A VIDEO SIGNAL GENERATOR

PRACTICAL TELEVISION

AND TELEVISION TIMES

1/-

EDITOR
F. J. CAMM

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FEATURED IN THIS ISSUE

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E.H.T. Problems
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A Television Engineer's Notebook
TV in B.A.O.R.

PRACTICAL TELEVISION

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Televiews

Commercial TV Debate

THE organised opposition to commercial TV let off its steam in the House of Lords debate with the expected negative results. The chief opponent was Lord Reith, supported by a number of other noble lords. Lord Reith, although he departed from Portland House several years ago, still thinks that he is in control of the BBC and endeavours, supported by several other ex-BBC servants, who strangely enough also find themselves in the House of Lords, to oppose this new development or change of policy. He gave evidence, it will be remembered, before the Beveridge Committee.

On this occasion he was supporting, by his opposition, the BBC policy, which is known to be anti-commercial TV. The main speakers were Lords Halifax, Waverley, Brand, Samuel, Simon of Wythenshawe and Inman. Indeed, they have something more in common than membership of the House of Lords. Lord Halifax is a past chairman of the General Advisory Council of the BBC, Lord Waverley a member of that Council in 1952, Lord Brand was a member of the General Advisory Council, Lord Samuel was its chairman, and Lords Simon and Inman, former chairmen of that curious body known as the BBC Governors.

Lord Reith was Director General until general dissatisfaction with the programmes and especially the Sunday programmes were expressed during his period of office.

Here is a typical Reith Sunday programme in 1933 : Weather Forecast ; violin recital ; Midland Studio Orchestra ; recital ; BBC Theatre Orchestra ; Bible story for children ; orchestral concert ; recital ; religious poetry of the seventeenth century ; religious service ; Week's Good Cause ; news ; Hastings Municipal Orchestra; Epilogue.

Save us from that sort of programme !

No one can deny that the programmes have greatly improved since he left. He was hardly, therefore, a wise choice as the spearpoint of the attack since his attitude was that the public must have what programmes he thinks they ought to have. He is unlikely to have changed his views and his opinions, therefore, are of no value as an expression of what the public wants on the television screen. Indeed, it might be thought that if he is in favour of a particular policy, then the reverse of that policy was what the public really required. We are, of course, glad to notice that he is taking a keener interest in TV than he did during his period of office, when the Prime Minister of the time found it convenient to attend a demonstration given by Baird, whilst he was otherwise engaged. Had Reith's judgment on programme material been sound there would have been no need for a Beveridge Report.

We are not greatly concerned whether commercial TV is introduced or not and we preserve an open mind on the matter. We are, however, concerned to see that inspired opposition does not outweigh public opinion. Most of the speakers in the House of Lords were arguing on behalf of the Church. Few of them could have taken any trouble to sound public opinion, and public opinion should be the deciding factor in this long drawn out dispute.

France has already planned commercial TV stations and they have been running in America for years. Whilst we are arguing about the matter over here the Americans are experimenting with flying TV stations. 'Planes will fly over France and relay programmes to Britain. This system was a British invention ! The object of the experiment is to ascertain how far such programmes will penetrate into this country. The test pictures are, of course, being picked up by special sets.

Sponsored U.S.. TV programmes, recorded on film, will be televised directly from the Continent. This will test whether the British public likes the American style of programme. When the French commercial TV stations have been built, the revenue from advertising will go to a counterpart of Radio Luxembourg.

This new system may force Great Britain to step up her own plans for commercial TV. America has plenty of telefilm already in existence and the scheme would not be expensive. It seems, therefore, that the British public will be able to have a commercial TV programme ; whether supplied by us or the U.S.A. remains to be seen.

—F. J. C.

The Interlace Problem

AN ARTICLE MAINLY FOR THE BEGINNER, EXPLAINING THE IMPORTANCE OF THE INTERLACE AND ITS EFFECT ON THE PICTURE

By "Serviceman."

THE beginner to the study of television: the home-constructor who has completed his first set, and even those who like to know about the technical side of TV, all probably have some idea about the interlaced picture radiated by the BBC and how it is reproduced on the screen of their own receivers.

Not so many, however, are certain on the degree of interlace to be expected on their own particular receivers, or, in fact, how to ascertain that they are obtaining optimum interlace anyway; and, indeed, the beginner often wonders whether his receiver is interlacing at all! It is hoped, therefore, that this article will shed more light on the problem—more from the practical aspect as opposed to theoretical considerations, which have been adequately covered elsewhere (see "Obtaining a Good Interlace," PRACTICAL TELEVISION, March, 1953).

At the outset it may be advisable to emphasise the fact that a receiver which is not interlacing is throwing away 50 per cent. of the transmitted signal! Nevertheless, although a good interlace is of utmost importance, a perfect interlace is not as essential, and probably the experimenter has already discovered that, even though the popular-priced older style commercial receiver provides a good picture, the quality of interlace is not all to be desired. A variation in interlace quality frequently occurs after

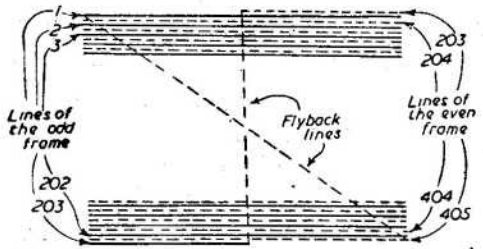


Fig. 1.—A perfect interlace showing scanning line formation and numbers.

this type of receiver has been operating for any length of time, or if the frame hold control is moved slightly from its extremely critical optimum interlace position.

With the more common use of interlace filter circuits, and with advancing design of the timebase section of the receiver as a whole, modern receivers, even though popularly priced, achieve a remarkable degree of good interlace, and many of them hold it so firmly that the lines tend to pair only when the frame hold control is deliberately maladjusted to the extent of frame break up (to the point where the picture commences slowly to roll)—unless, of course, a fault of the receiver is the prompting factor.

A Bad Interlace

A perfect interlace is only achieved when successive horizontal scanning lines comprising a complete picture are exactly the same distance apart on the screen (see Fig. 1). A picture with an extremely bad interlace may also satisfy this statement, however, but for this to happen the lines which should be interlacing between successive frames pair so closely that the picture appears composed of hard solid lines, separated equally by comparatively wide, firm black lines. This condition is absolutely obvious and leaves little doubt in the mind of the observer that the interlace quality is sadly lacking (see Fig. 2).

To newcomers to television viewing difficulty is often encountered in detecting interlace conditions of a picture by closely scrutinising the picture-tube screen in an endeavour to trace out the interlaced lines. The eyes quickly become fatigued, and often convey the illusion that the whole line formation is on the move, with lines weaving in and out of each other, and the picture (or preferably a plain synchronised unmodulated raster) seems intermittently to go in and out of interlace the longer this tiring mode of viewing is tolerated. In fact, it often happens that the more efficient the interlace the more difficult it is to detect.

The Degree of Interlace

The degree of interlace quality varies considerably between receivers, but as previously mentioned, the

Fig. 2.—The obvious condition of a non-interlace.

modern competitively priced receiver provides an excellent interlace, and a constant 100 per cent. interlace should be expected from the more expensive modern set. Interlace other than 100 per cent. is meant to mean that the spaces between successive lines of one scan are not equal either side of the lines of the other scan—a 100 per cent. interlace meaning, of course, that the spaces above and below the interleaving line are equal as in Fig. 1.

The precise degree of interlace can, therefore, be considered as a ratio; for instance, where the ratio 5:5 indicates a perfect interlace, the ratio 4:6 would imply that the interleaving line is out of balance in

the space provided by the lines of the previous scan, in the same ratio. Or in other words, four-tenths of the space is above, and five-tenths is below—or the converse may follow—the interleaving line.

In actual fact, it is very unlikely that a 4:6 interlace would be observed by the average viewer as a poor interlace, particularly on a 9in. or 12in. picture-tube. From the practical aspect it is quite a good interlace, and provided the receiver can hold it throughout a programme sequence, the receiver may be considered as having a satisfactory interlace performance.

The critical viewer should not tolerate an interlace ratio any higher than this, however, owing to the tendency for the paired lines actually to touch each other, and appear as a very broad single line, which gives rise to a distinctly "liny" picture of poor definition. A receiver operating under extreme conditions such as this is often characterised by displaying any straight or curved black to white edge of picture composition, which may resolve inclined from the vertical, in the form of prominent steps as the image cuts across the line structure.

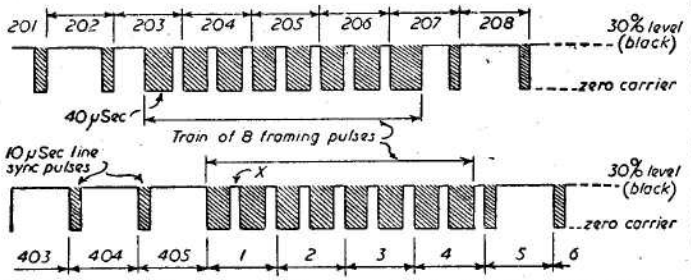


Fig. 3 (above).—A section of the sync pulse train that would occur at the start of the "even" frame, and Fig. 4 (below) at the start of the "odd" frame.

It is surprising the number of viewers who do actually suffer this "half-missing" style of picture, particularly the less fortunates possessing a receiver of two-or-three-years-ago vintage. Certain receivers in this category do interlace provided the frame hold control is critically set, but this precise setting is rather an achievement, and dealers installing receivers for "first-time" viewers have probably been unsuccessful in conveying the finer points between an interlace and non-interlace, or that the customers themselves have considered that the most important function of the frame hold control is to prevent the picture from "rolling"—and surely one effect with one control is sufficient!

Generally speaking, modern receivers interlace anywhere between the two limits on the frame hold control at which the picture begins to roll. Although, even in some current models, a critical point will be found where the interlace deteriorates—which, it will be noted, is opposite to the effect of the early receivers.

Interlace Checking Aids

One way of providing a comparison between a suspected non-interlace and a known non-interlace is by adjusting the frame hold control until the timebase repetition frequency is made slightly faster than that of the sync pulses. Under this condition the picture slips very slowly downwards, and if the eyes are allowed to follow it the total inertness of the line structure and the empty spaces between them, indicating a perfect example of non-interlace, are conspicuously revealed. If now, the picture is suddenly brought into lock, the resulting interlace—or non-interlace—is clearly visible in comparison with the mental image of the known non-interlace.

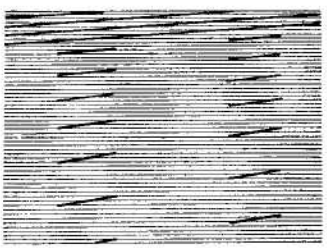
We have already seen that when a receiver is interlacing to any degree the whole line structure appears to be moving up or down the screen and, although this is really an illusion, it is possible to follow the apparent line movement with the eyes. When this is done the separate scans (frames) can be picked out and the picture appears out of interlace momentarily.

Although this ocular check for interlacing is simple and almost automatic, once the art has been acquired, it takes a little practice to transfer the gaze up the screen at just the right speed, and in this respect some people find it easier to keep the eyes fixed and raise the head to cause the eyes to scan the screen. Until one has really discovered the knack of this method, however, the difficulty is eased somewhat by following the apparent line movement with the point of a pencil, and provided the eyes are kept fixed on the pencil point the same effect is observed.

By increasing the amplitude of frame scan it is often possible to discern clearly a section of a synchronised raster, and thereby tell sufficiently whether or not a satisfactory interlace is occurring. The experimenter should beware if this method is adopted, however, for it sometimes happens, on receivers of certain types, that if the picture height control is advanced too far, the picture automatically goes out of interlace anyway. Opening the frame only slightly is generally sufficient to produce the desired effect without upsetting interlacing, and an additional aid in the form of a piece of cardboard in which a viewing aperture is cut, greatly facilitates this method of observing interlace conditions without the eyes becoming tired in having automatically to embrace the whole screen area. The employment of a convex lens suitably positioned over the viewing aperture further assists the viewing process.

The Production of an Interlaced Picture

At this point it might be instructive to consider



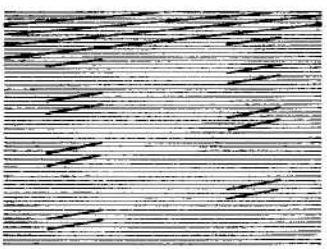


Fig. 5 (left).—The formation of flyback lines indicating a possible interlace. Fig. 6 (right).—The formation of flyback lines indicating a definite non-interlace.

how the transmitted picture is actually interlaced on the picture-tube screen. Before we can do this, however, we must get perfectly clear in our minds that a complete picture is made up of two frames (two separate scans), and for the purpose of identification one is known as the "odd" frame and the other as the "even" frame. Now, since the number of lines per complete picture in the BBC signal is 405, both frames are composed of 202½ lines, and, as we have already seen, if the picture is interlacing, the lines of the "even" frame occupy the spaces in between the lines of the "odd" frame, and thus we resolve our complete picture of 405 lines. If interlacing is not occurring, however, we get a picture of only 202½ lines, and half the picture is lost.

Referring again to Fig. 1, we can see that the scanning spot starts at the top left-hand corner of the screen to trace out the horizontal scan of line number 1, which constitutes the beginning of the "odd" frame. On arriving at the right-hand side of the screen the line flyback occurs and the scanning spot commences to trace out line number 2—the frame timebase is, of course, deflecting the spot relatively slowly down the screen at the same time so that it is in the correct position for the commencement of successive lines.

This continues until line number 203 is started, when, instead of being completed, only one-half of it is traced by the spot, and the first or "odd" frame is concluded. The spot is then initiated by flyback to line number 203, which is finished at the top of the picture, and thus the first half line of the "even" frame commences. This process continues down to line 405 to conclude a *complete* picture, after which the spot is prompted to flyback to re-commence tracing a further interlaced raster.

It is evident from this, perhaps, very well-known explanation, that the degree of interlace is controlled solely by the flyback. This is, indeed, the case, and it is probably already known that the sync pulses radiated together with the picture signal have the effect of initiating this flyback.

Now, if we look at the sync pulse train of Fig. 3 we shall get a better idea of how this happens. Actually, this is only a section of the sync pulse train of the composite signal which would occur at the start of the "even" frame (for the sake of convenience we have not shown any picture modulation on this waveform). By studying this waveforn we can see that at the end of line 202—as at the end of any line—the carrier falls from 30 per cent. (black level) to zero, and remains there for 10 microseconds.

This is a line sync pulse, and it is the leading edge of this pulse which initiates the line flyback. After the flyback, which must take place within the 10 microsecond period, the scanning spot starts tracing line 203, but in the middle of this line the carrier again falls to zero level and remains there for 40 microseconds. The resulting pulse constitutes one of the series of eight framing pulses, which initiate the "firing" of the frame generator to produce the frame flyback so that the remainder of line 203 is traced at the top of the screen as shown in Fig. 1.

At this point it should be noted that the line flyback does not occur half-way along line 203, but that the frame flyback is the prompting factor of the half line. The line flyback occurs regularly during the framing pulses due to the 10 microsecond spacing between them and, although they do not resemble the normal line sync pulses, their leading edges serve to "fire" the line generator at the correct time. It is necessary to maintain line synchronism during the framing period in this way so that the generator will be operating precisely at the correct frequency at the commencement of the following line scan.

The sync pulse train of an "odd" frame is shown in Fig. 4, where it will be seen that the only differences between this and Fig. 3 are that in the latter the framing pulses commence and finish in the middle of a line, while in Fig. 4 the first 40 microsecond framing pulse is also the initiating pulse for line number 1. This simply means, then, that to secure a good interlace between successive frames the start of a frame scan must coincide with the start of a line scan every other frame only.

Causes of a Bad Interlace

It would seem from this rather brief description that, provided the sync pulses are in actual control of the timebases, the system is bound to create a perfect interlace. Unfortunately, this is not the case, for the line and frame sync pulses need to be separated by various circuit networks in the receiver for application to the appropriate timebases. Furthermore, it is the voltage built up by the sync pulses which "fires" the generators (timebases) to initiate the flyback; and when it is realised that to provide sufficient voltage to "fire" the frame generator the framing pulses progressively charge up a capacitor to a critical potential (the "firing" potential), it is easy to see that any minor disturbances, such as fluctuation of signal or mains voltage, may cause the generator to "fire" slightly off time to seriously impair the interlace.

There are still other sources of undesirable coupling by which the line pulses might reach the frame circuits. For instance, a coupling might exist between a section of circuit wiring, or transformer—the line output transformer particularly—carrying currents at line frequency, and connections or components directly associated with the frame generator. Defective or insufficient decoupling in the H.T. line used to supply power to the timebase circuits represents another way by which line pulses may upset the timing of the frame generator—but a suspicion in this respect could easily be proved by operating the timebase section from a separate isolated power source.

In some of the older receivers a large degree of coupling exists between the line and frame scanning coils, and, due to this, it has been known for line pulses to gain admittance to the frame generator via the N.F.B. path provided in certain circuits to linearise the frame scan. If it is thought that line pulse coupling is the cause of a poor interlace, a pair of headphones connected in turn to various parts of the frame generator circuit should soon establish whether this is a fact. For this test the frame generator should be stopped, and one lead of the 'phones connected, through a suitably rated isolating capacitor, to the receiver chassis, the other lead should also be isolated by a similar capacitor and used as a probe for making contact to the more critical parts of the generator in an endeavour to trace any line pulse leakage, which, of course, will be heard from the 'phones in the form of the familiar 10,000 c.p.s. whistle.

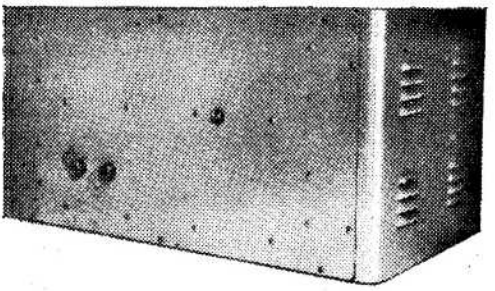
(*Concluded on page* 376).

A *Video* SIGNAL GENERATOR

DETAILS OF AN ELABORATE PATTERN GENERATOR WHICH WILL BE FOUND OF GREAT VALUE TO THE EXPERIMENTER

By D. W. Thomasson, A.M.Brit.I.R.E.

(*Continued from page* 328 *December issue.*)



THE light passing through the transparency is focused on a multiplier photocell, which produces a picture signal. The cathode-ray tube must have a very high intensity spot, and a 5FP7 has been used with success. The grid of the tube is fed with blanking signals during the flyback periods so that subsequent blanking is not needed, and the picture signal can be combined with a sync signal in a modified form of shaper unit.

The shaper unit consists of two sections, one dealing with synchronising signals and the other with picture signals. There is no reason why the two sections should not be built on a common chassis, except that the sync section can be used without change in association with several kinds of picture shaper. The two sections will therefore be described separately.

Sync Shaper

The circuit of the sync shaper is shown in Fig. 5. Two marker signals are required, the 20,250 c/s and 50 c/s outputs from the timer unit, and these are used to generate the synchronising signals, i.e., the part of the video waveform below the 30 per cent. level, or the video waveform as it appears when the picture is entirely black.

The 20,250 c/s marker is fed to V1, the half-line pulse flip-flop. This circuit may be unfamiliar but its operation is quite simple. The right-hand triode is not biased at all, and its anode current raises the common cathode potential so that the left-hand triode is normally cut off. When a positive input pulse is applied of sufficient amplitude to make the left-hand triode pass current, the voltage across that valve—and hence between grid and cathode of the right-hand triode—falls due to the drop in the anode and cathode resistors. This reduces the current flowing in the right-hand triode, which reduces the cathode voltage, allowing the left-hand triode to take more current.

This action is cumulative. It continues until the right-hand triode is cut off, and the left-hand triode is passing current even when the input voltage is zero. The coupling capacitor then begins to discharge through R2 and R4, so that the voltage on the right-hand grid rises at a rate determined by the time constant of these components. Eventually, the right-hand valve again passes current, and the circuit "flops" back to the original condition. The short trigger pulse produces a positive-going square pulse at the right-hand anode, the length of this pulse being determined by the recovery time of the circuit.

In the present case, the pulse must be 10 μs long, to form the serrations of the frame sync pulse. As a negative-going pulse is required, the circuit is followed by an inverter. A negative pulse could have been obtained from the left-hand anode, but it would not be so well shaped. However, this is a possible simplification if valves are short. Note that the inverter—V4a—does not act as a normal amplifier, but merely as a controlled switch, the valve being overloaded at both ends of its characteristic. This is the type of operation most often found in this kind of circuit.

The line sync pulses are generated in V3. Since the leading edge of each line pulse must fall at the trailing edge of alternate half-line pulses, the triggering signal is obtained by differentiating the negative-going half-line pulses—the trailing edge forming a positive-going pip—and using the resulting signal

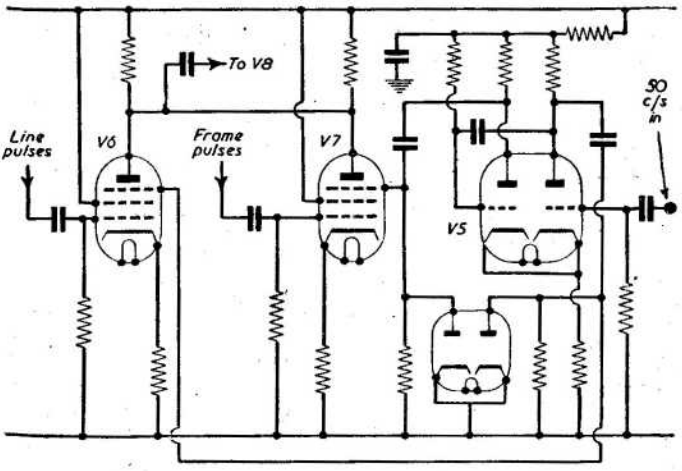


Fig. 6.—A modification as suggested on page 345.

to trigger a 2-1 counter stage of the Eccles-Jordan type (V2) in this circuit only one triode can pass current at a time, and the current changes from one valve to the other at every input pulse. The voltage at either anode, therefore, has the form of square waves at half the input frequency, in this case at 10,125 c/s, the line frequency.

The line generator, V3, is another flip-flop, and works in the manner described for V1. Inversion is not necessary here, as a positive-going pulse is wanted. Both the line and the half-line pulses are fed to the keying valves V6 and V7.

The 50 c/s input is used to trigger a third flip-flop of the same type, V5. The only difference in this circuit is that the grid return of the normally conducting valve is taken to H.T. instead of to the common cathode. The effect is much the same, but a sharper triggering action is obtained. The circuit is set to produce 400 μs pulses.

The output is directly coupled to the right-hand grid of V7, and the standing bias on the other half of the valve is set so that the valve operates normally in the absence of a pulse from V5. When V5 triggers, however, the cathode potential of V7 is raised, and the left-hand part of the valve is cut off. Meanwhile, a negative-going pulse is obtained at the anode of the right-hand half of the valve, and this is directly coupled to the right-hand grid of V6. The fixed bias on the left-hand half of V6 is set so that the valve only operates during the period of this negative pulse.

The left-hand halves of V6 and V7 have a common anode load. The line pulses appear across this except during the 400 μs frame switching pulse when the line pulses are switched off and the half-line pulses replace them. The two bias potentiometers should be set so that there is no appreciable D.C. shift at the changeover.

The pulses having been combined in an appropriate manner, all that remains is to clip them (V8) and feed them to the final mixer. This circuit, I hasten to point out, is not really a "Cascode," though it bears some resemblance to that controversial circuit. The important thing is that the synchronising signal must cut off the lower valve completely at the negative pulse tips, so that the cathode voltage falls to zero, while the positive peaks of the pulses must take the grid up to cathode potential, further rise being prevented by grid current. Once again, the valve is merely a switch, presenting a very high resistance at the negative tips, and a resistance of about 8,000-10,000Ω at the positive peaks. The upper valve is inactive during the negative-going pulses, and behaves as a cathode follower with a

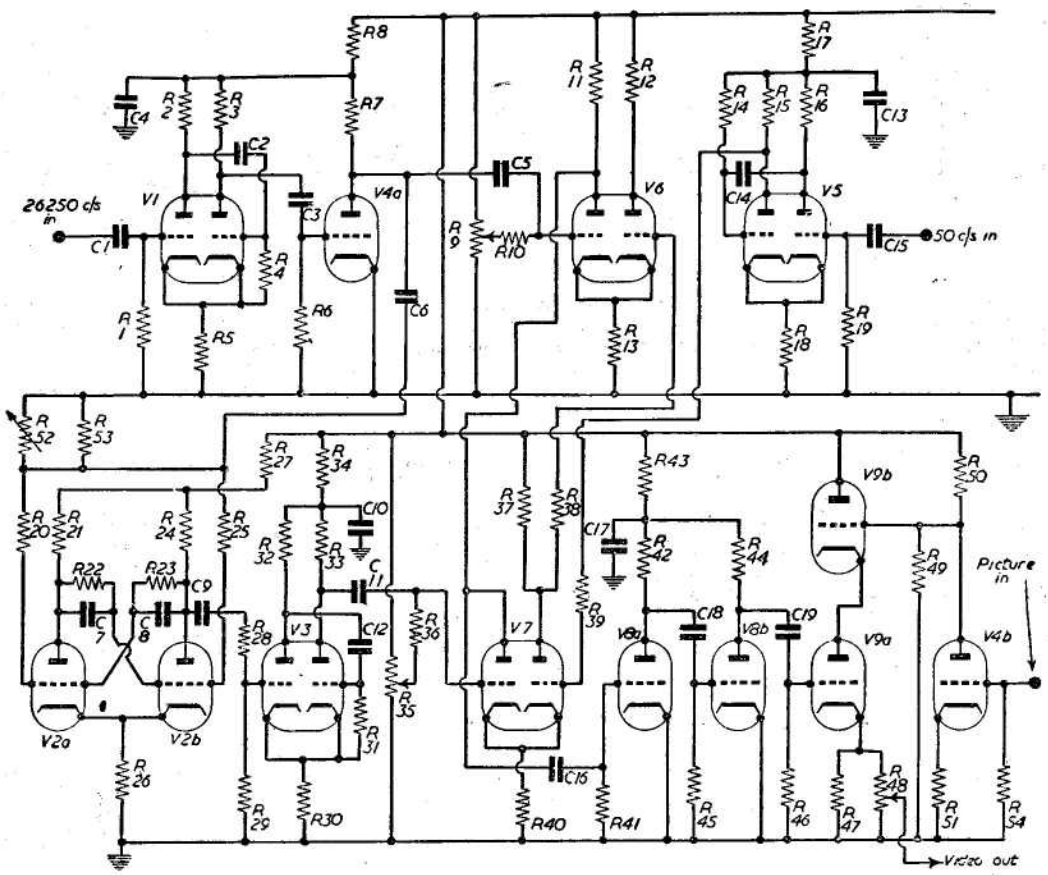


Fig. 5.—Complete circuit of the sync shaper. A list of parts appears on page 345.

cathode load of about 15,000Ω between the sync pulses. The picture signal is fed to the grid of this valve, and the potential at this point determines the setting of the 30 per cent. level. This is adjusted by varying R49, which should hold the "black" level constant unless V4b is violently overloaded. The picture signal input is at the grid of V4b.

Modifications

This circuit uses nine double triodes, a moderate force compared with that required for some sync generators, but nine may be too many for convenience on top of the five double triodes in the timer unit and two in the picture shaper. Two may be replaced by suppressor-switched pentodes (V6, V7), but a double diode is then needed. The modification is shown in Fig. 6.

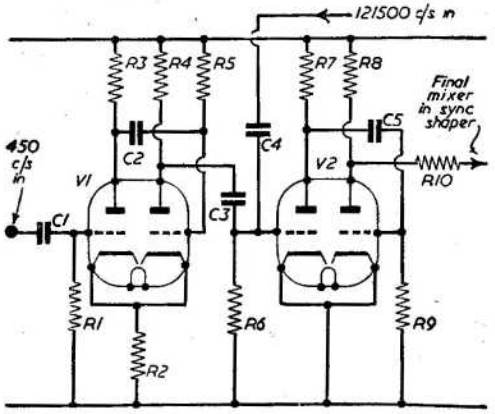


Fig. 7.—Circuit of the picture shaper.

Those with sufficient patience and optimism may care to try leaving out V2, the 2-1 divider, and attempting to persuade V3 to trigger reliably on alternate input pulses. This can be done by careful adjustment of the input feed circuit, for the left-hand triode tends to draw grid current when a generous positive pulse is fed in, and this charges C9. If the charge can be made to leak away just at the right rate, alternate triggering can be obtained, but it is by no means an easy job.

A final possible simplification is the omission of the double clipper, V8. This will probably lead to a rather rough final waveform, but that may be acceptable.

Setting Up

The three flip-flops should trigger without difficulty, providing the input pulses are fed in correctly, but the 2-1 divider circuit (V2) may prove reluctant, in which case a variable cathode resistor helps to find a good operating point. It is also worth while making an effort to match the corresponding resistors in the two chains running from H.T. to earth, so that the circuit is well-balanced.

When everything is operating properly, the pulse times should be checked and adjusted, if necessary. The times can be measured with a ruler, since the total duration of each cycle is known, and the pulse length can be increased by increasing the coupling capacitor and vice versa. The capacitor values given were obtained by experiment, but individual circuits may vary somewhat.

The 30 per cent. level in the output cannot be set until the picture signal is available, but the procedure is simple. R49 is adjusted until the proportions of the waveform as displayed on the C.R.T. screen are correct.

The Picture Shaper

After the timer unit and the sync shaper, the picture shaper seems ultra-simple. (Fig. 7.) The original circuit used was far more complex, as it had to

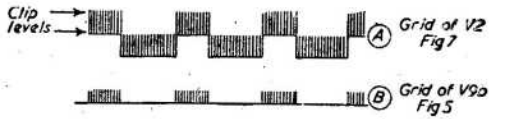


Fig. 8.—Pulses found in the picture shaper.

produce a pattern of white bars. A black bar pattern requires much less circuitry because the bars and blanking pulses can be the same.

In the present circuit the vertical bars are formed by 5 μs 121,500 c/s pulses and the horizontal bars by

TABLE B: COMPONENTS FOR SHAPER UNIT.

Components likely to require selection by trial are marked +

Sync Shaper :
R1—100 KΩ
R2—47KΩ
R3—22 KΩ
R4—47 KΩ+
R5—4.7 KΩ
R6—1 MΩ
R7—47 KΩ
R8—100 KΩ
R9—1 MΩ (V)
R10—1 MΩ
R11—22 KΩ
R12—47 KΩ
R13—100 KΩ
R14—4 MΩ
R15—47 KΩ
R16—100 KΩ
R17—47 KΩ
R18—4.7 KΩ
R19—100 KΩ
R20—100 KΩ
R21—100 KΩ
R22—100 KΩ
R23—100 KΩ
R24—100 KΩ
R25—100 KΩ
R26—38 KΩ+
R27—100 KΩ
R28—100 KΩ+
R29—100 KΩ
R30—4.7 KΩ
R31—47 KΩ+
R32—47 KΩ
R33—22 KΩ
R34—100 KΩ
R35—1 MΩ (v)
R36—1 MΩ
R37—100 KΩ
R38—470 KΩ
R39—100 KΩ
R40—47 KΩ
R41—1 MΩ
R42—22 KΩ
R43—470 KΩ
R44—10 KΩ
R45—2.2 MΩ
R46—1 MΩ
R47—10 KΩ
R48—10 KΩ (v)
R49—100 KΩ+
R50—22 KΩ
R51—1.5 KΩ
R52—500 KΩ (v)
R53—270 KΩ
R54—1 MΩ
C1—0.002 μF
C2—50 pF+
C3—100 pF
C4—0.1 μF
C5—100 pF
C6—0.001 μF+
C7—25 pF
C8—25 pF
C9—100 pF
C10—0.1 μF
C11—100 pF
C12—50 pF+
C13—0.1 μF
C14—240 pF
C15—200 pF
C16—10 pF
C17—0.1 μF
C18—0.002 μF
C19—0.002 μF
Picture Shaper :
R1—100 KΩ
R2—4.7 KΩ
R3—47 KΩ
R4—22 KΩ
R5—4.7 MΩ+
R6—1 MΩ
R7—22 KΩ
R8—22 KΩ
R9—2.2 MΩ
R10—22 KΩ
C1—200 pF
C2—0.001 μF+
C3—100 pF
C4—0.001 μF
C5—0.001 μF
Valves : All 6SN7.

1,400 μs 450 c/s pulses. The high frequency pulses are obtained directly from the timer unit master oscillator, and the 450 c/s pulses are generated by a flip-flop. (V1.) The two sets of pulses are mixed (Fig. 8a), and then clipped (Fig. 8b) to form the required picture signal. It should be noted that the 1,400 μs pulse must be negative-going and must start from the trigger pulse, as it is to be used for frame blanking.

V2b works in exactly the same way as a sync separator, and is, in fact, a sync separator circuit. The amplitude of its input signal must be large enough to ensure that it is completely cut off during the 1,400 μs pulse, and V2a is used for this purpose. The final output is inverted, ready for feeding to V4b in the sync shaper.

It will be seen that all picture signal elements are suppressed during the 1,400 μs pulse for frame blanking. Line blanking is obtained as follows. Owing to minute time delays in triggering action the line pulse is retarded some few microseconds in relation to the 121,500 c/s pulse which nominally falls at the start of the line pulse, and the corresponding white trace thus forms the right-hand edge of the picture. The next 121,500 c/s pulse is removed by the sync pulse, and the next falls after the end of the frame blanking period.

As time delays of this kind depend very much on wiring layout, and so on, it may be necessary to use a little trial and error to obtain the best condition, but the effect is well worth the trouble.

The only part of this circuit calling for adjustment is the flip-flop pulse length setting, and that is by no means critical.

Power Supplies

The complete shaper unit as described requires 6.3 v. 6½ amp L.T. and 300 v. 60 mA H.T. (approximately). Once again, the exact current drawn depends on the setting of the various circuits, chance synchronisms of different pulse generators, and so on. A maximum figure is quoted.

A common H.T. supply may be used for both timer and shaper units, as the decoupling circuits are designed to allow this. In actual fact, the blocking oscillators in the timer unit will work for several cycles on the H.T. stored in the 0.1 μF decoupling capacitors.

The Complete Generator

Constructional tastes and ideas of optimum size for chassis and cases show wide variations, and the reader may not relish the idea of fitting the complete unit on two chassis measuring 16in. by 6in. by 1in., with the power unit on a third chassis 16in. long and 4in. wide. It can be done, however, and the two main chassis can then be mounted one above the other in a standard cabinet designed for a 19in. by 10½in. panel, with the power pack at the rear. This makes a convenient portable unit.

Before determining on the cabinet design, however, it is as well to consider future development. If only a simplified version has been built, it is quite likely that the full circuit will be completed later on, and room should be left for that. Later still, perhaps, it may be desired to add a flying-spot scanner. A 5FP7 cathode-ray tube, plus the time bases, E.H.T. supply, and video amplifier of an old television set provide much of what is needed for that. In addition, the scanner calls for a multiplier photocell, blanking generators, and a video pre-amplifier. That, of course, would have to be a separate unit, unless the constructor wants to follow the old-fashioned taste in pattern generators and build a rack that looks as if it would sink a battleship!

A final word as to cost. Gone are the days when gear like this could be made up from surplus costing £4-£5. (Yes, it *was* possible.) The once ubiquitous 6SN7 is getting costly, but once the valves have been bought and a power supply provided the remaining cost should not be great. I would certainly expect to be able to keep the total under £12, even for the full circuit. The full retail cost of brand-new parts should not exceed £40, including case, chassis, power pack, and so on.

The most precious requirement is patience, and the greatest reward is the sight of your own "local transmission" on the receiver screen.

Belgium Buys British

LACK of transmission equipment, which prevented Belgium seeing the Coronation on television, will not prevent her taking part in any forthcoming European TV link-up. The first Belgian television station, consisting of two studios fitted entirely with the latest British equipment, opened on Oct. 31st last.

For the past two months Pye engineers have been working in Brussels to complete the installation of the first dual-standard system ever to be operated. The system has been made necessary by the fact that up till now television receivers in Belgium have been on either 625 lines, for Flemish-speaking viewers to receive programmes from Lopeck in Holland, or on 819 lines for French-speaking viewers to receive programmes from Lille. To avoid making one half of the population's sets useless, the new system has been designed to satisfy the requirements of all parties.

The two studios which Pye has equipped will have four cameras in each, either studio being able to switch quite simply from one standard to the other.

Homelab Pattern Generator

THE pattern generator, type 4, is designed to meet the needs of television service engineers, home constructors and experimenters requiring an inexpensive instrument for the testing and installation of television receivers. With its aid it is possible to carry out many tests in the absence of a BBC transmission. Provision is made for carrying out the following tests with speed and certainty:

(1) Vision frequency alignment. (2) Sound frequency alignment. (3) Frame timebase frequency. (4) Line timebase frequency. (5) Frame and line timebase linearity. (6) Vision channel bandwidth. (7) Adjustment of sound rejection circuits.

Frequency Coverage: 40-70 Mc/s on fundamentals.

Patterns: Frame timebase seven horizontal bars. Line timebase six vertical bars.

Screening: Careful attention has been given to the shielding of this instrument. Double screening of the R.F. oscillator is employed to reduce unwanted radiation to negligible proportions.

E.H.T. PROBLEMS

SOME OF THE COMMONER FAULTS AND TROUBLES EXPLAINED

By W. J. Delaney (G2FMY)

AN analysis of readers' problems shows that one of the principal causes of trouble in a home-constructed receiver is that due to the E.H.T. supply. Where a published design is being followed no difficulty should arise, but in an attempt to hook-up various parts of different designs the constructor often fails to appreciate the importance of certain voltages, and as a result finds himself in trouble. Provided reliable components are used, and the specified values are chosen, building from a published or sponsored design should give rise to no difficulty, but components which are not within the normal tolerance can introduce troubles, although they are not usually difficult to locate. The resultant trouble is usually indicated in the raster or picture and the present series of articles on Fault Symptoms should enable the faulty part to be located.

When "mixing" circuits, however, there is a vastly different problem and it would occupy far too much space to try and list some of the things which we have heard of in this connection.

Types of Supply

There are three main types of E.H.T. supply—the mains or 50 cycle supply; the R.F. unit, and the fly-back supply. The first mentioned is little used to-day, but it is a very handy source of supply, provided that it is borne in mind that the current it can deliver is very high, and in this respect it is just the opposite of the other two types. Accompanying this ability to deliver high currents at high voltage is, of course, the question of danger and a mains-E.H.T. supply can be classed as lethal and should therefore be treated with great respect. It has the advantage that it is more easily controlled as it is not dependent on any part of the remaining television equipment so that the output voltage, housing, etc., can be considered quite alone. It is more expensive as a special transformer is needed, and it has the drawback that the E.H.T. voltage will probably be available, on switching on, before the rest of the receiver is working and thus may give rise to damage. However, as it is now not much used we will pass on to one of the popular arrangements—the R.F. supply. This is outlined on page 348 which is a typical arrangement, and it will be seen that a pentode or tetrode is used as an oscillator, and produces an output which is rectified by a half-wave rectifier of the H.V. type. If standard commercial parts are used for the various components everything should be in order, but high-voltage insulation must be observed if an attempt is made to construct the coils at home. The frequency employed is usually about 100 kc/s for normal values of E.H.T. whilst for high voltages as required for wide-angle tubes to frequency may be quite low. This is the first trouble which this type of unit may give—radiation at the frequency of operation which affects neighbouring radio receivers. It may be kept within bounds by housing the entire supply in a metal box which is soundly earthed, but the type of valve which is used as an oscillator usually runs at a fairly high temperature, and thus adequate insulation ventilation must be afforded, and this, in turn may lead to a reduction in the screening efficiency. It has been found that by perforating the metal—similar to the sheets of perforated zinc used in food safes and some ventilators, assists in providing adequate screening with good ventilation, but we have not found that the zinc is good enough, and sheet steel or copper drilled out has had to be used in certain experiments. The efficiency of the earthing connection to the box, coupled with adequate

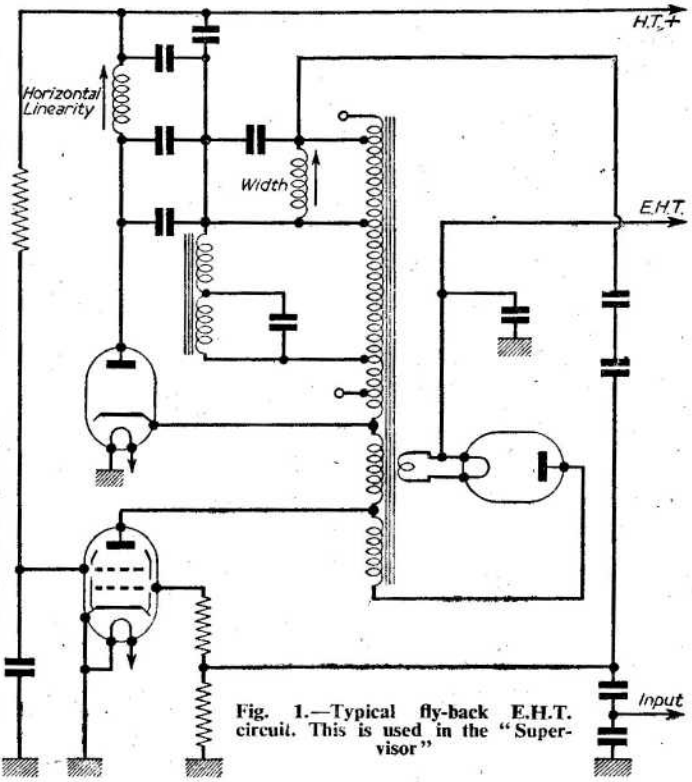


Fig. 1.—Typical fly-back E.H.T. circuit. This is used in the "Supervisor"

insulation inside, are essential points to watch. The output voltage may be varied by adjustment of the H.T. and the screen voltage, and it is here that the constructor may fail to appreciate the fact if taking this part of the circuit out of a design to include in another ; the H.T. rails on the two designs may differ, and as a result the H.T. may be excessive on the unit in the new arrangement.

Fly-back

In the fly-back circuit, the same remark applies—the H.T. rail which feeds the circuit must be very carefully examined, especially in circuits such as that used in the Super-visor, for instance (reproduced on page 347). Excessive H.T. on the output stage may result in the E.H.T. rising to such a value that breakdown will occur in certain components, apart from other difficulties. In some fly-back circuits, the output valve is also arranged to function as the oscillator also, and even more care is necessary in this case to make certain, if mixing the circuit that the applied voltages are as in the original design.

Failings

The main failings with both the fly-back and the R.F. supply are the regulation and the inter-relation between brightness and line-scanning power. Unless a published design is followed and strictly adhered to it may be found that the final receiver design will be satisfactory in every respect except that the picture cannot be opened out sufficiently to fill the screen. The height will be controllable and probably more than adequate, but no adjustment of the line timebase controls will enable a sufficiently wide picture to be obtained. The reason in such a case is probably that the E.H.T. is excessive and a reduction in voltage is called for. Failing this the line output stage may have to be changed to provide more power. The reverse also will hold good in many circuits—too low an E.H.T. supply will provide a picture of extreme width which cannot be reduced by the specified controls. This is not such a common fault as the former, however, as most constructors seem to aim at an extremely bright picture and obtain this by excessive E.H.T.

With all types of supply, the residual spot seems also to cause a lot of trouble. When switching off a bright spot is left about the centre of the screen and this gradually defocuses and then runs off or fades out without moving. The appearance of the spot in the same position time after time will eventually result in a black spot which will mar the tube. Rotating the tube is sometimes recommended as a cure, but there is no need to go to this trouble if a bleeder chain is placed across the E.H.T. output. Special high-voltage types of resistor are supplied by firms such as Erie and should be joined in series to provide a value of about 100 MΩ which will take a slightly increased current from the supply (resulting in a slight reduction in voltage), but on switching off these will drain away the residual voltage very quickly and prevent the formation of the spot.

Corona

The final trouble which appears very prevalent is the failure to appreciate that at very high voltages what is known as corona discharge may take place. All connections carrying the E.H.T. voltage should have the soldered connections made in the form of a perfectly round " blob," whilst right-angle turns or bends should be avoided. Any flex used should be carefully tinned first so that no " whiskers " remain, and when soldering is called for the wire should first be locked or firmly attached by twisting round the tag or contact so that on the application of the soldering iron a length of solder may also be applied at the same time so that it will run and form a good round blob. When taking the iron away do this carefully so that a point is not pulled up, and if necessary " wipe " the joint with a piece of wood to ensure that it is perfectly smooth. The actual lead should preferably be a length of standard coaxial with the outer covering and braiding removed, or alternatively standard

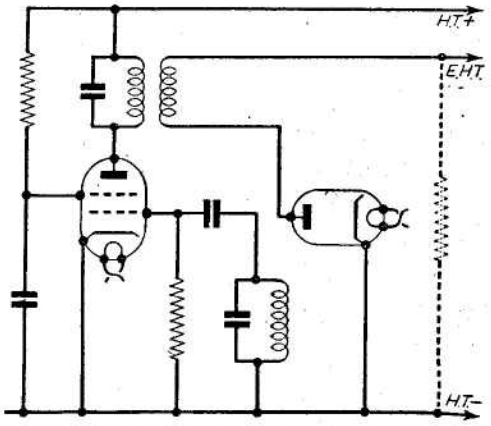


Fig. 2.—Typical R.F. E.H.T. unit.

motor-car ignition cable. The latter is, however, less easy to handle than the coaxial material. Let the output point of the E.H.T. unit and the wire right up to the tube be kept at least 2in. away from any earthed object, as there is a danger of it arcing across. A series of very fine dots all over the screen all the time the set is on will probably indicate corona discharge, and this may be confirmed by looking into the cabinet in the dark (taking care, of course, not to place any part of the body inside where a risk of contact with the E.H.T. leads may be made), and the point at which the discharge takes place will easily be identified by a faint blue glow or line, or even a chain of blue sparks. Furthermore, there will usually be a smell of ozone, an unmistakable smell. If the sound can be turned off and there is a very low hum level from the set it may also be possible to hear the corona discharge in the form of a slight frying or rapid ticking noise. One awkward case of this occurred in a receiver in which the actual discharge occurred from the output tag of the E.H.T. unit on to the anode of the line output valve. The blue glow in the valve obscured the actual discharge, which was due to a rough soldered joint where the E.H.T. lead was attached to the output tag. The distance from this to the glass bulb of the line output valve was just over 1¾in.

FAULT SYMPTOMS

THE CAUSES OF COMMON FAULTS, AND METHODS OF CORRECTION

By Gordon J. King, A.M.I.P.R.E.

(*Continued from page 303 December issue*)

Incorrect Line Timebase Frequency (Philips)

A SLIGHT deviation from general practice of timebase frequency control is embodied in the Philips 1100U series receivers. Fig. 19 depicts the system employed, and as will be observed the PL81 performs the dual functions of line sawtooth generation and line output. The line output and pulse E.H.T. section follows normal practice, and since we have already considered its mode of operation in detail earlier in this series we shall not dwell upon it further.

We shall, however, focus our attention mainly upon the triode oscillator section which is formed by the screen-grid and control grid of the PL81 in conjunction with the associated oscillator transformer. In this respect we can realise that the initial rise of screen current through L1 generates across the winding a back E.M.F. This induces an E.M.F. across the grid winding L2, which drives the control grid of the valve positively, causing an increase of screen current (and also, of course, an increase of anode current ensues through the appropriate winding on the line output transformer to give rise to the normal function of this section). A further increase of induced E.M.F. across L2 occurs, the action of which is regenerative, and the valve is rapidly driven into grid current.

At the end of the line-scan the sync pulse comes along and drives the control grid of the valve *negative*. The effect of this reduces sharply the instantaneous value of screen current, and therefore a reversal of the induced volts across L2. This in turn provokes a further reduction of screen current. Again, the action is regenerative, and the valve is quickly cut-off to initiate the line flyback.

In this circuit the time constant consists of the inductance of the oscillator transformer and the hold control inductor reflected across L2 in series with the 33 KΩ resistor R1. It should be appreciated, though, that the capacitance formed by the valve itself and the circuit wiring, together with the total distributed capacitances of the inductive elements, materially affect the frequency of oscillation. Nevertheless, the time constant of the circuit, and thus the frequency of oscillation, is rendered adjustable by virtue of the variable inductor L4, giving the line-hold control.

Frequently on the model receiver cited it is found necessary for correct line-hold to employ maximum line-hold control inductance, and even then in certain cases more inductance would be advantageous for a real "solid" lock. This means, then, that the adjustable iron dust core in the hold control inductor (accessible from the front of the receiver cabinet) is screwed all in. Since the time constant is primarily composed of the inductive elements, such a defect can present rather a bewildering problem to the experimenter. Changing the PL81 valve, or altering the value of R1, sometimes provides a less limited range of hold control, but at the best under these conditions, unless R1 has severely altered in value, it is generally found that the core is still practically at the end of its traverse for optimum line-hold.

Fortunately, the oscillator frequency can be readily altered by reason of the capacitive elements without the necessity of replacing the inductive elements, so that the correct frequency is obtained at the

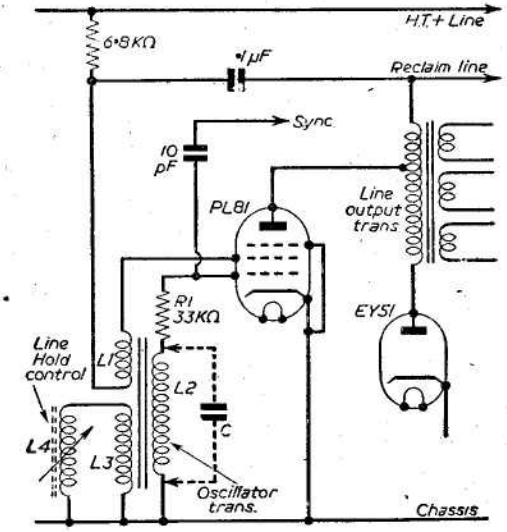


Fig. 19 (left).—Line output/generator stage as used in the Philips 1100U.

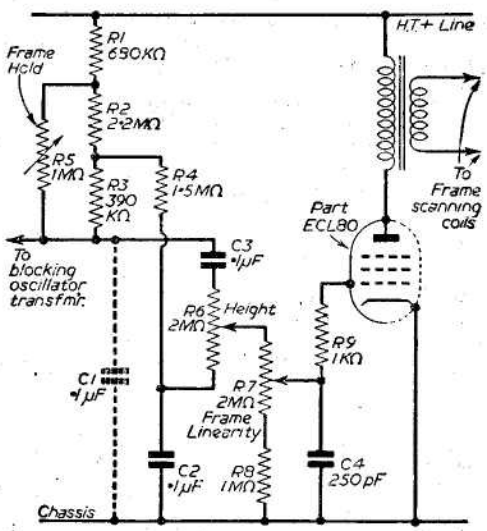


Fig. 20 (right).—Frame output stage and coupling of the Bush TV22, TV24 series.

approximate centre of the hold control's range. It is only necessary to shunt the grid coil L2 with a good quality capacitor as indicated in Fig. 19. The precise value is best determined by experiment, although it has generally been found that a value in the region of 250 pF is sufficient for optimum balance.

Frame Bounce (Due to Defective Generator)

Apart from defects in the sawtooth generator which give rise to the symptoms of an incorrect

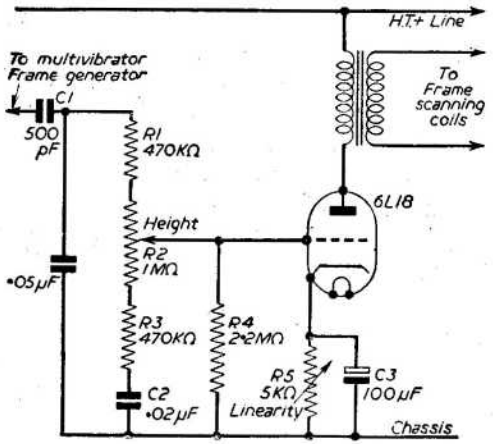


Fig. 21.—Frame output stage used in the Argosy 1412 series.

repetition frequency or insufficient amplitude of scan, other faults which actually interfere with the normal operation of the timebases can frequently be traced to the output section proper. There are, however, one or two mystifying symptoms directly associated with the generator which we have not yet considered.

One of these is what is sometimes known as "frame bounce," or "frame judder." The symptom being that the whole picture appears to be on the move and vibrating rapidly in a vertical direction, and little or no alleviation of the effect can be achieved by adjusting the vertical (frame) hold control. It is generally found that receivers employing a "soft" valve frame generator are much more prone to the effect than, for instance, the "hard" valve blocking oscillator. This should not be taken to indicate that other generators, apart from the thyratron, are completely immune from the effect, however, for it can occur in any type of generator for the same reason; but, generally speaking, the symptom in the majority of "other cases" is due to synchronising trouble, which will be adequately dealt with later in this series.

It will, of course, be obvious that, apart from being most disconcerting in itself, the fact that frame bounce is occurring at all—however slight—is bound to impair severely the receiver's interlace performance. Clearly, then, accurate frame synchronisation is an extremely important factor in preventing bouncing of the frame scan caused by the charging capacitor failing to be discharged to the same potential after each scan.

In this respect the generator valve itself, ageing or developing a defect that renders it incapable of "firing" exactly at the same potential on each effective framing pulse, is often proved responsible. And from this aspect it is fairly safe to state that a receiver employing a T41 or 6K25 frame generator valve, and exhibiting the symptom of frame bounce, can be completely cured by simply replacing the appropriate generator valve.

Slow Flyback

Another symptom characteristic of a defective frame thyratron valve is the appearance of three or four brilliant horizontal lines within the region of an inch or so at the top of a synchronised raster or picture. The lines are similar to those corresponding to the frame flyback, but are conspicuously in evidence at the normal setting of brightness control. Furthermore, since the effect is due to a fall-off in the ionisation efficiency of the valve, resulting—in certain cases—in the charging capacitor failing to become wholly discharged before the commencement of the succeeding frame, a degree of frame foldover is also sometimes displayed.

Vertical Scan Distortion

Generally speaking, one of the most frequent causes of poor vertical linearity can be traced to a modification in the working conditions of the frame output valve. This can be provoked either by an alteration in the characteristics of the valve itself—due to a reduction in emission, or a modification of grid base, for instance—or more frequently by the result of a "leaky" capacitor, or an alteration in the value of a resistor associated with a critical part of the circuit.

In this respect it is interesting to note that certain television receiver manufacturers adopt this principle and employ a variable form of linearity correction which, in effect, simply alters the operating conditions of the frame amplifier. A typical example of this style working is shown by Fig. 20, which depicts the frame timebase interstage coupling circuit between the oscillator charging capacitor and the output valve.

At first glance this may appear a rather formidable network and well outside the grasp of the average experimenter. This is not really true, however, for

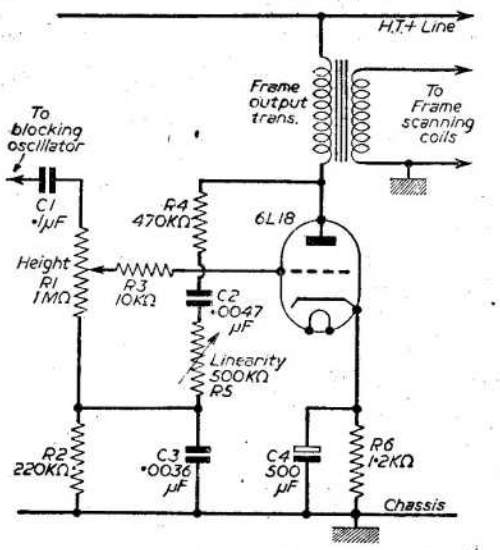


Fig. 22.—A method of frame linearity correction by N.F.B. used in Ekco T161 series receivers.

once the circuit is divided into its various sections it is quite straightforward and easy to follow.

The capacitor C1, shown in dotted lines, together with R1, R2, R3 and R5, form the time constant circuit of a blocking oscillator—the repetition frequency being controlled, of course, by the variable element R5. The sawtooth voltage thus appearing across C1 is conveyed via C3 to the picture height potentiometer R2, whose circuit is completed through C2. A suitable sawtooth voltage is, therefore, tapped off and applied to the frame linearity potentiometer R7 and resistor R8. The sawtooth voltage arrives at the control grid of the pentode section of an ECL80 valve via R9.

It may be wondered at this point why the frame linearity control functions as such, and why it does not in effect simply control the amplitude of sawtooth voltage applied to the grid as does the height control. The explanation is that to a degree it does affect the drive voltage, but more important is the fact that a potential-divider is formed across the H.T. line by virtue of R8, R7, R6, R4, R2 and R1, so that by varying the setting of R7 the grid-bias voltage of the frame output valve is also varied.

Now, a manual adjustment of grid bias enables the operating point readily to be moved up or down the mutual conductance characteristic curve of the output valve; and since the curvature of this characteristic has a large bearing on the scanning stroke an admirable means of correction is available. It generally follows that cramping at the bottom of a picture is indicative of insufficient bias, while cramping, or a fold at the top of a picture, can be taken as a fair indication that the bias of the frame output valve is too high. Most designers employ either a fixed degree or adjustable frame linearity correction by taking advantage of the curvature of the output valve characteristic, which is generally opposed, and tends to counteract the exponential nature of the sawtooth waveform from the generator itself.

Reverting again to the circuit of Fig. 20, it will be observed that operation of the height control potentiometer is also bound to have an effect similar to the linearity control. This does occur in practice and the two controls are somewhat interdependent; but by increasing the drive voltage the control grid of the output valve is driven more negative, whereas by altering the linearity control in a direction that would apply more sawtooth drive to the valve, the grid is made to go more positive. Furthermore, the direct alteration in bias effected by the height control is proportionally less than the effect due to the linearity control, owing to the judicious distribution of resistor values in the overall network. For this reason, therefore, each control has a definite function, and even though a degree of interaction is noted an excellent compromise adjustment is possible.

Clearly, then, a slight fall off in efficiency of a component which may tend to alter the grid bias, or affect the operating conditions of the frame output valve in any way, is bound to result in poor vertical linearity, or distortion of the frame scan. Poor insulation of C3 (Fig. 20), for instance, may not appear on the face of it to be of any consequence, since the lower end of R6 is in connection with the H.T. in any case. But let it be realised that R6 in itself has a value of 2 megohms, plus the 1.5 megohm resistor R4, and it becomes plain that a "leaky" C3 will severely modify the evenly distributed voltages between the resistors in their respective circuits and, therefore, completely nullify the desired effect of the frame linearity potentiometer.

A leak developing either in C2 or C4 will, of course, provoke a similar state of affairs. The output valve bias potential will be affected and, instead of operating on the part of the curve consistent with optimum linearity, the valve will tend to function with too much negative bias, and cramping will be evidenced at the bottom of a picture. Furthermore, attenuation of sawtooth voltage applied to the control grid of the output valve owing to the damping effect of the "resistive" capacitor will produce a distorted scan possessing insufficient amplitude.

One of the first tests the experimenter should perform when investigating the cause of sudden frame distortion is to ensure that the coupling capacitor

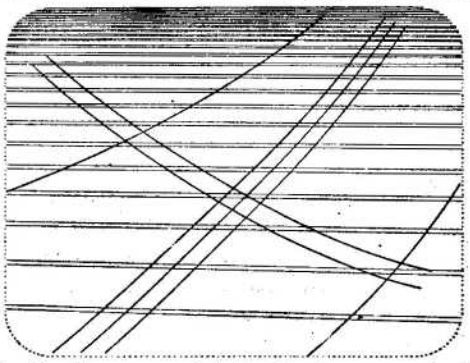


Fig. 23.—Frame scan distortion due to an open circuit N.F.B. loop.

possesses adequate insulation. Most frame timebase circuits possess such a capacitor, which, of course, has its counterpart in the ordinary audio output stage of a radio receiver. And as the sudden occurrence of distortion generally prompts one to suspect the coupling capacitor as being "leaky" in sound circuits, the same reasoning should apply to frame circuits—indeed, the faults are synonymous, not only in character but also in regularity, and many of the older style frame timebase circuits even look like an audio output stage.

The circuit of Fig. 21 shows the frame output stage of the Argosy range of receivers, and as will be seen is much less complex than our previously considered example. The output from a double triode multivibrator circuit is coupled via C1 (the coupling capacitor) to a potential divider R1, R2, R3 and C2, the element R2 being variable, whose slider conveys the sawtooth voltage to the grid of the output triode, which provides a means of height control. Resistor R4 facilitates a grid return path for the output valve, and can be considered analogous to a normal grid leak. Bias voltage is developed across the cathode resistor R5, which is decoupled by a large value electrolytic capacitor to prevent negative feedback at the low frame frequency of 50 c.p.s.

The cathode of the triode is thus at some positive potential above chassis—or above control grid, since the grid is at chassis potential by reason of R4—or in other words, the control grid is negative with respect to cathode. This bias potential is adjustable by R5, which can be used to alter the operating conditions of the valve, and thus affect the linearity of scan.

The three components which are generally found to give rise to a distorted scan in a circuit of this nature are (a) the valve itself losing emission, (b) the coupling capacitor developing a leak, or (c) an open circuit, or leak in the bias decoupling capacitor C3. It should be mentioned at this point, however, that a fall off in H.T. line voltage will affect not only the amplitude of scan, but, owing to the resulting modification in output valve grid base, an endeavour to obtain added picture height by reason of the appropriate control will tend to over-drive the valve and scan distortion will be produced in this way. This applies equally to any type of frame generator output stage (and to certain line output stages), and distortion or cramping will result at the bottom (or at the right-hand side when the line section is so affected) of a picture. It is worthy to note that a large number of distorted raster faults can be traced to this cause.

Variable N.F.B.

Apart from purposely altering the operating condition of the frame output valve to provide a variable linearity-compensating feature, it is now progressively becoming more popular to use a variable degree of negative-feedback as a scan linearising agent. A form of capacitor/resistor potential divider is generally incorporated in the anode circuit, and arranged so that by making one of the resistive elements variable a desired portion of sawtooth

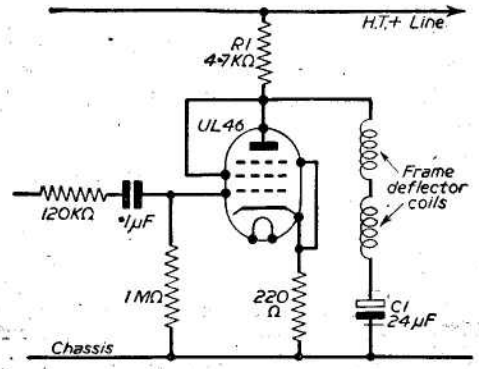


Fig. 24.—Frame output section of the Ultra V710 series.

potential can be fed back to the control grid circuit.

The circuit of Fig. 22 is a typical example in this connection, and illustrates the method of frame linearity correction adopted in Ekco T161 series receivers. From this we can see that resistors R4, R5 and R2, together with capacitors C2 and C3 constitute an A.C. potential divider across the output of the frame amplifier. A tapping is provided between R5, and C3 and R2 in parallel, which feeds back into the grid circuit a ratio of sawtooth voltage, via the height control resistor R1, and the grid resistor R3; the ratio being determined by the setting of the linearity control R5.

It should be noted, however, that, although inherent scan waveform distortion is readily alleviated by the application of N.F.B., it is still essential to ensure that the valve itself is operating on the point of its characteristic curve, providing minimum distortion and optimum counteracting effect of the exponential waveform from the generator proper. In this connection, then, the cathode resistor and associated electrolytic decoupling capacitor still represents a section of the circuit highly important to scan quality, as also does the coupling capacitor C1, and it is advisable to ascertain—should slight scan distortion be in evidence—that these components are well up to standard in all respects.

Scan distortion arising from a defect in the negative-feedback loop is generally of an extremely severe nature, for it should be remembered that a fault which may cause the feed-back to be reduced, or open-circuited altogether will, apart from provoking a deterioration in linearity, very much exaggerate the amplitude of scan—very much the same as a marked increase of signal output would result from an audio amplifier which was suddenly subjected to a reduction in negative-feedback voltage. From the timebase aspect, therefore, the scanning lines become very widely spaced, particularly towards the bottom of a picture or raster, and the effect of an open circuited feedback loop or an increase in the value of one or more of the associated components appears very similar to that illustrated in Fig. 23.

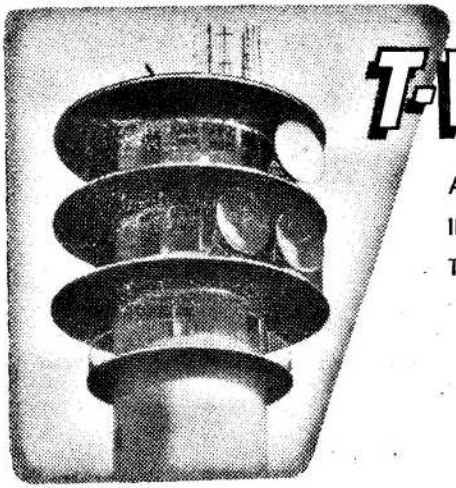
It sometimes happens that short-circuited turns within the frame output transformer gives rise to a distorted or non-linear scan. But owing to the lower peak pulse voltage generated across the primary winding of the transformer during the frame flyback, however, as compared with the very high voltages produced during the line flyback, a breakdown of insulation of the frame output transformer is much less frequent than a similar occurrence in the line output transformer. Nevertheless, frame scan distortion has, in a number of cases, been traced to this cause. Intermittent frame scan distortion on the Cossor 916 series receivers has, on several occasions, been proved to be the result of a transformer defect, and it is as well to bear this point in mind when investigating such a fault, particularly if the smaller components of the circuit check normal.

Short-circuited Turns

As with the line output transformer, defective insulation or short circuit turns in the frame output transformer is extremely difficult to establish definitely, and often well outside the range of the experimenter's testing facilities. In cases where, apart from being certain about the condition of the frame output transformer, the remainder of the circuit checks normally, transformer replacement should be contemplated; but, even so, one should bear in mind the possibility that a similar defect in the frame scanning coils themselves may be the provoking factor.

In this respect scanning coils energised via an output transformer are generally of very low impedance. This means, then, that only a few turns of heavy gauge wire comprise the coils, and the peak voltage appearing across each turn, or even across the entire winding, is very low, and not normally sufficient to cause an insulation collapse. From the practical aspect, however, low impedance scanning coils do sometimes suffer from this cause, and when this is the case a foldover often results at the bottom of a picture, and the raster appears wedge shaped. It is not unknown, by the way, for just one of the frame coils to break down, resulting in the picture being narrower at one side than the other.

(To be continued)



T-V with B.A.O.R.

A DETAILED ACCOUNT OF THE MANNER IN WHICH THE ROYAL SIGNALS PROVIDED A TV RELAY OF THE CORONATION BROADCAST

IT is now a well-known fact that the television programme of the Coronation ceremonial in London was relayed by an intricate radio network to France, Holland and Germany.

In most areas of the British zone of Germany where troops are stationed, reception from the local television transmitters was adequate. One important exception, however, was the Bad Oeynhausen Area where Headquarters, Northern Army Group, is situated. Due to this locality being low-lying and outside the accepted service area of any German television transmitter, reception of the programme from England was virtually impossible. Ironically enough, the radio link carrying the programme from England to Cologne, and via Minden to Hamburg passed overhead.

An Investigation

The nearest station to Bad Oeynhausen in this radio relay chain was situated at the Jacobsberg Radio Tower, Porta Westfalica, seven miles from Bad Oeynhausen. The Chief Signal Officer, Northern Army Group, ordered that the possibility of providing television coverage from this relay station should be thoroughly investigated.

Relay

After studying this matter in consultation with German Post Office technicians, it was decided that a small television transmitter could be installed in the Jacobsberg Tower. This transmitter would then be fed by the video at the monitoring screen of the German relay equipment. As this tower is situated at a height of 240 metres above the level of the River Weser, it was anticipated that a wide area would be served.

Immediately, negotiations started for a loan of a television transmitter from German industry. This equipment, having a peak power of 60 watts for both sound and vision, was erected in the tower and beamed by three multi-dipole arrays in the direction of Bad Oeynhausen, Minden and Bad Eilsen ; the latter being the Headquarters of the Second Allied Tactical Air Force. The effective power in each beam was of the order of 700 watts over an angle of 27 degrees beam width. It was decided to transmit in the channel of 174-181 Mc/s.

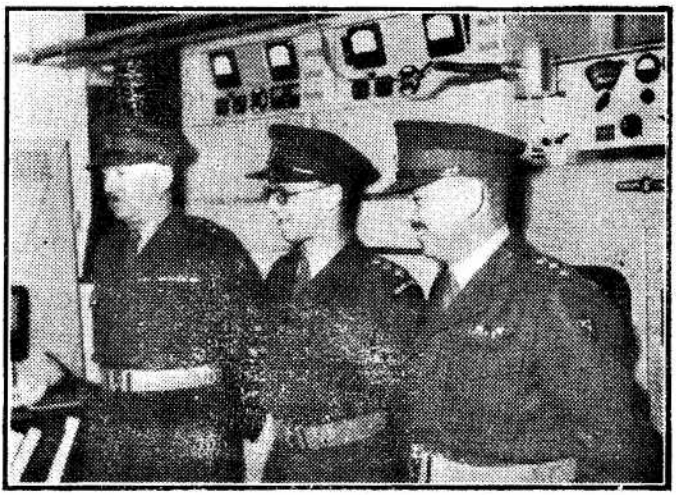
Sound Channel

The sound commentary transmitted with the vision from the German installations was obtained by immediate translation into German of the television sound commentary carried from England by line to the Nordwestdeutsche Rundfunk studios at Cologne. The opportunity to bring this English language transmission from Cologne to the Jacobsberg Radio Tower Station obviously could not be missed. This was, indeed effected by utilising one of the 24 radio circuits from Cologne passing through the Jacobsberg Tower.

Thus troops in the Bad Oeynhausen area were enabled to enjoy the same television facilities as if they had been at home in the United Kingdom.

This event, it is believed, is the first occasion upon which Royal Signals has been responsible for the installation and running of a television transmitter.

The illustration at the top of the page shows the three transmitting aerials mounted on the top of the Jacobsberg Tower. The lower parapoloids are the relay aerials.



Brigadier R. H. O. Coryton, C.B.E., O.B.E., Colonel R. M. Adams and Captain R. O. Dunmore at the Jacobsberg tower.

TELEVISION PICK-UPS AND REFLECTIONS

UNDERNEATH THE DIPOLE

By Iconos

IT used to be said that beauty is but skin deep. I suppose that that assertion was reasonably true in the days before cosmetics came into general use and the fair sex was gently beguiled by attractive advertisements into purchasing X skinfood, Y lipstick or Z powder for the express purpose of "enhancing their natural beauty." In this day and age most young (and also not so young) women would feel half-dressed if they walked down the street without their make-up on. And they would look it!

MAKE-UP

BUT make-up has always been necessary for the theatrical stage, originally because of the extremely poor illumination, with footlight candles or gas jets, and later, in a different form, because of the brilliance of electrical stage lighting. In the early days of the theatre, following the abandonment of the use of masks, make-up was applied to the face by an actor to emphasise his features and the type of character he was playing. His stock-in-trade included fuller's-earth, burnt cork, prepared chalk, rouge, powdered blue and carmine, which were applied with a camel's-hair brush or a hare's foot. With electric footlights came grease paint, and with the brilliant rays of the Kleiglights of the early silent movies the plot—and the grease paint—thickened! Make-up akin to that of a clown was necessary to prevent the dirty-face effect of these strong arcs when used for photographing with orthochromatic (non-red-sensitive) film stock. An exactly similar effect was obtained in the early low-definition television days, when a yellow face and blue lips seemed to give the best results. Time has marched on, and film and TV make-up has lightened, or rather, thinned. Portrait photographers have never favoured very much the use of make-up, even by women. It so happened that on the opening night of "Quite Contrary," I viewed this feature with an eminent portrait photographer, who was keenly interested in "Make-up Spot," in which an expert explained how the correct use of cosmetics could enhance the features of even the most beautiful woman's face. A very attractive girl was the model, who reappeared after the expert had applied his beauty aids. My friend had already forecast that the girl's face could not be improved for photographic portrait work, not even by retouching the negative! Nevertheless, he was staggered by the unbecoming crudity of her final appearance. It was not surprising that the so-called "Hollywood make-up expert" proved to be a hoaxer, as was revealed two weeks later, when he was recognised at a soap and scent stall in Salisbury market place. This amusing series of events proves three things: how easy it is to delude the BBC; that make-up should be very sparingly used for TV; and that the bona fides of alleged make-up men should be thoroughly checked. The line of business of cosmetic expert is one which lends itself to easy exploitation by witch doctors of stage, screen and TV studio.

TELE-RECORDING

LAST month I wrote in praise of the BBC newsreel and the personnel responsible for it. A day or so later I was present at the reading of a paper before the British Kinematograph Society on "Filming the Coronation for TV." Details of the elaborate arrangements for siting dozens of cine-cameras, multiple telerecordings of sound and picture over a period of hours, the astronomic statistics of film footages consumed, and the weeks of planning, designing and testing of special equipment were revealed by Philip Dorte, who was dubbed "the BBC's ambassador to the Film Industry" by a speaker who seconded the vote of thanks. Amongst the films demonstrated at this lecture was a 35 mm. film (enlarged from an American 16 mm. Kinescope recording) of the J. Fred Muggs TV programme on Coronation day. It was presented without comment by the lecturer. It proved to be a rather dull magazine-type programme dealing with events of the day, in which a commentator at a switchboard carried on a conversation with viewers, with asides to the mascot, a chimpanzee, J. Fred Muggs. After reading terrible descriptions of this particular programme in various newspapers, the tele-recording seemed tame and innocuous.

RECORDING TV MAGNETICALLY

FROM time to time claims have been made that television could be recorded on magnetic tape on magnetic coated film. Considering the frequencies involved, one visualised super-streamlined recorders, with the tape racing through at a colossal speed. No public demonstrations have been made, however, and it seemed to be a doubtful proposition, excepting for very low-definition TV. However, now that David Sarnoff, Chairman of RCA and of the NBC, has announced that recording of both black-and-white and of colour television has been accomplished on magnetic tape it can be taken seriously. A public demonstration will be made at Princeton, New Jersey, very shortly. No technical details have been revealed, but it is claimed that the system can be used for direct recording of television (with immediate play-off for checking), for telerecording or for the electronic recording of scenes for films. The pace of progress in the field of electronics, optics and photography gets faster. Full-scale and highly satisfactory stereophonic reproduction of sound was heard for the first time in London when *The Robe*, a super-wide screen film on Cinemascope was given its première recently. Here was immense spectacle, colour, magnificent dialogue and music recording, put before an invited audience on a screen 50ft. wide and 20ft. high—compared with the old normal width at the same theatre of 23ft. Though the new wide screen was excellent, the film itself seemed too long, and there were dull periods.

Notes on Power Supplies

DETAILS OF DESIGN FOR A.C. AND A.C./D.C. RECEIVERS

By N. T. Cook

WHEN considering the power supply aspect of television receivers A.C. mains spring first to mind. The great majority of TV owners have A.C. mains, and not always with the minimum amount of receiver (and house !) protection. A study of many published designs both commercial and private (namely home-constructed) shows that the cheapest of all protections, the fuse, is by no means standard. There is absolutely no case at all for the omission of fuses, whereas there is a great deal to be said in favour of them. When selecting the correct rating normal load figures are desirable, for the more that is known about normal conditions the greater protection efficiency factor can be obtained from the "link" in the power supply that is deliberately made weak. Many readers will need no advice or guidance about fuses, but in television ownership and construction, as in all things, there are the interested newcomers who rather than leave out a good point will accept values from similar apparatus. To copy other values is to grade the whole business rather broadly and is risking expensive trouble. Fuses, by their very nature and intended usage, are made quite cheaply ; it is far better to spend a shilling or two on over-caution than spend pounds for lack of any care at all. Domestic supply fuses cannot protect a receiver, for their ratings must cover loads other than the set itself and consequently such fuses would allow currents that could do much damage to the TV without "breaking."

A good average value for normal protection is given by :

$$R = 1.5 \frac{\frac{ImA \times Vht}{1,000} + \frac{Afs \times Vfs}{1}}{Vmi}$$

Where : ImA is total receiver H.T. current—milliamperes (Fig. 1) Vht is receiver H.T. (smoothed D.C.) voltage—volts (Fig. 1) Afs is total valve heater currents in a parallel run (Fig. 2) and Vfs is heater voltage of one valve in such parallel runs. Where several secondaries are found and their voltages differ, the respective wattages are added together, but where such separate secondaries have a common voltage parallel then only the value of one need be considered against the total currents of the related windings. Vmi is mains input voltage.

As beginners are mostly concerned at this point an example may not be amiss. Assuming ImA as 300, Vht as 300, Afs and Vfs as 25 valves with 6.3 volt 0.3 Amp heaters and a Vmi (mains input volts) value of 250, the resultant rating is 0.8, but this would be carried to 1 amp. in practice and allows as such for transformer efficiencies involved. As the formula assumes blowout on 50 per cent. overload it should be closely followed for best protection, and in this respect where fractional answers occur discretion should be used in "rounding off" the figure, as much addition to the rating of the formula's allowances would risk a fault ruining components without protecting the receiver.

Series Heaters

Some receivers, though designed solely for A.C. mains, also employ a type of modified A.C./D.C. technique for valve heaters as in Fig. 3. Where such circuits occur the total wattage is VI where V is the voltage across the entire winding and I is the current in amps. of one valve only. In some cases also shunt resistors may be employed where valves of "odd" current ratings are included in series heater chains. Suppose it is desired to include a 12.5 volt 0.15 Amp. type in a chain of valves of varying voltages (htr) but identical current ratings (as they should be if no series or parallel ballasts are used). Then Fig. 4 system (for 0.3A) would be used and the chain current is that of the valves not shunted, the odd valve rating not being considered as the shunt compensates for the difference. However, if the chain consisted of 0.15 types, and a 0.3 type were inserted, then Fig. 5 system would be needed and the chain current then becomes that of the higher-current valve, in this case 0.3 Amps. It will be noted that the "odd" valve is placed to avoid an additional shunt as would be required if the valve were set in an intermediate position. Where mains transformers have

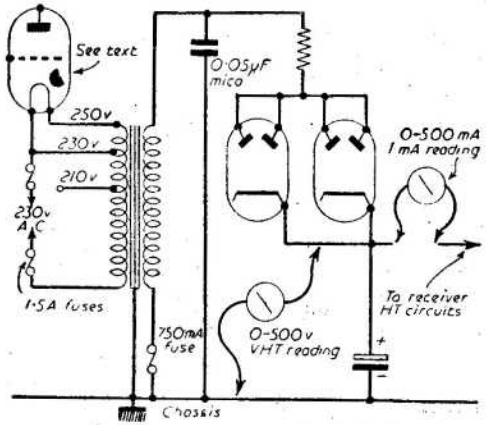


Fig. 1.—Checking current for load values.

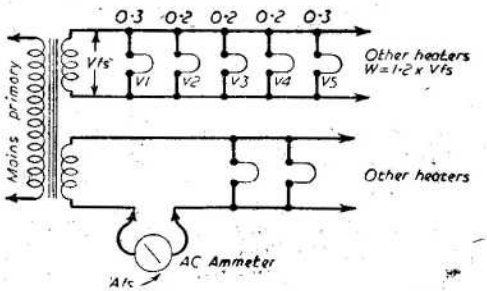


Fig. 2.—Checking heater currents.

tapped primaries for correct loading the differences existing between such taps (in typical cases 10 volts ; inputs 210-230-250 etc.) can be used (Fig. 1), where practicable for low current loads. An odd valve heater voltage can be supplied by such taps, but no great load should be so imposed, for primary windings are gauged for primary currents. The point is raised as a caution and also concerned is the after-caution necessary for with such " stunts " carelessness can lead to violent shock from the heater of the valve so connected.

Where A.C./D.C. techniques are contemplated (by constructors) the drawbacks to such systems should be overcome or minimised. Not the least snag is the possibility of chassis being " live " at full mains potential and a definite hazard to life. The writer is surprised by the attitude of many to any talk of shocks and care to avoid them. Perhaps such attitudes are bred by the apparent inability of A.C. mains to give lethal doses in most cases of contact. However, circumstances vary, as do physical health levels, and frequent survival of shocks may be due entirely to conditions favouring persons involved, which is no guarantee that such will always be the case. Many fatal accidents concern persons that have often received shocks before the time when, perhaps, familiarity bred contempt ! Take no chances.

Protection

The circuit of Fig. 6 shows a simple arrangement that will give excellent protection against " live " chassis and associated risk. It will enable readers interested to ensure that apparatus can be handled safely, and many constructors must wish to leave a newly-built job open for adjustments, modifications and the like. A true earth is necessary, but as shown it should not be taken to chassis except through the condenser Cx. Two lamps are shown in the circuit, though one will do quite well. Two are in Fig. 6 to allow for the possibility of live chassis not being indicated by reason of lamp failure. With two lamps such a possibility becomes very remote. Small 15-watt pygmy type lamps are an ideal choice for the job and if coloured red would give the idea a " sharper " action.

Whilst discussing A.C./D.C. drawbacks, the popular negative resistance elements must be included. Former protections against surges consisted, in the main, of barretters, ballast tubes, etc., and such devices usually dropped the surplus voltages in heater strings whilst maintaining constant current over fluctuating voltage values. A modern system is the " Brimistor," and when these are used the manufacturer's recommendations should be followed. Details are published of operating temperatures and particular note should be made of the minimum value to which each type falls (value of ohms resistance). Allowance should definitely be made for such a minimum working figure and, taking one example, one type starts at 3,000 ohms cold and absorbs surges by reason of this. However, as it warms so its resistance drops, but according to maker's data at full operating temperature its resistance when passing 0.3 amps is 44 ohms. If this is not considered then the valve or valves will be under-run by an average of 13 volts.

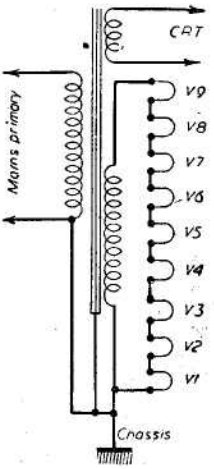


Fig. 3.—The modified A.C./D.C. circuit for heater supplies.

Fig. 7 shows a typical heater chain, and it will be obvious that A.C./D.C. type valves should always be used in such schemes. The resistance RKP represents the cathode resistors of associated valves all in parallel, as they are so far as stresses are concerned. The resultant value is very low as calculation from typical values will prove, and for this reason valve-heater chains are arranged so that the high-voltage heaters " bear the brunt." Such heaters are normally those of the output and rectifying valve types. Also, audio detectors are usually placed at the " dead " end of chains because, though the potential across individual heaters may be quite low, the heater-chassis (via cathode) stress may be considerably more ; the result is an unpleasant and unpopular hum ! Detectors normally dealing with audio, the latter (hum) will be quite strong if detectors are not restricted to the low-stress section of a chain.

Vibrators are a means of obtaining high voltages from low-voltage D.C. sources. The latter are generally batteries of the automobile type, as current demands with vibrator systems are fairly heavy. Synchronous vibrators do not require a valve for output rectification, but such saving is false economy ; synchronous vibrators are more susceptible to mechanical breakdown due to their more complicated design. Also, H.T. currents are carried by additional contacts in the device, which encourages trouble not met with where non-synchronous vibrators are used.

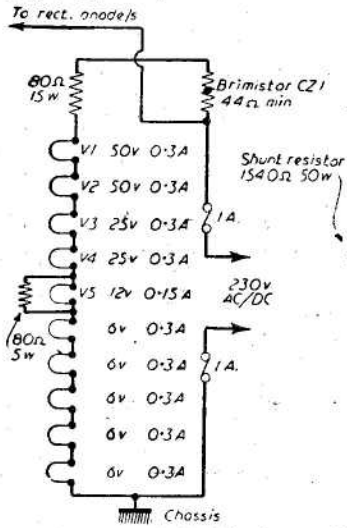


Fig. 4.—Using "mixed" valves in a chain.

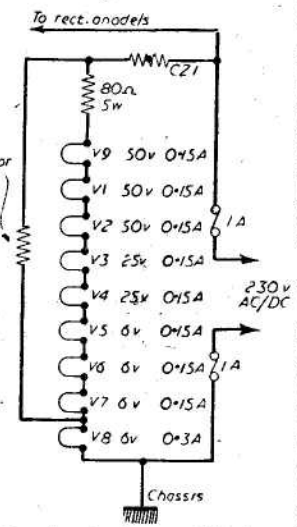


Fig. 5.—Another modification where only one valve is different.

Vibrators

Vibrators are just another form of transformer, the D.C. input that will not itself operate a transformer is "cut-off" and "switched-in" by the moving parts, thus becoming a form of A.C. The moving parts will still function well enough for voltage purposes even when fatigued by time. The difference in a new and old unit is often measured by the "hash" level!

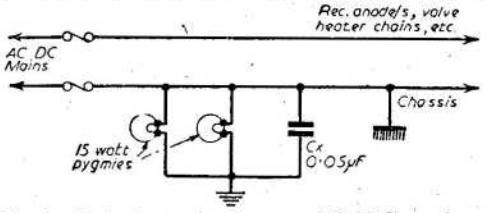


Fig. 6.—Protecting a chassis on an A.C./D.C. receiver.

Filters for vibrators must cover both output and input and such filters may prove useless when the unit begins to age. Hash troubles are normally of the broad-band type, tunable only inasmuch that an objectionable level becomes impossibly high at certain frequencies. Summarising the former remarks: Do not cling on to weary vibrators and spend hours fitting condensers and chokes; do not save a valve (rectifying) only to find it a temporary gain. Also note that inquests and surgery are wasted on troublesome vibrators. If any improvement is effected by lucky prodding of internal organs such improvements rarely last, and vibrator units are quite cheap.

When setting up for power supplies for receivers from a battery it is policy to choose, if possible, the 12-volt system. Current drain is roughly half that of six-volt systems for a given load and two typical values are (for a six-valve radio in this instance): 12-volt unit, 2.7 amps; 6-volt unit, 4.8 amps. Note that valve heaters are fed direct from the battery in either case.

Vibrator transformers can sometimes be obtained with dual-input primaries (battery windings). These, in conjunction with a 12-volt battery, are very good systems, for it is easy and inexpensive to convert to six volts at some later date if desired. With the 12-volt unit 6-volt valves are used with heaters in series pairs (current differences allowed for; of course, and resistors used accordingly). The note bracketed concerns only those valve pairs with *differing* heater currents. When converting from the above idea to a 6-volt unit, all that would be required would be a 6-volt vibrator unit and changing of the adaptable transformer primary. The valves used could then be restored to their 6 volts parallel function. Consider against the foregoing the desire to change from 6 volts to 12 volts! The cost of valves alone would preclude the change. Flexibility of apparatus is a "must" for constructors desiring to couple range and interest with economy. Fig. 8 shows a vibrator transformer with a dual-purpose primary; (a) and (b), respectively, are 6 volt working and 12 volt working. Remember that 6 volt working calls for double the 12 volt working currents, and it will be seen the winding becomes two windings in parallel for the lower voltage use. Average secondary winding outputs (A.C. for rectification) are 200 to 250 volts at 60 to 70 milliamps, though such output values are intended for small demand apparatus such as radios (auto). Of course, the considerably higher requirements of a television receiver would necessitate a vibrator unit designed for the load. The writer's experience of vibrators has been that primary current requirements can be calculated very closely by formulæ as for mains transformer, the secondary watts being divided by primary volts to give the current concerned as taken from the source. Of course, vibrator primary circuits differ in design and the load calculated as drawn will always be lower than that found in practice.

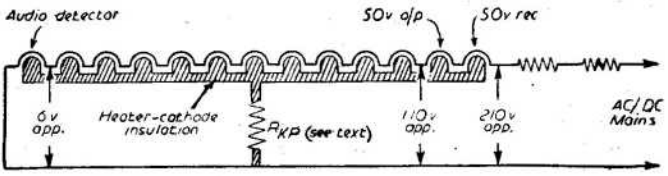


Fig. 7.—Diagram illustrating heater-cathode insulation.

Finally, where vibrator units with adaptable transformer primaries are employed without definite guidance as to connections, care should be taken to see that primary phasings are correct.

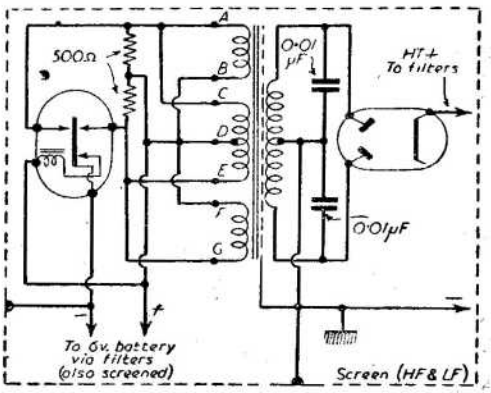


Fig. 8 (a).—A vibrator power pack for 6 v. working.

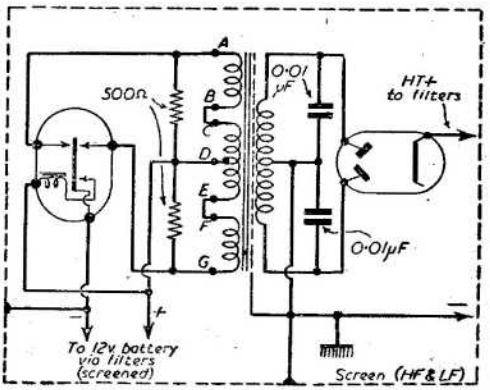


Fig 8 (b).—Modified circuit of Fig. 8 (a) for 12 v. working.

Projection T

SOME DET
MODERN

THE quest for larger television pictures is developing on two distinct lines. The first is the use of larger tubes, the picture being viewed directly on the screen of the tube, and the second is by use of small tubes which provide a small but brilliant picture projected by a system of lenses and mirrors on to a screen.

At the moment the projection televisor provides the largest picture for home viewers; commercial models provide a picture 16in. wide. The largest directly viewed tube available on the British market at present is the 17in., which gives a picture 14½in. wide.

The 16in. picture of the projection model involves a cost of £8 6s. 10d. for tube replacement whereas the 17in. tube giving the smaller picture costs £23 12s. 8d.—almost three times as much. It is this difference in the replacement costs which makes the projection system rather attractive.

Against the low cost of the projection tube must be set the ingenious system of mirrors and lenses which makes the commercial production of this form of television possible. However, once the initial cost has been met there are no expendable parts which require replacement.

When considering the production of optical systems for mass production and retail at a reasonable price the designer has two main avenues open to him. The first is to project the picture directly from the end of the tube by means of a lens system such as is used in the cinema, and the second is to use a spherical mirror as a collector and enlarger.

Now the first system suffers from several disadvantages which are not easily overcome. One of the most important is the brightness of the resultant picture. In cinematography a powerful light source independent of the intelligence it is desired to project is used. The light is concentrated into a very narrow beam providing maximum illumination of the object, the resultant rays being focused into the projection lens.

The whole optical system is thus very efficient and makes the utmost use of the available light source (Fig. 1).

If the film is replaced by the picture on the screen of a cathode-ray tube the conditions are very different. First there is a limit to the amount of illumination which can be provided by the fluorescent action of the screen when activated by an electron beam at high velocity, and secondly, the nature of the screen is to scatter the light which it produces. This means that a large percentage of the available light is wasted (Fig. 2).

In order to conserve the available light as much as possible a lens system having a large aperture is necessary, and to secure freedom from distortion the system becomes complicated and costly.

Lens Deficiencies

Spherical Aberration.—This is a feature of optical lenses which results in light rays entering the outside edge of the lens coming into focus at a point different from those in the centre.

The practical effect is that the centre of the picture comes into focus while the outside edges do not. The problem is overcome in the photographic world by "stopping down" the lens. This means that only the centre portion of the lens is used where the spherical aberration is the least. It results in a considerable amount of loss in the total amount of light which the lens will transmit.

Reflection.—A certain amount of light is reflected from the surface of the lens reducing the total amount which will pass through the lens.

Astigmatism.—This is the production of two focal points for light rays entering the lens at oblique incidence. With this form of distortion it is not possible to obtain focus at a point; there are two

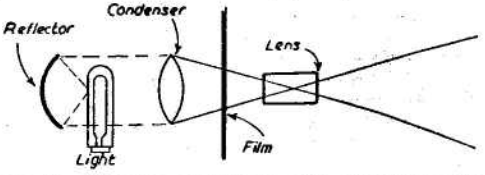
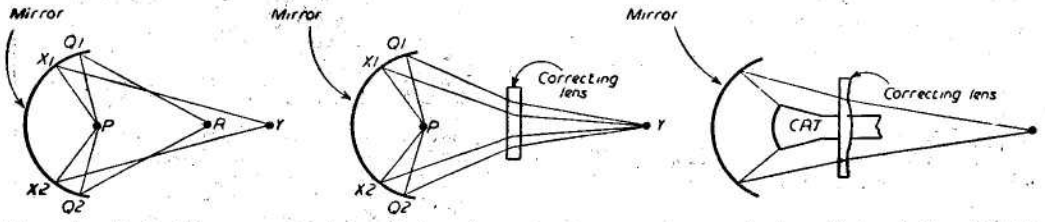


Fig. 1.—Elements of projection for cinematography.

limits of focal positions; a nearer one where the rays form a short horizontal line, and a further one where the rays form a short vertical line. Midway between the positions is a point where a circular spot can be found but it is a spot and not a point.

It is possible to get this form of distortion on cathode-ray tubes.



Figs. 4 and 5.—Diagrams showing reflection from a concave mirror and the effect of the Schmidt optical system.

AILS OF THE PROBLEMS INVOLVED AND OF
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Magnification Distortion.—This is where the edges of the lens do not have the same magnifying power as the centre. There are two forms of this distortion known as pin-cushion distortion and barrel distortion (Fig. 3).

These are the main forms of lens distortion which have to be considered in projection television.

The various distortions can be counteracted to a certain degree by combining different lenses having opposite characteristics. For example, a lens giving

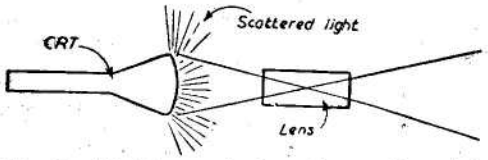


Fig. 2.—Television projection using a direct lens.

pin-cushion distortion can be combined with one giving barrel distortion to produce a correctly shaped image.

Fully-corrected lenses are costly to produce; the small lens used on a modern precision camera can cost more than £50 and the larger lenses needed for projection of a television image would, of course, be much more costly.

Concave Mirrors

It is not necessary to use a lens for projecting an image; it can be done by the use of concave mirrors, and modern telescopes fitted in observatories employ a system of mirrors, huge magnifications being obtained.

The advantages of the mirror are:

Spherical Aberration much less than that of a lens.

Reflection much less than that of a lens as only one optical surface is in use instead of a multitude as in a fully-corrected lens system.

Astigmatism. The mirror does not suffer from this defect.

Magnification distortion. Less than that of the lens.

Cost. Much less than that of lenses. Large sizes can be produced easily and cheaply as no expensive grinding process is involved.

These advantages have lead the designers to concentrate on the use of concave mirrors rather than lenses.

The Schmidt Optical System

One of the deficiencies of the concave mirror is its spherical aberration. A solution to the problem was discovered by Dr. B. Schmidt who developed, in 1930, a special correcting lens; the lens was originally used in the design of astronomical photographic equipment.

The lens, which is of a rather special shape, bends the rays of light which enter it from the concave mirror in such a manner that they come to focus at the same point.

Fig. 4 shows the elements of the system. Two rays only are shown for the purpose of clarity. In Fig. 4a a ray from point "P" striking the mirror at "Q" will come into focus at point "R." Where the ray from point "P" strikes the mirror at point "X" it will come into focus at point "Y." The practical result is an overall blurring of the picture.

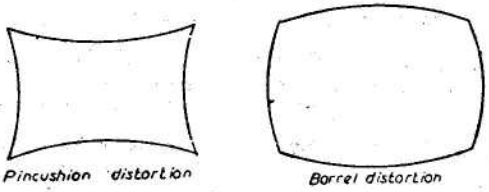
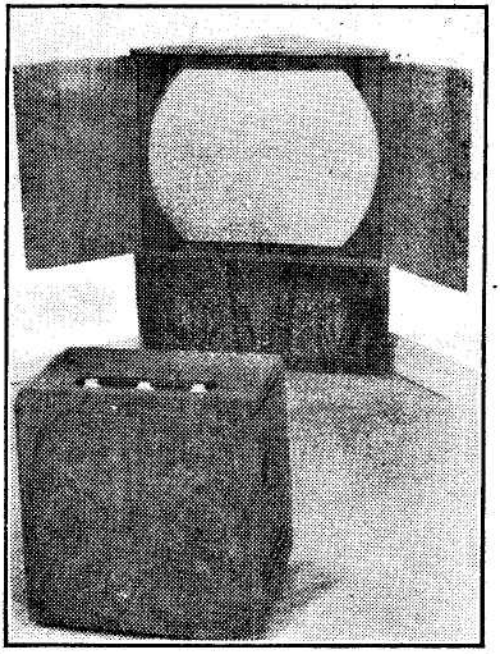


Fig. 3.—Two common forms of distortion.

When the correcting lens is placed in the path of the rays reflected from the mirror the rays become bent so that they all come into focus at one point.

One difficulty is that the source of the light comes in the way of the rays. The correcting lens must then be designed to overcome this defect and to bend the rays past the tube and deflector coils. Fig 5 shows the elements of the scheme.



A typical big-screen projection outfit by Valradio.

A lens of this nature is difficult to produce economically by normal grinding processes ; a solution to the problem has been found in a process developed by the I.C.I. company for the production by moulds of plastic lenses which fulfil the requirements of the system. This process enables the lenses to be made by mass production methods which considerably reduces their cost—an important point to the designer.

A further problem introduced by the use of this system is that of maintaining contrast. If the concave mirror is a perfect reflector then reflection will take place between the screen of the C.R.T. and the mirror ; the net result is that the highlights in the picture on the tube would be reflected back to the dark areas, resulting in an overall reduction in the contrast.

This effect is avoided by blacking the centre of the mirror opposite the tube. Some loss of the overall brightness of the projected picture results but contrast is maintained.

Complete Optical System

The complete optical system comprises the tube, concave mirror, correction plate, plane reflecting mirror and translucent screen. (Fig. 6.)

The correcting lens is actually a combination lens, the correcting plate being combined with a simple convex lens which corrects the curvature at the edges of the picture.

The plane mirror is usually silver surfaced and is used merely to reflect the picture on to the translucent screen. It introduces some small losses in the overall brightness of the image.

The Screen

The screen deserves special mention as it has been carefully designed to conserve the brightness and to maintain contrast.

Contrast is a most important function of the quality of the picture. By contrast we mean the difference between the highlights and the shadows ; a picture which shows the blacks as being really black and not a dark grey, and yet shows the white portions as really white, has good contrast.

The screen would function if made of finely-ground glass such as is used in plate cameras. One of the main drawbacks of such material is that it scatters light in all directions (Fig. 7). The result is not only a loss in contrast but also a wastage of available light, rays being directed at the ceiling and the floor.

A second defect is that of " flare spot ; " the brightness of a section of the picture being greatest in a certain spot, dependent upon the angle of view. At " A " (Fig. 8), for instance, the centre of the screen would appear brighter than the edges ; at " B " the " x "side of the screen would be brightest, while at " C " the " y " side is the brightest.

A third defect is that the front of the screen will reflect the room lighting and give another reduction in the contrast.

These defects have been overcome by the employment of a special screen. It is constructed in a plastic material and the receiver side has been moulded so as to bend the light rays arriving from the mirror into parallel rays. The moulding is in the form of a Fresnel lens. The result is that the light rays are so bent that they are concentrated into the horizontal plane. Rays which would otherwise be wasted on the ceiling and the floor are thus added to the total brightness of the picture.

Fig. 9, which is on the same plane as Fig. 7, shows the idea.

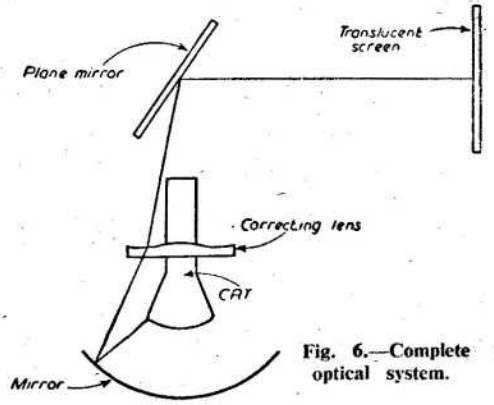


Fig. 6.—Complete optical system.

The parallel rays and the actual location of the screen are so arranged that a person sitting in a chair in front of the screen receives the benefit of the trapped rays.

The front of the screen is also treated in a special manner ; it is formed into a large number of vertical corrugations which are individually much smaller than each picture element. This helps to spread the light from the image in a horizontal plane so as not to restrict the field of view, and at the same time reduces the reflection of room lighting from the surface.

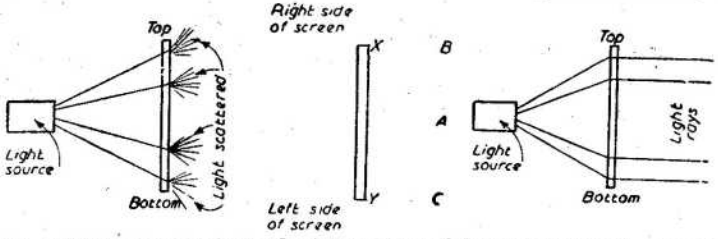


Fig. 7 (left).—The drawback of using a screen of finely-ground glass, showing how light rays are " scattered." Fig. 8 (centre).—Positions for viewing a projected picture. Fig. 9 (right).—Light rays are bent so that they are concentrated into the horizontal plane.

The Mullard Projection System

This modern system has been developed by Mullards and has been made available to the manufacturers of television receivers as a complete projection unit. Fig. 10 shows the system.

The small projection tube (a Mullard MW-62) is mounted within the optical system.

(To be continued.)

It should be emphasised that components for the projection equipment are not available to the home-constructor and thus we are unable to give any constructional features, at the moment, for this type of apparatus.

Pages from a TELEVISION ENGINEERS Notebook

12.—AERIAL ATTENUATORS

IN areas of very high field strength, say within some five to 10 miles of a television transmitter, the normal gain (usually marked Contrast) control of a reasonably sensitive receiver does not provide a sufficient degree of attenuation, and so, at very low settings of this control, the picture quality suffers and cross-modulation at the mixer, among other things, occurs. It is then advisable to attenuate the signal before it enters the receiver, and operate the latter at a higher setting of the Contrast control.

An ideal attenuator would be a device which enabled us to obtain some desired fraction of the input voltage as our output, this fraction being constant whatever the frequency. This implies that perfect resistances would have to be used in its construction since reactive elements would give frequency discrimination. However, for the purposes of television where only a single channel is to be dealt with, considerations of frequency are of little importance in attenuator design, and ordinary carbon resistances can be used safely.

An attenuator may be made up as a single **T** or π section, or a repetitive series of such sections, and these two forms are shown in Fig. 1(a) and (b) respectively. By a proper proportioning of the resistances making up R_1 and R_2, these networks can be made to have a constant resistance (viewed from the input) no matter how many sections are added. This resistance is made to be the same as the impedance of the feeder which in turn is equal to the input impedance of the receiver. Correct matching is then secured, and the correct degree of attenuation obtained without serious reflections on the feeder.

Terminating Resistance

As the T-type attenuator is most common with co-axial feeder, consider the section shown in Fig. 1(a) again. As it stands there, the input resistance is obviously

$$R_{OC}=R_1+R_2$$

where R_{OC} refers to the fact that the output is open-circuited. In the same way, when the output is short-circuited, the input resistance is made up of R_1 in series with R_1 and R_2 in parallel, that is

$$R_{SC}=R_1+\frac{R_1R_2}{R_1+R_2}$$

If now the output end is shunted by a resistance of value R_O, the input resistance becomes

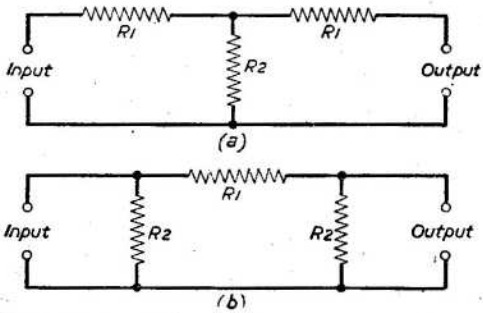
$$R_i=R_1+\frac{R_2(R_1+R_O)}{R_1+R_2+R_O}$$

Now it is clear that if R_O is altered, the input resistance R_i must also alter; it should be equally clear that there must be a certain value of R_O, which will make the input resistance R_i also equal to this value. If we write $R_O=R_i$ in the last equation, we find that

$$R_i=R_O=\sqrt{R_1^2+2R_1R_2}$$

Thus, with this terminating resistance, the input resistance will be the same, no matter how many sections are used.

A desired value of R_i can be obtained with numerous combinations of R_1 and R_2; thus, the two examples of Fig. 2 will both be found to match into a 30Ω load, but the second circuit will provide a greater attenuation than the first. The problem in practice, therefore, is that given the input



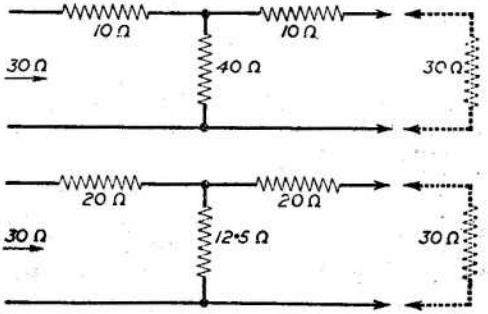


Fig. 1 (left). — T and π section attenuator networks. Fig. 2 (right). — T-networks, both of which will match into 30Ω cable but having different attenuations.

resistance and the degree of attenuation required, the values of R_1 and R_2 have to be calculated.

Practical Calculation and Design

The attenuation may be expressed in decibels or as a direct voltage ratio V_2/V_1, where V_1 is the input and V_2 is the output voltage. To convert such a ratio to decibels, of course, the simple formula $20 \log_{10} V_2/V_1$ is used. Let the ratio $V_2/V_1 = K$, the attenuation ratio.

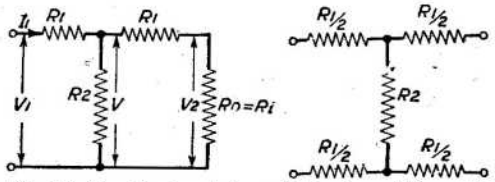


Fig. 3 (left).—T-network from which values of R_1 and R_2 are calculated for a given ratio of V_2 to V_1. Fig. 4 (right). — An H-section system suitable for use with balanced twin-wire feeders.

Then, from Fig. 3, we have

$$R_i = V_1/I_1$$

$$V = V_1 - R_1 I_1$$

$$= V_1 \left\{ 1 - \frac{R_1}{R_i} \right\}$$

$$V_2 = V \frac{R_i}{R_1 + R_i} = V_1 \left\{ 1 - \frac{R_1}{R_i} \right\} \left\{ \frac{R_i}{R_1 + R_i} \right\}$$

from which $K = \frac{V_2}{V_1} = \frac{R_i - R_1}{R_i + R_1}$

From this we have $R_1 = R_i \frac{1-K}{1+K}$

Similarly, it is easily shown that

$$R_2 = R_i \left\{ \frac{2K}{1-K^2} \right\}$$

As an example, suppose an attenuation of two times (6dB) is required, that is, let $K = 1/2$, the input resistance being the common 70Ω. For R_1 we have

$$R_1 = 70 \frac{1-\frac{1}{2}}{1+\frac{1}{2}}$$

$$= 23\Omega$$

and

$$R_2 = 70 \frac{2 \times \frac{1}{2}}{1-(\frac{1}{2})^2}$$

$$= 92\Omega$$

Preferred resistances of values 22Ω and 91Ω would be used here.

When twin wire feeder is used, the attenuator form generally takes that of the H-section, as shown in Fig. 4. Here again the formulæ for R_1 and R_2 are as given above, but due note should be taken of the fact that half-values are used as the series arms in this system when calculations are made.

Attenuation		R_1	R_2
Volts ratio	db		
2 : 1	6	22	91
5 : 1	14	47	33
10 : 1	20	56	15
20 : 1	26	68	7

Resistances should, of course, be of the carbon variety, these being substantially non-inductive, and when wiring up a unit, stray capacity should be kept to a minimum. When very high attenuation is desired, it is better to use two or more low-attenuation sections in series than a single section designed for the required degree of loss.

In a practical design, a suitable layout is shown in Fig. 5. A small protective box made of paxolin or brass sheet is built to house the system which is wired directly across between input and output co-axial or twin feeder type connector sockets. The unit can be bolted to the back cover of the receiver close to the aerial input point.

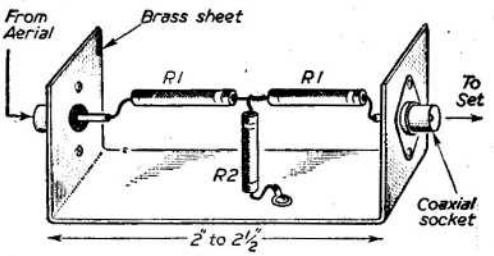


Fig. 5. — Practical design for a single attenuator section. A cover should be made to fit over the assembly.

The table above gives various values of attenuation (in voltage ratio and db) and the required values of R_1 and R_2 for both T- and H-networks, assuming a cable impedance of 70Ω. Resistance values are given to the nearest preferred value; quarter watt types are suitable.

Book Received

"Measurement of Atmospheric Noise at High Frequencies," Radio Research Special Report No. 26, recently published for D.S.I.R. by H.M.S.O., price 1s. 9d. (45 cents U.S.A.), by post 1s. 10½d.

THE success and economical development of all forms of radio communication depends upon the establishment of a signal at the receiving station of adequate strength compared with that of the prevailing atmospheric noise. To provide further knowledge on this subject measurements of atmospheric noise at high frequencies have been made for several years past at a number of stations in various parts of the world. Results of the early observations have already been published but the present survey is based upon measurements made during the years 1945-51, during which period improved equipment has been used. A great deal of information at frequencies of 2.5 and 5 Mc/s has been obtained and diminishing quantities at frequencies up to 20 Mc/s.

The original plan drawn up in 1944 provided for sixteen measuring stations; these were, in the main, at existing communications stations which were supplied with a standardised type of equipment for making noise measurements. The stations are operated by a number of commercial communications companies in various countries and the observations are transmitted for analysis to either the National Physical Laboratory, the American Central Radio Propagation Laboratory or the Australian Radio Propagation Laboratory. At present there are twenty stations widely spaced over the world.

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5 pf., to 500 pf., 1/-; 600 pf., to 3,000 pf., **1/3**.
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Tubular Wire ends		Can Types, Clips, 3d. ea.	
4/500 v. Hunts,	2/-	16/450 v. T.C.C.,	3/6
8/450 v. B.E.C.,	2/6	16/500 v. Dubilier,	4/-
8/500 v. Dubilier,	3/-	32/350 v. B.E.C.,	4/-
10/500 v. Dubilier	2/6	60/350 v. T.C.C.,	6/6
16/500 v. Dubilier,	4/-	250/350 v. B.E.C.,	8/6
8+8/500 v. Dubilier,	4/6	8+16/450 v. B.E.C.,	5/-
16/350 v. B.E.C.,	3/-	8+16/500 v. Dubilier,	5/6
32/350 v. Dubilier,	4/-	16+16/450 v. B.E.C.,	5/6
32/500 v. Dubilier,	5/-	16+16/500 v. Dub.,	6/-
32+32/500 v. Dub.,	7/6	32+32/275 v. Dub.,	4/6
50/150 v. Dubilier,	4/-	32+32/350 v. +25/25 v.	
25/25 v. Dubilier,	1/9	in same can B.E.C.,	6/6
50/12 v. T.C.C.,	1/9	60+100/350 v. Hunts.,	
50/25 v. Dubilier,	1/9		11/6
50/50 v. T.C.C.,	2/-	16 mfd. 700 v. Hunts	6/6

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KNOBS, GOLD ENGRAVED.—Walnut or Ivory, 1¼in. diam., **1/6** each. "Focus," "Contrast," "Brilliance," "Brilliance—On-off," "On-off," "Volume," "Vol.—On-Off," "Tone," "Tuning," "Treble," "Bass," "Wavechange," "Radio-Gram.," "S., M., L., Gram.," "Record-Play," "Brightness," Ditto not engraved, 1/- each.
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GOODMANS.—Latest Wide Angle Duomag type Focus Unit. Adjusted controls for Focus and Picture Shift. **ELAC.**—C.R.T. Ion Traps, **2/6**.
LOUDSPEAKERS P.M., 3 OHM.—3in. Plessey, **12/6**. 5in. Goodmans, **13/6**. 6½in. Goodmans, **14/6**. 8in. Lectrona, **15/6**. 8in. Goodmans, **17/6**. 10in. Lectrona, **25/-**.

TV for the Beginner—8

THE FINAL ARTICLE OF A SERIES EXPLAINING THE PRINCIPLES OF RECEPTION FOR THE NEWCOMER TO TELEVISION—THIS MONTH WE DEAL WITH THE CONSTRUCTION OF CHASSIS AND LAYOUT

By "Alpha"

(*Concluded from page* 306 *December*, 1953, *issue*)

OF the materials available for the construction of the chassis, aluminium is generally considered the best from the novices' point of view. It is easy to work, has good electrical characteristics, and can be obtained from most dealers. One drawback is that soldered connections cannot be made directly to chassis with this material, and soldering tags must be used.

There is no reason why other materials should not be employed. For V.H.F. work silvered steel is an excellent material, but is difficult to obtain and is expensive. Copper can be used, but it lacks the overall strength of aluminium. Tinplate can be used, though supplies are sometimes difficult and it is inclined to rust easily.

Sheet steel about 18 s.w.g. is a good material to use but is difficult to obtain. It is stronger than aluminium, and is most suitable where heavy components are used, such as in the timebase and power pack.

Sheet zinc is not recommended ; it is rather on the soft side and corrosion sets in where it comes into contact with copper or brass.

Preparing the Metal

The measurements of the chassis and drilling positions will be given in the data. A steel scriber should be used for marking the outline of the chassis and the position of the drilling holes.

Where a full-sized drawing is given it can be used as a template.

The gauge of the material used can be varied according to the type of chassis being constructed. If the televisor is in unit form then 24 gauge aluminium can be used for vision and sound receivers, and a heavier gauge for timebase and power pack (20-22 s.w.g.).

Having marked the drilling positions the outline of the chassis should be cut out first. This can be done by a pair of tinman's snips, though care must be taken to avoid the metal curling. A hacksaw blade mounted on a strip of wood, so that the teeth protrude below the level of the wood forms a useful cutting tool.

Drilling

Small holes for the wiring and bolting of the components can be drilled with an ordinary drill though it will be found that a straight fluted drill gives the best results.

Accurately-sized holes for the valveholders can be cut with a special tool, such as the " Q-Max " chassis cutter. This cutter, which costs a few shillings, can be obtained in different sizes suitable for B9G, B7G and 10 valve sizes.

Another useful cutting tool is the " Tank Cutter," which is used in an ordinary carpenter's brace, and will cut holes varying in size from 1in. to 4in. in diameter.

For square holes it is possible to obtain a tool especially designed for the job. It is called the " Q-Max Square Punch," and will punch square holes of 1in. diameter. To obtain oblong or square holes of any size it is only necessary to punch a series of squares side by side.

Where holes are drilled it is essential to centre punch the hole or the bit will slip and the hole will not be drilled in its correct position.

If a hand drill is used it is wise to drill from both sides in order to avoid burring ; it is possible to do all the drilling with a power-driven machine, though in this case it is difficult to avoid burring.

When a considerable amount of drilling has to be done in aluminium, better results can be obtained by regrinding the drill so that the cutting edges are without a front rake.

Bending

The most satisfactory method of bending aluminium is to clamp the metal between two pieces of wood, the edge of the wood appearing at the edge of the scribed line indicating the position of the bend. The length of the clamping pieces of wood should be longer than the length of the chassis.

A second piece of wood of the same length as the pieces used for the clamping is then pressed against the edge to be bent, the pressure continuing until a right-angle bend has been obtained. (See Fig. 1.)

In no circumstances should a hammer be used for bending or the metal will be bruised and the edge of the bend will not be true.

Where it is necessary to hammer to straighten the metal, either a leather-faced hammer should be used or a leather washer should be fitted on the face of the hammer.

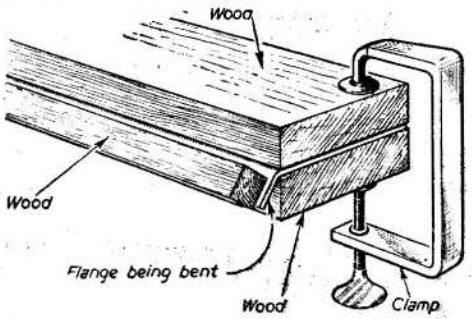


Fig. 1.—An effective method of bending metal for chassis construction.

If the bottom edges of the chassis are turned over, then a smooth edge will be left which makes the loaded chassis more comfortable to handle. (Fig. 2.)

In cases where it is desired to fix the chassis firmly in a cabinet then an L-shaped flange can be left on the bottom edge, as shown in Fig. 3.

Cutting Large Holes

Several methods can be used for cutting large holes, such as are required for drop-through transformers.

The best method is to use the square hole cutter mentioned previously; the worst is to use a cold chisel. If a cold chisel is used the edges will be slightly bent towards the direction of the cut and a clean edge will not be obtained. One consolation is that the rough edges will be covered by the component and will not be visible from above!

Another method is to use a small hacksaw blade as a fretsaw, but it is difficult to keep the edges clean and straight.

A drill can be used to perforate the periphery of the hole with a series of small holes, a good file being used afterwards to trim up the edges. This method can also be used to drill valveholder holes where a special cutter is not obtainable.

Riveting

Riveting is the best method of joining edges together and for aluminium work aluminium rivets should be used. It is possible to rivet quite satisfactorily and cheaply by using brass eyelets such as are used for shoes and which can be obtained at the cobbler's or leather-worker's shop.

Bolts are not satisfactory for this job, as they usually manage either to work loose or to come in the way of a component.

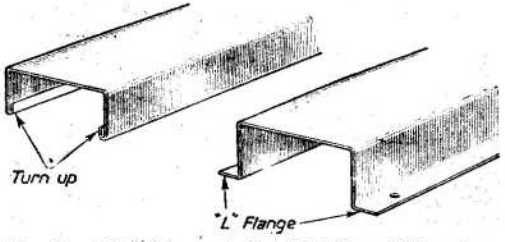
It is common practice in commercial televisors to rivet most of the components, but this practice is not recommended to the amateur as it destroys flexibility and makes the rearrangement or replacement of components difficult.

Screens

It will be found more practicable to mount the screens as the wiring proceeds: this is especially important where intervalve screens are concerned, as component mounting and wiring becomes quite difficult in a compact chassis.

Mounting the Components

When following a published design the actual layout given in the data should be followed faithfully. The designer has placed each component according to a prepared plan and trouble is likely to ensue if departures are made.



Figs. 2 and 3.—Two methods of finishing off the edges of a chassis.

The ambitious constructor who is working only from a theoretical diagram should bear the following points in mind.

If it is necessary to mount transformers and L.F. chokes close to each other they should be placed so the cores are at right-angles.

Precautions should be taken to ensure a free flow of air for the purposes of ventilation.

Tuned circuits should not be positioned where they are subject to heat from adjacent valves or it will be found that the tuning is likely to drift. This is especially important when dealing with the oscillator circuits of a superhet.

Anode and grid circuits should be kept clear of each other. The components in the anode circuit of one valve which is feeding into the grid circuit of a second valve need not be kept clear of each other as they are all part of one circuit, but the anode components of the second valve must be kept clear of both the anode and grid components of the first valve or instability and losses will be experienced.

Frame and line transformers should be kept clear of each other, both blocking oscillator and output transformers. It is wise to keep line and frame components clear of each other, as it is very easy to upset interlacing of the frame circuit by pick-up from the line oscillator or output.

Arrange the components so that anode and grid leads are as short as possible, especially in the sound and vision sections.

The C.R.T. should be so placed that it is clear of any magnetic fields arising from transformers and chokes.

It is good practice to fit gantries on the chassis so that it can be turned upside down for testing purposes.

The E.H.T. portions of the circuit should be carefully arranged so that at least half an inch exists between points at E.H.T. potential and the chassis.

Where open fuses in the mains input are fitted, they should be shrouded so that it is not possible to touch them accidentally with the hand when moving the chassis.

The various points mentioned are, perhaps, more for the advanced amateur than the beginner, but an understanding of them should enable the novice to appreciate the importance of adhering to the designer's specification.

It is most unwise to depart from the published design unless one is fully aware of the probable results of such departures.

Television Licences

THE following statement shows the approximate number of television licences issued during the year ended October, 1953. The grand total of sound and television licences was 13,153,314.

Region	*Number*
London Postal ...	832,953
Home Counties ...	304,033
Midland	552,215
North Eastern ...	336,907
North Western ...	364,706
South Western ...	103,881
Wales and Border ...	118,669
Total Eng. and Wales	2,613,364
Scotland	107,661
Northern Ireland ...	6,045
Grand Total	2,727,070

Only 12s. 9d.

AT a recent meeting of the Southgate branch of the Radio Society of Great Britain an exhibition of amateur-constructed radio equipment was held.

One of the exhibits which was warmly praised by Mr. J. Clarricoats, general secretary of the Society, was a television receiver built by Mr. M. F. Smallwood from odd components in his spares and junk box. It cost him 12s. 9d. altogether.

Hope for East Anglia

IT was announced recently in the House of Commons by Mr. L. D. Gammans that provision had been made by the BBC for a television link to East Anglia.

Full approval had not yet been given, he said, but priority had been agreed for it in the next extension programme.

They Like It in the States

AT the end of last October, there were 25,690,000 television receivers in the United States, an increase of 4,456,000 on the number at the beginning of 1953.

It is reported that about 56 per cent. of homes in the United States possess a TV set.

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to: The Editor, "Practical Television," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of radio apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Longer Viewing

THE BBC intends to boost its TV service after what has been described as a "belt-tightening period" owing to the enormous expense of televising the Coronation.

The main principles of the new scheme are at least three hours viewing each evening and a programme on Sunday afternoons which has long been a strong subject of complaints. It is also intended that a different form of news presentation be prepared including "live" outside broadcasts.

New Station's Range

THE range of the new transmitting station to be constructed on the Isle of Wight is expected to extend to Lyme Regis in the West to Seaford, Sussex in the East. The reception area will include Hampshire, Dorset, West Sussex and parts of Wiltshire, Berkshire, Surrey and Somerset.

It is still ironic, however, that some villages on the Isle of Wight itself will not be able to enjoy the amenities of television as they are still without an electricity supply.

Low Net Profits

THE Scottish Radio Retailers' Association report that although good gross profits were made on last year's sales of television sets and equipment, the net

Michael Pertwee, Helen Cherry, Wolf Mankowitz and Pat Kirkwood take their seats for another edition of "Guess My Story," TV's parlour game in which the panel try to guess the identities of people recently in the news.

profits were still "distressingly low."

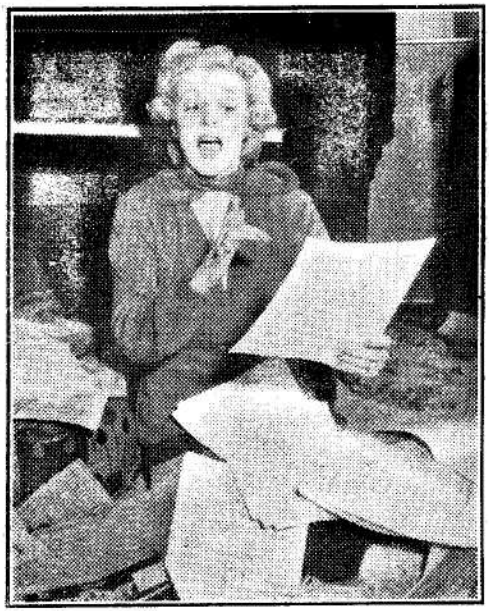
The Association believe that this is brought about by the large percentage of receivers that arrive at dealers' shops in need of immediate attention and servicing before they can be installed in a customer's home. Valves, more than cathode ray tubes, have been the main trouble.

Beware Poultry Thieves !

IN the few weeks preceding Christmas, Colonel John Wynne-Morgan of Boxmoor Farm, Hertfordshire, used his TV set for a very unusual purpose. He switched it on every evening not as a source of entertainment but as a burglar alarm.

On the Colonel's farm are 200 fat turkeys and poultry and he did not wish to take any chances. Whenever a small flicker of interference appeared on the receiver screen, he knew that a car was approaching the farm and took action. The lawns and coops of the entire farm were flooded with light at the pull of a switch and Colonel Wynne-Morgan was ready with his shot-gun for the visitor.

"Our friends were a little put out at first," he said, "but they know about my 'tele-spotting' now. I just pity the Christmas poultry thief who does not!"



Sally Barnes, whose first appearance on television resulted in a monthly appearance until the end of last year and a series of her own, rehearses new songs at her Wandsworth home.

Problem of Public Showings

A SMALL television theatre on Brighton promenade has produced a problem. It is only open to the public during television viewing hours and is officially known as an "exhibition of TV receivers" for which an entrance fee of 6d. in the afternoons and 1s. in the evenings is charged. The theatre is run by Switchit Relay Company, a radio firm, and is managed by Mr. Jack Leslie. A large notice outside reads "Tele Theatre Exhibition and Café."

"If it were exclusively a TV theatre, we should need a licence from the Postmaster-General," Mr. Leslie has stated, "but we haven't got any licence. We charge people to see the exhibition of family-size sets and the theatre is only there to help us sell sets."

The point of argument appears to be whether the theatre comes under the category of a place of entertainment or an exhibition.

Aid to Fire-fighting

IT is possible that television may be used in the future as an important aid to fire-fighting.

The Glasgow Fire Brigade recently staged a mock fire at the city fire headquarters with TV cameras picking up the scene from a nearby building. The pictures were transmitted on a closed circuit to a control room where officials were able to watch the progress of the brigade's efforts, while a running commentary was given by radio.

In this way, it is hoped that the appropriate instructions can be relayed back to the firemen without delay.

In the demonstration, the camera was operated by engineers of the Pye Scottish Telecommunications Company. Their only difficulty was smoke being blown across the lens.

Guard Substitute

AT Houston Gaol, Texas, prison officials are keeping a closer watch on prisoners by means of television cameras set up facing cells, in the dining-hall and the reception room.

Pictures are relayed by a closed circuit to eight monitor screens in a control room. As soon as any trouble seems likely, the alarm is given and precautions taken immediately.

The prison disciplinarian, Inspector W. P. Haley, has said: "All incidents between prisoners and guards have ceased since cameras were brought in. They are a great success." His enthusiasm, however, is not shared by the prisoners themselves. They complain that the cameras make them feel shy and embarrassed.

Leave Brightness Alone

TOO many viewers like to look at a picture of standard brightness instead of a raster of varying shade.

Speaking on this at Nottingham recently, Mr. D. C. Lightbody, a lighting engineer at Lime Grove Studios, said: "We try to give varying picture qualities to portray the mood of a particular incident. The sooner viewers appreciate this the better. It will save them the trouble of twiddling the knobs."

Dutch May Pay £3

IT is learned that the Dutch Government is considering the possibility of a commercial television service. The Government has proposed that the licence fee per year should be £3 and that the number of weekly viewing hours be increased from five to 12 hours.

There are about 10,000 sets in use in Holland.

Less Press Information

A REPORT from the United States says that newspapermen are not taking very kindly to the impact of TV on the country. They claim that it is killing the press conference.

When a high Government official is interviewed nowadays, press reporters rub shoulders with television engineers as the interviewee addresses more to the TV camera than to the journalists who believe that the frank information that was given them before is replaced by political campaigning speeches.

CORRESPONDENCE

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

VCR97 VARIATIONS

SIR,—I feel prompted to write to you as I think the following may be of some use to the dozens of home constructors who are building sets and experimenting with the VCR97.

I recently built an "Argus," and after numerous "learner's" troubles, finally got a good picture—but, out of four different tubes which I tried in the set, none had the same characteristics, but only one did not suffer from "cut-off." However, this one was not a good enough picture compared to my other three so I chose the best of these to watch, despite the fact that it had a dead square cut-off of 4in. This annoyed me, however, and I finally hit upon two old permanent magnets from a two-stroke cycle magneto.

These are about 6½in. from pole to pole and semi-circular in shape—about the same size and shape as the tube screen periphery.

These, when placed at each side of the line-scan area immediately pulled the picture area clear round the curved edge of the tube. They now supply a very useful and powerful supply of push-pull deflection when used in conjunction, and they centre the picture independently, without using the shift controls. Better definition is now possible through being able to increase the E.H.T. without it being necessary to call for more timebase H.T. from an already heavily-worked 425 volt. Also, my picture and raster always suffered from a slight wave in the vertical resolution, but this has now disappeared, and line and frame row "hold" over a much larger area of the potentiometer travel.

I am sorry if the foregoing sounds like rambling to you TV theorists, but it does seem to overcome the "cut-off" drawback, and also seems to have other advantages—not the least being simplicity!—N. HENDERSON (Huddersfield).

VALVE DEFECTS

SIR,—With reference to the letter on this subject in the December issue, and your comment on it, can any reader suggest a reason for the following occurrence.

Just after switching on my home-built TV I heard a loud crack such as is caused by high-voltage flash-over. I took a chance and left the set on; performance was normal and a later investigation failed to reveal any defect. Nothing further occurred and the set has run normally for several weeks since.

Recently, I decided to change over to Pontop Pike; on taking the line timebase out I saw that the glass of the EL38 was starred for about 1in. as if a discharge had occurred through it. I suspected a flashover from the E.H.T. cable but investigation showed the starring to be on the side furthest from this cable. The only lead near was the anode connection, but where could it flash over to? My only explanation is that the arc-over was from the anode lead to the suppressor-grid support clips inside the EL38.

The starring of the glass seems to be on the inside surface over an area of roughly 1in. by ¼in. It takes a form suggesting a flash travelling over the inside surface rather than through the glass.

The C.R.T. is a 9in. Mazda, the line output and E.H.T. transformer is Haynes, type T27. E.H.T. is reduced by additional cathode bias to approximately 7 kV.

Incidentally, the EL38 valve seems to be still serviceable.—H. C. ROBINSON (Crook, Co. Durham).

IS TV A MENACE?

SIR,—I warmly disagree with V. B. Richards (Notts), re television as a menace. To put it mildly, this tremendous achievement is surely due for a colossal future, but let us look for a minute at some of the previous inventions. Did the motor-cycle oust the bicycle? Did the advent of wireless oust the gramophone? On the contrary, their sales increased!

What *is* peculiarly interesting is that in the cinema, vision came first and sound arrived later; whereas in radio transmission, sound arrived first and vision second!

Personally, I doubt whether public entertainment is due for extinction via the advent of television. The experience of the normal human is that, if he or she hears music they really like, they desire either to buy it or to hear it again, say locally, at a concert, etc. I strongly suspect that if spectacular swimming, or boxing, or acting, or opera, and so on, is televised, and later an opportunity occurs to see the same in the flesh, plenty of the previous television "audience" would go. For instance, why do enormous crowds flock to see famous film stars when they visit our shores—and they are not even acting at the time?

The fact seems to be that these great modern inventions only serve to whet the human appetite for the "real thing," if, and when, it comes along. Till very recently, personally, I detested boxing as a public sport. After four weeks of television, I am getting quite keen on it! The close-up views fairly opened my eyes to several things in the game!

If a boy, keen on astronomy, sees an eclipse of the moon televised, will he remain indoors, a passive armchair spectator? Hardly! He is far more likely to rush outside and get his own experience, without delay, as well. After all, the human mind has a wonderful knack of sorting out real value; and that which is good survives. Do public theatres kill the multitude of intensely active, amateur dramatic bodies, up and down the country?—"SCIENCE MAN" (Belfast).

"H" AERIALS

SIR,—I feel I must cross swords with Mr. Harknett, regarding his article on "H" versus the multi-element array. This article would appear to be a gross modification of the facts in order to present a point of view.

First, a reputable manufacturer always takes steps to ensure that the matching of a multi-element array is correct.

Secondly, a quarter wave space "H" aerial has an impedance of 50 ohms, and only by a large stretch of imagination can be termed nearly 70 ohms.

Thirdly, the use of twin feeder is in theory advantageous, but in practice the proximity of the feeder to near-by objects results in considerable unbalance, and severe interference pick-up. A coaxial feeder on the other hand, by virtue of its outer screening, cannot be upset by proximity to near-by objects.

Fourthly, the use of a metal pole is common to both the "H" and multi-element array, and must, therefore, have the same bad effects on each aerial.

Fifthly, the question of interference reduction by virtue of the considerably improved polar diagram of the multi-element array has been conveniently overlooked by Mr. Harknett. The improvement in signal-to-noise ratio obtainable by the use of an reputable multi-element array should be seen by Mr. Harknett.—W. R. FLUDE (Northampton).

ADMIRALTY PATTERN, 4790B RESPONSER UNIT, DESIGN A

SIR,—Re Mr. F. C. Penfound's (Patchway) letter on the Responser RX for TV, is this the 1½ metre RX?, because I definitely join in wishing for details of the conversion, although both is quite simple for all five channels, and very good results obtained.

Thanking you for most interesting publication in the PRACTICAL TELEVISION; may it continue with the same balance of interest for the constructor of complete receivers and for the conversion of VCR97, etc.—J. LANGFORD (Parkstone).

[*Has any reader any information to offer covering this particular unit?*—EDITOR.]

A SHORTCOMING

SIR,—A recent letter in your pages from Mr. V. B. Richards has started me thinking.

Although I do not entirely agree with him on his views, I do think that he has won a point when it comes to his opinions of the cinema as an entertainment medium. He says that no one will ever convince him that an evening at the pictures is not better than an evening watching television. Here, I am in complete agreement with him and I think I can prove him right.

A recent Sunday play was entitled "Golden Boy," a story which I saw as a film in 1940. One scene was set in a young boxer's dressing-room a few minutes before a big fight. This, by the way, was about half an hour after the interval when we were again becoming interested in the play. The young boxer is called from the room to go into the ring and instead of following him to see how he fares, the camera remains in the dressing-room with the roars of the crowd giving us our only indication of the way the fight is going. Here, the cinema triumphs, for such a fight can be faked realistically by a film producer but he has to have the time to retake shots, if necessary. Presently the boxer returns to the scene. He is covered with blood and is, of course, dressed in shorts and boxing shoes only. We learn that he has won and that he is champion. At this point, atmosphere has been produced and has to be maintained but instead, the word "Interval" again appears on our screen and the illusion is broken. We could not understand the need for two recesses in half an hour but when the next scene began we discovered why. The boxer had wiped the blood from his face, had donned an immaculate suit and was pacing up and down his manager's office.

Thus, every time a complete change of clothing is necessary, some form of interlude takes place. Take, also, the case of the Guy Fawkes play last November. In the scene prior to an explosion, the whole action of the players was filmed. This was obvious as all observant viewers can see the difference between a filmed piece and a direct action, as well as hearing the more subdued tone in the recorded sound. We soon discover that the filmed scene had been necessary to allow the players to reappear after the explosion with torn clothes and bandaged heads.

The point I am trying to make is that in a television play, when the action is continuous, many allowances and tricks have to be used which spoil continuity. In the cinema, we still see the action continuously, but use of film has enabled the camera to record the story in any location and as many times as are needed to get the scene right.—L. H. MALLING (Sevenoaks).

THE INTERLACE PROBLEM

(*Continued from page* 342.)

The Frame Flyback

It was once considered definite that provided the frame flyback lines, which can be displayed across a picture or modulated raster by advancing the brightness control (in certain receivers, mainly current models, this is not possible owing to the inclusion of a flyback trace blanking circuit), are evenly spaced, as in Fig. 5, a perfect interlace must be occurring. This, unfortunately, is not always the case, as it is possible—although extremely rare—for the frame timebase to be "fired" at the precise moment yet not to produce a perfect interlace. On the other hand, though, very unevenly spaced lines, as in Fig. 6, are a sure indication that the interlace is severely impaired, if occurring at all.

In this form, then, the experimenter has available another fairly accurate interlace checking aid, and provided it is used with a little thought it can be extremely useful in determining the approximate degree of interlace quality. The two sets of lines actually represent the path traced by the scanning spot during the flyback of the "odd" and "even" frames.

The formation of the short lines are due to the 10 microsecond tops separating the eight framing pulses (marked "x" in Fig. 4), and the full lines above them correspond to the series of unmodulated lines which always follow the framing pulses. They show up horizontally, instead of vertically as would be expected, because the line generator is continually deflecting the scanning spot horizontally at a much faster rate, even during the frame flyback periods, and it is because the spot in tracing them actually crosses the same line twice that they show up at all (and even then only when the brightness of a modulated raster or picture is lifted above the black level).

The precise number of lines displayed depends on which framing pulse initiates the frame flyback, and the speed at which it occurs. Two vertical columns of lines are always in evidence, however, since the prompting 10 microsecond tops occur at half-line intervals, and the flyback lines are interlaced just as the lines are in the picture. It will be noticed that the space between the lines tends to diminish towards the top of the screen, this being due to the gradual reduction, in the vertical direction, of the scanning spot speed during the flyback periods, and due allowance should be given for this when assessing interlace quality by such a means.

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

USING RF27 UNIT

I have recently purchased an RF27 unit and have not been able to get any results with it, and I wondered if you will be able to help me.

I have connected an aerial to the co-ax socket on the front of the unit and 6.3 volts and 250v to the respective connections at the back. The output I have taken from the rear connector via a screened cable to the aerial socket of a 5-valve superhet tuned to the S.W. band at approximately 7-8 Mc/s, also coupling the two units with a common earth. All I can get when I rotate the tuning condenser of RF27 is a sharply tunable hum at various points of the dial, and at varying strengths. I am well within the range of Wenvoe and should be able to receive this station. The valves of the unit appear to be okay, and the H.T. readings I get are as follows :—

First VR136=7mA approximately ;
Second VR136=2 mA approximately ;
VR137=8 mA approximately.

I have changed the VR136s around but still get the same results. These readings were taken with just the one valve connected in the unit.—D. Ralph (Yeovil.)

You should use an aerial designed for the transmitter for maximum results. A dipole is necessary, mounted in a vertical position for Wenvoe.

Rotating the dial will not necessarily tune in the station for you, if your broadcast receiver is not tuned to the IF given by the RF27.

Perhaps the best method of approach would be to tune the broadcast receiver to a quiet spot between 7 and 8 megacycles and then move the tuning dial of the RF unit by 10 degree stages, and at each stage give the oscillator trimmer, which is underneath the chassis, a complete turn, slowly. You can then be sure to tune to the IF pre-set on your broadcast receiver.

TUNING ADJUSTMENTS

I have a Pye television console F.V.I.C. On the back of the set are marked two adjustments of which I hope you can inform me of their use. (1) Aerial Trimmer, (2) I.F. Rejector. Also, what effect would these adjustments have if I tried moving them.—P. Roberts (Aberdare).

The aerial trimmer is for setting the tuned frequency of the aerial coil, and is generally adjusted with the use of a signal generator. In certain cases it is desirable to adjust it, in conjunction with Test Card "C," for maximum picture brightness consistent with optimum definition and a balance between sound volume and picture brightness.

The I.F. filter should not be adjusted unless a signal generator capable of tuning 35.9 Mc/s is available. In this case the generator should be connected to the aerial terminals and the I.F. filter adjusted for *minimum* video output. Its inclusion prevents spurious signals at the intermediate frequency gaining admittance through the aerial circuits to interfere with a picture.

DEFECTIVE COILS

Could you assist me to locate the fault in my Sobell T41 television receiver. I cannot get a raster on the tube. They are high resistance scanning coils and are O.K. The symptoms are that I can get plenty of E.H.T. when the line coil is disconnected. I have tested the condensers in the line network and they are O.K. The diode valve in the line is a Mazda U281, the E.H.T. Rec. is a U24.

I suspect the line scanning transformer is not giving its output as when line is out of circuit. If, in your opinion, it is the line scan trans., could you advise me where to get an equivalent.—R. Jackson (Prescot).

Although the line deflector coils in your receiver may exhibit D.C. continuity, a short-circuited turn or poor insulation within the coils may be the cause of the symptom you describe. Coils possessing a defect of this nature would tend to load heavily the line output transformer with a consequent lowering of E.H.T. potential. Removing the coils and thus the loading, often restores E.H.T., which can often be taken as an indication that the line output transformer itself is up to standard.

Unfortunately, there are no direct equivalents to the line output stage components used in your receiver, but you should be able to obtain them easily enough through a Sobell agent.

PROJECTION TROUBLES

I have a Phillips projection model 704A. Recently there has been a fault in the vision which has caused large blobs of white to appear on the screen, travelling from right to left very quickly. Sometimes it has lasted only five or ten minutes, but at other times perhaps all the evening. Now I can get no raster or picture, but there is a bright horizontal line across screen when the set is switched on. Sound is O.K. I have substituted one or two valves in the "frame section."

I have access to Phillips circuit if you can help me. —L. J. H. Winter (E.11).

The initial symptom of interference spots on the screen would indicate that a transformer or coil winding was flashing over or on the verge of breaking down. The final symptom is obviously indicative of frame time-base trouble, but since the tube protection circuit has not operated the cause is almost certainly due to an open circuited frame deflector coil.

Projection receivers embody a tube protection circuit which is arranged to come into operation and cut off beam current should a fault develop in one of the timebase circuits. Such a feature prevents the fluorescent phosphorus on the tube face from being damaged due to excessive local heating which would otherwise occur. Unfortunately, though, while this circuit protects the tube from burns due to scanning generator failures it is not entirely foolproof, for an open-circuited deflector coil can still cause a brilliant horizontal or vertical line on the fluorescent screen.

VISION BREAKTHROUGH

I have a Bush television receiver type TV12B and would be obliged if you could help me with a fault that has developed. This takes the form of a loud hum, which increases as the volume is increased, but the picture remains perfect. It seems to increase also when a bright object appears on the picture, for instance, a close-up of a white dress or a white background to a caption.

A few weeks ago I had reason to change the brilliance control and it is since then that the fault has become apparent. I have been over all the joints I made to make sure there was no dry joint. Is it possible that one of the valves EB41 has broken down ? I changed these two valves about but it made no difference. The set is 3½ years old. The contrast control has also been renewed but the hum remained.—G. George (Stourport-on-Severn).

Since the hum varies in volume as the picture content alters, the cause would appear to be due to the vision signal gaining admittance to the sound channel. You can test this possibility by removing the aerial from the receiver during a transmission, and if the hum ceases it is almost certainly the result of vision on sound.

Incorrectly-adjusted tuned circuits associated with the sound channel generally provokes the symptom, and in this respect you may have inadvertently disturbed the setting of an iron-dust core during the process of replacing the brilliance control. Carefully adjust each core associated with the sound tuned circuits in turn for maximum sound consistent with minimum vision on sound.

SUBSTITUTING THYRATRONS

I should be most grateful if you could answer a query regarding my Murphy V118/6.

I have been having trouble with both frame and line scanning oscillators, both Thyratrons, and these I find most unstable, as usually during the evening's programme one or the other has to be flicked with the finger. After this rather crude treatment the oscillators operate normally.

Having purchased four of these T41's during the past nine months, I feel that I should like to remove these oscillators by modifying the circuit to a hard valve scanning generator. Transitron preferred.

If you feel that such a modification is feasible, could you advise me of a suitable circuit ? I have available several valves which I feel would suit the purpose, SP61, EF39, SP41. Suitable voltage for the first two could be taken from the noise limiter heater supply. —W. Hathaway (Redditch).

Although it is possible to modify your receiver in the way suggested, extensive experiment and circuit analysis will be demanded to obtain optimum performance, and we regret that such data is not available. We would point out, however, that the design of the Thyratron type generators embodied in your receiver is of high standard, and we are surprised to hear that extensive trouble is being experienced with the valves themselves. It may be advisable to check the circuits, for a defective component may be the provoking factor of the symptom described.

RE-TRIMMING

You wrote to me recently regarding sound on vision on my Masteradio T917. The effect I previously complained of has disappeared, but I now get it instead after the set has been in operation for a while and it persists. I presume it is due to the same cause as you mention in your letter, but as it is now rather annoying I shall be glad to know whether there is anything I can do to eliminate it.—J. Pugh (Tredegar).

If you remove the back cover from your receiver you will observe four trimmers located to the right-hand side of the chassis back. The aerial trimmer is positioned between the two aerial terminals, and the oscillator trimmer of similar type is positioned to the extreme right of this, while two core-type trimmers are mounted one above the other between the aerial and oscillator trimmers—the top one being mixer tuning and the one underneath the R.F. anode trimmer.

You should adjust the oscillator trimmer for maximum sound consistent with minimum sound interference on vision, and the other trimmers can be adjusted, if necessary, for maximum picture brightness consistent with optimum definition, though it should be noted that in certain cases it is necessary to adjust these trimmers also for a balance between sound output and vision sensitivity. The sensitivity and contrast controls should be used during the tuning operation to prevent overloading.

PICTURE SHIFT

I have a Pye which recently developed a fault that when switched on it is about 10 minutes before the picture appears, though the sound comes through quite normally. We have had the set some time now —about four years. When the picture does appear there is a black band at the bottom—a thin light strip above it, giving the impression that the picture is not centred. When the brightness is increased to get a good "view" the uprights seem to get a "ghost" and parts of the picture seem out of register. When the picture is in register it is very black. Our mains supply is 190 volts and there is a transformer to bring it up to 230 volts. Can you advise me ?—A. E. Brown (Watford).

These symptoms could be due to a worn picture-tube, although the black band at the bottom of a picture is probably due to the picture being out of centre on the screen face. You should be able to correct this by adjustment to the picture shift controls located on the focus unit.

LINE TRANSFORMER FAILURE

My TV. set (Bush T11A), has developed a fault which I believe to be the line output transformer being off centre, there is no E.H.T.

The tube and rectifier (C751) were tried on another set and found to be in working order. I still get the whistle from the transformer which I believe indicates that the line time base is working, but there is no fluorescence on tube face.

As I would like to do the job myself, but fail to get the particular type of transformer, I should like to know if there is any make suitable for this set and if you can give me the connections for same.—A. Burgoyne (N.W.1).

Your query indicates that a probable cause of the symptom is due to line output transformer failure, as suggested. It will be necessary to use the correct type of replacement transformer, however. You should be able to obtain this direct from the manufacturers concerned, or if there is any difficulty in this respect, you could have the original transformer rewound.

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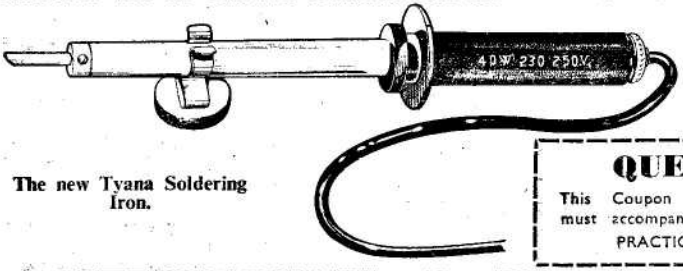

The new Tyana Soldering Iron.

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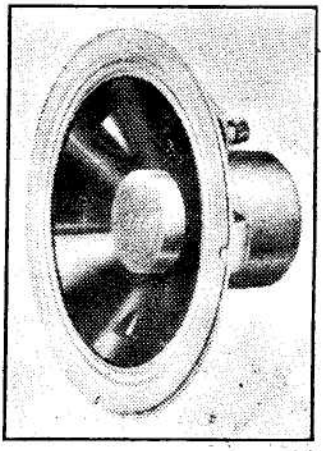

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Data and Circuits of TV Receiving Valves

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