (OA81) determines the amplitude of the resulting steady voltage.

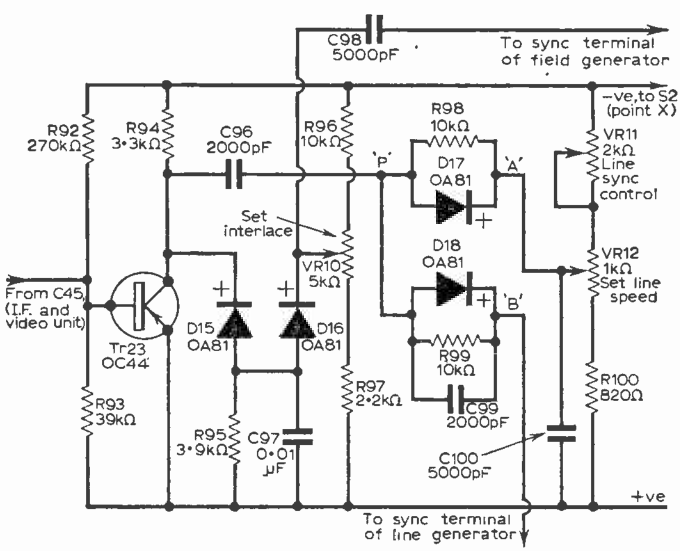


Fig. 33—Circuit diagram of Sync Control Unit.

However, a constant-amplitude negative-going pulse from the line output transistor, shaped and attenuated by a c.r. network, is also rectified across circuit "B" and contributes to the voltage developed at point P. If these two pulses coincide they behave as one pulse, since their amplitude is constant, but if they occur at different times the total pulse width, and hence the voltage developed at point P, increases. This increases the total base current into the base of Tr15 (line scan generator) and the speed of the generator tends to rise until the pulses coincide, when the action ceases. If the speed of the line scan generator decreases therefore, the action of the circuits described is to speed it up to synchronisation point. Should the speed of the generator tend to increase from synchronisation, nothing will stop it rising until the pulses are quite distinct and a constant voltage is generated. No harm is done by

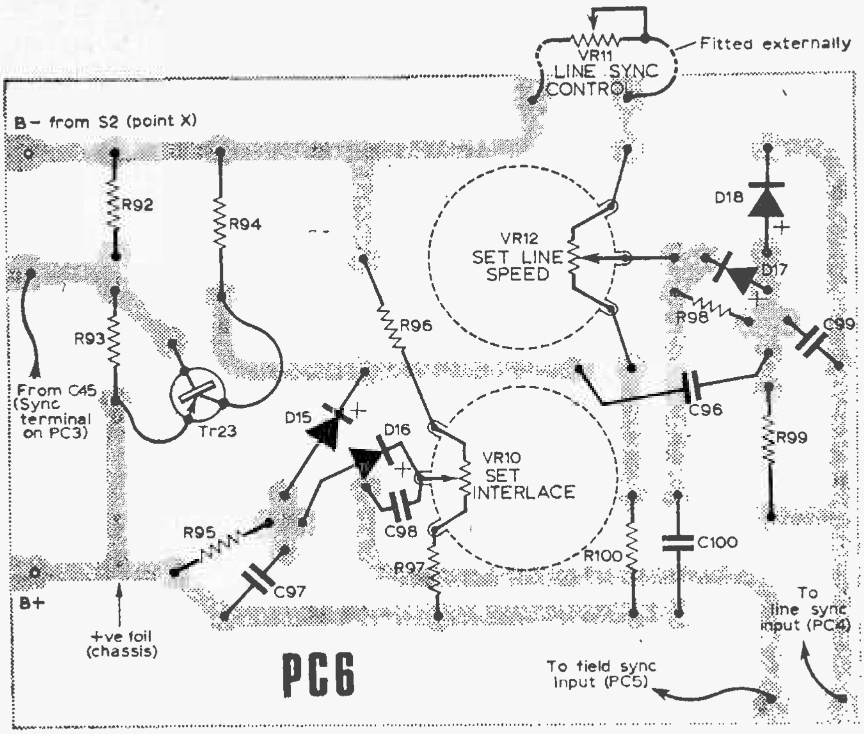


Fig. 34—Sync Control Unit printed circuit board PC6 (full size)—copper parts are shown shaded.

this however; the synchchronisation first fails. It is therefore necessary to arrange that at all times the tendency is for the speed of the line scan circuit to be less than that of the sync pulses. This is similar to conventional practice with valve circuits, and the arrangement behaves in a very similar way.

The suggested etched circuit is shown in Fig. 34. It will be noted that the output from " B " circuit —the line sync connexion—is not a true sync output in itself; it serves the dual purpose of carrying d.c. sync output to the first transistor of the line scan circuit and of transferring a shaped pulse from the scan unit to the sync unit.

To set up the unit, it should be connected to the vision i.f. amplifier and the line scan generator, and the assembly switched on, but **NOT** the line output transistor. The method previously mentioned (of receiving the line pulse harmonics, as radiated from the line oscillator timing circuit, on a synchronised domestic TV) may be used to keep a check on line scan speed. Otherwise the speed may be judged by ear, listening for the magnetostriction whistle from the blocking oscillator and driver transformer.

VR11 (line sync control) is set at about the centre of its travel, and likewise VR4 (setting-up speed control) in the line scan generator itself. VR12 (set line speed) is then adjusted to obtain the correct oscillator frequency.

If an oscilloscope is available, it should be connected between the field sync terminal and "earth," and the field sync pulses displayed. When VR10 (set interlace) is correctly set, Fig. 35(a) is the display obtained—the line sync pulses are just cut off. If noise is appreciable, it will be well to adjust the control so that the sync pulses are appreciably shorter—this cuts off some of the noise.

If an oscilloscope is not available, the " set interlace " control VR10 should be set to its mid-point temporarily, and later—when a picture is being displayed—adjusted for best interlace. In noisy circumstances advantage will be had by reducing the degree of frame lock available, by rotating the 5kΩ potentiometer until the frame speed control has a suitable range of movement.

It will be found that both line and frame "hold" controls are quite " hard," and that no difficulty is experienced in obtaining a stable well-interlaced picture.

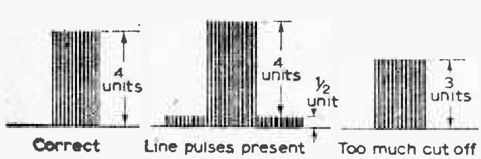


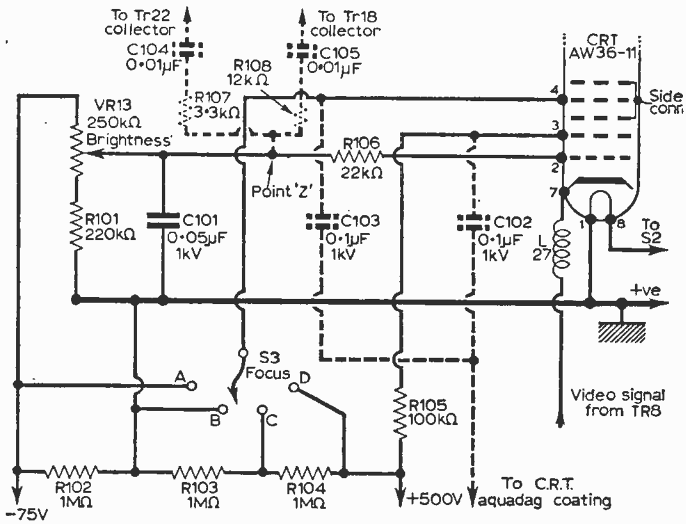
Fig. 35—Display of field sync pulses.

The C.R.T. Control Unit

This small unit is strictly not essential, for the various elements could well be dispersed among the other units already built. However it has the advantage as a separate circuit that all the d.c. supplies to the c.r.t., except heater and e.h.t., are controlled at one point and this is very handy for servicing and layout. It is not expected that any major servicing will be needed, for the chief cause of failures is usually heat in one place or another and this receiver develops negligible heat. However, volume controls and other variable resistors do wear out in time!

The theoretical circuit is shown in Fig. 36, and the suggested etched circuit in Fig. 37.

There is nothing special about the etched current layout, which may be altered as desired as long as high-voltage points are well insulated. Note that there is no battery −ve connexion. The socket which is mounted on one shorter end of the circuit board is one of the small and popular non-reversible fly-and-socket components widely available for connecting h.t. and l.t. batteries to radio receivers. Only the socket is here used, to enable a suitable focus voltage to be selected.



The range of focus voltage available is −75 to +500V and the tap giving best results should be selected for the particular tube supplied. In the prototype +500V gives the finest focus, but other tubes of the same type may need another setting. A small cut-out is made in the etched board to accommodate the socket. The wander plug to fit the sockets is taken from the plug supplied, soldered on to the end of a flex lead long enough to stretch from its printed circuit board connexion to any of the sockets A, B, C or D.

This small unit is, in the prototype, mounted below the chassis on 4BA screwed rod. It may however be put in any convenient place, according to receiver layout.

The Flyback Blanking Unit

Fig. 38 shows the way the c.r.t. grid connexion is wired to receive the flyback pulses from the two scan generators. This assists in removing from the picture the return traces of the scanning sweeps. There are, of course, blanking pulses in the transmitted wave-form, and this reaches the c.r.t. cathode. However, their amplitude is not great in any case, and since the video amplifier is called upon to give a relatively high voltage output for video it may well be worth working on a non-linear part of its characteristic as far as these pulses are concerned. Hence, their amplitude tends to be less than necessary unless such an aid is provided.

Line Scan Linearity Control (L28)

Because of resistances in the line output stage—either direct ohmic resistance or by way of losses—the early part of the scan is not quite linear enough to give the perfect picture. Accordingly, a conventional correcting circuit is employed which makes use of a saturable reactance. The required components are Mullard core type FX1054 and magnet M2529.

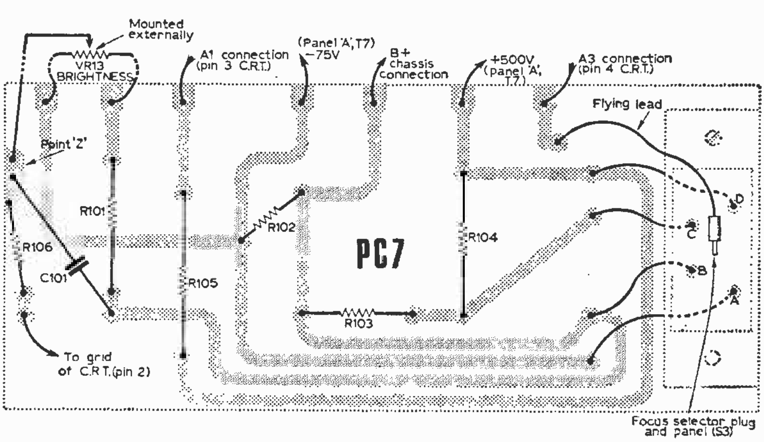


Fig. 36 (above) and Fig. 37 (below)—Circuit diagram (parts shown dotted are not on PC7) and printed circuit board PC7 (shown actual size) of the c.r.t. control unit.

These may be subject to delay in delivery, and in the prototype a 1in. length of ¼in. diameter ferrite aerial rod was used instead, together with a couple of small bar magnets. This worked quite well—is still in use. L28 comprises 48 turns of 20s.w.g. enamelled copper wire, wound in two layers each held firmly with Sellotape. It is wired in series with the deflector coils. The adjustment required is to magnetise the core sufficiently, that almost as soon as scan current flows it saturates and its inductance drops to quite a small value. This is done by mounting one (or perhaps two, if temporary arrangements have to be made!) bar magnet close to the reactor. The polarity needed is found by trial and error, and so is the position of the magnet. Once adjusted the two can be bound together with Sellotape; no further alteration will be required. The connections to the scan coils and L28 are given in Fig. 39.

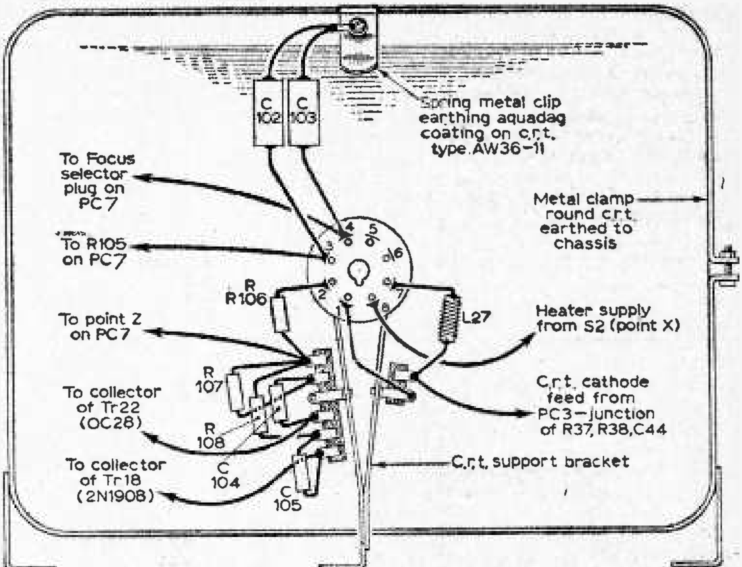


Fig. 38—C.R.T. base connections and flyback blanking circuit layout.

Assembling the Receiver

Certain precautions are necessary when the various units of the receiver are collected together into the relatively small compass dictated by practical considerations. Room has to be found for the loudspeaker, in addition to the assemblies already described, and while the location of the units is not critical, there are certain things which must not be done, and others which should be done.

To begin with, the line output transformer must not be too close to the middle part of the cathode ray tube. There is a considerable magnetic field associated with this component, and it varies from the beginning to the end of the scan. Although a "closed" magnetic circuit, there is a good deal of leakage in practice, and distortion of the raster is possible. The best place on a limited chassis is as far away from the tube as convenient, and nearer the base of the c.r.t. than elsewhere. If some distortion is encoutered a small bar magnet can correct it quite well. Its position must be found empirically.

It is also important that the line scan transformers are not too near the a.f. transformers of the sound receiver but much more is it necessary to separate the latter from the frame scan components. If too close, a pronounced hum at 50c/s will be heard in the loudspeaker.

The tuner unit can go nearly anywhere, and so can the sync unit and the c.r.t. control unit. The various adjustments needed can be made on the bench, and there will be no call for alteration later. However, the "setting-up control" VR4 in the line scan generator may need alteration if the receiver is to be used in conditions of widely different ambient temperature, and so this should be placed in a position which is reasonably accessible without having to put fingers too near the 500V terminal. It is by no means simple to arrange to compensate this temperature dependence; but experiments are currently being undertaken, and in a short time the necessary modification (replacement of part of the timing resistor of the line scan oscillator by a positive temperature coefficient resistor) will be published.

Because of the effects of ambient temperature, it is preferable to mount the "hold" controls on the front of the receiver. In the prototype they are

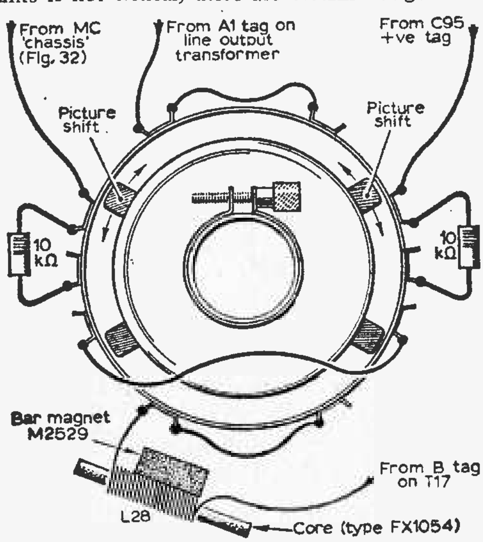


Fig. 39—Scan coil connections.

Fig. 40 (below)

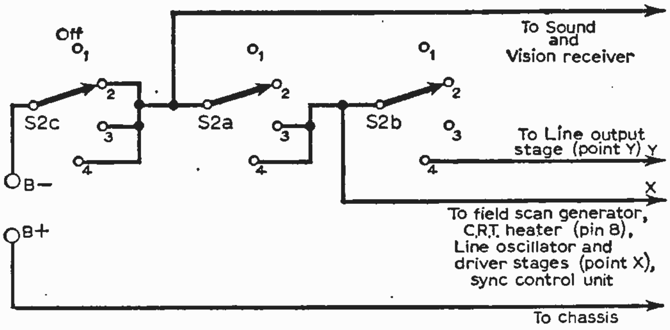
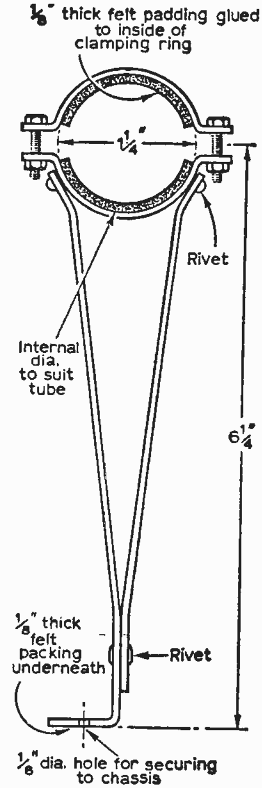


Fig. 41 (right)



fitted with smaller knobs than the main controls, to distinguish at a glance.

The function switch is arranged as in Fig. 40.

The reason for this is twofold. In the first place, it may well happen that only the sound is required, especially when using an accumulator with the receiver. The second switch "on" position enables the line oscillator to attain its steady frequency before the output stage is switched on. It might well be possible to do without this intermediate switching, but the writer has not cared to risk it! The line whistle can be heard very faintly, so this switch position ensures that the operator knows all is well before switching in the line output transistor.

It is worth remarking that this receiver uses a 14in. cathode ray tube requiring 90° deflexion, and therefore does not come into the category of receiver using a tube requiring only 42° deflexion, for which the line scan requirements are quite modest. While such tubes have their place, this receiver requires the output transistor to operate close to its limits, and although a good safety margin has been left it will be prudent at all times to exercise care.

Fig. 41 shows c.r.t. neck support bracket.

Power Supplies

Since either accumulator or car battery can provide power, as well as the mains unit already described, a chassis-mounted plug should be provided. The free sockets, on the end of appropriate leads, can then be plugged-on, whichever supply it is desired to use. There is difficulty in obtaining such components commercially, and the usual non-reversible plugs and sockets used for domestic electricity are not suitable because of the serious chance that some day somebody will plug the receiver direct into the main. The solution to this problem is one which constructors will have to solve out of their own resources. There are some reversible components on sale, but these are best avoided for obvious reasons. If use has to be made of such components, a power diode *MUST* be wired in series with the supply so that if a plug and socket are connected the wrong way round no harm will be done. For this purpose the collector-base junction of a germanium power transistor is very suitable. If a silicon rectifier is used, the IS411 is suitable; its voltage drop on load is not high and little effect will be noticed on the working of the receiver. The chassis can act as the heat sink for this diode, and it will then be best to wire it in series with the B+ lead.

Conclusion

Where new techniques are introduced, it is likely that a good many queries may be raised at first, and readers intending to build this receiver are asked to let the Editor know. This will enable some kind of estimate to be made of the possible enquiry load which may be involved, so that maximum assistance can be given as needed. Readers will appreciate that most help is possible if the components used conform to specification, where one is given. For example, if AF116 transistors were used in the i.f. stages instead of the specified OC171 virtually a complete re-design would be involved, especially in the centralising circuits, and the overall gain would be very different from what was expected.

Specifications have therefore not been given unless necessary, for one 100μF 12V working electrolytic capacitor will not differ much in its electrical characteristics from one of another make. However, good quality components are most desirable, lest failure should have dire consequences in damage to other components. Mostly the design is "fail safe". A good deal of attention has been paid to this point, but there are of course positions in the circuit where it cannot be done except at great expense or inconvenience, as for example in the case of the brilliance control potentiometer. If during construction equal care is given to soldering and the placing of components, a sound electrical and mechanical job will result whose performance will not disappoint. It is confidently claimed that this receiver is in a class of its own as regards picture and sound quality, consistency of performance and versatility of application.

Concluding Notes Next Month

UNDERNEATH

THE DIPOLE

THE plushy premises of the Independent Authority in Brompton Road, London, are well planned. The comfortable offices, conference rooms, viewing rooms and restaurant are good to look at, warm in winter and well ventilated in summer. *Fresh air* has been a feature of ITA and of ITV programmes with a few notable exceptions.

Fresh air seems to be seeping into the premises and programmes of the BBC, too, with a marked decline in the number of downbeat, unwholesome and neurotic dramas, belligerent and ill-mannered compères, less foul language and with more sense of responsibility. A great deal of credit for the improvement (which has still a long way to go) is due to the "Clean Up Television" campaign of the Viewers and Listeners' Association. This organisation claimed the credit for the demise of TW3 and *Not so much a Programme* and other mildly amusing but allegedly smutty and malicious BBC programmes.

According to *The Stage* newspaper, this campaign was followed up by a letter to the Prime Minister calling for the Government to insist on the resignation of the BBC's Director General, presumably because he should be held responsible for the irresponsibilities of some of his programme producers.

Times and headmasters have changed since the days when Lord Reith ruled the BBC. Nowadays headmasters seem to pat naughty little boys on the head for writing rude words on the walls instead of giving them a walloping. The name "nonconformist" once applied solely to specific religious principles; it now also seems to apply to rule-breaking teach-ins as well as law-breaking bust-outs. It also applies to the uproariously funny Milligan and other Goon shows in which Aunty BBC gags herself—and is (almost) forgiven!

Censorship

The modern trend is to deride the rigidity of censorship. The British Board of Film Censors (at one time T. P. O'Connor M.P. was its president) had a list of 43 specific items for which objections could be made. These were as clear and concise as a technical specification drafted by the British Standards Institution.

Alas, the only BSI Censorship specification concerns the size and shape of the actual classification certificate "U", "A" or "X". The moral standards of the theatrical stage have been safeguarded by the Lord Chamberlain and though performing licences are more easily granted than they used to be, evasion is carried out through the back door by turning small theatres into clubs for members only.

If the BBC feel there is a public demand for a specifically unsavoury wavelength, they should acquire the special exclusive technical facilities of the remnants of PAY-TV and follow the example of the Court Theatre, London, which became a club for a recent production not approved by the Lord Chamberlain.

The 43 Rules

For the information of writers of television plays, the 43 rules of the British Board of Film Censors which were publicly revealed on 30th April, 1917, by Mr. T. P. O'Connor seem a little out-dated in this day and age. Nevertheless they might provide a useful 50-line imposition for writers and producers in lieu of the cane! How difficult for them to write a scenario today without breaking these rules, and yet good and entertaining scripts for films and plays were written in 1917 which were produced, declaimed, "hammed" or sub-titled. This is now a matter of history.

Turning from these 1917 admonitions to the exhortations of 1965, we note that nearly 400,000 people have signed the Clean-Up Television Manifesto, in which clause 3 states:

We deplore present day attempts to belittle or destroy it, [a Christian way of life] and in particular we object to the propaganda of disbelief, doubt and dirt that the BBC pours into millions of homes through the television screen.

If 400,000 people take the trouble to sign their names on a Manifesto, followed up by critical verbal missiles in the House of Commons, then something has to be done—and, indeed, will be done. Never let us hear again such remarks as "the reputation of the BBC has reached a low level as it has ever known in our lifetime" which Mr. King, M.P. for Dorset South said—with justification.

It is a pity that the excellent work of the majority of BBC programme executives should be tarred and feathered with the brush intended for the few with the arty-crafty nitty-witty brains. The P.M.G. (and previous Postmasters General) always keep up a defensive line of talk which is not always convincing.

The House of Commons

A visit to the public gallery of the House of Commons discourages most spectators from the possibility that such debates will be put on television. Modern sensitive television cameras and complicated microphone set-ups might make this technically possible, but the proceedings would be dreadfully dull unless subjected to careful editing of taped or filmed recordings. Who would be suitable or willing to

43 CENSORSHIP RULES (1917 VERSION)

1. Indecorous, ambiguous and irreverent titles and sub-titles.
2. Cruelty to animals.
3. The irreverent treatment of sacred subjects.
4. Drunken scenes carried to excess.
5. Vulgar accessories in the staging.
6. The modus operandi of criminals.
7. Cruelty to young infants and excessive cruelty and torture to adults, especially women.
8. Unnecessary exhibition of feminine underclothing.
9. The exhibition of profuse bleeding.
10. Nude figures.
11. Offensive vulgarity and impropriety in conduct and dress.
12. Indecorous dancing.
13. Excessively passionate love scenes.
14. Bathing scenes passing the limits of propriety.
15. References to controversial politics.
16. Relations of Capital and Labour.
17. Scenes tending to disparage public characters and institutions.
18. Realistic horrors of warfare.
19. Scenes and incidents calculated to afford information to the enemy.
20. Incidents having a tendency to disparage our allies.
21. Scenes holding up the King's uniform to contempt or ridicule.
22. Subjects dealing with India in which British officers are seen in an odious light and otherwise attempting to suggest the disloyalty of native States or bring into disrepute British prestige in the Empire.
23. The exploitation of tragic incidents of the war.
24. Gruesome murders and strangulation scenes.
25. Executions.
26. The effects of vitriol throwing.
27. The drug habit, e.g. opium, morphia, cocaine, etc.
28. Subjects dealing with white slave traffic.
29. Subjects dealing with the premeditated seduction of girls.
30. "First night" scenes.
31. Scenes suggestive of immorality.
32. Indelicate sexual situations.
33. Situations accentuating delicate marital relations.
34. Men and women in bed together.
35. Illicit sexual relationships.
36. Prostitution and procuration.
37. Incidents indicating the actual perpetration of criminal assaults on women.
38. Scenes depicting the effects of venereal disease, inherited or acquired.
39. Incidents suggestive of incestuous relations.
40. Themes and references relative to "race suicide".
41. Confinements.
42. Scenes laid in disorderly houses.
43. Materialisation of the conventional figure of Christ.

undertake that colossal responsibility? And what about the make-up, hairdressing and sharp suits that MPs would feel compelled to adopt to become pin-ups for their viewing constituents?

Individual performances in party political broadcasts vary a great deal in their appeal, and the best man doesn't always win. If we don't watch out, national policies will be governed by personalities whose principal assets will match the good looks, charm and sheer theatrical professionalism of the star compères and disc jockeys! MPs will rush to the division lobbies looking like juvenile leads beating the clock.

Surrealism

In the strain to catch the attention of newspaper television critics and the judges at television festivals, new styles, techniques and gimmicks are injected into individual TV plays as distinct from TV series. The reaction of one important critic to the second Granada play by Edward Albee *The American Dream* was discouraging to say the least. His laconic comment on the second work of this prize-winning author was that "a third would give a real fillip to BBC's share of audiences". The intentions and messages of the author, Mr. Albee, were designed to be an attack on the substitution of artificial for real values in our society. This was not conveyed by the surrealistic pattern of dialogue, hard to "take" for many minutes without switching over to another channel. This, on BBC proved to be another episode of *Slattery's People*. Very professionally made, it duly reached its finale with the problem unsolved, excepting that the author was assisted by the modern uprising "curtain" of endless credit titles.

End Credit Titles

What a blessing these end credits are for authors! Stories which have no ending (and often no middle) are becoming as gerry-built as some of the modern prefabricated houses. They have contrived foundations, not much that is solid in bricks and mortar, no damp course, but plenty of cavity, in the walls. A satisfying ending to a play is more difficult for the author to achieve than the beginning; the intrusion of the end credit-titles is a cheap way out, for which he is entitled to a reduction in remuneration. Compare these incomplete story-lines with those in old cinema films recently transmitted, such as *The Cruel Sea* and *Scott of the Antarctic*, which survived the intrusion of commercials and twenty-minute interpolations of "What the Papers Say" and demonstrated the value of well-built scripts compared with a well-built house which will stand solid for years—which takes me back to the plushy but practical ITA premises in Brompton Road. Good evening, Lord Hill! Good evening Sir Robert! Good evening, Mr. Pat Bevan! Turned out nice again!

Iconos

PRACTICAL OSCILLOSCOPY

IMPROVEMENTS FOR YOUR 'SCOPE

by H. T. Kitchen

IT is not so very many years ago that the oscilloscope was seldom found outside a professional establishment, and possibly in the hands of a very few enlightened—and affluent—amateurs, being regarded by many as a mystical piece of equipment operated by superior beings. Nowadays the picture has changed considerably and a great many amateurs possess oscilloscopes of varying degrees of complexity, and make good use of them.

Among the many constructors who have built oscilloscopes there must be some who have fallen by the wayside and whose intended pride and joy refuses to behave as it should and leaves its (proud ?) owner scratching his head. Most fortunately a faulty oscilloscope is considerably easier to put right than almost any other piece of test equipment because of its tell-tale c.r.t. screen. The wave forms displayed (or not displayed) on the screen provide a very good clue to the actual fault or faults and are often as good as a written message.

There will also be constructors who, having started with a fairly simple design, have exhausted its possibilities, found its limitations, and long to improve it. The author has at one time or another built oscilloscopes of varying degrees of complexity—with varying degrees of success and feels that he can reasonably offer a modicum of advice to constructors who may be just a little dissatisfied.

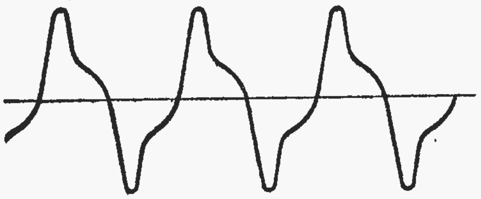
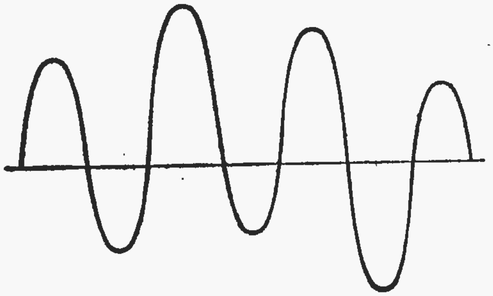


Fig. 1 (above)—Distorted waveform due to magnet interference.

Fig. 2 (below)—Hum pick-up in Y-amplifier causing double trace and undulating waveform.



Mu-metal Screens

It is strange how many constructors ignore the advice to use a mu-metal screen round the c.r.t. and then wonder why their waveforms consist of rather more squiggles than they legitimately ought to. Normally, without an input to the oscilloscope, the c.r.t. should display a straight horizontal line. If the "line" consists of distorted sine waves (Fig. 1) then the trace is being subjected to magnetic interference from the mains transformer. This can be checked by either fitting the c.r.t. with a mu-metal screen or if this is unavailable, by temporarily disconnecting the Y-plates from the Y-amplifier or other circuitry and momentarily connecting them to earth. If the deformation persists it is due to magnetic interference and the c.r.t. will require a mu-metal screen or the mains transformer will have to be re-sited. Mu-metal screens, incidentally, are very peculiar things that lose their efficiency if they are roughly handled or dropped. Sawing, filing or drilling them is tantamount to scrapping them.

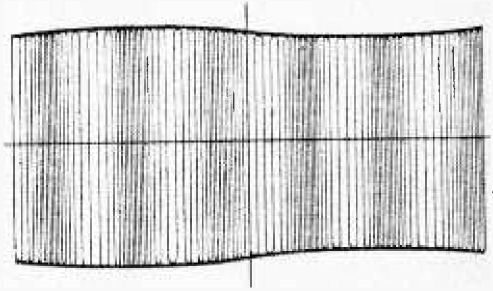


Fig. 3—Hum modulation on the c.r.t. grid.

Hum

If shorting the Y-plates to earth reduces the interference to zero then the cause is not magnetic, and a further search will have to be initiated. The Y-amplifier valves can be removed one at a time from rear to front until the culprit is found. The hum injection could be caused by poorly sited heater wiring, a heater-cathode leak or poor h.t. smoothing. Hum pickup in the Y-amplifier will also be shown as a double trace if the timebase is run at a few cycles above or below 50 c/s and the Y-amplifier fed from

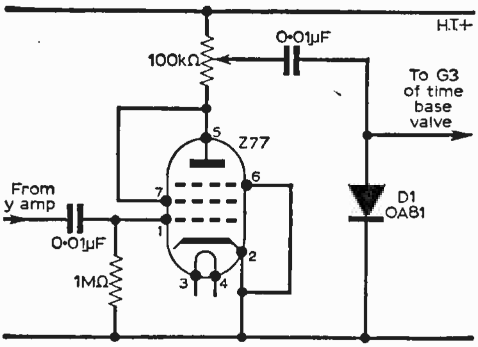


Fig. 4—Sync amplifier with variable output.

the heater line. Fig. 2 shows the trace to be expected, which will undulate up and down.

Hum in the tube circuit can also cause some queer effects if it is impressed upon the grid. This effect is most noticeable if the timebase is set to a frequency much slower than the Y-signal input, the result being a luminous rectangle with vertical stripes (Fig. 3). Unless grid modulation is to be used a capacitor from grid to cathode should cure this fault, the actual value required being experimentally derived. If grid modulation is necessary a resistor will have to be included in series with the capacitor, the value again being experimentally determined. The ideal is a combination of R and C that suppresses the hum but not the modulating voltage. The voltage from grid to cathode is usually quite low so a low voltage component will suffice. The voltage from grid and cathode to chassis however is likely to be quite high, being practically the whole of the e.h.t. voltage, so that some care is necessary in siting the additional components.

Timebase Sync

The synchronising of the timebase to the signal in the Y-amplifier is something which does not always receive the attention it merits and yet it can make the difference between an oscilloscope that is a joy to use and one which one is tempted to throw out of the window. Too little sync results in the image continually sliding out of lock whilst too much can cause jitter and waveform deformation. A separate sync amplifier with variable output is a most desirable accessory and Fig. 4 shows a suitable circuit which could be incorporated into almost any oscilloscope without too much trouble. The valve can be almost any pentode strapped as a triode, the Z77 or EF 91 proving eminently suitable. Due to its cathode being earthed it operates, without any bias, as a clipper or limiter of positive peaks, passing mainly the negative going peaks which are applied to the suppressor grid of the timebase oscillator valve. The OA81 diode serves to further suppress any positive going peaks which may be passed by the valves. The 100kΩ potentiometer in the anode circuit is the variable output control which allows just the right amount of sync to be applied to the timebase oscillator valve.

On some simple oscilloscopes no provision is made for blanking the flyback stroke of the timebase. For simple sine waveforms this can be tolerated, but where complex waveforms are to be viewed, flyback suppression is much to be desired and again is not difficult to incorporate in any oscilloscope lacking it. Fig. 5 shows the essentials and although an EA50 single diode is shown, a double diode such as a D77 or 6AL5 could be used in which case the spare diode could be used for the OA81 diode of Fig. 4. Some experiment with component values may be necessary, particularly the 0·01μF capacitor to the grid. This should be kept as low in value as possible and must be a first class component, since any failure in its insulation could be disastrous for the c.r.t. A thermionic diode was suggested in preference to a crystal or germanium diode because it is less likely to be irreparably damaged if circuit conditions and voltages are not quite what they should be, though this should not deter the intrepid experimenter.

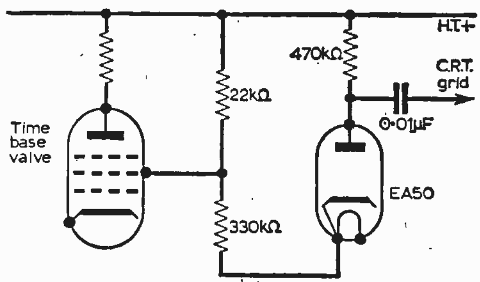


Fig. 5—Flyback suppression utilising an EA50 valve.

Timebase Coupling

Coupling between the Y-amplifier and the timebase is all very well when it is wanted such as for experiments in the sync stage. Unwanted coupling whether due to inadequate mechanical screening where the two circuits are close to one another or to an insufficiently decoupled common h.t. supply can give rise to some very peculiar and puzzling faults. Fortunately, the offending waveforms usually give a good clue to the actual fault which can be further verified by additional faultfinding. Fig. 6 shows the result of cross coupling which, incidentally, is rather

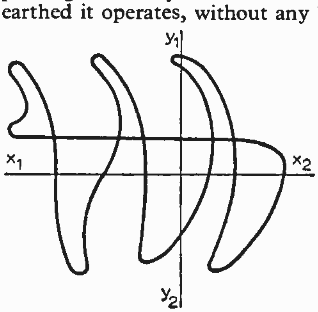
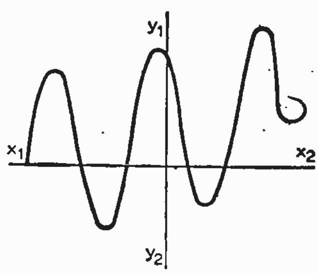


Fig. 6 (left)—Effects of cross coupling between circuits.

Fig. 7 (right)—Unwanted coupling between timebase and Y-amplifier input.



similar to the effect caused by excessive sync. If a metallic screen is interposed between the two circuits and the symptom stops the cure is obvious. If not, further generous decoupling of the h.t. line must be tried whilst severe cases may require a bit of both.

One bad case of interference the author once investigated was caused by the timebase voltage affecting the Y-amplifier and was due to a badly sited capacitor from the Y-amplifier to the sync stage picking up the t.b. voltage and re-radiating it into the front end of the Y-amplifier where it could do the most damage. This unintentional two-way, instead of the intended one-way traffic, caused the displayed waveform to lift up at one end as shown in Fig. 7.

Sensitivity

It is not always realised by intending constructors that the ultimate sensitivity of an oscilloscope is dependent on the value of e.h.t. voltage applied to the c.r.t. The higher the e.h.t. voltage the greater is the input required to the oscilloscope to provide an equal amplitude waveform on the c.r.t. This is due to the increased e.h.t. increasing the velocity of the electron beam which provides the waveforms necessitating an increase in the deflecting voltage. This is no disadvantage—up to a point, the point at which the amplifier cuts off or otherwise distorts, this usually taking the form of crest slicing which can almost always be attributed to the output stage. In the author's opinion the oscilloscope should be able to provide a waveform of at least one screen diameter before distortion sets in so that some sort of compromise is required. Either the e.h.t. will have to be reduced or the Y-amplifier redesigned, perhaps even both.

Almost all oscilloscopes benefit from symmetrical or push-pull output stages being used to feed the c.r.t. unless the c.r.t. is specifically intended for single ended working. Although many simple oscilloscopes feed the c.r.t. direct from the t.b. or main Y-amplifying stage there is much to be said in favour of a separate push pull output stage. Fig. 8 illustrates such a stage which could be incorporated into many simple oscilloscopes without too much difficulty and is equally suitable as an X or Y output stage.

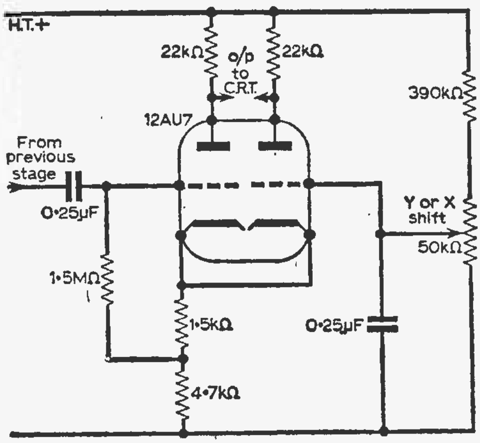


Fig. 8—Symmetrical deflection amplifier.

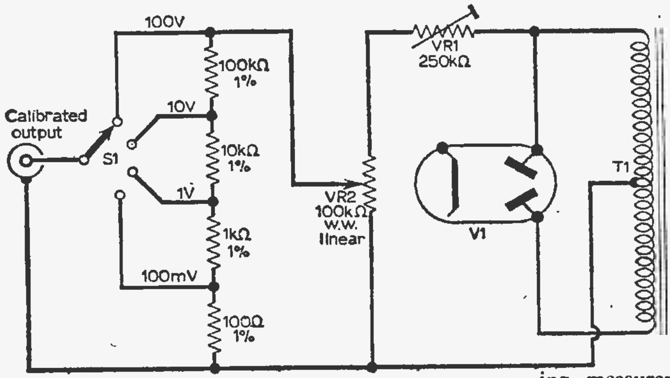


Fig. 9—Voltage calibration circuit giving a fairly high degree of accuracy.

Although the oscilloscope is often used for the sole purpose of waveform examination, it can also be used for quantitive measurement of time and frequency. It is not possible to do this directly with great accuracy due to circuit drift and component tolerances. Indirectly however a quite high level of accuracy can be achieved and fairly simply where voltage calibration is concerned.

Graticule

In order to measure voltage or time, a graticule is essential in front of the c.r.t. Although some people prefer a grid of vertical and horizontal lines every 5 or 10 mm. the author personally prefers a simpler graticule which consists of just one vertical and one horizontal line intersecting at the c.r.t.'s centre line. These are then subdivided every 5 mm. with alternate lines 5 mm. and 10 mm. long and have the important advantage of allowing measurement without obscuring any part of the waveform, which the type with multitudinous lines is apt to do.

The most common method of voltage calibration is by comparing a known voltage against the unknown one. This can be achieved by using the circuit of Fig. 9 by means of which any voltage from 100V to under 10mV can be measured to a fairly high degree of accuracy. The transformer T1 and the rectifier V1 are the existing h.t. supply components, into one side of which are connected the two potentiometers VR1 and VR2 in series. The principle which will be apparent to the experienced reader is somewhat as follows. VR1 is adjusted to provide a certain predetermined voltage across VR2. From the slide of VR2 are connected four 1% high stability resistors which further tap off this voltage in increments of 10. By making VR2 a linear component and providing it with a scale divided into 10 or 100 parts any desired voltage can be obtained. The unknown voltage is caused to set up a waveform of unknown amplitude on the c.r.t. and

—continued on page 568

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

Jera Trade Fair

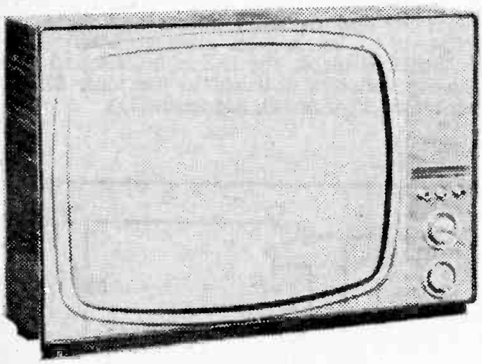
THE first Trade Fair organised by the Japanese Electrical and Radio Importers' Association will include a range of new miniature radio and TV receivers. Products bearing National, Sanyo, Standard, Crown, Sharp and Eagle trade names will be among those exhibited.

The fair will be held at the Europa Hotel, London, from August 23rd to 26th.

Panoramic 23in. Receiver from Baird

CURRENT release from Baird TV Distributors Ltd. is model 652, a compact 23in. dual-standard receiver having a panoramic viewing tube. This tube is specially designed so that it needs no safety screen and an advantage is the absence of space to contain dust, ensuring that the picture remains bright throughout its life.

The circuitry is designed with ease of access for service very much in mind; the cabinet is of sapele veneer with high-gloss polyester finish and gold frontal coverings. Working voltages: 200-250V a.c. and 210-250V d.c. Width is 27in., height 18$\frac{7}{8}$in. and depth 16$\frac{5}{8}$in. Matching leg stands are an optional extra. Model 652 retails at 76 guineas. *Baird TV Distributors Ltd., Empire House, 414 High Road, Chiswick, London, W.4.*



Model 652 receiver from Baird

Tuner and Switch Cleaner

TUNE-O-LUBE is a new tuner and switch cleaner which does not affect plastic parts. It cleans and lubricates in one operation, is non-toxic and non-flammable.

A needle-thin spray aid is supplied with each aerosol can. The price of an 8 oz. aerosol is 18s. 6d. nett trade. *D.T.V. Group, 126 Hamilton Road, West Norwood, London, S.E.27.* (Trade only or through your local retailer.)

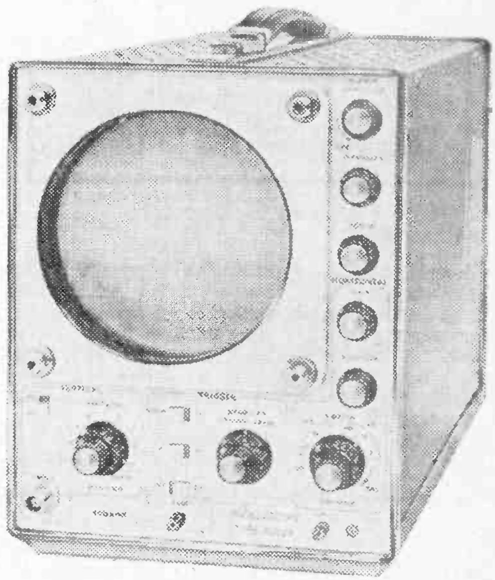
Portable Oscilloscope

THE Roband oscilloscope range—marketed in the UK by Livingston Laboratories Ltd.—now includes the Model R0501 which is a small ultra-portable 'scope costing £79. The R0501 has a 5in. c.r.t. operating at 3·3kV and employs a printed circuit board with all the main components coded.

It has a bandwidth of d.c. to 6Mc/s, a risetime of 55 nanoseconds, sensitivity 50mV/cm to 20V/cm covered in 9 calibrated ranges, and a measuring accuracy of ±5%.

The sweep range is 1 μSec/cm to 100 μSec/cm in six calibrated steps and a 10:1 continuously variable control extends the range to 1 Sec/cm; a X5 variable magnifier offers a maximum sweep speed of 200 nanoseconds/cm. Sensitivity is: internal, 5mm and external 4V peak to peak.

The overall size is 9$\frac{7}{8}$in. high, 14$\frac{3}{4}$in. deep and 7$\frac{1}{2}$in. wide. Weight is 17$\frac{1}{2}$lbs. *Roband Electronics Ltd., Charlwood Works, Lowfield Heath Road, Charlwood, Horley, Surrey.*



Roband portable oscilloscope

Servicing TELEVISION Receivers

No. 117: Pye, Pam, Invicta, Ekco, Ferranti and Dynatron switchable models, including: Pye 3, 11, 12; Pam 5100, 5102, 5106; Invicta 7013, 7019, 7020; Ekco T418, TC419, T420; Ferranti T1093, TC1094, T1095; Dynatron TV70, TV71, TV72. See text for full list.

by L. Lawry-Johns

No Valves Alight

A quick run along the mains dropper will often reveal the fault in next to no time. An open circuited mains dropper section is by no means rare. The neon screwdriver may be used for this quick check. It should light at all tags if the sections are intact and if the chassis is not live. It is not a difficult matter to follow the heater chain through if the dropper is intact.

White Line Across Screen

This of course denotes a failure in the field (frame) timebase. The VA1054 thermistor wired in series with the deflection coils sometimes becomes open circuit and this component should not be overlooked if the PCL85 and associated voltages appear to be in order.

Loss of Vision Signal 405

If the sound is in order and a blank raster can be resolved when the brilliance is advanced, attention should be directed to V6 (PCF80), the vision detector V7 and its series chokes and the video amplifier V9. V6 is most often at fault. This fault would result in the loss of both sound and vision signals when switched to 625 with BBC-2 being received (or rather, not received!)

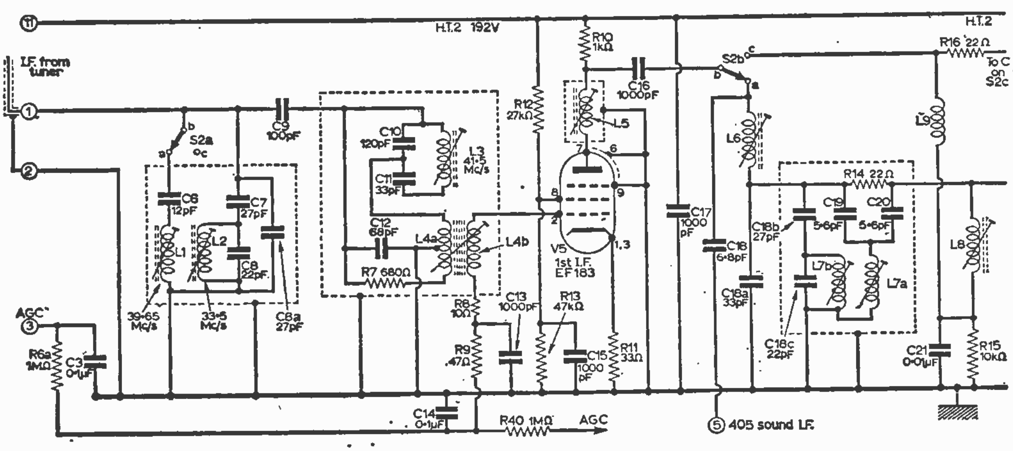


Fig. 4—Invicta 7019—showing i.f. stages common to vision and sound channels.

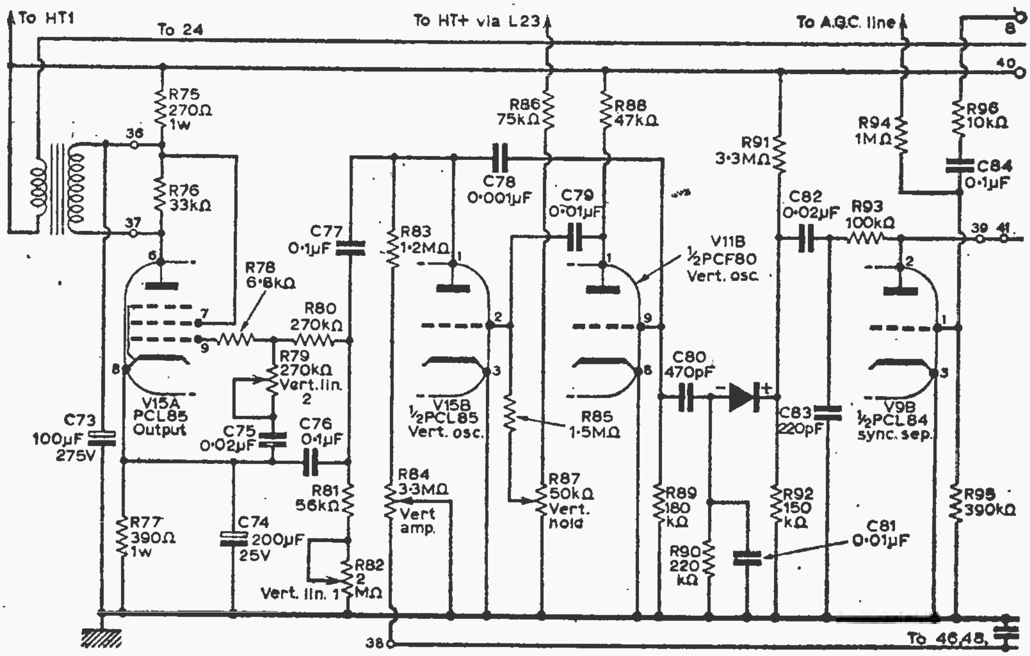


Fig. 5—Invicta 7019—Field time base generator and sync separator.

No Sound, White Line Across Screen

Replace V11 (PCF80) which is the sound i.f. amplifier and part field oscillator. These functions are performed when switched to either standard.

Fuse Blows

If a replacement blows at the instant of switching on, check the BY100 silicon rectifier which may be shorted, the 1800pF 400V a.c. capacitor

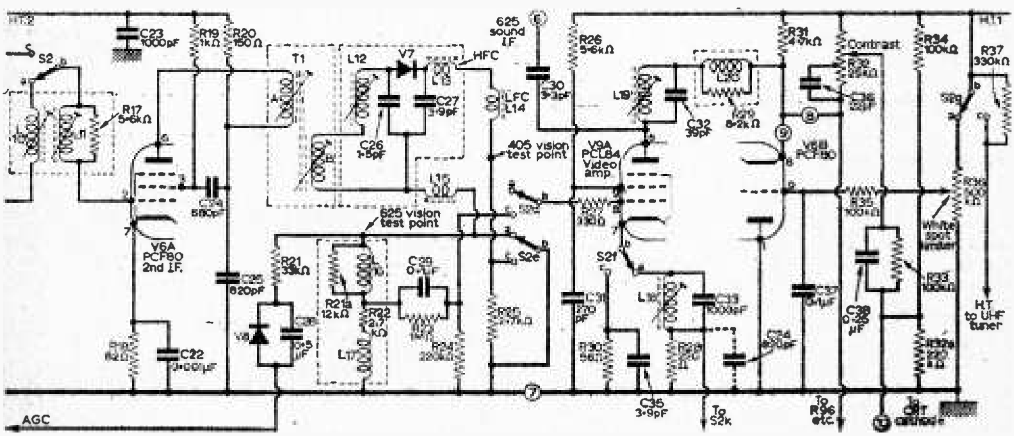


Fig. 6—Invicta 7019—vision i.f., detector and video stage.

wired across it and the 0·02μF (C39) 400V a.c. capacitor. If these items are not at fault, check the electrolytics and valves for shorts, and of course C68. If the fuse only blows when the line timebase warms up suspect the PY800 efficiency diode.

If the fuse has failed but a replacement does not result in anything happening except the valves warming up, check the voltage dropper sections R68, R69, R70 and if one is o.c. and marked, check above before replacing.

Bottom Compression

If the bottom of the picture is compressed with lack of height, the upper part being elongated although not filling the screen, check C74 (200μF 25V) electrolytic capacitor. If these symptoms are more apparent when the receiver is first switched on but gradually improve, replace V15 (PCL85).

Lack of Height

If the picture will not fill the screen with an equal gap top and bottom, check R83 (1·2MΩ) to pin 1 of the PCL85 from the height (Vert. Amp.) control. If there is a difference between the amplitude of the two standards, e.g. screen is filled when switched to 405 but lacks height when switched to 625, set up the field equalisation system in the following way. Ascertain which switch position gives the highest boost line voltage at tag 45 or 26 (pin 3 on c.r.t. base as alternative) then plug the vertical amplitude flylead (field oscillator feed) on to the appropriate tag for the system with the highest voltage. This can be tag 46 (405) or tag 48 (625). Then equalise the height by means of the equalising control—preset control R115. The circuit shows that the boost line is direct to tag 46 switched to 405 and indirect via the control to tag 48 in the 625 position.

Preset Width Controls

These on most later models are R111 and R112. They are switch selected and vary the line drive bias to the PL36 by applying a backing off voltage to the control grid.

Early models produced late in 1962 had the preset positions shown in Fig. 1 (last month) for the Invicta 7039. Remember that this is the *front* view as would be presented with the chassis swung down.

Contrast

The main contrast control operates by dividing the output from the video amplifier to the c.r.t. cathode. It has no effect on the a.g.c. line at all The preset contrast R42 varies the degree of effect of the a.g.c. voltage. This is the control which should be adjusted if cross modulation is apparent, i.e. vision buzz on sound, sound modulation on the picture.

Fault Tracing

Before tackling a fault on these receivers it is essential to study the valve functions (on each standard) and fully appreciate what these functions are. Once this is done, tables given in the May issue of PRACTICAL TELEVISION should enable the fault to be quickly located and rectified. The tables referred to were included in the excellent series of articles by H. Peters—A Viewer's Guide to TV Servicing.

PRACTICAL OSCILLOSCOPY

—continued from page 564

without altering the oscilloscope gain control the voltage calibrator is connected in circuit. VR2 and S1 are then adjusted to provide a waveform of similar amplitude, and the voltage is read off the scale. Where there is space available in the oscilloscope the voltage calibrator could be made an integral part of it with the output brought out to a terminal or socket on the front panel. Lacking such space the calibrator could be made up in a small box or cabinet in which case T1 could be replaced by a small converter type of transformer.

Word of Warning

It would not be out of place to conclude this anthology of hints and tips with a word of warning. From time to time the author has stated that some experiments may be called for to ascertain the exact component value required. This is quite safe if one takes adequate precautions against electrical shock by disconnecting the mains and shorting out high value, high voltage capacitors, not by a screwdriver which doesn't do the capacitor (and some people's nerves!) any good, but by a low value resistor. Although it is unlikely that the average e.h.t. circuit will be fatal it can cause severe shock and burns. Switching off may add several minutes to an adjustment or modification —it could however save your life!

LETTERS TO THE EDITOR

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

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

TEST CASE QUERY

SIR,—I would like to comment on one of your Test Case answers. It is No. 29, Bending of Verticals at the top of the picture. Firstly, this fault can be one of the most difficult to trace, and it is very rarely cured by shifting of the ion trap magnet (which is practically extinct now). We have had several faults like this one in our service department and they have been caused by variations in the components in the time constant components in the sync circuit, faulty diodes in the flywheel sync or excessive damping in the line amplifier stage. These faults can only be traced and cured by the proper use of an oscilloscope and using it with a service manual.—S KELLY (Portlaoise, Ireland).

We agree with Mr. Kelly that tracing the cause of bent verticals at the top of a picture can present something of a problem, diagnosis often being aided by the use of an oscilloscope. Of course, even when such an instrument is available, one needs to be well versed in the normal waveform characteristics of the set under examination. The waveforms differ between sets. In this respect, it would certainly help if all circuits and service sheets of TV equipment indicated the nature and magnitudes of the waveforms to be expected at the various places in the timebase and sync circuits. Even so, with regard to sync troubles, the waveform display can be confusing if the timebases themselves are left running. One could, of course, make many comments concerning fault diagnosis with an oscilloscope. We are hoping soon to publish a down-to-earth article along these lines, using the waveforms actually picked up from defective and normal sets as illustrations.

Regarding the ion trap comment, while we thoroughly agree that sets of current vintage have almost completely passed the ion trap era, there are, nevertheless, millions of sets of the old kind still in active use. Mr. Kelly, of course, sees more of the new ones (being in business) than the ordinary viewer and TV enthusiast. We make no apologies, therefore, for including the ion trap possibility of bent verticals in our Test Case feature. Indeed, it is not generally well known that the symptom can, in fact, be caused by beam distortion. The author has known several technicians who have roamed merrily for hours round the sync separator and pulsed sections of the set, only later to find the trouble caused by simple ion trap maladjustment!—Editor.

TEST CASE AND PROBLEMS

SIR,—With reference to A. J. Littlewood's letter in the June issue of *Practical Television* criticising Test Case and Problems I have this to say: There is a saying in the police force that if you let them talk long enough they will convict themselves and this is what I think he has done. Firstly I ask: Why does he read *Practical Television?*—presumably because he is unable to trace faults with the information supplied by the manufacturers' service sheets.

Thank goodness we still have a few men like Gordon King who not only make television equipment but help the lesser informed to make their own.—A. E. GREEN (Moatlane Taynton, Gloucestershire).

DX IN THE SHETLANDS

SIR,—I should like to tell you of DX reception obtained here in the Shetlands. I switched on at 8 p.m. and received channel 3 with the picture all broken up and sound like a two-stroke motor-cycle running. On channel 2 there was a double picture from France with no sound and on channel 1 good BBC-1 sound but no picture. On channel 4 there was no picture but an advertisement for Guinness and Rennies and on channel 5 there was good French sound with black bands running across the screen. These conditions prevail throughout the summer and in winter in Shetland BBC-1 channel 3 station is received perfectly and all the other channels are completely blank.—W. G. JOHNSON (Mid Yell, Shetland).

VIDEO TAPESPONDENT WANTED

SIR,—I would like to video tapespond with someone in London so that we can exchange Danish and English television programmes. My video tape recorder is a Philips 3400/00.—SV. ANDERSEN (Bjergmarksvej 12, Brh. Copenhagen).

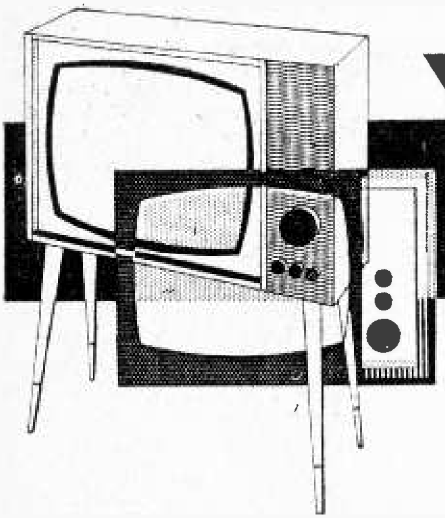
OLYMPIC II (MAY ISSUE)

I.F. inductors L16/L17 consist of 17 and 21 turns respectively, and not as given in Table II. Both coils are close-wound from end to end, and taps can be made, by simply twisting small loops in the wire. The diagrams above Table II give the correct number of turns.

In Fig. 20 a DY80 was shown as the e.h.t. rectifier—it should be DY86. Fig. 19 shows two C84's—the values given in the diagram are correct.

A TRANSISTORIZED E.H.T. VOLTMETER (AUGUST ISSUE)

Table I listed the calibration currents in mA's—this was incorrect, and should have read μA.



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

R.G.D. DEEP 17

The sound is good but there is no picture. Previous to the e.h.t. "going dead" if the set was left on for an hour or two, the picture would gradually come on.

I have replaced the PY81, PL81 and EY51 without success. The EY51 does not light up although there is voltage at the anode of this valve, there is no voltage present at the heater tags. There is a capacitor coupled near this valve rated at 220pF 5kV. Could this be at fault?

Can you give any clue why the current is absent from the heater of the EY51?.—R. Wilson (Consett, Co. Durham).

Check the h.t. voltage. If it is low, check the PY32 h.t. rectifier.

If the line whistle is audible and a good arc discharge is obtainable at the EY51 anode, check the heater winding of the EY51 on the line output transformer. If the PL81 is running hot, check V6 PCF80 on the rear left centre of the chassis. The 220pF 5kV capacitor could be faulty, disconnecting one end would prove this. Check the 0·1μF boost line capacitor.

REGENTONE 10-6

The 1A anti-surge fuse keeps blowing. I have checked L31 choke and replaced the two diodes FST/1/4 by Radiospares type 51A. R98, R9 glows red hot before the fuse fails. There is a faint bright line to the left of centre (vertical).—W. A. Pearce (Welling, Kent).

The trouble could be shorting silicon diodes or shorting electrolytics. Indeed, a short-circuit on the main h.t. line almost anywhere would be likely to cause the symptoms mentioned. Note that surge limiters should be used in conjunction with the type 51A rectifiers.

BUSH TV62

This set has developed the following faults. On switching on, the picture is normal, but within two minutes the sides close in leaving a black strip approximately 1½in. at each side. It was noted that the PL81 glowed blue and a replacement went red hot and did not restore the width. The PY32 valves have also been changed without any effect. The width control appears normal except that reducing the width also reduces the height evenly top and bottom.

The line whistle can be heard and varies with the operation of the hold control.—J. M. Best (Co. Durham).

You should check the screen resistor to pin 8 of the PL81 on the rear end of the tag panel. This may be a 5·6kΩ or a 3·3kΩ 1W component. We would suggest a 2W resistor or a wirewound of approximately this value. Check the ECC82 and the coupling capacitor if necessary.

FERRANTI 17T6

The sound was low and distorted and there was no picture. I changed PL81 which was faulty and the set worked normally for three weeks then the sound became distorted and went low again. I changed PCL83 and the sound was very loud just after switching on but soon became distorted. Also, this valve seems to get very hot. The picture is very good.—T. Wilson (Glasgow, C.4).

Although the new PCL83 could be faulty, it is more likely that the old one damaged the cathode bias resistor wired to pin 7 and changed its value. The correct value is 220Ω.

It is also probable that the 0·01μF audio capacitor from the EB91 via the screened cable to the volume control has become leaky.

PHILIPS 1768U

The raster appears in the centre of the screen about 3in. wide. After about two hours, the picture fills the screen and works perfectly.

The sound is perfect and the e.h.t. appears to be in order.—H. Brown (Orpington, Kent).

If the picture is only 3in. wide, but of full height, check the PL36, PY81 and associated components. Check the PY82 valves if necessary. If the picture is of full width but lacks height, check the centre PCL82 and associated components.

G.E.C., 2001DST

The last three inches on the left side of the screen are cramped. Also, on some programmes, the verticals are wavy. It is just as if the picture had been cut into horizontal strips about half an inch wide and every other one moved slightly to the right. When the next programme starts there is a slight click and the verticals are straight again.—T. E. Greener (North Blyth, Northumberland).

If the distortion is on the left looking at the screen, you should adjust the linearity closed loop sleeve on the neck of the tube and if this is already in the optimum position, check the PY800 efficiency diode.

The other fault-pulling etc is probably due to an inefficient aerial used in a heavily ghosted area.

FERGUSON 546T

This set has cramping at the bottom. The top linearity control works OK. When the height control is adjusted excessive frame bounce occurs. PCL82 valve has been changed, also the bias resistor and its associated 100μF capacitor.—G. Field (Epsom, Surrey).

You should check the two capacitors, 0·02μF and 0·05μF, from the triode anode of the PCL82, and if this fails, the 0·05μF capacitor from the anode of the ECC82. All of these tend to develop leaks after long usage.

MURPHY V410

When the volume is full on it can just be heard, but if the contrast control is advanced, the sound comes on and the picture is far too bright. I have tried a trimming tool in the cores in the tuner but this made no difference.—H. Wadsworth (Cadishead, Manchester).

The symptoms you describe suggest sound i.f. instability. This is usually due to a faulty screen grid decoupling capacitor 0·001μF on the 30F5 sound i.f. valve. This must be replaced with a special Hunts W99 type.

DECCA DM 4C

The trouble with this set is that it needs a new PL81 every three or four weeks.

There is a white line about ¼in. down the screen about one third from the left. At the same time the PL81 glows red hot and the width is about normal, then when inserting a new PL81 the line disappears and there is excessive width even with the control at the maximum setting.—J. Breesuta (Lancaster).

You should replace the resistor to pin 8 of the PL81 (from pin 9 of the PY81). The original value is 4·4kΩ. A wirewound resistor should be used for replacement of approximately this value, say between 2·7kΩ and 4·7kΩ.

MURPHY V210C

The sound and picture quality are both very good with the exception that there is a black space of about 1in. at the bottom of the screen and slight cramping is noticeable.—W. N. Brown (Newcastle upon Tyne 7).

Your fault is possibly due to a defective frame scan generator valve. This is the 20L1 situated on the upper left-hand panel. Check also its associated 50μF cathode bias bypass electrolytic, fitted between pin 4 and chassis.

EMERSON E708

There is sound but no picture. The TV tuner seems to be the fireball type and the coils are not disconnected in any way. The cathode ray tube grid connection only reads 2V and this seemed rather low. The line and frame are working but the frame has tendency to roll.—E. Purkiss (London, W.12).

Since the sound is okay, the tuner must be working. There should be a variable positive voltage on the tube grid, with operation of the brightness control. With control at minimum voltage should be zero, rising as the control is turned clockwise. If this fails to occur on your set, make a careful check of the brightness control and associated circuits.

PYE VT4

After the set has been on for some time, a white wavy horizontal line appears and is followed by several lines and eventually breaks up picture. Turning the contrast right down stops this but seriously reduces the brightness.—J. Read (Nottingham).

We suggest that you check the ECL80 line oscillator valve just in front of the "Black Box", and the PL81 line output valve within the "Black Box".

If the latter is faulty, check also that its screen grid feed resistor (3·3kΩ) has not overheated and changed value.

H.M.V. 1824

The sound is perfect, the raster is perfect, but there is no picture.

This fault started some time ago. The raster and sound would both appear shortly after switching on, but the picture took about ¼ hour. This time lag gradually lengthened to ½ hour then 1 hour until it got to 2 hours.

I have a circuit diagram etc. and have substituted V5, N153, but with no results.—G. Moore (Stoke-on-Trent).

Check the 0·001μF decoupling capacitor from pin 8 of the vision i.f. amplifier to chassis. If this is not at fault, check the XL1 vision detector diode OA60 (or OA70) and then the bias rectifier of the video amplifier (use a 200Ω resistor as a temporary substitute if necessary).

ULTRA VP17-72

When this set is switched on, the brightness seems all right although the control is to its extreme. After a short time, however, the picture goes very dark and eventually disappears.

I have replaced C40, C48 and R48 without any results.—W. J. Banage (Gosport, Hampshire).

The tube itself could drop in emission as it warms up and thus cause the brightness of the picture to fall in sympathy. On the other hand, a short in the tube heater has been known to cause the symptom. Note the brightness of the tube heater when the picture is normal brightness and if there is a dimming tendency, a heater short in the tube should be suspected. Thermistor failure would cut off the heater current in the valves and tube. However, an increase in resistance of this part could reduce the heater current and dim the picture in the same way as described for a shorting heater.

PHILCO 1000

The trouble is a horizontal white line across the centre of the screen.—E. Molyneur (Manchester, 16).

This symptom indicates failure of the field timebase section. Check the field timebase valves and associated components. Also ensure that good connections exist between the field output transformer and the field scanning coils. A fault almost anywhere in the field timebase circuits could cause the effect.

QUERIES COUPON

This coupon is available until SEPTEMBER 23rd, 1965, and must accompany all Queries sent in accordance with the notice on page 571.

PRACTICAL TELEVISION, SEPTEMBER, 1965

TEST CASE -34

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions, but are based on actual practical faults.

? *The symptom on an Ekco was intermittent and random fluctuation of both picture contrast and (to a smaller extent) sound volume. Checks were made on the tuner and common i.f. stage and no fault could be found. Since both vision and sound to a smaller degree were affected the trouble was considered to lie somewhere in a circuit common to both sound and vision.*

An enthusiast investigating this trouble discovered that immediately after replacing the aerial previously removed, the contrast control would seem to lose effect. That is, the picture would tend to go very bright, approaching negative overload, while the sound also would be very loud and at distortion point. It was discovered that after a few minutes of this operation the picture and sound would slowly return to normal, still accompanied by the original fluctuations.

In which section of the circuit would the cause of this trouble most likely be found, and for what reasons? The solution to this problem and a further Test Case will be found in next month's " Practical Television ".

SOLUTION TO TEST CASE 33

Page 524, (last month)

The symptom had the obvious characteristic of blocking in the line timebase oscillator only when a vision signal was applied to the set and the set was responding to this. It will be recalled that without an aerial signal or with the set turned to a blank channel number the line oscillator worked correctly, only to be muted each time the aerial was connected with the set tuned to a " live " channel.

It will also be remembered that the set featured flywheel-controlled line sync, and in Pye and equivalent type receivers a pair of small metal rectifiers or diodes is used in a discriminator network to control the line oscillator. The action is that as the line oscillator tends to deviate from the repetition frequency of the line sync pulses, the discriminator produces a correction potential across its load and this is fed to the oscillator to pull the frequency into step with the sync pulses. Depending upon which way the oscillator tends to drift or deviate, the control or correction potential rises positively or negatively about a mean value.

Now, since the line oscillator blocking was a function of the signal, it is reasonable to suppose that the connection in terms of the fault is related to the section common to both the signal and the line oscillator. Namely, the discriminator.

This, in fact, turned out to be true. The blocking was caused by an abnormally large correction potential being fed to the oscillator valve from a very much unbalanced discriminator. Indeed, the unbalance was due to open-circuit of one of the rectifiers.

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