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DECEMBER 1964

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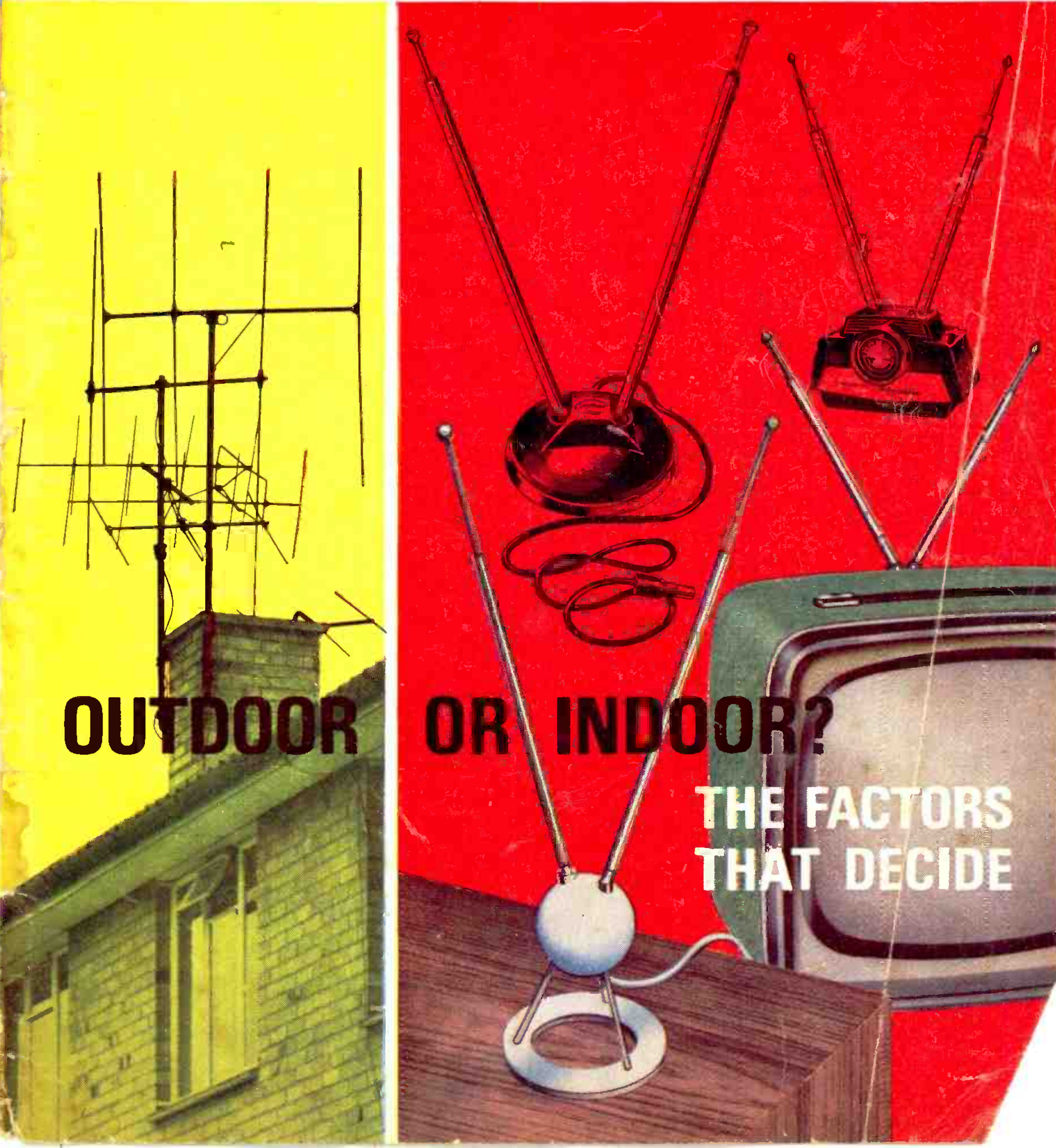

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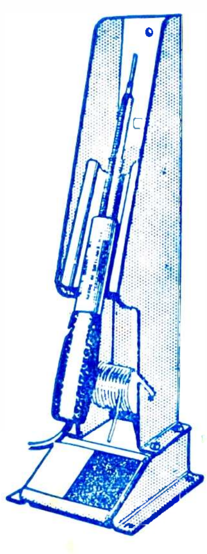

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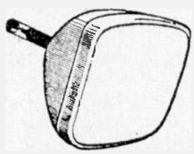

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Practical Television

AND TELEVISION TIMES

VOL. 15, No. 171, DECEMBER, 1964

Editorial and Advertisement Offices

PRACTICAL TELEVISION

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Contents

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Ten Years of Achievement

IT was just over a decade ago that we switched on our TV sets to watch the first pictures from across the Channel. This was indeed an historic occasion, for it was the first tentative step towards the vast inter-European network which has grown from these humble beginnings.

The experiments in the early '50s were highlighted by the commendable technical feat of televising the Coronation of Queen Elizabeth II over the French, Dutch and German networks, in addition to our own, using temporary links. From then onwards, the inter-European network blossomed rapidly until "Eurovision" ceased to be a novelty and became a practical everyday aspect of the TV scene.

Recent events, however, have tended to overshadow the achievements of Eurovision (somewhat unfairly, perhaps!) and these reached their climax in the remarkable programmes of the Olympic Games from Tokyo, via the Syncom satellite and the European link.

Syncom, in one dramatic stride, seems to have transformed the idea of worldwide TV from an optimistic dream to something approaching hard reality. Early prophets of worldwide TV must have kept their fingers crossed, for apart from a vast and enormously expensive network of microwave links, landlines, etc., there seemed little hope of overcoming the barriers of line-of-sight limitations, and the lack of suitable ionospheric density layers.

But the advent of satellites at once heralded a new chapter, and new hope, for international TV. Telstar I, Relay I, Telstar II and now Syncom, have shown effectively that if nature is unable to provide an ionospheric layer capable of reflecting TV frequencies then man can supply a substitute.

Although many years must obviously elapse before anything more than an occasional or temporary international hook-up can be set up, the way is much clearer. And it is worth remembering that it is only seven years since the first artificial satellite zoomed into orbit and only two years since the first communications satellite was launched. Events have a habit, nowadays, of catching up with one's imagination!

And while the big boys are working hard to solve the major basic problems, what remains for the enthusiastic amateur? Plenty! The amateur transmitting movement continues to grow and from conversations with enthusiasts we know that they are all working extremely hard.

The rewards are there, too. This month we must heartily congratulate the two British TV amateurs G3NOX/T and G3ILD/T on breaking the world long-distance record for two-way amateur TV contacts (see *Teletopics*).

There is also the field of TV broadcasting DX. Still in the pioneering stage, this pursuit is attracting more and more followers and is a good opportunity for those wanting a new outlet.

There are still many frontiers to breach, records to be broken, breakthroughs to make. The humble u.h.f. DX-er, the 70cm amateur transmitter or the scientist working on communications satellite projects or microwave links—all have a part to play.

Our next issue dated January will be published on December 22nd

TELETOPICS

BRITISH TV AMATEURS SET WORLD RECORDS

NEW world records were created recently when an amateur television contact was established between G3NOX/T, near Saffron Walden, Essex, and G3ILD/T, near Darlington.

The path distance between the two locations was 200 miles and this QSO has the distinction of being the first in which amateur TV sound and vision signals have been transmitted simultaneously over such a range, and also of being a distance record for two-way /T contacts.

The QSO took place on September 3rd this year, at 08.30 GMT, with G3NOX/T transmitting a vision signal on 436Mc/s and G3ILD/T on 428Mc/s. Respective power inputs at peak whites were 150W and 100W.

Cameras Monitor Rocket Blast-off

AT Cape Kennedy, Florida, where America's space scientists conduct their practical work of rocket launching, two Marconi colour television cameras were installed recently to televise the blast-off and first few minutes of flight of a Saturn rocket. (These are the rockets being used by the U.S.A. in its research and development programme for more advanced manned space flights.)

One camera was installed one thousand feet from the launching pad, where by remote control it followed the course of the rocket after take-off.

In a more vulnerable position was the second Marconi camera. This was at the very top of the umbilical tower which holds control connections between the rocket and the launch control centre. Here the flaring jet stream of the rocket passed within fifteen feet of the camera, moments only after blast-off.

To protect the camera from the heat and shock waves, a specially designed housing was employed. This was made of wood sheathed with copper, with a protective glass lens window set in one side, and purged with nitrogen to eliminate the possibility of explosion in the terrific heat.

New target material for Image Orthicons

A NEW material known as ELCON is the result of an extensive research and evaluation programme carried out by the English Electric Valve Co. Ltd. to improve the properties of its image orthicon camera tube targets. This new target material achieves an unprecedented 750 hours of guaranteed life of the image orthicons, with indications from experience with pre-production samples of operational lives as long as 3,000 to 5,000 hours.

With the ELCON target, electronic rather than ionic conduction is employed in transferring the charge pattern from the image side to the beam side. (ELCON—ELectronic CONducting, as opposed to ionic conducting.) Ion migration is therefore virtually eliminated and in consequence there is no significant deterioration in performance with time. This means that sensitivity and stability of contrast reproduction remains constant and there is complete freedom from sticking pictures for life. Also no warm-up delay is experienced with the ELCON target.

This new material, which is seen as a major technical breakthrough, will be featured in the full EEV range of 3in. image orthicons now in current production.

C.C.TV AT AIRPORT RELAYS FLIGHT INFORMATION

A CLOSED-CIRCUIT TV installation at Liverpool Airport enables visitors to see arrival and departure board information on television receivers situated in lounges and restaurants throughout the main airport building.

As subcontractors to Standard Telephones and Cables Limited, EMI Electronics Ltd. installed three cameras, four monitors and a control console in a soundproofed studio.

One of these cameras transmits pictures of the arrival and departure boards, while another transmits advertising slides. The third televises the girl announcers, who can make special announcements from time to time over the system.

In the studio the announcer can see her own picture, a preview picture of the flight board, or the next advertising slide on the three monitors situated at the head of the control console. From this position she selects the picture to be transmitted and this appears on the fourth monitor.

World-wide TV coverage for Olympics

HOWEVER else the success of the 1964 Tokyo Olympic Games is estimated, its world-wide broadcast coverage will surely be remembered as one of the biggest and most complex broadcasting operations ever undertaken.

Television broadcast of Games events alone involved forty-two organisations in thirty-nine countries, the BBC and the Independent Television companies being closely concerned with the arrangements made by the European Broadcasting Union to bring programmes to viewers in Europe.

Sound programmes were sent from Tokyo to Hawaii via the recently laid trans-Pacific telephone cable, and thence to Vancouver by means of the Commonwealth Pacific telephone cable. Microwave links carried the signals across Canada, and the Canadian trans-Atlantic telephone cable brought them to Scotland, where they were fed into the GPO's trunk circuits to London.

Because the satellites Relay and Telstar were not favourably placed during the Games, television coverage in Europe was mainly dependent on video tape recordings without live transmissions. The use of the Syncom III satellite, however, brought recordings to Europe a day earlier than would otherwise have been possible, as its position 22,300 miles over a point in mid-Pacific made transmissions between Japan and the U.S.A. feasible. Using this route, a daily programme recorded on video tape, was transmitted from Tokyo to the Japanese satellite ground station by a microwave link, and thence via Syncom III to California. From there microwave links took the signal across the U.S.A. and to Montreal, where it was re-recorded on video tape. The tapes were then flown to Hamburg and from there the pictures were distributed over the Eurovision network.

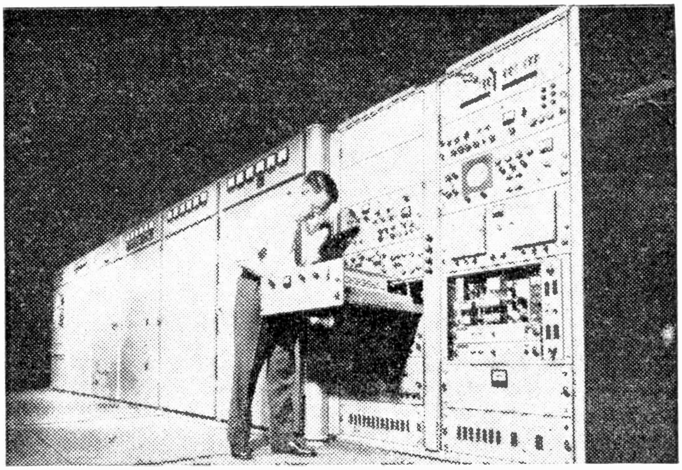
In addition to the Syncom III transmissions, video tapes flown from Tokyo gave European viewers higher-quality material and more detailed coverage only one day after the events took place.

The pictures distributed over the Eurovision network were also sent to the Intervision network for distribution to Eastern European countries.

BBC-2 Transmitters for Birmingham

THIS 25kW u.h.f. television transmitter (below), shown here under test at the Marconi Company's Chelmsford works, is the first of 12 ordered by the British Broadcasting Corporation for their 625-line BBC-2 service. This transmitter has since been installed at the BBC's Sutton Coldfield site in the Midlands, where it will form one of a pair to bring BBC-2 to a further 3¼ million viewers in the Birmingham area next summer. It will, however, go into service before this date, transmitting the service to a limited audience from a temporary mast and aerial at Sutton Coldfield.

The opening of this station is the second stage in the BBC's scheme to cover the whole country with u.h.f. transmitting stations, and the Marconi Company has already received contracts for u.h.f. aerials for six of them, including the Crystal Palace station, which is now radiating the BBC-2 service in the London area.



A 25kW u.h.f. TV transmitter made by the Marconi Company for the BBC.

Closed-circuit TV speeds London traffic

A NEW British Beulah Electronics Ltd. closed-circuit television system has been purchased by the Ministry of Transport for use in conjunction with a "Tidal Flow" traffic scheme at Hammersmith Bridge.

The system is being used by the Hammersmith police to observe traffic on the southern approach to the Bridge. From its position on a lamp post, 25ft. above the road, the Beulah D.80 camera relays pictures of the traffic to a police officer housed in a control hut on the southern side of the Bridge. From this post the policeman can operate traffic lights and "keep left" signs to permit single or double lane traffic across, according to the number of vehicles in any one direction, as shown on the TV monitor in the hut.

For protection the camera is housed in a weather-proof case with a thermostatically controlled heater and a windscreen wiper. Operation of the Beulah system is on 625 lines, which combined with the efficient automatic light control obtained by the use of a separate accelerator mesh vidicon tube, gives a fully acceptable picture, even at dusk before lighting-up time.

Aerials! OUTDOOR INDOOR? the factors that decide

BY GORDON J. KING

IN this present age we have on the one hand those highly appreciative people whose work it is to preserve the amenities of this small island and on the other hand engineers whose job it is to insist on the erection of aesthetically offensive aerial systems to satisfy technical requirements!

Although it can be happily reported that these inherently incompatible groups are now tending to understand more of each other's problems there frequently occurs a clash of opinion. This has been more so of recent years, resulting from the mad growth of house and roof mounted television aerials, than during any other recorded period.

The engineers and technicians endeavour non-technically to put over to the amenity preservers the absolute necessity of good and high outdoor aerials of curious shapes and sizes to ensure pictures that are free from grain and interference. This is not always a simple matter and it is now being made more difficult with the added necessity of complex and high u.h.f. aerials!

The truth is that at distances in excess of about 30 miles from a television station, especially in hilly and screened districts and towns, the goodness of a picture is almost proportional to the height and complexity of the aerial system connected to the receiver.

Less than about 30 miles in reasonable reception areas less complex outdoor aerials are needed for good results. Towards about 20 miles and less from a transmitter indoor aerials can often do a good job of picture getting, but even under this condition local screening and interference problems loom high and it has been known for good outdoor aerials to be needed to do full justice to a good receiver at distances as little as ten miles from a station.

For the reception of BBC-2 in the u.h.f. channels outdoor aerials are normally required at closer distances from the transmitter. Take, for instance, an area, say, 20 miles from the station where good BBC-1 and ITV reception is possible on a good indoor aerial, for BBC-2 reception a reasonably elaborate outdoor u.h.f. aerial would almost certainly be needed to get the same results.

The range of BBC-2 is also much more limited. An area where reasonable BBC-1 and ITV reception is possible on an outdoor aerial system—say 50 miles from a station—would barely receive any BBC-2 reception even with an elaborate outdoor aerial. Such are the laws governing signal propagation.

Boosting

There are various ways and means whereby these diverse conditions can be partly equalised. One is by the use of a low-noise transistor u.h.f. aerial amplifier or booster; and it may also help to boost ITV relative to BBC-1. Amplifiers are now readily available for these purposes.

On the face of it then it seems as though the potential for indoor aerials is very small. This is pretty much of a fact, though the indoor aerial potential is somewhat increased due to three factors. One is that owing to the increase in number of relay stations being installed by the BBC and ITA more and more viewers are progressively finding themselves within indoor aerial range of the transmitter.

At least it is often possible to delete the outdoor BBC-1 aerial in many areas nowadays and in place use either an attic or set-top type.

Another factor is the increased usable sensitivity of modern receivers. While sets may produce a picture with a signal input as low as, say, 25μV, a picture which is relatively free from "snow" may need a signal as high as 100μV. Modern low noise, frame grid valves, however, may mean that a similar sort of picture can be obtained with a signal down to 75μV, thereby probably making it possible to use an indoor aerial in areas where earlier models demanded an outdoor array.

The third factor is the use of u.h.f. and v.h.f. transistors in the first stages of the receiver. Transistors produce less noise than valves, thereby making it possible to produce a picture of the same snow effect as valve receivers but with approximately half the signal input.

It is not unduly difficult for set designers to create sets that will work on extremely small signal inputs—that is, to produce some sort of picture. The problem lies in producing a noise-free (freedom from snow effects) picture at very low inputs.

This then is where the special type of v.h.f./u.h.f. transistors are now coming into their own. Transistors improve the signal-to-noise ratio of the receivers. To outweigh the noise (snow) the aerial signal has to be not less than 100 times greater than the noise signal generated in the set.

Clearly then a set using front-end transistors with an internally generated noise signal half the strength of that of a set with front-end valves will operate similarly with an aerial signal half the strength of that required by the valve set.

Signal Grip

The amount of signal picked up by any aerial is dependent upon two major factors. One is the size of the metalwork in the aerial, bearing in mind that the metalwork has to be cut to a specific size to tune the aerial to the required channel. This factor is sometimes called the "signal grip" of an aerial. The other one, of course, is related to the strength of the signal field surrounding the aerial. The stronger the signal field the greater will be the signal picked up by the aerial and fed to the set.

Generally speaking the signal field increases with height, meaning that the higher the aerial is sited the greater the signal it will pick up. It should be noted, however, that this does not always follow and in some unusually screened locations of standing wave conditions the aerial signal may actually fall as the aerial height is increased.

The signal field is always greatest in free-space exposed locations. Indoors—even in the roof space—the signal field is always below its prevailing outside strength because of the attenuation imposed upon the signal by the walls of the building and the slate or tiles of the roof. This attenuation rises in damp and rainy weather.

An attic type of aerial can be almost as complex as its outdoor counterpart since there is usually room in an attic or roof space to cater for a multi-array. Thus there may be an insignificant difference between the signal grip of an outside aerial and one mounted in the attic.

There will, however, be a substantial difference between the signal field between the two sites and in the slightly lower and partly screened roof space the signal field may be less than half the strength of that surrounding the chimney stack.

An even lower inside signal field may exist if the roof is heavily leaded or screened in some other way or if the aerial is located close to a metal water tank or pipes, the effect of which is to absorb some of the energy of the signal field. As a rough guide one can say that the aerial signal will drop a little over two times by taking the aerial from the chimney stack and re-positioning it in the roof space.

The decrease so far as BBC-1 and ITV signals are concerned will be a little greater in wet weather.

High U.H.F. Attenuation

So far as BBC-2 is concerned the signal attenuation will be somewhat greater and it will rise steeply on rainy days. For these reasons, therefore, it is unwise to attempt the use of indoor u.h.f. aerials unless the prevailing outside signal field is extremely high indeed.

It will be many years before the whole of Great Britain is adequately embraced with a u.h.f. signal field and it is unlikely whether it will ever be covered to the extent of the existing v.h.f. (BBC-1 and ITV coverage. *This means that unless great strides occur in either the propagation or reception of u.h.f. signals there will always be a great need for outside u.h.f. aerials.*

To compromise with the amenity preservers, therefore, it seems logical that we should do two things. One to bring indoors the v.h.f. aerials to make room outside for the u.h.f. aerials and, two, wherever possible to arrange for the sharing of a good u.h.f. aerial between two or more neighbours.

It is often possible to feed the two dwellings of a semi-detached pair, for instance, from a single u.h.f. aerial via an amplifier of the low-noise transistor variety. Mains versions are available and since these consume only about a watt or so they can be left running continuously for a cost of a few coppers a year! Actually up to about six adjacent dwellings could be fed from a single u.h.f. aerial and a simple amplifier system.

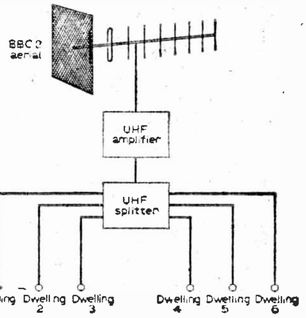


Fig. 1—After bringing indoors where possible the v.h.f. television aerials, a single roof-mounted u.h.f. aerial can be arranged to feed a number of dwellings by the use of an amplifier and splitter.

The idea is revealed in Fig. 1, noting that each dwelling has its own indoor aerials for v.h.f. channels. A previous article (see PRACTICAL TELEVISION, November, 1964) has already dealt with the wide aspects of shared aerial systems and there is no need to enlarge upon this here.

Set-top Aerials

An article dealing with indoor television aerials must, of course, also consider the type of aerial which is designed either for placing on top of the set or on a shelf nearby. The signal picked up by this type of aerial is much smaller than that derived from an attic or roof space aerial for two reasons. One is that the signal grip of the set-top version is somewhat less than that given by a full-sized attic array.

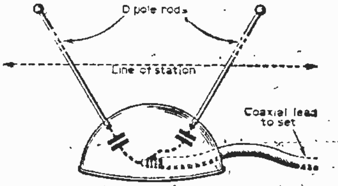


Fig. 2—A simple set-top aerial. Note the small capacitors connected between the coaxial and dipole for isolation. There are various versions of this kind of aerial, and for use in high signal field areas, u.h.f. set-top aerials are available with a reflector and sometimes with directors. Aerials of this kind are affected by metal in the room and sometimes by people moving around within the signal field.

Even the simplest aerial for optimum pick-up must have a length (overall) which approximates a half-wavelength of the required channel. This is the overall dipole length. For channel 1, for instance, this is 10ft 7in., which is really too long to cater for on top of the set!

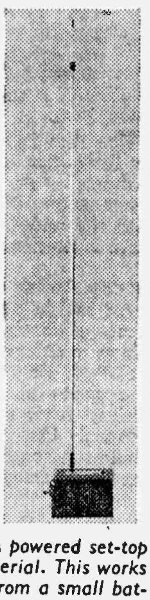
Actually most set-top aerials have the dipole arranged as a "V" (see Fig. 2) but, even so, 5ft 3½in. for each rod is a bit much on top of the set (with the rods in V formation the overall height above set top is about 5ft to tune channel 1).

This then means that on Band I (the BBC-1 band) a dipole less than the tuned optimum is adopted. The signal that this picks up is less than a single dipole correctly tuned. Moreover, the signal field at the top of the set is considerably less (normally) than what it is in the attic, which is reason two why the signal at the outlet of a set-top aerial is well below that of a tuned attic aerial.

In addition an attic aerial usually has a reflector, director, or both, giving improved pick-up characteristics and directivity. Nevertheless the V arrangement of the set-top aerial in Fig. 2 is endowed with a little directivity, maximum pick-up occurring when the two rods are in line with the station as shown.

A set-top aerial is generally called upon to serve both BBC-1 and ITV and to facilitate this the rods are often telescopic, allowing their length to be adjusted for the best results on both channels. Normally the rods need to be fully extended to give best BBC-1 results and reduced in length actually to tune the ITV signals in Band III.

On channel 8, for example, the tuned overall dipode length is about 30in., which means that each rod of the V needs only to be extended to 15in., giving an overall height from the top of the set a little under this. It is generally necessary to orientate the aerial on top of the set on changing channel for the best results.



A powered set-top aerial. This works from a small battery housed in the plastic case.

Mismatch

Now the coaxial feeder matches the termination impedance of the aerial only when it is correctly tuned. Thus when a compromise length is adopted a mismatch occurs on the feeder and is reflected into the set aerial input circuit. Sometimes this causes the set to go unstable (produce patterns on vision and whistles on sound).

It also means that the cable itself tends to pick up signal, and if this signal is out of phase with the signal picked up by the aerial cancellation occurs which can produce curious "ringing" symptoms on the picture—and, or course, a very weak picture.

Moreover, any radiation from the set itself is

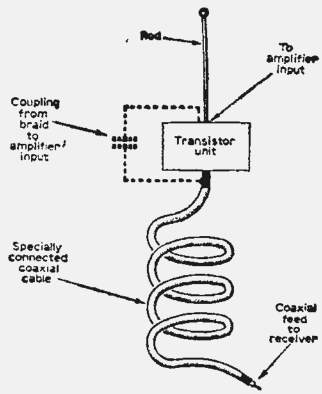


Fig. 3—The basic principle illustrated of the powered set-top aerial, as explained in the text.

picked up by the cable and displayed on the picture, often in the form of B-K oscillation. That is a thin, watery, vertical line towards the left of the screen. However, this can often be removed by careful positioning of the aerial and the cable at the back of the set.

Set-top aerials of the conventional kind certainly have their limitations, and are thus mainly suitable at locations of high signal field and little interference, for remember, domestic electrical interference is also much stronger near a set than it is towards the fringe of the household.

Recently, a new brand of set-top aerials has emerged. These are tuned devices, using a control knob which is adjustable to secure optimum loading at the set, and thus optimum signal transfer. However, the lack of metal in them, as with any type of simple aerial, greatly impairs the signal grip factor.

For years the author has been working with the amenity preservers endeavouring to rid the skyline of unsightly aerials while having in mind the technical requirements of the engineer. This work has led to the wide use of coaxial relay systems up and down the country.

Economically, there is a limit to the extent to which such systems can be developed, though they are absolutely ideal for new towns, estates and flats. They are, of course, being installed in existing towns, but the cost of wiring is extremely high, and this can ultimately be paid for either by the hiring of connected receivers or by hiring the network to pay-TV operators.

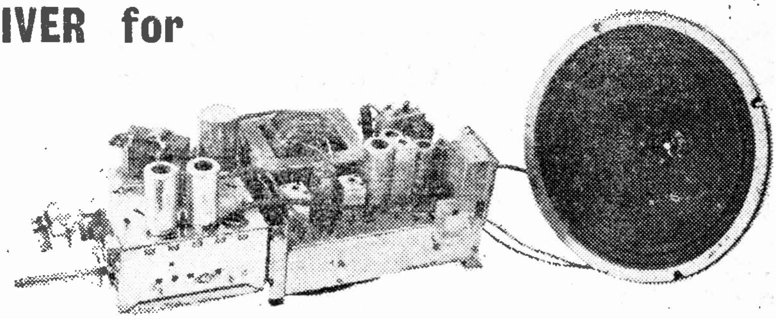
A coaxial relay system is basically a very efficient aerial system mounted in a lofty position on the outskirts of the town, with the signals being fed through amplified coaxial cable networks to the viewers in the heart of the town.

Powered Aerial

Having in mind the virtual impossibility of ridding the skyline of aerials by means of coaxial relays systems, attention has of recent years been concentrated on the design of a different type of set-top aerial. This development has been aided by the coming of the v.h.f./u.h.f. transistor and a somewhat different "powered aerial" for set-top

—continued on page 127

SOUND RECEIVER for BANDS I, II and III



An Inexpensive Conversion of a TV Chassis

By G. F. Clarke

THE basic chassis required for this modification is any one of the following Ekco TV receivers:—T293, TC209/1, TC267/1. These receivers came onto the market from 1957 onwards and can be given a new lease of life as a complete sound receiver. For those requiring a tuner to feed a tape recorder or pre-amplifier a similar conversion can be made.

It is possible to obtain one of the above models, according to condition, from 5s. to £1 and for either conversion a mains transformer can be wound or obtained from many of the advertisers in this magazine at a cost of £2 approximately. It is proposed to deal first with the complete conversion resulting in a rectifier with the following line up:—

V1 Cascode r.f. 30LI: V2 mixer and oscillator 30CI: V4 1st i.f. 30F5: V6 2nd i.f. 30F5: V8 ratio detector 6D2: V11 output 30PLI: V7 a.g.c. rectifier 6D2.

The output valve gives approximately 2W. After modification the receiver worked well on a vertical dipole to give full power on the FM station at Holme Moss which is about 40 miles from Scunthorpe. By following the instructions carefully, any person able to use a soldering iron and able to recognise components can successfully complete this modification.

Having obtained the television receiver it will be found that the turret will contain the coil strips for the local TV transmissions. Most of these sets came on to the market with a near complete set of Band I and Band III coils. The set of coils to tune the f.m. band are moved into position on the turret as a cam at the rear of the turret actuates the f.m./a.m. switch. If so desired the coils not in use can be removed and by rewinding used to cover other sections of the h.f. or v.h.f. bands.

The two bolts which hold the chassis to the cabinet should be unscrewed and after withdrawing the plugs to the scan coils, etc., the chassis taken out of the cabinet. It will be found that three bolts hold the receiver unit to the time base section. These should be removed and after removing all the valves in the receiver unit it should be placed upside down on the bench with the turret at the top left.

Carefully cut the thread holding the wiring harness together—this runs from the f.m./a.m. switch alongside the rear of the turret to the eleven pin socket. Remove the screening cover, over V6 and V8 base, which is held down by a nut and bolt and a Phillips screw. On the switch cut the yellow, purple, blue, green, red, white and pink wires as near to the switch tags as possible. This operation leaves a black screened cable and an orange wire connected to the switch, this latter point is used later as a tag.

Next pull off the cardboard cover, if this is still in place, at the right hand end of the chassis and after cutting the wires to the 100kΩ potentiometer, remove it. The wires to the two pin socket can next be cut and the socket removed.

Now comes the removal of the components associated with the vision circuits. Starting at the lower left hand corner underside view it will be seen that in a strip from left to right are a two pin socket, three i.f. cans, four valve holders and a five pin socket, at the two pin socket will be found two 0·04μF capacitors and a 10MΩ resistor, these components should not be touched at the moment. All the other components along this strip can now be removed. There is no need to take great care in removing them as they are not required in the modification.

Furthermore the leads are very short and difficult to unsolder without damage. It will be found that a pink lead runs from the five pin plug on the turret top to the top of the lower left i.f.t. can—this should be cut to release the can. The valve holders should be drilled on the holding down eyelets and the i.f.t. cans released by the removal of the two 6BA screws. After this operation one should have 3 i.f.t. cans, 4 valve bases, 21 resistors, 18 capacitors and 1 five pin socket. It should be noted that no components beyond those directly related to this strip should be removed. It is also policy when cutting the wires at the valve bases to cut these as near to the base tag as possible as it will be found that two heater chokes, one of which is to be used later, will now have one end disconnected. These are to be found above the chassis and consist of a coil of wire within a p.v.c. tube.

At this stage the 39kΩ resistor from pin 1 of the eleven pin socket to a h.t. terminal post can be removed as can the 39kΩ from pin 10 of the socket to pin 5 of V7. With the removal of the 300pF capacitor and the cutting of the brown wire to L25, this latter and the eleven pin base can now be removed. The trimmer at the right can now be disconnected from earth and removed. Whilst on the right the 120kΩ resistor to the five pin socket can be removed. The pink wire from this socket to V11 should be unsoldered and removed. Unsolder the two blue wires which run to pins 4 and 5 of the output valve V11. Along the lower part of the chassis will be found a number of insulated h.t. pillars which are now no longer in use and can be removed. Disconnect the grey lead at pin 2 of V7 and following the lead back to an h.t. pillar remove it, the 0·04μF capacitor, and the grey lead to the five pin socket on the turret top. The grey lead to the switch and thence to a 1MΩ resistor should be cut to length and connected to the junction of a 33kΩ, 0·1μF capacitor and a 100pF capacitor near V4. To apply a.v.c. to the turret this point should also be connected to the pin on the five pin plug on the turret from where the grey wire mentioned was removed. On the sets converted by the author this latter connection was not found necessary.

As the chassis is now turned over the short L-shaped length of copper tubed coaxial running and through a hole near the 16μF+16μF capacitor and connected to pin 4 of V11.

The yellow wire to pin 4 of V6 should now be disconnected and the small filament choke removed. The loose end of the remaining choke, that is the one coming up through the chassis near V7 should now be fed through the same eyelet as the choke removed and a connection made to pin 4 of V6.

The varistor near the bulb at the front of the turret should now be removed and the yellow wire running from the bulb through the chassis should now be soldered on the a.m./f.m. switch on the same tag as the orange wire which was left in place. This section of the switch is not in use and makes a convenient tag point. A circuit of the completed heater circuit is shown in Fig. 2.

Carefully free the two pin socket with its associated 0·04μF capacitors and 10MΩ resistor and carefully remove these components. Enlarge the hole at the front of the chassis, i.e. the hole nearer the chassis, to take a 500kΩ volume control. Mount a four-way tag (two earth) strip along the edge of the chassis and wire as follows. Connect the screened red lead to the tag nearer the front, a 0·04μF

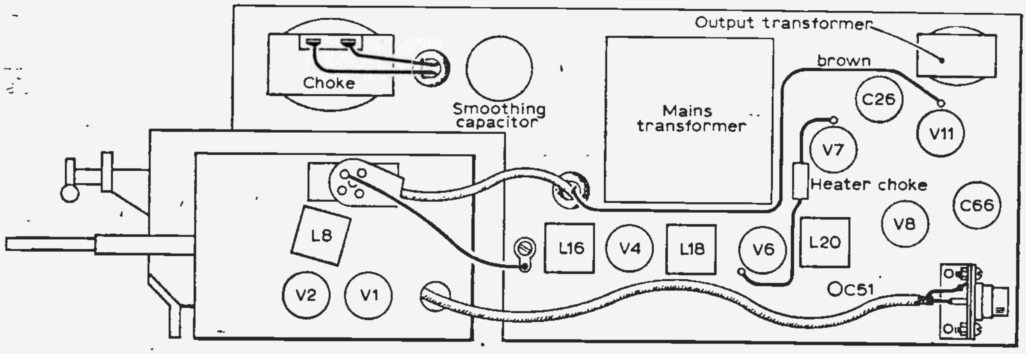


Fig. 1—An above-chassis view after modification.

round the side of the turret should now be unsoldered and removed. A short length of wire should now be soldered between the post near L16 to the pin on the five pin plug where a short length of pink wire remains. This wire should be run through the rubber sleeves along with the blue, orange and red wires.

Those not requiring the output stage should not recommence wiring at this stage but remove further components as detailed later. Those intending to use the unit as a complete receiver should now pull the brown wire through the sleeves back to the point where it goes through a rubber grommet. This wire should be led across the chassis (Fig. 1) capacitor from there to the centre tap of the volume control and the 10MΩ resistor to the last earth tag. Wire the screened black lead to the remaining tag and the other 0·04μF from there to one end of the volume control. The other end of the volume control being taken to earth. (See Fig. 3.)

The rectifier, smoothing capacitor and choke should now be removed from the time base section of the TV receiver and along with the mains transformer mounted as shown in Fig. 3. It may be felt that a new smoothing capacitor should be used, particularly if the one removed shows signs of leaking. This component should, in any case, be checked before being used.

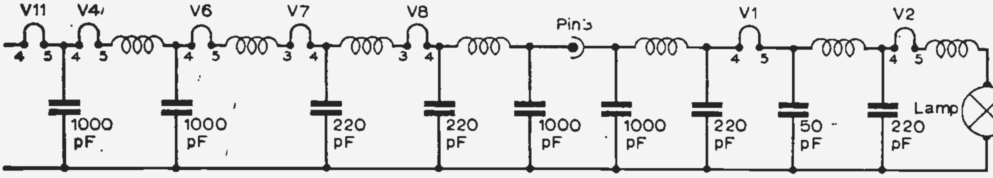


Fig. 2—The modified heater chain.

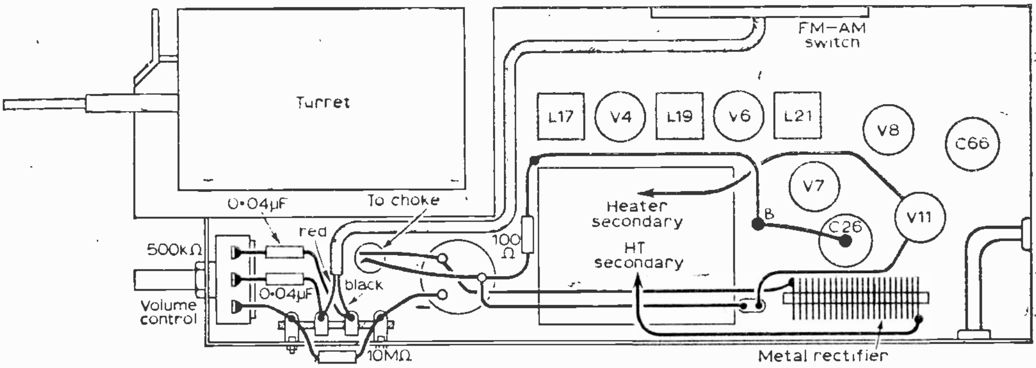


Fig. 3—An underchassis view showing power unit connections and volume control wiring.

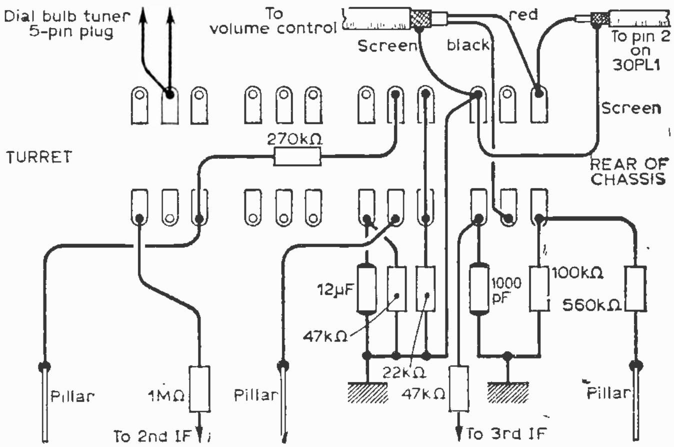


Fig. 5—Connections to the a.m./f.m. switch after modification for the complete receiver version.

The output transformer removed from the TV cabinet should now be mounted above the chassis. (For connections see Fig. 4.) One h.t. secondary lead from the mains transformer should be connected to the rectifier and the other h.t. lead connected to earth. A wire should then be connected between the rectifier cathode, usually coded red, and the 100μF section of the smoothing capacitor. A lead from this point should then be run to the choke and the return from the choke connected to the 200μF section, the earth tag of the capacitor being connected to any convenient earth point. The 100Ω resistor should then be connected between the 200μF capacitor and the h.t. pillar A. A short length of wire should also be run to connect pillar A with pillar B (see Fig. 3). A further lead is taken from the reservoir capacitor through a hole in the chassis to the primary of the output transformer. The other end of the primary (see Fig. 4) should be taken through the chassis to pin 6 of V11. The secondary of the output transformer should have two leads taken to the now disused five pin socket at the rear of the chassis. The plug to fit this socket being taken from the remainder of the chassis. Two leads are then soldered on to the plug and taken to the speaker which again is removed from the TV cabinet.

The mains transformer filament winding has one end taken to earth and the other end taken to pin 5 of V11. The primary winding should now be

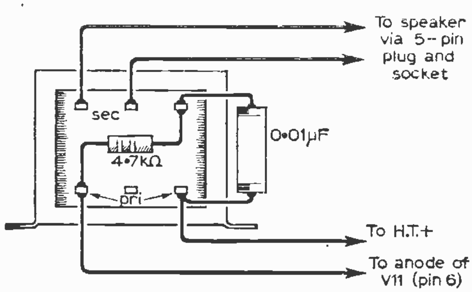


Fig. 4—Connections to the output transformer.

COMPONENTS REQUIRED

Complete Receiver:

Mains transformer, 3in. x 4in. maximum dimensions. Primaries: 250V 50 c/s, tapped 210 and 230V. Secondaries: 62·5V 3A, 225V 100mA.

500kΩ potentiometer (volume control) with d.p. switch.

100Ω 3W w.w. resistor.

4-way tag strip, two tags earthed.

Feeder Unit:

Mains transformer, 3in. x 4in. maximum dimensions. Primaries: 250V 50c/s, tapped 210 and 230V. Secondaries: 49·5V 0·3A, 225V 70mA.

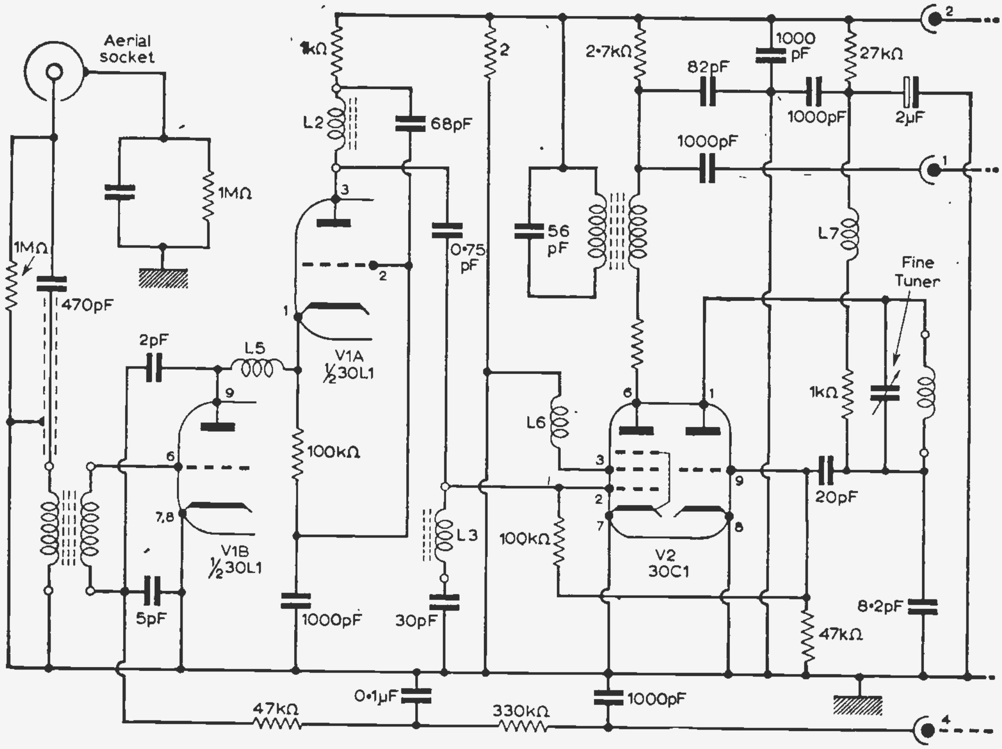


Fig. 6a—Circuit of the tuner unit.

connected to two tags on the mains switch on the volume control and a suitable length of mains lead soldered onto the other two tags.

The metal screening cover which was removed to cut the wires to the a.m./f.m. switch should now be replaced, care being taken to ensure that no shorting takes place. If the chassis has been stood for some time it may be found that the contact studs on the coils within the turret are dirty. These should be cleaned with any suitable contact cleaner. The receiver is now ready for operation although it may be found that the top dust core of the i.f.t. can L16 may require a touch to bring this circuit fully into line.

For those not requiring the triode pentode output stage, as mentioned earlier, additional components have to be removed. Having removed the strip of components as detailed earlier, next remove all the components associated with V11. These are most easily removed by cutting all components around the valve base with side cutters. The components removed consist of a 50μF bias capacitor C66, one 0·02μF capacitor, one 100kΩ, two 470kΩ and one 220Ω resistor. The screened black covered wire running from pin 2, V11 to the a.m./f.m. switch should be neatly cut off at the switch.

At the two pin socket at the left end of the chassis the 10MΩ resistor and parallel 0·40μF can be removed from the smaller of the two pins and **this socket** connected **to a** nearby earth tag. The two pin plug to fit this socket should be removed from the timebase chassis and a length of screened cable connected to it. The inner core being connected to the thick pin and the outer screening to the small pin. This lead should be terminated in a plug to fit the equipment with which it is to be used.

To complete the heater chain wiring the yellow wire to pin 4 of V6 should now be disconnected and

	Anode		Screen		Cathode	
	V	mA	V	mA	V	mA
V1A	165	15				
V1B	103	15				
V2P	172	6·1	165	1·8		7·9
V2T	30	3·8				
V4	120	12	120	3	1·8	15·0
V6	170	10	170	2·5	1·4	12·5
V11T	25					
V11P	173	29	163	7	8	36

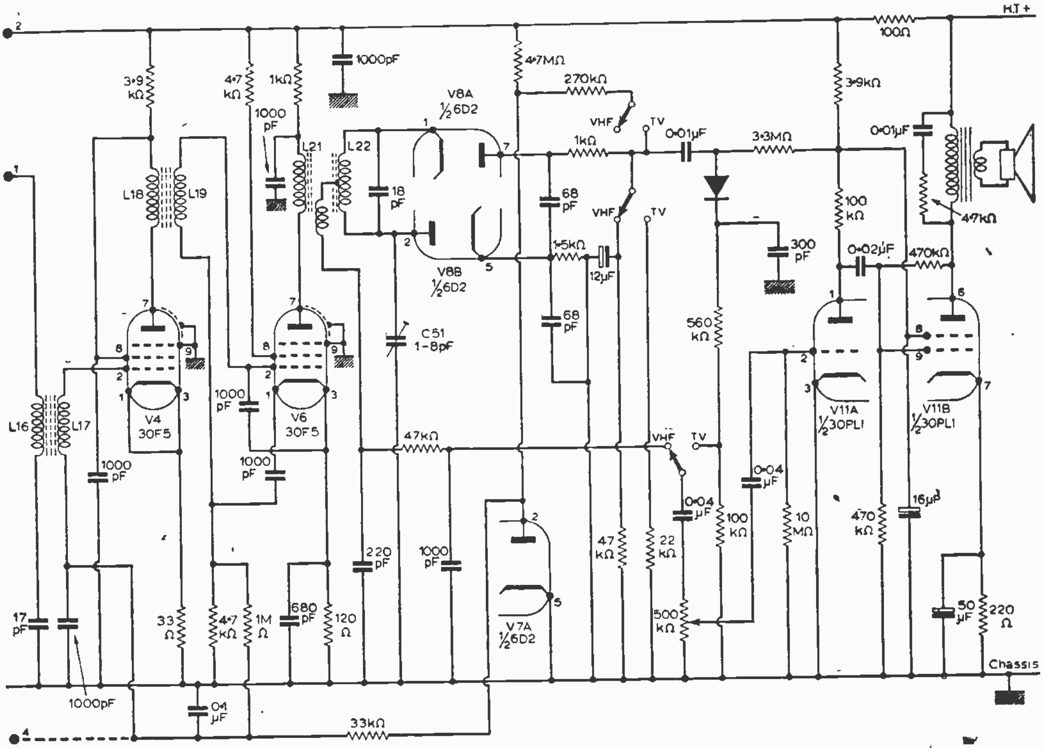


Fig. 6b—The i.f., detector and output stages of the receiver.

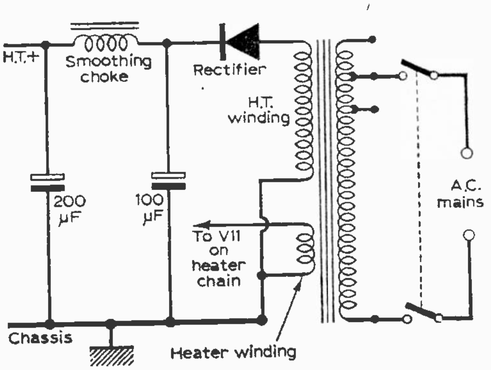


Fig. 6c—The power supplies.

the above chassis heater choke removed. The loose end of the remaining choke should now be fed through the same eyelet as the choke removed and a connection made to pin 4 of V6. The brown wire coming through the grommet near L16 should be taken across the chassis and down through a convenient hole.

The mains transformer, metal rectifier, choke and smoothing capacitor should be mounted as indicated in Fig. 1, the connections to these components being made as Fig. 3.

For both modifications the i.f.t.s should be aligned, if needed, by feeding in a modulated signal at 38·15Mc/s to the wire from the turret to the pillar near L16. When switched to f.m., C51 should be set for minimum output with an a.m. input. ■

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Servicing TELEVISION Receivers

No. 108: Radio Rentals 340 Series

by L. Lawry-Johns

THESE receivers have been the subject of many queries from readers who have purchased them second-hand and have been unable to obtain service information.

Many versions were produced and extensive modifications were made, and therefore any particular model may not wholly agree with the particulars here given.

The basic models were the 340 with a 14in. Mullard MW36-44 and 342 with added flywheel sync. The 350 used an MW43-64 17in. tube, and the 352 had flywheel sync.

With f.m. the 340 became the 344, the 342 became the 346, these being the 14in. models. With f.m. radio the 17in. became 354 and (flywheel 356.

There were also console versions: 360, 362, 366, etc. Later, fully modified versions became the 390 series.

The standard version used 17 valves and either a Cyldon or Brayhead tuner. Usually only two pairs of coil biscuits were fitted—one BBC, one ITV.

F.M. models used three extra pairs for Band II. The Cyldon has trimmer studs on top to identify it readily; the Brayhead does not have

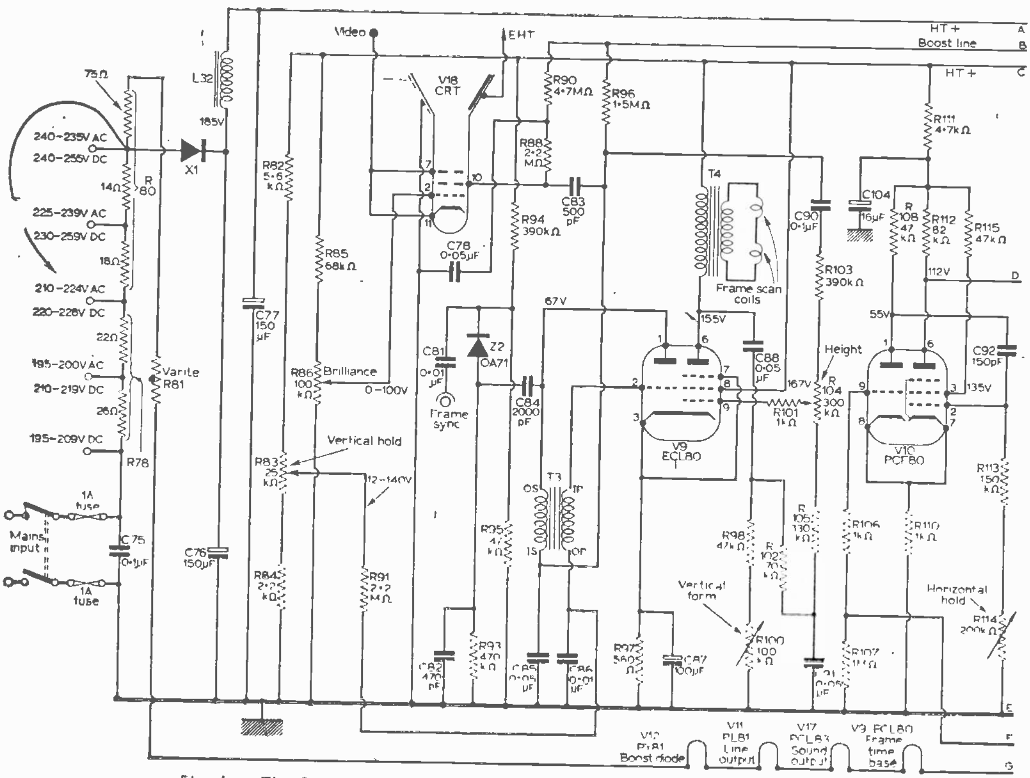

Fig. 1a—The frame timebase, line oscillator and c.r.t. stages of the circuit.

these screws.

Unless absolutely unavoidable, no adjustments should be made to the tuner unit except to tune the oscillator coil core from the front in the usual way with the control knobs removed.

It has been mentioned that many modifications were made, both during production and in the field. Some models may be encountered which have not been modified, and the following notes may be of help.

Modifications

The diagram of the i.f. chassis circuit shows in the V3 stage, a capacitor C27 of 0·001μF, pin 2 the chassis. Some models suffered from instability when the contrast was advanced, showing as severe patterning on the picture and pronounced hiss on the sound. The removal of C27 restored stability without any apparent loss of gain.

It is interesting to note that V3

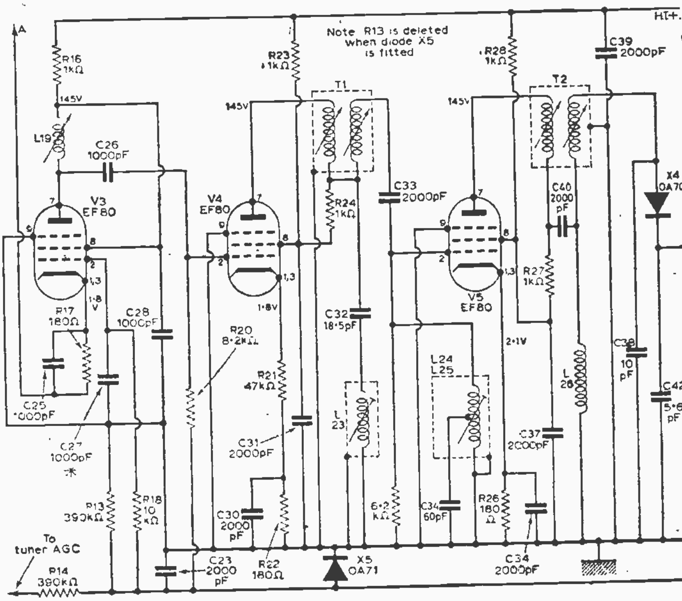

Fig. 2a—The vision i.f. sections of the original circuit. V3 and V4 were modified to a common i.f. amplifier in later models.

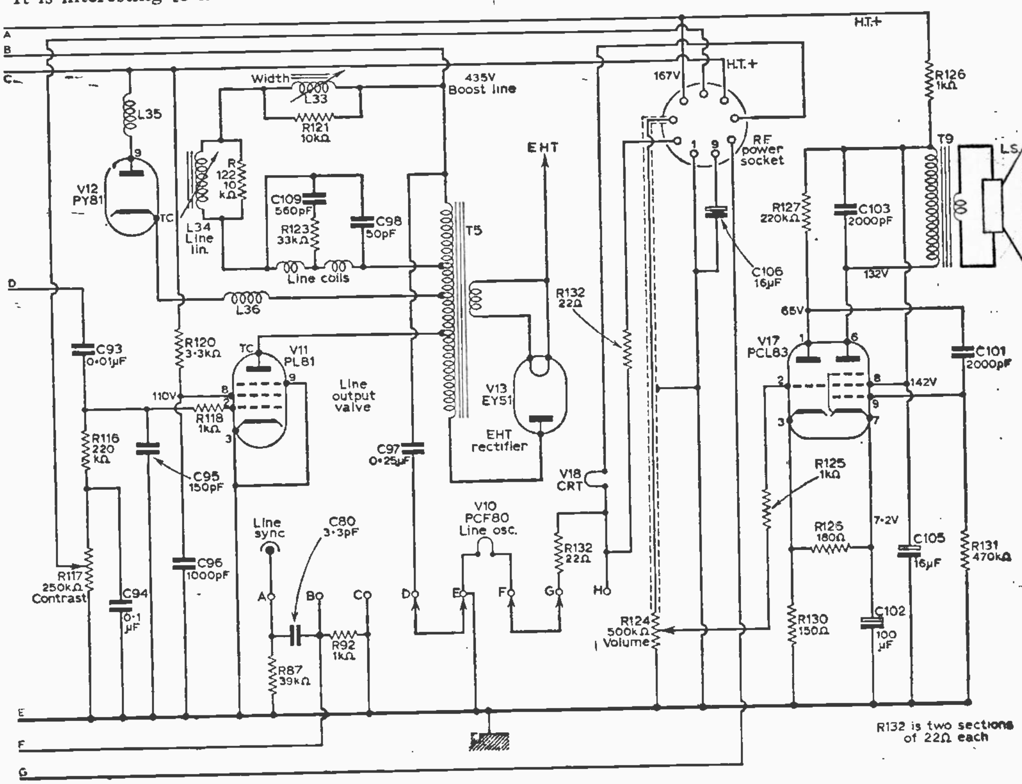

Fig. 1b—Line and sound output and e.h.t. stages.

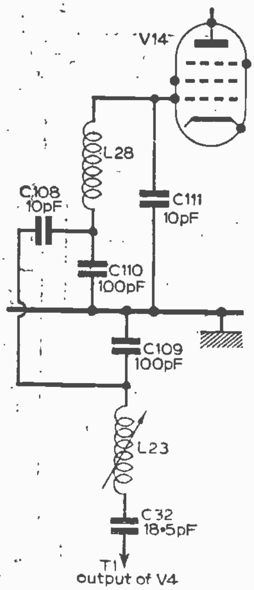

Fig. 2b—The modified V14 circuit of later versions.

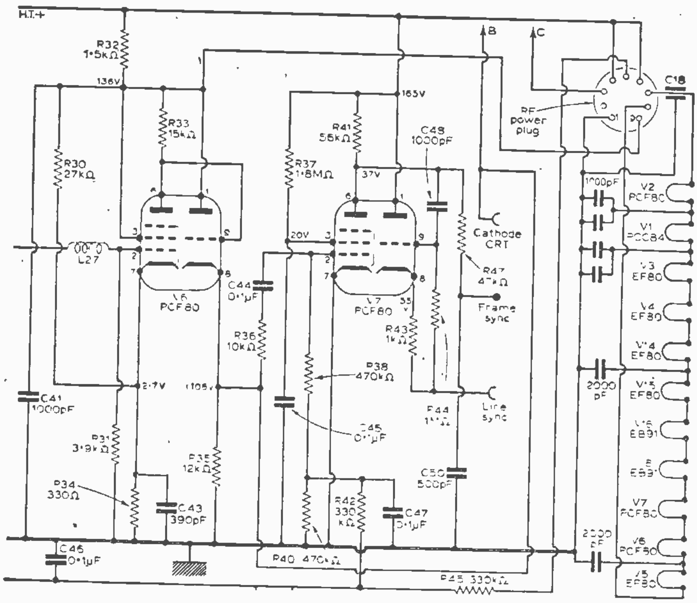

Fig. 2c—Video output and sync separator stages.

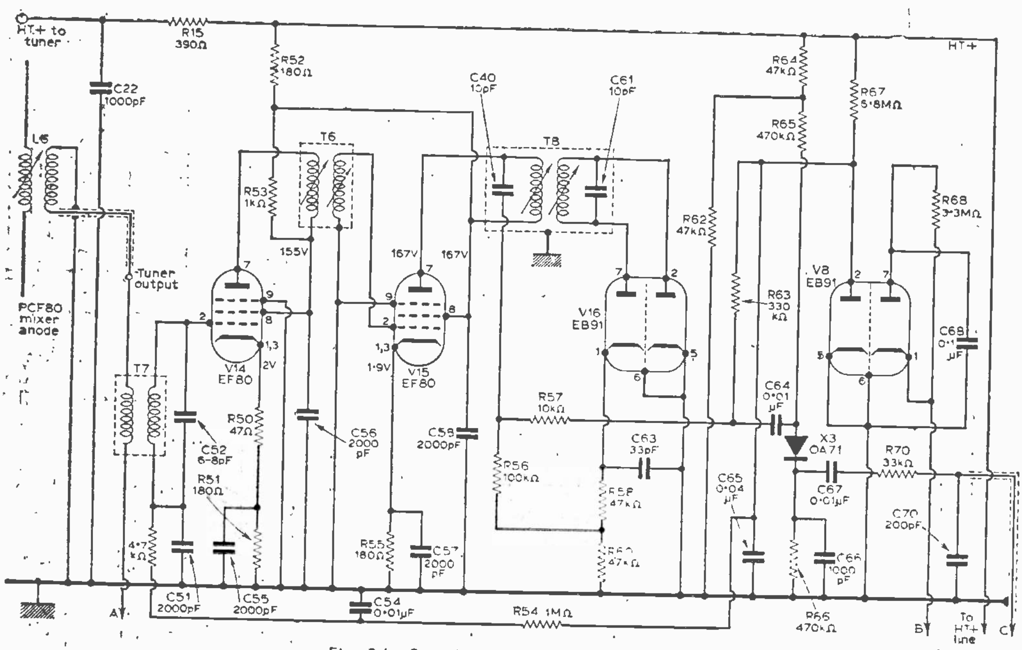

Fig. 2d—Sound i.f. and detector circuits.

is wired as a grounded grid amplifier with cathode signal injection via T7 and the tuner output transformer, L6.

All early models used V3 and V4 purely as vision i.f. amplifiers, but this was later modified with the removal of T7 so that the output from L6 went direct to V3, and this valve and V4 were used as vision and sound amplifiers.

The sound is taken from L23 and an added capacitor (C109) of 100pF. This point is coupled to V14 by a 10pF C108 to V14 control grid coil L28. This gave extra sound i.f. gain which was

—*continued on page 127*

CONTINUED FROM PAGE 87 OF THE NOVEMBER ISSUE

PUSH-PULL
X AND Y-AMPLIFIERS
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BLANKING
H.V. PROBE

The VIDEOSCOPE

TV OSCILLOSCOPE

BY MARTIN L. MICHAELIS

THREE important measures constitute the compensation of the Y-amplifier over video-frequency ranges. Firstly, the design of the probe. Secondly, the adjustment of the five-key attenuator. Thirdly, the stray-capacity compensation of the anode-circuits with inductances L1 to L3. It is necessary to point out at this point that, on the most sensitive range of the key-set (key 1 depressed) the circuit is unstable for all *inductive* loads connected direct to P1 if the inductance is tuned to the medium wave range. This is because V1 then functions as a tuned-anode tuned-grid oscillator with the external inductance and L1.

Instability is absent on *all* ranges when using the probe, and is absent on ranges with keys 2 to 5 even without the probe. When working on aerials and tuned circuits, or tracing signals through the r.f. and i.f. stages of receivers, the probe must be utilised. This instability is no design-defect, as it occurs only under circumstances under which the videoscope should not be used.

THE BRIDGE-BANK ATTENUATOR

A simple resistive voltage divider is in practice not frequency-independent if the time constant of the stray capacities with the resistance-values involved lies in the region of a period of the frequencies concerned. This is because the two stray capacities in parallel with the two resistors constitute a second (capacitive) voltage divider in parallel with the "intended" (resistive) one, and the dividing ratios may differ. In such cases, the stray capacitive ratio determines the transient (high frequency) division-ratio, and the resistive ratio the d.c. and low-frequency division-ratio. For complex waveforms with high harmonic content serious waveform distortion occurs.

To restore frequency-independence it is necessary to make the dividing ratios of the resistive and capacitive dividers equal, by augmenting the stray capacities suitably with deliberately-added small capacitors in parallel with the resistors. This amounts, effectively, to balancing the a.c. bridge circuit thereby represented. It is seen in the present design that keys 2 to 5 switch in four independent respective "bridges" with the required attenuation factors, whereas key 1, the most sensitive range, lets the signal "straight through".

The total stray capacitance of V1 grid circuit is across SK1 when key 1 is depressed, but is back-attenuated in all the other settings, so that no exact single effective capacitance is operative at SK1 on all ranges, and the probe-capacities should theoretically be switched too. However, this would be very clumsy, and is in practice not necessary. The probe is successfully carried-out as a single fixed-balance bridge (see below), as a result of two mitigating measures. Firstly, omission of a fixed capacitor across R1 (a value approximately equal to the settings of TC1 to TC4 would otherwise be needed) compensates errors, the stray grid capacitance of V1 taking the place of such a capacitor, very approximately. Furthermore the probe is fitted with a sufficient length of coaxial cable (about 2 yards) to make the capacity of this cable the dominant contributor to the total input capacitance behind the probe. The percentage contribution of the attenuator is thus small, and variations over the ranges are negligible. The probe is then bridge-balanced once and for all against the capacitance of the coaxial cable.

It need hardly be pointed out in this respect that a definite length of cable must be chosen. It is not possible to insert extension lengths between probe and videoscope indiscriminately if test-apparatus and videoscope have to be far apart. The required maximum cable length must be decided upon, and the probe designed for this.

The conditions for balance of an attenuator bridge are that the product of each resistor and its total parallel capacitance (stray and intentional) must be equal for all sections. The smaller resistors must thus be fitted with the larger parallel capacitors. It is only the ratio of the capacities which is important; the absolute values are unimportant for balance. Thus, if the bridge is balanced for a particular combination of total capacities, balance is undisturbed if *all* capacities are increased or decreased by the same *factor* (*not* same amount!). In practice, one will aim to keep the actual capacities small, to avoid total loading on the signal, yet not so small as to be unmanageable.

It is convenient to make the smaller capacity (across the larger resistor) in the form of an ordinary ceramic trimmer, for final true balance adjustment under working conditions. The advanced theorists among our readers can certainly measure strays with suitable capacity-measuring instruments (e.g. transistorised micro-bridge, or observation of shift of resonant frequency of a tuned circuit using a grid-dip meter), and calculate the correct required capacitors to establish balance, selecting and wiring these then as fixed capacitors in place of TC1 to TC4. However, such measurements are laborious and subject to arithmetical and measuring errors.

A much simpler method of final adjustment is to observe a waveform of *known* shape, and trim for optimum display with minimum distortion. Suitable test-waves are squarewaves, i.e. waveforms with sudden transients (exciting the capacitive branch) and long steady states (exciting the resistive branch). Fig. 11a shows an ideal squarewave from a signal generator. Fig. 11b shows the resulting display on the c.r.t. if the trimmer TC1 to TC4 in circuit is set at too high a capacity, and Fig. 11c the result when balance has been passed

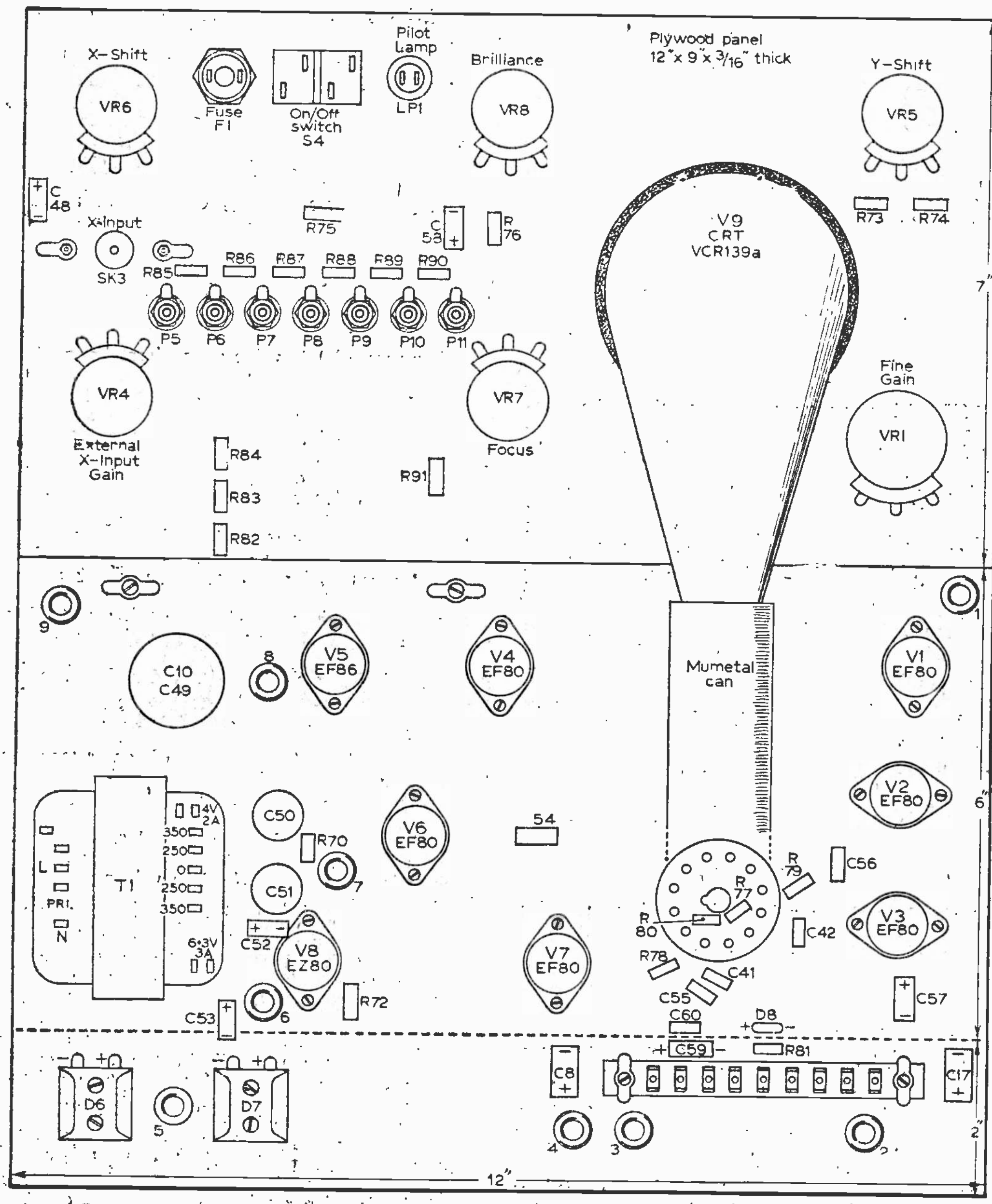

Fig. 8—Layout of the major components above-chassis.

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12K8GT	8/6	ECH42	7/3	U191	8/3
12Q7GT	3/3	ECH81	5/3	U801	15/-
20P4	13/3	ECL80	5/9	UABC80	5/-
25L6G	4/9	ECL82	6/3	UAF42	6/9
30PL1	7/9	EF41	5/9	UBC41	6/-
35L6GT	6/-	EF80	3/9	UBF80	5/6
35Z4GT	4/6	EF85	4/6	UCC84	7/11
85A2	5/9	EF86	5/9	UCC85	6/-
CL33	8/6	EF89	4/3	UCF80	8/3
DAC32	7/9	EL41	7/-	UCH42	6/9
DAF91	3/3	EL84	4/6	UCH81	5/9
DAF96	5/6	EY51	5/6	UCL82	7/3
DF33	7/6	EY86	5/-	UCL83	7/9
DF91	2/3	EZ40	5/-	UF41	6/3
DF95	5/6	EZ80	3/9	UF89	5/9
DH77	3/6	EZ81	3/9	UL41	6/6
DK32	7/6	PCC84	5/3	UL84	5/9
DK91	4/3	PCC89	8/6	UR1C	5/-
DK92	6/9	PCF80	6/9	UY21	7/3
DK96	6/-	PCF82	6/-	UY41	3/11
DL33	6/9	PCL82	6/3	UY85	4/9

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and the trimmer is screwed-out to too low a capacity.

Checks must be made at several basic repetition frequencies over as wide a range as possible.

However, it is not essential to use a squarewave; the requirement is merely a wave with a broad harmonic spectrum, i.e. one containing sudden transients as well as "waiting" periods. If the Auditron published in PRACTICAL WIRELESS has been built, the timebase output waveform there provided is excellent for the present adjustments of the Videoscope. The Auditron timebase mode should be set to "long" on the flyback selector to give the waiting period shown in Fig. 11e, and the trimmers TC1 to TC4 on the Videoscope adjusted on each respective range (starting with the trimmer at maximum capacity) until the "nose" shown in Fig. 11f *just* vanishes. Checks should be made at many frequencies throughout the entire timebase range of the Auditron. The signal may be fed direct from the timebase output socket of the Auditron to SK1 of the Videoscope, using not more than a couple of yards of low-capacity coaxial cable. The timebase output amplitude control on the Auditron can be suitably adjusted on each Y-amplifier range of the Videoscope for convenient observation. In this way the bridgebank attenuator will be known to be aligned prior to construction of the probe, so that new distortion subsequently obtained with the probe in circuit, using exactly the same procedure, can only be due to unbalance of the probe-bridge and not to confused multiple effects.

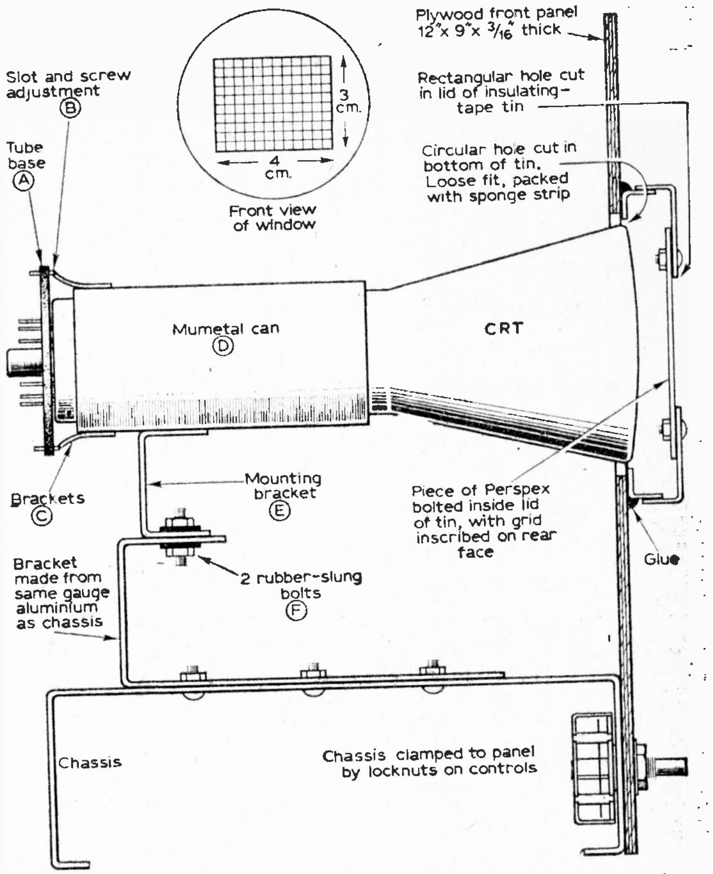


Fig. 9—Details of the c.r.t. mounting arrangements and screen window.

The reasons for having chosen a piano-key switchbank for the bridge-bank of the prototype Videoscope were in the interests of an open layout, giving easy grouping and access to the trimmers in a row. (A rotary wafer switch would give a clumsy arrangement, and because of the tight packing, cross-strays between the separate bridges would result.) A mutual release mechanism should be chosen, i.e. depression of any key releases any other one already depressed. If this component is difficult to obtain, the same function is obviously realiseable with a row if five ordinary DPDT toggle-switches—but it must be remembered to switch only one at a time down!

THE PROBE

This is designed to have an attenuation factor of 15. Other factors are usable, e.g. a higher factor is obtained by increasing the resistors and decreasing the capacitors by the same factor. This sacrifices overall gain but further reduces capacitive loading on the signal source.

Several probes of different characteristics can be built if desired, making one with very high resistances and low capacitances for observations on signal sources of high impedance where the slightest capacitive loading is serious.

If such ultra-high impedance probes are to be used with high signal amplitudes or d.c. components of several thousand volts, as in TV sets, it must be remembered that the voltage rating of each capacitor in the probe is generally only about 500V. The number of sections and thus the total length of the probe should therefore be increased, keeping to the same individual values as shown in Fig. 10. The attenuation factor and the maximum input voltage are then both directly proportional to the number of sections used.

It is important to use close tolerance, accurately matched resistor and capacitor chains for the sections. Balance should first be determined experimentally for the chosen length of coaxial cable between probe and Videoscope, using only a single section R92/C61 and selecting various C62 until the balance criteria on test waveforms applied to the prod are satisfied.

The number of sections desired can then be added by copying the component values of the balanced section as closely as possible.

E.H.T. PROBE

If an e.h.t. probe is required this can be about 18in. long and have 40 sections so that it will accept a.c. or d.c. components of up to 20kV at the prod with a total resistance of about 200MΩ.

The resulting maximum deflection sensitivity on the Videoscope will still be some 5V/cm, which is more than ample, and the maximum signal waveform amplitude displayable on the c.r.t. is about 20kV. Measurements can thus be made directly on the e.h.t. pulse winding, rectifier and smoothing capacitor.

A further great advantage is the facility to make an accurate measurement of the d.c. e.h.t. voltage present on the picture tube final anode or elsewhere. The attenuation factors are known and the deflection sensitivity set is also known and the d.c. e.h.t. component is observed as square pulses of "correct" amplitude in relation to calibrations when tapping the prod of the probe in rapid succession on to the e.h.t. points to be tested.

A word of warning: Only experienced constructors with good understanding and ability to work neatly should build or use an e.h.t. probe. A stout paxolin tube of correct length and generous diameter should be obtained and the attenuator sections built on to a long length of tagstrip as shown in Fig. 10.

This should be held centrally in the paxolin tube like the wick of a candle and the whole tube filled with transformer wax or other approved insulating compound (not candle wax). After allowing to cool and set hard the outside of the tube may be lapped with tinfoil as screening, securely connected to the outer braiding of the coaxial cable.

A second paxolin tube of larger diameter should then be pushed over the whole lot and the new annular space again poured full of molten insulating compound. Make sure that the prod end of the tinfoil lapping has adequate clearance from the prod (about 2in.) and is well below the surface of the set insulation compound to avoid e.h.t. flashover.

It is dangerous to use an e.h.t. probe of poor or indifferent insulation. When using hold the probe well back from the prod end.

GENERAL PURPOSE PROBE

The three-section probe of Fig. 10 leads to a small, handy unit which is a good compromise for general use. It will tolerate and display a.c. and d.c. inputs up to about 1·5kV, enabling most measurements in TV sets and elsewhere to be performed with safety. The calibration of the Y-amplifier controls of the Videoscope should be made correct with respect to this probe. Any other special probes made in addition should then be labelled with the *additional* attenuation or gain factor resulting with respect to the Y-amplifier calibrations.

THE ANODE PEAKING COILS

Any ordinary resistance capacity coupled amplifier has an upper limit set to the operational frequency range due to the stray anode and grid capacitances causing increasing shunting of the anode loads at higher frequencies.

Well-designed amplifiers of this type without special compensation, apart from simple negative

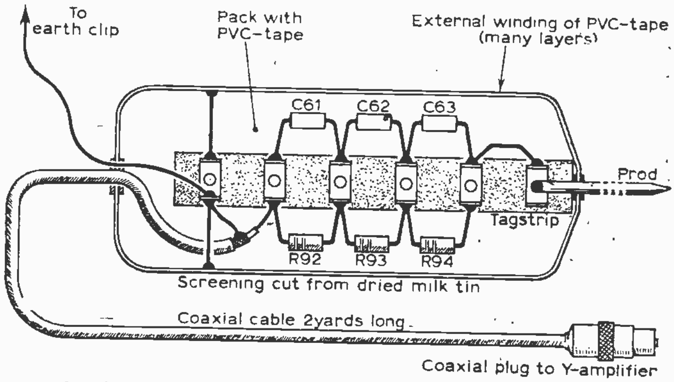


Fig. 10—Construction of the general purpose Y-amplifier probe.

COMPONENTS LIST

R92, 93, 94	4·7MΩ 10% 1W carbon.
C61, 62, 63	50pF approximately, 500V ceramic, see text.
Tagstrip, coaxial plug, coaxial cable, PVC tape, etc.	

feedback, can reach upper frequency limits of several hundred kc/s with usable gain.

This is not sufficient for the Videoscope, so that additional measures have been adopted to raise the upper frequency limit to about 2Mc/s. Regarding the low frequency end, there is little to be said—this is merely a question of using coupling capacitors of adequate size in r.c. amplifiers.

The principle of anode peaking coils inserted at the h.t. end of the anode load resistors is to give a resonance at or near the otherwise resulting cut-off frequency. This is achieved with the coil and the stray capacitances acting in parallel, representing then, as always in a parallel tuned circuit, a relatively high impedance at resonance.

The anode resistor is effectively in series with the coil for this tuned circuit, giving tremendous damping of the resonance. This is desirable because the resonance is required to be so broad that a smooth and matched lift to level response is obtained without preference for the resonant frequency or any frequency close to it.

The design must thus be for Q values less than unity. At frequencies well below the resonance

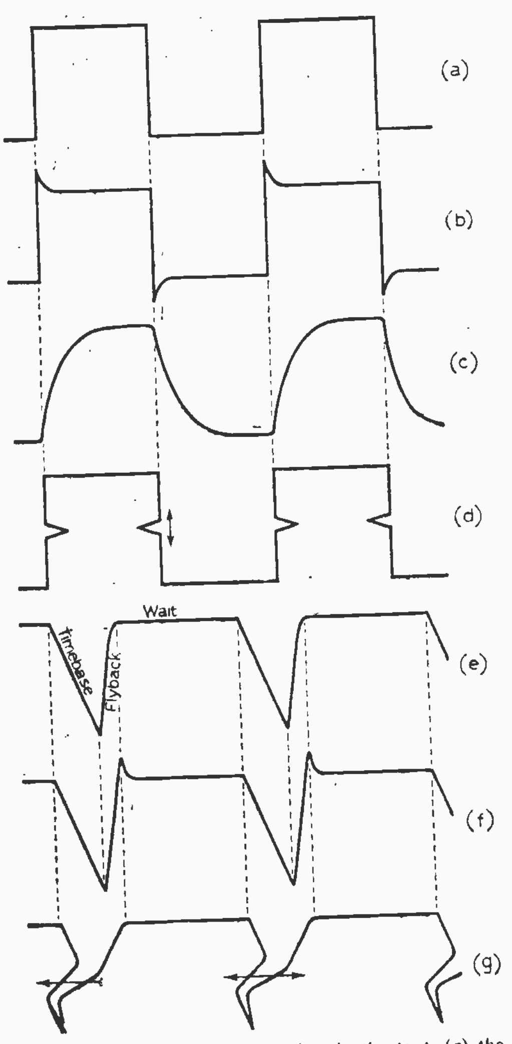


Fig. 11—Waveforms referred to in the text. (a) the ideal square-wave; (b) distorted square-wave when bridge-bank trimmer capacitor set to too large a capacity and (c) when set too small; (d) sync injection spikes on square-wave when operating at too intense sync setting or when floating screen between V4 and V6 is not properly adjusted; (e) Auditron timebase waveform in 'long' flyback setting; (f) display of (e) on Videoscope when bridge-bank trimmer capacity is too high, the 'noses' vanishing at correct capacity setting; (g) severe form of sync breakthrough into the X-amplifier under conditions of incorrect screening (see text).

the coil has negligible impedance and is thus as good as absent, i.e. the performance of the amplifier is not disturbed.

Provided that the circuitry and layout as published are *strictly* adhered to, the quoted inductance values will be found satisfactory. L2 and L3 must be matched. The required inductance values can be trimmed experimentally on small formers and using thin enamelled copper wire, checking resonant frequencies with a known parallel capacitor (large enough to swamp self-capacitance), using a grid-dip meter.

As a rough guide, about 300 turns of the type of thin enamelled wire taken off the primary of an ordinary wireless output transformer, pile-wound on to one of the standard small v.h.f. coil formers with screwed slugs (retain), should be required for L1 and about 400 turns for L2 and L3.

These windings will normally make the required inductance lie within the range of the slug. Further variation, to avoid rewinds unless really necessary, can be got by trying various slugs (v.h.f. types or medium wave types).

After dipping each finished coil in insulating lacquer and allowing to dry, a good layer of PVC tape (Scotch, No. 33) should be wound on and then a single lap of tinfoil as screening. This should be insulated with an interposition of PVC tape at the overlap in the same way as the screen winding of a mains transformer to prevent representation of a shorted turn. A lead from the screen should go to the nearest tag when wiring up.

The outside of the whole screened coil should be lapped with further PVC tape and finally dipped in insulating varnish. Stiff connecting leads should have been fitted and anchored so that the overall final appearance is that of a paper capacitor in roll form.

For those readers wishing to be more exact and possessing the necessary instruments the exact coils required can be determined by the same procedure used by the author in the prototype in establishing the initial design.

Two simple formulae are used for this. If Ra is the operative load resistor in the anode circuit and Ca is the stray anode capacitance total then the product of Ra (expressed in MΩ) and Ca (expressed in μF) gives the cut-off time-constant in seconds.

The reciprocal of this is $2\pi fc$ where fc is the nominal cut-off frequency without compensation. It is the frequency for which the amplification has fallen to $1/\sqrt{2}$ of the full value. We must now choose a value for the coil inductance such that the ratio of coil impedance to anode load resistance at fc is given by $(\sqrt{2}-1)$.

Then the gain is lifted back to level at fc instead of being about 30% down and remains level to beyond the resulting resonant frequency which lies at $\sqrt{2}$fc. Combining the formulae we get the single requirement for choice of inductance for the compensation coil:

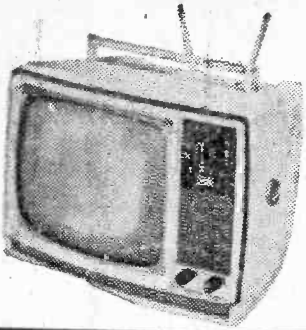
$$L = 0{\cdot}414\ Ca\ Ra^2$$

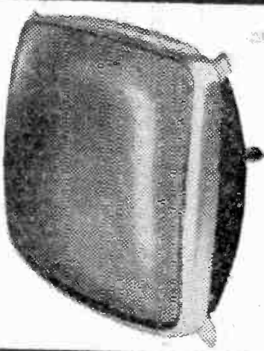
L = required inductance (μH)
Ra = anode load resistance (kΩ)
Ca = total anode stray capacitance (pF).

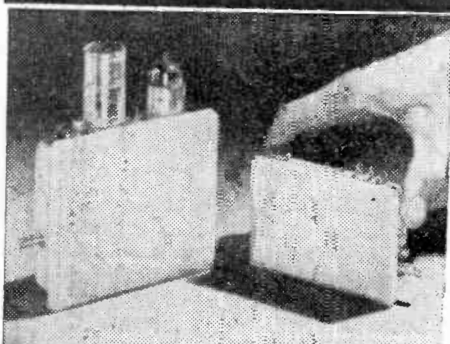
Here the only unknown is the anode stray capacitance, which must be measured. This is best done with a grid-dip meter by comparing the resonant frequency of any available test coil (even a makeshift multiple loop of connecting wire giving resonances in the short wave band is suitable) wired between valve anode and chassis with the resonant frequency of *the same* coil wired across various known or calibrated variable capacitors.

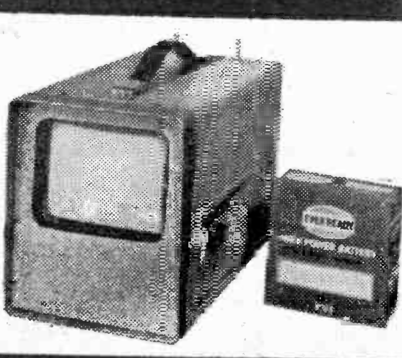
The inductance of the test coil need not be

—continued on page 129









Vision of the future

In these days of technical advancement and change, it is as well to keep an eye on the future. With television it certainly cannot be considered an easy task to foresee developments, but all the same we recently asked two of our leading contributors to do just that and here we present the result.

First we take "A Look Ahead" with H. W. Hellyer.

THE role of the prophet is a chancy one. In things electronic, events have a habit of turning predictions topsy-turvy. But the following is no S-F glimpse into the future; merely a review of some of the developments that are occupying our boffins, with comments on their possible commercial outcome.

As stated in Radio Show Roundup last month, there were several hints of future design to be seen in the private trade rooms of Earls Court, and at least one teasing example on the Ever Ready stand.

Already, the trend toward the second set, which has been in full swing for eighteen months in the U.S.A., has brought us two significant contributions, the STC design exemplified in the K-B *Featherlite,* and the Thorn contribution based on the "900" chassis, the 11 inch "bed-side" transportable.

The 900 chassis is already well-known, and has been incorporated in receivers under the brand names of Ferguson, HMV, Marconiphone and Ultra. It was developed with 625-line operation and u.h.f. reception in view, and has a number of noteworthy features.

The usual mains voltage dropping resistor has been eliminated, giving 30 per cent less heat dissipation. In place, an auto-transformer is used, a separate silicon rectifier fitted to feed the h.t. circuit. There are only 13 valves in the standard 900 chassis, some of them new types, previously available only for export models. Later, when the jelly pot line output transformer is fitted to the standard range, this valve complement will be reduced to 10.

The jelly pot transformer is another recent development, using fireproof plastic moulding

The photographs on the left illustrate some recent trends in television development. At the top is shown K-B's new "Featherlite" 11in. mains portable TV receiver. Weighing only 16lbs, it is available with or without a u.h.f. tuner. Below this is the Mullard "Panorama" c.r.t., which needs no additional protective screen and so ensures freedom from dust accumulation and multiple reflections. Next a Mullard continuously variable transistorised u.h.f. tuner (right) is compared with its valved counterpart. The bottom photograph is of a prototype portable TV receiver designed to operate from the Ever Ready T.V.I. dry battery beside it.

and a special insulant that was used in space research originally. Selenium rectifiers are inbuilt, doing away with the other weak link in today's sets, the e.h.t. rectifier. There is less magnetic radiation and a reduced line whistle with this type of transformer, and its size has been whittled down considerably.

Three fixing bolts allow the chassis to be released easily for inspection and servicing, and the whole chassis can be lifted free, in most designs, without disconnection. As usual with later Thorn designs, all components and circuit references are clearly marked on the panel, which is a single unit, set low across the bottom of the receiver, again for maximum heat dissipation.

The overall effect is claimed to be a heat reduction in vital chassis areas by as much as 25° C. When it is considered that an increase of 10° can half the life of a component and a reduction of 10° double it, the importance of cool running can be appreciated.

A further design point not often considered is the improvement in sound stages which has partly resulted from 625-line development and the f.m. detector and audio output techniques. Greater sound output has been obtained, with more feedback circuits, and much less distortion. As with radio and radiogram designs, the borderline between "hi-fi" and "domestic" becomes less clearly defined. The audio output, with full negative feedback over output transformer and valve, of the Thorn 900 chassis, is 2·2 watts.

In contrast to the single-panel design just discussed, the K-B *Featherlight* has a hand-wired construction, but is designed to come apart easily in sections. The great advantage is that, having been dismantled, the set can be operated and worked upon.

The STC design is valve-operated, but the heat producing ballast resistor is eliminated. Instead, a silicon rectifier is fitted to provide unidirectional heater current. The consequent suppression of each half-cycle of mains current gives a reduced heater current and the circuit is arranged to drop 240 volts.

Further heat reduction, and a saving in weight, is achieved by the use of a high-efficiency/low power line output transformer. The 11 inch tube requires only 11kV e.h.t., but is an 110° deflection type.

This is overcome by a special deflection coil assembly, augmented by two magnets which "pull" the spot to the full scan at the ends of its electronic deflection.

Cutting down the size of a set, in these days of micro-miniaturisation, is taken for granted. But, whereas defence projects are usually given a more generous budget, domestic designs have to be made compact within a tight production schedule—and, in the case of tuner units—have to be robust enough to withstand normal "customer" operation.

Transistorisation of v.h.f. units has been going on for some time, with a consequent saving in weight, and an incidental reduction in front-end noise, with increased gain. The u.h.f. turret constitutes another problem. Resonant lines take the place of coils, and size is limited by their length—usually half-wave.

STC have developed a quarter-wave u.h.f. tuner unit, little bigger than a pair of matchboxes. A four-gang tuning capacitor is used, in place of the usual three and the i.f. transformer is mounted outside the tuner case.

A novelty about this design is the way it is fed to the first i.f. valve. There is no grid switching, but both v.h.f. and u.h.f. tuners are connected by a bridge-coupling circuit and the only switching change is disconnection of h.t. from the unused tuner.

In the Mullard 11-inch dual-standard design, transistors are again used throughout. The line output stage uses a fast switching transistor, the AU103, while the other "hot-spot," the video output stage, employs a BF109 high frequency, high voltage transistor.

The tube is a 90° deflection type with a low consumption (0·7W) heater, a square-cornered screen with 4:3 aspect ratio and a reduced neck size to 20mm. to cut down upon deflection power demands. 11kV is required.

Whereas the STC design makes no particular concession to power consumption, and the Thorn design power reduction is basically concerned with heat reduction, the Mullard design is aimed at battery and mains use, and has been kept down to 12 watts.

This is still too great for the batteries available on the general market, and Ever Ready have been working for some years toward a purely battery-operated small screen "second set". Their success may be judged by the acclaim of trade critics who had the opportunity of inspecting the prototype made for Ever Ready by Thorn.

Two lines of approach were needed. First, design of the receiver must be aimed at absolute reduction in power consumption, which eliminated the usual line of scaling down a conventional receiver, and second, the battery itself must be improved if the lady of the house is expected to carry the set about.

The prototype, incidentally, although only 16 lbs with battery (which seems to be the acceptable norm at present), has been fabricated in the model shop and thus has some steel pressings which would probably give way in production to a lighter design.

Reduction of the power demand to about 3 watts made possible the use of batteries formed from Leclanché cells of a new construction, giving about 40 hours use, at two hour daily periods. The prototype Mark 5 is a 405-line receiver, and the extra circuitry required for dual-standard operation will increase consumption to about 3·3 watts.

The power requirements of a television receiver, using existing techniques, are dependent only partly on screen size, and the present 7-inch tube has been chosen because of the availability of other parts, and is, admittedly a compromise.

The tube is a Mazda V3271, with 7-inch rectangular screen, 42° deflection angle, electrostatic focusing, a 28mm. length and is just over 12 inches long. Final anode potential is 8kV and maximum beam current 150 micro-amps (average picture—30 micro-amps).

Sensitivity of this set is 10 microvolts signal for full picture modulation, which is near the average for a mains receiver, and the tuner unit is of standard design. The i.f. amplifiers also are conventional transistorised types, as is the video stage (actually two stages, emitter follower and output).

The audio amplifier is a diode peak interference limiter followed by transformerless driver and complementary p-n-p/n-p-n transistors, giving an audio output of 350mW.

Specially developed scan coils are used, and there is no conventional line coil e.h.t. storage, thus reducing the d.c. power requirement to some 240mW. A three-transistor sync separator is used, a two-transistor flywheel sync unit and mean level a.g.c. sampled from the video output.

The field time base uses a blocking oscillator, with special shaping circuits and a separate free-running blocking oscillator feeding into a five-stage Cockroft-Walton multiplier provides e.h.t. A metrosil is employed to regulate e.h.t. and give focusing potential.

The particular triumph of this circuit is the stabilised power generator which maintains the battery volt-ampere product substantially constant. This employs three transistors, five diodes and a high ratio transformer, with complicated suppression and smoothing.

If concentration has been toward the "smaller stuff", it should not be thought that the conventional design has been neglected by the assiduous boffins.

At Thorn/AEI, for example, they have been diligently improving field circuits, to cut down line interaction and reduce the poor interlace that the British public seems to have taken as a normal part of life.

Mullard have developed automatic line and field synchronising circuits that obviate the need for hold controls entirely—these being applicable as yet to the hybrid receivers for the overseas markets. An a.g.c. circuit is "noise protected" by a frequency selective gate.

From the same stable comes news of experiments with increased e.h.t. for the 23-inch tube, giving reduction in spot size, proportional light output, and reduction in deflection defocusing.

The idea is that when less light is needed, the tube can be operated at lower beam current, leading to the development of a self-compensating circuit.

Increase in e.h.t. means more scanning power is required. The circuits demonstrated at Earls Court by Mullard showed that 20kV could be achieved using the same PL500 and PY800 as in conventional circuits.

As a final tit-bit, the independent approach toward spot deflection and raster symmetry results in a coil design for best possible spot shape, with the consequent pin-cushion distortion corrected by external circuitry.

Tube design continues to exercise the makers, and the latest pointer to the way ahead is the Mazda CME1905 and CME2305 range, which will be added to the well-known "Gold Star" range. These have rimguard safety styling, a metal rim being cemented to the glass around the face. The risk of user damage due to implosion is virtually eliminated.

These are obvious signposts, drawn from existing development. A look at the trends in the higher reaches of the electronics industry will show further indications of the way ahead: things like micro-miniaturised modules, already creeping into some transistor radios, and new, multi-unit semiconductors that can be made into plug-in circuits.

By the time Colour Television turns that corner, it seems the industry will be prepared!

Now, Gordon J. King discusses "Television Design Trends".

PROBABLY one of the most outstanding developments in television receivers of recent months is the use of transistors. Several of the new models are now available with a transistorised u.h.f. tuner for the reception of BBC-2. It has been proved that transistors in place of valves undoubtedly have the edge on noise performance, particularly on the higher Band III channels and in Bands IV and V. However, in dual standard models, the u.h.f. tuner is of prime importance, and for the v.h.f. channels the valve-type tuner is retained.

Noise Factor

A u.h.f. valve has a noise factor of about 11dB at 470Mc/s, rising to approach 17dB at 860Mc/s. Good u.h.f. transistors, on the other hand, have a noise factor around 8dB at 470Mc/s and 11dB at 860Mc/s. Noise-wise, then, transistors show an improvement of about 2-to-1. From first principles, this means that a signal of half the strength of that required to get good pictures with a valve tuner is needed with a transistor tuner.

Tuner noise is displayed on a picture as "snow" or grain effects. This shows up more in fringe and weak signal areas, so the 2-to-1 noise improvement by the use of transistors is highly desirable, particularly on the u.h.f. channels where weak signals are more defined than on the v.h.f. channels due to the more critical screening effects and the shorter range of the u.h.f. signals.

From the practical aspect, a set displaying tolerable picture noise with a valve u.h.f. tuner would give almost a noise free picture on the same signal with a transistor u.h.f. tuner. Put another way, a set with a transistor tuner displaying a picture of just about tolerable noise would probably fail to lock with a valve tuner on the same signal.

A number of firms, including RGD, STC, Cyldon etc., are now making transistor u.h.f. tuners. These all have one thing in common, and that is the use of quarter-wave resonant lines instead of coils. Valve-type u.h.f. tuners also adopt the resonant line principle, but use half-wave instead of quarter-wave lines.

Quarter-wave lines lend themselves to transistor application They would be rather difficult to design in a valve circuit owing to the significant length of the conductors from the valve base to the electrode system.

In a transistor tuner, the transistor collector lead can, in fact, become part of the resonant line. Half-wave lines are thus more suitable for valve-type u.h.f. tuners.

The equivalent to a quarter-wave resonant line with one end short-circuited is a parallel coil and capacitor. The lines in u.h.f. tuners thus have their ends shorted or closed. At 470Mc/s the electrical quarter-wave length is 16cm (about $6\frac{1}{4}$in.), but the lines in tuners can be made much less than this and yet still resonate over the u.h.f. channels by loading the open end (i.e., that end connected to the transistor) with a capacitor. This sort of loading brings the line length down to about 2½cm (about 1in.).

Variable Capacitor Tuning

For tuning the u.h.f. channels, the loading capacitor is made variable, the spindle being mechanically coupled to the u.h.f. channel selector control knob. In u.h.f. transistor tuners suitable for conditions in Great Britain four variably tuned resonant lines are incorporated. These lines are equivalent to the inner conductor of a transmission line. The outer conductors are formed by the troughs in which the lines are supported, these being totally enclosed when the cover is clamped to the tuner case.

The complete circuit of the Cyldon transistor u.h.f. tuner is shown in Fig. 1. This uses the new Mullard AF186 u.h.f. transistor in both the r.f. amplifier and frequency changer positions.

Hybrid Dual-standard Set

A coming trend is the hybrid dual-standard television set, and a design for such a circuit has already been developed by the engineers at Mullard. Here transistors are employed for the small-signal circuits while valves are retained for the video amplifier, sync and timebase stages.

Transistors are used exclusively in the sound channel, a feature which is characterised by the sound being available immediately the set is switched on.

This circuit also incorporates a brightness correction network which tends to stabilise the picture black level and re-introduce a substantial portion of the d.c. component, thereby avoiding those degrading effects which have been present on past models such as the undesirable rise in picture black when the picture is mainly dark, giving the well known sooty grey effect and the streaking which can appear from captions on sets in which the d.c. component is largely suppressed.

The design caters for transistorisation of both the v.h.f. and the u.h.f. tuner. The v.h.f. tuner employs three transistors. Type AF180 for the r.f. amplifier and AF178's for the mixer and local oscillator. The u.h.f. tuner is very similar to that depicted in Fig. 1, using AF178 transistors both in the r.f. amplifier and in the self-oscillating mixer.

The fully transistorised vision i.f. amplifier employs two AF181 transistors together with an AF179, while the sound i.f. amplifier uses a pair of AF115 transistors. The audio section has an OC71 as the voltage amplifier, an AC127 as a driver and a complementary pair of transistors (AC128 and AC176) in a push-pull output stage. The practice of using p-n-p and n-p-n complementary transistors is now becoming common in audio sections (see Fig. 2). They have the great advantage of not requiring a driver or output transformer. They can also give up to about 2W (or more with high power devices) of audio at quite good quality.

A semi-conductor OA70 vision detector is employed, and this feeds into the L section of the new double-pentode PFL200 valve as the video amplifier. This valve uses the new decal (10-pin) base. The other pentode section (F section) is employed in the sync circuits.

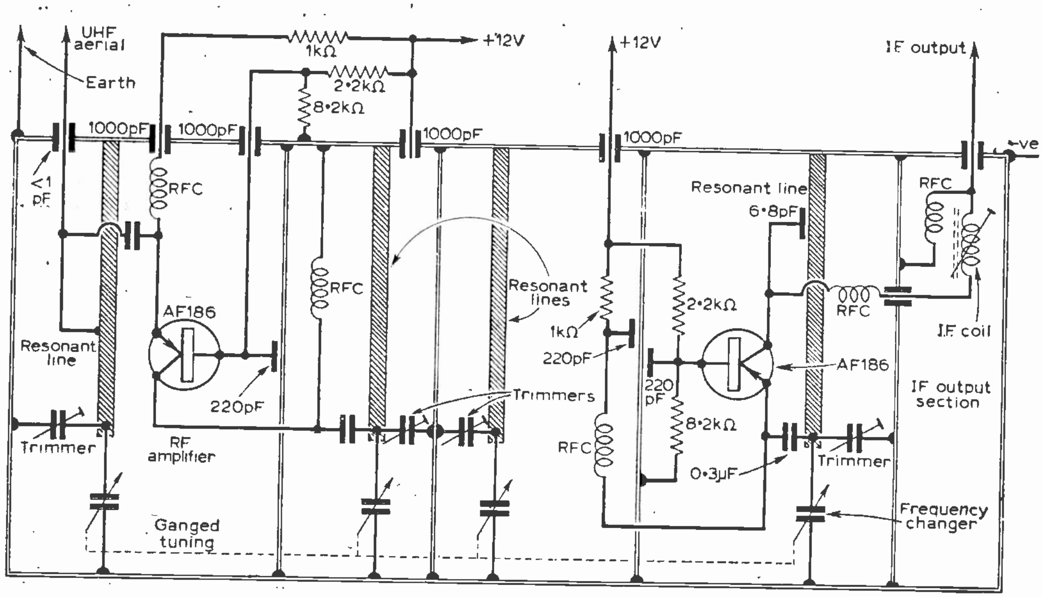


Fig. 1—The circuit of the Cyldon transistor u.h.f. tuner. This kind of tuning will find favour in the u.h.f. section of many new dual-standard receivers. The AF186 transistors are capable of giving high gain and low noise at u.h.f.

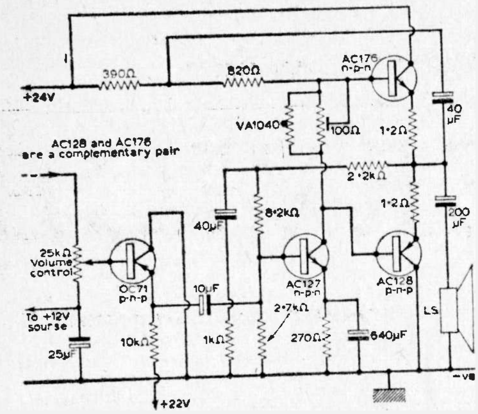


Fig. 2—This type of transistor complementary audio section will soon become common in hybrid receivers, as it has already in radios and hi-fi amplifiers.

The line and field (used to be called frame!) timebases follow the conventional valve design. The latest PL500 valve is found in the line output stage with the partnering PY800 in the booster circuit.

The line oscillator is accommodated by the triode-pentode PCF802 in a flywheel controlled circuit to avoid 625-line tearing in weak signal areas, phase detector being by a pair of BA115 diodes, while the field section uses a triode-pentode PCL85 with the triode in a blocking oscillator circuit and the pentode in the field output circuit.

Silicon rectifiers are found in the power supply circuits, a BY100 for the valve h.t. voltages and a BYY20 for the transistor voltages. An auto-transformer gives taps for the valve and tube heaters.

Battery Portables

All transistor portable television sets now have the tendency to develop along the lines for all-dry battery powering. A design after this style has been evolved by the Ever Ready company in collaboration with Thorn and is being made available to set manufacturers. This operates from a specially developed battery which has several hours continuous use and, of course, a much longer life when used under normal, intermittent conditions.

The Ever Ready design consumes only about 3W of battery power as against the 10 to 12W taken by the earlier transistor designs with re-chargeable batteries. Of course the Ever Ready design is smaller and lighter than most earlier models. At two hours per day, the new Ever Ready TV1 battery gives 40 hours of viewing.

The prototype features a low-consumption 7in. picture tube, measures 9 x 8 x 13in. and weighs only 16lb. complete with battery. Here, then, is a glimpse of the truly transistor portable television.

The American trend of 11in. sets has now arrived in Great Britain. The first set of this kind over here is the Kolster-Brandes KV003, the *Featherlight*. This is a dual-standard model with transistor u.h.f. tuner not only to facilitate noise performance but also to keep the internal temperature down which is an important factor in small-size models. The set weighs only 16lb.

An interesting design aspect is the elimination of the conventional mains dropping resistor by the use of unidirectional valve and tube heater current. The ballast resistor is, of course, the single hottest component in more conventional sets, and this just could not be accommodated in the small-size KV003.

Unidirectional Heater Power

Apart from the ordinary silicon h.t. rectifier, the set employs a second such component connected in series with the heaters. This rectifies the heater current so that it consists only of half-wave pulses instead of two half waves (there is no normal smoothing). Thus the heater power is effectively halved and this makes the ballast resistor unnecessary. There is virtually no heat developed in the silicon rectifier itself.

Another recent innovation is the "immediate-warm-up" set Here the valve and tube heaters are left running continuously while the set is plugged into the power supply. When the set is switched on it is only the h.t. supply that is switched. Thus as the valves are alight and thoroughly warm the set responds immediately when switched on.

This applies both to sound *and* vision. Normally the e.h.t rectifier would take a minute or two to warm up after switching on the h.t. supply, even with the remaining heaters alight, due to the heater of this valve being energised by pulse current in the line output stage and the pulse current not being available until h.t. is switched on.

By the use of an ordinary e.h.t. rectifier valve, therefore, the vision would be delayed. This is avoided, however, by the use of a semiconductor e.h.t. rectifier system which, of course, requires no warming-up time.

Other trends are towards push-button u.h.f. channel selection and towards greater efficiency in the timebase stages. In the latter respect new types of material for the cores of line output transformers facilitate the increased scanning power demanded by 625 lines and allows this to be provided by ordinary type valves if necessary.

In practice, however, new valves have been designed and these, with the new core materials, ensure efficient operation with less strain on the valves themselves.

Noise Improvement

In an endeavour to extend the service area (or reduce the effective fringe area) a current trend is towards the use of transistor amplifiers and boosters mounted either at the aerial itself or near the set. Such devices used with old models and existing sets devoid themselves of transistor front ends can give a remarkable improvement in performance in areas which have hitherto been considered as bad from the reception point of view.

The success here results from the relatively high gain and the low noise of v.h.f. and u.h.f. transistors when employed in well-designed circuits. Indeed, a good transistor booster can improve the noise performance of the complete receiving installation by as much as three times under certain conditions. We shall be seeing more of transistor u.h.f. boosters as BBC-2 spreads across the country. ■

a series for the intending professional serviceman

The business of SERVICE

PART 4

by John D. Benson

CONTINUED FROM PAGE 71 OF THE NOVEMBER ISSUE

THE faults enumerated in last month's article are by no means the only faults that can occur in the sound section, but by using the same systematic approach with reference to the service data, faults are soon located.

Absence of vision and sound immediately indicates a turret fault, but here we are also faced with the possibility of mechanical trouble, i.e. displaced or dirty contacts. Visual inspection soon reveals the source of the trouble. Having eliminated the mechanical fault, but with the original fault still persisting, then methodical checking of cathode, screen and anode voltages will reveal whether the fault lies in the valves or the components associated with them.

Having cleared the turret of faults, vision may still prove to be inadequate. As in the case of sound, tests are applied, starting with the video output valve and working back towards the turret. Valve voltages are checked against the maker's figures until the offending valve or component is located.

There are many more faults common to the vision section, especially receivers fitted with gated a.g.c. circuits. Modern receivers rely on a much simpler form of a.g.c. known as mean level, which is derived from the sync-separator valve, but whatever the type of circuit, methodical testing in conjunction with the maker's data will find the answer.

The locating of vision faults is made much easier since we have the c.r.t. to refer to as an indicator which will faithfully reproduce any discrepancies to the trained engineer's eye. Again guesswork is eliminated by efficiency.

The Timebases

A television receiver differs from a radio receiver in one major way. It contains timebases. Timebases produce the power required for moving the c.r.t. beam in such a manner that it produces the rectangle of light known as a raster.

The c.r.t. beam is modulated by the output from the vision section and in this way a picture is built up. The timebases are kept in step with the transmitted signal by synchronising pulses which are separated from the vision signal and fed to the line and frame timebases by a valve known as the sync-separator.

The line timebase moves the c.r.t. beam in a horizontal direction and the frame in a vertical direction. The c.r.t. beam is focused by the field produced by a permanent magnet or in some cases by electrodes within the c.r.t. This is known as electrostatic focusing.

The line timebase also provides the e.h.t. voltage for the c.r.t. by rectifying the high voltage pulses which are produced when the c.r.t. beam returns from the finish of one line to the start of another. They are called fly-back pulses.

This, then, is a brief description of the scanning equipment in a television receiver. The timebases can be studied as a separate unit, together with the c.r.t., their only connection with the vision receiver is by the sync-separator valve.

Timebases function in a very precise way and must continue to do so if the resolved picture is to be correct. Quite small changes in the performance of any of the components associated with their circuits can produce faults which make viewing intolerable.

Timebase faults account for a large percentage of the causes for failure in television receivers.

The circuitry connected with the timebase is often complicated, especially that connected with the line scanning. Only a trained engineer can hope to effect efficient repairs and so turn servicing into a profitable business.

The electrical demands made on the output valves of timebases is heavy. It follows logically then, that failure often occurs in this section. Output failure is immediately evidenced by lack of scanning power and inability to fill the screen by use of the appropriate controls, the c.r.t. acting as a measuring instrument. A replacement valve generally restores everything to order.

Sometimes an engineer is confronted with a picture which is dull and too large and cannot be controlled. His training immediately tells him that lack of e.h.t. voltage produces this form of fault, since a weak beam is deflected more than a strong one. The fault will generally be found to lie in the line transformer windings which supply the e.h.t. rectifier with heater and anode current, occasionally where a separate capacitor is used for e.h.t smoothing, this component is found to have developed leakage.

Timebases which include complications such as fly-wheel sync circuits, which are designed to eliminate the effects of impulsive interference, can be exceedingly troublesome and can only be effectively corrected by the intimate knowledge which a trained engineer possesses.

From a business point of view it is only the quick solution of such complex faults that can make the whole undertaking of servicing profitable.

The oscilloscope can be used to great advantage on the tracking of timebase faults, but is expensive and is best left until the business has progressed sufficiently to warrant this expenditure.

Intermittent Faults

One of the most irritating forms of fault which is all too often encountered, is the intermittent one. This type of fault comes and goes at unspecified intervals and is often only apparent after the receiver has been working some hours, in other words it is temperature controlled.

Some intermittent faults only show up when subjected to certain vibrations which may be produced by the loudspeaker or externally. Whatever their cause, their cure calls for the utmost patience coupled with knowledge and systematic searching.

Only training and experience can reduce the correcting of these faults to a profitable proposition. Such breakdowns come from dry joints which are sometimes within a component, capacitors which only break down upon reaching a certain temperature, and leakages between components windings and wiring when heated beyond a certain point.

Temperature

It is sometimes necessary to enclose the receiver to produce the temperature at which the breakdown occurs. This can make the task very difficult but by methodical checking and elimination as described, the most annoying and elusive fault can be found.

Cleaning the C.R.T.

By electrostatic attraction, the c.r.t. becomes very dirty, especially when used in a room adjacent to an open fire. The cleaning of the c.r.t. should never be neglected, it is a first-class prestige builder—customers often believe a new c.r.t. has been fitted and are very elated when they learn that the old tube has only been cleaned. Details such as this in repair work can often make or break a business.

Radio Receivers

A service business cannot exist on television repairs alone and the humble mains radio still occupies a prominent spot in the average home. Faults in radio receivers can be complex, but as in tracing faults in the sound section of a television receiver, so we proceed with a standard radio set. There is also the added danger point which does not occur in a television receiver—the tuning capacitor and its associated mechanism. Here the service engineer has to become the mechanical engineer in renewing dial drives and locating loose or bent vanes in tuning gangs.

A.G.C.

Faults in a.g.c. circuits can be elusive, but by using a high resistance testmeter, they can soon be located if approached methodically. The scourge of dry joints and temperature controlled intermittent faults are common to radio as in television and their cure is by the same patient and systematic approach as described, with constant reference to the makers' requirements.

Push-pull Output

In quality receivers and 'grams, the engineer has the added problems of push-pull output. Here again step by step testing invariably finds the fault, and turns the hit and miss methods of the dabbler into certainties.

TRANSISTORISATION

The mains receiver is slowly but surely being superseded by the transistorised receiver. The transistor has introduced a completely new way of thinking into the world of electronics and many older service engineers have had to re-adjust their concepts or circuitry to cope with this new world of semi-conductors.

Initially everything seems to be upside down, but the trained engineer who has had experience of the early days of television with electrostatic deflection is no stranger of positive earth connections.

The transistor with its low h.t. supplies calls for high resistance test instruments. Fractions of volts have very often got to be measured and this calls for high class reliable instruments.

The modern transistor is a very reliable component, much more so than the valve, and provided it is used under the makers' working conditions, has an almost indefinite working life. The transistor is also free of such faults as microphony and hum troubles which can be so troublesome in mains type radios.

Temperature, whether internally or externally generated, is the great enemy of the transistor, and the engineer soon learns that they must not be subjected to heat whilst soldering or carrying out soldering near them.

Routine Checks

As with television and mains radio receivers, the servicing of transistor receivers is only profitably carried out if a routine method is worked out for locating faults.

Again we will assume that a receiver refuses to function. Starting with the power supply (battery) the receiver is switched on so that the battery is tested under working conditions. The test shows extremely low voltage; with the receiver switched off, the battery voltage remains low, indicating that a replacement is required. With a new battery there is still no output.

Using the mA section of our testmeter, the current consumption is checked against the maker's figures. The test proves that no current is flowing. The engineer immediately checks the ON/OFF switch, which is found to be faulty. A replacement is fitted and the test continued. Still no output.

Starting at the output transformer, using the test-meter in the "ohm" position, the primary windings are tested for continuity and resistance. The readings correspond with the maker's figures but there is no expected "click" in the loudspeaker. Examination proves that one lead to the speech coil has become disconnected.

With the speech coil re-connected, the test is continued. Sound is present but accompanied by crackling and distortion. The bias voltage on the driver transistor is measured and it is noted that the instrument needle flickers instead of remaining steady. The bias potential divider is examined and a fine specimen of a dry joint is found. With the joint resoldered, we continue, but find that volume is low.

The diode detector now comes under suspicion. Carefully removing one end from its soldered joint, the diode is tested for backward and forward resistance. Our ohmmeter tells us that the backward resistance has dropped to a very low value. The diode is replaced and the receiver is switched on again, and although there is a great improvement, the receiver is unstable.

The i.f. stage comes under examination, and although all components check to the maker's specification, instability still persists. The transistor is carefully removed and replaced by a new one. Switching on, we find volume is restored to normal without distortion or instability.

The receiver is now checked over the entire range, but sensitivity proves to be low at the high frequency end of the MW band. The frequency changer transistor, bias emitter and collector voltages are checked and found correct; the tuning circuits are left to be examined.

Careful examination of the trimmers proves that the sealing has cracked on the medium wave trimmers, and the adjusting screw has slackened off. Re-adjustment restores sensitivity, but it is still not up to standard.

Further examination shows that the aerial coupling coil on the ferroxcube rod has shifted. With the coil restored to its original position, sensitivity is up to standard and another receiver has been repaired.

The example receiver which we have diagnosed illustrates how faults are progressively traced. The examples given are but a fraction of the possible faults which can occur, but whatever the fault the same methods of approach apply.

In the next and final article, the expanding business will be dealt with and the time saving equipment which can be added to the workshop equipment. The all-important keeping of records and clerical work will also be examined.

AERIALS!—OUTDOOR, INDOOR?

—continued from page 104

use has been evolved (patents pending).* This does not comprise the mere connection of set-top aerial to a transistor amplifier. Here the aerial is integral with the transistor circuit.

The elements consist of a rod and (purposely) the outer conductor of a specially connected coaxial lead, in fact, the lead which carries the signal from the aerial to the set.

By these means the signal grip is enhanced and the aerial system is simultaneously tuned to the required channels in Bands I and III. Moreover, the transistor section gives the aerial gain and makes it almost equivalent (gain-wise, that is) to a multi-element array. The basic idea is revealed in Fig. 3.

One attribute of the design it its directivity, since in this respect use is made of the signal additive effects due to " in phase " signals on and in the coaxial connecting lead, the lead being orientated for maximum signal pick-up, minimum ghosting and etc.

The use of the transistor means that the set will display a picture of a given noise performance with an aerial signal which is almost half the strength of that needed when applied direct to its aerial socket.

It should not be expected, of course, that even this type of set-top aerial will do away with outside aerials altogether. However, aided by more sensitive receivers, coaxial relay systems and more and more local transmitters, we should eventually see an improvement over the nightmare growth of chimney-mounted aerials which has in the past typified the television era. ■

* *A number of "amplified antennae" are now available in the USA and are designed for TV and f.m. reception—Editor.*

SERVICING TELEVISION RECEIVERS

—continued from page 112

particularly useful on models with f.m. radio facilities.

Video Stage

A 1kΩ resistor was added in the screen-grid (G^2) circuit of V6, pin 3. This stopper prevented flashover between the anode and screen during heavy grid voltage excursions.

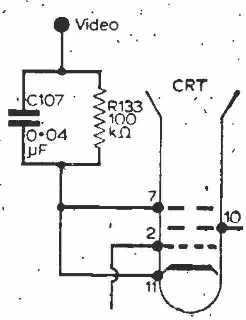


Fig. 3—The tube base connections incorporated later to limit the d.c. component of the signal and reduce aircraft flutter.

A 0·04µF capacitor and 100kΩ resistor were wired on the tube base socket in series with the cathode to limit the d.c. component of the signal and reduce aircraft flutter.

A.G.C.

All later models have a diode OA71 from the a.g.c. line to chassis and R13 (390kΩ) is then deleted.

CONTINUED NEXT MONTH

UNDERNEATH

THE DIPOLE

A MONTHLY COMMENTARY BY ICONOS

THE physical impact of bass notes on the ear has always had some psychological effect, whether from the pedal notes of a great church organ or the beat of a big drum. Fairground "barkers" of a hundred years ago realised this fact. They competed with one another by using both the big drum and the steam organ as a means of attracting public attention.

The great Steam Fair held recently near Maidenhead, Berks., was well furnished with drums, organs and fussy, glistening road locomotives which drew huge crowds and thousands of cars. There were many cameramen and sound recordists, amateur and professional, who recorded the exciting event, which appeared in various BBC and ITV programmes. The highly polished and immaculately painted roundabouts and side shows made stirring pictures and sounds. I counted no less than nine portable tape recorders picking up the grandiose overtures of one beautifully tuned steam organ! This was an exposition of the fundamental basis of showmanship: bang the drum and bring 'em in!

Progress in Publicity

The old-time fairground barker (who was reputed to spend some of his spare time in fly-posting playbills on walls) was the predecessor of the publicity man of the theatre, music hall and films. This go-getting character usually dashed around Fleet Street, Charing Cross Road or Wardour Street—or the offices therein—with a soft felt-hat pulled well over his eyes in the James Bond manner (if a high executive) or like a plain clothed policeman (if of lesser rank). Like most forms of entertainment, radio and television needs publicity, but, under the influence of the BBC over a long period, has become a profession which rejoices under the name of "public relations". The drum is still banged to push the message home to potential listeners and viewers, but the beat is as subtle as the roll on a snare drum. Percussion noises are "in the groove" these days.

Percussion

Percussion noises and the intricate patterns they weave reach high levels of musicianship in the music of the best of the military bands. Their precision in percussion timing and tone colour is quite remarkable, particularly as demonstrated in hi-fi stereo disc recordings. I was impressed by a recent Decca Four Phase stereo recording (+I.M.–C.R.), in which synchronised four track magnetic recordings of music, dialogue and effects were channelled into two tracks The coding mentioned above "I.M.20 C.R." means, incidentally, an "intermediately monitored 20 microphone channel recording", a complicated arrangement which enables the sound from any individual instruments or small groups of instruments to be controlled individually in volume, left or right channels (for stereo), echo treatment, tone equalisation etc. This is a tremendous advance in recording techniques for brass bands, orchestras (with or without soloists) and pop group recordings. Most directors of music are blinded by the mental dazzle of the whole idea—but there are a few of them who have grasped their possibilities for mono as well as stereo recording.

Bob Sharples, responsible for the music of several theatrical music shows, has prepared special musical arrangements which demonstrate his virtuosity in this field—notably "Battle Stereo", a dramatic music-and-effects descriptive piece which conveys the drama of the Franco-Prussian War of 1870, the American Civil War, 1914 War and the Blitzkrieg War. His handling of the band of the British Grenadier Guards was magnificent, as was the work of the recording producer and engineer. Taped on to mono, it was still very effective and demonstrates the progress we can expect in sound recording for musical shows on television.

Terry-Thomas

If you think hard about the earlier days of television programmes and the stars in them, it is almost certain that you will also remember the comedy shows and the stars. Harry Secombe, Peter Sellers, Dora Bryan, Max Bygraves, Cyril Fletcher, Tommy Trinder, Tony Hancock and Terry-Thomas are just a few of the stars who are now occasionally seen on television but have continued their careers on the stage or in films. Terry-Thomas (with hyphen, he insists!) has appeared quite a lot in American television, notably in The Danny Kaye Show, which was showing a month or so ago on BBC-2. He has returned to England to play in a big comedy film *Those Magnificent Men in their Flying Machines*, which is likely to be as funny as the classic picture *Genevieve*, which was all about old crocks—pardon me—vintage automobiles. Terry-Thomas has a poor opinion of British television programmes, especially light entertainment shows. He told the reporter of a theatrical paper that "In the main they are presented badly. Photography is crude and unimaginative." Warming up to his subject he continued, "There is far more enthusiasm backed by expert knowledge in America. By comparison, our light entertainment here is amateur. It's a technician's playground, whereas it should be an artist's."

Strong words these, whistling between T-T's well-known teeth, and they are all a matter of opinion. I don't know what medium was used by the makers of the Danny Kaye show; whether it was videotaped or telerecorded on film, or shot directly on to film—but this makes quite a difference to the photographic quality. Most of the important American television programmes are photographed directly on to film, so that they achieve a world-sale to stations operating on any line standard, be it 405, 525, 625 or 819 lines.

In Britain, many subjects are videotaped on 405 lines and re-photographed by a motion picture camera shooting at a monitor screen. This Kinescope end-product, as exported to countries not using 405 lines (which means everywhere except Eire) sometimes looks like a fourth carbon copy compared with the immaculate picture which is played off in Britain via a videotape machine. If Mr. Terry-Thomas has seen a badly photographed British television series on American television, then it is highly probable that it's the "carbon copy" he has been looking at.

Videotape

By the way, I continue to refer to videotape (abbreviated to "VTR") in my notes. This name has been registered by Ampex, the American company which produced the first really practical method of recording television pictures on to magnetic tape and set new standards. RCA followed up by similar tape machines, fortunately of compatible type. The Japanese have one, too, of their own particular non-standard type. They are all expensive but extremely useful tools in the operation of any television station. "Poor men's" versions of these television tape machines have been evolved, too, but these have not yet been adopted by the networks. None the less, the name *videotape* seems to be applied generally and, in many cases, illegally, to all apparatus for recording picture and sound on magnetic tape. It will probably find its way into the dictionary just as the words "gramophone", "kodak", "hoover" and "pianola" did—all spelt without capital letters!

The Election—BBC and ITV

So far as television is concerned, it seemed to me that the BBC won! I mean that they won the election from the point of view of presentation, production and technical qualities of their reportage on election night. Richard Dimbleby and his superb team of commentators and computorologists (if that's what you call them) did a wonderful job.

This was an improvement in every way on the simple preliminary interviews which the BBC transmitted prior to the election day. On those occasions, the lighting of some of the leading political personalities, including Sir Alec Douglas-Home and Mr. Wilson, was anything but flattering, and one wondered how it was possible for all the rules of photographic portraiture to be broken at one time in one camera set-up! Both gentlemen were given the type of lighting reserved in film production for the "heavies" (theatrical jargon for villains). One wondered also to which party the TV lighting man belonged!

There is one political angle about which we all agree: we must thank the Tories for making Independent Television possible.

Iconos Unmasked

It is quite a normal practice for a nom-de-plume to be pinned to a regular column in a newspaper or journal, be it the Londoner, Peterborough, Atticus or, for that matter, *Iconos*. The name is the copyright of the publishers and may, in fact, cover the writings of several journalists. Nobody worries too much about this, as the identity of the author is of minor importance. Regular readers will have noticed that this Iconos character has had his ears on the ground (and eyes, too!) in the television trade, particularly in television studios and institutions where engineers and production personnel meet.

The writer who provides this column (as he has done for many years) rather liked the cleverly carried out retouching which so effectively disguised him in an illustration at the head of the interview with the ghost of Thomas A. Edison in last October's issue. It was an excellent piece of art work. The friends in television circles who didn't recognise him in the picture and enquired after his health may now recognise him complete with button-hole, in the illustration in the heading, by kind permission of the Editor! But his pen-name remains—Yours truly, ICONOS.

THE VIDEOSCOPE

—continued from page 119

known for such measurements. The anode load resistor should be disconnected at the h.t. end for these measurements with a test coil.

Do not forget to have the valve inserted in the socket and the screening can in place, and all wiring complete at the anode, so as to measure the *total* operative stray capacity. The valve heater should preferably be operating but no h.t. applied to anode or screen.

It is important to point out in conclusion that the same procedure for determining the optimum peaking inductance can be applied to video stages of TV receivers. Many good sets already incorporate such coils. The question is of definite topical interest for the constructor at present because of the need to raise the bandwidth of all stages when converting older BBC standard receivers to CCIR standard or dual operation. ■

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

CONTINUED FROM PAGE 84 OF THE NOVEMBER ISSUE

PART 8
THE LINE TIMEBASES

THE trap into which the writer can fall, when preparing a series of articles such as this, is to ignore the obvious. Faults which are commonplace to the engineer—truly "stock faults"—sometimes seem hardly worth mentioning. Then one looks at the queries from readers with problems, and realises that the commonplace of a hundred tedious jobs is the special puzzle of one!

Screen-feed Resistor

A fault, for example, like the overheated screen-feed resistor of a hard-working line output valve. In the early stages of the fault, the symptoms are very similar to those of a valve which is losing emission. Indeed many a line output valve has been replaced to effect what seems to be a cure, only to fail again in a disappointingly short time. The width of the picture decreases gradually as the set warms up, the decrease being more marked to the right of the screen.

Without going too deeply into technicalities, the usual cause is a change in value of the screen-feed resistor. Even where this is a massive component, premature ageing takes place due to excess heat and the pulse voltages present in the circuit, especially when a carbon or composition resistor is used.

Generally, the value of the resistor is from 1·5 to 6·8kΩ; it may or may not be decoupled. Replacement should be made with a wirewound component, 3 to 5W, and the decoupling capacitor should have a sufficient working voltage rating. (Sufficient, in this case, being 350W d.c., at least.)

The overheated screen-feed resistor is so much of a "stock fault" that it needs no special circuit to illustrate it. Reference can be made to practically any of the accompanying diagrams.

Faulty Boost Capacitor

Similar in the regularity of its problem is the faulty boost reservoir capacitor. Here, there may be different symptoms, depending on the circuit. If the h.t. for the line stage is derived from the boost line, in effect, being a series feed circuit, as in many older receivers, the whole line stage will be dead.

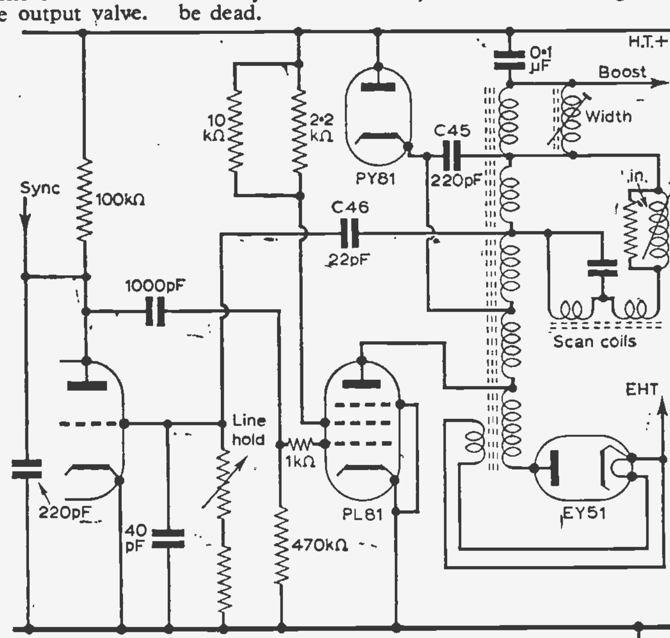


Fig. 43—Regentone TR177, 58C, Ten-8, etc., line oscillator and output stage circuit. Example of back-coupled multivibrator, using the output valve as part-oscillator, with coupling via C46 from the line output transformer.

Where the circuit allows normal h.t. to power the line output stage, symptoms may be very similar to those of a faulty line output transformer: reduced e.h.t., apparent lack of drive, impaired width and/or linearity, and even, as with circuits such as the Pye VT17, displaced verticals and a fierce line whistle.

In the later circuits, where a desaturated line output transformer is employed, the boost reservoir capacitor forms a "link" between the two balanced halves of the winding.

To digress briefly into theory, the desaturated transformer is wound so that h.t. current flows in opposite directions through two opposing windings, but with respect to a.c., the windings are continuous.

In these circuits there are two important boost capacitors; the reservoir component, usually from 0·25 to 1μF, and 1,000 volts working, and an electrolytic, which may be up to 100μF, of working voltage from 100 to 250, between the upper end of the transformer winding and h.t.

The function of this capacitor is to return this upper end of the winding effectively to chassis, with respect to a.c.

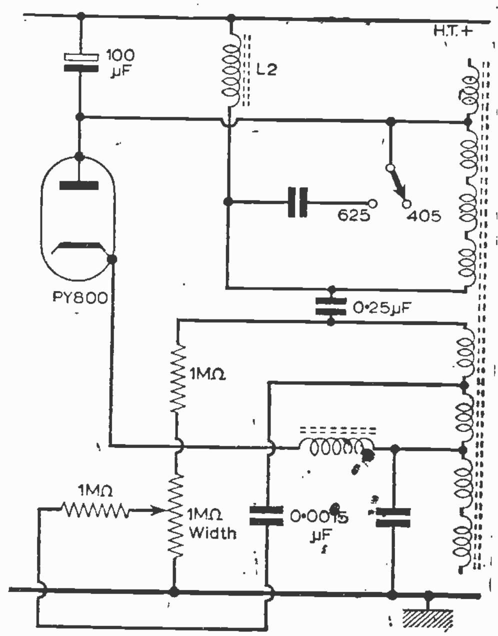


Fig. 44—Boost circuit of Regentone 195, 196 and RGD 624 and 625. The two sections of the line output transformer are wound in opposition as regards d.c. (desaturated transformer).

Scan Coil Breakdown

A further point to note with this type of circuit is that the scan coils are tapped to the central point of the winding, usually via a loading coil, and will thus carry d.c.

A common fault is breakdown of the scan coils to the ferrite core, or perhaps to the linearity sleeve within the coils, where this type of correction is used. Previous articles in these pages have dealt with these devices, and it not proposed to waste space by describing them here.

Again, because of the common nature of this type of fault, particular reference to any circuit is not needed. The only important structure that should be added is to employ a good quality paper capacitor of 1,000V d.c. working voltage for safe operation.

A quick check that can be made on many of the older receivers is to disconnect the cathode cap of the efficiency diode (as PY81) and note whether h.t. increases, and also whether h.t. is present at the cathode connections, denoting a leaky or short-circuited capacitor.

A glance at the circuit of Fig. 43, which is the line output stage of the Regentone TR177 (also applicable to the 58C and the Ten-8) will show why this should be so. H.T. is fed to the line output stage via the PY81, V9, and if the 0·1μF is short-circuited, a reading of h.t. voltage will be obtained at the cathode, with the cap disconnected from the valve,

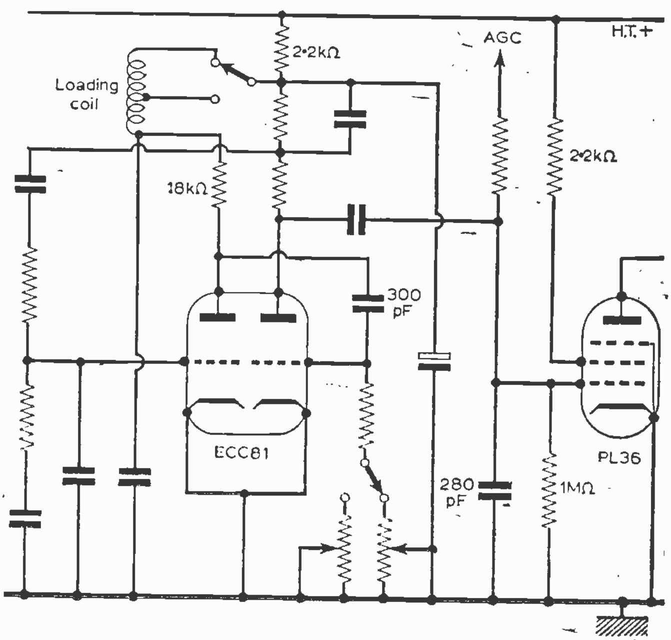


Fig. 45—Line oscillator and drive circuit of K-B WV20, WV70. Note 280pF and 300pF capacitors, which should be replaced with components of higher rating to avoid breakdown.

via C47, boost capacitor and the upper three windings of the transformer.

On this set the revealing symptom is a small spark obtained at the anode of the EY51, which increases when the PY81 top cap is disconnected.

The same circuit shows that the screen-feed resistor is shunted with a 10kΩ component. Trouble with this section is not so prevalent as with the Ten-4, Ten-12, Ten-6, etc., printed circuit models, where the screen resistor is a composition 2kΩ component.

Pulse Capacitors

Before leaving this circuit, however, there is another point to note. C45 (and, for that matter, C46) is a pulse ceramic capacitor mounted on the line output transformer. Failure of this component can give a perplexing reduction of width, a fault that is another "stock" item with Raymond, Emerson and Beethoven receivers.

Always use the correct "pulse" capacitor to replace even though a preliminary test with a standard component appears to cure the fault. Breakdown at this point can cause an expensive line output transformer repair.

Diode Flashover

On the subject of "chain faults", i.e. those which have small origins and large results, it is well to note the circuit of Fig. 44, which is used in a number of S.T.C. Group receivers such as Regentone 195 and 196, K-B and RGD equivalent models.

Here there is a 100μF electrolytic capacitor of 25V working in series with the PY800 boost diode and, when the changeover switch is in the 405-line position, effectively in series with the loading coil L2 also.

A flashover of the diode can cause a blow-out of this capacitor and the position of the coil, adjacent to the mains dropper resistor, has caused softening and distortion of the plastic mount, with the result that one of the tags touches the line output transformer top screen plate and short-circuits.

A burned-out coil, blown capacitor and—even if it seems in order—a boost diode valve complete the repair. Less prevalent but not unknown is open-circuiting of the 0·25μF reservoir capacitor.

Heater Line Fault

Also concerning the possibility of "chain breakdowns" mention must be made of the Decca DM45 and similar circuits. These employ a PY83 boost diode in a position in the heater chain following the two PY82 rectifiers and the PL81 line output valve.

Breakdown of heater-cathode insulation can result in all four of these valves having to be replaced and before switching on again it is wise to check the 175pF pulse capacitor from cathode of the boost diode to chassis.

A wise precaution also is the addition of a 10kpF capacitor of at least 500V working from pin 4 (heater) of this valve to chassis to bypass peak line voltages from the heater line.

Other components in this circuit that cause line breakdown are the 0·5μF reservoir capacitor and the 0·35μF capacitor coupling the line scan coils.

Width and Linearity Trouble

Faults which cause lack of width and non-linearity of the line scan seldom originate in the line output transformer. Indeed this component should be the last to fall under suspicion and, because of the difficulty of testing it, is usually the last thing to be tackled when trouble shooting.

General procedure is to try all the other possibilities—valves, boost capacitor, drive circuit, check voltages, disconnect scan coils and note difference in conditions and so on. But if access to a Skantest is available a certain check can be made.

This instrument, marketed by Direct TV Replacements Ltd., is a shorted turns tester costing £7 10s. and thus a boon to the field engineer who has no other way of determining whether a line output transformer or set of deflection coils is in fact faulty when it appears to be physically in order. One short-circuited turn is sufficient to "kill" the line output.

The principle is that of applying a peaky pulsed output from an oscillator to the windings of the component under test without the need for removing the component from the receiver. A neon indicator flashes when there is no loading on the instrument, as with a good transformer, but a shorted turn causes the neon to be extinguished.

The indication is quite definite, and even better than the sort of hook-up with oscillator and oscilloscope that we used to experiment with in the early days of TV.

However, to return to our brief, lack of width plus variation of height and brilliance usually indicates a line drive fault, which in turn causes variation of boost voltage. The input circuit of the line output valve should come under suspicion.

Cases in point are the 280pF capacitor across the grid of the PL36 of the K-B WV20 and WV70 models. Earlier sets in this range had components with insufficient working voltage rating, and this capacitor should be replaced with one of at least 350V d.c. working.

Two other capacitors in this range of sets fall under a similar shadow: the 300pF coupling anode of the first triode of the ECC81 line oscillator to grid of second triode (pins 1 to 7), and the 150pF component from the anode of the first sound i.f. valve (6BW7) to the grid of the second.

Should the first of these two have short-circuited, another "chain reaction" may have set in, and care should be taken to check the 18kΩ anode resistor of the ECC81 and the 405/625 selective loading coil in series with it.

There is also a 2kΩ resistor acting as common feed to the two halves of the ECC81, but usually the coil will burn out long before this component is affected.

The same kind of fault may be noticed on the Bush TV53. but this time it can be due to the boost capacitor changing value, and the clue is that cramping occurs from both sides of the screen while the middle of the scan is unimpaired.

On the Ekco 370, the 0·15μF in the anode of the U191 had a similar effect, and it is worth noting that this component, 500V working on earlier models, needs to be of a higher rating.

On another model, the T330, the 0·25μF capacitor from the anode of the U191 to chassis

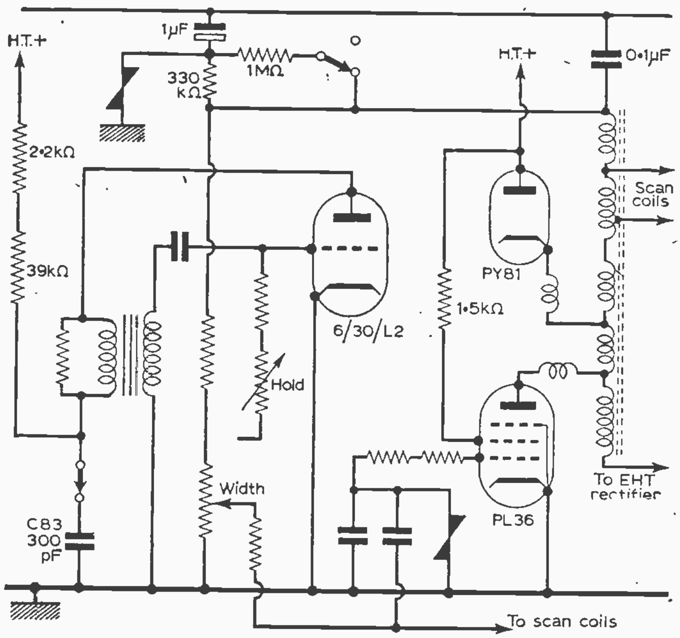


Fig. 46—Fundamental line stages of the Thorn 850 chassis. C83 is situated beneath protector cover at right of chassis (viewed from rear), mounted on change-over switch.

had a nasty habit of short-circuiting, blowing the 500mA fuse.

Fold-over

This symptom of decreasing width that has occupied us for too long should not be confused with the fold-over at one side, to which some circuits have been prone. On the Regentone 193, for example, false line lock and fold at the left can be due to some interestingly remote faults.

Normally, this effect, of a fold, or severe cramp, accompanied by a bright vertical strip at the left of the raster, indicates that the blanking pulse is going into an opposite excursion, and if there is a damping diode used in the flyback suppression circuit, check this for open-circuiting, a possible cause of the ringing that originates the fault. On the 193, the OA81 diode is the culprit.

Shading and Wavering

Another catch fault is the parallel trouble of shading at the left—not the obvious ringing that is noted when the damping components of the deflection circuits are open-circuited, but a thick patch of vertical shading, almost like a severe multiple ghost.

This is caused by an open-circuit somewhere in the a.g.c. decoupling. Result is that line pulses modulate the amplifier stages.

Again, a similar, but different fault, is the wavering line which may creep as far as the centre of the picture and which indicates line frequency pick-up in the r.f. circuits.

Not really a stock fault, this, for it is possible on any receiver where poor screening crops up, as with braided earth links of tuner unit to main chassis (Baird, Plessey, E.M.I. circuits), faulty inter-section coupling (Philips), main chassis fixing (Decca), and line output transformer mounting and screening (Alba, Cossor, some Philips).

The problem of line pulses modulating the scan may occur in different ways. The Alba T877 gives this symptom, plus the clue of varying width, or no control of width, when the 5pF capacitor across the width control (which is in the anode circuit of the boost diode) goes short-circuit.

Where the trouble is more directly attributable to the line pulses themselves, some curious symptoms may be observed. On the Ferguson 506 and 546 one may occasionally note line pulling, even when the contrast levels are good.

The video screen grid decoupling may help cause this, and can usefully be increased to 0·03μF from its value of 1,000pF. But it is also worth turning attention to the 50μF bias decoupling capacitor of the video output valve, as detailed in a previous article.

Poor Line Sync

Poor line sync is much less of a problem on modern receivers, and there are very few prevalent faults causing this symptom. But where 405/625 switching is incorporated, depending on the mechanical linkage of a slide switch, this should be inspected.

Also, modern circuitry has brought back the principle of the winding on the line output transformer feeding back a reference voltage to the oscillator, and the connections should be checked for dry joints.

Examples of this type of fault may be found in the several models employing the Thorn 850 chassis.

Similarly, a leak in the 0·005μF capacitor coupling the line pulses to the flywheel discriminator circuit of the Bush TV94/96, and imbalance of the discriminator diodes of the Bush 125, can give this symptom of poor line sync. Later versions of the 125 have an improved diode.

Some of the sets with dual-standard switching may evince peculiar symptoms, such as oscillation at one standard only. Very often, this is the result of a quite simple fault, and fears of line output transformer failure may be misplaced.

Example: the Ultra 6606, 7, 8, 10 and 1611 range has either a 180pF or 300pF capacitor switched from the anode circuit of the 6/30L2 when the standard change switch is operated. The 300pF capacitor develops a short-circuit and robs the valve of anode voltage on 405 lines.

This fault is also evident with other models using the Thorn chassis, and the first check when a set fails to oscillate on 405-line selection should be this capacitor, which is situated beneath the card flap at the side, mounted on the selector switch.

TV/Radio Switching

On the thorny subject of switching, mention must be made of the various models that incorporate a v.h.f./TV switch. General procedure is to add a mechanical cam to the switch rotor or actuating arm, killing the line oscillator by removing h.t.

Where this is done, there are two possible faults; (a) the line continues to oscillate during radio reception, due to insufficient switch movement, and (b) the return action of the switch is inadequate, and switching back from radio to TV causes the line to operate by fits and starts, if at all.

The solution is usually mechanical; tightening of a rocker cam, lubrication of slide portions, strengthening of return springs, etc.

Beware of the Bush TV106, however, which has a slightly different action. The push-button selector simply inserts a 4·7kΩ resistor in the cathode of the line output valve, effectively biasing it back. Simple, effective, and most perplexing the first time it is encountered.

Line Oscillator Faults

Thus far, more attention has been paid to the output stages than to the line oscillator itself. Most prominent fault is, of course, incorrect speed. This is usually a straightforward fault, caused either by the valve itself, or a component changing in value. Inspection of the circuit will, in most cases, give some clue to likely origins.

The important thing to remember is that the line stages are combined in such a way that both the frequency and the output of the oscillator are required to be correct for normal operating conditions.

An incorrect line speed can give apparent regulation faults, or even intermittent e.h.t. by this deprivation of drive from the line output valve. For this reason, it is advisable to ensure that the line speed varies over the range, and that it is correct.

A little practice is necessary to become used to diagnosis "by ear", but such practice may prove worth while when perhaps the circuit voltages—or the instruments to measure them—are not available.

Usually, the horizontal hold can be varied to give a smooth change above and below the 10,125 c/s mark, and, with sync pulses arriving, the whistle will be heard to fall into step at the correct position of the control. Doubts can be resolved by headphone listening (isolated by suitable paper capacitors) at the oscillator output.

A measurement of drive voltage at the grid of the line output valve will usually give from 10 to 20 volts negative indication, depending upon the circuit.

No Line Lock

Failure to lock can be caused by current carrying resistors going high, as in the HMV 2600, where the 390kΩ feed to the ECC82 suffers. In its early stages, this fault may appear to be cured by valve replacement, but will soon recur until the basic cause is eliminated.

As mentioned before, the video and sync separator conditions make a good deal of difference. A particular example is the Stella 1039A (and associated Philips and Peto Scott models), where a 10μF electrolytic decouples the screen grid of the video output valve.

Another is the Stella 5721, with an interesting circuit in which limiting is achieved by the biasing of the suppressor grid of the video amplifier. Bias voltage is derived from the line oscillator via a 220kΩ resistor.

Poor line lock can result from this resistor open-circuiting, and the secondary clue is the lack of limiter action.

One especially baffling fault in this category is the poor line lock caused on the Bush TV115 when C113 develops what is in effect a dry joint. This capacitor is under the line output transformer, and its earthy end is returned to a tag held by a nut. Looseness here is the cause—but it is neither easy to find, nor to get at this simple fault.

There are many more "stock faults" that could be mentioned, were space available, but as some are so obvious that their cures are self-evident, no apology is needed. It is hoped that the foregoing will at least have given a few ideas to set owners. ■

just out!

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DX-TV

A MONTHLY FEATU[RE] FOR DX ENTHUSIAS[TS]

by Charles Rafarel

RECEPTION conditions for Sporadic E DX are still practically non-existent and this is being borne out by the relative absence of readers' DX reception reports.

However, there is some improvement at last in the medium distance tropospheric reception and in many parts of the country there have been good openings. As I forecast, with the advent of cooler evenings after warm days we have had a marked improvement in this type of reception in Bands I and III, and this has applied equally to u.h.f. in Bands IV and V and I feel we should do even better in November.

With this in mind I think that DX viewers, particularly in the south and south-east of the country, may find it profitable to watch out for the new O.R.T.F. second chain u.h.f. transmitters. Those now operational include the following:

Lille-Bouvigny Ch. 27 (1,000kW), Paris Tour Eiffel Ch. 22 (1,000kW), Caen Mt. Pincon Ch. 25 (1,000kW), Le Havre Ch. 43 (100kW). These should be "possibles" here in the south.

A great number of French u.h.f. stations are due to open in 1965, including Brest Roch Tredudon Ch. 21 (1,000kW), Rennes Pern Ch. 45 (1,000kW), Rouen GDE Couronne Ch. 33 (500kW).

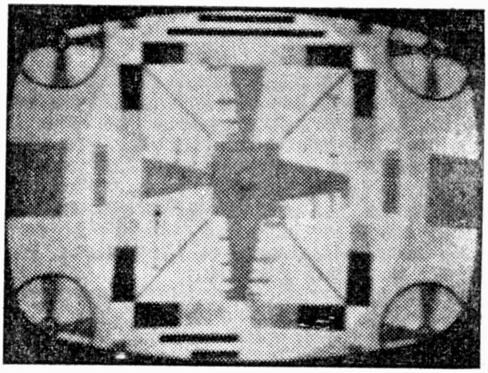
All of these, if Band I—III reception is anything to go by, should produce reasonable signals over here. Remember, however, that the French 625 u.h.f. is a *positive* image with f.m. sound.

MYSTERY SIGNALS

We are indebted to I. C. Beckett, of Twyford, Bucks., for an explanation of the test grid pattern with two graded horizontal bands seen on channel E3. He tells us that this originates from D.D.R. Helpterberg (East Germany) and that he has also seen it from Brocken on Ch. E6, followed by a D.D.R. opening caption. He also states that the checkerboard pattern seen on Ch. E4 originates from T.V.E. Spain.

Very many thanks indeed for this explanation, which at last clears up these two points. TV transmitters often change their test patterns and it is extremely difficult to keep track of them!

A further note to follow up on previous comment on the test card of Nicosia, Cyprus. We have just received an excellent photograph from Ch./Tech. Hesketh, of R.A.F. Heraklis (Cyprus), of this test card. It is, in fact, his local station, and this fully confirms what I expected—that this



The Nicosia test card, put out on Ch. E2

card (which has been logged by a number of DX-ers here, including myself) is, in fact, that of Nicosia on Ch. E2. Many thanks for this information.

READERS' LETTERS

We have just received a most interesting letter from a very long established DX-er whose experience dates back to 1955! I refer to **Keith E. G. Pitt**, of Hove, Sussex.

His first Continental reception was early in 1955 when he received good signals from the old 441-line French transmitters, Paris Tour Eiffel on Band I and also Lille on Band III. His "regulars" today are Caen Mt. Pincon on Ch. F2 and Paris on F8. He uses a converted Bush TV24 receiver for 625-line reception of positive/negative images and his log today includes 29 British and Continental TV stations with U.S.S.R., Sweden, Italy, Spain, France and Rumania.

Paris and Lille in 1955 is a very fine achievement and our congratulations to him. Just for the record and in the hope that somebody may make an even better claim that we would like to read about *my* first DX(?) was in 1935, between Leeds and London (212 miles), with reception of sound and vision from the old experimental 30-line transmissions received on a disc scanner! Any advance on this date?

Desmond Kelly, of Banbridge (Co. Down), asks where he can get a Bush TV53, TV62 type set second hand for conversion, and a number of other readers have been asking the same question. I am very sorry to say the supply seems to have become rather limited due, I understand, to a certain firm buying them up for conversion and export to Australasia! All that I can suggest is that readers put a small advertisement in their local paper and

—*continued on the following page*

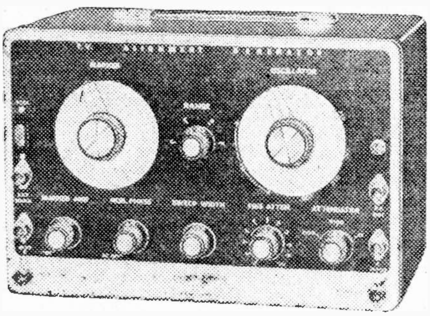
...EWS • TRADE ... TRADE NEWS ...E NEWS • TRADE ...WS • TRADE NEWS

...levision Alignment Generator

FROM Heathkit comes Television Alignment Generator, model HFW-1. Special design features include an all-electronic sweep circuit which uses a controllable inductor to vary frequency by magnetic means to produce wide range sweeps with excellent linearity and consistent results. The sweep circuit operates on fundamentals from 3·6Mc/s to 220Mc/s, in four bands. Sweep deviation is smoothly controlled from 0 to as high as 42Mc/s, depending on centre frequency. Fundamentals are used throughout the entire frequency range, providing well over 0·1V r.f. output at all frequencies, allowing cold alignment of tuned circuits, filters and traps etc.

Crystal and variable marker oscillators are built in. The 5Mc/s crystal (included with the kit) provides output at 5Mc/s and multiples thereof for use in calibrating the built in variable marker oscillator. Variable marker output is from 19 to 60Mc/s on fundamentals and from 57 to 180Mc/s on calibrated harmonics. Effective blanking eliminates return trace and a phasing control is also provided.

Power requirements are 110/200—250V a.c. 50W. Price ready built and tested £44 10s., or in kit form, £30 15s. *Daystrom Ltd., Gloucester.*



The new Heathkit TV alignment generator

U.H.F. Booster Mains Units

RCS PRODUCTS (Radio) LTD., announce the introduction of an eliminator for BBC-2 625-line Booster Units requiring a 12V or 18V d.c. supply, at 35s. retail.

Also available is a range of battery eliminators available with either single or double d.c. outputs. The single output units are available at 4·5V, 6V or 9V, at 29s. 6d. retail. All measure $2\frac{1}{4}$in. x 3in. x $1\frac{7}{8}$in.

Twin output units, 4·5V+4·5V, 6V+6V, 9V+9V, at 42s. 6d. retail, measure 3in. x 3in. x 2in.

The makers claim that these units available with double-wound mains transformers, are the cheapest of their kind currently available on the British Market. *Messrs RCS Products (Radio) Ltd., 11 Oliver Road, Walthamstow, London, E.17.*

Transistorised C.C.TV Camera

VISUAL ENGINEERS LIMITED, sole agents for Grundig Electronic equipment in the U.K., announce an addition to their rage of television cameras—the model FA41.

The FA41 is a compact, fully transistorised, solid state circuitry television camera with all the circuitry contained within the camera housing. The camera operates on the 625-line standard with either random interlace or, (by the addition of a frequency divider circuit inside the camera housing) with full interlace corresponding to C.C.I.R. standards.

There are three versions of the camera available; video output only, r.f. output only, and a combined video/r.f. output. The output of the unit at r.f. can be obtained on any channel from 2—13 (C.C.I.R.) and so allows the camera to be used with suitable domestic receivers.

The camera is designed for continuous operation and automatically compensates for varying light levels and mains supply fluctuations. It operates from either 110/240V a.c. or from a 12V d.c. battery. Weight is 10lb., size is approximately 11in. x $5\frac{1}{2}$in. square and the basic cost is £190. *Visual Engineers Ltd., Stockdale, Aylesbury, Buckinghamshire.*

DX-TV

—continued from previous page

hope that someone will turn out something for them.

I. C. Beckett, of Twyford (Bucks.), reports excellent u.h.f. reception as follows: 18 West German stations, East Germany Ch. 31, two French and one Dutch. A fine log that should encourage us all to "have a go" on u.h.f. now.

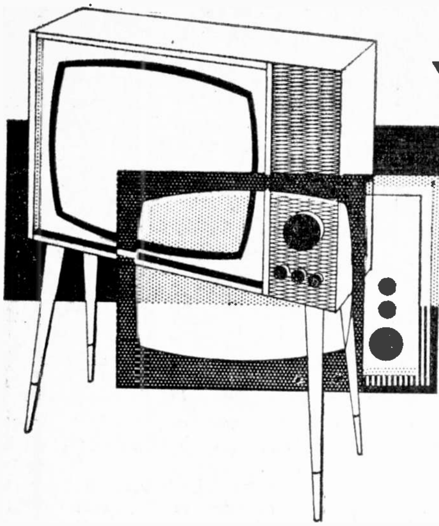
There have been a number of inquiries about the use of the new British 405/625-line u.h.f. receivers for DX work. They can, of course, be used immediately for Continental u.h.f. reception provided that two points are remembered:

(1) The sound-to-vision spacing here is different to that used on the Continent so that sound and vision cannot be obtained at the same time at one position of the tuner.

(2) These sets are not suitable, unless modified, for reception of the positive 625-line images transmitted by the French TV service.

Regarding the use of this type of receiver for reception of 625-line negative images on Bands I and III, the necessary modifications are dependent on the make of set but basically when the set is switched to 625 lines the h.t. supply to the Band I—III tuner is interrupted by means of a pair of contacts on the 405/625-line switch, and if these contacts are "bridged" most sets will work on Bands I and III at 625 lines.

If you can get a sight of the maker's service sheet to see what you can do in this respect, remember that in Bands I and III the sound-to-vision spacing will be wrong for Continental TV systems but it is possible to get a good Band I—III 625 image on this type of set.



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

SOBELL ST283

When this set is first switched on, the picture is normal, but after about 15 minutes a gap of 2in. appears at the top and bottom of the screen. This can be remedied by adjusting the height control, but the only drawback is that the next time the set is switched on the picture appears all stretched.

Also, could you please inform as to where to find the fine tuner cores on the push-button u.h.f. tuner?—R. C. Phillips (Swansea, Glamorgan).

We would advise you to replace the 560kΩ resistor from the height control to pin 1 of the PCL85.

The button covers conceal the channel selectors and fine tuners for each button. Pull off the cover of the required button, and adjust the centre spindle which is the fine tuner.

FERRANTI T1415

This set has two faults. The first is double white lines on each side of the screen about 1½in. from the top. The second fault is cramping at the bottom of the screen. R67 controls linearity at the top only.—J. Green (Bolton, Lancashire).

We would advise you to replace the ECL80 field oscillator-output valve. Check components associated with the valve and change the oscillator transformer if necessary.

MARCONIPHONE VT151

A few seconds after switching on, normal sound is present, but as the 10kc/s line timebase whistle makes itself evident, the sound quite suddenly disappears. A raster can be obtained but no video.

Tuner valves and common i.f. have been changed, and the d.c. voltages on them seem normal.—M. R. Shoesmith (London, S.W.17).

We would advise you to check the two 7·5kΩ PCF80 triode anode resistors in the front of the tuner unit.

The symptoms suggest that when the h.t. falls below a critical figure, the oscillator stops working. Also check the 0·001μF capacitor decoupling pin 8 of V3 (C22) and C26, C25 etc. by bridging with a known good capacitor.

DECCA DM14

The sound has a 50c/s hum superimposed on it, the intensity of which depends on the overall brightness of the picture, being at a maximum with an all-white picture.—J. R. Stewart (Dundee, Angus, Scotland).

The symptom mentioned is vision interference on sound, and is caused nearly always by misalignment of the sound i.f. channel. We suggest that you try adjusting the sound i.f. cores for maximum sound consistent with minimum vision breakthrough.

FERGUSON 506T

When first switched on the sound and picture are perfect but for a slight hum. After a few minutes, picture shrinkage takes place at the bottom of the screen to about 1½in. The height control is adjusted to maximum.—R. B. Mortlock (Upminster, Essex).

You should replace the 390Ω bias resistor of the field output PCL82 and check the shunt 100μF electrolytic. Check the main electrolytic 100+400μF if necessary.

DECCA DM3/C

There is a 2in. black line at the bottom of the screen, also a small white line. If the frame height and the frame linearity controls are adjusted, they only make the picture appear longer.—I. Lawson (Lanarkshire, Scotland).

We would advise you to check the field (frame) output valve. This is approximately in the centre of the chassis to the right of the centre section. If the receiver serial No. is before 50,000, the valve is an ECL80, if after 50,000 it is a PCL82. Check the bias resistor and electrolytic capacitor if necessary.

R.G.D. T600

After switching on, the picture comes on for about 3 minutes then collapses and the line output whistle disappears. Then after another 3 minutes the picture comes back again, then goes off; the interval between the on and off getting less all the time.—D. K. Mawby (Allenton, Derbyshire).

You will have to check the base voltages. That at pin 8 of the PL81 should be 145V. If this fails check the 1·8kΩ feed resistor and 0·001μF capacitor. The PCF80 anode pin 1 voltage should be 117V. If this fails, check the 100kΩ resistor, the 220pF to chassis, and the 0·001μF coupling capacitor. The PCF80 anode pin 1 voltage should be become red hot. Also note the effect of disconnecting the deflector coils.

SOBELL T346

On Channel 5 (BBC) there is severe sound on vision accompanied by mains hum. No adjustment of oscillator core or trimmers 1 to 4 has any beneficial effect. At maximum picture brightness there is the loudest hum.—J. Blackburn (Cardiff, Wales).

This trouble is due to excessive signal input. If the sensitivity control will not reduce the gain sufficiently, fit an aerial input attenuator.

ULTRA 6608

There is a good bright sharp-edged raster, but it is much too small, only about half scan in each direction. Operating the width and height controls has little effect on size, but the brightness, focus and hold controls appear to work normally.

The h.t. voltage is correct at about 200V, but the boosted h.t. is very high, about 800V instead of 580V, and the e.h.t. is also high—about 17kV. There is a voltage drop across the 680kΩ resistance in the anode lead of the part frame oscillator V13A, from which one assumes that the triode is working but the anode voltage is about 100V instead of 33V. The voltage on the pentode cathode V13B, is 19V which is correct. Valves PY81 and EY86 have been replaced.—T. Blockley (Loughborough, Leicestershire).

Switch to 625 lines: If boost and e.h.t. drops, check the 405 line capacitor which should be switched across the line coils when the switch is in this position—600pF 2kV, C91.

PHILIPS 1768U

On BBC there is good sound but no picture. On ITV there is no vision and no sound. The tuner valves have been replaced but this has made no difference, also several new valves have been fitted throughout the set but this has made no difference.

I have run a signal generator through the set and can find no faults.—E. Crabbe (London, N.16).

You should replace the 6·8kΩ 1W resistor in the tuner under the front section; this may be screened. A replacement must be of the same size and occupy the same position if oscillator retuning is to be avoided.

KB WF70

The sound and raster are perfect, but there is no picture. I have replaced R91. There are faint diagonal lines when I advance the brightness control. I have checked all the valves in the video amplifier section with no result, and all the voltages seem to be in order.—D. Francis (Chorley, Lancashire).

We would advise you to check the GEX34 vision detector diode and the 0·0022μF decoupling capacitors from pin 8 to chassis on V4 and V5.

PHILCO 1010

The grid of the PL81 gets red hot. I would be obliged if you would tell me the possible causes of this.—J. W. Robinson (Stalybridge, Cheshire).

You should check V11 ECC82 by replacement, and the components associated with the line oscillator if necessary. The PL81 itself could be at fault but the oscillator is far more likely to be at fault. Check the oscillator transformer T12 and its associated capacitors, hold control, etc.

PYE VT7

The fine tuner control is at the extreme position when on BBC channel 3 slight sound-on-vision being still apparent. The tuner is of the incremental type. I would like to adjust the local oscillator but can find no adjustment to enable this to be done. Adjustment of the brass slug (L5) has no effect, this is situated on end of tuner under fine tuner control knob. I have tried a new PCF80 and checked all resistors, which appear to be normal. ITV comes in at the normal position of the channel selector and fine tuner control. Clear pictures are resolved on both stations. I have tried without success to resolve a picture on the two adjacent channel positions to BBC.

A further slight, but annoying, fault is drift in one direction of the line oscillator, so that the hold control must be adjusted when first switching on, and then again about half an hour later.—C. Read (Havant, Portsmouth).

The adjustment for the BBC local oscillator on the VT7 is the core of the coil between the positions 5 and 6 on the switch. It is usually necessary to take the cover off the tuner to adjust

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it. You may be able to avoid this by leaving the can off of the PCF80 valve.

Your line hold fault suggests a slow heating ECL80 just in front of the "black box" e.h.t. unit.

SOBELL T171

There is a 1½in. black line at the bottom of the screen. The picture spins but stops for a few seconds when the vertical hold is adjusted. The fine tuner cannot be altered or there is acute sound-on-vision. The ECL80 has been changed but this has made no difference.—A. Howes (Enfield, Middlesex).

We would advise you to change the PCL83 valve on the rear centre of the chassis and check the associated components. Set the fine tuner mid-way and insert trimming tool with hole next to spindle to adjust oscillator coil core for maximum sound.

ULTRA V21-70

The picture is quite good, but when the contrast is full on I get the flyback lines showing on a dark picture. I have a circuit for the above.—E. S. Beel (Yiewsley, Middlesex).

You should check C92 which is the 0·001µF frame flyback suppression capacitor. This connects from pin 3 of the c.r.t. base to pin 9 of the 30PL13.

HMV 1847

I can obtain BBC picture with low sound, but no ITV. At another position of the channel selector I find a bright raster with noise from the speaker.

The two tuner valves are PCF80 and PCC89, and both look brand new. — J. Rodriguez (Liverpool, 1).

A tuner fault is most likely responsible, though the low sound could indicate misalignment in the sound i.f. channel. The vision i.f. channel could, of course, also be misaligned. This should be suspected if the i.f. tuning cores look as though they have been "unlocked."

The bright raster on one channel setting could be normal instability promoted by the set not being correctly loaded by the aerial to that particular channel number. Check also the aerial system, for the trouble may be due simply to the fact that the ITV aerial is failing to feed sufficient signal to the set to give a picture and good sound.

TEST CASE -25

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.

? *A receiver about five years old operated perfectly satisfactorily for up to thirty minutes or so on both sound and picture, the picture would then tend to reduce in size gradually and after a while would fade out completely, as also would the sound.*

Sparking could be seen reflected on the table top from beneath the set for a few seconds. This would then cease and gradually the sound would return, followed by the picture, building up gradually to full size.

A little later the whole cycle would repeat. A test of h.t. line voltage was made during one complete cycle and, contrary to expectations, the voltage was found to rise gradually as the picture faded!

What was the most likely cause of this symptom, and what would have been the best test procedure to prove the fault?

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

SOLUTION TO TEST CASE 24

(Page 92, last month)

On dual-standard models there is not usually any switching in the frame (field) timebase or sync sections. Thus, since 405-line pictures were locking correctly, the sync pulse on the 625-line picture should have been equally as strong. Indeed, the tests made proved this.

There is a major difference, however, between the framing signals between the two standards. On 405 lines, the field sync pulses are locked to the mains frequency, while on 625 lines there is no such synchronisation, and so-called asynchronous working is adopted.

It was eventually discovered that the mains ripple was fairly high in the h.t. circuits, and while this had no effect on the synchronous 405-line pictures, it was strong enough on the asynchronous 625-line picture to cause the field timebase to lock to it. The picture would thus tend to lock first on the actual sync pulses and then on the ripple.

The replacement of the main electrolytic capacitor unit effected a complete cure. It is interesting to note that the hum was barely noticeable on the sound channel and had virtually no effect on the 405-line pictures.

QUERIES COUPON

This coupon is available until December 22nd, 1964, and must accompany all Queries sent in accordance with the notice on page 137.

PRACTICAL TELEVISION, DECEMBER, 1964

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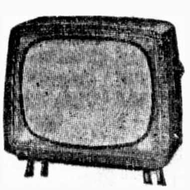

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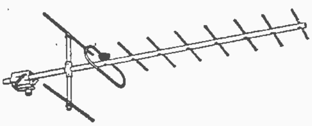

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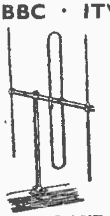

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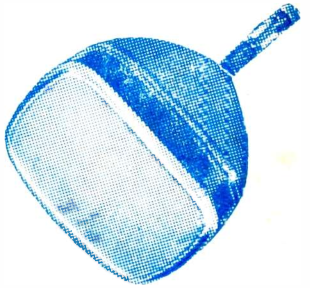

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