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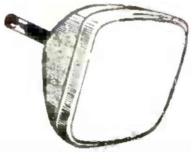

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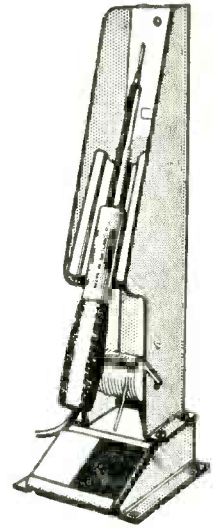

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has had personal experience of such a breakdown and can assure readers that the results are likely to be serious.

Preventing Access to the Chassis

Since we have a live chassis the obvious thing to do is to prevent anyone touching it or any leads or metalwork connected to it. The cabinet and the face of the c.r.t. provide good protection from the front and sides but the backplate is often a weak link. This must be properly fixed all round to prevent prying fingers from prising it open and finding their way inside.

It should always be secured by screws so that it can only be removed by the deliberate act of using a tool. Equally important, the ventilation slots and any other holes must be small enough so that a finger cannot squeeze through to the inside of the case.

The professional setmaker leaves nothing to chance and part of the routine safety tests involve going all over the cabinet with a "standard finger". This useful device is specified in BS415 and is designed to simulate a human finger although with the addition of a built-in spring balance. It is pressed against all likely parts of the cabinet and backplate with a pressure of 5 kilogrammes (about 11lb) to see if it will touch or come within certain specified distances of any live part. In the case of mains potentials it must not come closer than about ⅛in.

One common weak point is the speaker grille and it is often necessary to glue a layer of tough scrim over the speaker opening to prevent the standard finger from going right through the core and touching some metalwork inside the cabinet.

In some cases the lead between the ventilation slots in the backplate breaks and the material has to be changed or reinforced with an extra layer glued on. On other receivers the finger finds a way round a moulded plastic grille or escutcheon and the spring clips or other fixings have to be changed or improved.

One basic principle to bear in mind is that no metal object may pass through the cabinet from the inside to the outside. In the first place it might touch the chassis and secondly a live lead might drape over it or fall off and touch it, thus providing a live contact on the outside of the cabinet. Points to watch here are screws and panel pins used for securing metal trim, escutcheons and nameplates. They may well be too long and protrude inside the case Common culprits, which can be very dangerous, are the screws used for fixing stands, especially if the latter are made of metal. If the bottom of the cabinet is rather thin glue an extra piece of wood or hardboard over the area where the screw fixing is needed.

It is realised, of course, that not many readers have a standard finger available for carrying out safety tests properly. However, some useful work can be done by using your own little finger and pressing hard in all the appropriate places. But first make sure the receiver is disconnected! There is no point in taking realism too far. The main thing is to know what you are looking for and to use common sense and imagination in assessing just how safe your equipment really is.

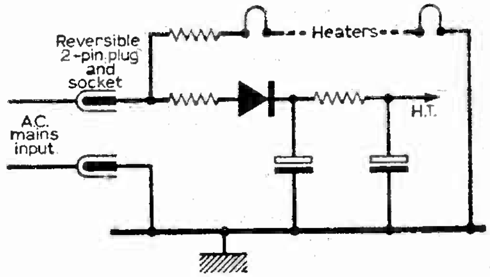


Fig. 1: Mains input circuitry of a typical a.c./d.c. receiver.

Isolating the Aerial

The input arrangements of most modern tuners provide a direct d.c. connection between the live side of the input and the chassis because the signal is usually coupled in through a coil. The earthy side of the input is connected directly to the chassis as far as a.c. is concerned. This means that if no special precautions are taken both sides of the aerial can be up at full a.c. mains potential. Even if the aerial was properly insulated on its mountings it does not need much imagination to anticipate what might happen if a builder was climbing about on the roof and needed something to hold on to.

Clearly it is essential for both sides of the coaxial aerial input to be properly isolated from the receiver as far as mains voltages are concerned. A typical circuit arrangement is shown in Fig. 3. C1 and C2 are special quality capacitors of a type which have been proved to be capable of withstanding 300V a.c. throughout the working life of the receiver and 3,000V d.c. for short periods. The capacitors should conform to the specification given in BS1597. Typical values are 470pF for v.h.f. tuners and 270pF at u.h.f.

Under certain atmospheric conditions it is possible for a very considerable static charge to build up on an aerial and this voltage is applied directly across the isolating capacitors. There is, therefore, a very real danger of these capacitors

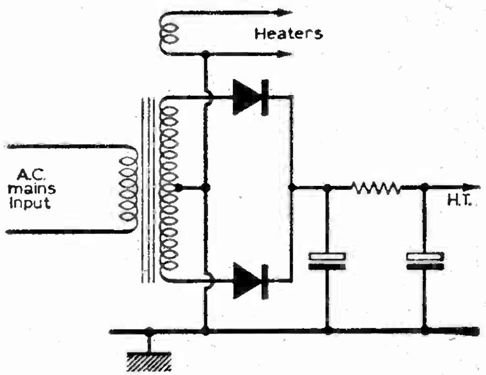


Fig. 2: A.C. only receiver mains input circuitry.

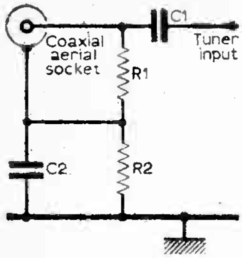


Fig. 3: Isolation of the aerial input circuit.

breaking down, unknown to the owner, and then failing to give any further protection. R1 and R2 of Fig. 3 are leakage resistors built into the circuit to enable any static charge to leak harmlessly away.

These resistors, too, must be special quality components which can be relied upon to dissipate any static charge without themselves breaking down. The resistance value of R2 should not exceed 1·5MΩ and must not be appreciably less. If it is too high it will not provide an effective discharge path and if too low it will pass too large a current from the chassis and this is what we are trying to avoid. (R1 can be a few thousand ohms.)

It should be remembered that it is not voltage as such that causes harm but the current that this voltage causes to flow. The maximum safe current is of the order of 0·3mA and so the minimum safe value of aerial leakage resistor connected to the chassis is in the neighbourhood of 1·0MΩ, but this will depend upon the circuit used.

It is of little use planning an aerial input isolating circuit and choosing special components unless the physical layout is equally carefully designed. It is essential to prevent any possibility of accidental short-circuits occurring and here a bird's nest or a piece of knitting is absolutely out.

The layout must be designed so that there is at least half an inch clearance between points which it is desired to isolate. All the components should be mounted on an insulating plate, such as SRBP, and the leads passed through holes or tags half an inch apart and drawn straight but not tight. Alternatively it is sometimes convenient to use good quality hard paper shields to prevent leads from touching each other in place of the standard ½in. clearance. A possible layout, based on the circuit of Fig. 3, is shown in Fig. 4.

Another consideration to be borne in mind is that the aerial socket must be properly protected so that no one can touch any live part in the vicinity. Some people, for instance, poke a piece of wire into the socket instead of using a proper aerial and, if they happen to miss the socket, the wire may go inside the receiver. A good way to avoid this possibility is to fit a hardpaper disc over it, properly secured, that extends at least 1in. in all directions. Both these possibilities are illustrated in Fig. 5. Make sure also that the backplate is a close fit and cannot bow outwards and leave a gap.

Mains Input Arrangements

Let's start with the mains lead. This should be of good quality with sturdy conductors and a tough insulating covering that will not easily perish or chafe. If a two-core lead is used the conductors should be coloured red and black, denoting the line and earthy connections respectively. In a three-core lead the true earth connection, which must *not* be connected to the chassis, is coloured green. In passing it should be noted that the colour coding used by foreign countries is often different from the above and if you have any imported equipment it is important to check up on the coding before connecting the equipment to the mains.

Where the mains lead enters the cabinet it is good practice to terminate it with a non-reversible shrouded mains plug of the type that has been standardised by the industry. This plug traps the backplate in position and when the backplate is taken off the mains supply is automatically disconnected. It can only be reconnected by the deliberate act of refitting the plug and this reminds you that the receiver may be live.

The standard type of plug and pin connections are shown in Fig. 6. Note that the plug is shrouded so that it is not possible to touch the live contacts when the plug is pulled off the pins. The pins themselves are on the chassis. This is an elementary but important point.

An alternative arrangement is to solder the mains lead to the fuseplate without using a plug and socket. In this case it is important to make sure that the lead is properly anchored with a padded clamp. Try giving the lead a steady pull to make sure that it is properly secured.

After the mains lead comes the fuse. Only one is needed and this should be in the live side of the mains input. Use the lowest rating practicable, which will commonly be 1-1½A. If silicon diodes are used as h.t. rectifiers it may be desirable to use anti-surge fuses which will withstand the large current that flows at the instant of switching on. This refinement is often useful for h.t. fuses also.

The switch itself must be a good quality double-pole type but can have any type of operating mechanism such as tumbler, rotary or push button.

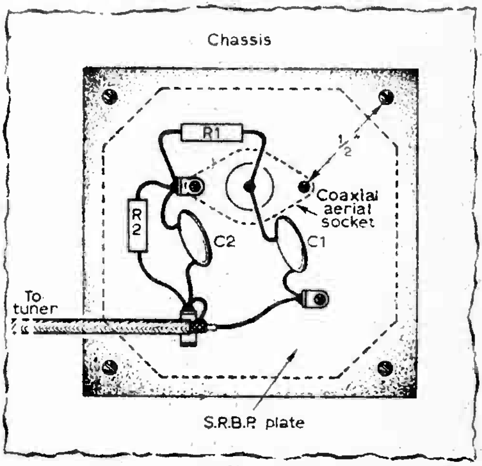


Fig. 4: Practical layout of components shown in Fig. 3.

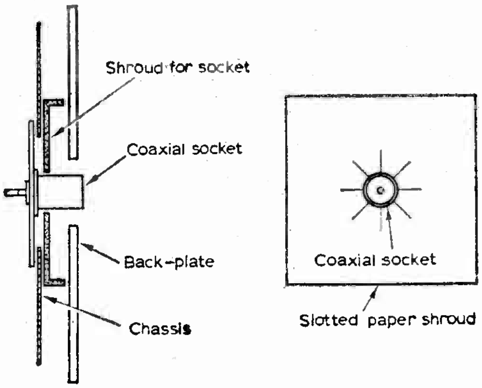


Fig. 5: Insulating the aerial input socket.

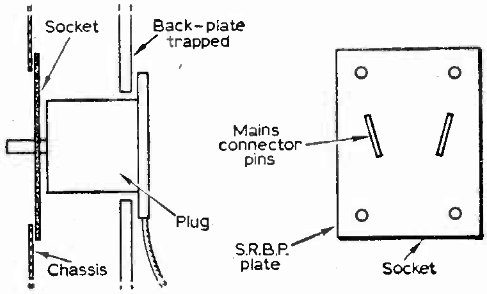


Fig. 6: Standard type mains input socket.

A two-pole switch is essential in order to disconnect both sides of the mains because often you are not sure which way round the mains are connected. With a single-pole switch not only might the chassis be live when the receiver was switched off but one of the aerial isolating capacitors would be permanently stressed by the full mains voltage and this would invite a premature failure.

Reverting to silicon diodes again, the mains switch should be capable of interrupting 10A if this kind of rectifier is used in order to avoid the likelihood of burnt-out contacts. In the case of ordinary thermionic diodes the switch will only need a 2A rating.

Knobs

Knobs are handled more than any other part of the equipment and must receive special attention if we are to achieve our object of making everything safe. Undoubtedly the best technique is to use controls which have insulated spindles. All that needs to be done then is to make sure that if the knob is pulled off there is not sufficient clearance between the spindle and the hole in the cabinet to allow access. See Fig. 7a. However, potentiometers with insulated spindles are not in universal use and so other precautions are often needed.

In the first place it is important to make sure that the knobs cannot be pulled off accidentally, even after extensive use. Spring-clip devices are generally not very reliable and it is better to use a proper grub-screw fixing instead.

The screw should not merely bite into the surface of the spindle but actually pass into or through it because otherwise a positive fixing cannot be guaranteed. The screw itself may, of course, be live and so it must be short enough to allow a plastic insulating plug to be screwed in on top of it. This arrangement is shown in Fig. 7b.

Fig. 7c shows a knob that, however well fixed, is still not safe because thin metal objects such as bracelet safety chains can pass down behind it and touch the live spindle. The clearance between the knob and the cabinet or escutcheon should not exceed $\frac{1}{16}$in. It is often a good plan to fill this gap with a felt washer, since this will also help to give the control action a pleasing feel.

The gap problem can be overcome completely by using a knob with a long shank. Dimensions and clearances can then be so arranged that even if the knob does become detached no live parts are exposed or accessible. This approach is illustrated in Fig. 7d.

Headphones

People often ask how headphones should be connected to television receivers. Judging by their comments it seems almost certain that there are

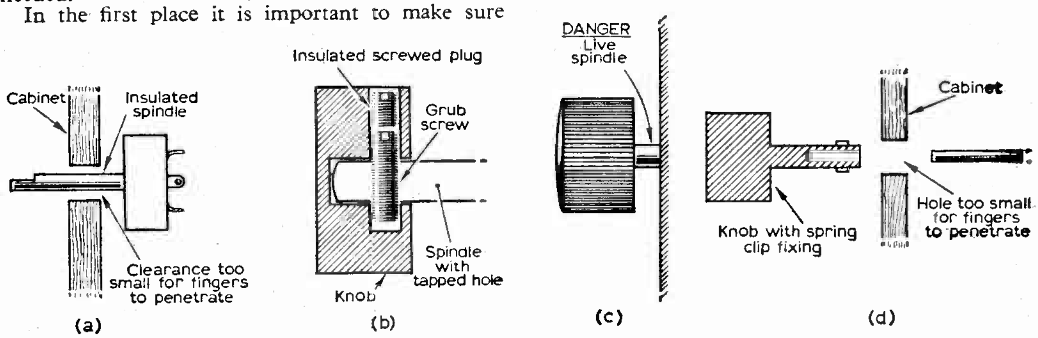


Fig. 7: Various types of control knobs that may be found on TV receivers.

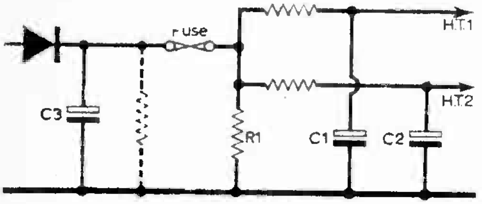


Fig. 8: Typical mains input circuitry with h.t. fuse.

some downright dangerous installations about. Anything worse than a pair of live headphones is difficult to imagine. There is only one way to feed a pair of headphones—through an isolating transformer. This transformer must be of guaranteed good quality and made specifically for isolating purposes.

The turns ratio needed will depend upon whether it is to be connected across the primary or the secondary of the sound output transformer fitted to the receiver. The secondary of the isolating transformer must *not* be connected to either the chassis or true earth but left floating.

Pity the Poor Service Man

No survey of safety requirements would be complete without bearing in mind the problems which may arise during routine servicing operations. After all, most television receivers need attention at some time in their life and, since this may be done by an inexperienced engineer learning his trade, or by the owner himself, who may know a little about electricity, it is up to us to prevent them from being exposed to unnecessary hazards.

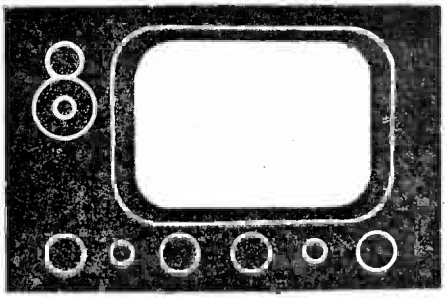
The first requirement is to fix a bold label on the backplate as a reminder that the chassis may be live (if the a.c./d.c. technique is used) and that the mains supply should be disconnected. The next thing to do is to make sure that no high voltages exist anywhere in the receiver after it has been switched off. If this is impracticable then offending parts must be protected.

A c.r.t. that has been discharged by, say, a spot-suppression circuit or an externally applied short-circuit will regain an appreciable charge if it is left to recover for a few minutes. Therefore the anode connection should have a properly insulated cover so that the cap cannot be touched accidentally. In any case this cover helps to prevent corona or tracking across the inevitable layer of dust on the surface of the glass.

Electrolytic capacitors can provide some unexpected surprises. If the design of the receiver is such that no bleeds or potential dividers are connected across the h.t. line any electrolytic capacitors connected to it may retain a charge long after the receiver is switched off. It is good practice to make sure that an adequate bleed does in fact exist.

A special case occurs where an h.t. fuse is fitted. Fig. 8 shows a typical h.t. supply with one common fuse.

(To be continued)



THE OLYMPIC II Transistor TV

by D. R. Bowman

Concluding Remarks

WHILE the articles on the *Olympic II* transistor television receiver have been appearing, there have been very many letters from readers to answer. This final article is written to answer some of the questions asked which are of general interest, and to make some suggestions which may help those constructing it.

625-Line

One question which has occurred frequently refers to the 625-line conversion. While the majority of queries about this have been from overseas readers, the subject is of wide enough interest to make it worth while considering in more detail at the present time. It should be realised that what follows effectively states the problems; how they will be solved is another matter.

There are three important matters to consider in the 625-line conversion: namely, the increased receiver video bandwidth to be achieved, with appropriate gain; the fact that frequency-modulated sound is the means of transmitting audio information; and lastly the increased number of picture lines and the effect of this on the working of the line-output transistor. These will be discussed in turn.

The r.f. tuner need cause no concern since the bandwidth for each channel will be adequate for the reception of 625-line transmissions, should these ever be undertaken on any of the channels 1 to 13. This now seems highly doubtful, the chance being that these channels will be devoted to the present 405-line transmissions for the forseeable future.

Operation at u.h.f. will require a separate u.h.f. tuner, which will probably by bought from a commercial source. However, the development of a suitable kit for home construction is being undertaken; and as a by-product a u.h.f. signal generator has been designed. The article on this will appear in the November issue.

As to the i.f. and output sections, these will require some modification unless it is desired to construct new printed circuit boards which can be switched in or out as required. This may be simpler, though more expensive, and it will be for the constructor to decide whether he wishes to convert or duplicate.

To ease design problems, which can be time-consuming, it has been arranged that the increased bandwidth needed in the vision receiver can be obtained by altering the inter-stage coupling. Referring to Fig. 10, C26 and C31 will be altered in value, and C31 attached to the tap (4) on L17. The sound rejector system L18, C32, C33, R26 will be removed, and C36 may need to be altered in value.

The damping resistor Rx may also need to be reduced in value, and the polarity of the diode D1 reversed. This will involve an alteration in the mode of operation of the video amplifying stages Tr7 and Tr8.

It is probable also that inter-carrier sound will be the best way to arrange audio reception, but initially this will not be attempted, since the twin superhet already exists and will only need altering in frequency. However, a discriminator will have to be provided instead of the detector D2. The audio section will need revision—but not because of the change in frequency standards.

A.F. Transformer

It is a matter of considerable disappointment that Messrs. Gilson have discontinued the supply of the very excellent transformers specified for the audio stages. As an interim measure, Radiospares transformers have been quoted as alternatives, but the makers do not claim that these can "take" more than about 750mW, and when "pushed" a little can cause poor quality reproduction.

A transformerless output stage is therefore being designed, and as this will be ironless up to the speaker it should be possible to obtain high quality with good output. However, suitable transformers can be wound by hand.

The driver transformer can still be the Radiospares item, but the output transformer should be of rather more substantial size, of turns ratio primary/secondary about 3·3+3·3:1 for 3Ω speaker, tightly coupled, and of d.c. secondary resistance below 0·2Ω. Primary inductance should be about 0·5 to 1H, or bass response will suffer and magnetising current will be excessive.

Extra negative feedback can be used with the Radiospares output transformer, however, to improve output and diminish distortion, and this is effected by connecting a 100μF capacitor and 5·6kΩ resistor in series, and connecting these between one "side" of the loudspeaker voice coil and the collector of Tr12.

Care should be taken to observe capacitor polarity, and to avoid positive feedback by the correct selection of the loudspeaker lead to which connection is made. This gives relatively heavy feedback, but there is ample gain in the sound receiver to overcome the drop in amplification resulting.

In addition, it may improve the noise level to use a selected OC44 instead of an OC75 as Tr11, reducing collector current to about 0·3mA by adjustment of bias.

Line Output

The line output stage is, of course, a quite serious problem, although rather simpler of solution than the vision receiver. The calculations resulting in the design of the scanning yoke and e.h.t. transformer are tedious and will not be quoted here, but briefly the results are that with 405-line transmissions the peak collector voltage is about −65V under the conditions specified, while peak collector current is of the order of 7A.

With 625-line working the peak current is about the same, but the peak collector voltage rises to about 100V, and this results in a state of affairs in which the output transistor is operating nearer its limit of 130V. This is safe, of course.

However, the scan period is much reduced and in order for peak currents to reach the required value the e.h.t. transformer must be used as an output transformer in the same way as is done with valve circuits. This involves a tap on the e.h.t. transformer primary; it is not difficult to modify the specified transformer in this way, but currents are heavy and switching from 405 to 625 standards will involve the use of a very low-resistance switch if linearity is to be retained. Also, the third-harmonic tuning conditions will be changed by the modification, and extra coupling turns will have to be switched in.

It is emphasised that although all the foregoing may seem complicated, the design problems are quite capable of solution, and in due course conversion details will be given. However, some experimental work is going to be needed as well as calculations, and readers are not advised to "have a go" in advance unless they are very much aware of the details of the physical situation!

Corrigenda

A number of minor errors have occurred in the typescript, and these have already been noted with readers who brought up the queries. These are regretted, of course, but is most unusual for an article such as this to contain none and on the whole we think we have done extremely well!

The most important of these is in Table II (June edition, p.391), the specification for L16. The number of turns is correctly shown in the diagram, however, and should read 17 turns, *not* 4; the 4-turn coil is L15, the preliminary sound rejector.

Fig. 15 has also been found confusing, since it does not correspond with the theoretical circuit of the photograph on page 394. VR2 is the potentiometer controlling the voltage output of the unit, and is not a pre-set. VR1 should be shown as a pre-set control.

The photograph is correct and shows VR2 (output voltage control) at bottom left with VR1, the pre-set hum balance control at bottom right.

Field Generator

One point made by a reader concerns the statement (page 488) that the input resistance of the "Darlington pair" in the field scan generator is about a megohm. This statement was intended to refer to the transistors Tr20 and Tr21 alone; naturally the bias network is in parallel with this, giving about 25kΩ effective input resistance in all.

However, without the Darlington connection the input resistance would be only a few kilohms, if that, and as the charging resistors are small and the value of the timing capacitor large, 25kΩ is relatively negligible as a drain affecting linearity adversely.

Aerials

A request has been received to indicate what aerials may be suitable. Obviously a good aerial is an advantage, but for portable use a telescopic dipole has proved quite satisfactory in field trials. Owing to the exceptionally low noise figure for the receiver, quite rudimentary aerials have been found to give good results, but it is worth mentioning that the aerial bandwidth must be sufficient if resolution is not to be impaired.

For channels 1 to 5, ¼in. tubing is recommended; heavy flex separated out may well do at a pinch, but it is unlikely to give better than 1·5-2Mc/s resolution. For Band III frequencies, however, flex can be quite satisfactory.

Wherever possible the aerial should be no nearer the receiver than 4ft. In spite of good screening some of the "radiated" energy from L29 does escape, and may well result in the appearance of faint vertical lines on the raster (as in Fig. 28). Actually, this field is inductive rather than radiative, and falls off in intensity as the cube of the distance of the aerial from the receiver, so an extra few inches may make all the difference.

Theoretical Analyses

The response to the writer's offer of theoretical analyses of the main parts of the receiver has been surprising, and it is feared that he is in arrears with these. However, the matter has not been forgotten, and everyone who has asked will be supplied in due course. It may be worth mentioning that the analyses are mostly mathematics—it is hoped that readers do not mind this, since pages of sums are not awfully bright reading!

Final Adjustments

If the receiver units have been aligned as and when they have been constructed, little remains to do when the whole assembly is complete. Doubtless sound only will have been received for some time before the time comes to check overall operation, so that will be one worry out of the way.

The moment of truth arrives, however, when the picture is to be switched on as well, and the likelihood is that on turning up the brilliance control a good picture will be seen at once, needing only the adjustment of the line linearity control and the video correcting choke L22. It should cause no dismay if mirror-imaged or upside down, since the connections to the scan coils can be reversed without difficulty.

If, however, the image is broken up and negative in appearance the vision detector diode has been joined into circuit the wrong way round; this will, of course, have been detected in preliminary setting-up operations, and is not unlikely.

One final point may be mentioned; it is intended in the near future to develop a new line oscillator-driver circuit, so that a highly stable line base generator results.

THE NEW RECEIVERS

A quick run through of the new TV sets and the new trends.

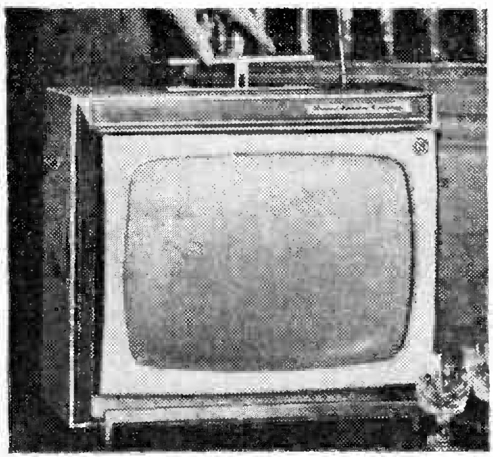
THE various trade shows organised by manufacturers during the normal exhibition period (the Radio Show itself, of course, being cancelled) presented an opportunity to have a look at the new season's models. Nothing startling was seen in the way of circuitry, as to be expected, but a few interesting trends were noticed.

Circuitwise, the only real point of interest was the introduction of more hybrid receivers, using transistors for the front end and for the i.f. and video circuits but with valves for the timebases.

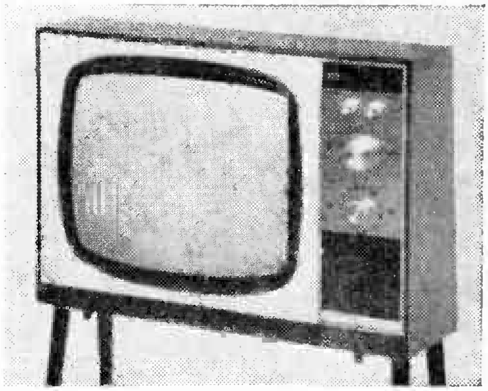
A very noticeable trend was the swing-back towards more portable receivers again and this has resulted in the appearance of one or two new tube sizes. In this group we have 12in., 13in. and 16in. receivers, and also a 9in. fully-transistor model. So far as the home market is concerned, the new smaller sets are designed mainly to appeal as "second sets" to augment the existing large screen family set. Proportionately they are not *that* much cheaper than their more conventional fellows.

At the other end of the scale, we saw one set with a 25in. tube. Apart from this, the favourite still remains the 19in. screen, followed by the 23in. models. Several sets represent a real attempt to produce above-average sound reproduction, with good size speakers and so forth.

Two manufacturers exhibited "clock TV sets" with a built in clock and automatic timer which can be set to switch on the receiver (TV or v.h.f. radio) at any predetermined time.



G.E.C.'s new 13in. portable.



KB KV005 19in.

Alba

Three new ones on show were the T1090 (19in., without u.h.f. tuner, 62 gns.), the T1095 (19in. with u.h.f., 68 gns.) and the T1135 (23in. with u.h.f. 78 gns.).

The transistor u.h.f. tuners have slow motion drive. The v.h.f. tuner features a "memoriser" fine tuner. System switching is by push button. Suitable for communal aerial systems.

Bush

New from Bush is the 19in. TV135 which has all-transistor v.h.f. and u.h.f. tuners and receiver chassis. It has automatic contrast control. Price 73 gns. (65 gns. without u.h.f. tuner). The TV138R is a 23in. version at 71 or 79 gns.

Cossor

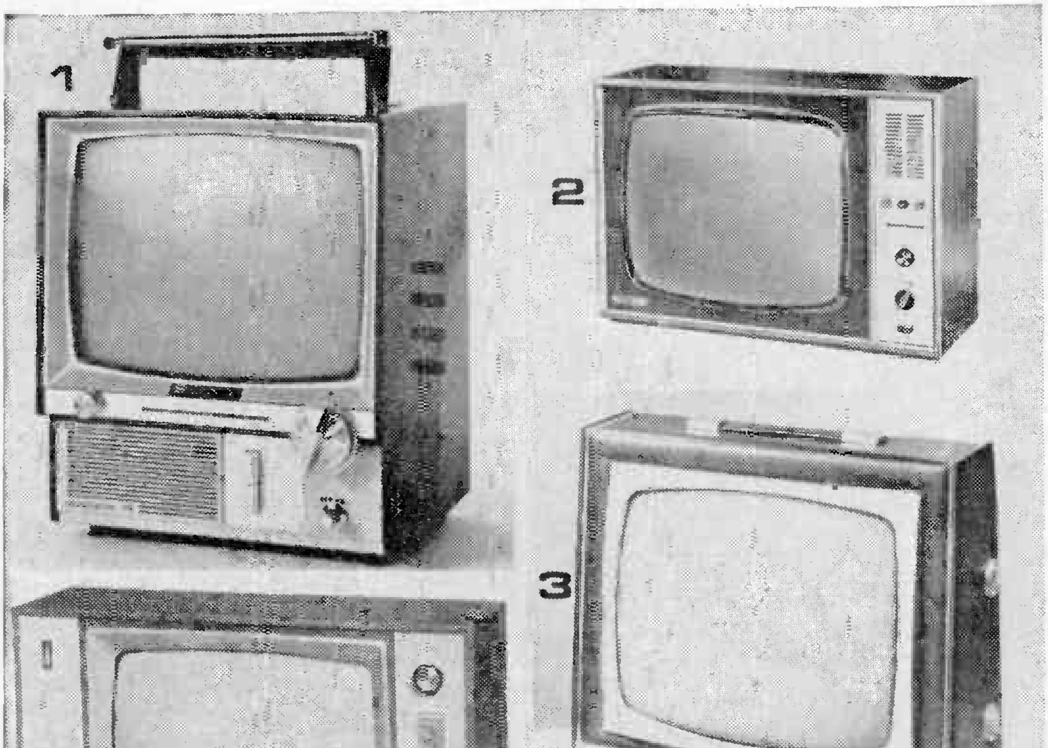
The new CT1974/02 is a 19in. model with transistor u.h.f. tuner and adjacent BBC1/ITA switching.

Decca

Decca introduced a new range of sets. The DR1 is a 19in. set with "magic memory" fine tuner on v.h.f. The DR1/T is identical but finished in fashionable teak. (Both 76 gns.) The DR3 is an alternative styling (79 gns.). The new DR121 is another 19in. set but featuring tambour doors and matching wooden stand and a Prestomatic push button u.h.f. tuner giving a selection of up to four pre-set channels (89 gns.). The 23in. version (DR122) retails at 108 gns., and a console version (DR123) at 125 gns. Finally, there is the TV/SGR888, an impressive combined 23in. TV receiver and stereogram which incorporates a Garrard AT6 autochanger, *Deram* transcription cartridge, 21-semiconductor stereogram with 5W output per channel into 10 x 6in. and 4in. speakers. Radio coverage—VHF/FM, LW, MW and SW. Price: 198 gns. Decca sets now carry a 12 months' guarantee on all parts, including valves and c.r.t.

GEC

Most interesting new one from GEC is the 2015 13 in. portable, which has tuner (transistors), i.f. and sync circuitry exactly the same as the larger



Some of the new receivers. 1: Sony TV9—306UB. 2: Alba T1135 23 in. 3: HMV 2633 16 in. 4: Bush TV135R 19 in. 5: Philips 9173 (clock). 6: RGD 12 in. RV211 (clock).

models. The set is supplied with telescopic (v.h.f.) and loop (u.h.f.) aerials and inputs for external aerials. The v.h.f. tuner is loaded for adjacent positioning of BBC1/ITA channels. It has flywheel sync. Weight is 21½ lb. Price 55 gns.

Also new is the 2012, a 19in. hybrid set with transistors up to the video output. Price 69 gns.

HMV

From HMV comes another portable. The 2633 is a 16in. set with built-in aerials and weighing 27 lb. Price, 60 gns (without u.h.f.) or 65 gns. Other additions are the 2627 (19in., 59 or 64 gns.), the 2629 (23in., 70 or 75 gns.) and the 2631 (23in. luxury model with folding doors and v.h.f. radio, 104 gns.).

KB

The new KV005 is a 19in. model with "memory" tuner for v.h.f. and two-speed tuner drive on u.h.f. The cabinet and facia panel have been designed with particular emphasis on durability. The chassis is based on the well-tried VC1. Price is 57½ gns. or 65 gns. (with u.h.f. tuner).

Marconiphone

The 4613 has automatic system switching which, it is claimed, permits changing from 405 to 625 without the need for fine tuning. This 19in. set retails at 60 or 65 gns. The 23in. version, the 4614 is priced at 70 or 75 gns.

Masteradio

Two additions. The 4011 (19in.) and the 4013 (23in.) are two more hybrid sets with transistors up to the video output stage. The v.h.f. tuner is a 5-position rotary device, four positions of which can be preset to give any required combination of Band I and Band III channels. The fifth position automatically operates the system switch for u.h.f., or may be preset to give 625 on a Band I or Band III channel for use on wired TV systems.

McMichael

The new 3013 is another receiver with transistor tuners and i.f. circuitry. It features a.g.c. amplifier, diode surge suppression circuits for protection of the semiconductor complement and uses a 23in. c.r.t. The chassis can be withdrawn by the removal of two screws.

Murphy

Yet another hybrid is the new V939 19in. receiver which features 20 semiconductors and eight valves, amplified a.g.c. (optimised for 405/625 by the use of separate preset potentiometers), automatic black level correction, flywheel sync. Price, 63 gns. or 71 gns. Other newcomers are the V929 (19in., 59 or 67 gns.) V979 (19in. luxury finish, 66½ or 74½ gns.) and the V923 (23in., 69½ or 77½ gns.) On all these sets, programme selection is by the touch of a button

Philips

"Planned Viewing" and brighter pictures was the Philips theme. Models 9173 (19in., 72 gns.) and 3173 (23in., 81 gns.) incorporate an electric clock which automatically switches the set on at a pre-set time. A neon glows when the set is on "standby". Also featured is increased e.h.t. (18kW, or 12½% greater than normal), and greater picture reliability by means of totally encasing the scan coil assembly in solid polyester. Philips are so confident in their "Surecool" printed circuit panels that they are guaranteed for life against damage from overheating. The u.h.f. tuner is transistorised.

The two other models in the "Style 70" range are the 19in. 9170 (67 gns.) and the 23in. 3170 (75 gns.).

RGD

The RV211 "Night Owl" is a 12in. model based on the well-known "Featherlight" but with the inclusion of a clock timer and also v.h.f. radio facilities. The clock may be used to switch on either TV or radio. There is also a 2-hour elapsed time control so that the set can be automatically switched off. The weight of this set is 23½ lb. and the price is 69 gns.

At the other end of the scale is the new RV309, a luxury 23in. consolette with fold-back doors, twin 8 x 5in. speakers and a teak cabinet. Price is 110 gns.

Sobell

New to the Sobell range is the 1013, a 23in. model with transistor u.h.f. tuner, "memory" fine tuner on v.h.f., flywheel sync, stabilised height and width controls. No separate user function switching is necessary. Also new is the 1012, a 19in. set with transistor tuners and i.f. section. Power consumption is said to be 20% down compared with a fully valved receiver. A newly designed v.h.f. tuner has five position switching, four for v.h.f. and one for u.h.f. selection.

Sony

The only fully transistor set we saw was the Sony TV9-306UB. It uses a 9in. 90° c.r.t. and incorporates nearly 50 semiconductors, including tunnel diodes and epitaxial transistors (which carry a ten-year guarantee). Maximum sensitivity at u.h.f. and v.h.f. is 10μV/10V p-p (in/out) and the audio output is 300mW into a 2¾ x 4in. speaker. A telescopic aerial is supplied but there are sockets for 300Ω v.h.f., 200Ω u.h.f. and 75Ω v.h.f. or u.h.f. aerials. The receiver operates from 200—250V 50/60c/s a.c. mains (consumption 23W) or from a 12V rechargeable battery (consumption 15W) obtainable as an optional extra. The receiver weighs 12 lb. Size is 10¼ x 8¾ x 7⅞in. Supplies are expected to be available by November, and the price will be approximately 85 gns. with 12 gns. extra for the battery accessories.

Ultra

Another 16in. portable is the new Ultra 6640, which is fitted with telescopic v.h.f. and loop u.h.f. aerials. It is housed in a teak cabinet and sells at 60 gns. (65 gns. with p.h.f. tuner). Ultra also introduce the 6638 which is unusual in having a 25in. c.r.t. (50 sq. in. more area than the normal 23in. tube). Again in teak. Price 89 gns. Two more new ones in the Bermuda range are the 6635 (19in., 71 gns.) and the 6634 (23in., 75 gns.).

UNDERNEATH THE DIPOLE

COLOUR TV—to be or not to be! That is the question. As the days become shorter, the weather goes greyer and the H.P. facilities get tighter the prospects for colour television in this country seem to grow grimmer.

Britain appeared at one time to be on the verge of adopting the American NTSC colour TV system, but later developments of the French SECAM and German PAL systems, followed by a second version of PAL, all had their differing advantages, particularly in obtaining acceptable results at the studios on magnetic videotape recorders.

The introduction of the 625 lines 50 cycles standard seemed at one time to be the appropriate medium on which the colour system selected could be introduced on BBC-2, transmitted on u.h.f., to be followed by ITV-2, also on u.h.f.

The U.H.F. Flop

Alas! U.H.F. has been a geographical flop, giving good results only within limited areas around each transmitter and even then subject to the distortions, poor signals and multiple reflections which were at first anticipated to some extent when ITA transmitters started up on the Band III channels.

The BBC-2 625-line pictures look wonderful at the Shepherd's Bush Television Centre and at the transmitter but on a fairly large proportion of home receivers they look inferior compared with BBC-1 and ITV pictures.

405 Lines—For Keeps?

In the meantime the 405-line black-and-white transmissions on BBC-1 and ITV have reached past the point of no return, have been improved in many ways, and it now looks as though they will remain with us for keeps. That BBC-2 transmitting 625-line pictures on u.h.f. does not attract the public in the London and Midland areas is proved by the pathetically low figures on TAM ratings, which for certain programmes indicate that the number of viewers is reduced almost to the staff gazing at the monitors at the studios and transmitters!

What hope is there for anyone investing in ITV-2 on u.h.f. other than non-profit making organisations like the Arts Council or a welfare state? Of course it is easy to be wise after the event but the failure of BBC-2 to attract viewers is mainly a technical one and not due to the programmes.

Clearly the quickest and cheapest way to introduce colour to television programmes in Britain would be to adapt one of the colour systems to the present 405-line standards on u.h.f. and to reduce the cost of transmitters and receiving sets by abandoning u.h.f. in areas other than London, the Midlands and the North.

Costs and Complications

Just think of how many transmitters will be necessary for BBC-2 to provide a good 625-line picture on u.h.f. in all parts of the country! And the cost? Estimates of the essential numbers of u.h.f. transmitters vary from 50 to 100 (if not more), including large, medium and low powered local transmitters, plus unattended remote controlled satellites.

The opinion of your backward-looking crystal-gazer Iconos is that the development of television on u.h.f. has been yet another major mistake. The first one was the reintroduction (and perpetuation) of 405 lines immediately after the war instead of waiting a year or so for the European decision on a 625-line standard or the American 525 lines on u.h.f.

There was a hurried restarting of the British public service on 405 lines on Band I, followed by Band III. That has proved to be a success story saddled with the handicap of "going it alone". The continued and exclusive use of 405 lines could have been avoided by compensating the mere 38,000 or so owners of pre-war television sets. However, our 405-line system is here to stay and the sooner we have colour on it the better.

The BBC's remarkable computer systems (of which there are two) for converting from one line standard to another has certainly eased the position. Which of the four colour systems is the most suitable for the existing 405-line transmissions and their restricted bandwidths? Who can answer that—GPO, BBC or ITA, whose engineers don't always agree?

It rather looks as though for "staged" subjects, at any rate, direct colour photography on film using telecinė, will be a world currency for many years.

A Rating in your Tank

This headline is not a co-production of a petrol company and a cigarette manufacturer with strong naval associations; it refers to the increased popularity of Independent Television according to TAM ratings. Over the years, viewers have "grown accustomed to the face" of the commercial breaks in programmes—and even if they have utilised the time to make their instant cuppa—they have continued to stay tuned to the commercial channel.

Commercials have become an integral part of the income of the actor and film technician—advertising agencies in palatial offices devote more and more time and money to producing ingenious filmlets of as little as fifteen seconds' duration to sell their clients' products.

Competition is keen among actors to appear in commercials. Thirty separate auditions and interviews might be necessary for one commercial—but royalties for their appearance on the repeats of the commercial over the entire ITV network can net the actor a useful nest-egg. There is one particular draw-back for the actor, and that is that constant exposure in commercials, or association with one product, can preclude him from appearing in TV productions on either channel, and in films.

But, because an actor looks different in the flesh, it does little to affect him as far as the theatre is concerned. However, this is an actor's hazard shared by all who appear in serials or who impersonate famous detectives of fiction.

Progress in Commercials

The technician is in a more favourable position, and the growth of the "commercials" industry has led to a mushrooming of small studios often no larger than rooms, but even the shortest 15-second commercial needs the facilities available for a feature film—expert lighting, editing, dubbing and scripting. Most of the leading film directors, lighting cameramen and editors, make commercials—directors are able to experiment to a greater degree on the narrower canvas of the filmlet, than on the expensive epic where safety first is often the main watchword.

Perhaps where previously it was the modest documentary with its aura of social realism that catapulted the director and camera to international acclaim, now it is helicopter shot of a stately home zooming in to the butler's bow tie to "sell" a "bright, new, exciting" starch! These technical gimmicks are spreading to other fields, but their continuous use can lead to eye-strain and headaches.

OB's Are Still In

As commercials can be the stepping stone to the success of a director with their insatiable demand for ingenuity and pace, so the regional ITV companies make their own individual contributions to the national TV scene. From time to time, I have mentioned the different regional companies, each of whom has developed many of the idiosyncrasies of their own area of viewers, and this is as it should be

The local companies have done a lot to draw attention to problems in their areas—from rail closures to sea erosion—and most of this work is done by their film units or independent "stringers". The most ambitious use of Outside Broadcast facilities by a regional company is made by Southern TV (with an area stretching from Ramsgate to Weymouth) developed and encouraged by Berkeley Smith, now their Programme Controller. The Southern TV OB's are thoughtful and thought-provoking.

Ideas such as taping the American *New Christy Minstrels* at the Chichester Festival Theatre were an example of the regions setting the trends and directions that television must take; the big four are taking a greater interest in what the regionals are doing and that is a good thing for TV and the viewer.

The Knockers

Journalists who write about television programmes for daily and weekly newspapers have the bounden duty of looking regularly (and almost continuously), at television. This applies also to TV writers in all kinds of periodicals, whether they are women's magazines, trade or technical journals.

They are faced with a continuous diet of entertainment, instruction, propaganda, treacly sentiment, nightmarish horrors and — of course — commercials. No wonder the TV critics develop a mental indigestion which numbs the critical facilities, as one of them recently admitted.

They are *not* entertained by the conventional light entertainment preferred by the masses. The effect of this diet gives an acquired taste for unusual production techniques, shock treatment horrors and story-lines which have no ending—or middle, for that matter. Some of the avant-garde dramas which are given wonderful notices by these critics are not liked by the vast majority of viewers, who pay their licence money to be entertained rather than bored or confused.

In comedies, however, the custard-pie techniques originated by Mack Sennet and the Marx Brothers on films, the Crazy Gang on the music halls and before them by circus clowns, are accepted by viewers generally, if put over with the professional touch and timing.

Balloons and Goons

As the cameras zoom in closer on Mars, so the attention paid to the past continues to grow. What the film *Genevieve* did for veteran cars, surely the BBC's International Balloon Race did for balloons.

Here was BBC reportage at its best—entertainment that gave the viewer brilliant camera angles and considerable excitement, especially when the balloons made an intermediate stop to change passengers. Surely it was amongst these intrepid aeronauts that you would expect to find the famous Count Jim Moriarty, balloonist extraordinary of late-lamented Goon Show fame.

But Spike Milligan was busy on the other channel, with his inimitable humour that cannot be described! *Milligan's Wake* often falls flat on its face, mainly because of the studio audience—the *Fred Shows* utilised the technicians only for noises off. Actors always say if the crew laughs, relax and enjoy yourself.

However, Milligan damp squibs are worth any amount of bright - sparkling - hard - sell - comedy patter with its predictable punch lines. Keep it up, mate!

Iconos

SYNC PROBLEMS IN FRINGE AREAS

by John D. Benson

IN areas where the (man-made) noise-to-signal ratio is high, problems relating to synchronising have always loomed large in the service engineer's life. For the experienced engineer much of the contents of this article will be "old hat"\ but it is felt that the young engineer should be fully aware of the problems which existed, and still do in a number of situations.

Sync circuits and timebases constitute one of the main differences between radio and television receivers. Synchronising pulses are transmitted in order to keep the timebases in a receiver in step with the transmitted signal and are therefore of the highest importance. A receiver may be capable of reproducing the maximum definition in the final picture, but if the sync circuits are not equally efficient the results are marred by a continually rolling or disintegrating picture.

The frequency spectrum of man-made interference covers a very wide range and is to be found at its maximum in Band I. The amplification of the pulses from local interference can be exceedingly high and, unless suitable precautions are taken in sync circuits, may be a source of continuous annoyance.

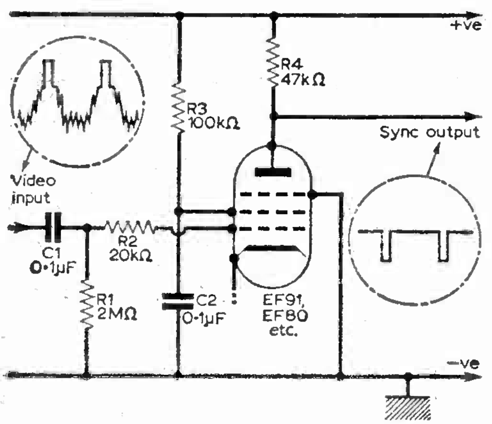


Fig. 1—The basic pentode sync separator circuit.

The pulses of high voltage energy transmitted from ignition systems, vacuum cleaners, etc., are of very short duration when compared with sync pulses and it is this characteristic of which advantage can be taken when studying their effects on synchronising.

The 405-line system of television transmits positive-going vision signals with negative-going sync pulses. This in itself results in the major part of the interference being confined to the resultant picture and is generally recognised as white spots which mar the picture content. This annoying feature can be largely eliminated by simple circuitry and is not the concern of this article.

Unfortunately, as has been mentioned, the frequency spectrum of the interference is so wide it also invades the region of the sync pulses and must receive special attention if satisfactory results are to be obtained.

In early receivers both timebases were equally affected, but in the case of the line timebase an almost 100% cure was found by including "flywheel" sync circuits which isolated the timebase from the disturbing effects of impulsive interference.

Flywheel sync was introduced from America where, because their vision modulation is negative-going with positive sync pulses, it was necessary from the start, as with this mode of modulation the interference pulses, which are positive-going, had most effect in the sync region and therefore made viewing almost impossible without "flywheel" sync circuits.

Modern practice is to use a pentode as sync separator as it not only lends itself to more efficient separation but can also deliver the larger amplitude pulse required by many sawtooth generators. Fig. 1 illustrates the basic circuitry and component values for valves of the EF80, EF91 class when used as a sync separator.

It will be noted that the video input is negative-going with positive sync pulses; such a supply is available at the video anode when the cathode of the c.r.t. is modulated.

The high amplitude video output drives the pentode beyond cut-off, leaving only the positive sync pulses to appear at the anode, where they are now negative-going and suitable for applying to blocking oscillator or multivibrator timebases.

It will be seen from the diagram that the screen feed is unusually high, resulting in a low screen voltage. This ensures that the valve is driven beyond cut-off by the video input.

R2 is sometimes included in the grid circuit to "hold off" the input capacity of the sync separator from the video anode load which would tend to reduce the frequency response. The original d.c. level of the video waveform is lost by reason of the a.c. coupling, but this is re-inserted by the diode action which takes place between cathode and grid when the grid is driven positive by the sync pulses.

It is interesting to note that as we approach Band III frequencies, the effect of interference diminishes until we reach Bands IV and V where, although the vision modulation is negative-going with positive sync, interference effects are greatly reduced, but it is still necessary to include flywheel circuits in line time bases.

It is not practical to fit frame timebases with flywheel circuits, so every endeavour must be made to eliminate the effects of random interference on the frame pulses *before* they arrive at the time base; i.e. sync separator input and output circuits.

The sync separator derives its name from the fact that its function is to separate the sync pulses of both line and frame from the composite video waveform. In the early days of television it was common practice to use gas filled triodes as time base oscillators and the positive going sync pulses required to trigger them were obtained in many cases from a double diode valve.

As only low amplitude pulses were required to trigger gas triodes, they were taken from the cathodes. Gas triodes and diode separators have long since become obsolete and have only been mentioned for the sake of completeness.

It should be pointed out that the circuitry for sync separators can vary considerably from that shown, but the basic requirements remain the same.

Intermittent synchronising of both timebases can often be traced to the sync separator. The combined frame and line sync pulses appear at the anode of the separator, so before proceeding to their separation for use with their respective time bases, let us examine the pulses to ascertain that correct separation from the video waveform is taking place.

For this operation an oscilloscope is needed. With the oscilloscope timebase running at 3,375c/s we get a trace similar to Fig. 2a, showing three lines of sync pulses. The base line represents the remaining video waveform.

If the oscilloscope timebase is now run at 50c/s, we get one frame pulse as shown in Fig. 2b. Again the base line indicates video content, and if this base line is more than a small percentage of the total amplitude of the pulse, erratic synchronising will ensue.

If the video content exceeds 10-15% of the total pulses, the separator components must be examined for faults. If none are found, the design is at fault and is not suitable for fringe area conditions.

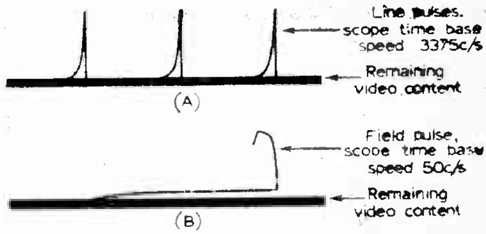


Fig. 2—Synchronising pulses at the anode of the sync separator, as seen on an oscilloscope.

The greatest benefits can be obtained by increasing the value of the screen feed resistor so that the voltage is 50 or lower. Further improvements can be gained by increasing the value of R2 to, say, 50kΩ, but since it is imperative to retain a high frequency response at this point, the value of R2 must be kept as low as possible.

In some circuits this resistor is omitted and the separation controlled by the screen voltage only. A reduction of R1 also improves separation by altering the bias voltage.

Having ascertained that the line and frame pulses are correctly separated from the video content, we can now pass on to the frequency-selective circuits which are used to channel the line and frame pulses to their respective timebases.

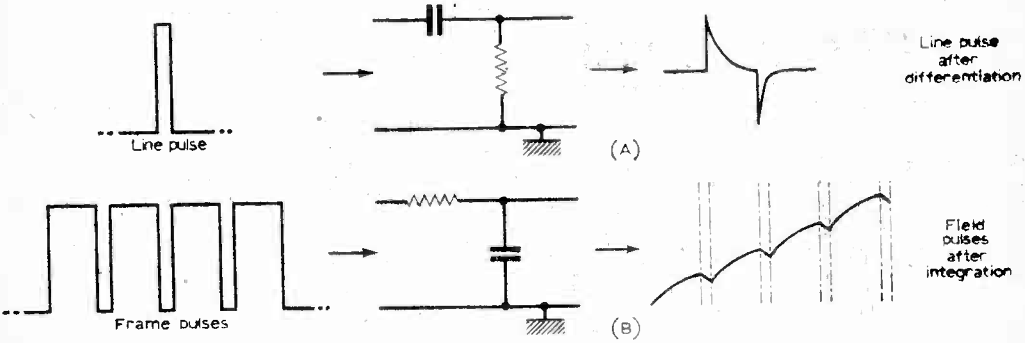


Fig. 3 (A)—Differentiating and (B) integrating frequency selective circuits and their effect on line and field pulses respectively.

Fig. 3 shows two principal types of frequency selective circuits which are most commonly used for pulse separation. The differentiating circuit shown at "A" produces steep fronted pulses which are ideal for triggering the line timebase and at "B" we have the integrated frame pulses.

It was stated earlier that in low signal areas frame sync pulses are prone to disturbance by impulsive interference because they are so much broader than the short line pulses. The integrating circuit shown at "B" although ideal for removing line pulses also greatly modifies the leading edges of the frame pulses, with consequent loss of interlacing.

This fault can be remedied by the use of the diode circuit shown in Fig. 4. The h.t. potentiometer is designed to bias the diode so that it con-

—continued on page 23

TELEVISION BANDWIDTH

By G. J. KING

THE practical sound spectrum extends from a few cycles per second up to about 16,000c/s. A person with first-class hearing would perceive sounds right up to 16,000c/s, and some people may hear sounds of even higher frequency. There is no clear demarcation between sound frequencies and very low-frequency radio frequencies.

Sound waves, however, differ from radio waves because the former are propagated by mechanical and air vibrations while the latter depend upon the ether for their propagation.

Whatever the frequency, though, the information that it represents can be propagated over long distances by the process of modulation. The electrical representation of sound waves, for instance, is modulated on a high frequency radio wave, and when the radio wave is received a large number of miles away the information which was originally modulated can be extracted by a process of demodulation.

This leaves the electrical representation of the original sound waves which can be translated back to sound waves by the loudspeaker, as we are all well aware.

Modulation

Any information can be modulated on a radio wave, or carrier wave as it is generally called, irrespective of its frequency or range of frequencies. It is possible for instance to modulate one radio wave upon another. Moreover, one of the radio waves may itself be modulated at sound frequencies.

Thus at the receiver there would be two detection or demodulation processes, one to extract the radio wave carrying the sound frequencies and the other to extract the sound information from the demodulated radio wave.

There are two main kinds of modulation. One is called "amplitude modulation" and the other "frequency modulation". As their names imply, the information is carried either by the *amplitude* (a.m.) or the *frequency* (f.m.) of the carrier wave being caused to vary to the pattern of the modulation frequency.

The depth of a.m. is given by the extent of amplitude variation of the carrier wave, while the depth of f.m. is given by the extent of deviation of the carrier wave frequency. In the latter case, the *rate of change* of the carrier frequency is a measure of the modulation frequency.

Both types of modulation are used in contemporary television. The picture information is carried by a.m. and the sound (in the 625-line system) by f.m. Before we investigate the f.m. sound system let us consider the picture modulation.

The Video Signal

It is fairly easy to understand how sound frequencies can be modulated on a carrier wave, but with vision, since there are no specific frequencies involved, the process may be a little puzzling at first. What happens, of course, is that the scene viewed by the television camera is broken down into very small elements. This is done by a scanning process.

Each picture element is then translated to a corresponding waveform. The television camera reels off many thousands of these elements for each picture which is flashed on the screen each one-twenty-fifth of a second. As is well known, each picture is made up of so many lines.

The two systems currently used in Great Britain use 405 lines and 625 lines. Thus, a string of picture elements is produced for each line.

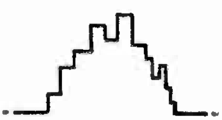


Fig. 1: A video waveform. The "steps" correspond to picture elements.

Fig. 2: Video waveform representing a black line.

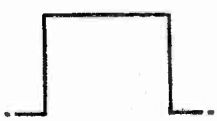


Fig. 3: Video waveform representing a white line.

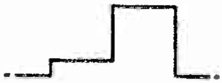


Fig. 4: The waveform of a half black/half white line.

Fig. 5: A narrow, white strip in the centre of a black line.

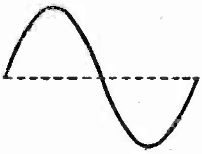


Fig. 6: A sine wave.

The result is a video waveform, and this is generally shown for each line of picture. The basic idea is given in Fig. 1. This represents a complex line; that is, one that has a widely changing variation of tones (between black and white).

A line of all black would give the simple waveform of Fig. 2, while a line of all white would give the waveform of Fig. 3. A line half block and half white would give the stepped waveform of Fig. 4.

As the line becomes more complicated in terms of variations of shade, detail and so forth, so the stepped waveform becomes more complex. Fig. 5 shows the waveform corresponding to a predominantly dark line with a narrow band of white in the centre.

Of course, each line is different on a continuously changing picture, but on a still picture each line could be the same. For example, if the waveform of Fig. 5 was repeated on each line, then the picture would be mainly dark with a narrow, vertical band of light in the centre. In that manner the picture is composed.

At this juncture, it is interesting to see how the waveform of an audio tone differs from a picture waveform. In Fig. 6 is shown the waveform of what should be a pure tone. This is a sinewave. It will be noticed that the datum line of this cuts through the centre of the waveform, giving positive and negative half cycles. With the video waveforms the datum line represents the base of the waveforms.

This means that the waveforms are relative to d.c., building up to a maximum amplitude towards peak white. With audio signals the d.c. is not retained, there being no need for it.

An audio waveform of music or speech is far more complex than a simple sine wave, and Fig. 7 gives some idea of the complexity of a music waveform. This is a photograph taken from the screen of an oscilloscope.

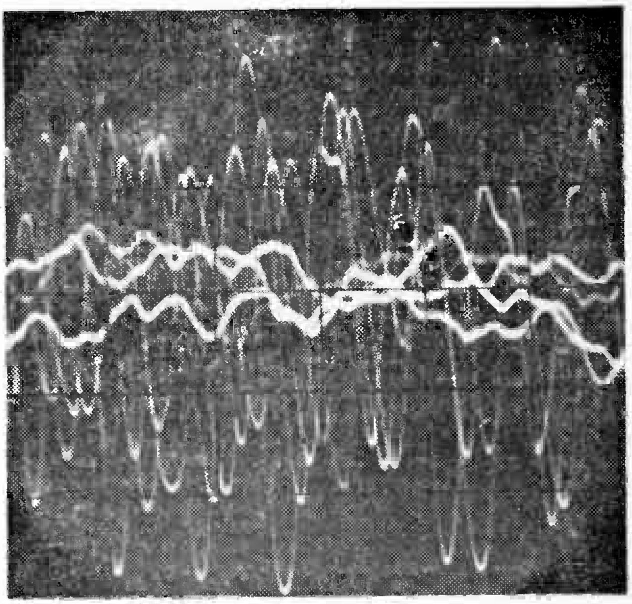


Fig. 7: A complex sound wave of music applied to an oscilloscope.

Square Waves

For sound, then, we need to modulate upon the carrier wave waveforms essentially of the sine wave character. With video, however, we need to modulate stepped, pulsed and square waves. This sort of waveform can be decomposed into a series of sine waves which are harmonically related.

Conversely, then, a square wave can be made by the integration of a large number of sine waves, starting from the fundamental frequency and working up through the harmonics to quite high frequencies. A perfect square wave would need all the harmonics of the fundamental frequency up to infinity.

This is impossible, of course, as it is impossible to create a perfect square wave. Nevertheless, very good square wave forms can be produced by integrating only a limited number of harmonic components of the fundamental sine wave.

The waveforms demanded for a well defined television picture have to contain component frequencies extending towards 3,000,000c/s on the 405-line system and towards 5,000,000c/s on the 625-line system.

Now we come back to modulation. For sound we need to carry information frequencies up to a maximum of 16,000c/s and for vision information frequencies up to 3Mc/s or 5Mc/s, depending upon system. Moreover, the vision has theoretically to go right down to d.c..

Sidebands

Now, when a carrier wave is amplitude modulated, there are produced sideband frequencies. These equal the carrier frequency plus the modulation frequency and the carrier frequency minus the modulation frequency, giving upper and lower sidebands respectively.

To accommodate these sideband frequencies the transmission channel, right from the transmitter to the receiver, should have a bandwidth equal, at least, to twice the modulation frequency.

Take sound. A high quality channel to reproduce the very highest audio frequencies would need to be two times 16,000c/s, or 32kc/s. If the bandwidth of the channel is narrower than this, then the higher order sideband frequencies will be suppressed in amplitude and attenuation of the treble will result.

The effect is shown diagrammatically in Fig. 8. At (a) the extremes of the sidebands extend beyond the channel response curve, meaning that the higher modulation frequencies fail to cause any response. Therefore there is a lack of high audio frequencies in the transmission channel, or in a section of it, depending upon where the suppression exists, which may be at the transmitting end, in the link or land lines between the studio and transmitter or in the receiver. The limitation is generally in the latter.

At (b) is shown the same range of sideband frequencies relative to a wider response. Here it will be seen almost all of the high audio signals get through without attenuation and good quality is assured.

The same reasoning applies so far as the video sidebands are concerned. These, however, extend over a much greater range of frequencies than sound, as we have seen. The channel width, then, needs to be that much greater for video.

This is taken care of at the transmission end by the authorities. At the receiver, the channel width is governed very much by how well the set is

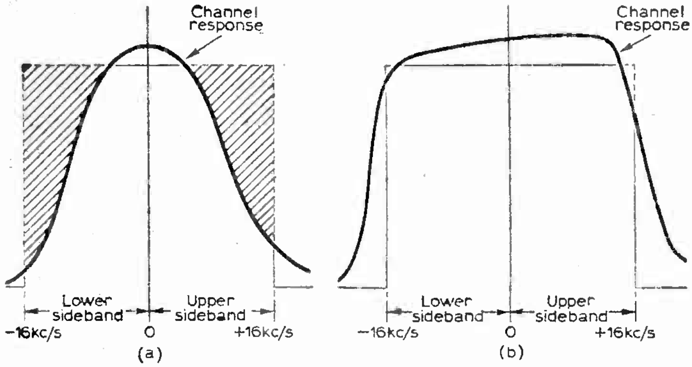


Fig. 8(a): A narrow channel response suppressing the higher frequency ends of the sidebands. On sound this would result in treble attenuation and on vision lack of definition. (b): The whole range of sidebands accepted without attenuation by a suitably wide channel response.

aligned. If the alignment is such that the video bandwidth is narrowed, then the high video frequencies will be attenuated.

This has the effect of impairing the desirable "squareness" of the video waveforms, as shown in Fig. 9. It will be seen that the corners are rounded, and this prevents the waveform elements of the picture causing almost instantaneous changes in brightness on the screen. This, of course, is necessary to secure a crisp, clearly defined picture.

Thus, limited video bandwidth impairs the definition of a picture by causing a slow change in brightness of the scanning spot as the picture elements themselves change in brightness.

Fig. 9: Restricted bandwidth in the vision channel distorts the video waves by rounding off the square corners, as this diagram shows.

Bandwidth Check

Test Cards provide a measure of bandwidth judgement in terms of the vertical frequency gratings. These relate frequency to changes in brightness of the scanning spot. If the bandwith of the set is good, then the brightness changes will be rapid and the vertical lines will be clearly defined.

However, if the bandwidth is suppressed for some reason, then the vertical lines of the frequency gratings may not even be seen, the effect being just a blurred greyness.

The Test Card C picture in Fig. 10 shows that the definition of the set from which the picture was taken falls off around about 2Mc/s. The 2·5Mc/s and 3·0Mc/s frequency gratings cannot be seen. The effect on an ordinary picture is a blurring on thin, black and white vertical picture content. Indeed, the horizontal definition (i.e., how well verticals are refined) is a direct function of the bandwidth of a television channel.

The vertical definition is set by the number of lines making up the picture. However, if the number of lines is increased, the bandwidth has also to be increased to avoid impairment of the horizontal definition. This is why the 625-line system needs a greater video bandwidth than the 405-line system.

It is not generally known that if the number of lines is increased without the video bandwidth being increased to correspond, the overall definition of a picture may be decreased rather than increased.

This is one of the early problems encountered by our 625-line system. While the number of lines has been increased, it is not always possible on all transmissions to run at the full 5Mc/s video bandwidth because some of the programme and video links are still equalised only for the 405-line bandwidth. The result, then, is an apparent fall-off in definition of the 625-line pictures, rather than the improvement which 625-line viewers expect.

Fortunately, this problem is rapidly being resolved from the transmission aspect, but there have been reports of poor 625-line definition due

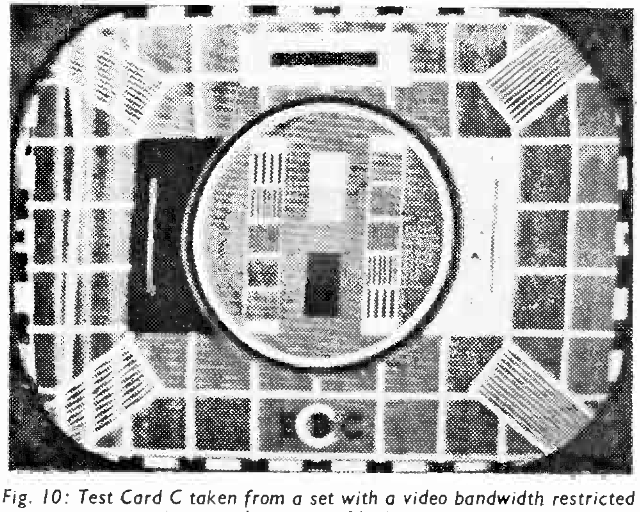


Fig. 10: Test Card C taken from a set with a video bandwidth restricted above about 2Mc/s.

to bandwidth restriction in the receivers themselves. This may be due to bad alignment or to the compromises that have to be made in the design of a dual standard receiver within a competitive price range.

Single-sideband

The bandwidth of a video channel is not two times the highest modulation frequency, as may be expected. This is because single-sideband working is adopted in Great Britain. This means that one sideband only is transmitted in full, the other being almost totally suppressed. Full suppression is impossible, but partial suppression knocks the required video bandwidth down to almost half that needed by double-sideband working.

The detector stage at the receiver is adjusted to accommodate one-and-a-bit sidebands. To avoid pre-emphasis at the frequencies, where both sidebands are present, the set is aligned so that the vision carrier falls about 6dB down the vision channel response.

The balance can be finely adjusted by the viewer, simply by operating the fine tuning control. This has the effect of shifting the vision carrier relative to the vision response curve.

405-line System

The 405-line system has an overall 5Mc/s channel width in which is accommodated the 3Mc/s video bandwidth and the relatively much narrower sound bandwidth. Although from the sideband aspect, the a.m. sound of the 405-line system requires a bandwidth of only about 32kc/s for top quality reproduction, a bandwidth in excess of this is generally employed in the receiver itself. A bandwidth approaching 200kc/s is not uncommon.

This wide bandwidth allows room for adjusting the fine tuning control for the best picture quality without losing sound. It also allows for oscillator drift in the tuner and it facilitates suppression of impulsive interference (such as car ignition interference) on sound. The wider bandwidth narrows the interference pulses and thereby makes their suppression easier.

The 405-line channel width provides a separation of 3·5Mc/s between the sound and vision carriers, the vision being higher in frequency than the sound.

625-line System

The 625-line system has an overall 8Mc/s channel width. This carries the 5Mc/s video bandwidth and the f.m. sound bandwidth. Again, this is about 200kc/s wide, but it needs to be wider than the minimum of twice the modulation frequency because f.m. creates a series of sidebands which, for optimum quality, need to be retained. In this system the sound/vision spacing is 6Mc/s, with the sound the higher frequency.

The sound and vision carriers are actually caused to modulate each other at the vision detector in the set. The result is that a difference-frequency of 6Mc/s (the difference between the vision and sound carriers) is produced. This is called the "intercarrier" frequency which is used for the sound.

A limiter is used to get rid of the varying amplitude of the vision component and an f.m. detector then extracts the modulation from the sound component. Filters are used to prevent the 6Mc/s intercarrier signal from getting to the picture tube.

When considering bandwidth of a television channel, one must take into account not only the video and sound bandwidths separately, but also the overall channel width. This is because the aerial and the tuner of the set have to respond to the entire channel width if optimum picture quality and correct balance between sound and picture are to be achieved. ■

SYNC PROBLEMS IN FRINGE AREAS

—continued from page 19

ducts only when the pulses exceed the required value. In this way the same amplitude of pulse is always used to trigger the timebase; thus ensuring that good interlacing is obtained.

A number of circuits, some complicated, have been designed to improve frame synchronising, but the interlace diode circuit illustrated is the most popular. It should be remembered that manufacturers can only design for average conditions, so it is quite often possible to improve the action of the sync separator for specific conditions.

In troublesome areas, marked improvement can be obtained by reducing the size of the coupling capacitors. This has the effect of differentiating the pulse. The resultant sharpened pulses are less liable to be interrupted by random interference.

Where a coupling capacitor does not follow the diode, a differentiating circuit can be fitted with a short time constant, i.e. C=47pF and R=10kΩ. When fitted this will greatly improve the lock of the frame timebase.

The pulse shapes shown in Fig. 2 were observed on a 3in. workshop oscilloscope. For detailed examination of sync pulses, it is necessary to use an oscilloscope which has provision for expansion of the timebase trace. In this way, the pulses can be expanded and examined in detail.

It is then possible to note the effects of modifications and is the only positive way of securing satisfactory synchronising in difficult areas. ■

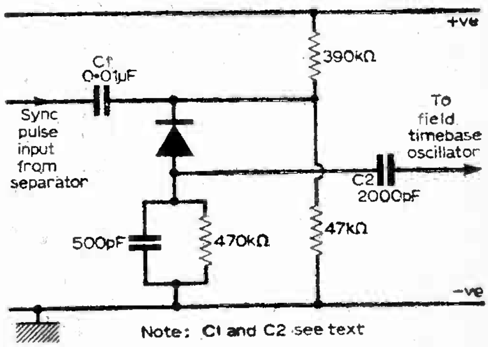
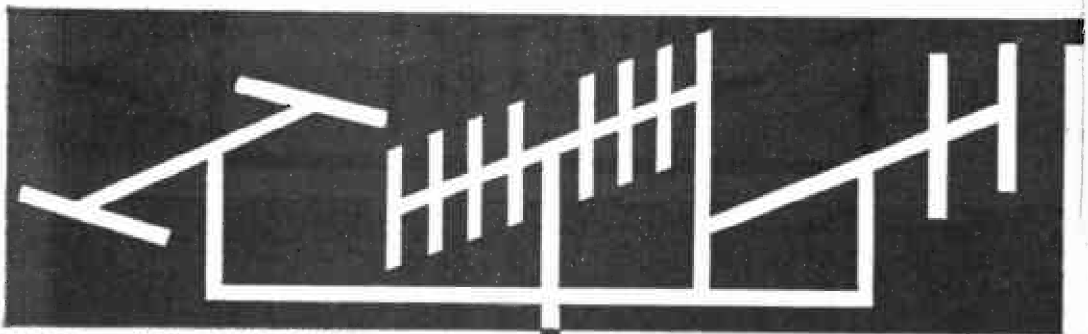


Fig. 4—A diode circuit to remedy the loss of interlace incurred with the frequency selective circuit of Fig. 3 (B).



EXPERIMENTAL V.H.F.

FOR years now the author has been experimenting with and developing v.h.f. amplifiers of various types and designs for a host of applications. Some of these developments are now used in coaxial relay systems and as set-side aerial signal boosters.

The early circuit developments employed valves and some of these were arranged for experimental construction and described in the pages of PRACTICAL TELEVISION during the 1950's. When the first of the v.h.f. transistors became available, the author produced a two-stage single v.h.f. channel transistor amplifier. This was later featured as a constructional article in the April and May 1962 issues of PRACTICAL TELEVISION.

Since then there has been quite a bit of development work carried out on both v.h.f. transistors and their circuits, and this article gives an insight as to what is going on in this sphere of activity at the present time.

40-220 Mc/s

For some time now there has been a need for a medium-gain wideband v.h.f. set-side amplifier, covering Bands I, II and III, from about 40 Mc/s up to about 220 Mc/s with a gain in the order of 12dB (16 times power amplification and four times voltage amplification). Such an amplifier can be useful for connecting between the common coaxial downlead and the television receiver's aerial socket, especially in those areas of weak and mediocre signal field and where the common downlead carries BBC and ITV television as well as Band II f.m. signals, as shown in Fig. 1.

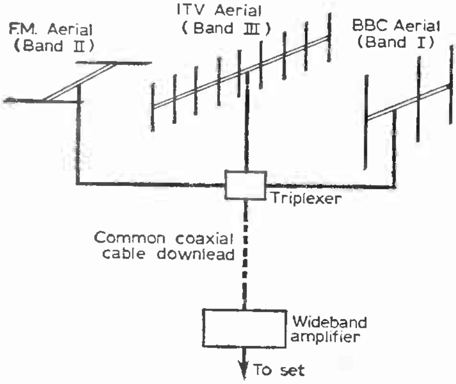


Fig. 1—The amplifier can be connected to a common downlead as shown to amplify all signals simultaneously.

An amplifier of this kind would also have a very useful application for supplying the whole range of signals to a number of receivers from a single set of aerials, as shown in Fig. 2. Nowadays, of course, quite a number of television sets feature f.m. radio facilities, so an amplifier with gain over almost the entire v.h.f. spectrum is ideal for boosting signals for applying to this type of set.

There is no reason why, on the other hand, it could not be used for boosting the signals of just one Band I or Band III television channel or even the f.m. signals alone. It thus has a versatile application.

The amplifier to be described is of this type. Moreover it lends itself to ease of cascading for added gain and for line-powering in extended aerial systems.

Circuit Description

The circuit of the amplifier is shown in Fig. 3. This is well worth consideration as it differs substantially from most ordinary v.h.f. transistor amplifiers. Two transistors are used, Tr1 and Tr2, each connected in the common-base mode. That means that the base is common to both the input and output signals. The signals are thus applied between the emitter and base and taken from between the collector and base.

Tr1 is coupled to Tr2 via the special wideband transformer T1, while the signals are taken from Tr2 via a similar transformer T2. Neither of these transformers is tuneable. This makes the amplifier easy to construct and operate as alignment problems are totally avoided. It is absolutely non-critical.

A medium-gain wide-band set-side amplifier covering Bands I, II and III

AMPLIFIER

BY G. J. KING

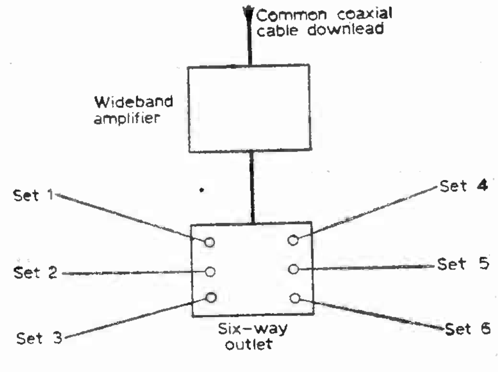


Fig. 2—The amplifier can also be employed to feed signals in all channels to six receivers, as shown.

The transformers can in effect be considered as extensions of an ordinary transmission line. The windings of this kind of transformer are arranged so that the interwinding capacitance represents a component of the characteristic impedance of the transmission line. The inductive component is produced by winding the sections on a ferrite toroid in bifilar fashion.

Bifilar simply means that the two windings are wound together in parallel, the ends of the windings then being sorted out afterwards to provide the correct phasing and so forth. This method of construction avoids resonances which, in conventional transformers, can limit the overall bandwidth. The core permeability in conjunction with the number of turns on the windings governs the low-frequency response. This means that fewer turns are required for a given low-frequency response with a high permeability core material as compared with a transformer made with a core of lower permeability.

The permeability of ferrites drops at v.h.f. but the efficiency of the transformers is maintained at the top end of the v.h.f. spectrum by the normal effect of the increase in frequency holding up the capacitive reactance between the windings.

Tl and T2

T1 and T2 are of identical design, the exact mode of construction being revealed in Fig. 4. Here it will be seen that one winding starts at 1 and finishes at 2, while the other winding starts at 3 and finishes at 4. The two windings can be identified as one is drawn in thick line and the other in thin line.

The two windings are wound in parallel with each other to give the bifilar attribute. There are four complete turns on the ferrite toroid. The toroid itself is nothing more than a simple ferrite bead costing about 2d. There are various types and sizes of such bead. The type employed by the author, having been proved to be perfectly satisfactory, is the kind designed for threading on to a conductor for increasing its inductance. This artifice is often adopted in v.h.f. equipment for "blocking" v.h.f. signals from power supply circuits and for similar applications.

This sort of bead is about $\frac{3}{16}$in. in length by about $\frac{3}{32}$in. in diameter with a hole through the centre of about $\frac{1}{16}$in. in diameter. It is very small and there is not a great deal of room for the wire. Nevertheless the windings can be accommodated without difficulty and the small size is technically desirable as it keeps proximity effect losses at a low level.

The wire for the windings is enamelled-covered 36 s.w.g. for winding 1-2 and 30 s.w.g. for winding 3-4. The two sizes of wire facilitate winding identification and ensure that the four double windings can be accommodated on the small size bead. Larger diameter wire should not be used.

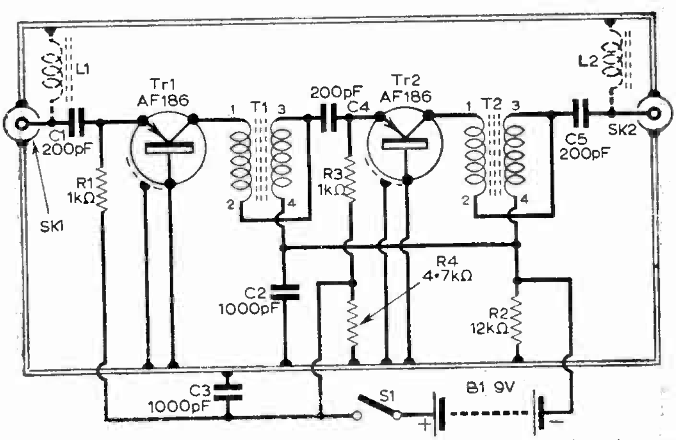


Fig. 3—Circuit diagram of the amplifier. This is fully described in the text.

A finished transformer (T1) is clearly visible in the sub-assembly picture in Fig. 6.

The winding numbers on Fig. 4 correspond to the numbers against the transformer windings on the circuit in Fig. 3. It will be seen that on each transformer ends 2 and 3 are connected together. This joint should be processed as close as possible to the core of the transformer, connection then being taken to the circuit from this transformer winding joint. On no account should the joint be processed actually at the circuit connection as this would put two lengths of wire in series with the windings. The high-frequency response would then be impaired.

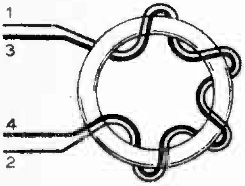


Fig. 4—Winding details of the ferrite transformers, T1 and T2. The numbers on the windings correspond to those on the transformers in the circuit.

The way that the windings are connected endows the transformer with a 4-to-1 ratio impedance step-down. This means that the impedance at the collector is stepped down four times or, conversely, that the impedance at the output of the transformer (i.e. as at the emitter circuit of Tr2 or across socket Sk2) is "seen" by the collector to be four times as high. It is by virtue of this impedance transformation that amplification is provided.

It is instructive to see just how this happens. When a signal is applied to the emitter circuit, as in the common-base mode, the signal current flowing in the collector circuit is approximately equal to the signal current as applied to the emitter. The input signal power P_{in} is thus equal to

$$P_{in} = i^2 Z_{in}$$

where i is the signal current and Z_{in} the transistor input impedance in the common-base mode.

Similarly the output signal power P_{out} is equal to

$$P_{out} = i^2 Z_c$$

where i is the collector signal current and Z_c the impedance as "seen" by the collector.

The power gain P_g is thus equal to P_{out}/P_{in} or $(i^2 Z_c)/(i^2 Z_{in})$, which is equal to Z_c/Z_{in}

Thus if Z_c is equal to Z_{in} the power gain is unity. However, if Z_c is four times Z_{in}, as arranged by the 4-to-1 impedance transformer, then the power gain is four times or 6dB, while the voltage gain is two times. Two cascaded stages will give 2×6dB (12dB) or a power gain of 16 times (4×4) and a voltage gain of four times (2×2).

This is the basis of design of the amplifier in Fig. 3. The input and output impedances are taken to be in the order of 50/70Ω. A number of transistors were experimented with and the new Mullard AF186 was found to be highly suitable. In the common-base mode and adjusted for an emitter current in the order of 2·5mA (at 9V) the input impedance is around 50Ω. If the collector impedance is 200Ω, as reflected by the wideband transformer, the gain of each stage is as calculated above.

In practice the source impedance (i.e. that impedance as "seen" by the transistor input circuit) and the output impedance (i.e. that impedance as present across the output of the wideband transformer) are more like 70Ω, assuming ideal matching to the coaxial cables and freedom from standing waves. Thus the gain is slightly different from that calculated above, depending upon the extent of mismatch.

Matching Problems

Clearly the gain will be greater if the impedance to which the output of the amplifier is connected is greater than the source resistance at the input and, conversely, the gain will be smaller if the input source impedance is greater than the impedance as "seen" by the output terminals of the amplifier.

A great deal of attention was given to the question of matching by the author and attempts were made in an endeavour to present the emitters of the transistors with a source impedance of 50Ω from a 70Ω coaxial cable. This sort of matching is not impossible but it is difficult over a very wide range of frequencies.

Many tests made by the author on this and a host of different transistor v.h.f. amplifiers have revealed the futility of designing for a 100% impedance match when the equipment is to be used with an average television set and aerial system.

Although v.h.f./f.m. and television aerials are designed to load the feeder cable to match its characteristic impedance, say 70Ω, in practice the dipole impedance is rarely exactly equal to the characteristic impedance of the downlead, particularly in the case of wideband and composite aerial systems and when separate aerials are connected to a common downlead through certain types of diplexer and triplexer! This is not a criticism of aerial design but it reveals certain compromises that

COMPONENTS LIST

Capacitors:
C1, C4 and C5 200pF ceramic.
C2 and C3 1,000pF ceramic.

Resistors:
(All $\frac{1}{4}$- or $\frac{1}{2}$-watt insulated) R1 and R3 1,000Ω, R2 12,000Ω, R4 4,700Ω.

Transistors:
Tr1 and Tr2 Mullard AF186.

Battery:
Ever Ready PP4.

Miscellaneous:
2-oz. tobacco tin. Piece of sheet tin. Two coaxial sockets. S.P.S.T. toggle switch. Two ferrite beads. Lengths of 30 and 36 s.w.g. enamelled-covered copper wire. Two four-tag strips. Battery clips (for PP4 battery). 6BA nuts and bolts. Connecting wire and battery leads.

cannot be avoided in "domestic electronics".

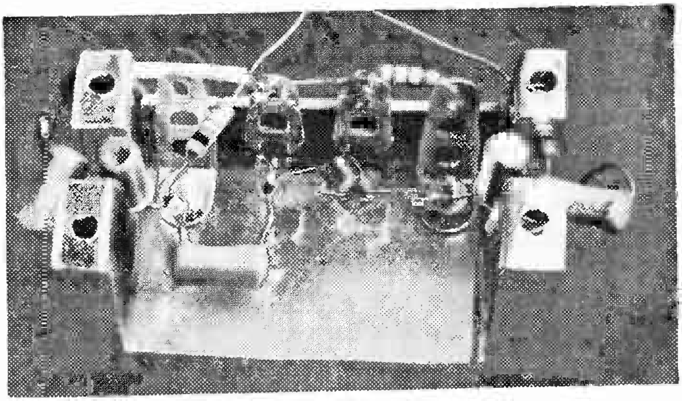
While an aerial manufacturer may go to great pains with matching stubs and similar devices to ensure that, erected under ideal conditions, his aerial shows its feeder a perfect match, the whole equation is in practice unbalanced due to the need these days to erect aerials very close to neighbouring aerials on a shared chimney stack. The proximity of other large bits of metal does a great deal to destroy the matching that the manufacturer spent a lot of money and time on optimising.

Other mismatches occur when a flylead of coaxial cable slightly different from that of the main downlead is connected between the television or f.m. radio receiver and an outlet socket mounted on the window-sill, for instance. Bad mismatches can also occur in diplexers and triplexers as already intimated

Moreover, while the aerial input at the receiver may be nominally valued at 70Ω or so this impedance is not consistent over all channels (or rarely so). Indeed tests of admittance performed by the writer some years back showed changes of impedance ranging from about 30Ω up to 100Ω over the channels. This gives trouble in coaxial relay and shared aerial systems.

Nevertheless for optimum noise performance the best impedance match possible is necessary. If, for instance, it is required to use the amplifier essentially for lifting a very weak signal, say on channel 9, an external matching arrangement could be connected between the aerial downlead and the input of the amplifier. If there is a slight mismatch on the channel 9 aerial system then the simplest way of matching is by carefully adjusting the length of the downlead until the impedance that it shows to the amplifier is in fact 50Ω.

The downlead should be cut about an inch or less at a time and tried in the amplifier at each cut, aiming for the best noise performance (i.e. least grain or "snow" on the picture). This



Details of the sub-assembly. Note the ferrite transistor T1 connected between the transistors.

technique applies to any transistor amplifier.

The impedance variation at the receiver aerial terminal is less important. It is best to "swamp" it as much as possible by connecting the amplifier to the receiver through a piece of coaxial feeder of good quality not less than 9ft. in length. This again applies to all transistor amplifiers which are output impedance sensitive—and most of them are.

This technique should also be adopted if there is any tendency for the amplifier to develop instability. In nine cases out of ten an amplifier to set coaxial lead not less than 9ft. long will solve the problem.

An alternative method of matching an ordinary downlead to 50Ω is by the use of a quarter-wave coaxial transformer. This simply consists of the appropriate length (as dictated by the frequency—or channel number—for optimum matching) of cable inserted between the downlead and the input to the amplifier. The characteristic impedance Z_t required by the coaxial transformer is equal to

$$Z_t = \sqrt{Z_1 \times Z_2}$$

where Z_1 is the characteristic impedance of the downlead and Z_2 the input impedance of the amplifier. Cable with a characteristic impedance of about 60Ω would serve to give a reasonable match at the required "low-noise" frequency.

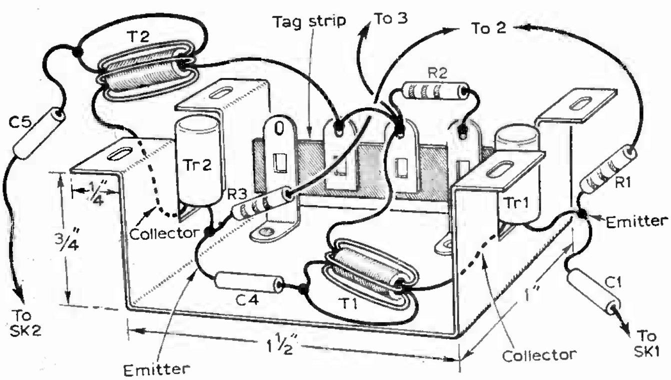


Fig. 5—Point-to-point wiring details of the sub-assembly.

Now let us investigate the construction of the experimental amplifier. The prototype was built into an ordinary 2oz. tobacco tin as shown by the photograph. The body of the amplifier is in the form of a sub-assembly (see photograph). The dimensions and make-up of this sub-assembly are shown in Fig. 5.

It consists of a piece of ordinary, thinnish tiplate (cut from a second tobacco tin or cocoa tin) cut to 1in. in width and bent to have ¾in. sides, a 1½in. top and ¼in. top and ¼in. flanges each side for fixing to the tobacco tin. Before the tinplate is bent, however, slots are cut either

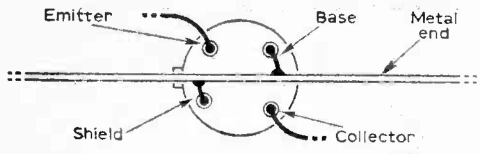


Fig. 6—This diagram identifies the transistor lead-outs and shows how the transistors are mounted.

side to accommodate the body of the transistors as Fig. 5 shows.

The top of the tin sub-assembly is drilled so that a four-way tagstrip can be mounted inside. The two outside tags are "earths", the inner two being isolated. The tagstrip should be cut to have a length just equal to the inside of the bent tin so as to give it rigidity. The flanges are drilled to take 6BA screws.

After the sub-assembly has been drilled and the tagstrip fixed the transistors should be mounted, wire ends down, as shown in Fig. 6. This diagram identifies the lead-out wires as looking at the base of the transistor. Note that both the shield and the base lead-out wires are soldered to the metal ends of the sub-assembly, giving the emitter lead-out on one side of the metal and the collector lead-out on the other. In this way almost perfect input/output screening is assured.

Fig. 5 shows that the collector lead-out of Tr2 is outside the sub-assembly, while that of Tr1 is inside. Thus inside there is the emitter lead-out of Tr2 and the collector lead-out of Tr1. This facilitates the inter-transistor coupling via T1 and C4.

When the sub-assembly is wired to the extent shown in Fig. 5 the tobacco tin can be prepared to accept it. Fig. 6 gives the idea. Firstly the tin is drilled to take the sub-assembly, the input and output coaxial sockets, Sk1 and Sk2 respectively, tagstrip 2 and the on/off toggle switch. Tagstrip 2 is similar to that employed inside the sub-assembly, having two outer "earths" and two inner isolated tags. Fig. 6 also shows the point-to-point wiring

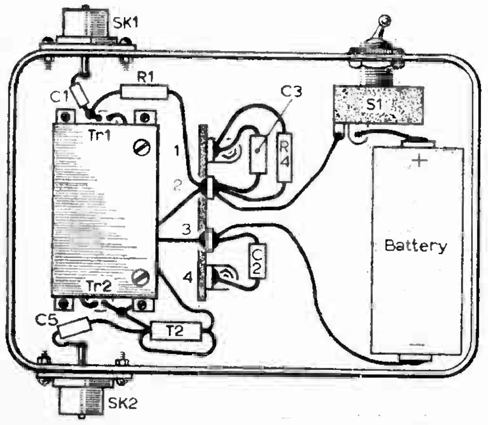


Fig. 7—Point-to-point wiring diagram of the complete unit.

of the sub-assembly to the various tin-located components and tags.

Finally clips suitable for a type PP4 (or equivalent) 9V battery are soldered to the wires from C2 and S1 and to avoid the battery terminals shorting against the metal tin a length of thin rubber or cork should be dressed round the battery as shown in the photograph.

Testing

Before connecting the battery and switching on the circuit should be thoroughly checked for correct continuity and to ensure that there are no short-circuits as these could be expensive! When completely satisfied in this respect the battery can be connected and the unit switched on. The total current consumption at 9V will be in the order of 5mA. Currents differing substantially from this would indicate a fault condition, in which case the unit should be switched off, the battery removed and the wiring rechecked. Note that the metal tin is common to the bases of the transistors and *not* to the battery. Neither battery terminal must be allowed to come into contact with the tin.

If the current is normal the unit can be connected to a television set in series with the coaxial downlead, when a dramatic increase in signal strength will be noted on all programmes. The extra signal strength on f.m. will tend to reduce the amount of interference due to electrical effects such as car ignition systems, vacuum cleaners and so forth, since the receiver will now be pushed harder into amplitude limiting.

Transient Protection

It is rather important that any a.c./d.c. type receiver which is used with the amplifier be connected to the mains supply so that its chassis is at mains neutral. This is the correct way of connecting a set anyway. If the set is connected so that mains "live" is connected to the chassis there is the possibility that transient currents will flow through the transistor junctions each time the set is switched on and off.

These may well have a magnitude sufficient to destroy the transistors, even though the capacitor isolation in the set is well up to standard. This is because the transients are of an electrostatic nature, causing the charging and discharging of the input and output capacitors C1 and C5 via the isolating capacitors of the set

The effect is considerably aggravated if the aerial happens to be earthed. One could then almost be sure that the transistors would fail either when the amplifier is connected or disconnected from the set and/or aerial or when the set itself is switched on and off.

One way of making sure that some protection is afforded should the set be wrongly connected to the mains supply is by connecting a small dust-iron core v.h.f. choke across the input socket and a similar choke across the output socket as indicated in Fig. 3 by the dotted inductors L1 and L2. Ordinary 1A TV suppressor chokes are ideal for this purpose.

They are virtually open-circuit at v.h.f. and an

—continued on page 40

Servicing TELEVISION Receivers

No. 118: The Alba T866 and T877

by L. Lawry-Johns

THESE notes may be used in conjunction with several models in the Alba range but are mainly concerned with the T866 and T877 which are the 19in. table models, the latter having remote control facilities.

Touch tune buttons are featured with the band selector at the front and the tuning knobs at the side. Easily removed and replaceable panels carrying most of the components are used and if any serious trouble is encountered these may be exchanged through an Alba dealer at a very nominal price. This is part of the Alba " Packaged Service " scheme.

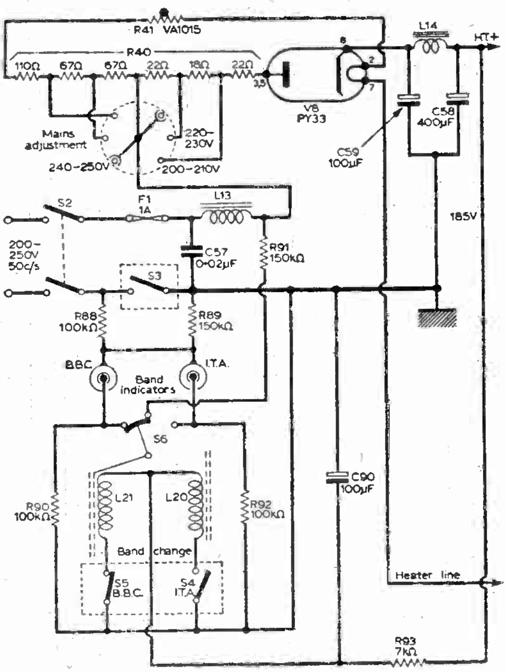


Fig. 1: Mains input stage.

Servicing Notes

Channel tuning: It is essential to tune the Band III channel first. Depressing the left side of the switch selects Band III and the side button is then rotated to the fully clockwise position.

Unscrewing anti-clockwise then selects the lowest channels first, Channel 7 about three turns, Channel 8 about six and so on up to Channel 13 which requires about 20 turns.

To tune the required Band I channel, depress the right hand side of the switch and then rotate the Band I knob from the fully clockwise position, the channels selected are Channel 5 two turns, Channel 4 four and a half, Channel 3 seven turns, Channel 2 ten, Channel 1 about 15.

The remote model uses the same procedure but the button on the remote unit must of course be selected first.

Dismantling

Remove the screw securing the volume-contrast assembly, pull off the tuning knobs, remove the speaker leads from the output transformer. Remove the two screws at the top corners of the chassis and the three screws beneath the cabinet.

Ease out the bottom first and then remove the complete assembly—tube and screen in one unit. The remote control model has the volume and contrast on the extension unit which is unplugged from the side recess but other than this the above details apply.

Tube Removal

Remove the tube base socket and unplug the deflection coils leads—noting the colour coding to the field and line coils. Loosen the clamp and slide off the neck of the tube.

Remove the e.h.t. connection from the side of the tube. Remove the six screws and remove tube complete with mounting and screen in a forward direction. The screen is held by four screws to the strap.

When fitting a new tube ensure that a gap of $\frac{1}{8}$ inch is left between the tube and screen.

Tuner

The tuner is held in position by four screws on the underside. There are eight connecting leads to remove and the lever from the channel selector to the switch extension before the tuner can be removed completely.

Panels

The two panels are secured by a single screw each and when this is removed the panel can be pulled out by a horizontal movement.

Frequent Faults

The most frequent fault which occurs with these models apart from valve failure is associated with the video amplifier end of the i.f. panel where R36, R37 and R38 often change value sometimes with severe overheating, blown fuse etc.

This severe condition is caused when R37 (47kΩ) changes value dropping down to a virtual short causing a heavy flow of current from h.t. through R38 (330Ω) to chassis.

This of course necessitates replacement of R37 and R38. The latter may still read the proper value but it may be damaged internally and will probably fail later.

A less severe condition occurs when R36 changes value. This results in the "tone" of the picture changing, it being impossible to obtain the correct setting of contrast and brilliance, a condition similar to that which would normally point to a low emission video amplifier (V7—PCF80).

If replacement of this valve does not restore normal conditions, check R36. The correct value is 10kΩ. The writer normally uses two resistors in this position, either two 4·7kΩ in series or two 22kΩ in parallel (exact values are not unduly critical).

We are also in the habit of making R37 of two resistors, two 27kΩ in series or two 82kΩ in parallel. There is no objection to the resistors being mounted vertically so that they may be more easily accommodated.

No Picture

If there is no raster when the brilliance is fully advanced the fault is quite likely to be in the line output stage. Check the EY86 if the line time base whistle is audible. This may have an o/c. heater or may be internally shorted.

If removing the top cap brings things violently back to life this latter is the more likely condition. If this is not so and the timebase remain dead check the PY81 and the PL81. The latter is more often at fault.

If the PL81 is running hot check V11 ECL80 which is the line oscillator, also C76 0·01μF which may be o/c. or leaky see "volume control." If the valves are in order and the PL81 is not over-heated check C80 0·25μF and R76 width control (300Ω).

Dark Picture with Reduced Height

This is usually the result of reduced boost line voltage and C82 0·1μF may be found to be shorted. Reduced height but at full brilliance however is

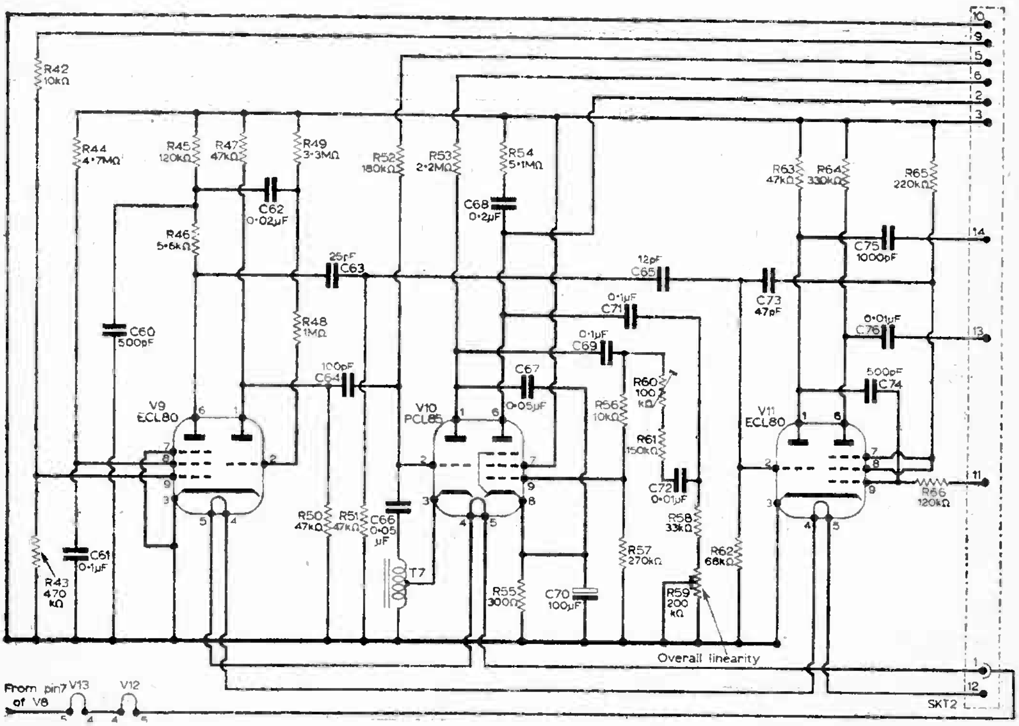


Fig. 2: Sync separator, frame oscillator and output, and line oscillator.

more likely to be due to R53 2·2MΩ going high.

By reduced height we mean an even loss of height top and bottom. If a loss of height is experienced which is more evident at the bottom, this being much reduced and compressed, check C70 100μF which often becomes o/c.

Check V10 PCL85 if necessary, also R55 300Ω. In stubborn cases check C72 0·01μF.

Small Picture

Lacking both width and height or slow to reach full size, check V8 PY33 h.t. rectifier. If this width is lacking and the height seems excessive, check V13 PL81 and the other line time base valves and components.

Good Sound Raster but No Picture

This means that the aerial and tuner is probably in order as the sound is well received, also that the tube and timebases are in order as the brilliance is controllable. This leaves the vision i.f., detector and video amplifier stages as suspects.

In this case the writer would cut across routine tests and check the continuity of L12 the video choke as it is a simple matter to check it by noting the effect of shorting it out.

The reader will probably find that this has done him no good at all! However it's worth making this quick check before checking V7 PCF80, V6 EF80, D3 OA70 and C47 in that order.

If difficult inject 35·75Mc/s to pin 2 of V3 EF85, then pin 2 of V6 EF80, force signal to pin 7 if necessary but valve and voltage checks should have revealed the fault before signal injection is necessary.

Sound Absent

If there is no response from the loudspeaker at all check V5 PCL82 and the continuity of the audio output transformer T10. No h.t. at tag 11 socket 1 or pin 6 of the PCL82 base directs attention to the continuity of the transformer.

If there is a hum in the loudspeaker check R26 100kΩ, D2, OA81, D1 OA79, V4 EF80 and valve base voltages preferably the latter first.

Contrary to any impression gathered by readers, that the writer believes in short cuts and snap diagnosis, the fact is that we have always held the opinion that there are few faults in TV receivers (and for that matter transistor radios) which are not revealed by careful routine voltage checks and however helpful a neon tester may be, it is the voltmeter which is the cornerstone of all serious servicing.

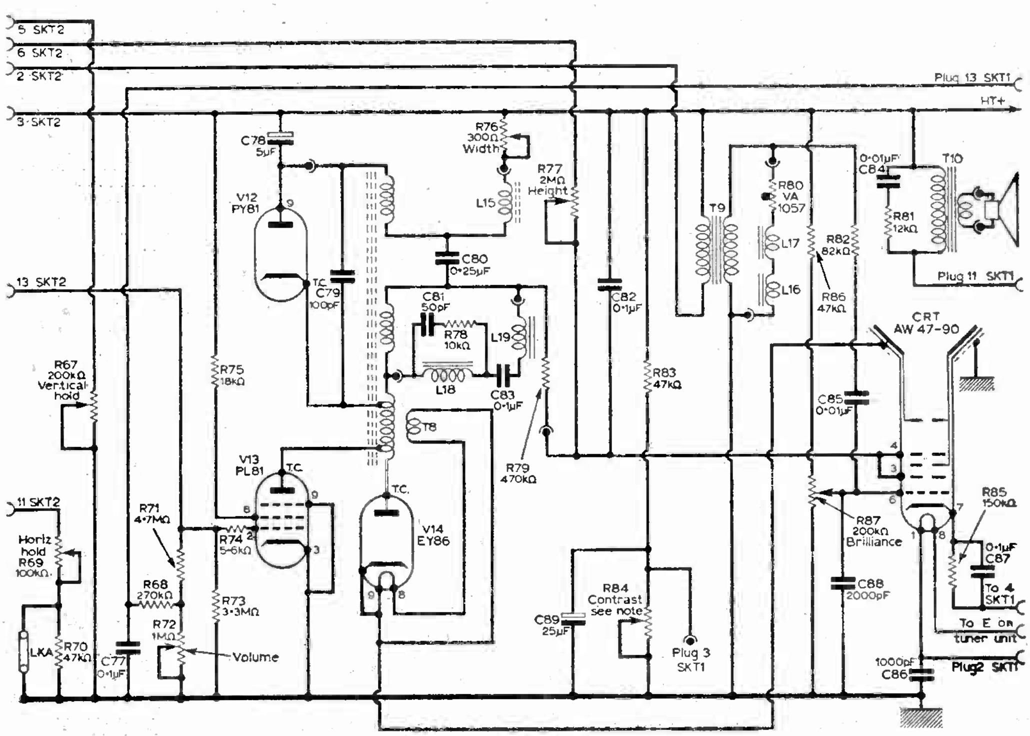


Fig. 3: The line output and c.r.t. circuit.

ON THE AIR
Amateur Band Topics

A DESCRIPTION OF AMATEUR TV STATION G6CTS/T

G6CTS/T is located at Norwood Technical College in S.E. London, and is operated under the aegis of G. L. Danielson, M.Sc.Tech, B.Sc., A.M.I.E.E., Head of the Telecommunication and Electronics Department.

The station is currently being used in the training of some fifty final-year full time Diploma Course students and a number of part-time day and evening students attending Television Technology classes. Full time students also assist in work on a research project relating to the transmission characteristics of surface wave feeders.

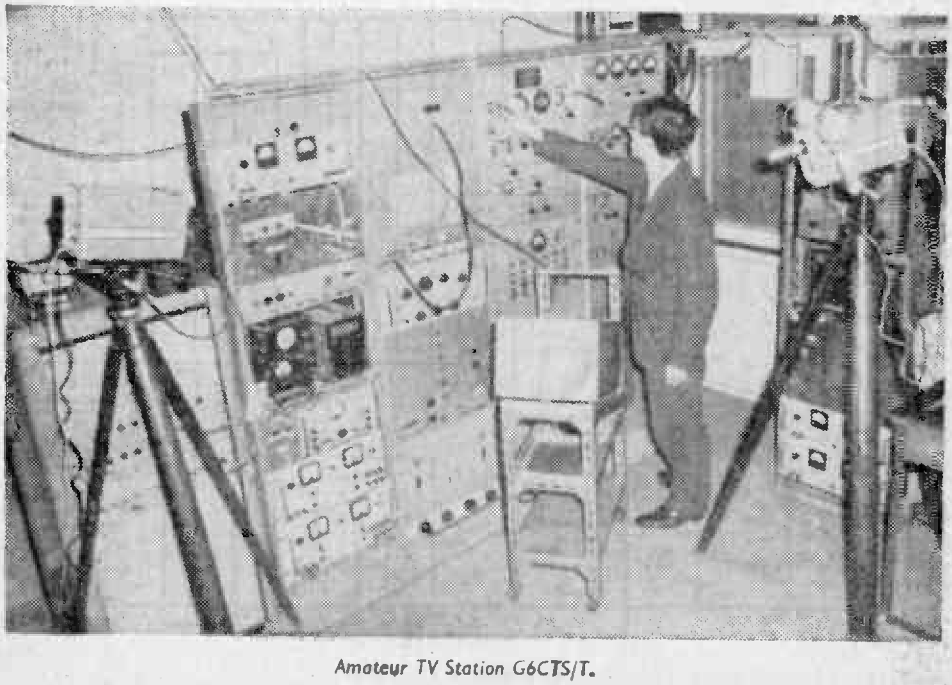
The vision transmitter uses a 4X150A grounded-grid linear output stage using 405-line positive modulation standard on a frequency of 430Mc/s, with a power input to final stage of 150 watts.

The sound transmitter (and the driver of the vision transmitter) uses QQVO6-40A valves in push-pull tripler and output stages. Sound power is 45 watts input to the final stage, using 426·5Mc/s.

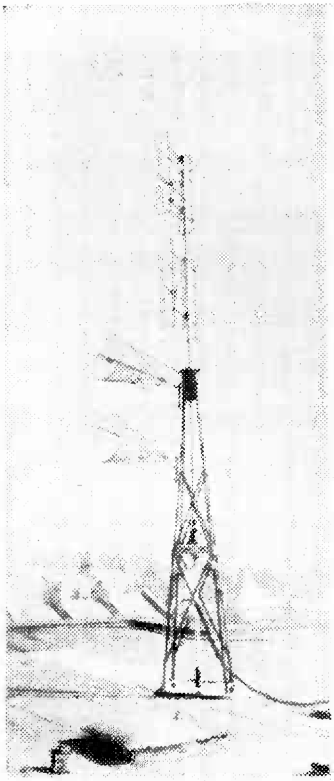
There are two sets of aerial arrays. G6CTS/T has a 10-element broadside array for each transmitter, directed due North from a site giving line-of-sight over London. Driving is via surface wave feeders. There is also a 16-over-16 slot element broadside, rotatable, and available for reception as well as transmission and with a range of 30-40 miles in standard conditions.

The station is well placed for picture sources. There are three vidicon cameras, a monoscope test card generator, various electronic pattern generators (wedge, bar, cross-hatch, etc), telecine using a vidicon camera and a 16mm projector.

The facilities at G6CTS/T also include CCTV for college programme presentation, with provision for vision mixing, fading, etc. The CCTV system is used in TV programme presentation in collaboration with other Departments of the College.



Amateur TV Station G6CTS/T.



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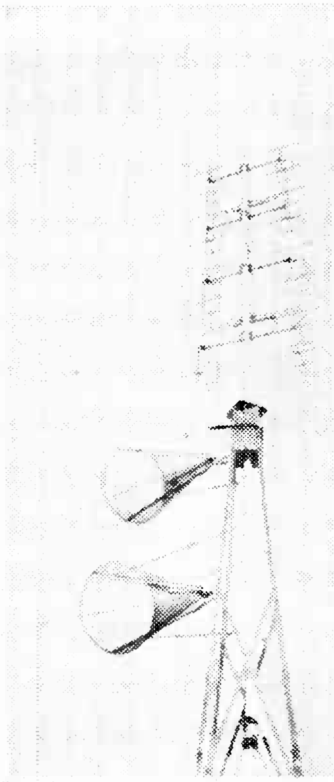

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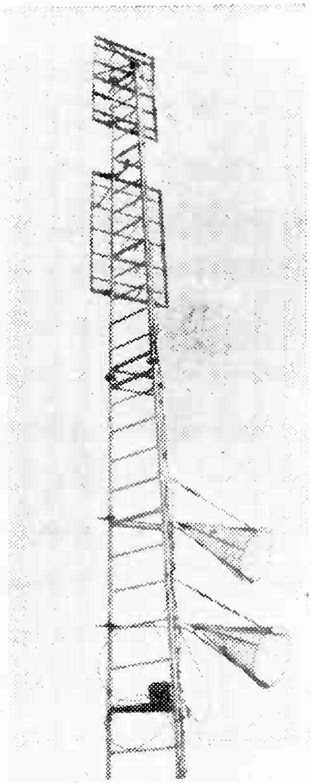

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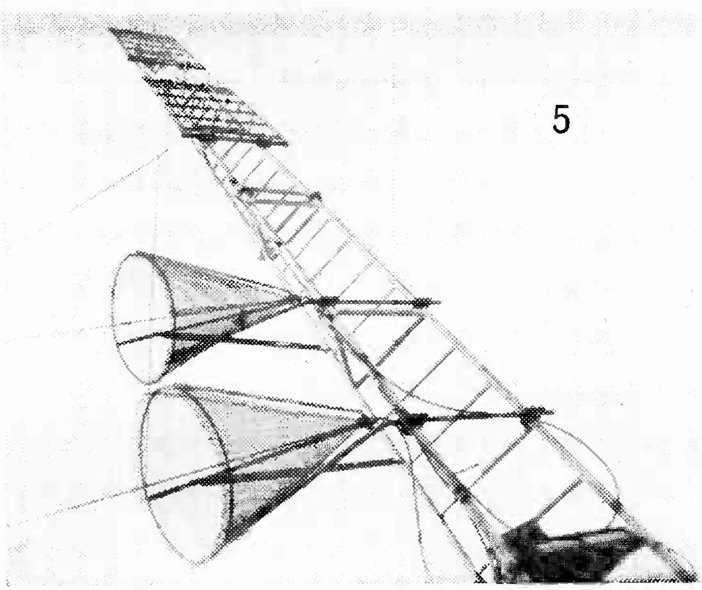

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Pictures 2 and 3 show the tower with cones at the sending end of the surface-wave feeders. The tower also supports the rotatable array. Pictures 4 and 5 show the 30 ft. tower supporting the vision and sound arrays and the cones at the receiving end of the surface wave feeder

FIRST TIME TESTS

By H. W. Hellyer

PART 2: LINE SCAN CIRCUITRY

IN the last article a few rudimentary tests for faulty power supplies were discussed. We assumed the set to be dead. Our tests, however, showed that quite a lot could be done to localise the source of trouble, even if it could not immediately be put right, using only a simple neon tester.

The next logical step is the situation where the set is "live", with valve heaters glowing and probably h.t. in order (which must be proved), but no raster when the brilliance control is turned up. Without the armaments of the professional engineer, how do we go about that?

First thing to remember is that there are two distinct ways of tackling the job—three, if you include the hit-or-miss, try-everything technique of so many who should know better!

The two methods are distinguished by the equipment, test gear, etc., which is available. Obviously, if you have a multimeter, signal generator or pattern generator, oscilloscope and all the relevant data, there are short-cut tests that can be made.

With our assumed limited resources we travel a little more slowly. After all, time is an important factor to the professional engineer, when labour charges form such a high proportion of repair costs. The only pressure on our time is the family, pointedly playing patience, and pretending a child-like faith in our ability to solve all problems.

For the moment we discount the sound, remembering however that if sound is received at its normal level the h.t. supply is probably in order and another test may be saved. On the other hand, several circuits are arranged so that the signal is not amplified until the line stage operates, and thus an apparent "No Sound" fault may be misleading. However, very few receivers made in the last five years or so require a signal before a raster can be obtained.

We can therefore make a rule: if there is no raster, forget about the signal circuits for a while and concentrate on the line stages.

The reason for directing our attention to the line stages is probably familiar; modern methods employ the rectified line flyback pulse as a source of e.h.t. applied to the final anode of the cathode ray tube. Without e.h.t., no raster is obtained.

The whole system is summarised in Fig. 1., from which we can see that the oscillator drives the line output valve, whose output is developed across the windings of an autotransformer. The output in the form of a sawtooth (current) waveform as a frequency of a little more than 10 kc/s.

This frequency is in the upper part of the audio spectrum, and is thus audible to most people, especially if varied slightly; a fact which makes testing a little easier.

At the end of the sawtooth waveform, the current (which also flows through the scan coils) changes very rapidly. This causes the spot on the face of the tube to fly back to the commencement of the next line of scan very quickly.

This fast change of current produces a large voltage pulse in the overwind section of the

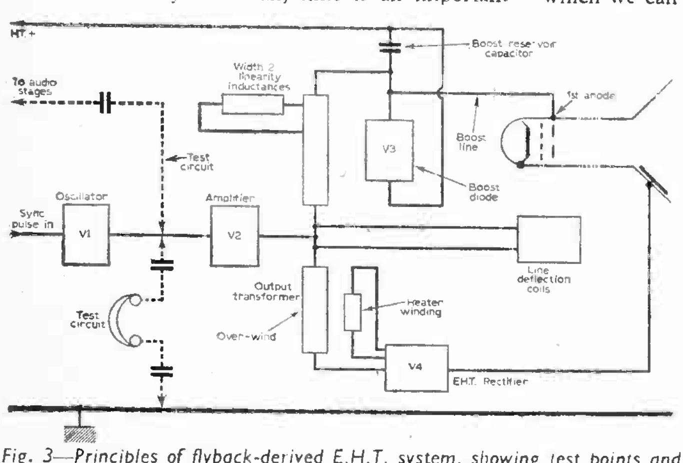


Fig. 3—Principles of flyback-derived E.H.T. system, showing test points and features discussed in the text.

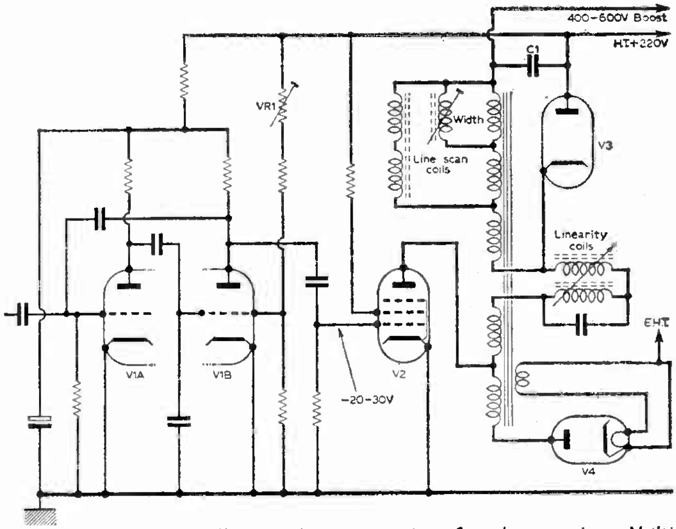


Fig. 4—Typical line oscillator and output section of modern receiver. Multivibrator oscillator V1 drives amplifier V2. Speed of oscillation is controlled by VR1. Flyback pulses are rectified by V3 and developed across C1 to produce boost voltage. V4 is E.H.T. rectifier, with heaters powered via a separate winding (see also Fig. 6).

transformer. This extra high tension, e.h.t. voltage, is applied to a special rectifier, converting it to a high voltage d.c. for application to the fianal anode of the cathode ray tube.

The heater current for the e.h.t. rectifier is also supplied by a winding on the line output transformer, and thus if no line output is available the heater of this valve will not light. This does not indicate that the valve is faulty.

Another important function is carried out in this section of the receiver. This is the action of the boost diode, V3 in Fig. 1. Briefly, what happens is that the combined inductance and self-capacity of the scan coils and line output transformer circuit, which will usually include line amplitude (width) and linearity inductors, tends to oscillate and causes a back e.m.f. across the coils.

The boost or efficiency diode is connected in such a way that this back e.m.f. is rectified and added to the normal h.t. voltage, so that the line output stage can operate more efficiently at the higher voltage, usually in the region of 500-600 volts r.m.s.

In many sets the field (frame) stages are also fed from this "boost line" and the first anode of a tetrode or pentode tube also receives the higher voltage, acting as an accelerator anode.

As this action takes place during the rise of the first half-cycle of the oscillations which follow flyback, it can be seen that the first quarter or so of the screen's width has its line output power contributed by the boost diode, which is a useful factor to remember when a distorted raster is produced.

Oscillations Damped

The presence of the boost diode also tends to damp these oscillations and the method of connection, with the boost diode effectively in series with the line output valve, means that as the voltage of the cathode of the boost diode rises, the line output valve takes over the scanning job, beginning to conduct.

The important component in the circuit here is the boost reservoir capacitor, which will usually be a highly rated (i.e. 1,000V. Wkg.) paper capacitor, of 0·5 or 0·25μF, is sometimes a combination of two or more lower capacity components, or an electrolytic, easily identified as the negative pole connects to the h.t. line.

From the foregoing, it will be seen that the first requirement is drive to the line output valve. A high resistance voltmeter will show the negative bias at the line output valve grid, giving a reading of 20 to 30 volts.

Without a meter, things are a little more difficult, but much can be done with a neon tester, a short length of insulated wire and a 0·1μF capacitor, preferably of 400V rating for safety. Connect this between the output of the oscillator stage—convenient point, the grid pin of the line output valve, Pin 2 of a PL81, Pin 5 of a PL36—and the upper or centre tag of the volume control, or other convenient audio point.

Varying the line hold control should produce a definite note if the oscillator is working.

Alternatively, hold a transistor radio near the line oscillator and tune through the Light Programme on Long Wave (200 kc/s), when a whistle should be heard on the radio. Varying the line hold control confirms that this is indeed the beat note of the line oscillator with the radio aerial circuits.

A better coupling can be made with a loop or wire around the oscillator valve in the TV and around the LW aerial coil of the radio.

A pair of headphones, isolated from chassis by two 0·001μF capacitors, can be used in place of the audio hook-up, if there is any doubt about connections.

Line Drive

Remember that it is possible to have adequate drive *but at the wrong frequency*, and this will result in little or no output as the transformer, scan coil, width and linearity coil system all form a circuit designed to resonate at the correct line frequency.

With a little practice, it is possible to recognise the correct line oscillator note, and even distinguish the "steps" in the changing note which indicate the sync pulse is present.

Some line oscillator circuits depend on the boost voltage for their operation, and others use the line output valve either as a self-oscillator or as part of the oscillatory circuit. In these cases, lack of drive may not indicate incorrect conditions.

The fault can possibly be "farther back" and becomes more difficult to trace.

If line oscillation is not producing drive at the line output valve grid, first suspect must be the line oscillator valve. Very often this will be a similar valve to another being employed for a different circuit.

An example is the PCF80, the ECL80 and the ECC82, whose triode section forms part of a multivibrator circuit with the line output valve, and the feedback if from the output transformer, sometimes via a pulse capacitor.

Next most likely culprit will be the anode load resistor of the oscillator valve. In far too many sets a half-watt component is used where a 1-watt type would be desirable.

Usual fault is that the resistor goes "high" and may cause such symptoms as intermittent picture (when hot), overheating line output valve (because of lack of drive) lack of width (for the same reason) or no raster at all.

Cases of line output valves overheating are sometimes found when drive is available, and may be due to other symptoms, such as the short-circuiting of the boost capacitor, shorted turns in a width coil, and so on.

A quick check for a shorting boost capacitor is to disconnect the cathode top cap, and note whether a voltage reading can be obtained at the cap connector. If so, it is a reasonable assumption with most circuits that the capacitor will have developed a "leak". As the line output stage is virtually in series with the boost capacitor and boost diode, the lack of output, no raster symptom, yet apparent normal voltage at the line output valve anode cap may simply indicate that the boost capacitor has developed a complete short circuit.

In this case, the output stage will be attempting to work with ordinary h.t., sometimes with partial success, in that a slight r.f. spark can be drawn from the line output valve anode.

This "drawing off" of a spark is another quick test, *but one which must be done with some care.* The high voltages in the line output stage will tend to "leap" across small spaces to a screwdriver blade.

A well-insulated screwdriver, held so that the blade is not touched with the fingers, can be moved near the line output valve anode cap, from whence a blue spark can be "drawn", to follow the blade away for a half-inch or more, if the stage is operating correctly. A similar test can be done with the e.h.t., as we shall note later.

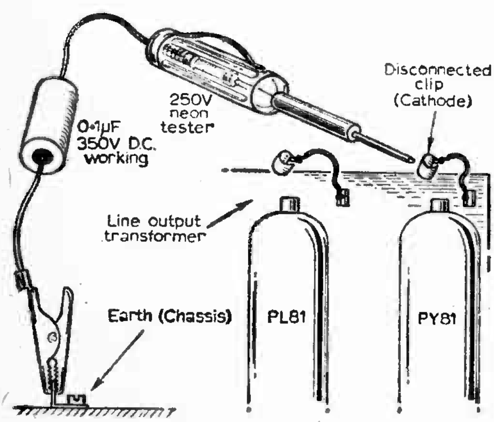


Fig. 5—Voltage tests, using only standard neon tester and capacitor. See text for interpreation.

Line Output Transformer

Where line drive is available, and the line output valve, the boost diode, and the boost diode capacitor are in order, having been proved by substitution, yet there is still no e.h.t. or boost voltage, the next possibility is the line output transformer itself or part of its associated circuit.

This is a difficult fault to prove without instruments. An oscilloscope for example, can quickly assist us to determine whether the line output transformer, scan coils, width coil, etc., have short-circuited turns. An ohmmeter does not give up a very useful indication, as a single shorted turn can have a drastic effect on results, yet make little difference to the resistance measurement of the windings.

Another instrument that is invaluable in the workshop is the *Skantest*, which indicates a faulty line output transformer at a glance, with it still in situ. However, we are assuming ourselves with the minimum of test gear, so must resort to more roundabout methods of testing.

Simple Voltage Check

One simple test for voltages can be made with a neon tester and a 0·1µF capacitor of 350V or 400V rating. The capacitor is connected to chassis and to the clip of the neon tester to form a series circuit. The tester is held by the barrel, with neither blade nor clip being touched by the fingers.

If the blade is now tapped on an h.t. point, the capacitor will charge through the neon bulb and its series resistor, giving one short flash.

Tapping it again immediately on the h.t. point should not produce another flash until the capacitor has been allowed to discharge by shorting the junction of clip and capacitor to chassis.

If the same set-up is used and the boost line sampled, two or three successive flashes should be obtained because of the higher voltage. It is a wise precaution to experiment in this way while the set is still in order to obtain an indication of the "readings" obtained under good conditions. These can then be compared with fault samplings.

To return to our faulty set: we now assume that there is line drive and no output, and must find what is preventing the pulse being amplified.

First, disconnect the "externals". These will possibly be the scan coils, width and linearity coils, and the e.h.t. connection to the tube. This last is necessary as a short-circuited e.h.t. rectifier can "kill" the line output stage.

If the stage now tries to work, lighting the heaters of the e.h.t. rectifier, or producing a strong whistle in a nearby radio tuned to the Light Programme on Long Waves (1,500 metres), reconnect the externals one by one, noting at which point the line output stage is damped down.

Possible faults are short-circuited turns in deflection coils, breakdown to core, burned-out or shorted width coils, short-circuited pulse capacitor (where back coupling is used) and a faulty e.h.t. rectifier.

The "shorted turn" width sleeve which consists of a foil strip on a paper backing, wrapped round the neck of the tube, should be checked. Sometimes a loss of output is caused by breakdown of scan coils to this foil, puncturing the paper with the high-voltage pulse.

With certain types of set, the line output transformer can be proved by temporarily short-circuiting one section of it while the note of the line pulse is sampled in headphones or via the loudspeaker, as shown.

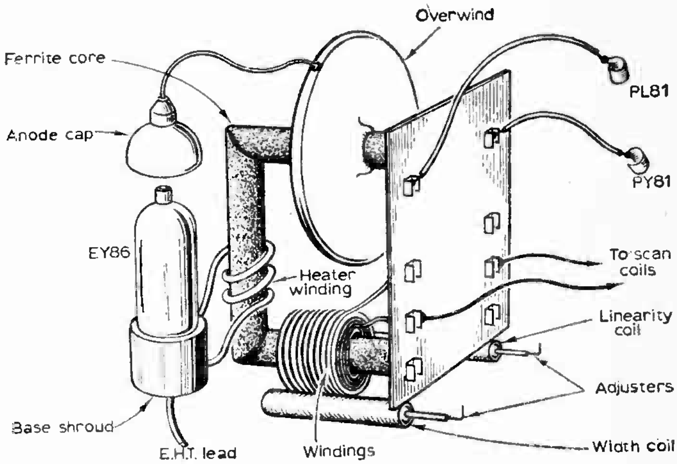


Fig. 6—Typical line output transformer assembly, with mounting brackets, etc., omitted.

This circuit, using a desaturated line output transformer, has the boost capacitor between sections of the winding and d.c. flows equally in both sections of the winding, cancelling a certain amount of the magnetising flux.

To test, remove the boost diode cap, check that no voltage is present at the line output anode, then touch this point briefly to chassis with screwdriver blade. Increase in the strength of the note in phones or speaker indicates that the line output transformer is in order.

An alternative method would be to simulate a shorted turn with a wire loop, but the coupling is not always easy to arrange.

E.H.T. Rectifier Tests

Where line output is present, as evinced by a healthy blue spark drawn off the anode of the e.h.t. rectifier with a long-bladed screwdriver—*one hand in pocket for this test*—and no spark can be drawn off the cathode, or the tube connection, with this lead disconnected, the e.h.t. rectifier itself may be suspected.

Continuity of valve heaters may be checked, and the continuity of the winding to the heaters checked with a 6V dial lamp (for EY51, EY86; 2V for U25, U26), and a short length of cable.

Where a blue spark may be drawn from the cathode of the valve with the tube disconnected, and this is "killed" by connecting the final anode lead, then the e.h.t. rectifier is probably passing a.c. and should be replaced.

But always check heater circuit continuity if a replacement is not immediately to hand. This is especially necessary on many two or three-year-old sets, with plastic-shrouded holders mounted on the body of the transformer.

The possibility of poor joints is not unusual, and the e.h.t. tends to make these joints grow rapidly worse.

If the line output stage is correct and yet there is no raster, the fault may be the tube, but could be other factors, such as incorrect biasing, incorrect ion trap setting, and so on.

Much has already been said on this subject: for the one a meter is definitely needed, for the other patient adjustment is the order of the day.

A rapid check can be made by short-circuiting grid and cathode of the c.r.t. and switching off. A good tube will show a spot briefly.

Where a raster can be obtained by patient juggling with controls, note whether an increase in the applied control voltage (increasing brilliance) causes the raster to increase in size. If so, suspect a low emission line output or boost diode valve.

A low emission line output valve usually shows secondary symptoms such as lack of width and cramping at the right of the picture.

A low emission boost diode may cause cramping at the left also, or a non-linear section about an inch or two in from the left.

Brushing

A frequent fault with some sets is "brushing" of the e.h.t., causing a vertical stripe of faint white lines on the picture, usually at the left of the screen, most noticeable when there is a weak incoming signal.

This requires careful tracing in darkened conditions, and eyes, ears and nose may have to be called into play to locate the source of high-voltage flashing. This may be between the line output transformer windings and core, in which case there is little one can do except insulate with one of the proprietary varnishes, waxes or silicone greases, and hope for the best.

An arcing at the d.c. side of the e.h.t. rectifier causes definite white spots on the screen and a "frying" noise. As this is generally due to a badly made-off joint, a damaged e.h.t. lead, or incorrect lead routing, the remedy is obvious.

(TO BE CONTINUED)

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

SPORADIC E reception since mid-July has fallen-off, and there has been something of a lull. Previous years have shown similar characteristics, with a return to better conditions a little later in the season, I am hoping that this will again apply.

As in previous months I will give a brief summary of what reception was possible in this area, and from readers reports this would seem to be in line with other DX'ers findings.

21/7/65. USSR R1, Czechoslovakia R1, Austria E2a.

22/7/65. USSR R1, Czechoslovakia R1, Spain E2, and E4.

26/7/65. Roumania R2, Czechoslovakia R1, and R2, Austria E2a, W. Germany, Grünten E2.

31/7/65. Austria E2a, Czechoslovakia R1, USSR R1, Poland R1.

2/8/65. Austria E2a.

3/8/65. Czechoslovakia R1, USSR R1, and R2.

6/8/65. Czechoslovakia R1, France Carcassonne F4 (rare).

13/8/65. USSR R1, Poland R1 and R2, Czechoslovakia R1 and Austria E2a.

15/8/65. RAI Italy IA and IB, and TVE Spain E4.

16/8/65. Poland R1, and TVE Spain E4.

18/8/65. USSR R1 and R2. (With Aviation Day Programmes.)

The above refers to acceptable reasonably strong and long duration signals only. There has been some Sporadic E activity nearly every day and, as noted previously, the best openings have been to the East for USSR, Czechoslovakia and Austria.

Tropospheric reception has once again been generally very poor, but this is what one would expect with the poor weather we have had this summer, and the disturbed atmospheric conditions. Later this year, Tropospheric conditions should improve again.

PROPAGATION METHODS

Apart from our old friends Sporadic E, and Tropospheric propagation, I would like to suggest two further possible methods for the propagation of DX/TV signals:—

(1) Reflection from meteor showers.

(2) Reflection from satellites, and carrier rockets still in orbit.

Reader **George Le Couteur,** of Guernsey, reminds us of the first method and he and I have been doing a little experimenting along these lines.

Occasionally it has been noted that if a receiver is left running on a certain channel when no normal Sporadic E reception is present, there can be at times sudden reception of images of *very short duration only*, that is for even one second or less at times. These "flashes" have been noticeable even during the winter season when Sporadic E activity is at a minimum, but when meteor activity is present to a greater degree. I feel that this type of reception can be attributed to meteor reflections, this type of propagation being known to our amateur radio friends working on the v.h.f./u.h.f. bands.

Later this year we hope to give you a list of predicted dates for these meteor "showers", and I suggest that you too have a look and see what can be received.

Regarding reflections from satellites and rockets it has been noted here recently that very short duration signals of the above type have been received when there are apparently no meteors about, and I think that this may well be due to the second type of reflection.

All objects in orbit are largely metallic and moving very rapidly indeed, so the exact location in space required for reflection between transmitter and receiver can only be occupied for a very short duration of time indeed.

We shall be most interested to have your comments and experiences in this field.

NEWS

Finland. We are indebted to **Albert Davis** of Gillingham, Kent, for the following information, received from the Finnish TV Authority.

The old TES network has now ceased as a separate organisation, and has now been absorbed by the YEL group, hence the absence of the TES card from our screens, since early this year.

A further piece of news is that Tampere E2 does *not* operate during the summer months, and as noted previously, this test card is marked TV2, so that is why this has not been seen recently. We hope to have the dates in due course for the winter re-opening.

Tele-Luxembourg. It is understood from French newspaper sources that an increase in power is envisaged for this station to give better coverage in Northern France. This has been a "difficult" signal over here, so this should help.

READERS' REPORTS

L. Clark of Margate, has entered the DX/TV ranks with the reception of France Lille-Bouvigny, and I hope this will encourage him to further activity.

J. Readings of Cowley, near Cheltenham, has given us an excellent log, including Spain, Poland/Hungary (the old test card trouble!), Italy, Sweden and France—u.h.f. as well.

Mr. Stockton of Doncaster has sent us a number of test card photos, which we have been pleased to identify for him, and his log now includes Poland/Hungary, Italy, Spain and USSR.

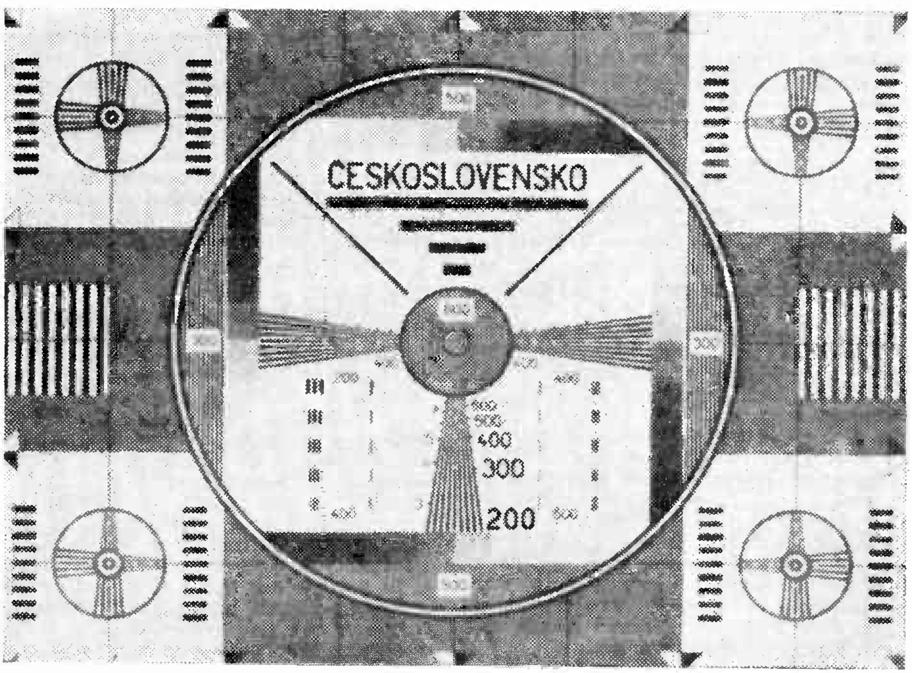
W. Miller of Catterick reports Finland, with test card photo, and Switzerland (a new one for him). I am always pleased to read of Swiss reception, it is after all one of the "rarer" ones.

Our old friend **George Le Couteur** of Torteval, Guernsey, C.I., reports most interesting Sporadic E reception of BBC Divis Northern Ireland at his home, and there is no doubt about this as the signal was identified by means of a Regional News programme.

This was, of course, very short skip distance, but it means that similar reception from Northern Ireland or Scotland may be possible in the South of England, and/or vice-versa. I myself have been on the look-out for Orkney on B5 for long enough but so far no luck!

Well, my friends, that about "winds it up" for this month, so Good DX/TV to you all, and I look forward to reading your reports. See you next month!

DATA PANEL—2 CZECHOSLOVAKIA



Test Card—as photo.

Channels. Czechoslovakia is very well received here via Ostrava on channel R1 and Bratislava on channel R2.

Transmissions. Monday to Friday—from 0.800, either test card or programme until 22.30 or 22.45. Saturdays—as above, but extended until 00.00. Sundays and Public Holidays—no test card, but programmes as weekdays.

Further Data. Further information concerning programmes, etc., may be obtained from either:
(a) Collet's Holdings Ltd., 44 Museum Street, London, W.C.1, or
(b) Artia Ltd., Smecky 30, Praha 1, Nové Meste, Czechoslovakia.

LETTERS TO THE EDITOR

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

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

Power to P.S. and T.C.

SIR,—Re Mr. A. J. Littlewood's letter in June issue on Test Case and Problems, the writer can't resist replying to this. Mr. Littlewood criticises "Test Case" and "Problems Solved" features. Not only do these articles encourage the "layman" but they do help him so much. You, Sir, I imagine are an expert engineer, probably employed by some firm or you may be self-employed. Yes, I spare a thought for you, maybe in common with many others. You and your employer, as may be, are only in business for what you can get out of the set owners by either selling or renting another set, and taking back their old set, and if it is a 14in. or above you do it up and rent it out.

I have seen some terrible jobs carried out on sets under maintenance contracts by experts, jobs which the "layman" or a member of the "Kitchen Table Brigade" would not dare to have done. I recall one job an expert did and the writer saw this, about 3 years back, he burnt out 3—U.801 valves when the 100Ω resistors were at fault, and this "expert" expected the set owner to pay for these valves, plus 15s. per hour.

No, Mr. Littlewood, many set owners have a great deal to thank the "layman" for, after all you folks have, or should have all the test gear needed and no problem should be difficult for you to sort out as you suggest.

Finally I say and mean "Power to Problems Solved" and "Test Case", may they go on for many many years. I am constantly being asked to look at some set which the expert engineer has failed to rectify and in many cases it's a valve, resistor or capacitor which is at fault.

I know of one engineer who quit his job on account of the vile practices that went on with the firm he was employed with, from whom he got commission from both on sales and service payments.—H. WILDASH (Manchester 22).

Not Only, But Also . . .

SIR,—If I may be so bold as to venture a reply to the pathetic but amusing letter from our "cliche quoting" friend, the esteemed Mr. A. E. Green.

What wondrous and fascinating processes must have gone on in this gentleman's mind to have enabled him to come to the shattering conclusion that the "Test Case" and "Problems Solved" features were the focus of my attention in this admirable magazine.

Somehow it seems to have escaped his notice that there are interesting articles and constructional projects appearing from time to time in addition to the aforesaid and now famous T.C. and P.S.

With regard to previous replies to my original letter, all I would like to say is, "Alas!" What a total misconception the public has of what an HONEST, QUALIFIED ENGINEER earns in one week. If they but knew this, then they would realize why there are so few in the entire British Isles.—A. J. LITTLEWOOD (Coventry).

VHF AMPLIFIER

—continued from page 28

almost (but not quite) short-circuit to transients. They also serve to discharge any static build-up in the aerial system during thundery weather, which represents another transient source.

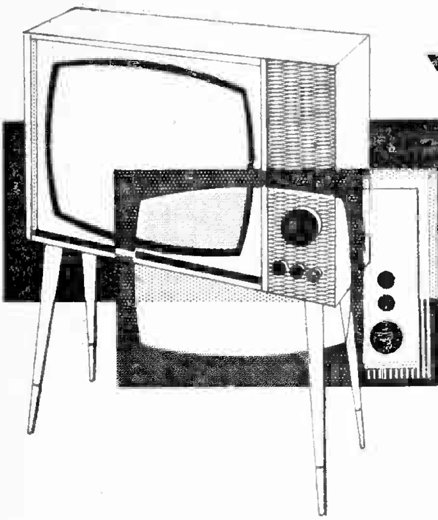
Cross-Modulation Performance

The emitter junction of any transistor amplifier is biased for forward current. A potential-divider, R2/R4, in the circuit performs this function for both transistors. The emitter junction, which is really a semiconductor diode, is very non-linear if insufficiently biased. Non-linearity at the input of a wideband amplifier which is called upon to handle a multiplicity of signals is highly undesirable, for it could result in bad cross-modulation. This is when one signal modulates another.

In practice this could cause bad pattern effects and inter-channel breakthrough, including sound-on-vision and vision-on-sound. The amplifier has been tested for cross-modulation and it has been discovered that with the transistors mentioned an output of at least 30mV can be obtained on six TV carriers and three f.m. carriers with cross-modulation still below 46dB (200 times down on the carrier signal voltage). It is thus invisible! The amplifier has a good application therefore for communal aerial and shared aerial systems.

Next month it will be shown how the amplifier can be mains-powered, how it can be line-powered for line cascading and how a simple unit for feeding up to six receivers can be made.

(PART 2 FOLLOWS NEXT MONTH)



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

T221

The picture failed so I disconnected the e.h.t. lead from C49 and put it to the anode at the side of the c.r.t. and the picture returned. I replaced C49 with a new one, but I used the old metrosil. I put the e.h.t. back via C49 but there was still no picture. There was a blue flash in the U25.

When I connected the e.h.t. to the c.r.t. anode straight from the U25 the picture curved on the left hand side about 2in. in from the side.—J. Griffin (London, N.W.10).

Your remarks indicate that when the e.h.t. circuit is directed by way of C49, a short circuit is present. If this is not in C49 itself, it must be somewhere on the wiring or connections in the circuit. It should be remembered that the insulation may break down only under electrical stress, meaning that a low voltage insulation test may not reveal poor insulation. The curved picture edge may be due to lack of e.h.t. filtering when the e.h.t. is derived with C49 out of circuit.

ENGLISH ELECTRIC T40A

This set has an 80Ω balanced aerial input. Could you please say what modification is required in order to use 75Ω co-ax cable for the input.—R. Murphy (Cumberland).

You could obtain a balun (balance to unbalance) transformer to wire in between the coaxial aerial cable and the terminal block but usually good results are obtained without such a device.

Alternatively, you could remove the cabinet lead from the centre tap of the aerial coil and connect it to one end. Replace it if necessary.

DECCA DM35

When switched on, the picture is about 2in. wide. All the valves in the set have been replaced but this has made no difference.—D. V. Ford (Willenhall, Staffordshire).

We presume that when you say the picture is 2in. wide, you mean that the height is compressed into a 2in. band across the screen. If this is so, you should replace the 4·7MΩ resistor to pin 1 of the left hand ECL80 as viewed from the rear.

If, however, the picture is actually 2in. *wide*, check the 0·35μF capacitor in series with the deflection coils.

EKCO TC209

There is trouble with the horizontal hold. The set will work perfectly for some time, then the picture will break up into horizontal lines.—J. Rosenberg (Wembley, Middlesex).

The fault you describe is possibly around the line discriminator stage. Check the 20D1 valve just outside the e.h.t. compartment adjacent to the 20L1, and its associated components.

McMICHAEL M22T

The screen is filled with a mass of lines which cannot be controlled in any way. I have checked most of the valves, the 50kΩ line horizontal hold. P29848 looked to be in a damaged condition, but I have been unable to get a replacement.—A. E. Anthony (Aldridge, Staffordshire).

The 50kΩ line hold control has a switch (SW3) which is operated by the spindle of the control. Order a replacement from a Sobell dealer.

Also check the front right ECC82.

K-B NEW QUEEN

After about an hour the sound deteriorates and can only be restored by switching off and immediately switching on again.

When first switching the set on, the sound takes 35 seconds to appear and the picture comes on after about 2 minutes. When the set is switched off the picture goes straight away, without the small spot in the centre of the screen.

I have cleaned all the tuner contacts but this has made no difference.—W. Howell (Ringwood, Hampshire).

The sound output valve could be intermittent in

operation, it being temporarily corrected by the surge resulting from switching the set on and off (which, incidentally can harm the h.t. circuits). On the other hand, the trouble could be caused by almost any component in the sound channel developing an intermittent fault, being temporarily corrected by the surge as mentioned above.

Your best plan would be to have the sound channel valves tested first. If these are in order, and are making good connection with their holders, you may find it necessary to check the smaller parts of the sound channel by substitution.

PYE CW17

I have replaced all time base valves and metal rectifier but cannot cure fold-over at the bottom of the picture. Adjusting the vertical-height controls merely moves this fold-over up or down.—T. W. Scott (Blyth, Northumberland).

We suggest you look for your fault around the EL83 frame output valve. Check that the cathode decoupling capacitor (if fitted) is efficient, that the 0·1μF capacitor coupling the drive from pin 6 of the ECC82 to the grid of the PL83 is not leaky, and also make sure that the boosted h.t. line is at its stated voltage (in excess of 350V. d.c.). If a fault is apparent on the boosted h.t. line, it can frequently be due to an A1 leakage on the c.r. tube itself.

FERGUSON 991T

My receiver is VERY critical with its frame (field) locking, and needs constant adjustment. I have replaced the ECL80's and checked component values in the frame circuits as advised in old editions of " Practical Television ", e.g. April 1959, but the trouble still persists.—C. A. Child (Glasgow).

This trouble is often caused by leakage (or low value) in the capacitors feeding the field sync pulses to the field timebase from the sync separator stage. You will know, of course, that a field pulse clipper arrangement is used in this model. We have found that deterioration of several components in this section have been responsible for the symptoms, and that replacement of just one or two parts may not fully clear the trouble.

GEC BT302

This set tends to be unstable in both "holds" unless the contrast is set slightly low for picture quality (which is not too good). The tuner unit valves have been replaced and the line output valve and boost diode checked. It appears that the instability is associated with the sound channel at least to some extent.—J. R. Camp (Epsom, Surrey).

We would suggest that you realign the i.f. stages, particularly the "beehive" type rotary capacitors C56 and C58. Correct adjustment of these should remove the sound-on-vision and the vision instability. Check decoupling capacitors and electrolytics if necessary.

COSSOR 950

With this set, I have got perfect sound and raster, but no picture. I have changed the following valves, without success: 6BX6, 8A8, 6AL5, and both valves in the tuner.—R. Margetson (Neath, Glamorgan).

Your fault is one that would be more readily traced by use of a signal generator. The most frequent trouble which the writer has experienced, causing the symptoms you describe, is that of instability in the vision i.f. stage. This is normally due to inadequate decoupling of the screen grids of the relevant 6BX6 valves.

PYE V14C

There is a gap top and bottom of my screen, 2½in. deep, picture full width of screen. Have changed PL83, no change in picture, will be grateful for help.—G. E. Fowles (Gosport, Hampshire).

Check the frame output valve cathode bias components and also check on the boosted h.t. line which provides h.t. for the frame generator valve. A low boosted h.t. line is frequently due to an A1 electrode leakage on the c.r. tube.

EKCO T380

In my receiver, the 6D2 a.v.c. delay diode (V7) pin 5 goes very negative (46V) and sound disappears. I have changed valves V1, 2, 4, 6, 7, 9, and 11, capacitors C57, 64 also R40, 41, 44, and 50. Sound is not so loud as it should be. I have tried tuning i.f.t's. without success, and all other voltages appear to be normal. Picture is perfect.—P. G. Cook (Co. Durham).

Your symptoms indicate instability of the sound i.f. stage. The most common causes of this trouble are the screen grid decoupling capacitors to V4 and V6. On our circuit diagram these are C34 and C42, and their positioning and quality are extremely critical.

EMERSON 704

This set was working perfectly, when the picture suddenly went off, leaving the sound working. There is slight e.h.t. on the top cap of the EY86 and the same on c.r. tube e.h.t. cap. I have replaced the PY81 also the EY86, and PL36.—W. Smith (Huddersfield, Yorkshire).

It seems as though the line timebase has failed. If the line whistle can be heard when the line hold control is adjusted, the line oscillator section is in order, in which case attention should be directed to the output stage. Here, shorting turns in the line output transformer could be responsible.

MURPHY V430

The set was working normally, and then the picture began to dim and suddenly the screen went blank. Investigation showed that the fuse (500mA) was blown, this was replaced and the picture became normal, for about fifteen minutes, then the bottom of the picture began to creep up and resulted in severe fold-over, together with poor linearity. The line hold is also affected. I have changed valves 6/30L2, 30P4, and 30P12, also capacitors C89 (250μF) C14 and C15 (100-200μF) but the defect persists.—E. L. Dunster (Abingdon, Berkshire).

A frequent cause of your trouble is low h.t. due to a faulty h.t. rectifier. You may use a silicon diode as a substitute but it must be mounted in the cooler part of the chassis.

G.E.C. B.T.1252

There is no sound and vision, but the tube seems O.K., as there is a good raster. H.t. and e.h.t. are O.K., all valve heaters are working.—T. G. Marsh (Brierley Hill, Staffordshire).

This trouble must lie either in the tuner (including aerial) or in the i.f. amplifier which is fed from the tuner and which is common to both the vision and sound signals. Firstly, check the aerials and coaxial cables and/or diplexer. Next, the tuner valves etc., and then the common i.f. amplifier. A valve may have failed or a resistor may have burnt out due to a shorting capacitor in the tuner or i.f. stage.

TEST CASE -35

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

? *After the purchase of a second-hand Invicta 538 series, an experimenter noticed that after about an hour or so of operation the bottom of the picture tended to roll up, leaving a black horizontal band and a bright line indicating the fold. Having had experience of this sort of trouble before, the new owner promptly bought a new PCL82 field timebase valve. To his surprise this replacement had not the slightest effect on the symptom. The foldover occurred exactly as before after the set was really warmed up.*

Thinking that a component somewhere in the field timebase section was at fault and altered in value or insulation when hot the experimenter made a number of replacements of the components which are often said to cause the trouble. The trouble was still present even after every single small component in the field timebase had been substituted. Thinking now that the trouble must lie either in the field blocking oscillator transformer (an auto-transformer) or in the output transformer the experimenter took steps to order replacements here.

Could anything else have been responsible for the symptom? If so, what?

See next month's *Practical Television* for the solution and also for a further Test Case item.

SOLUTION TO TEST CASE 34

Page 573 (last month)

The clue to this problem lies in the apparent inoperation of the contrast control after removal of the aerial and its subsequent reconnection. All receivers now have their vision channel gain adjustable by virtue of the contrast control causing an increase in negative voltage on the vision a.g.c. line as it is rotated anti-clockwise. The tuner amplifier and common i.f. amplifier are also controlled in this way. It figures, therefore, that an a.g.c. line fault would affect both the sound and vision. The sound may well be less affected than the vision, since the sound channel often has its own independent a.g.c. system in addition.

Indeed a voltage test made on the vision a.g.c. line with a very high resistance voltmeter revealed that the negative voltage had a tendency to fluctuate in sympathy with the picture and sound fluctuations. Normally, however, it was found that the a.g.c. line would go more negative as the contrast control was turned down.

When the aerial (i.e. the signal) was removed the a.g.c. line fell to zero voltage and the pointer tended to kick towards the positive side of the scale, thereby indicating that the a.g.c. line was in fact going a little positive. On reconnecting the aerial the a.g.c. line remained for a short while at zero and then gradually swung negative. While it was at zero there was no significant change with operation of the contrast control. This meant, therefore, that the vision channel was at maximum gain, hence the overload. As the a.g.c. line gradually turned negative so the overload ceased and the contrast control worked correctly.

This indicated that the a.g.c. line was connected to a component which was leaking a positive potential and that the time-constant capacitor was holding this charge until it was eventually overcome by the normal negative a.g.c. potential.

The culprit was found to be the coupling capacitor in the tuner (0·001μF). This has a very small intermittent leak and, since it was connected between the mixer anode and the a.g.c. line, it was responsible for reflecting the intermittent positive potential on to the a.g.c. line as already explained. Replacement cured the trouble completely.

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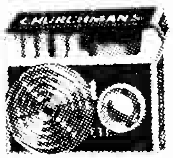

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