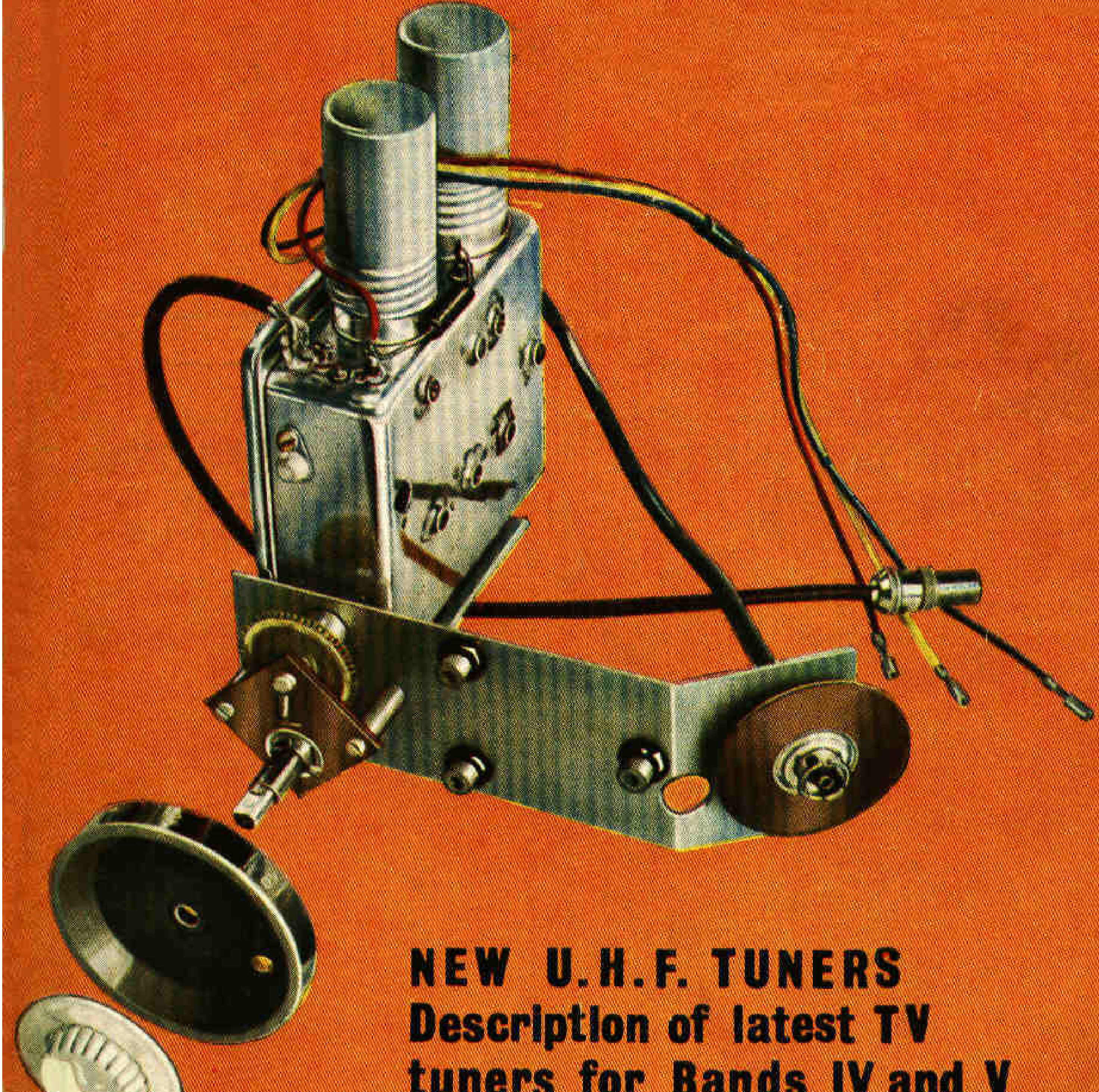
Practical TELEVISION

FEBRUARY 1963 2/-



NEW U.H.F. TUNERS
Description of latest TV tuners for Bands IV and V

Practical Television

AND TELEVISION TIMES

VOL. 13, No. 149, FEBRUARY, 1963

Editorial and Advertisement Offices:

PRACTICAL TELEVISION
George Newnes Ltd., Tower House
Southampton Street, W.C.2.

Phone: Temple Bar 4363.

Telegrams: Newnes, Rand, London.

Registered at the G.P.O. for transmission by Canadian Magazine Post

SUBSCRIPTION RATES
including post for one year

Inland - - - - £1.8.0 per annum
Abroad - - - - £1.6.6 per annum
Canada - - - - £1.5.0 per annum

Contents

The Second White Paper

THE second Government White Paper on the Pilkington Report, dealing with questions said to be more contentious, again shows a reluctance to accept the findings of that Committee. It perhaps goes half-way on some points, and hedges on others.

The proposals on the important aspects appertaining to the set-up and administration of the ITA are now widely known, and have been fully discussed in the national press, so we do not intend to enlarge on these opinions here.

One definite outcome is the fact that there will be no second ITA programme—at least for a long time. It seems ironic that one of the advantages of the move to u.h.f., i.e. more room for extra channels, is not to be taken full advantage of because (a) there is little public demand for a second ITA channel and (b) there would probably be insufficient advertising revenue. We could, of course, add that there might also not be sufficient material available to maintain a high enough standard.

The Government is cautious on the subject of public television in cinemas or theatres. And although the Postmaster General is now prepared to consider applications on their merits, it seems that the coverage of public spectacles or sporting events will not be permitted at the expense of the BBC or ITA, although it is obvious that this type of presentation is the one for which public wide-screen showing is best suited.

Similarly, there is a tentative go-ahead for Pay-TV. At least, an announcement is promised shortly for applications from organisations wishing to participate in a 2-3 year experiment aimed to answer the many questions which are at the moment speculative and problematic. Pay-TV will, however, not be available before 1964.

As with wide-screen public TV, one of the major preoccupations appears to be the possible impact of such activities on the BBC and ITA. There is a scarcely veiled anxiety that both these services would draw away viewers from both existing programme sources. And this raises an interesting question.

On one hand, the Government seeks to stimulate competition between the two existing broadcasting organisations. From the viewers' point of view this is a good thing as it must lead to better programmes. But on the other hand, there is apparent alarm at competition from two new sources, both of which in their own way have obvious attractions to offer viewers.

The question is, of course, are the BBC and ITA being unduly sheltered from outside competition? And if they are, is this in the interests of the viewers?

Film Show

Just a reminder that this is your last chance to obtain your free tickets for the PRACTICAL WIRELESS AND TELEVISION Film Show which has been arranged in collaboration with Mullard Ltd. and will be held at Caxton Hall, Westminster, London, on *February 1st*, starting at 7.30 p.m.

Our next issue dated March, will be published on February 22nd.

Telenews

Television Receiving Licences

THE following statement shows the appropriate number of Television Receiving Licences in force at the end of November, 1962, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London	2,034,955
Home Counties	1,729,090
Midland	1,811,150
North Eastern	1,934,510
North Western	1,616,625
South Western	1,057,416
Wales and Border Counties	733,735
Total England and Wales	10,917,481
Scotland	1,113,490
N. Ireland	193,332
Grand Total	12,224,303

Improvements at Rosemarkie

THE BBC recently placed a contract for the building of an extension at the Rosemarkie television station. The extension will house additional transmitting equipment which, with improvements to be made to the aerial, will provide a considerable increase in the effective power of the transmissions. This has been made possible by the easing of international restrictions agreed at the 1961 European Broadcasting Conference in Stockholm.

These improvements, which are expected to be completed towards the end of 1963, will provide better reception of the Rosemarkie transmissions and will be important in the extension of the BBC television service to the western highlands and the outlying islands of Scotland by means of low-power relay stations now under construction or being planned. The programmes from Rosemarkie will be picked up at special receiving sites and carried by radio links to the relay stations for re-transmission.

Colour Visual Flight Simulator

BRITISH Overseas Airways Corporation recently ordered the first colour visual flight simulator ever built that gives the trainee pilot on the ground a mid-air view in colour of the runway and surrounding scene. Equipped with a colour television camera supplied by EMI Electronics Ltd., a large screen projector and a three-dimensional coloured model of an airport and adjacent countryside, the simulator covers the critical stages of take-off and landing approach in a way which previously could not be synthesised when training flight crews were on the ground.

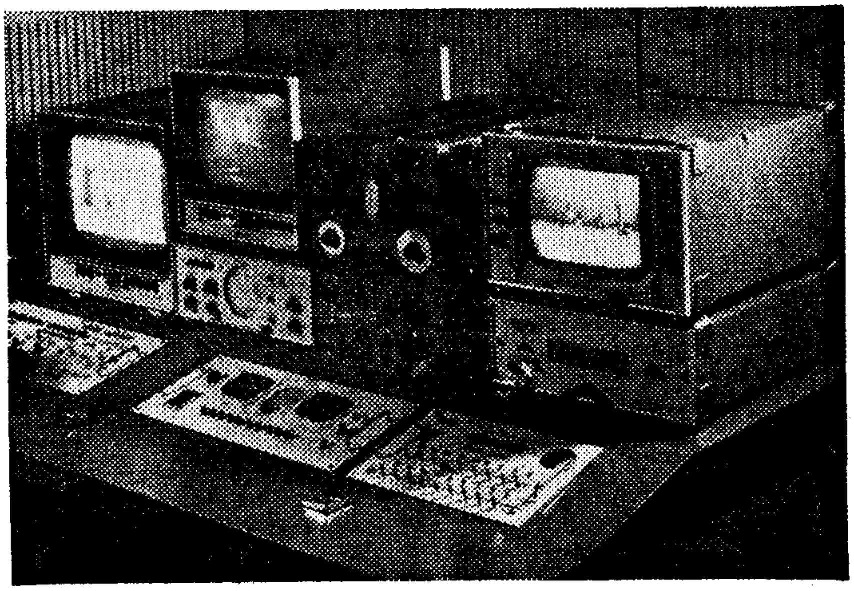
Television on the Underground

HOLBORN underground station, on London Transport's Piccadilly and Central lines, has been equipped with closed-circuit television to help in controlling the movement of crowds through the station. About 18 million passengers a year start or end their journeys at Holborn and a further 14 million interchange between the Piccadilly and Central lines or to and from the Aldwych branch. The results of the Holborn experiment will assist in planning similar installations for stations on the new Victoria line.

For this experiment a special "crow's nest" observation room has been built on the rear wall of the circulating area at the foot of the main flight of escalators. From this room the main escalators can be seen directly through the one-way glass window and the arches leading to the Piccadilly line escalators and to the Central line platforms can be seen on the left and right respectively.

Three monitor screens on a desk in front of the observer enable him to see what is happening on all the main platforms, in the ticket hall and in the circulating area. The monitor screens can be switched individually to any of eight strategically sited cameras. Three of the cameras are fitted with pan and tilt equipment which can be operated remotely from the viewing desk.

When action is needed the observer in the "crow's nest" has



The master control desk of the Dublin studio of Telefis Eireann, the Irish Television Authority.

a microphone by means of which he can use the public address loudspeakers anywhere in the station. He also has a compact telephone switchboard which enables him to speak to the staff throughout the station as well as to other points on the railway system.

Automatic Telecinema

THE largest group of electronics companies in France, C.S.F., has recently opened its only British subsidiary, C.S.F. United Kingdom Ltd. At the official opening, Cameca, a C.S.F. subsidiary, demonstrated their Telescopitone. This is an automatic telecinema which can be loaded with 36 films and worked by push-button selection.

With this machine it is possible for one person to run a television station for a day.

Control Desk at Dublin Studio

NOW in use at the Dublin studio of Telefis Eireann, the Irish television authority, is a new master control desk. This desk consists of vision and sound panels for examination of all incoming and outgoing sources.

Much of the broadcast television installation was supplied by EMI Electronics Ltd. and the equipment now in use includes 11 4½in. image orthicon cameras, three studio vidicon cameras and all the associated studio vision and sound mixing equipment.

New Television Station for Pembrokeshire

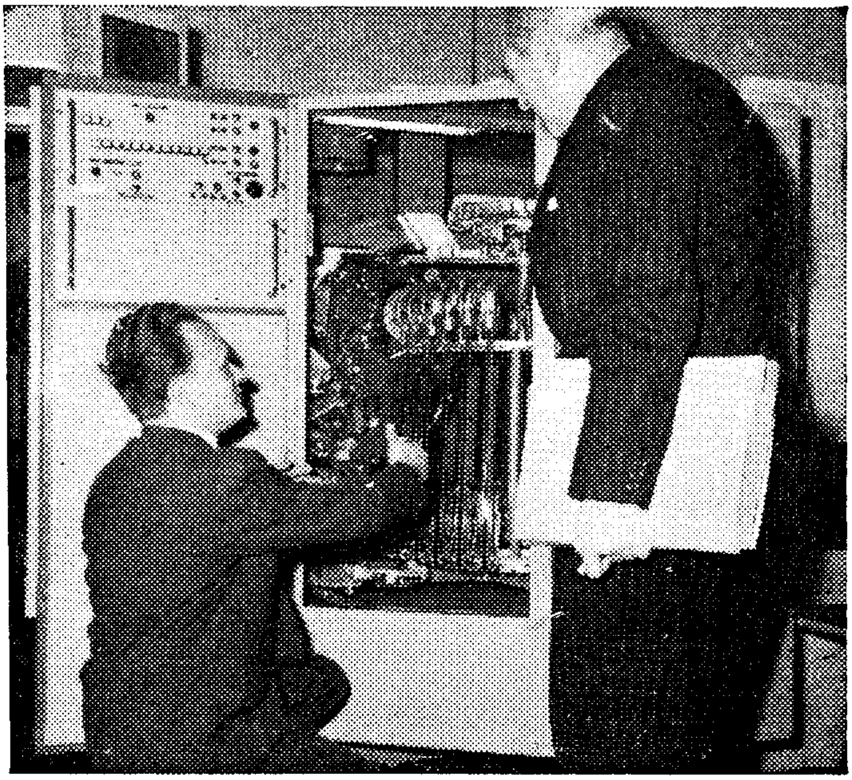
THE BBC has placed a contract for the design, supply and erection of a 500ft aerial mast for the new television and v.h.f. sound broadcasting station which is to be built at Woodstock Slop, some seven miles north-east of Haverfordwest, Pembrokeshire.

This new station, which it is expected will be completed in the autumn of this year, will serve some 40,000 additional people and provide improved reception for a further 40,000 people in Pembrokeshire.

Telecine Equipment for BBC

THE British Broadcasting Corporation has placed a contract with Marconi's for the supply of four simplex 35mm. vidicon telecine systems.

In essentials the telecine equipment consists of a BD896 Mk IV vidicon camera mounted on the front of a 35mm. projector mechanism. Both are mounted on a common table with a single lens projecting the film image on to the vidicon tube face.



M. Duval of CAMECA, a C.S.F. subsidiary, describes a prototype of the Telescopitone to a guest at the official opening of C.S.F. United Kingdom Ltd.

The BD896 vidicon camera channel has been designed primarily for telecine work and the high quality of its output has been assured by using a vidicon tube with a high (1,000V) wall voltage.

For BBC requirements the equipments are switchable to either 405- or 625-line operation, but similar units are available for 525-line standards also.

More Vidicon Cameras

A CONTRACT for the supply of another four vidicon television cameras and associated equipment to the BBC has been placed with EMI Electronics Ltd.

Supply of this new order will make a total of 23 EMI vidicon cameras supplied to the BBC for use in its London studios and throughout the British Isles in regional studios.

The camera now ordered will be used in the new presentation studio at the White City Television Centre for interview and short feature programmes.

These cameras make use of removable printed circuit boards, and a simple change of plug connectors enables them to be used on 405-, 525- or 625-line standards.

New Station at Fort William

THE new television and v.h.f. sound broadcasting station of the BBC at Fort William, Inverness-shire, started test transmissions on December 17th last year. This new station will bring these services within reach of some 4,000 additional people living in and around Fort William.

The television programmes are transmitted on channel 5 (vision 66·75Mc/s, sound 63·25Mc/s).

Both the television and v.h.f. sound transmissions are horizontally polarised which means that receiving aerials should be mounted horizontally.

Equipment for the new BBC Channel

NINE 35mm flying spot telecines are to be supplied to the BBC by Rank Cintel, a division of the Rank Organisation. These equipments form part of the installations for the BBC's additional Channel which will be brought into operation early in 1964. Two colour telecines are included for use at a later stage when the BBC introduces colour programmes.

Two of the telecines are specially designed to work not only on 405 and 625 lines but also on the American 525-line standard.

The PRINCIPLES and PRACTICE of TELEVISION

By G. J. King

THE PROBLEMS OF LINE STANDARD SWITCHING

(Continued from page 161 of the January issue)

IT was shown in last month's article how the basic characteristics of the 405-line and 625-line signals differ from each other. In effect, two entirely different vision, sound and tuner sections are required in dual standard receivers to provide optimum reception of each type of signal. This, of course, being in addition to the line timebase switching to give a line frequency of 10,125c/s on 405 lines and 15,625c/s on 625 lines.

Vision I.F. Switching

At the present time there are two distinct ways by which the vision i.f. response is changed to accommodate the two different signals. In all true switchable models a single i.f. strip is employed. This is designed essentially for the wider passband of the 625-line signals, but also incorporates switched filters which reduce the passband to match the requirements of the 405-line signals.

In the majority of the convertible-to-switchable models, two separate r.f./i.f. circuits are used, often right up to the video amplifier including the detector. Coupling to the picture tube is then accomplished by a cathode-follower stage. A few of these models, however, adopt the single, switchable i.f. strip of the former arrangement.

The two ideas are shown in block diagram at (a) and (b) of Fig. 24. At (a) the standard switch S1 selects either the v.h.f. or u.h.f. tuner, while S2 switches in the bandwidth suppression filters on 405 lines and removes the restriction on 625 lines. Response curve B gives an approximation of how the vision i.f. strip behaves without the suppression filters in circuit. The overall vision passband is in the order of 5·5Mc/s, which is required to provide a horizontal definition to match the improved vertical definition given by the greater number of lines.

When the filters are switched in on the "405-line" position, the overall vision i.f. response narrows to that shown at A, which is almost representative of the vision i.f. response of 405-line-only models. The overall vision passband then approaches 3Mc/s, the normal sound rejector comes in at 38·15Mc/s (the "standard" 405-line sound i.f.) and the other filters put low-amplitude ripples at either side of the curve.

Two points to note are that the overall response on each standard is shaped partly by the coupling circuits at the output of the tuners and that more than one switch section is likely to be used in practice to introduce the 405-line suppression filters.

Moreover, the trough at 33·5Mc/s on response B does not completely suppress the 625-line sound i.f. signal for, as already explained in this series, it is necessary for the vision i.f. stages to carry this signal so that the 6Mc/s beat signal between the sound and vision i.f.'s can be developed at the vision detector. It is this signal which is used for the 6Mc/s intercarrier sound.

With an ordinary 405-line sound rejector, the response to the sound i.f. in the vision channel has to be several hundred times down to avoid the sound from breaking into the vision. If this requirement is not satisfied sound-on-vision interference occurs since the sound signal is amplitude modulated.

On 625 lines the sound signal is frequency modulated so the fact that sound signal is present in the vision channel does not matter too much, for the picture tube can only respond to amplitude modulation. Nevertheless, the sound signal cannot be allowed to rise to too great a level otherwise other equally as bad interferences could result. For optimum results the sound i.f. has to be a little more than thirty times (30dB) down on the vision i.f. If it is less than this interference would be troublesome and if greater the intercarrier sound signal would be weak.

This, then, shows how critically the vision i.f. stages of dual standard receivers need to be aligned to provide the best possible performance on both standards.

Separate Channels

When two separate i.f. strips are used, as shown in Fig. 24(b), each strip can be adjusted independently for optimum response of the two line standards. One big advantage of this arrangement is that switching at high frequencies can be avoided by transferring the h.t. supply by the standard switch, as the diagram shows. In this way the channel not in use is effectively out of circuit and only the channel in use is energised h.t.-wise.

The 405-line channel is aligned in accordance with existing practice, while the alignment of the 625-line channel is somewhat more specialised to ensure that a symmetrical response, as at B in Fig. 24(a), is obtained. Alignment is best undertaken with a wobbulator and oscilloscope, aided by a signal generator to provide marker pips on the response display.

Converting

Some models which are designed for conversion to switchable sets already embody the v.h.f. tuner, the 405-line vision i.f. strip, detector and video amplifier and also the 405/625 standard switch. Conversion from the i.f. and signal aspects thus resolves to the fitting of the u.h.f. tuner, the 625-line vision i.f. strip, detector and video amplifier and coupling these to appropriate contacts on the standard switch.

"Convertible-to-switch" models are designed mechanically for the inclusion of the extra 625-line units. Plug-in or automatically aligning contacts are also provided to simplify fitting. The unconverted chassis often has a cut-out or similar arrangement to cater for the plug-in components.

Another idea takes the form of a plinth unit in which all the 625-line components are housed. This is designed to match the set cabinet and connection to the parent receiver is accomplished by plugs and sockets.

Not all convertible models incorporate dual channels right up to the video amplifier; some finish at the output of the i.f. strip, using a common switched detector and video amplifier stage. But all convertibles and some switchables require the installation of a u.h.f. tuner to make them suitable for immediate 625-line operation. With the true switchable models it is a relatively simple operation to add the u.h.f. tuner when required, while with convertible-to-switchable models the u.h.f. tuner is added when the extra 625-line components are fitted.

Standard Switch

The standard "405/625" switch does more than just change the r.f./i.f. channel or alter the bandwidth of the combined type of i.f. strip. It also changes the line timebase frequency, switches the vision detector for positive- or negative-going picture signal, switches the video amplifier to cater for the appropriate picture signal (that is, on models with a combined vision detector and video amplifier), changes the sound channel to or from 38·15Mc/s or 6Mc/s (the former the "standard" 405-line sound i.f. and the latter the intercarrier 625-line i.f.), transfers the sound take-off point from the common i.f. stage to the output of the vision detector or video amplifier where the intercarrier sound signal is present on 625 lines and changes the sound detector for f.m. on 625 lines and a.m. on 405 lines.

In addition, a flywheel line sync circuit may be switched in on the "625-line" position (with direct triggered sync on the "405-line" position). This is to provide "clean" line synchronising on the negative modulation system, having in mind that interference and inherent receiver "noise" is far more troublesome with negative-going picture modulation than with the 405-line positive-going modulation. Some models may feature flywheel line sync on both standards, but several manufacturers choose to adopt direct triggered line sync on 405 lines. Note that it is essentially the line synchronising which suffers most on a 625-line picture due to "noise" and interference; the effect actually upon the picture is less disconcerting than on 405 lines, since it resolves as grey or black dots, spots or dashes.

The basic switched circuits of a dual standard receiver are shown in block diagram in Fig. 25. Although these are tied to a receiver with a combined

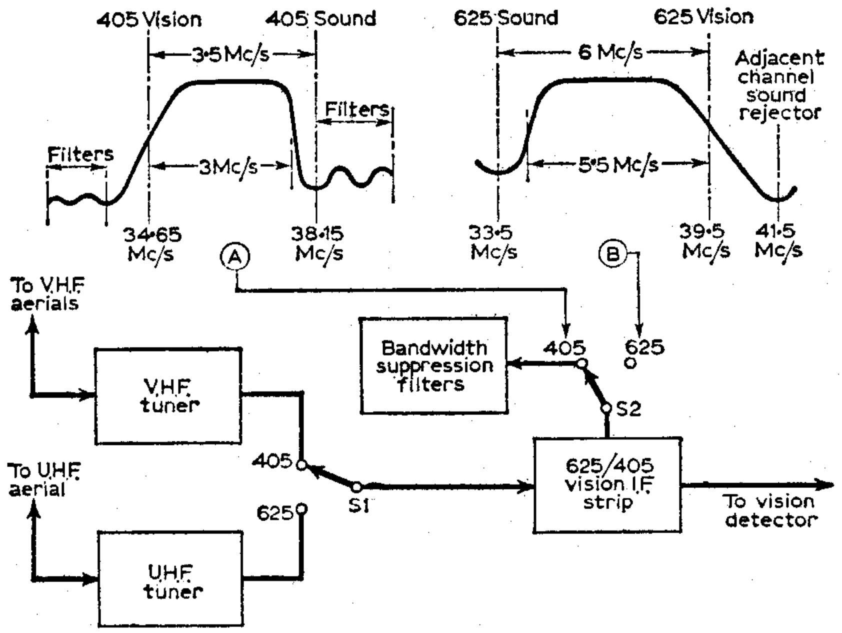
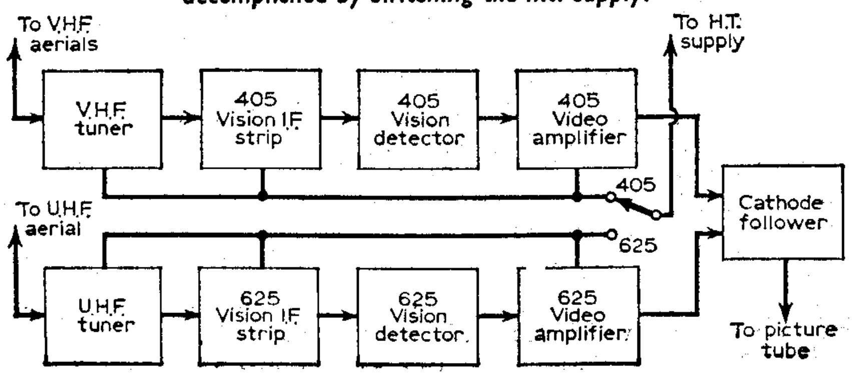


Fig. 24—Vision signal-channel switching in dual standard receivers. The block diagram above shows the arrangement used in switchable models and in some convertible-to-switchable models. On the majority of convertible-to-switchable models the block diagram below applies. Here two completely separate vision channels are used and changeover is accomplished by switching the h.t. supply.



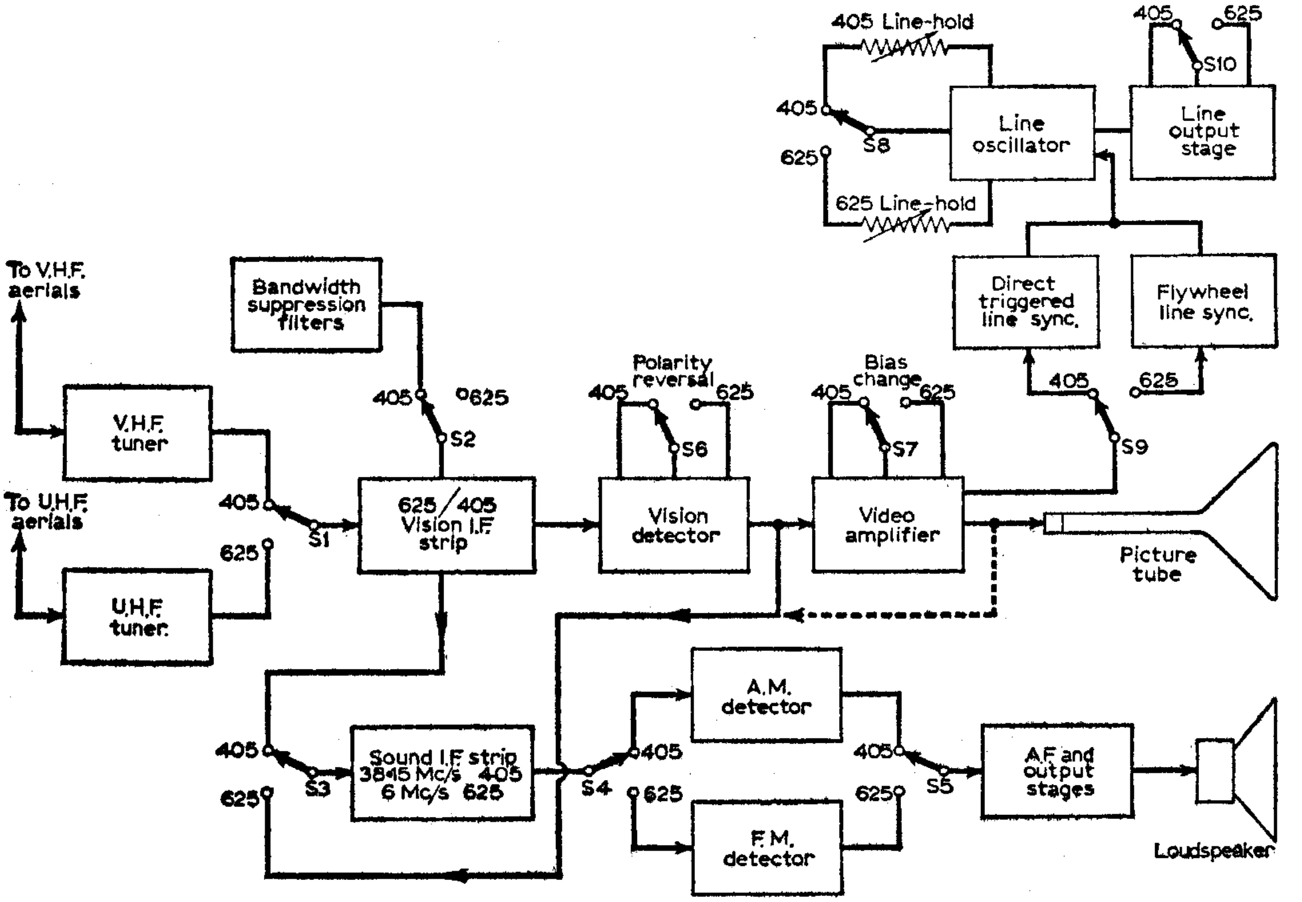


Fig. 25—This diagram shows all the switched circuit sections in a dual standard model. This would apply to true switchable models and to convertible-to-switchable models after conversion. The u.h.f. tuner may or may not be fitted when the set is purchased.

625/405 vision i.f. strip, the switching other than the h.t. changeover would be just the same on a model employing separate strips or complete vision channel—see Fig. 24(b). The switching also applies to true switchable models and to convertible-to-switchable models after conversion.

Switch functions S1 and S2 have already been explained in relation to the block diagram in Fig. 24(a). Section S6 alters the mode of connection of the vision detector for the positive- or negative-going signals, while S7 adjusts the biasing of the video amplifier correspondingly.

The sound i.f. channel is also usually a combined affair, rather like the a.m./f.m. i.f. stages of an a.m./f.m. broadcast receiver. The anode and grid circuits are loaded with series-connected transformers, one set responding to the 405 38·15Mc/s i.f. signal and the other set to the 6Mc/s intercarrier i.f. of the 625-line system.

On 405 lines S3 conveys the 38·15Mc/s sound i.f. from the common stage in the vision i.f. strip to the sound i.f. strip, while on 625 lines the switch changes over and picks up the 6Mc/s intercarrier sound signal either from the output of the vision detector or from the output of the video amplifier. If, after the video amplifier, extra lift is given to the signal, less gain is required in the sound i.f. amplifier.

S4 selects either the a.m. or f.m. detector at the input and S5 does likewise at the output, the latter feeding the a.f. signal to the a.f. and output stages and thence to the speaker. Most models employ a conventional ratio detector for f.m. but a few models use a so-called "locked oscillator" type of f.m. detector. This employs a multi-grid valve in which the frequency changes of the sound i.f. react with a phase difference applied capacitively between the grids and thus gives an audio output. The a.m. detector is conventional in all models.

Several things happen in the line timebase. Firstly, the line repetition frequency is altered by S8, which also changes over the line hold control. This is convenient, for the line on each standard can be set independently, thereby avoiding line resetting on standard change.

S9 is concerned with the sync and where flywheel sync is adopted on 625 lines a discriminator or phase detector is brought into operation in relation to the line oscillator.

S10 changes the line output stage to give maximum efficiency on either 10,125c/s (405 lines) or 15,625c/s (625 lines). Changes here usually involve the switching in of different tappings on the line output transformer, alteration to the h.t. supply to the line output valve and retuning the line output transformer to the third harmonic. Another idea makes use of a small ferrite rod across the limbs of the line output transformer core. This small core carries a winding which is either short-circuited or loaded by a resistor on standard change and in that way the loss inductance of the transformer is suitably modified for optimum performance.

Next month we will deal with the various circuits which are used in the new models.

(To be continued)

Practical factors involved in u.h.f. aerial installations

Ghosts on the u.h.f. bands

By M. L. Michaelis

As most readers are aware, two or more signals must reach the receiver, from the same transmitter but along different paths of different lengths, if "ghosts" are to be produced. Such ghosts appear as faint duplicates of the picture, displaced bodily from the main image, by an amount governed by the quantitative factors outlined in Table 1.

Contrary to common belief, such ghosts need not necessarily appear to the right of the main image; they *can* also sometimes appear to the left, as will be discussed later, but frequent only on the higher-frequency bands.

Since ghosts invariably spoil the entertainment value of the picture, it is important to be able to reduce or remove them. This is virtually entirely a design question for the aerials, *including the feeders.* One of the purposes of this article is to show how the feeders play a far greater role in determining the presence or absence of ghosts than many people suppose.

Image Separation

For major ghosts to be possible, one usually requires some reflecting object (large buildings, hills, etc.) relatively close to the receiver compared to the distance of the transmitter. The reflection being considerably weaker than the incident signal on to the reflecting object, comparable magnitudes of direct signal and reflected signal *at the receiver* result only if the reflecting object is relatively close.

It is the path difference between main and reflected signals which causes a proportionate time delay between the two signals, according to Table 1. We can distinguish three principle conditions, shown in Fig. 1, assuming the *same relative* transmitter-receiver and reflector-receiver distances in each case. In case (A), where these two distances are at right angles, so that *a* and *b1* are roughly equal, the path-difference is very roughly *b2*, the reflector-receiver distance. In case (C), where transmitter, receiver, reflector are in line, in that order, the path-difference is seen to be twice *b2*, so that the ghost will appear twice as far from the main image as in case (A).

In case (B), where the transmitter, reflector and receiver, in that order, are in line, there is no path-difference, and no ghosts will be produced. Thus reflectors in the direct path of the signal from transmitter to receiver cannot produce ghosts; they can only disturb the picture reception by cutting it out altogether, if they lie high enough to cast a shadow at the receiver location.

From this we see that a good aerial, having strongly directional properties making it insensitive to signals from the side (Case A) or from behind (Case C) will do much to remove responses to signals otherwise creating ghosts. Also the aerial should be mounted as high as possible, to be able "to see over the top of" any obstructions.

However, the influence of poor feeder-design and installation on the directional characteristics of even the best aerials is far less appreciated and many ghosts are reintroduced by shortcomings in this point.

Indoor Aerials

With the very high standards of sensitivity and low-noise performance of modern television receivers, the signal amplitude picked up by many indoor aerials, even at very considerable distances from the transmitter, is very often quite sufficient for a reasonable picture, were there no other objections.

This is evidenced by the fact that the sound channel usually comes in very well indeed with such aerials, especially if it is frequency-modulated, as in the CCIR-standard. However, it is seldom that a usable picture is obtained, especially at the higher-frequency bands now about to open up.

The author has been able to view 625-line transmissions on channel 26 in Band IV for a considerable time on the Continent, and Fig. 2 shows conditions prevailing at his home for the Band IV, channel 26, TV station Frankfurt 2.

The square divided into four represents the plan view of the four rooms (fourth storey) of the building in which reception experiments with indoor aerials of various types have been carried out.

Speed of radio waves: 300,000,000m/s (186,000 miles/sec).
Speed of scan spot on c.r.t.—
405 lines: 20in. line length on c.r.t. at approximately 10kc/s = 5,000m/s (3·1 miles/sec).
625 lines: 20in. line length on c.r.t. at approximately 15kc/s = 7,500m/s (4·6 miles/sec).

$$\frac{\text{Main signal/reflected signal path difference}}{\text{Main image/ghost image separation on c.r.t.}} = \frac{\text{Speed of radio}}{\text{Speed of scan spot}}$$

=60,000m/s at 405 lines or 40,000m/s at 625 lines.

Table 1—Factors relating to the production of ghosts.

The building is of brick and concrete on a substantial crossed steel girder framework which produces pronounced cavity resonance effects in Band IV at a high harmonic of the fundamental frequency of each room considered as a tuned cavity.

This causes a build-up of large standing waves, having very considerable amplitude at the maxima, within the rooms; the accumulated energy comes in largely through the walls communicating directly to the outside.

Using a good indoor aerial with dipole, reflector and three directors, in room 2 reception is very reasonable, as the main signal has to pass only one wall, but reflections at least two walls. The picture is very usable, ghosts very weak or even invisible on good days.

In room 1 the signal is spoilt by a strong ghost to the right of the main image, due to the reflection from the gasholder. In room 3 the strongest signal is the reflection from the gasholder, and is the "main image" of very good quality. The direct signal is much weaker after passing through both walls of room 1 into room 3, but nevertheless arrives earlier, as it has the shorter path. Consequently it produces a reasonably strong "ghost" *to the left* of the "main" image.

In room 4, conditions are worst of all. The direct signal and the moderate reflection from the office block come in at about equal strength, and the other reflection, from the gasholder, also comes in quite strong. It is impossible to get any one image dominant, and even timebase lock is extremely difficult; the picture mostly rolls and/or tears up, due to mixed (erratic) sync pulses from the three signals.

The aerial gave a performance no better than that of a simple dipole. This is because, once the energy is in the room in question, the tuned cavity effects of the room destroy virtually all directional advantages of the aerial. True, a particular orientation of the aerial gave best results, but this varies greatly from point to point within the room. Even rooms without metal girders in the construction could show tuned-cavity effects at u.h.f.

Conditions are not generally likely to be much better even quite close to the transmitter, as that would merely multiply all signal levels to a higher amplitude without removing the *relative* effects leading to the ghosting. It must be stressed that the signal levels themselves were *excellent* even under the typical conditions shown. The (f.m.) sound reception of the TV-signal was really superb in all four rooms, and the pictures were well-above the tuner noise.

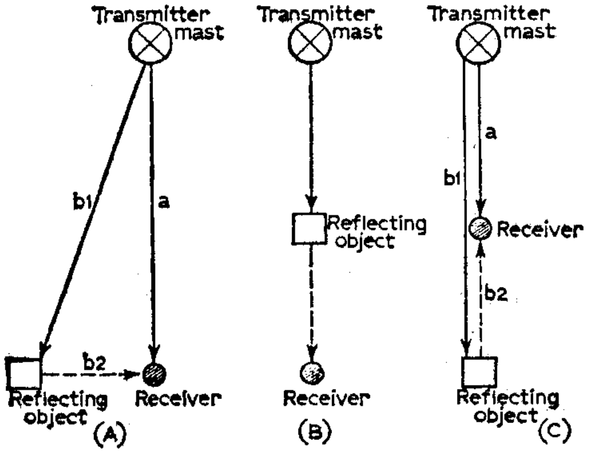


Fig. 1—The basic geometric relations of transmitter, reflector and receiver for ghost production.

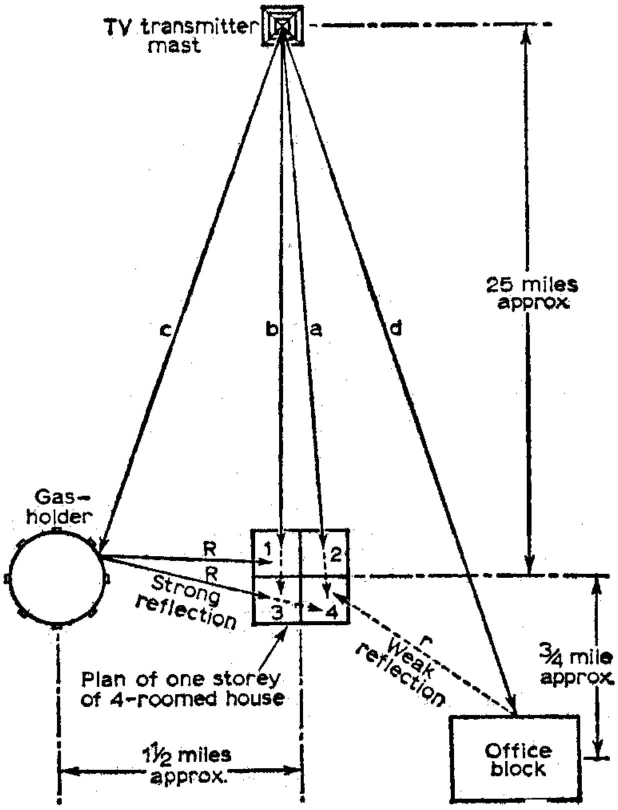


Fig. 2—A set of typical reception circumstances for Band IV indoor aerials.

It is thus clear that a good high aerial on a roof mast, with well designed feeders, very often does not serve the prime purpose of increasing signal strength to a usable level, as indoor aerials can give ample signal strength—if that were all that were needed.

The high aerial is more useful for obtaining very highly directional effects at a location free of standing waves, i.e. where the received waves are proceeding unhindered past the aerial. Under such circumstances the aerial can be used to maximum advantage, to select only the pure direct signal.

Effects of poor feeders

The coaxial line feeder, unbalanced to earth (i.e., outer screening earthed at the receiver chassis), impedance around 80Ω, is very popular, especially on the lower bands in Britain. On the Continent, however, balanced (unscreened) twin feeder, as used now in Britain for Band II v.h.f.-f.m. radio, is more popular, and has an impedance of around 320Ω.

Twin feeders have two major advantages over coaxial lines; they permit easier and better matching to conventional Yagi aerials, and there is less signal attenuation per unit length, provided that the feeder is clean and dry (which it is usually not, if installed out of doors!).

The great disadvantage is the need to maintain absolute symmetry to earth for both wires of the feeder, for the whole distance from aerial to receiver. This requires distance pieces to hold the feeders some inches away from all roofs, gutters, walls, etc., and can often lead to rather unsightly installations trailing down the side of buildings.

Failure to observe such symmetry, results in (a) reduction of the directional dB-ratio of the aerial-array, *increasing* response for directions supposedly insensitive in the ideal case, and (b) considerable response of the feeder itself functioning as pick-up aerial. Only if the feeder is itself truly balanced is it unresponsive to any signals except those injected from the aerial array at its end.

Remembering the remarks regarding tuned cavity effects inside domestic rooms, it is clear that such a poorly balanced twin feeder can pick up large spurious signals in the room just before entering the receiver, with amplitudes comparable to the main signal from the high aerial. The results would be severe ghosting and a general performance hardly different from that of a set-top aerial.

It is very difficult to install a twin-feeder for Band IV signals in city areas where numerous reflecting objects are around; if diplexing is attempted on arrangements using twin feeder for the main runs, conditions are even more critical. However, in rural areas of reasonably flat topography, twin feeder installations often give very little trouble, and have the advantage of cheapness.

Symmetry Transformers

After conducting the indoor aerial experiments for Band IV, and failing to get usable results thereby in room 4, the author also tried a twin-feeder system from a roof aerial, without any better results. The reasons for this will be clear from the previous paragraph.

Careful installation of the feeder failed to reduce ghosts to a tolerable level. Accordingly, a coaxial feeder was resorted to. The main signals at the site are on Band III (channel 8) and Band IV (channel 26). Both transmissions are 625-line, CCIR-standard, with f.m. sound.

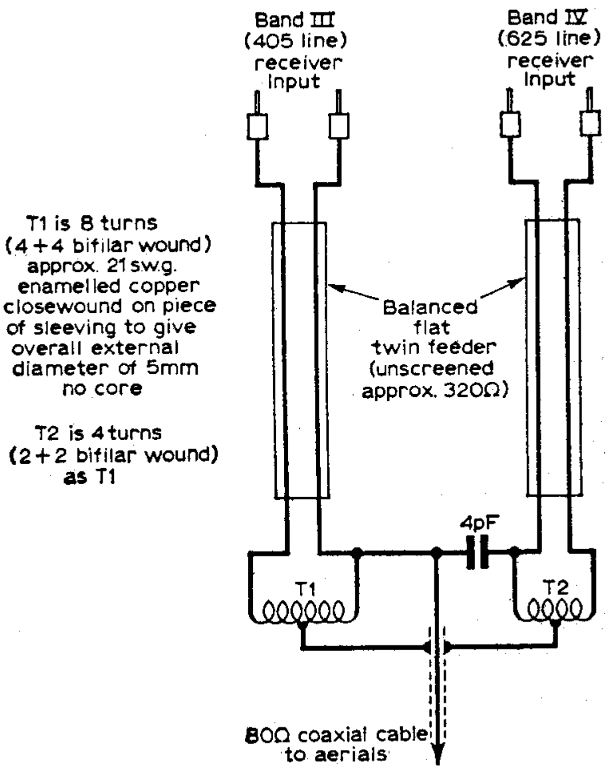


Fig. 3—Prototype diplexing and symmetrising arrangements for coaxial feeder.

A five-element single-tier Yagi of conventional type for Band III and a twenty-element single-tier Yagi for Band IV are used on the mast on the roof; both are for 320Ω balanced twin feeder. The arrangement of Fig. 3 (in reverse) is used right at the mast-head for diplexing these aerials on to a single coaxial line of 80Ω impedance, and the same arrangement is used again at the receiver end, to separate the signals for the dipole sockets of the receiver taking 320Ω twin-feeder again.

This arrangement gives very good performance on both bands.

On most nights and picture scene types, ghosts are now invisible; they are faint on poor reception nights.

Careful prodding and bending of the turns of the coils were required to achieve optimum performance, and the valve of the 4pF capacitor may need to be modified slightly in other installations, and/or a capacitor of around 10pF inserted in the feed to the Band III symmetry/transformer coil.

Any reader adopting these measures for his own aerial installation must conduct his own final trimming-experiments, which are always largely empirical. It is possible to diplex or triplex Bands I (BBC-TV) or Band II (v.h.f.-f.m. radio) into the same feeder and out again, by logical extension of the principles of Fig. 3.

The coupling capacitor valve and coil size will need to be increased proportionately. About 10 turns (5 plus 5, wound bifilar) and some 10 to 20pF coupling capacity would be suitable for initial experiments for Band II, for example. The coil should be wound to about 7 to 10mm external diameter. The same coil with a small slug inserted can be tried for Band I (BBC TV).

When using such an arrangement, the location should be such as to use an ***absolute minimum*** length of twin feeder at the receiver end. It is preferable to build the transformer unit in a non-metallic (plastic) container on the end of the coaxial line, immediately behind the aerial sockets of the receiver, with at the most a couple of inches of twin feeders.

Fig. 4 sketches the line of experiments for the case of receivers with coaxial-line aerial sockets. T1, T3 and C1 will be as in Fig. 3, and the pairs T1, T2 and T3, T4 respectively will generally be identical. The pairs C2, C3 and C4, C5 will respectively be of equal capacities, and around twice the capacity of C1—optimum values should be tried by experiment.

Experiment should also determine whether or not the leads (shown dotted) joining the centre-taps of respective pairs of transformers improve the performance. Fig. 4b explains what is meant by "bifilar winding"; all transformers should be wound in this fashion. Experiment should also determine the optimum side of T2 or T4 to which the output coaxial-line inner conductors are to be joined.

Also, in Fig. 3, the effect of reversing each pair of plugs in the receiver aerial terminals should be tried. Such measures should, theoretically, make no difference if the transformer balance and matching is perfect, but in practice appreciable differences will exist, giving better performance in one orientation.

It must also be pointed out that, in receivers with the continental type of twin-feeder aerial sockets, requiring Fig. 3 diplexer and symmetriser for a coaxial main-feeder, the conditions of Fig. 4 nevertheless actually exist, because the tuner input-grid circuit is necessarily assymmetric to chassis, i.e. of the " coaxial input " type, primarily.

Thus, if one looks behind the aerial terminals inside these receivers for twin-feeder, one generally finds C2, C3, C4, C5 of Fig. 4a located there, and the input tuned-circuits of the tuners designed in the fashion of T2 and T4 of Fig. 4a. The tuner input-stage grid is fed from the positions of the output-coaxial inners in Fig. 4a, and the bifilar centre-taps go to chassis of the receiver.

Take care that the use of the dotted connections between the transformer centre-taps in Fig. 4a does not create a d.c. connection between chassis and aerial which would allow mains voltages from an a.c.-d.c. receiver to proceed up the aerial. A capacitor of about 100pF should then be used instead of a direct connection, if this connection is at all necessary.

The theoretical explanation of the function of these symmetry transformers (often called " bazookas " when carried out with coaxial lines instead of actual coils at the very high frequencies) is reasonably obvious. Being of ratio 1 : 2 step-up in auto-transformer arrangement, the impedance ratio is clearly 1 : 4 step-up, i.e. from 80Ω to 320Ω as required. Also, the ends of the windings are clearly symmetrical to earth (centre-tap), as required for twin feeder.

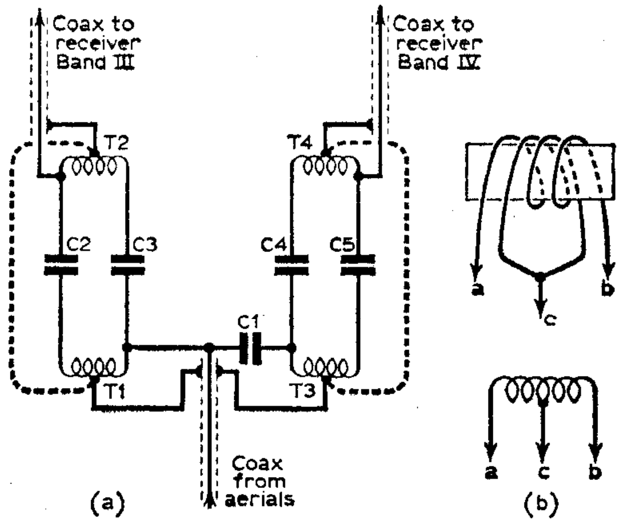


Fig. 4(a)—Coaxial to coaxial diplexing arrangements in their simplest form; (b)—explanation of "bifilar winding" of symmetrising transformers.

Instability Effects

All feeders, whether twin-balanced or coaxial, should be cut to the proper length required—not too short and certainly not excessively long. Any excess length left trailing about on the floor behind the receiver often lead to instability, as well as reintroduction of ghosting due to resulting aerial efficiency deterioration. Signal strength is usually less affected.

The instability can take the form of " body capacity " in the higher-frequency bands. These instability effects—which in the severest cases and with poorly-screened tuners can send the whole tuner into oscillation—vanish completely when a neat feeder of correct length is installed.

One would imagine coaxial cable feeders to be less prone to this sort of trouble, as " the external conductor is earthed, after all ". But this assumption is a fallacy, and the strength of such instability even with coaxial line can be surprising.

Thus using an excess length of some two yards of coaxial cable before passing through Fig. 3 into the receiver caused such severe instability when this cable was draped *spirally* behind the receiver operating on Band IV that the picture could be brought into and out of lock by a person moving about two yards away! Draping the excess length in a non-spiral fashion caused a reduction of the instability.

Conclusion

It is hoped that this article has contributed to the explanation of some important TV aerial problems in general, and for the u.h.f. bands now opening up in particular. With the use of transmitters of around 500kW or more e.r.p, signal strength itself is not difficult to raise to the necessary levels in normal service areas.

The aerial problems amount far more to getting high signal-to-reflection ratios, by means of efficient directivity and adoption of the other measures discussed in this article.

The problems arising at u.h.f. are so manifold that one is continually being surprised! At the short wavelengths involved, many objects reflect strongly which at the lower bands play little or no role. Thus the author observes regularly on Band IV that on changeable, windy and stormy days, reception fluctuates greatly, even in areas of very high basic signal-strength.

The causes seem to be fluctuating reflections from waving trees, and also from passing groups of clouds. A high aerial will combat the former effect, but to remove the cloud-effect on stormy days it may be necessary to use multi-tier Yagi arrays to reduce the vertical angle of response of the aerial.

One sees such aerials here and there on the Continent on the houses of serious viewers. Another interesting Band IV effect recently noticed is the gradual and unambiguous vanishing of a former prominent response direction of an indoor Yagi as the trees outside the window progressively lost their foliage last autumn.

Unmatched Cables

If feeders are not properly matched as regards their impedance, this does not produce ghosts directly, contrary to common belief. The multiple signals produced by repeated traversals of an unmatched feeder are generally too close to each other in time to generate noticeable ghosts, unless the feeder is exceedingly long.

The primary effect is far more that of an apparent loss of horizontal focus, due to very nearly coincident multiple images. If real ghosts or large separation are also produced thereby, then these are secondary effects of unbalance causing aerial-directivity to deteriorate, on account of the mismatch.

A receiver giving consistently poor focus even though the raster-lines appear sharp and the bandwidth is correct should lead one to suspect mismatch in the aerial and feeder system. ■

The ABC of TV Circuits

AN ANALYSIS OF THE DEVELOPMENT OF TELEVISION CIRCUITS

By T. L. May

(Continued from page 172 of the January issue)

CONTRAST control systems have undergone several interesting changes during the last decade. If we look back to a circuit of a 1951-vintage receiver, for example, we will probably find that the contrast control arrangement is rather like that shown in Fig. 32. The controlled valve will be either the second in the t.r.f. chain or the first vision i.f. amplifier (or common i.f. amplifier) in the case of a superhet circuit.

What does the Contrast Control have to do?

It is the job of the contrast control to set the drive of the picture signal between the grid and cathode of the picture tube so that a picture of the most desirable—and accurate—contrast (black and white) ratio is achieved. The term " drive " means the change of signal voltage between the cathode and grid of the picture tube. Thus, the greater the *change* of signal voltage here, the greater will be the contrast ratio of the picture.

Clearly, then, the contrast control to the vision signal is very similar to the volume control to the sound signal. There is a difference in operation between the two controls, for the volume control adjusts the level of the sound signal applied to the output stage by acting as an attenuator, while the contrast control adjusts the *gain* of the vision channel and in that way causes a change of signal drive at the control grid of the video amplifier valve and hence a similar change of drive at the picture tube.

Now, the gain of a television amplifying stage depends to a large extent upon the mutual conductance or slope (gm) of the valve—the larger the gm, the greater the stage gain. One of the easiest ways of adjusting the gm of a valve is by altering its grid bias, and this is exactly what the contrast control is arranged to do in Fig. 32.

The bias applied to the control grid of a valve is always relative to the cathode, which means that if the cathode is made positive relative to the control grid, the grid is, in fact, negative with respect to the cathode. One way of making the cathode positive with respect to the control grid is to return the control grid to chassis either through a resistor (grid leak) or coil winding and then put a resistor in the cathode circuit of the valve—e.g., between cathode and chassis. The anode and screen currents thus flow through the cathode resistor in such a way that the voltage dropped across the resistor is positive at the cathode side with respect to the chassis side.

Now, in Fig. 32 R1 and the contrast control R2 are connected in series with the cathode. Let us suppose that the contrast control is turned right down so that it represents zero resistance. The voltage dropped across R1 thus provides a nominal grid bias, since this condition the control grid is connected to chassis through L1 and R3 and R4 in parallel.

As the contrast control is turned in the opposite direction a greater resistance is introduced into the cathode circuit. This causes the voltage at the control grid, relative to the cathode, to rise negatively, with a consequent fall in gm and stage gain.

It may have been noticed that the suppressor grid of the valve is also returned to chassis, which means that this electrode is also biased negatively. Note also that when the contrast control introduces resistance to the cathode circuit the potential divider R3 and R4 comes into effect in terms of the control grid. Actually, what happens is that the potential divider arranges for the change of grid bias to be less than the change of suppressor bias as the contrast control is adjusted.

The reason for this is that by altering the gm simply by varying the grid bias badly alters the input capacitance of the valve. This affects the alignment of the tuned circuits connected to the control grid—and hence the definition of the picture—as the contrast control is adjusted, but by arranging the circuit as shown in Fig. 34, so that there is a greater change of suppressor grid than control grid bias, the input capacitance of the valve is maintained substantially constant over the full range of contrast control adjustment.

Another way that this can be achieved is by connecting a low value resistor between the cathode of

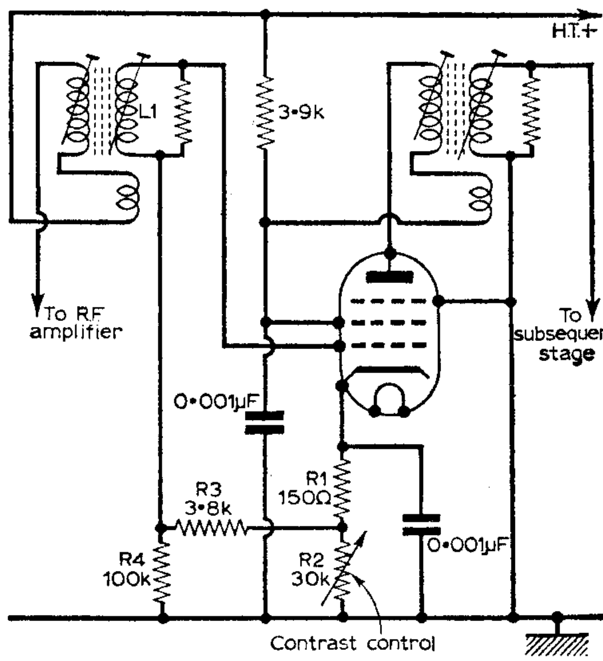
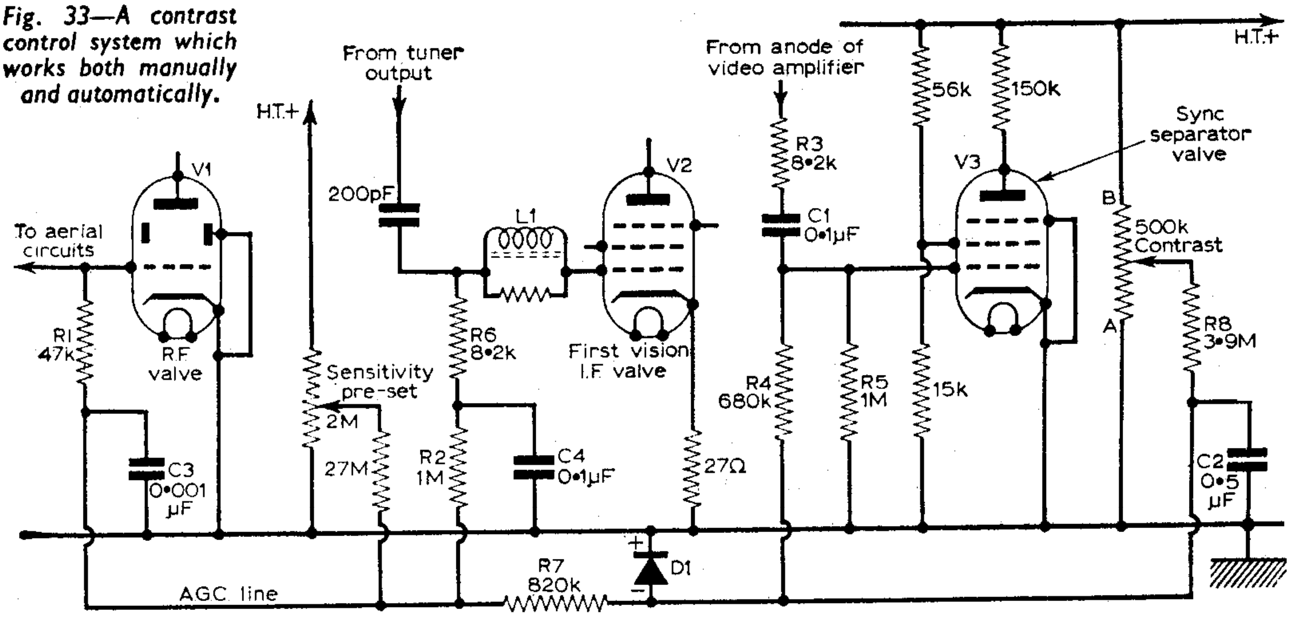


Fig. 32—An early type of contrast control system in which the overall gain of the vision channel is adjusted by altering the bias of a valve.

Fig. 33—A contrast control system which works both manually and automatically.



the controlled valve and the normal biasing resistor. The resistor should not be bypassed by a capacitor, and the resulting negative feedback so applied to the stage stabilises the input capacitance. A typical value for such a resistor is 27Ω.

Automatic Contrast Control

On most modern receivers the contrast adjusts itself automatically to suit the strength of the aerial signal applied to the set. This saves re-adjustment each time the programme is changed, as the aerial signal is rarely at the same level on all channels. Moreover, the gain of an average receiver is usually greater on the low Band I channels compared with the high Band III channels.

This feature is often integrated with the manual contrast control, and comes under such names as "automatic picture control" and "automatic gain control" (a.g.c.), as well as "automatic contrast control".

The circuit in Fig. 33 shows how a.g.c. is applied to the vision channel of a modern receiver. It will be seen that two valves are controlled—the triode r.f. amplifier in the tuner and the first vision i.f. amplifier valve, V1 and V2 respectively.

There is no cathode bias applied to the r.f. triode since the cathode is returned direct to chassis, but there is a little grid current bias developed across the grid resistor R1. Likewise, V2 has virtually no cathode bias, since in the cathode there is only a 27Ω resistor which is used to avoid changes of input capacitance—as already explained—and the voltage dropped across this is insufficient to bias the valve correctly. However, a small standing bias is again given by grid current in the grid resistor R2. Thus, the gain of V1 and V2 is at a maximum due to the nominal standing bias so derived, and as this represents *maximum* contrast the manual and automatic contrast control arrangements must *increase* the bias to provide a decrease of gain and contrast.

Negative Voltage from Sync Separator

V3 in Fig. 33 is the sync separator valve. In accordance with conventional practice, this receives a negative-going picture signal from the anode of the video amplifier valve, via R3 and C1. The negative-going picture signal drives the valve into anode current cut-off and picture signal does not appear at the anode. However, as the sync pulses are positive-going, these cause a response at the anode (and screen) and from these electrodes the sync pulses are conveyed to the timebase oscillators—minus picture signal.

The positive-going sync pulses at the control grid also push the grid into grid current (rather like a diode effect). This causes C1 to charge, negative at grid, and the charge leaks away through the grid leak R5. The time-constant C1 R5 is arranged for optimum sync separation.

We are not particularly interested in the normal operation of the sync separator stage at this time, but we are very much interested in the negative voltage which occurs at the control grid (e.g., across R5). This rises negatively with increase in the level of video signal applied to the grid. Thus, as long as there is a signal the grid is negative.

It is this negative voltage which is now nearly always used to bias the controlled valves automatically. In the circuit under discussion, the negative voltage is fed from the grid through R4 and R7 to the r.f. valve through R1 and to the i.f. valve through R2, R6 and L1. The gain of the vision channel is now tied to the signal conditions, for when the signal is weak there is only a small negative voltage and the controlled stages are working almost flat-out, and when the signal is strong the negative voltage increases, the stage gain decreases and the contrast is adjusted automatically to suit the applied signal.

There are, however, one or two other features of the circuit which should be understood. The most important is the manual control of contrast, and this is best considered by assuming that the set is receiving a good solid signal which is making the "a.g.c. line" nicely negative. The circuit shows that the contrast control is connected between h.t. positive and chassis, and that the slider of the control is connected through a 3·9MΩ resistor (R8) to the a.g.c. line.

Now, when the slider of the control is at the chassis side of the track (point A), R8 is effectively between chassis and the a.g.c. line, and owing to its very high value is has barely any effect at all on the negative bias, which means that the contrast is at

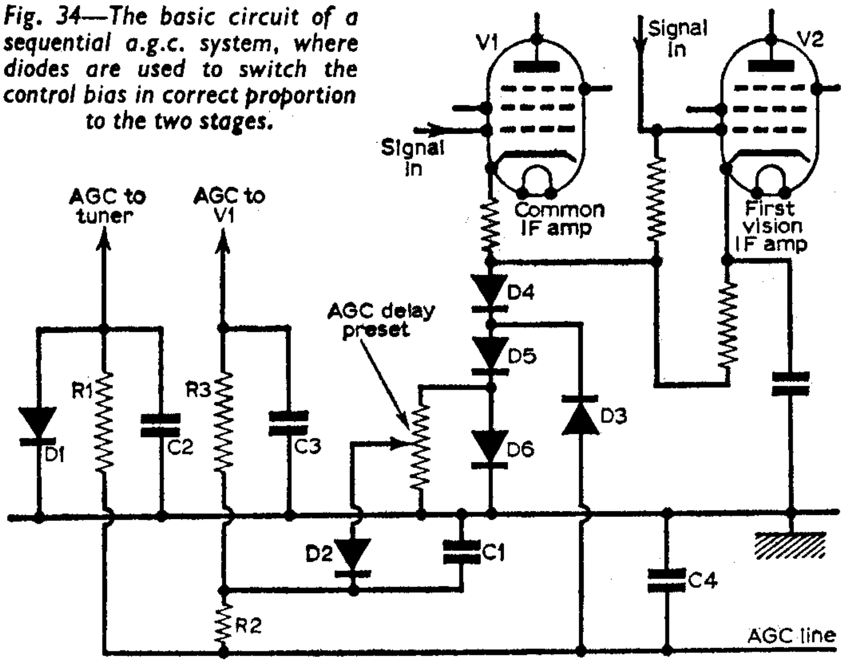


Fig. 34—The basic circuit of a sequential a.g.c. system, where diodes are used to switch the control bias in correct proportion to the two stages.

minimum (e.g., minimum vision gain). However, when the slider is rotated towards point B a positive potential is reflected on to the a.g.c. line. This counters the negative voltage from the sync separator and thus effectively reduces the negative voltage applied to the controlled valves. The vision gain thus rises, dependent upon the setting of the contrast control.

To avoid the a.g.c. line going positive, which could happen in the event of signal failure and when changing channel, diode D1 is connected between chassis and the a.g.c. line in such a way that when the line is negative it is biased for reverse conduction and when positive for forward conduction. This, then, makes it totally impossible for the a.g.c. line to go positive with respect to chassis.

Another feature of the circuit is the sensitivity preset. This is connected to the a.g.c. line in much the same way as the contrast control, but since it is connected to V1 side of R7 it mainly affects the r.f. valve. This means that when the set is receiving a weak signal the sensitivity preset can be advantageously adjusted to reduce the negative bias applied to the r.f. valve without upsetting the a.g.c. bias applied to the i.f. valve.

In that way, therefore, the signal/noise performance of the set can be kept at a maximum—having in mind that the noise produced by an r.f. amplifier stage tends to rise as the negative grid bias is increased. On a strong signal, of course, this is of little consequence because the signal will outweigh the noise, but on a weak signal even the small bias developed by the sync separator, if applied to the r.f. amplifier in full force, could put excessive grain on the picture.

Sequential A.G.C.

The circuit in Fig. 34 solves this problem automatically. Here the a.g.c. line from the sync separator stage and the contrast control is connected to the controlled valves by way of a network of diodes. Diodes D4, D5 and D6 hold the cathodes of V1 and V2 at a constant voltage, irrespective of changes in cathode current which will occur due to changing signal conditions.

On a weak signal, D1 is biased for forward conduction and the a.g.c. feed to the tuner r.f. stage is held at chassis potential (e.g., zero bias). The forward conduction conditions of D1 are derived from the potential at the junction of D5, D6, being reflected through D2, R2 and R1. Under this condition, then, the set gives the best noise performance.

Now, as the a.g.c. bias increases due to a stronger signal the a.g.c. bias applied to V1 rises in proportion until D2 becomes biased for forward conduction. When this happens the a.g.c. bias applied to V1 no longer rises since D2 acts as a shunt on the a.g.c. bias feed to V1.

During the rise in signal as considered above, D1 is pulled progressively away from the forward conduction stage and the tuner receives a progressively increasing negative bias. The circuit set-up is such that on weak signals the i.f. valve only receives a small a.g.c. bias, but as the signal strength increases the bias applied to the i.f. valves slows down while the bias applied to the r.f. valve increases. This

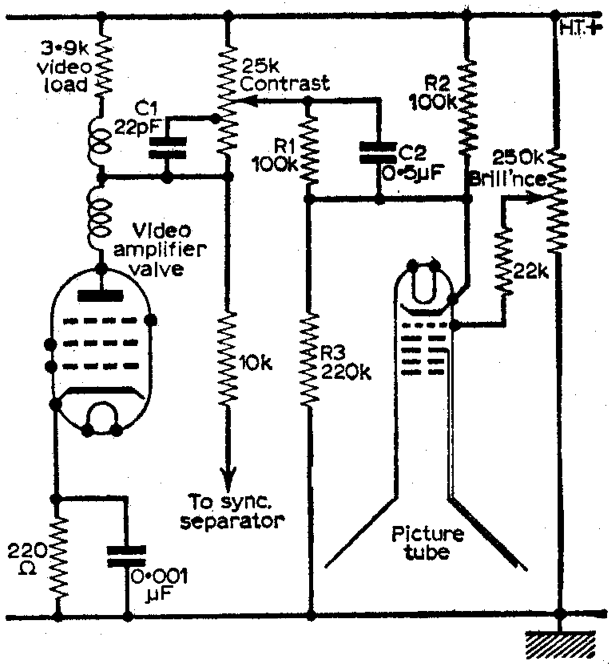


Fig. 35—A manual contrast control system connected between the video amplifier stage and the picture tube.

ensures that the receiver always operates with the minimum of noise and intermodulation. The point at which the r.f. valve starts receiving a.g.c. bias and the bias applied to the i.f. valve stabilises can be set by the " a.g.c. delay " pre-set control.

D3 is the clamp diode—the same as D1 in Fig. 33—which ensures that the a.g.c. line never goes positive during channel changing and when the set is operated without an input signal.

(Continued on page 219)

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 86: PETO SCOTT 1726 and 1729

THESE receivers are 17in. models using an AW43-80 tube with a standard turret tuner for Band I and Band III reception. The circuit is very straightforward and conventional except perhaps for the alternative line sync provision for use in fringe areas. Whilst this does reduce line tear, at the same time it does weaken the line hold and the setting becomes more critical.

The provision of a *line drive* and *e.h.t. regulator* is a little unusual and it is essential to adjust these together correctly. The line drive is R107 and the e.h.t. regulator R54. Both are slider elements under the chassis and are shown in Fig. 2. They should only require adjustment when V8 (PL36) or the line output transformer is replaced.

Under normal conditions V8 should pass 115mA. To check this a milliameter should be inserted into the cathode circuit (normally returned direct to chassis) by breaking the chassis connection of pin 8 and inserting the meter. R54 should be set to minimum resistance (slider to chassis end).

Adjust R107 for maximum width and then set R54 so that the meter reads 115mA. Before adjusting these controls ensure that the ECC82 (V7) and the PL36 (V8) are both in good order.

Regulation Circuit

A brief explanation of the circuit will perhaps make the function of R54 clearer. The basic function of a regulator circuit of this type is to provide a steady e.h.t. voltage over varying load conditions so that the focus does not change when there is a change of brilliance. This is accomplished by a feedback circuit and rectifier to provide a varying bias for V8 (PL36) control grid.

A part of the output of V8 is fed back via C50—R57—C87 to the rectifier which is one of the V12 diodes. The rectified voltage is developed across R78 and R62, which are fixed resistors, and across R54 which is variable to pre-set the conducting or operating level of the diode. The resulting negative bias is applied via R52 and R51 to the V8 control grid.

Thus V8 is to an extent automatically biased according to the load conditions imposed on it or reflected back to it from V10. It will immediately be seen that the desired effect can only be realised when V10 is capable of handling a load current.

If this (EY86) valve is not in good order large variation of focus and picture size will occur at varying brilliance levels, and as the brilliance is well advanced the picture will lose focus, enlarge and disappear completely.

Usual Faults

As outlined above, a failing EY86 produces symptoms which are quite easily recognised, but if with the brilliance level low the width is inadequate, failing to fill the screen at each side, it may well be that the EY86 is being under-supplied and the valve should not be replaced until the circuit has been more thoroughly checked.

First check the h.t. voltage, which should not fall below 175V. If the voltage is below this check the PY32 by replacement. A PY33 is a more recent replacement of improved construction and drops less voltage across it. With this valve fitted the h.t. voltage may be higher than that specified.

If the h.t. is over 175V check both the PL36 and the ECC82. An unsuspected low emission ECC82 will often cause a new PL36 to overheat and fail prematurely, sometimes with a cracked glass envelope.

No Picture

If the line whistle can be heard clearly and evidence of high voltage is present at the EY86 top cap first check whether the heater of the EY86 is glowing or not. If not and there is no e.h.t. at the side of the tube it is fair to assume that the EY86 has an o/c heater and a new valve should be fitted.

If, however, the line whistle sounds a little ragged and no high voltage indication can be found at the EY86 top cap, switch the set off, remove the top cap and, when the valves have completely cooled, switch on again. If the top cap can be removed without switching the set off and without coming into contact with the cap it is quite in order to try this.

The point is that, although the top cap may appear dead when on the EY86, as soon as it is removed it may suddenly come to life with the one apparent object of arcing to the nearest body, including a human one, if available! Now if this does occur (i.e., dead when on, live when off) it is again reasonable to suspect that the EY86 is internally shorted and a replacement is needed.

An internal short in the tube would produce similar symptoms but generally the EY86 will be be found at fault. If more convenient, removal of the anode clip from the side of the tube would again identify the fault.

First confirm that the PL36 and PY81 valves are lighting up (the EY86 won't be). Quite often it will be found that one of these, usually the PL36, fails to light. This is due to loss of vacuum and the glass envelope may well be found completely loose so that the base has to be gripped in order to remove it without the risk of a cut hand.

It may be found that both valves are lighting but one may be red hot. In the case of the PY81 this can be due to C49 developing a short. C49 is a 100pF 12kV capacitor and a replacement must have a similar high voltage rating, although a rating of over 6kV is usually sufficient. This condition usually results in the width control VR4 being damaged and a replacement 10kΩ wire wound is therefore required.

If the PL36 is red hot attention should be

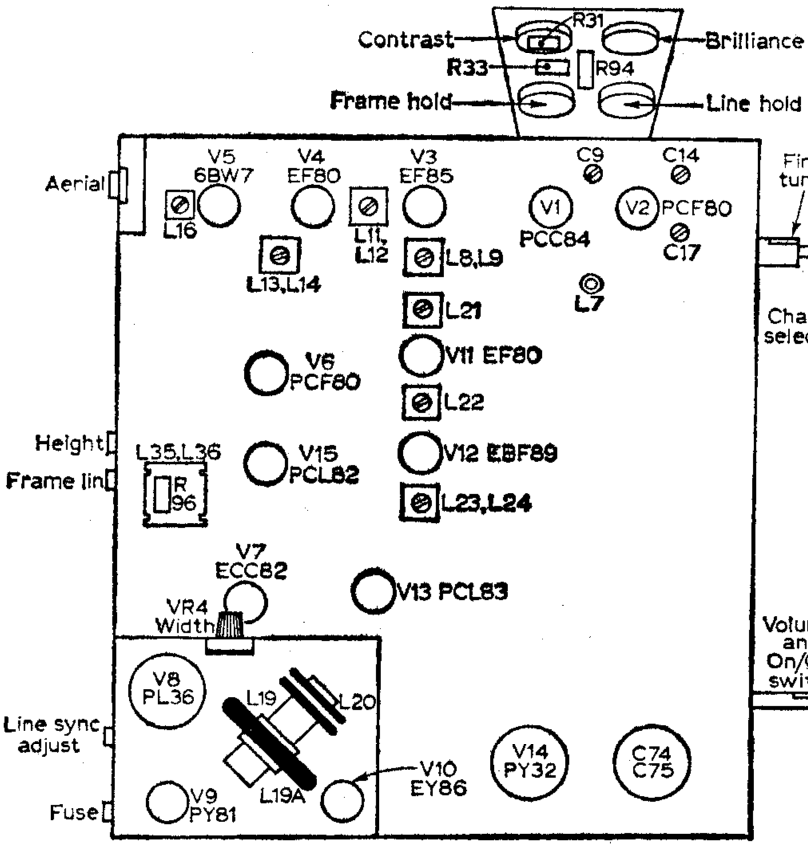


Fig. 1—A general above-chassis view of the receiver, showing the positions of the larger components.

directed to the ECC82, which if defective fails to supply a driving bias to the PL36, resulting in this valve passing excess current. Leakage through C46 will produce a similar symptom, as will a shorted C47.

If the line whistle is barely audible and neither valve appears overheated attention should be directed to C51, which may either be o/c or shorted. Also check the capacitors C79 and C88 associated with the line scan coils and C80. If the ECC82 is driving the PL36 and all valves, including the EY86, are in order and capacitors have been checked, the *line output* transformer may fairly be suspected provided that the *line coils* have also been checked through.

The PY32

A low-emission PY32 will result in a small picture and a check of h.t. will confirm this, but these valves often go soft with a characteristic blue glow and the reported symptoms may then be "the picture takes about a half-hour or more to come on but the sound comes through fairly quickly".

This is because the PY32 is soft (impaired vacuum) and the getter fights a losing battle, the period of delay becoming longer each time the receiver is used (from cold) until, if left, the h.t. remains low and does not rise or the PY32 lights up with a lovely purple glow and the fuse fails.

We have yet to see whether the PY33 will suffer a similar fate after a period of use.

These remarks concerning the PY32 have been included under the *no picture* fault condition and to continue with this condition and assuming the sound is in order let us assume that the line time-base whistle cannot be heard.

No Line Hold

If the control is at one end of its travel check the ECC82 and the 1MΩ resistor R49 in series with the hold control. Check the hold control itself if necessary.

If the control is not at one end and the picture can be made to hover at or about its correct locking position check C42, C43 and C89.

Lack of sync and a distorted picture should also direct attention to C39 (32μF), also check C74. If the picture is not distorted and the condition is clearly one of loss of line and frame sync check V6, PCF80.

Frame Timebase

The frame oscillator-output valve is V15, PCL82. Loss of emission in this valve will cause bottom compression and also at times loss of hold with the frame hold at the end of its travel. In both cases the valves may not be at fault. Bottom compression is often due to C86 (100μF, 25V) becoming open circuited or sometimes R106 (390Ω) changing value. If this resistor falls to a low value the bottom of the picture may fold up, showing a bright band at the bottom.

Top compression or white lines at the top of the picture can indicate a faulty PCL82, a defective capacitor C84 or C85, a faulty linearity control or associated resistor. Frame hold at the end of its travel should direct attention to R95 (560kΩ) and VR5.

The *thermistor* in series with the frame deflection coils rarely gives trouble. It is a VA1033 and has a d.c. resistance of about 4Ω when cold.

(Continued on page 213)

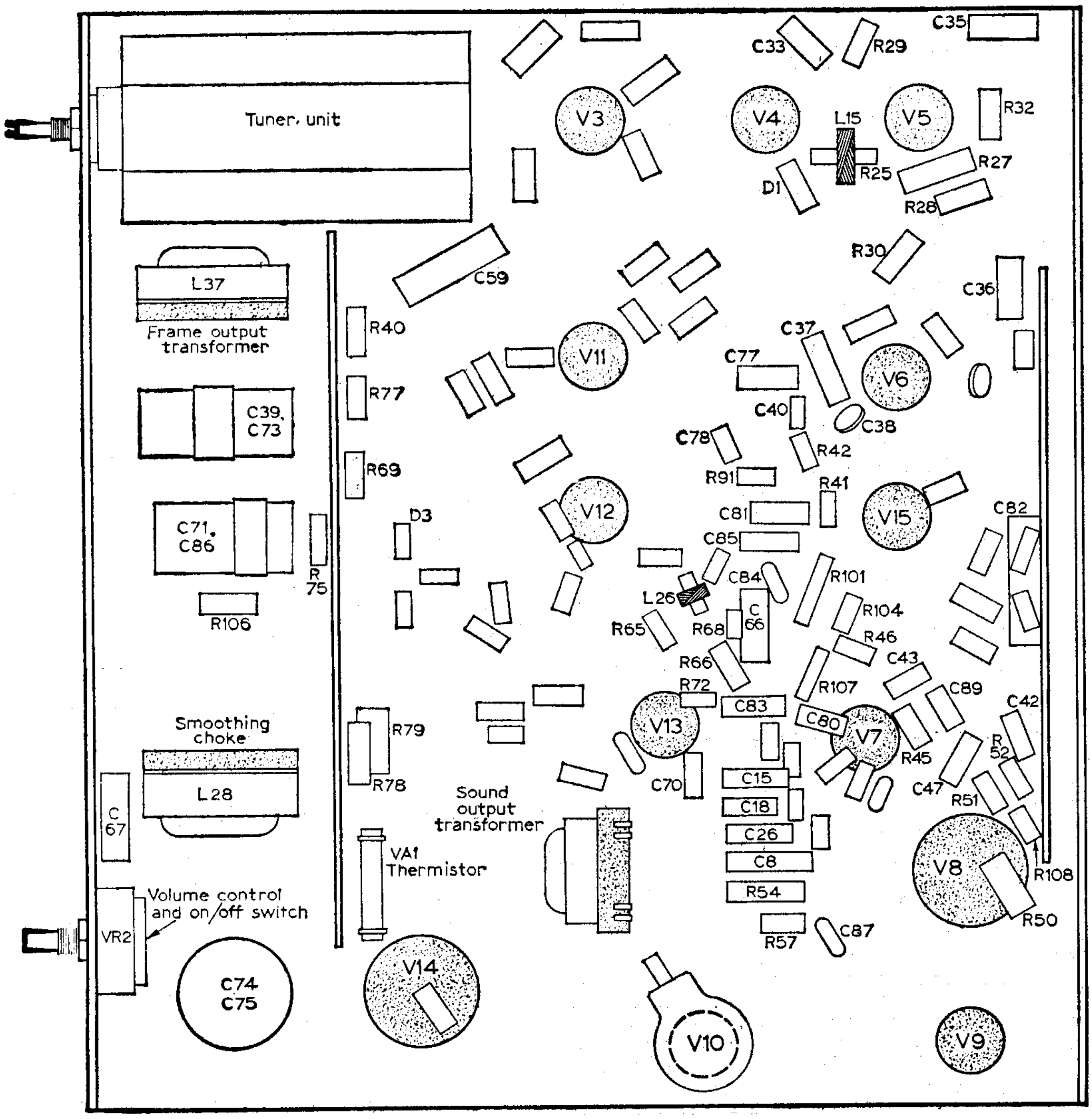


Fig. 2—An underchassis view of the receiver.

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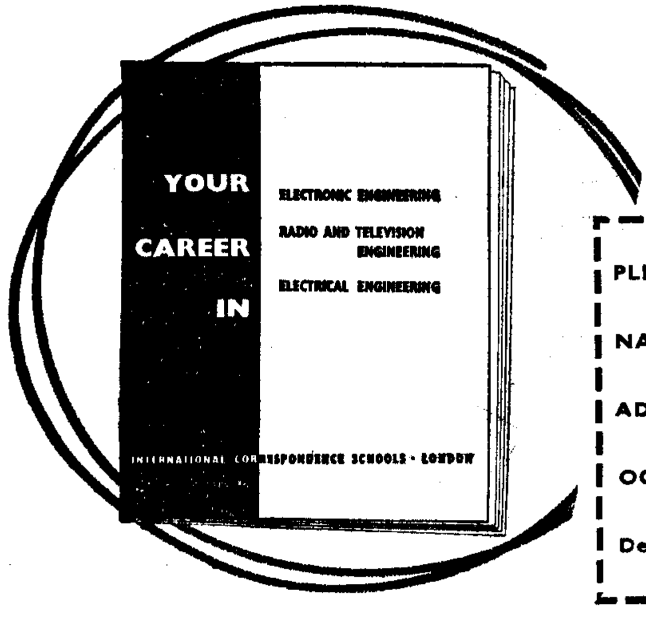

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PY82	7/-	UBC41*	8/6	X109	29/1	OC78	8/-
PY83	7/6	UBC81*	11/-	Y63	7/6	OC81	8/-
PY88	13/-	UBF80*	9/-	Z66	9/6	OC82	10/-
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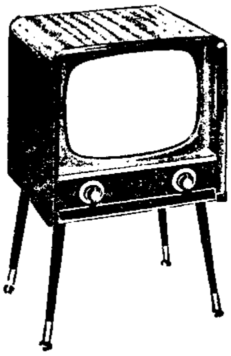

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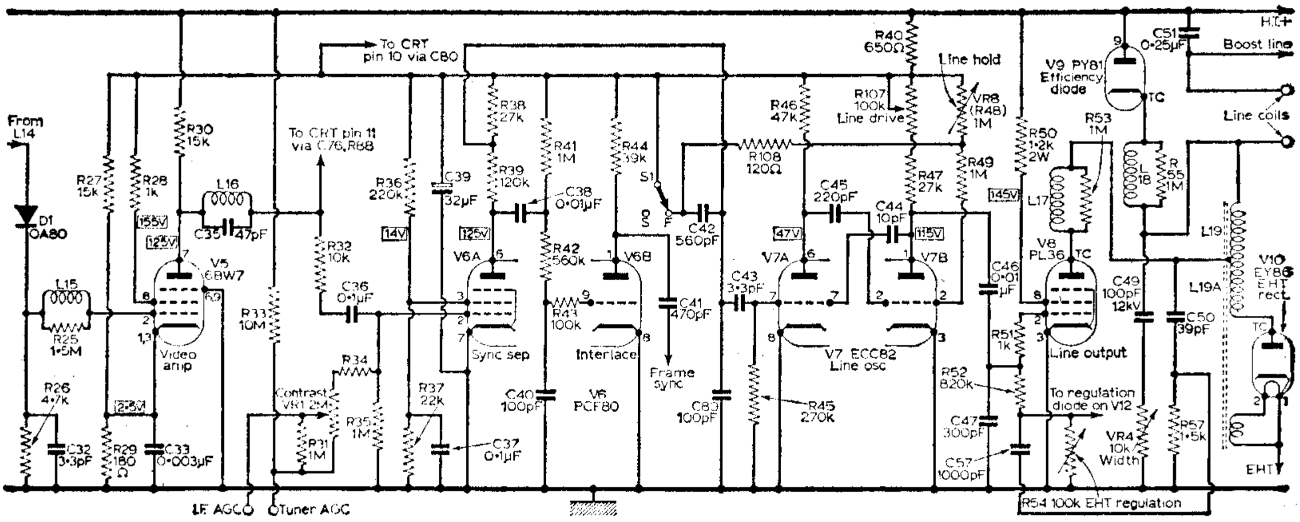


Fig. 3—The video, sync and line timebase stages of the circuit.

(Continued from page 210)

At operating current its d.c. resistance is extremely low.

White Horizontal Line

A white line across the centre of the screen, the remainder being blank, denotes complete collapse of the frame timebase. This should first direct attention to V15, but if this PCL82 valve is in order check the h.t. voltage to pin 6. If the voltage is absent it is virtually certain that the output transformer L37 is open circuited. If the voltage is present check at pin 9, which is the triode anode. This voltage should be about 165V.

If the voltage is absent altogether check the other end of the winding at the junction of C83, VR5 and R98. If the required voltage is present the winding (of the oscillator transformer) is open circuited. If the voltage is absent, however, check C83, which could well be shorted.

No Picture, E.H.T. Present

On occasions it may be found that if no raster can be resolved at all at any brilliance setting the e.h.t. may be in good order as evidenced by the normal line whistle, EY86 lighting up and a healthy spark at the tube anode. It is then that the operating conditions of the tube must be checked.

First see that the ion trap magnet is in the correct position on the rear of the tube neck. Then note the effect of briefly shorting pin 2 to pin 11. If there is a flash on the screen the bias conditions should be checked. The cathode, pin 11, voltage should be about 120V. That at the grid pin 2 should vary smoothly from 0-150V approximately.

If these voltages are about right check at pin 10 (first anode) which, if the timebase (e.h.t., etc.) is in order, must read about 390V. The only exception to this is when R93 (4·7kΩ) changes value due to a faulty focus control or shorted C80.

If all is in order here, check the position of the ion trap magnet more closely and ensure that the tube heater is dropping its correct voltage (6·3V a.c. normally). If the voltage across the heater pins 1 and 12 is much less than 6·3V, say 3-4V, sharply tap the neck of the tube. If the voltage reading varies up to 6·3V, even though it returns to the original reading, the heater is partially shorted. Sometimes it is possible to clear the short for a prolonged period by the method of tapping the tube neck.

Sometimes it will be found that the pin 11 voltage is considerably higher than 125V, perhaps nearer 300V. It can then be assumed that there is a first-anode to cathode leak. This may not be as serious as it sounds as the short can often be completely cleared by the simple process of shorting pin 11 to chassis.

A mild flash inside the tube will indicate that the short has cleared. If there is no clearance flash inside the tube and the timebase whistle changes do not keep the cathode shorted to chassis as damage may be inflicted to the timebase or at least to R93. If the short cannot be cleared remove the pin 10 lead and see whether the resulting dull picture is acceptable. If not the tube must be replaced.

It may be found that the pin 2 (grid) voltage is very low or absent. This results when C77 shorts to chassis or, when there is no voltage on the other side of R89, when the brilliance control is open circuited at the h.t. end.

(To be continued)

UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

BY ICONOS

THE BBC is getting naughty at forty. Caught up with the flood of the "new wave", it broadcasts on television and sound, material which would have shocked its original organisational architect, Lord Reith. In more and more programmes, standards in behaviour, courtesy, and even decency are thrown aside in a most unbecoming effort to be "with it" or "in the groove". Do-gooders, often earnest young clergymen, talk to teenagers on intimate subjects which are completely unsuitable for general broadcasting. Sneering satire of the most objectionable kind is given free rein. Psychologists are allowed to run riot. Dignity has been replaced with sick humour. The former high standards of presentation may at times have seemed a little stuffy, but Auntie BBC had a certain charm which seems to have slipped more than a little as she passes into her forties, with Mr. Carleton Greene as her consort. The middle-aged lady is having bouts of irresponsibility which are as unattractive as the babblings of an inebriated old witch. You often don't appreciate gold standards which are soundly based until you have a taste of the pinchbeck coin. I take back everything I have ever said which might have been critical of Lord Reith!

"Do-Gooders"

The ITA programme companies are not altogether blameless in matters of taste, even if they don't plumb the depth now reached on occasions by the BBC. The ABC-TV feature "Sunday Break", for instance, is an example of do-gooder broadcasting which, in the opinion of many, does more harm than good. People in charge of programmes which reach millions should bear in mind the guiding principles of the British Board of Film Censors, which are stated in its brochure to be:—

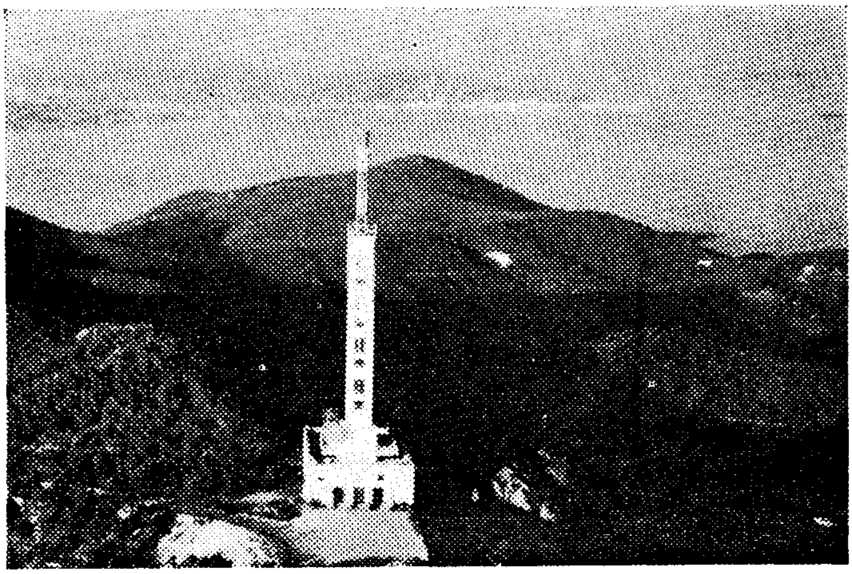
"Broadly speaking, the Board's aim is to exclude from public exhibition anything likely to impair the moral standards of the public, by extenuating vice or crime or by depreciating social standards, and anything likely to give offence to any reasonably-minded members of the audience".

The only trouble is that the British Board of Film Censors seems to ignore its own principles, thus becoming a mere hander-out of "X" certificates! The result of the lifting of the ban on "Lady Chatterley's Lover" has had an unfortunate effect on practically all media for the communication of ideas.

All writers and artists are anarchists at heart, and take advantage of unlimited licence, short of libel. Civilisation is like good engineering, dependent upon rules, regulations and codes of practice. Otherwise, there would be no speed limits, the air would be full of oscillations of jamming radio stations and the odour of unwashed humanity. We used to look up to Auntie BBC. Poor old dear, who respects her now? She was an unspecified standard at the British Standards Institution who has got off the groove.

I.T. News

W. H. O. Sweeney, the Chief Engineer of Independent Television News, gave the members of the British Kinematograph Society a fascinating glimpse into the complex operation of television newscasting. The paper he read before a crowded meeting of the Society in a private theatre, was copiously illustrated with excellent slides, and was rounded off with a sound relay from Television House of the intercom instructions, cues and corrections that went on behind the scenes during the presentation of the nine o'clock news. I have often seen rehearsals for the 5.55 news



The transmitter and aerial of this television station, near Cannes, France, was supplied by C.S.F.

at Television House, when chaos appears to reign supreme. News and film material continues to flow in during these last frenzied minutes. But at 5.55, the jig-saw puzzle of newscasting, film, commentary, music and what-have-you goes on the air with the astounding precision we all know. During the actual transmission items are added and deleted with lightning rapidity as the cool and calm director issues instructions to all via the intercom. The sounds of intercom at the B.K.S. meeting were reproduced on loudspeakers by the side of large monitors reproducing the "on air" transmission. The effect was fascinating, for some reason or other even more dramatic than being in the Central Control Room at Television House. The technical facilities at Independent Television News are a fine example of economical layout under cramped conditions and the recent improvements and enlargements are a great help. My only reservation is based on the thought that it might have been better to move to more commodious premises and started afresh. Proximity to Fleet Street is probably a main requirement, otherwise I would have thought that a section of the fine new ITA building in Brompton Road would have been ideal. I have the feeling that it won't be long before I.T.N. is once more bursting at the seams in its present premises, covering, as it now does, a very wide scope for Commonwealth and foreign exchange television news items.

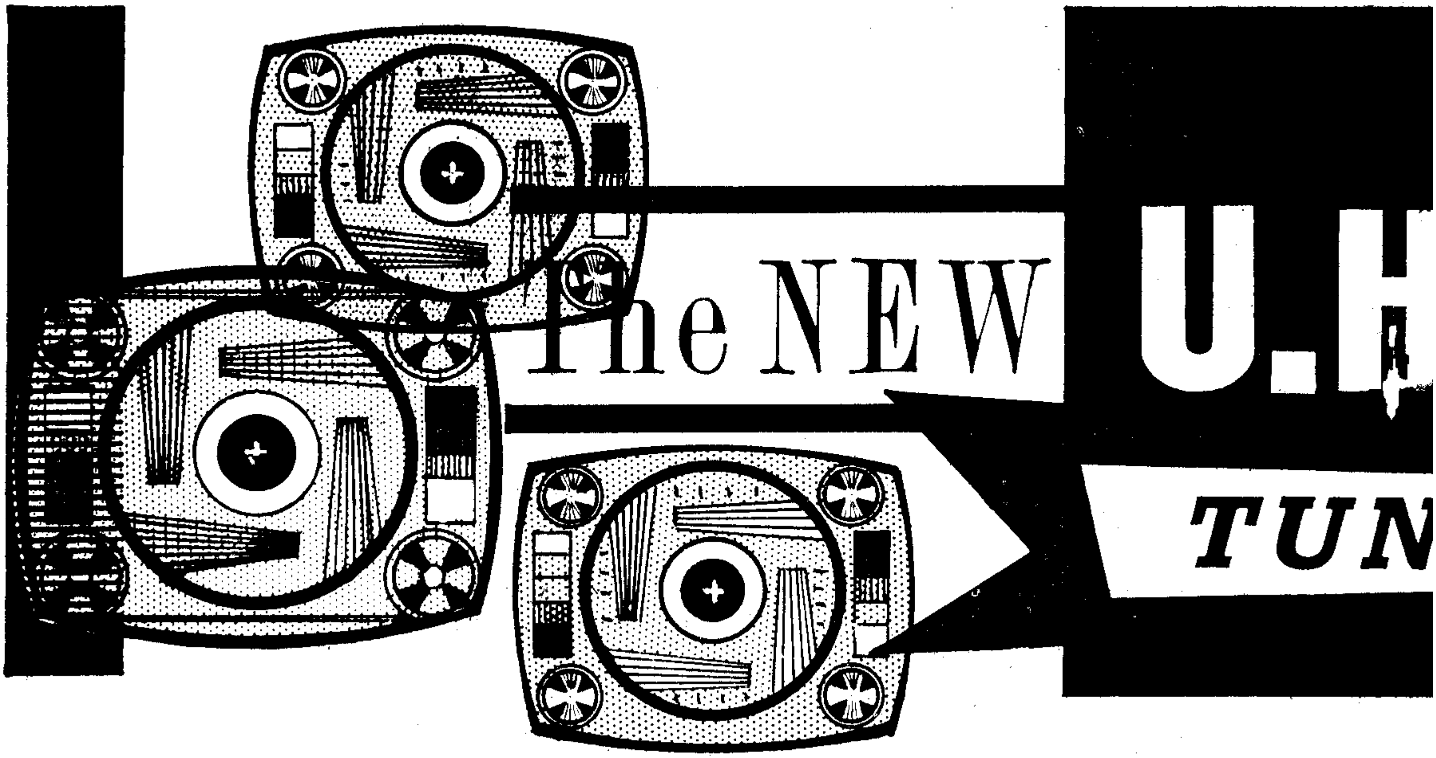
"Take Four"

A-R have been putting on a fascinating filler item, four minutes long, which mainly comprises film clips from the past age of the silent cinema. Sequences from old Hepwix comedies, newsreels and very dramatic dramas are shown with modern rock-and-roll musical accompaniment.

This, I think, is a mistake. A synchronised piano accompaniment from Arthur Dulay, the brilliant pianist of the British Film Institute, would be much more effective and appropriate, especially if the films were run at their correct speed—16 frames per second for old silent films, as compared with 25 frames per second for modern television film speeds. The only ITV station with this provision at the moment is Westward, who are able to show snippets from very ancient locally shot films correctly. They do this with a certain amount of the flicker which characterised the early cinema, but this shortcoming is in the process of being eliminated.

"Candid Camera"

Refreshed after being rested for some months, ABC-TV's "Candid Camera" team have been at work again, headed by producer Ronnie Taylor and that eminent practical joker Jonathan Routh. Ronnie Taylor recently addressed the Production Division of the British Kinematograph Society on the techniques used in "Candid Camera", which, from the technical point of view, have been much improved lately. Hidden cameras, remote controls, radio microphones, jokes which succeed (and those which fail) were all dealt with in a manner which had the crowded audience reacting in a way quite unusual for a learned society. At times they nearly fell off their seats with laughing after taking precautionary looks at each other to see that Jonathan Routh wasn't hiding amongst the audience. David Samuelson, the cameraman, explained the difficult conditions under which this series is shot, and excellent examples were shown on the screen of the flexibility of the new 10 to 1 zoom lens for obtaining head close-ups to cut in the long shots. He can accomplish the lightning change in less than three frames! This enables the film editor to cut out the zoom and present a continuity which appears to have been photographed with two separate cameras, one for long shots and one for close-ups. Arthur Bradburn, sound man, related the subterfuges and technical aids that had to be used to pick up the voices of the victims. Victims? That is the wrong word. Nothing is used without the full consent of the participants, who almost invariably enjoy the joke. In the latest batch of "Candid Camera" snaps I liked best the classic shot of two women holding a serious conversation with a parrot in a cage who was "in charge of the pet shop" during the absence of "the guv'nor". The transaction was successfully carried out and they bought their packet of bird seed to the satisfaction of everybody, including the parrot and Jonathan Routh, whose squawks and suitably adjusted voice were reproduced on a loudspeaker under the cage. "Funny!", said one woman, "I didn't see the parrot's beak move, did you?" "No", replied the other knowledgeably, "some of them hardly move their mouths—just like ventriloquists". How right she was!



The NEW U.H TUN

By K. Royal

TUNERS designed for the new u.h.f. channels differ considerably from those which we have been used to on the v.h.f. channels on Bands I and III. The difference in design is brought about by the extremely high frequencies associated with the channels of Bands IV and V, for while Band III goes a little above 200Mc/s Band V goes up to the 900Mc/s region.

If we examine a Band III coil of a turret v.h.f. tuner, for example, it will be seen that a channel 12 or 13 coil pair has just two or so turns of wire. Clearly, then, only a fraction of a turn would be required for Band V, and even then the inductances of the connecting wires and the internal capacitances of the circuit would make it virtually impossible to tune to u.h.f. channels.

There would also be many problems associated with contact resistance between the studs on the coil biscuits and the connecting springs. In short, the conventional turret tuner as we know it today would be totally unsuitable for tuning the u.h.f. channels. The same also applies to incremental tuners, so it is pointless for the experimenter to attempt to modify such tuners for the new u.h.f. channels.

New Approach

There has been an entirely new approach to the design of u.h.f. tuners, for instead of employing switched coils, " resonant lines " are used, and these are continuously tuned over the available u.h.f. channels by means of a ganged variable capacitor assembly.

Mullard Limited has recently developed a u.h.f. tuner of this kind for set manufacturers, and Cyldon also have a similar type of unit. Two valves are used which have been specially developed for u.h.f. service. They are both triodes of the frame grid construction, giving high values of mutual conductance, low inter-electrode capacitances and excellent noise figures. That used as the r.f. amplifier is a type PC88 and the other, which is employed in a self-oscillating mixer circuit, is a type PC86. These valves are well worth remembering as we shall be hearing quite a lot about them in the future.

What are Resonant Lines?

A resonant line, sometimes called a " lecher wire " or " trough line ", has much in common with a tuned half-wave dipole. Indeed, like a dipole, it is just a length of metal rod or strip. The length determines the frequency at which it works—just the same as a dipole.

Now, when the " electrical " length of the line is adjusted to correspond to the half wavelength of a signal, the signal current in the line is at maximum in the middle and at a minimum at each end, while the signal voltage is at minimum in the middle and at a maximum at each end, as shown in Fig. 1. For those who have had anything to do with the theory of aerials, it will be recalled that this is exactly the same as the current and voltage distribution in a tuned half-wave dipole.

Here, then, we have a means of tuning a signal

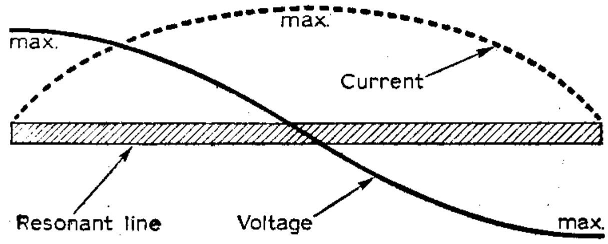
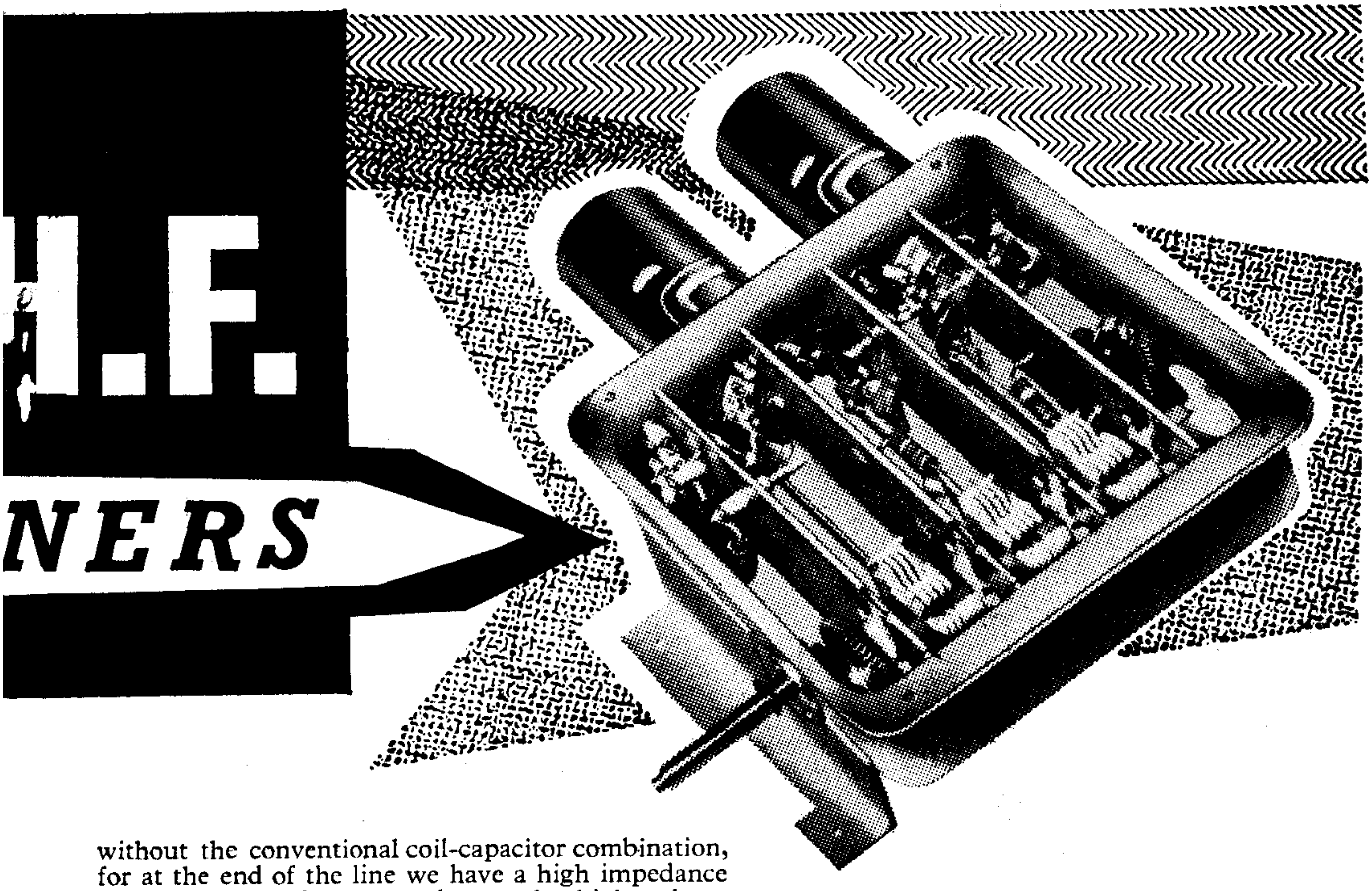


Fig. 1—Tuning is accomplished by means of a resonant line, and the effective half wavelength is varied by means of a tuning capacitor. The diagram shows the voltage and current distribution in such a line at resonance.



without the conventional coil-capacitor combination, for at the end of the line we have a high impedance at the resonant frequency due to the high voltage and low current factor. If this is applied to a high impedance circuit, such as a valve grid or anode circuit, maximum signal transfer will occur only when the length of the line corresponds to one half of the signal wavelength. With a parallel tuned circuit, it will be remembered, maximum impedance occurs only when the circuit is resonated by the signal—which is really the same thing as with a resonant line.

All this is very well at one particular frequency, but one may well ask how variable tuning of a resonant line is achieved. One way, of course, is immediately apparent — simply by altering the length of the line. At ultra high frequencies this is barely a practical proposition, particularly when four tuned circuits need to be ganged. Length is highly critical, and even a slight alteration in length due to temperature change of the oscillator resonant line could be sufficient to swing the oscillator partially off the tuned u.h.f. channel. Similar changes in length of the resonant lines associated with the aerial and r.f. stages could impair both sensitivity and definition of the picture. Due to this some u.h.f. tuners have resonant lines composed of a plated alloy which is endowed with a very low coefficient of expansion. Thus, the difficulties associated with adjustable lines are now apparent.

Capacitor Tuning

Fortunately, the "effective" length of a resonant line can be altered by means of a variable capacitor.

> *The u.h.f. tuner shown on the cover is an Ekco model, and that illustrated in the heading of this article is made by Cyldon.*

One end of the line is connected to the valve or other circuit, while the opposite end is connected to a small variable capacitor. An earthed-grid r.f. amplifier using this idea is shown in Fig. 2. It is interesting to compare this with a similar amplifier circuit using ordinary coils for tuning, such as that in Fig. 3.

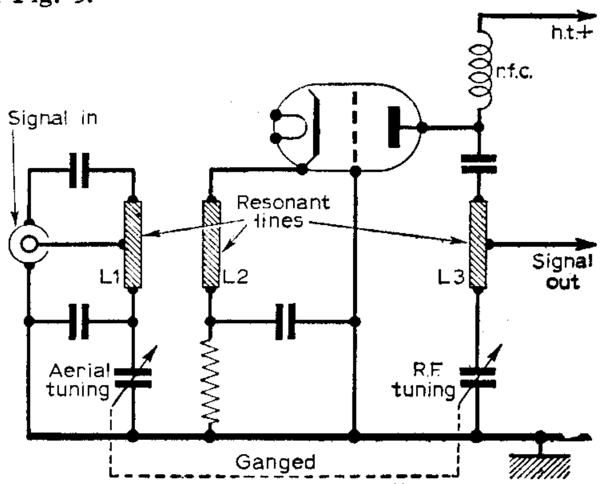


Fig. 2—An earthed-grid r.f. amplifier using resonant lines instead of the more conventional tuned circuits.

Now we have the principle of resonant lines clear in our minds, it will be understood that they can be used to replace ordinary tuned circuits in almost any section of a receiver or r.f. amplifier and oscillator. Actually, of course, they are only of practical use in ultra high frequency circuits where the lines can be made of usable length.

CONTINUED OVER

A half wavelength at, say, 800Mc/s is only about 7in., while at 200Mc/s it is about 28in. Coupling between resonant lines is possible inductively, as between L1 and L2 in Fig. 2, and the degree of coupling can be altered by arranging slots in a screening between the two circuits. Alternatively, the signal output from a resonant line can be taken from a tap at a suitable impedance point on the line, as is done on L3 in Fig. 2. At the centre of the line the impedance is low and rises to a maximum at either end.

A Practical Tuner

The circuit diagram of one version of the Mullard tuner is given in Fig. 4. Here we have the PC88 acting as an earthed-grid r.f. amplifier, with the signal applied to the cathode via three tuned circuits, L1, L2 and L3. L1 is little more than just a critical section of the screening, determined by the placing of the 3pF and 1·5pF trimmers. The signal from the aerial is coupled to the centre point of L1 and from here it is coupled to the resonant line L2 through the capacitors mentioned above.

The signal is further coupled to L3 which is in the cathode circuit of the valve. This rather elaborate arrangement is necessary to avoid L2, which is tuned by C1 section of the gang, from being too heavily damped by the aerial and the cathode circuit of the valve and, although the damping is relatively high there is, nevertheless, a useful contribution to the overall pre-mixer selectivity of the tuner. Earlier u.h.f. tuners had no variable tuning here and as a consequence suffered from poor selectivity, which resulted in insufficient second-channel (image) rejection.

The grid of the PC88 is earthed from the signal point of view direct to a screen and the amplified signal is developed across the resonant line L6 in the anode circuit, this being tuned by C22 section of the gang. C3 is simply a coupling capacitor, while L4 is an r.f. choke to feed h.t. to the anode of the valve without damping the signal.

The signal across L6 is extracted from a suitable tap and fed to a bandpass resonant line section, L7, via L30, with the bandpass section being tuned by C23 of the gang.

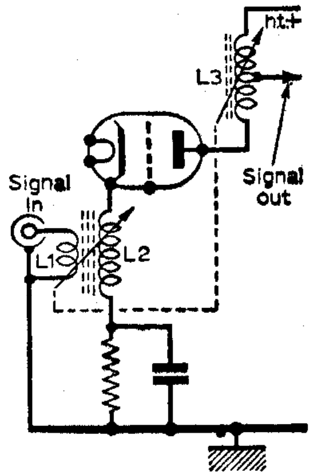


Fig. 3—The equivalent of Fig. 2, but here dust-iron coils are used instead of resonant lines.

This, then, pretty well takes care of the r.f. stage, it being remembered that the three variable tuned circuits are necessary to ensure adequate pre-mixer selectivity.

The Mixer Stage

The PC86 operates as the self-oscillating mixer, this also being arranged in the earthed-grid mode. The resonant line L9 forms the oscillator tuning, with C24 as the gang section. The oscillator can

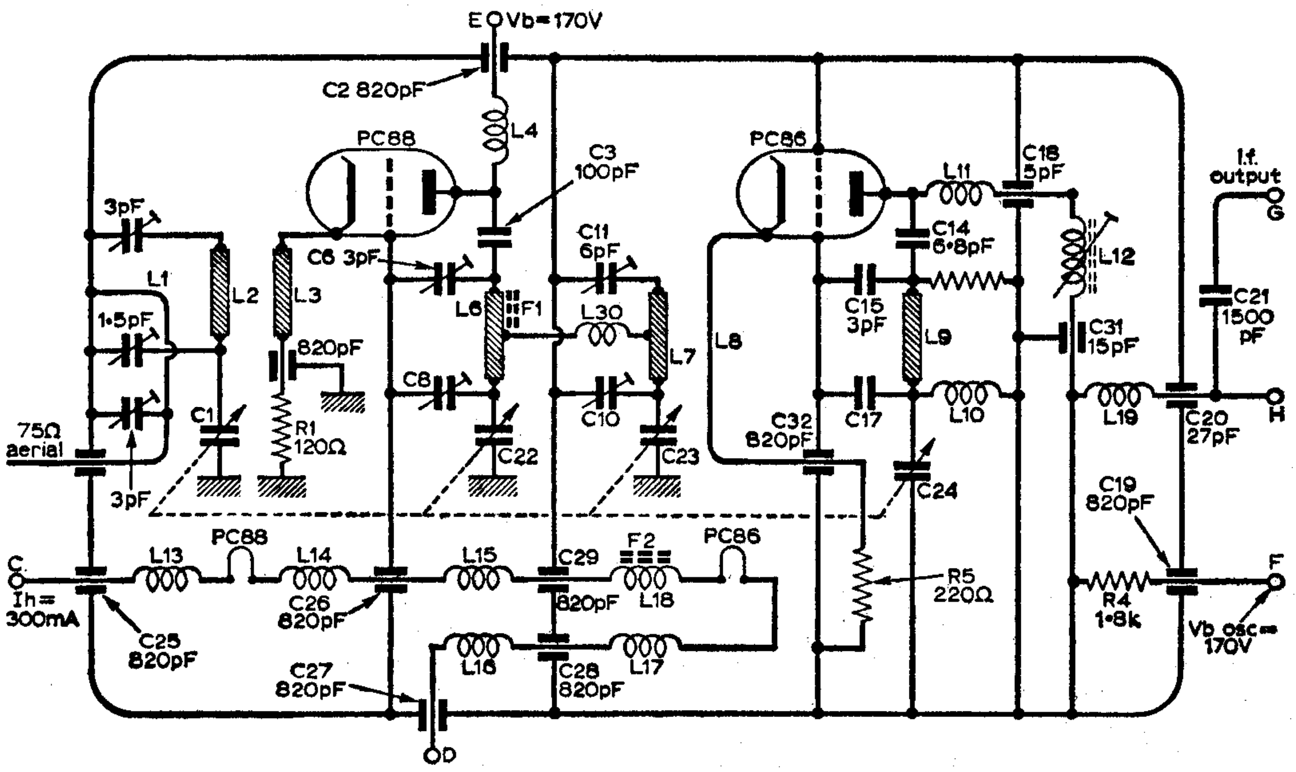


Fig. 4—The circuit of the new Mullard u.h.f. tuner, type AT6360/02. Type AT6361/02 incorporates a circuit for the automatic control of the oscillator frequency, otherwise it is the same as that shown.

be reduced to a Colpitts circuit of fairly conventional make-up, and the signal across L7 is coupled to the cathode of the stage via a loop L8.

The oscillator and u.h.f. signals in the mixer thus heterodyne in the usual manner and i.f. signals are developed in the anode circuit. These are filtered out by L11, L12, which is the i.f. coil, and L19, along with the associated capacitors. The arrangement is rather like a low-pass filter which lets through the i.f. signals but blocks the oscillator signal.

The frequency of the local oscillator in relation to the incoming signals is such to produce sound and vision i.f.'s of 33·5Mc/s and 39·5Mc/s, this now being accepted as "standard" for British 625-line receivers. The sound i.f. is really the true i.f., for in the sound channel proper a 6Mc/s i.f. is adopted, this being the difference between the sound and vision i.f. carriers. This, of course, is when intercarrier sound is adopted, as it is on the majority of models.

The Mullard u.h.f. tuner has a continuously variable range from 470 to 862Mc/s in Bands IV and V, which is accomplished by the four-gang variable capacitor. A geared-down drive (1-to-5·4) is coupled to the spindle of the gang, and a simple drive cord and tuning scale calibrated in channel numbers is used in conjunction with the tuner on dual standard receivers.

As a means of maintaining optimum tracking over the entire tuning range, small trimmers are connected at each end of the resonant lines, such as C10 and C11 in Fig. 4. The trimmer near the tuning gang section of the line acts rather like a padder in an ordinary radio receiver, and is adjusted for optimum sensitivity at the low-frequency end of the band, while the trimmer at the opposite end of the line is for optimising the sensitivity at the high-frequency end of the band.

The tuner has an overall gain between 20 and 25dB for an i.f. bandwidth of 7Mc/s, while the noise figure is around 12·5dB at the low-frequency end of the band, rising to 14·8dB at the high-frequency end.

Another model tuner by Mullard incorporates an automatic frequency-correction circuit. This takes the form of a reversed-biased silicon diode connected across the oscillator circuit. Since the capacitance of this diode can be caused to change by altering the bias voltage, a means of frequency correction is possible by deriving the bias from a discriminator circuit in the receiver proper. Thus, any tendency for the local oscillator to drift results in a correction voltage from the discriminator, which in turn alters the oscillator frequency in such a way as to restore the tuning. ■

THE ABC OF TV CIRCUITS

(Continued from page 207)

A.G.C. Filtering

All a.g.c. lines need to be adequately filtered to prevent the picture signal and sync pulses from affecting the controlled valves. The chief filtering elements in Fig. 33 are the 0·5μF capacitor C2, R7, R2, C4 and C3.

Failure of one of the resistors would cut off the a.g.c. bias and possibly cause the control grid of the controlled valve to give the symptoms of open-circuit. Thus, the vision gain would be very high—possibly outside the influence of the contrast control —and a very bad hum bar would appear across the picture. A short in one of the capacitors would give the same symptom without the hum bar, and the contrast control would not work at all. An open-circuit in one of the capacitors would cause a vertical, dark shading effect on the left-hand side of the picture.

Filter elements in Fig. 34 are C2, C1, C3, C4, R1, R2 and R3.

Video Contrast Control

A system of contrast control which is becoming popular in the dual standard sets is shown in Fig. 35. Here the contrast control is connected in parallel with the load of the video amplifier valve. In effect, then, the video signal appears across the resistive element of the control and the slider taps the required level to the cathode of the picture tube. Frequency correction is given to the signal by C1 connected across a tapped section of the contrast control, while d.c. attenuation is introduced into the coupling to the tube cathode by R1 and C2 (see under "The ABC of TV Circuits", in the September 1962 issue).

The potential-divider consisting of R2 and R3 ensures that the d.c. voltage conditions at the tube cathode are held substantially constant over the range of contrast control adjustment. This, of course, is to avoid having to reset the brightness control each time an adjustment is made to the contrast control.

Receivers with this type of circuit also incorporate an automatic contrast control circuit, possibly operated from the sync separator stage, as distinct from the so-called "gated" systems used mor frequently when vision a.g.c. was first introduc into British receivers.

(To be continued)

SERVICING DATA AND MODIFICATIONS

By D. Elliot

(Continued from page 155 of the January issue)

NOW that the majority of the country is adequately covered for almost service-area television, the old-style receiver employing flywheel line synchronising is often more trouble than the complicated and temperamental sync system is worth.

Flywheel line sync was first introduced about a decade ago when many receivers out of necessity had to operate on next to no aerial signal. The picture was, therefore, extremely "grainy" and the "noise" producing this symptom also found its way into the line oscillator along with the sync pulses. Thus, in addition to bad grain, the vertical parts of a picture used to have ragged edges owing to the noise triggering the line timebase in a somewhat random manner.

The flywheel feature of the sync circuit introduces a kind of momentum into the line oscillator, thereby endowing it with the property to run at almost the correct synchronised speed for a short while even in the absence of sync pulses. The effect also irons out any irregularities due to noise on the tips of the line sync pulses, for the circuit tends to average the sync pulses over a number of lines and use the resulting voltage to hold the line oscillator at the correct frequency.

Unfortunately, the early flywheel circuits were prone to a number of faults, they were difficult to set-up correctly and they used to respond to certain adverse characteristics of the received signal to which the conventional type of line timebase was immune.

Eventually, manufacturers realised these field troubles and produced two types of set—one with conventional sync for service areas and the other with flywheel sync for fringe areas and locations of high interference level. It must be recorded, however, that certain circuits embodying the flywheel feature and later flywheel systems—apart from their extra complexity—are equally as reliable as their direct-sync counterparts. This, of course, also applies so far as the very latest circuits are concerned, for many dual standard models have flywheel line sync either as a regular feature on both standards or switched in on 625 lines only. Indeed, flywheel sync is highly desirable on the negative-going vision modulation of the 625-line system to cope with the noise on the positive-going sync pulses and the more fringe-area-nature of the u.h.f. signals.

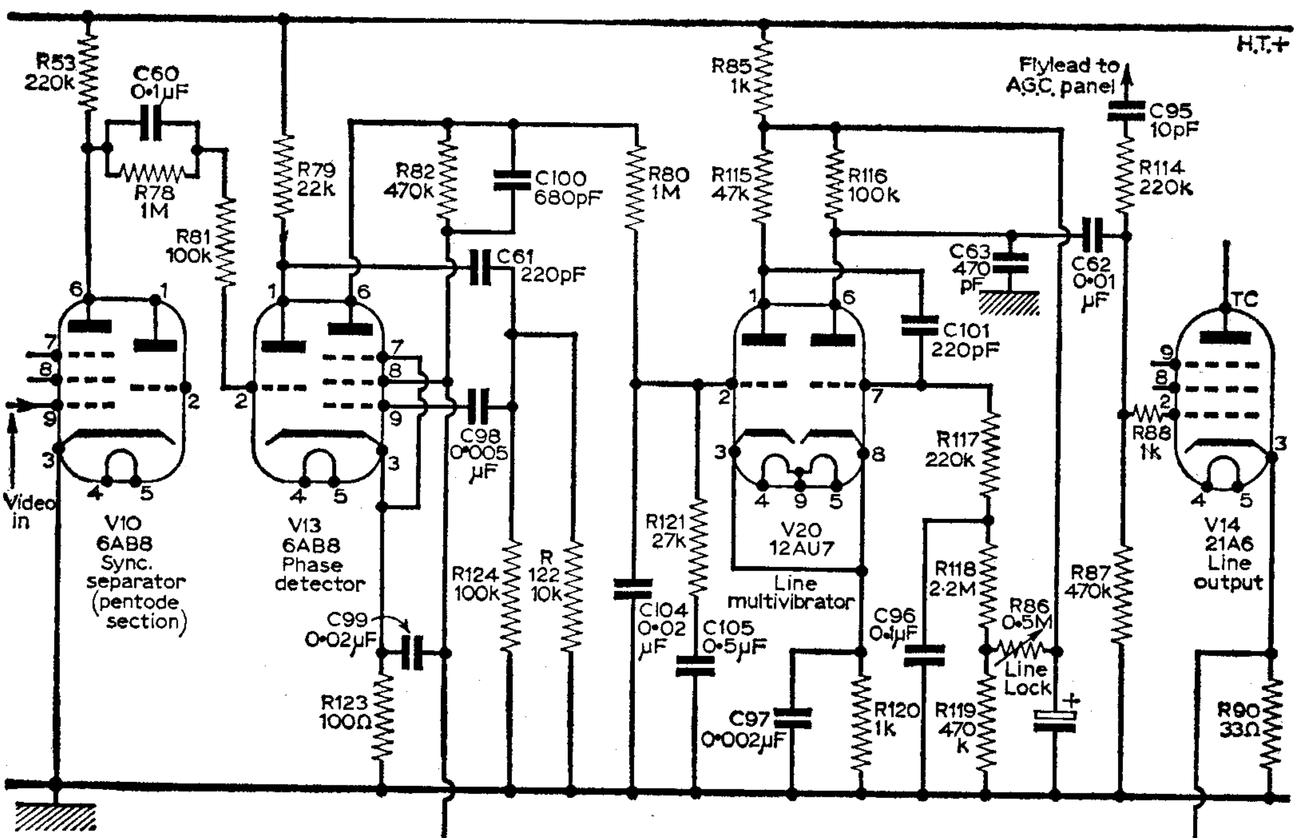


Fig. 51—The flywheel line sync circuits of the Cossor models 937, 938F and 939F.

As there are many old-style receivers with flywheel sync still in operation and many more still on the second-hand and surplus markets, details of how the flywheel sync may be replaced by conventional direct sync will undoubtedly be of interest.

It will be recalled that old flywheel sync systems are subject to residual phase modulation on the transmitted signal. This causes bending and twisting of the picture verticals, an effect which, while absent during certain programmes, may occur during the advertisements or outside broadcasts—or the trouble may clear on advertisements, depending upon the type of receiver and the characteristics of the transmission.

Another typical defect is that the line oscillator will suddenly unlock on the burst of interference or on a channel change, thereby requiring very careful re-setting of the line lock control. Drift in associated valves and components can instigate the trouble after the set has been working satisfactorily for an hour or so.

Cossor Models

Cossor models employing flywheel sync are 937, 938F and 939F. The appropriate circuit section is shown in Fig. 51, and here the pentode section of the 6AB8 (V13) is a phase detector, while the 12AU7 (V20) is employed as the line timebase multivibrator.

Sync pulses are fed from the sync separator to the grid of the triode section of V13 through C60, R78 and R81. This triode both amplifies and reverses the polarity of the line sync pulses. The resulting positive-going pulses at the triode anode are then applied to the control grid of the pentode section of V13 through C61 and C98. The screen grid of the same valve also receives line pulses as developed across the cathode resistor (R90) of the line output valve V14. Now, the mean voltage at the pentode anode is governed by the relative phase of the sync pulses applied to the control grid and the line pulses applied to the screen grid. When these two signals are in step (or phase) the voltage reflected from V13 pentode anode to the grid of the first triode in the line multivibrator (V20) is such that the line frequency is correct for optimum lock. However, should the line frequency tend to drift, the resulting phase difference between the sync pulses and the line pulses alters the voltage at V13 pentode anode and at the grid of V20 in such a way that the line frequency is corrected and line lock is automatically restored.

Direct-sync Modification

The circuit at Fig. 52 shows how the line timebase section can be altered in the Cossor models to direct sync. It will be seen that the phase detector is eliminated. In fact, this now becomes the line multivibrator (still V13) and the 12AU7 (V20) is no longer required.

V13 needs to be completely rewired, as also does the line sync feed circuit from the anode of the sync separator to the line multivibrator. Also note that the cathode resistor of V14 is decreased from 33Ω to 10Ω.

Cossor models 937, 939 and 393F have vertical hold, height, horizontal hold and contrast controls mounted on a panel on the side of the cabinet, while models 939 and 939F also have the tuner turned through a right-angle and mounted on the opposite end of the chassis, the sub-base-

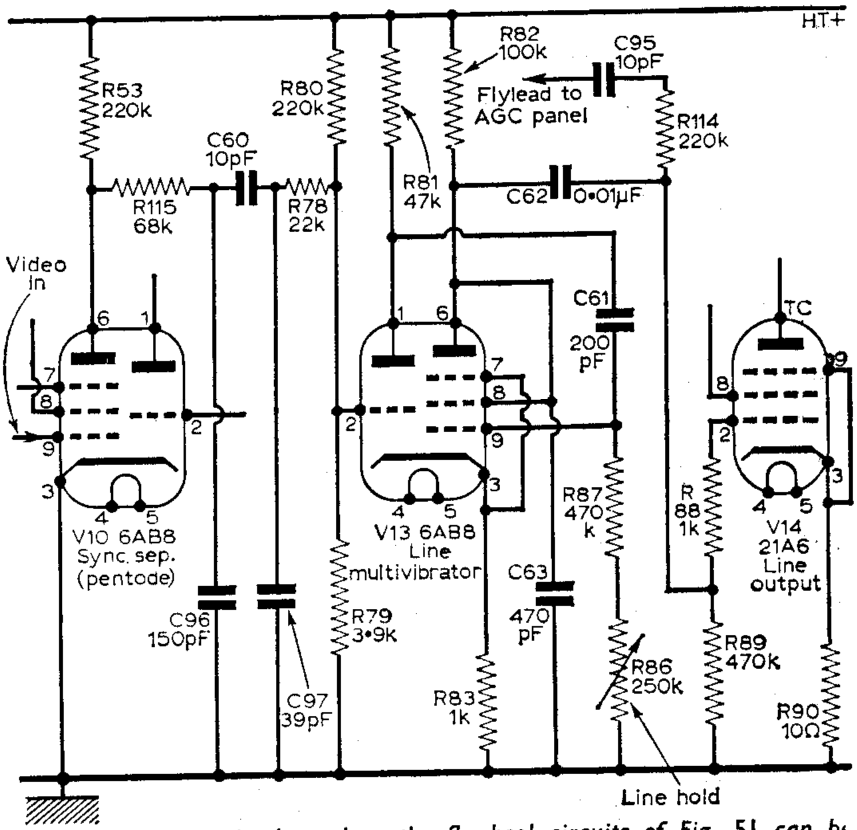


Fig. 52—This circuit shows how the flywheel circuits of Fig. 51 can be replaced by direct sync.

board being omitted.

In the modified circuit V13 operates as a simple cathode-coupled line multivibrator, with the pentode section of the valve being strapped as a triode. The line frequency is controlled by varying the time-constant of the pentode section by means of the line hold control (R86), while the stage is locked direct to the sync pulses by the coupling from the anode of the sync separator to the grid of the first multivibrator triode.

Ferguson Models

Ferguson models employing flywheel line sync in one series are 991T, 990T, 993T, 995T and 997T. Many of these receivers are still in use and available on the surplus and second-hand markets, but the method of conversion to direct sync is not very well known.

The circuit of the flywheel system is given in Fig. 53 which, as will be seen, is rather complicated. The line oscillator (V16) adopts cathode feedback

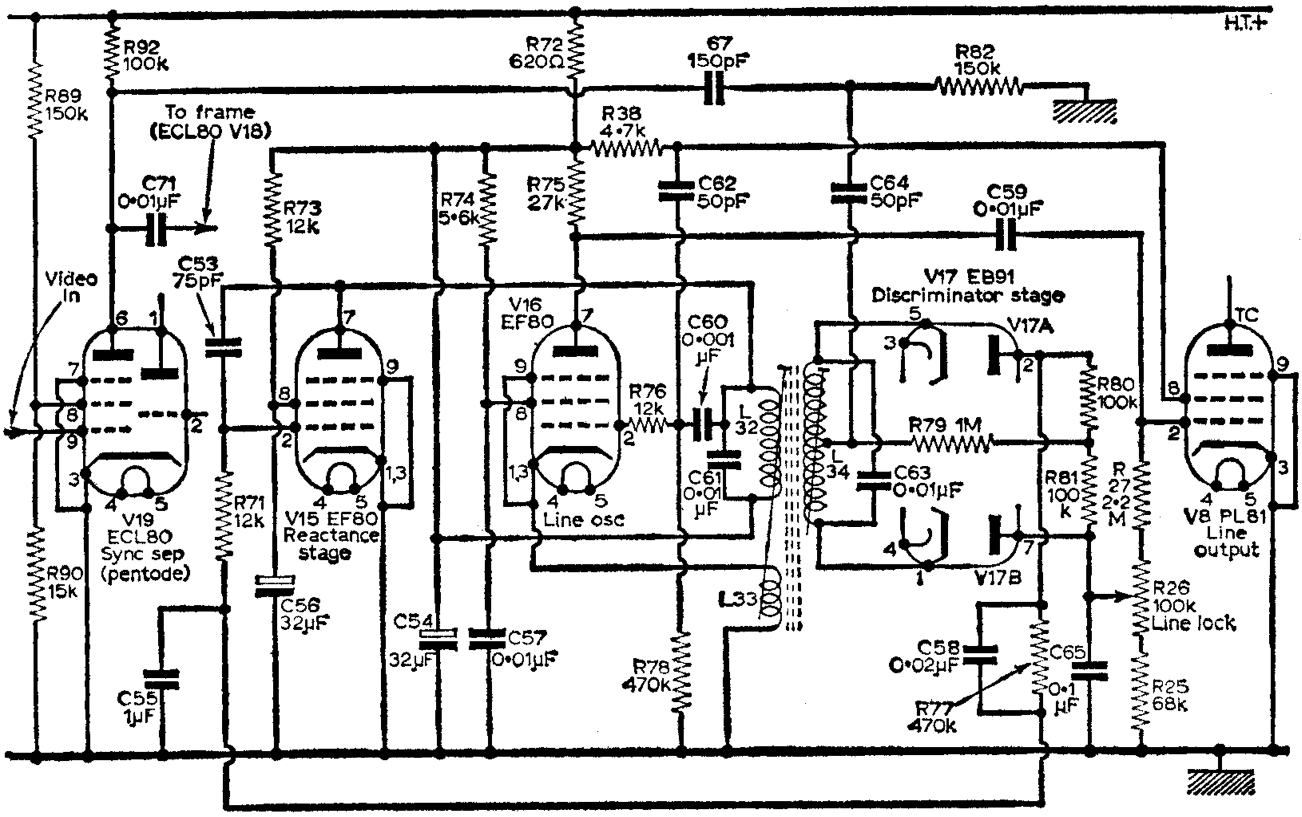


Fig. 53—The line flywheel circuits of the Ferguson 990T, 991T, 995T and 997T receivers.

with electron coupling to the anode circuit. The sinusoidal oscillatory voltage is given a square-wave character by a suitable choice of the screen and anode resistors, the signal then being suitable for direct application to the control grid of the line output valve V8.

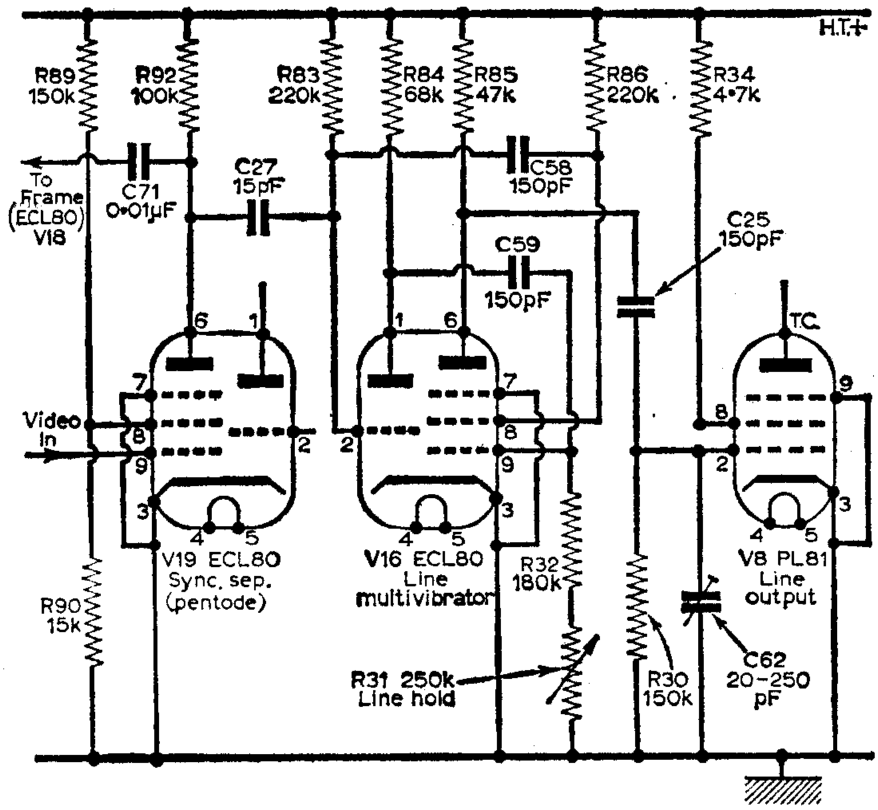


Fig. 54—This circuit shows how the flywheel sync of the Ferguson series may be replaced by direct sync.

The frequency of the line oscillator is controlled by the reactance valve V15. This looks to the oscillator circuit as a capacitive reactance whose value depends upon the voltage at the control grid. Thus, by altering V15 grid bias the oscillator frequency is altered correspondingly.

Control bias for V15 is derived partly from the line lock control R26 and partly from the phase discriminator stage V17. The discriminator stage is in receipt of two signals—the sync pulses via C67 and C64 and the line signal via the coupling between L32/33 and L34. Now, when the phase of these two signals matches, the current in the two diode sections of V17 is equal and the voltage across the loads R80 and R81 is also equal. The voltage across the two loads is added in opposition, which means that when the line oscillator is in step with the sync pulses, zero voltage is applied to the control grid of the reactance valve V15 through R77.

However, should the oscillator tend to drift away from the sync pulses, then the condition of

(Continued on page 228)

IDENTIFYING AND TRACING

INTERNAL INTERFERENCE

BY T. S. SMITH

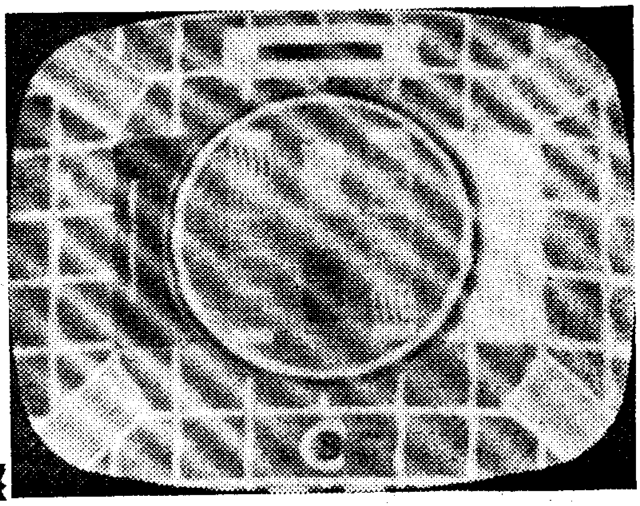


Fig. 1—Pattern interference of this kind is caused by an interfering r.f. signal beating with the vision carrier or i.f.

TELEVISION interference on both sound and vision can be caused by some form of electrical machinery or electrical equipment, external to the receiver, producing interference signals which are acceptable by the receiver. This type of interference is usually termed "external interference" since the interfering signals are propagated either by normal radiation or through the mains supply system and picked up along with the wanted signals by the television receiver.

Another type of interference occurs due to a fault or some shortcoming in the receiver proper, and is usually called "internal interference". Internal interference of this kind can affect both sound and vision and is sometimes present only on sound or vision. This article is concerned only with internal interference, but before it can be cured it must be localised and before this can be done one must be sure that, in fact, the interference is internal.

As with external interference, internal interference can produce crackles on sound and white spots and bright dashes on the picture. It can also produce whistles on sound and drifting, shaded patterns on the picture. The former is called "impulsive interference" and the latter "radio-frequency (r.f.) interference".

Interference Check

If the sound is disturbed by random, staccato clicks or plops continuously and the vision is affected by random bright spots in no particular pattern formation, the set should be left in the existing conditions or adjustment and the aerial should be removed from the aerial socket. This operation will, of course, cause both the sound and picture to go off, but if the sound and vision interference effects remain, then one can be fairly sure that the trouble lies in the set itself.

If the strength of the interference effect decreases considerably when the aerial is removed, it could still be external interference since the aerial socket and associated first-stage wiring may be picking up sufficient interfering signal to cause the effects in smaller degree, but insufficient wanted signal to give picture and sound.

The next move is to short-circuit the aerial socket with the aerial removed. If the residual interference is now totally suppressed the set may well be free from blame. But even now we cannot be absolutely sure of this, as certain faults in the set produce interference which is radiated and which gets back into the set by pick-up on the first stage circuits. It is most important to have this in mind when investigating for interference in general.

Even if by adopting the foregoing procedure one still cannot be sure whether the interference is external or internal, the most conclusive test is to try another television receiver positioned as per the affected receiver and using the same aerial and power supply point. If there is no interference on this test set, then, of course, the original set is definitely faulty.

It usually follows that external interference affects more than just one set in the neighbourhood, so it would be well worth while to call on the next-door viewer to see whether or not he is experiencing similar interference effects, having in mind that the strength of the interfering signal (if external) may be weaker or stronger next door, depending upon the type of receiver, the aerial system and the location of the interfering source in relation to the aerial.

Another point worthy of note is that internal interference produced by a television receiver may affect not only that receiver but also other receivers operating nearby. So if the tests point to such a possibility the suspected receiver should be switched off and then a second test of interference made.

Pattern and Whistle Interference

The interference which causes patterns on a picture is of the same kind as that which produces whistles on sound. It is, in fact, an r.f. signal carrier signal. The interfering r.f. and the wanted carrier beat together and produce a third signal which causes the trouble. This has a frequency which is the difference between the carrier and the r.f. signals, and arises after the detector and is thus present in the a.f. or video stages along with the sound or picture signals.

Let us suppose that the interfering r.f. is, say, 5kc/s away from the sound carrier or sound i.f. signal. This 5kc/s signal appears after the detector and is amplified by the a.f. stages and gives rise to a 5,000c/s whistle in the loudspeaker—superimposed on the normal sound. If the interfering r.f. is 5kc/s away from the vision carrier or i.f. signal, the resulting 5kc/s signal at the output of the vision detector will "look" to the video amplifier and picture tube rather like component parts of an ordinary picture signal, and will thus get through to the tube along with the wanted picture signal. This results in the familiar pattern effects on the picture, as shown in Fig. 1.

If the frequency difference in the sound channel is outside the audio spectrum (in excess of, say, 15kc/s), then, of course, it will not be heard and it may have no effect at all on the sound reproduction. This is not so in the video channel, however, for this responds almost up to 3Mc/s, and so as long as the difference frequency falls within this passband some form of patterning will occur.

At low difference frequencies the shaded patterns on the picture are fairly wide and heavy and occur horizontally or diagonally across the tube, but as the difference frequency increases towards the limit of the video passband the pattern lines become narrower and more towards the vertical. At the extreme of the video passband, the patterning melts away and the horizontal scanning lines break up into small dashes or dots—a disturbance which does not help the horizontal definition of the picture.

On the receivers with an extended video response, the 3·5Mc/s beat between the sound and vision carriers tends to cause dot interference on the picture, but is usually avoided by a tuned 3·5Mc/s rejector circuit connected in the cathode of the video amplifier valve (Fig. 2). This deadens the response of the video amplifier at 3·5Mc/s in the same way as sound rejectors attenuate the sound signal in the vision i.f. channel.

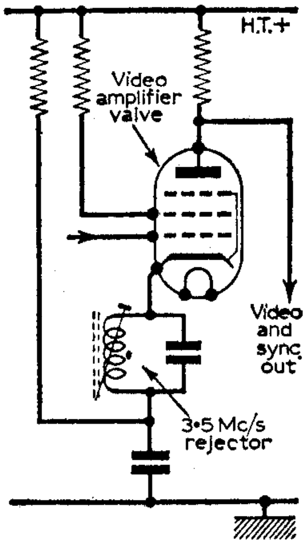


Fig. 2—A 3·5Mc/s tuned rejector circuit is sometimes connected in the video amplifier valve cathode circuit to suppress the dot effect which may otherwise result from the beat between the sound and vision carriers.

Radio - frequency interference sometimes arises in the set itself due to some sort of defect, but it is chiefly caused by an external signal. It rarely confines itself to just one location and is fairly widespread in its manifestation. Thus, one can often tell whether it is external or internal by checking with neighbouring viewers. It should be remembered, though, that if external it may not be near the vision carrier frequency, for it could be accepted by any spurious response of the receiver, such as at i.f., image frequency (e.g., second channel) or via some other more subtle response which may or may not exist on receivers of different make and model. The qualification for pattern interference, then, is that ultimately by some means or other the interfering signal must cause a beat with the wanted carrier to produce a signal whose frequency is acceptable by the stages following the detector.

It is not possible to check for pattern interference by removing the aerial, for then the carrier is eliminated and the interference has nothing to beat with. If the trouble is in the set, more often than not the pattern formation alters by moving the position of the aerial downlead at the back of the set and by adjusting the contrast control. In some cases of a set fault, the pattern effect (or whistle) may occur only when the contrast control is advanced beyond a certain point.

Causes of Internal Interference

Internal interference of the impulsive kind arises chiefly from trouble in the e.h.t. circuits of the

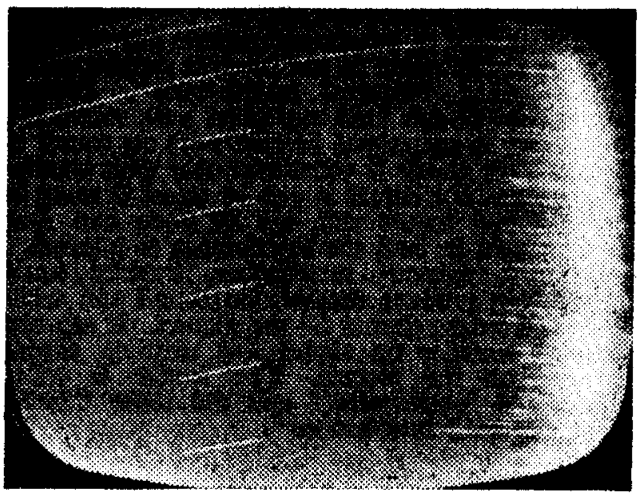


Fig. 3—Interference on a raster due to a discharge of pulse voltage in the line output stage.

RADIO BARGAINS

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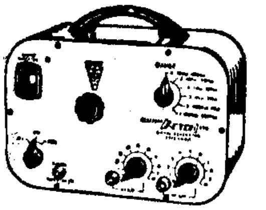

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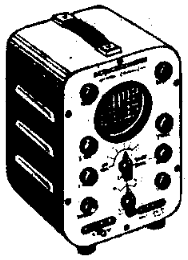

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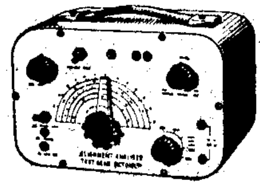

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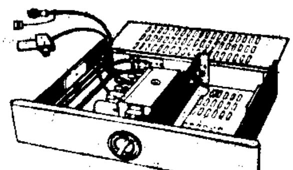

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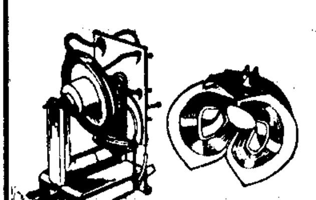

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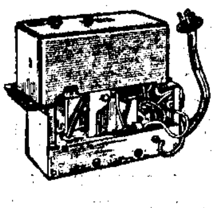

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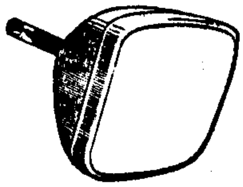

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receiver. Poor insulation between the windings of the line output transformer is a classic cause of the trouble. Although the winding insulation may be adequate from the h.t. line voltage point of view and during the line scanning period, flashover or corona results from the poor insulation during the line flyback period, when the pulse voltage across the windings is at a maximum.

Corona or flashover is sometimes visible by observing the line output section while the set is operating in a darkened room. Mostly, though, its presence is revealed only on a picture or synchronised raster, as shown in Fig. 3. Here the effect takes the form of a vertical column or irregular, white dashes or flashes on the right-hand side of the screen. The disturbance may, in some cases, occur on the left of the screen, but in either case when the interference is caused by the discharge

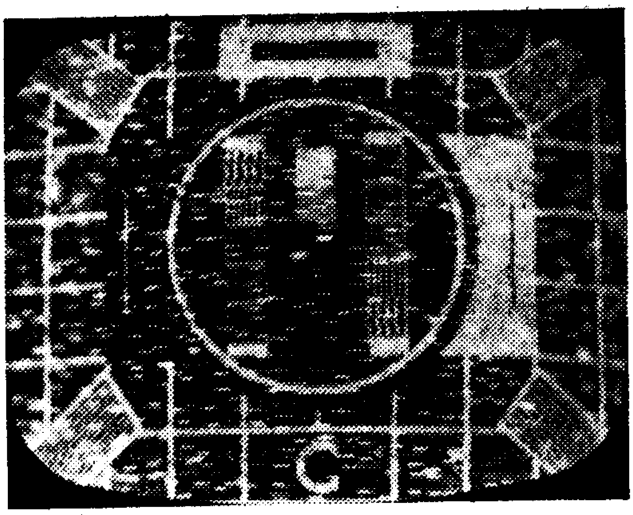

Fig. 4—An entirely different form of interference effect occurs (compare with Fig. 3) when the discharge is after the e.h.t. rectifier valve.

of pulse voltage *before* the e.h.t. rectifier valve or at the valve anode it is always displayed as a vertical column of flashes. This is because the discharge takes place at approximately the same instance on each line flyback, and the interference effect spills on to the edge of the picture or raster.

Discharge of the actual e.h.t. voltage (which is the rectified pulse voltage) gives an entirely different effect, as shown in Fig. 4. Here the interference dashes occur in a random manner over the entire area of the screen. This trouble would be caused essentially by a visible discharge somewhere between the cathode of the e.h.t. rectifier and the final anode connector of the picture tube. A poor e.h.t. connection to the tube final anode is often responsible, as also are a breakdown of insulation in an e.h.t. filter capacitor (if used) or of the e.h.t. connecting lead and insulation collapse on the winding on the line output transformer which supplies the heater of the e.h.t. rectifier.

On sound, the pulse voltage discharge usually causes a hiss, while the discharge of *rectified* e.h.t. voltage results in sharp, staccato clicks. The latter symptom is likely to be aggravated when the picture brightness is decreased, for the smaller load then presented to the e.h.t. circuits causes a slight rise in e.h.t. voltage, and a more vigorous discharge.

Note that pulse discharge effects (Fig. 3) may take place in any inductor or component associated with the line output stage generally, so one should not immediately change the line output transformer before considering the other suspects.

Causes of Internal Pattern Interference

For this symptom to be caused by a fault in the set, the fault in some way must produce an interfering r.f. signal near to the vision carrier or vision i.f. Instability resulting from the breakdown of a bypass capacitor somewhere in the vision i.f. stages is such a fault, for instability means that an amplifying stage turns into an oscillator. The oscillation may be insufficiently vigorous to prevent signal amplification, but will be sufficient to create a spurious r.f. (or i.f.) signal fairly close to the nominal frequency of the amplifier. Thus, the i.f. amplifier, for example, may have a nominal or centre frequency of 34Mc/s and an oscillatory frequency of, say, 34·5Mc/s due to the instability.

Here, then, we have our two signals; the i.f. at 34Mc/s and the interference at 34·5Mc/s. From these we get a 0·5Mc/s beat, which would produce a pattern very much like that in Fig. 1. The spurious signal produced by the instability is unlikely to remain frequency stable, so the pattern will tend to drift, wriggle and alter in formation as the contrast control is adjusted or the position of the aerial downlead is altered at the back of the set.

Apart from open-circuit bypass and decoupling capacitors, instability is also caused by defective valves in the signal stages, incorrect alignment and misplaced wiring. The use of an extra high-gain aerial pre-amplifier may trigger an otherwise stable receiver into vigorous oscillation, particularly if the coaxial downlead is not too good or if there is a bad mismatch between the aerial and the pre-amplifier or between the output of the pre-amplifier and the aerial socket of the set.

The feedback which is responsible for the instability and oscillation becomes greater as the overall gain of the receiver is increased by turning up the contrast control, for example. Thus, it may happen that the set will be perfectly stable at low and nominal settings of the contrast control, but beyond a certain point go completely wild.

Modern sets which feature vision a.g.c. automatically operate at maximum contrast on weak signals and at a much smaller level of contrast on stronger signals. If the set is instability-prone, it is likely to be perfectly stable on the strong local channel but very touchy on a weaker distant channel, meaning that the weaker channel is likely to be affected by patterning.

Sound Affected

As well as the vision, the sound may be affected by whistles due to conditions similar to those described above. In some cases, both sound and vision may be affected simultaneously, and here the trouble may be in the stages which are common to both the sound and vision signals—like the tuner and common i.f. amplifier stage.

If the tuner is at fault the whistles and patterns are invariably altered in character by adjustment to the fine tuning control, but not always, and this is not a conclusive test that the tuner is at fault. Remember also that the instability may be caused by deterioration of several bypass or decoupling capacitors, so that replacement of just one may modify the effect but not cure the trouble completely. ■

Letters to the Editor

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

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

AMATEUR TELEVISION

SIR,—I am surprised that Mr. D. M. Evans (Letter to the Editor, December) should not have heard of amateur television prior to your recent article on closed-circuit television. There have been several hundred "TV hams" in this country now for a number of years. Most of us are members of the British Amateur Television Club, which not only produces and co-ordinates data for amateur use but also obtains certain essential components at reduced prices.

Mr. Evans and anyone else who is interested can obtain further details from the secretary of the Club, Mr. D. S. Reid, 21 Silverdale, Sydenham, London S.E.26.—D. L. JONES (Totnes, Devon).

CURIOUS FAULTS

SIR,—In your December issue, a reader from Bromley, Mr. Greenfield, requested help in connection with a fault on his Ferguson 968T receiver, which you described as "curious".

I have come across this fault quite often in my work as a TV engineer. I think Mr. Greenfield will find that either the 0·5μF capacitor he used is short-circuited, or there is another 0·5μF component in parallel with it, that has become short-circuited. These capacitors are between the h.t. line and the boost h.t. line, and are, in fact, responsible for the boost h.t.

When the top cap (cathode) of the efficiency diode is removed, the line timebase is fed from the h.t. line via this short-circuit capacitor. The fact that the efficiency diode is now inoperative will account for the poor linearity, and the resulting low e.h.t. will account for the brilliance control being "well advanced".

I would be very interested to hear from Mr. Greenfield if this information is of any use to him.—R. S. DIXON (Swansea).

CONGRATULATIONS

SIR,—Congratulations on the new feature in P.T., "Test Case". I think that this will prove to be of great help to many amateurs in diagnosing faults.

There seems to be a serious lack of this sort of information in other television books and I, for one, would like to see more than one Test Case in each issue.—R. SOLESBURY (Sheffield).

INEXPENSIVE CAMERA

SIR,—We read with interest Mr. H. Peters' article in your December issue, on Closed-Circuit Television, which was directed at the lower priced type of C.C.T.V. camera.

At the end of Mr. Peters' article he states that E.M.I. makes only high grade specialist units. Mr. Peters should be aware of the fact that such a statement is very far from the truth as E.M.I. makes two types of TV camera, the Type 6, selling at approximately £500, and the Type 8 which was announced to the Press last May and sells for £160, inclusive of lens and vidicon tube. The Type 8 camera operates at 405, 525 or 625 lines, has a random sync system and has both r.f. and video outputs, and what is more important, at the "flick of a switch" operates off either battery or mains supplies. It is one of the only C.C.T.V. cameras which consists entirely of transistors and its power consumption is only 15W.—MR. D. G. ASHTON DAVIES (Manager, Instrument Division, E.M.I. Electronics Ltd.).

SERVICING DATA & MODIFICATIONS

(Continued from page 222)

discriminator balance is destroyed and a positive or negative voltage occurs across the combined loads. This is fed to the grid of V15 and the corresponding change of virtual capacitance of that valve pulls the line oscillator back into step and restores line lock. A flywheel action is given essentially by the time-constant R77 and C58 in the control voltage feed circuit.

Conversion to Direct sync

The circuit in Fig. 54 shows the best method of applying direct sync to the range of Ferguson models under discussion. Stages V15, V16 and V17 are eliminated and V16 valveholder is rewired to take an ECL80, as per V16 in Fig. 5. The sync separator stage remains the same but the line sync pulses from the anode are fed through a single 15pF capacitor (C27) to the control grid of the first section of V16.

Apart from the line oscillator section, a slight alteration is also required to the control grid and screen grid circuits of the line output valve V8. The 4·7k resistor (R38 of Fig. 53) is now connected direct to the h.t. rail—as R34, a single grid resistor R30 is employed instead of the line lock control and two series-connected resistor of Fig. 53; also a line drive trimmer is connected to the control grid as shown so as to allow the line drive to be optimised.

Normally, this trimmer should be adjusted for an e.h.t. voltage of 14kV, but if an e.h.t. voltmeter is not available adjustment should be made for the best e.h.t. regulation consistent with optimum line linearity and absence of line foldover towards the left-hand side of the picture or raster. Care should be taken to avoid disturbing the frame sync pulse feed circuits from the sync separator stage when undertaking this conversion.

(To be continued)

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. 236 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

PYE VT7

About six months ago I fitted a booster tube heater transformer, thus giving the set a new lease of life. I joined the previous heater leads together and wired the transformer straight to the tube heater tags. Is this correct? The trouble now is that fuse No. 1 keeps blowing, sometimes as often as three times a week The fuses are 250mA and the current at this point is 130mA.—F. W. Johnson (Newcastle-on-Tyne).

You have fitted the boost transformer correctly. The commonest causes of fuseblowing are a faulty PL81 or PY81 in the e.h.t. unit, or breakdown of the contact cooled metal rectifier beneath the chassis.

FERGUSON 991T

I have a Brayhead turret tuner, model 165, which I wish to install in this receiver. Unfortunately I have no instructions for fitting, and therefore I would very much appreciate your assistance in this matter.—C. H. Matthew (Portsmouth).

The best idea would be to wire the converter into the circuit. The procedure is as follows. Remove the EF80 r.f. amplifier valve from the set and across pin 4 and 5 (heaters) of the valveholder, connect the grey and brown wires of the tuner, thereby introducing the tuner valve heaters and maintaining heater chain continuity in the set.

Completely remove the oscillator section of the ECC81 frequency changer valve in the set (one triode section). The other triode section is the mixer and this should be retained. Remove the capacitor connected across the cathode resistor of this section and inject the tuner signal (inner conductor of the screened cable) to the cathode via an 0·001μF capacitor. The screened outer conductor should be connected to chassis along with the black wire from the tuner.

It now remains to connect h.t. to the red wire of the tuner and this can be accomplished by connecting this wire to the receiver's h.t. line.

COSSOR 938F

I would like to complete the set of coil biscuits in the turret tuner of this set. It has three coil sets in at the moment, and the only identification on them are small coloured dots (red, orange, and white).

I have assumed that these dots follow the standard colour code and stand for channels 2, 3 and 9, but although I have managed to tune in a station on channel 3, there is quite a lot of vision signal on the sound.—A. C. Whitehill (Weston-super-Mare).

The coils follow the standard colour code as you have already discovered, but occasionally a set of blue coded coils are found. These are channel 8, not channel 6, and are coded thus to prevent confusion between grey and white.

The buzz on channel 3 is probably the adjacent vision carrier from channel 4.

EKCO T216

I would like to convert this set to receive channel 11. Could you let me know of a suitable converter?

Could you also tell me of any other sets using a similar circuit to this one—A. C. Mould (Southampton).

A suitable converter is the Cyldon U16H, but it is rather a tight squeeze to fit inside the cabinet.

The T216 is similar in many respects to the 15in. T164, and other models in this series.

MURPHY V410

The fault in this receiver takes the form of a vertical line about $\frac{1}{4}$in. wide, just to the right of the centre of the screen. The line seems to be composed of rapidly moving dots, and is unlike the steady white line which is usually associated with incorrect line drive. Critical adjustment of the tuner oscillator and contrast control will eliminate the line, but I still have no idea of the cause and I should like to know your explanation. —G. H. R. Doubtfire (Stanmore, Middlesex).

These symptoms can be due to parasitic oscillation of the line output valve, which may be cured by valve replacement or ferrite beads on the anode lead. Check also for instability of the last vision i.f. stage caused by a faulty 0·001μF screen grid decoupling capacitor. This should be replaced by a Hunts type W99.

ENGLISH ELECTRIC 1650

From this old receiver I have taken the e.h.t. unit and I would like to know if the coil unit could be used to provide e.h.t. for an oscilloscope, etc., and what voltage could be expected.—E. Wells (York).

The e.h.t. unit from this receiver could be used to provide a source of e.h.t. voltage for an oscilloscope or other purpose, but it requires to be driven from a sawtooth waveform such as derived from the line amplifier section of the receiver. The e.h.t. voltage is from 8 to 10kV.

ULTRA V1770

The trouble is a 3in. blank strip along the bottom of the screen, accompanied by compression at the bottom of the picture. There is a 1½in. blank strip along the top of the screen. The width is normal, and so is the sound. The voltage to the 30PL13 is within tolerance, so is the bias voltage. The valve itself was tested as normal.—A. Tilney (Co. Durham).

Check the 100μF electrolytic capacitor connected to the cathode (pin 2) of the 30PL13 frame timebase valve. If in order, check the Varite in series with the frame scanning coils. This may be shorted out for a test.

FERRANTI 20T6

The picture recently decreased to a height of about 1½in., the width being unaffected. On Test Card C this seemed to be due to line foldover. The fault cleared after about an hour and the set ran for two days before the trouble came on again. Then the fault appeared for some hours, after which it cleared. I have checked the capacitors C92 and C84C but they seem to be normal. I have also tested by substitution the ECL80, again without success.—R. M. Anderson (Crieff, Perth).

This trouble is often caused by partial failure of the frame blocking oscillator transformer. If the scan can be restored or altered in amplitude by applying pressure to the windings of this transformer, replacement will solve the problem. On the other hand, such action may not alter the scan even though the transformer is, in fact, faulty.

K.B. QV30/1

Since fitting a new U26 e.h.t. rectifier, the picture will not fill the screen by about ¾in. each side. The sleeve for width control will not close or widen the picture but will shift the picture sideways from the centre. The picture is otherwise perfect.—A. Philpott (Heathfield, Sussex).

Replace the FC31 h.t. rectifier.

PHILIPS 1446U

The picture comes on for about 25 seconds and then collapses from the side in with a vertical flash. If the cabinet is tapped, the picture can be made to return for a short time. If left alone, the picture restores itself for 25 seconds. I have changed the following valves: PL81, PY81, EY51, ECL80's.—D. Fargie (Lanark.)

This seems rather like instability in one of the stages common to both sound and vision signals. Check the first three valves by substitution. If these are in order, check the decoupling capacitors connected to the screen, anode and cathode feed circuits to the valves.

SOBELL T24

Every few seconds the frame hold has to be adjusted to stop the picture going round. The ECC82 and PL81 valves have been changed.—S. J. H. Barton (Derby).

Check by substitution the ECC82 frame sync clipper and frame multivibrator valve. This is located in the bottom left-hand corner of the timebase panel when viewing from the rear of the cabinet.

H.M.V. 1890

A black border has been "growing" at the bottom of the picture until it is now about 1in. deep. The picture is normal at switch on but within an hour the full depth of the black band will be reached. It will stay at this stage for the rest of the evening. The set is well ventilated at the back and stands away from the wall.—F. J. Wells (Banstead, Surrey).

Suspect the PCL82 frame timebase valve for low emission. This is located on the left-hand side of the chassis when viewing from rear of cabinet. Also check the VA1033 thermistor connected in series with the frame coils. Check by shorting. If height is restored, replace the thermistor.

MASTERADIO T918

The trouble is flashing lines across the screen, accompanied by crackling noises. This seems to be caused by shorting at the point where the earthing disc fits on to the tube. I have tried securing the disc to the tube by black plastic insulating tape but this has not cured the trouble. Also, in some parts of the tube the coating appears to be wearing off.—J. H. Thompson (Leeds, Yorkshire.)

The external conductive coating of the tube should be adequately bonded to chassis and the use of coiled expansion springs stretched across the flare and connected to chassis can help when the coating is starting to flake.

K.B. OV30

I obtained this set second-hand and immediately changed the voltage tapping from 220-230V to suit the local 240V mains. The picture is quite good but sound and contrast are low. The sensitivity control is at maximum. Although the PCF80 was found only 50% "good" on test and was replaced, the new valve did not improve matters much. I have also changed the PCC84.—J. Roberts (Newcastle-on-Tyne).

The set itself may be in good order and the poor sound and low contrast may be caused by a weak aerial signal. Check that the aerial system is optimised and if all seems well here, have the set checked for alignment and overall vision and sound sensitivity.

STELLA ST5721U

The set was switched on and the picture started rolling, then disappeared. The sound also went off. All the valves have been tested, as well as the aerial, and all were satisfactory.

When the set is switched on now there is a loud coarse noise which vanishes when the set warms up, leaving a good raster and brightness. —S. Cox (Hull).

This symptom could be caused by a s/c in the picture tube, but is usually indicative of trouble in the line amplifier—especially in the booster diode section. If you are sure that the line amplifier and booster valves are in order, check for dry joints in proximity of the line amplifier section Also check the components on the screen grid of the PL81 valve.

(Continued on page 235)

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(Continued from page 232)

EKCO T344

When this receiver is switched on from cold, the sound comes on as normal and remains until the e.h.t. comes up, when both the sound and vision disappear.

To get the picture and sound I have to switch off and then on again which brings everything back to normal. I have replaced the two tuner valves without improvement. The e.h.t. is normal throughout, and after this double switching, the picture and sound remain normal all evening. —A. Livingstone (Renton, Dunbartonshire).

The fault may be in the a.g.c. system. Suspect especially the 6/30L2 a.g.c. valve, and also the 0·25μF capacitor decoupling the a.g.c. line (0·04μF in some sets).

Try fitting a 3·3kΩ grid stopper resistor on the control grid of the video amplifier valve.

DEFIANT 7A21

Normally the picture is perfect except for a faint, white, vertical line in the centre of the screen. However, the centre part of the picture occasionally jumps, leaving this part of the screen with a double image. The remainder of the picture is quite normal.

This fault can be removed by changing the channel selector switch to another channel and then back again.—C. Murray (Edinburgh).

We would advise you to change the 30FL1 sync separator/line oscillator. This valve is on the right-hand side just above the screened section.

Check, if necessary, the PL81 line output valve in the screened section.

SOBELL S.C.24

On first switching on the picture is only about 3in. deep and lies across the centre of the screen. This very slowly expands to fill the screen with a good picture, except for 3 or 4in. of screen at the bottom, which remains blank. The bottom part of the picture itself appears to be slightly cramped.—C. King (Rotherham).

Replace the right-hand side PL84 frame output valve if this is faulty. If this valve is not at fault or if the bottom compression persists after replacement, check the cathode components C104 (250μF), R79 (560Ω), R80 (390Ω) and C98 (0·01μF).

BUSH T36

This set is fitted with the manufacturer's convertor for receiving channel 9. I shall be moving to Whitstable in Kent soon where, I believe, the ITA programmes are on channel 10. Can you tell me how to adjust the coils to receive channel 10 signals, if this is possible?—L. C. Lodge (London, S.W.12).

You may well find that channel 10 is within the range of the tuner knob. If it is not, remove the bakelite cover and on the right you will see the plastic core which is actuated by a spindle. This can be adjusted to bring in channel 10 and, if necessary, the rear cores may be finely set for optimum reception.

If the picture is grainy, change the PCC84 valve.

STELLA ST1029U

The fault which has developed in this receiver takes the form of vertical rulings down the left-hand side of the screen. This fault is more noticeable on the BBC channel.—S. O. Brown (South Shields, Co. Durham).

This fault is probably caused by incorrect operation of the boost circuit in the line timebase. Firstly, therefore, check the emission of the booster diode and line output valve, and replace this if low.

PETO-SCOTT 1412T

The raster is cramped into the centre of the screen, leaving about 3in. clear at the top and bottom. The lines are very close together at the bottom, almost forming one broad band. The height and frame linearity controls are set at maximum.

I have changed the ECL80 and checked the output transformer and oscillator transformer. The voltages to the pins of the ECL80 are approximately correct.—H. Fawcett (Leeds).

You will probably find the trouble is in the boosted h.t. supply to the height control. The supply comes from the boost line (350V approximately) through a 100kΩ resistor to a thermistor VA1008, decoupled to chassis by a 32μF capacitor, the thermistor then connecting to the height control. An 820kΩ resistor connects this control to the oscillator transformer (thence to pin 1 of the ECL80). Check this circuitry thoroughly.

EKCOVISION

I recently bought an Ekcovision receiver having four pre-set m.w. radio stations incorporated in the design. It has a 12in. c.r.t. marked CRM 121A and I have noted the following valves: U24, 6P28, PY31, PZ80, SP61 and 6K25. Could you please identify this set for me?

When I first had the set it presented a blank screen when switched on, with the U24 glowing purple. I changed this valve and now receive a reasonably good picture. However it is not yet perfect.

The U24 heaters do not glow although heater current is available and there is a good spark at the top cap. The brilliance control appears to be defective as past a certain point in its travel, the picture disappears, and also this control gives little gain.

Almost full contrast is needed to give a reasonable picture.—D. W. Lamplugh (Hatfield, Hertfordshire).

We would say that your set is the TRC138, or similar chassis. The U24 heater voltage is taken from an overwind on the mains transformer and this may be faulty or the valveholder pins broken. Alternatively you may have fitted a defective U24.

Low gain is usually the fault of the small i.f. decoupling capacitors which can be checked by bridging, or else due to dirty valve pin connections.

PYE VT7

The fault on this receiver is a blank portion at the top of the screen where no picture is visible and is about 2in. wide. The picture itself is cramped at the top and stretched at the bottom.

The vertical amplitude control is turned fully clockwise for the best possible picture.

I have changed the line output, booster diode and frame oscillator valves but the situation remains unchanged.—P. Woollard (Glapthorne, Northamptonshire).

Suspect the PL82 frame output valve and the 32μF decoupling capacitor between pin 9 and pin 3 of this valve. Also check the 100μF decoupler from pin 3 to chassis, and the 0·5μF capacitor from pin 6 of the ECC82 to the height control.

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PRACTICAL TELEVISION, FEBRUARY, 1963.

TEST CASE -3

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

? *A normally working receiver suddenly develops severe symptoms of sound-on-vision on both channels and over the entire range of the fine tuning control.*

What are the most likely causes of this trouble and what tests should be made to establish the cause?

See next month's PRACTICAL TELEVISION for the solution.

SOLUTION TO TEST CASE—2 (Page 188, last month)

Receivers with mean-level vision a.g.c. are usually arranged so that the voltage—negative with respect to chassis—which is produced by the normal operation of the sync separator valve is employed to control the gain of the tuner r.f. amplifier and the vision i.f. amplifier stages.

The negative voltage at the sync separator control grid is fed to the signal grid of the controlled valves through suitable filters, and as the negative voltage rises and falls as the applied aerial signal does likewise, the vision channel gain automatically increases when the signal is weak and decreases when the signal is strong—which, of course, is the normal a.g.c. action.

Manual contrast on such receivers is accomplished by the contrast control working as a potentiometer and thereby applying a counteracting positive voltage from the h.t. line to the a.g.c. line, as shown in Fig. 1. Let it be supposed that the set is receiving an aerial signal and that the a.g.c. line is negative in proportion to the signal strength. Thus, at maximum setting of the contrast control the positive voltage applied to the a.g.c. line is relatively large and so much of the sync separator-derived negative voltage is counteracted, thereby reducing the negative voltage applied to the controlled valves and increasing the gain of the vision channel.

Conversely, at minimum setting of the contrast control, the controlled valves receive almost the full sync separator-derived negative voltage and so the gain of the vision channel is reduced. In other words, the contrast control varies the negative bias —as derived from the sync separator—to provide a manual range of contrast, while the signal does likewise to provide an automatic range of contrast.

Failure of the manual contrast control so that the vision channel gain is at maximum—resulting in overdrive on both channels and a negative picture on the stronger BBC channel—would mean that the sync separator-derived negative voltage is either being short-circuited or fully counteracted by a positive potential reaching the a.g.c. line at all settings of the contrast control.

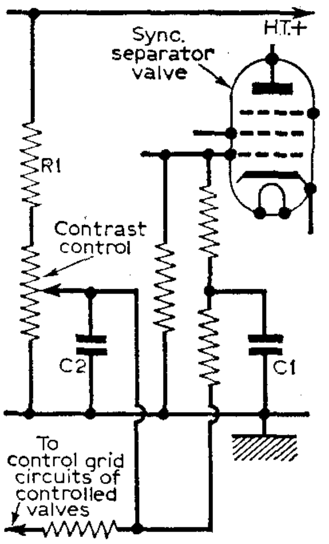

Fig. 1 - See text.

The first test should be to establish that the voltage at the slider of the contrast control varies from zero to a maximum positive value (relative to chassis) as the control is turned clockwise from its fully anti-clockwise position. If this happens, then the contrast control circuit itself is in order —otherwise the contrast control or R2 would be open-circuit.

The next test should be for a voltage reading on the a.g.c. line proper, relative to chassis. A high-resistance (20,000Ω/V, at least) voltmeter is required for this test to avoid shunting the high resistance a.g.c. feed and filter components with a low meter resistance—a practice which would greatly affect the voltage reading and possibly prevent any deflection at all.

Normally, a negative voltage should be recorded, and this should reduce in negative value as the contrast control is turned towards maximum setting. If there is zero voltage at all settings of the contrast control a short-circuit in a filter capacitor—such as C1 and C2—would be a likely cause, while a fixed positive value would mean either a control grid short in one of the controlled valves or a short-circuit or leak in the capacitor coupling the tuner to the common i.f. amplifier stage.

Published on the 22nd of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, London, W.C.2, and printed in England by WATMOUGHS LIMITED, Idle, Bradford; and London. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia), Ltd. South Africa and Rhodesia: CENTRAL NEWS AGENCY, LTD. East Africa: EAST AFRICAN STANDARD LTD. Subscription rate including postage for one year: Inland £1.8.0. Abroad £1.6.6 (Canada £1.5.0). Registered at the General Post Office for the Canadian Magazine Post.

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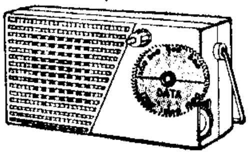

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