THE NOISE FACTOR

# PRACTICAL TELEVISION

# & "TELEVISION TIMES"

EDITOR F. J. CAMM

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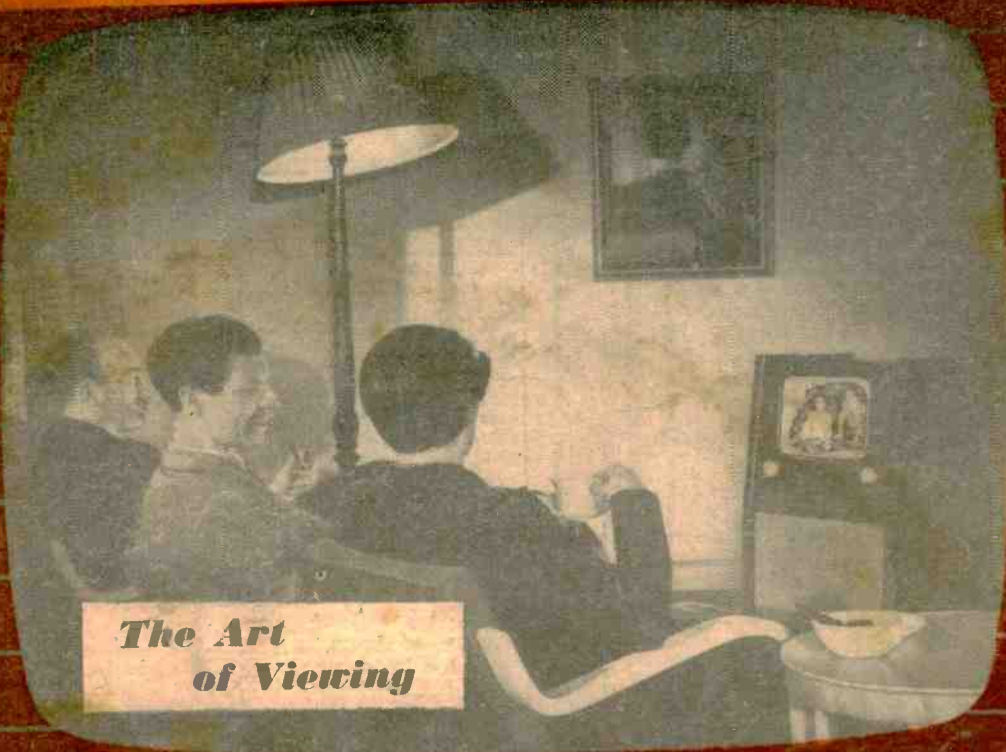

*The Art of Viewing*

IN THIS ISSUE

# PRACTICAL TELEVISION
## & "TELEVISION TIMES"

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# Televiews

### BEVERIDGE OR SELECT COMMITTEE?

WITHIN a few months of the publication of the Beveridge Report, which urged the construction of further television stations to provide a nation-wide coverage, comes the recommendation from that watchdog of the public purse, "The Select Committee on Estimates," that one of the three high-powered television transmitting stations now under construction should be delayed to help the rearmament programme. The three stations are Holme Moss, Kirk o'Shotts, and Wenvoe.

The Committee expresses the view that their completion will increase the demand for scarce raw materials by the call for more television sets, apart from the raw material such as steel which is required by the stations themselves.

A further reason given is that skilled labour is leaving the machine tool industry because of the better wages paid in industries such as radio and television, which are meeting boom export demands.

This is a case of the report of one Select Committee being set aside by another. Surely the Beveridge Committee in making its recommendation that work on the new stations should proceed apace took the supply position into consideration? It would hardly make recommendations which the material and labour position would make impossible of fulfilment. It is true that when the Committee first sat there was no talk of rearmament, but the need to rearm became very apparent a year before the report was issued, and this should have caused the Committee to hear further evidence to ascertain how far armaments would impinge upon and cause them to modify their recommendations.

The completion of the three stations at present under construction is a matter of national importance, and we do not think that the amount of raw material required for the television sets which will be required when they are completed will seriously affect rearmament.

Substitute material can be employed, even as plastic cabinets were introduced when the shortage of timber became acute.

At the moment of going to press there is no indication as to whether the Government proposes to adopt the suggestion of the Select Committee on Estimates.

### PLAYS

SOME of the plays selected for television show a surprising lack of judgment on the part of those responsible for allocating programme time. Whatever merit the plays of Shaw possess or lack, they are quite unsuited, without considerable cutting and editing, for television. Shaw was not noted for succinctness; in fact, for prolixity, tautology, and literary verbosity he was without peer. During his lifetime he refused to have any of his plays cut or altered in any way. The result was that they occupied far too much time on the stage and some of them failed as a result. But Shaw is dead, and if it is felt that the public wants to see a Shaw play on their television screens, a better one than Cleopatra could have been picked, for that is one of Shaw's most boring plays.

In any case, television programme time is short enough as it is without the whole evening being taken up by a ponderous production of this sort.

### PICTURE PAGE

IT is not generally known that Picture Page is the oldest television programme in the world. It was a source of disappointment to all viewers when it was announced that it was to be discontinued. The decision seems to have been reached capriciously, for it was a most popular picture programme—probably the most popular of all the features.

It is good news, therefore, that wiser counsels have prevailed, and that its sentence of death has been commuted to one of a further indeterminate period of public servitude. There must be a programme of this type into which topical items and personalities can be fitted, and particularly in this Festival year, when there is such a vast pool of interesting material to bring before the television public. One of its main appeals is that the contributors are chiefly non-professional people without public platform or stage experience and their very "amateurishness" makes a pleasant change from the regimented efficiency of professionals.

The B.B.C. is not yet so rich in first-class programmes that it can dispense with an approved favourite such as Picture Page.—F. J. C.

# A Compact Televisor—3

## A Complete 6in. TV Receiver on a Single Chassis

By E. N. BRADLEY

WHEN the chassis is completely drilled, mount all the valveholders below their holes with a soldering tag bolted below one fixing nut of each holder to serve as an earthing point. Remember that in the R.F. sections all the earthed points of each stage should be taken to their particular soldering tag. In each case the tag should be fixed at the mounting hole nearest the Nos. 1 and 8 pins of the valveholder (the 1 and 9 pins in the case of V6; the V6 holder should also have an EF50 retaining ring bolted to the chassis top deck).

Note that the connections to the 6AC7 stages are unconventional so that the most convenient wiring is given by connecting tags 1, 2 and 3 together and to earth. The pin No. 6 of the associated coil is then wired between tags 5 and 6 to tag 3 of the valveholder to give the shortest earthing run—where the lead passes between the Nos. 5 and 6 tags on the valveholder it should not touch either of them, but in any case it will be insulated with sleeving.

The first wiring to be run is the heater lead, a single run linking one heater tag of each valveholder together. There are no heater chokes anywhere in the circuit—any necessary filtering is handled by the heater capacitors fitted to some of the stages. The heater circuit is completed through the chassis. The R.F. stages should then be fully wired, one by one, remembering that the shortest and neatest possible wiring is essential. It is easily possible to group all the components for each R.F. stage right below the valveholder in a compact assembly.

### Decoupling

The decoupling circuits R5, C4, R11, C9, etc., are supported between the H.T. contacts on the R.F. coils, the final resistor in this chain, R21, being connected via R27 to C25 which serves as a feed and anchoring point. When the four R.F. stages are completed the wiring should continue through the diode and video amplifier stages up to the video output socket. The capacitor C27 is taken directly from this socket to the grid tag of the V7 holder.

The sound section should then be wired, commencing with the sound coupling from L2 to L6. The connection is made through a twisted pair, using rubber-covered flex leads. Two leads about 6in. in length are twisted together to make a suitable feeder. The pair should be kept fairly close up to the chassis top deck, and take a reasonably direct route.

Little need be said concerning the method of wiring the rest of the circuits, either sound or timebases. The valveholders are positioned so that components fall naturally into place and so long as cathode circuits are connected in first, and kept close to the valveholder, it should be found possible to group the rest of the parts in each stage closely under the valveholder. C30 is best supported on a small tag-board. The grid and anode leads to the sound output stage run close together and, therefore, a screened grid lead is employed. Tag No. 6 on the V12 holder is unused and, therefore, can act as an anchoring point, as can tag No. 5. C50 is, therefore, taken to tag No. 6, from which R54 goes to earth, whilst R55 is supported between tags Nos. 6 and 5. The core of the screened lead is taken to tag No. 5 and the outer screen to an extra soldering tag bolted under the valveholder mounting nut at the hole between tags Nos. 4 and 5. The screened lead is then taken through the nearby chassis hole, whilst two twisted flex leads are taken through the other chassis hole and away to the speaker and transformer. The loudspeaker and T1 are the only components not mounted on the chassis. Room could easily be found for them at one side of the chassis towards the rear, but in the original receiver it was desired to bring up the speaker to a position on the front panel of the cabinet.

The H.T. and E.H.T. sections of the receiver are kept to the rear of the chassis behind the electrolytic capacitors.

The transformer hole, 3in. in diameter, is cut with a tank cutter and the component fixed by having washers placed over its two bolts so as to grip the edges of this hole below the chassis. Make sure that the edges of the hole are well filed and cleaned and that they cannot touch the unshrouded part of the windings at any point. By slackening the two transformer bolts the component can be rotated through any angle—when the transformer is connected up, therefore, the leads should not be cut short but should be coiled into tight spirals so as to allow some slack.

The three H.T. rectifiers are mounted on a long 4 B.A. bolt (at least 3in. in length) with a small stand-off washer between the first rectifier and the chassis wall. The washer may be cut from thick paxolin. In the original R76 is a large vitreous resistor bolted to the chassis wall behind the rectifiers, but a smaller component may be employed, and supported in the wiring. The input from the transformer goes to the negative side of the first rectifier, and the three units are series connected positive to minus, leaving the final positive side to supply the output.

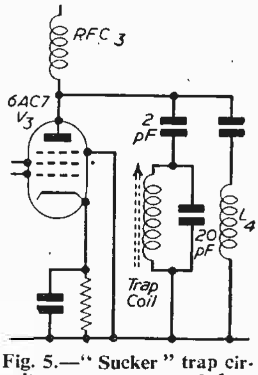



Fig. 5.—"Sucker" trap circuit to remove sound from the vision channel.

The most convenient method of mounting the E.H.T. section is to use a long single-way tag-board supported about 1¼in. off the chassis wall, immediately below the four shift controls. Before these controls and the tag-board are placed into position the output socket must be mounted. This is placed over the 1¾in. diameter hole and recesses in the edge of this hole are filed for the four mounting bolts. The 4-volt heater leads, the deflector plate leads, the brilliance and focus leads and the final anode lead, should all be wired in to the socket tags, and the shift control wiring completed before the E.H.T. system is mounted. The order in which the tags of the socket are wired up is not particularly important though it is as well to take the E.H.T. lead to one of the more widely-spaced sockets. Obviously a note of the wiring order should be taken so that the plug can be connected up accordingly. Since the socket and plug have 10 pins, one is unused (remembering that the video lead is taken directly to the tube base from its own socket).

If the rectifiers as used in the original (SenTerCel K3/40, sold as 1,000 volt 1 mA. units) can be obtained it will be found that these can be fitted into a space 3½in. long. It would appear from the normal SenTerCel codings that these rectifiers should actually be employed as 500-volt rectifiers—in the receiver the A.C. voltage actually applied is of the order of 700-750,—but on long trial runs they appear not to be overloaded and have given no trouble at all. If new, non-surplus rectifiers are used they will require a greater space—about 7½in. long—and so will require to be mounted across the chassis rather than along one wall. There is plenty of room below the mains transformer for this; once again a long, narrow tag-board should be mounted on the chassis wall—the back wall, in this case—and the rectifiers, with their associated capacitors, mounted on this tag-board. It will, however, be necessary to change the placing of the L.F.C.

It will be found that the wiring can be kept perfectly neat until it comes to running several wires the full length, or nearly so, of the chassis up to the front panel controls, but a little cable-forming helps here. The mains wiring comes into the chassis at the rear edge and must run the full length of the chassis up to the switch—a well-insulated cable should be employed for this, clamped down to the underside of the chassis top deck. A clear run for the cable can be found between the sound and timebase sections. At the transformer end of the run it is definitely desirable to anchor the mains cables and the transformer primary leads to a small tag-board stood off from the chassis by a small insulating pillar.

Other long runs are from the E.H.T. section to the brilliance and focus controls. These leads can be grouped together and made into a tied cable with thin thread; they should not be clamped down to the chassis but allowed to be self supporting.

**The Tube Mounting**

The mounting of the C.R. tube will depend to some extent on the housing intended for the televisor. In the prototype, which was to be kept as a chassis model for experimental purposes, it was found very convenient to make a front panel of millboard, a suitable hole being cut for the tube face and backed by a round rubber mask. A rectangular mask could, of course, be employed although the writer does not much favour this type, preferring to run the corners of the picture off the tube face to give greater overall size.

The panel is cut to the width of the chassis, is 12in. high and is supported by the retaining nuts of the five front controls. The tube hole, which is 5¼in. in diameter is centred 3½in. below the top edge of the chassis, the tube then being supported well clear of the EL32, the tallest valve. The tube base is supported at the rear of the chassis by a strip of stout aluminium bolted to the chassis rear wall and bent over to give light pressure inwards, so holding the base firmly to the tube. The base is bolted to this aluminium strip by the bolt hole in the base centre—a countersunk 2 B.A. bolt was found suitable.

**Alignment**

Before switching on the receiver the wiring should be very carefully checked—a voltmeter check also is recommended, especially to the newcomer to this type of construction. Both power packs, H.T. and E.H.T., are loaded by various paths to earth, and it is therefore safe to switch on without the added valve load—the valve warm-up period is also covered and there is no need for delayed H.T. switching. To test the circuit, first plug in the video valves, V1-V6. Temporarily connect a pair of high impedance 'phones to the video output socket, via 0.1 $\mu$F., and earth. Inject a signal into the aerial socket from a signal generator, either on the frequency for which the coils have been wound or, if the generator will not tune so high, its sub-harmonic. For example, on the London frequency, the generator would be tuned either to 45 Mc/s. or to 22.5 Mc/s. If no signal generator is to hand reliance must be placed on the vision signal itself.

A little rapid core tuning of L1-L5 should very quickly bring in a strong signal. As the cores are peaked up it is possible that some feedback will make an appearance—this will almost certainly be due to stray coupling on the part of the 'phone leads. When the signal is heard the test is complete and the 'phones may be disconnected.

Plug in the sound section valves, V10-V12, first ensuring that the speaker and output transformer are connected to the output leads. Rotate R53 to see if the regeneration point can be heard—probably it will be difficult to determine when the detector slides into oscillation, and there should certainly be no "plopping." Feed in a signal from the generator, either on the fundamental or sub-harmonic, and by swinging the generator tuning and controlling R53 it should very quickly be possible to hear a strong heterodyne, showing both oscillation and the direction in which the sound section tuning must be altered. Since L7 employs transformer coupling the sound tuning will be found a little sharp, but not difficult to bring to the correct frequency. Adjust L7 first, on both cores, then L6. Follow this with an adjustment to L1, then L2, though these latter adjustments must be amended when a picture is received. If no generator is to hand the sound signal must be found by patient work with various core settings.

The C.R. tube may now be plugged in. Ensure that the brilliance control is only slightly advanced and give the tube heater a minute to warm up. Ensure that the screened feeder is in place between the video output socket and the tube cathode.

Slowly turn up the brilliance control. A spot should appear somewhere on the tube face. Bring it into focus, and keep its brilliance right down so that it can only just be seen. Quickly check the four shift controls, making sure that each moves the spot, then turn the brilliance control down and make the spot invisible.

Plug in V8, V9 and V13. As the line timebase comes into action a faint whistle may be heard. Turn up the brilliance control; a raster of some sort should be seen on the screen. Adjust the height of the raster by R59, and vary the frame hold, R61, till the timebase is running at 50 cycles per second—there is enough residual hum to make this apparent, besides which it is possible that the mains transformer, as yet unaligned, will cause a curvature on the side of the raster. Any hum bar or curvature so caused should be stationary.

Turn R36, judging roughly by the whistle or by eye when a frequency of about 10 kc/s. is attained, and then adjust R34 and R43, one after the other, for a full screen width raster. The working of these controls will soon be mastered. A wrong setting of R43 will be found to "fold-over" the ends of the raster, and a setting will soon be found where a wide excursion of R34 requires no correction from R43. Centre the raster by turning the shift controls, setting each as near to the middle of its run as possible.

Now inject a modulated signal into the aerial socket from the signal generator and tune to the vision frequency, previously turning down the brilliance till the raster just disappears. The screen should brighten and, with a modulation frequency of 400 c.p.s., 8 bars should appear horizontally, though these will not be stationary. Now plug in V7, adjusting the frame hold control whilst the valve warms up. The bars should lock in, showing that the sync. separator is operating.

If no generator is to hand these tests must, of course, be made on a vision signal. In this case, the line hold control should also be adjusted until a picture of sorts is received.

On either an actual picture, or on an *unmodulated* carrier from a signal generator, there may now be some evidence of "tearing" on the right hand side of the screen. The capacitance of C30 should be reduced until this ceases; the final capacitance should be set on an actual picture until synchronisation is good without any tendency to tear.

The connections to the deflecting plates should now be checked. If the picture is upside down, reverse the connections to the Y plates; if reversed from left to right, reverse the X plate connections. It is a good plan to plug the tube leads temporarily into the output socket on the chassis and to check the sense of the deflector plate connections before soldering the leads onto the spills in the plug.

The final tuning can now be carried out. The best tool for the purpose is a plastic or ebonite blade—do not use a screwdriver in the small core slots as this will eventually cause the slot edges to crumble. A good trimming tool can be made from a plastic knitting needle of suitable diameter, its ends being filed into fairly broad blades. If final tuning on the sound section is required it will be necessary to dismount the tube for this, to allow access to the top core of L7.

**Transformer Orientation**

If a signal generator can be employed the cores should be tuned to give best output on staggered frequencies for the London transmitter. L1 should be tuned to about 43.25 Mc/s., L2 to about 44 Mc/s., L3 to about 45 Mc/s., L4 to about 46.5 or 47 Mc/s. and L5 to 45 Mc/s. On other frequencies where the upper sideband is suppressed it is probably as well to tune by eye on a test pattern, aiming at good reproduction of the bars without sound-on-vision interference.

It now remains to check the picture and to obtain the best transformer orientation to minimise any stray field effects. It is quite possible that no such effects will be noted but, in some receivers. a kink rather than a curve may appear, especially towards the left hand side of the screen on the edge of the picture, and a tendency to "roll" or close-up might be seen towards the base of the picture.

**Sound Suppression**

To remedy such defects slightly slacken the two transformer bolts and, with the receiver running normally, gently rotate the transformer through a few degrees. Remember that it is supplying 700 volts and use corresponding care. If the effect worsens rotate in the opposite direction—as a general rule a few degrees to the left will clear the picture of the hum effect.

On the frequencies mentioned above where the vision carrier has its upper sideband suppressed it may prove difficult in some areas to obtain good vision results without sound break-through. Sound break-through can be observed in various forms—a waved edge to the picture, varying bars, etc.—but it is easily identified as the effect varies in time with variations of sound from the loudspeaker. What is needed is a trap at some point along the vision R.F. strip to tune and absorb the sound frequency whilst allowing the vision signal to pass unimpeded. Of the many types of trap employed for this purpose the "sucker" is probably the most easily fitted and the most effective.

The circuit of a "sucker" trap is shown in Fig. 5. It consists simply of a tuned circuit coupled through a very small capacitance to the anode of one of the R.F. valves. In the present circuit the trap may follow V3 and may be positioned actually beside the valve in the present space between V3 and V12. It would be a simple matter to drill the necessary holes in a completed chassis and to mount and wire the coil.

The winding of the trap should be identical with the tuned windings of L3, L4 and L5 as already given for the particular frequency at which the televisor is to be used, and the coil is wound on one of the spare formers from the set of nine. Across the coil is wired a 20 pF. capacitor, and this parallel tuned combination is then earthed on one side to the stage earthing point. The other side of the tuned circuit is connected directly to the anode of V3 through a 2 (two) pF. capacitor.

## VOLTAGE TESTS

As many constructors like to make comparison readings, the following list of typical operating voltages is appended. Not too great a reliance should be placed on such voltage readings, however—they are affected by the mains loading and time of day, the measuring instrument, different valve stocks, resistor tolerances and other externals for which no true allowance can be made. They therefore serve as a guide only.

### VOLTAGE READINGS

| | | | | | |
|---|---|---|---|---|---|
| V1. | Anode | 175 | V8. | Anode | 100 |
| | Screen | 100 | | Screen | 200 |
| V2. | Anode | 195 | V9. | Anode 1. | 120 |
| | Screen | 140 | | Anode 2. | 80 |
| V3. | Anode | 210 | V10. | Anode | 260 |
| | Screen | 145 | | Screen | 145 |
| V4. | Anode | 230 | V11. | Anode 1. | Variable. |
| | Screen | 145 | | Anode 2. | 175. |
| V6. | Anode | 220 | V12. | Anode | 260 |
| | Screen | 255 | | Screen | 265 |
| V7. | Anode | 125 | V13. | Anode | 80 |
| | Screen | 60 | | Screen | 200 |

All readings taken with a 2,000 ohms-per-volt instrument, 300 volt range.

Note that the voltages applied to V12 are a little above the rated maxima of 250 volts for anode and screen. Under no circumstances should higher voltages be applied than those shown in the readings—if a higher voltage is registered in the constructor's televisor the output valve may be fed from the junction of R27 with C25, to bring down the anode and screen potentials to their rated limits.

The same method of feeding V12 may also be employed to give a slight reduction in H.T. line voltage, should the vision R.F. amplifier appear a little unstable or the anode and screen voltages of V1-V4 appear a little high for any reason. The screen voltages of the 6AC7 valves should not be allowed to rise above 150 volts.

# Time-base Calibration

## Circuits for the Production of Marker Pips

By D. McDONNELL

THE calibration of the X time base of an oscilloscope is an essential feature for measurement of sync. pulse width and many T.V. waveforms.

The methods generally adopted for the calibration of the X time-base are:

(1) Direct calibration from a knowledge of the sweep period.

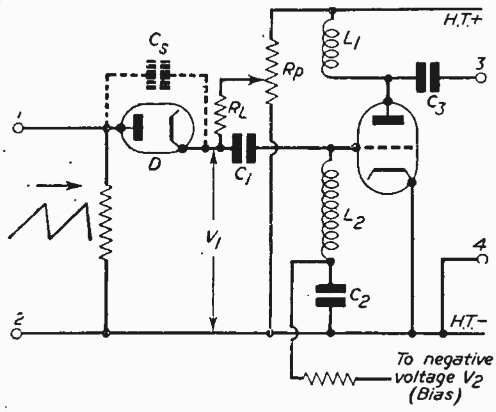



Fig. 1.—Multiar circuit for the production of marker pips.

(2) Calibration by means of fixed marker pips produced by a ringing circuit.

(3) Production of a variable marker pip by auxiliary circuits.

Two types of circuits suitable for the production of marker pips as under the last heading will be described. They are the multiar circuit, using a pick-off diode and blocking oscillator, and the Miller circuit triggered by the time-base being used.

*Method* 1.—Fig. 1 shows the multiar pick-off circuit and blocking oscillator which may be used to give the variable marker pip. The time-base voltage supplied from the oscilloscope is applied to terminals 1 and 2. The voltage is of course of a saw-tooth waveform. The output marker pip is obtained from terminals 3 and 4. The marker may be used on the tube by application to the Y terminals when used as a pip or, alternatively, applied to the grid of the tube to produce a brightening or black-out marker; in the latter case the marker appearing as a bright or dark spot on the trace.

### Operation of the Circuit

In the circuit shown in Fig. 1 the diode D will remain non-conducting until the input voltage becomes equal to the voltage V1 which can be adjusted by the potentiometer Rp. When the voltage between points 1 and 2 exceeds V1 the diode conducts. At the instant when the diode begins to conduct the voltage developed across RL is applied via C1 to the grid of the blocking oscillator. This lifts the grid voltage, which has been previously held beyond cut-off by the negative voltage V2, and the blocking oscillator is excited and produces a single pulse due to heavy positive feedback between anode and grid (L1 and L2 are tightly coupled together on laminated iron core). This pulse, which is used to produce either the brightening, black-out or pip, depending whether the pulse is applied to the grid or to the Y deflection plate, is taken off through C3. Although this circuit may appear more simple than the one to be described below, it is not recommended by the author due to the stray capacity Cs across the diode causing direct feed-through at high time-base frequencies.

*Method* 2.—Fig. 2 shows the Miller-Sanatron circuit which provides the marker pulse as follows:

The trigger pulse for the Miller is obtained by differentiating the leading edge of the saw-tooth waveform of the time-base being calibrated. It is applied to V1 suppressor through D1 and the auxiliary switching valve V2. This initiates the run-down of the Miller in the usual way. During the run-down V2 remains cut off. At the end of the run-down V2 conducts causing the anode voltage to fall rapidly. This fall is differentiated by C1 and R1 giving the desired output marker pip. The position of this pip in time may be changed relative to the start of the time base in the oscilloscope under test by adjusting the potentiometer R6.

The valve V1 should preferably be one with a short suppressor base in order to ensure correct switching by valve V2. If the control grid base of V2 is shorter than that of V1, the resistance R3 may be omitted since this ensures that the valve V2 is cut-off during the

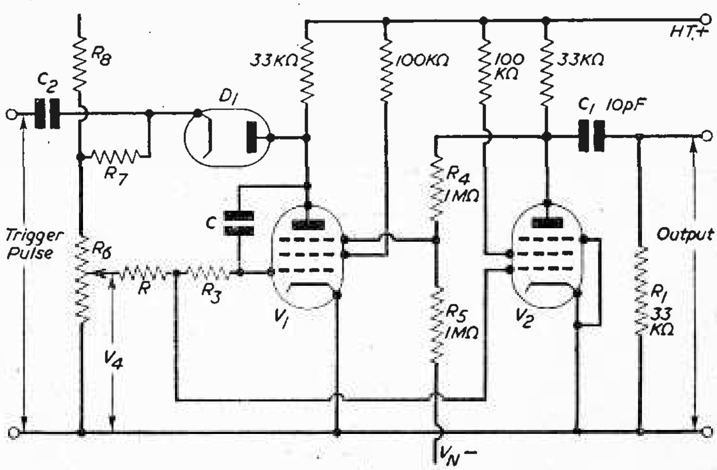



Fig. 2.—The Miller-Sanatron circuit.

run-down of V1. The total voltage applied to the grid of V2 during the run-down is that between grid and cathode of V1 plus that across R3 due to the charging current.

**Non-critical Loads**

The anode loads are not critical providing the gain from the grid to anode is high. R1 may be made equal to the anode load. C1 should be fairly small (10pF). If too small the output capacity will reduce the amplitude of the pulse. R4 and R5 should be adjusted in conjunction with the negative voltage Vn just to cut off V1. The resistors R8 and R6 set the cathode potential of the diode to some value less than the H.T. voltage limiting the maximum potential to which the anode may rise thus reducing the recovery time. R7 and C2 form the input differentiating circuit providing a sharp triggering pulse.

The main factors governing the rate of run-down and hence the position in time of the marker pulse are C, R and the voltage V4 across R6. This time is given approximately by

$$\frac{\text{high-tension voltage} \times C \times R}{V4} = t.$$

A third method very similar in operation to the circuit just described with the exception that a monostable flip-flop replaces the Miller circuit, is sometimes used. However, as it has no distinct advantages over the last circuit described it will not be given here.

# Portable T.V. Camera

A NEW portable television camera and transmitting station, designed to operate in the field as a one-man back-pack unit, was demonstrated recently by the R.C.A. Laboratories.

Weighing only 53lb. the back-pack station is planned to function with its own battery-power supply. It has a range of approximately one mile. Because of its easy portability numerous applications for the new equipment are foreseen by R.C.A. research engineers. Among these are news coverage, with television-equipped reporters flashing pictures and commentary directly to editorial rooms, and remote industrial viewing and control.

**Long Range**

The new transmitter operates in conjunction with a control station which may be located as far as a mile from the camera. Signals corresponding to the scene being televised are transmitted to the control point on an ultra-high frequency with a power of two watts. In addition to acting as a monitor for the televised picture, the control point performs two other functions. It sends out a stream of pulses which stabilise the camera and can be used to issue vocal instructions to the cameraman.

**Sub-miniature Parts**

Recent developments in the design of pencil-sized tubes and other sub-miniature component parts made possible the impressive reduction in bulk and weight of the equipment.

The back-pack is carried in knapsack fashion, suspended from the narrator's shoulders by flexible straps. Two small antennas extend from the top of the pack and are used respectively to transmit the picture signal to a base station and to receive voice and control signals from the same point. It was illustrated in our last issue.

**42 Valves**

The equipment contains 42 valves which, with their associated circuits, provide all synchronising frequencies for a standard 525-line, 30-frame interlaced television picture. Included in the unit are the battery-operated power supply, deflecting circuits, amplifiers, and a radio receiver for receiving instruction and other essential information from the control point. A single battery operates the portable station for about 1½ hours.

# UNO Television

FOR the past few months the United Nations Organisation have been providing their own television service for American networks and, during that time, have used two Marconi Image Orthicon cameras on trial. These broadcasts have been so successful that Marconi television equipment has been chosen by U.N.O. for permanent installation at the new headquarters in New York, in the face of keen international competition.

The order comprises three Marconi camera chains and full ancillary equipment. All the equipment will be the new Mark II series recently designed and developed in the Chelmsford works and laboratories of the Marconi Company.

**Recordings**

Marconi cameras have already televised many important meetings of the Security Council and the General Assembly, including the address given by President Truman on United Nations' Day.

The proceedings are made available to television networks all over the world via kinescope recordings.

**Boat Race**

The superlative performance of Marconi television cameras has been proved by the British Broadcasting Corporation in many of the outstanding outside broadcasts of the last three years. Three times in succession it was one of these cameras which brought the Oxford-Cambridge boat-race pictures to British viewers when, mounted in the bows of a launch, it followed the two crews over the full 4¼-mile course.

**From the Air**

They have also been used recently in two historic outside broadcasts of 1950, one from the gaily-bedecked town square of Calais, and one from a flying television station 1,000 feet above London.

In addition to these fundamentally experimental broadcasts, the Image Orthicon camera has been employed on many other television outside broadcasts under greatly-varying conditions, such as televising the opening of the new chamber of the House of Commons; pantomimes from the Empress Hall and the Grand Theatre, Croydon; Bertram Mills' Circus from Olympia; snooker from the Leicester Square Hall; international rugby from Twickenham and soccer from Leicester.

# Improving a Commercial Receiver

## Obtaining an Improved Performance at Long Range

By B. L. MORLEY

ONE of the main advantages which the home-built televisor has over the standard commercially built model is that the home-built receiver has those subtle additions and adjustments which conditions it for the locality in which it is designed to work, before being put into its cabinet. The commercial receiver, on the other hand, is a mass-produced article, and it is not possible to individualise it for separate localities without making the cost prohibitive.

Some idea of what can be done to " hot up " a commercial receiver to make it capable of handling the rather exacting conditions of " beyond the fringe " areas is given in the following paragraphs, covering an actual experience. The main defects of the instrument were very poor-quality pictures due mainly to excessive grain ; poor synchronising, and insufficient volume on the sound channel.

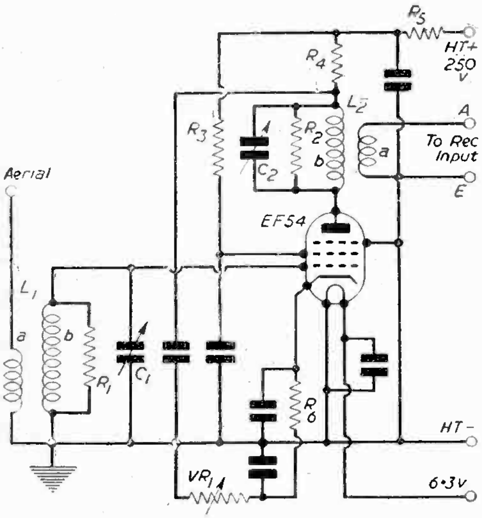



Fig. 1.—Single-valve pre-amplifier circuit.

### Aerial Design

The first step was to replace the H aerial with a high-gain array comprising director folded dipole and reflector. This resulted in a marked improvement.

The next step was rather unorthodox ; the picture was extremely " grainy," although there was a certain amount of gain in hand, and full amplification could not be used because of this grain.

**LIST OF PARTS FOR FIG. 1.**

C1, 2—0-21 pF. R5—1 KΩ.
R1, 2—6.8 KΩ. R6—10Ω.
R3—10 KΩ. VR1—2 KΩ.
R4—5.6 KΩ. V1—EF54.
Rest of condensers—500 pF.

L1—Primary 1½T (a) —Secondary 4T (b) } 22 SWG.—Aladdin coil formers.
L2—As above.

### Pre-amplifier

The receiver was fitted with a two-valve pre-amplifier possessing a separate gain control. After a series of experiments this was replaced with a one-valve pre-amp., using an EF 54. The circuit of this amplifier is shown in Fig. 1. The wiring was kept very short to reduce losses to a minimum.

Incidentally, the ex-Govt. EF54s seem to vary in the amount of their gain and it is wise to try two or three in order to obtain one giving optimum results.

This step in conjunction with the new aerial gave a picture free from grain under normal conditions, with some gain in hand which was useful for counteracting fading conditions.

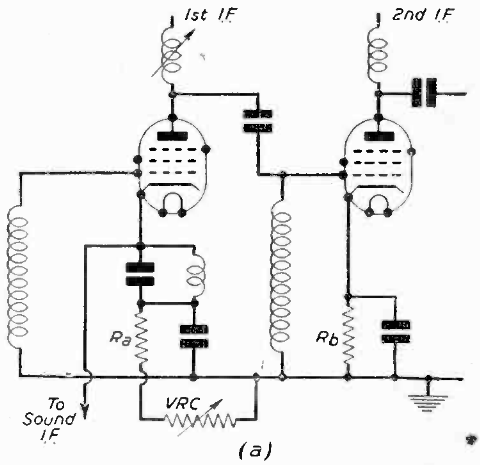



Fig. 2 (a).—Circuit as in original model.

### Controls

The fading problem was the next to be tackled. The sensitivity control VR1 (Fig. 1) was extended to operate remotely by mounting the control in a small box and extending it to the pre-amplifier by a length of coaxial cable, the outer conductor of the cable being earthed.

The contrast control in the receiver was next altered. The trouble experienced here was that it interacted with the sound receiver, the volume being somewhat dependent on the position of the contrast control ; this meant that quite often the volume could not be increased to comfortably audible conditions without spoiling the picture by increasing the contrast control and reducing the brilliance.

A superhet circuit was used and the R.F. and mixer stages were common to sound and vision ; a rejector circuit in the cathode of the first vision I.F. enabled the sound signal to be tapped off and amplified by a separate I.F. stage. The contrast control was fitted in the cathode circuit.

As the possibility of the receiver being overloaded was extremely remote the contrast control was removed to the cathode of the second vision I.F. valve. Fig. 2 shows the conditions.

The final modification was to reduce the bandwidth of the receiver. This was done by retrimming the vision I.F.s while Test Card C was being radiated. The original bandwidth was 2.5 Mc/s and it was reduced to just under 2 Mc/s. This may appear to be a bit drastic, but the improved gain makes it worth while in difficult areas. It is done in not a few commercial receivers.

### Remove Damping

One other small detail may be attended to, but care must be taken not to upset the general response of the receiver. Many coils are provided with damping resistors shunted across them to improve the bandwidth, and the other effect of these resistors is to reduce the gain of the stage with which they are related. If the resistors are removed the gain will increase but the circuit will be more sharply tuned. If it is not desired to remove the resistor entirely it may be modified in its value.

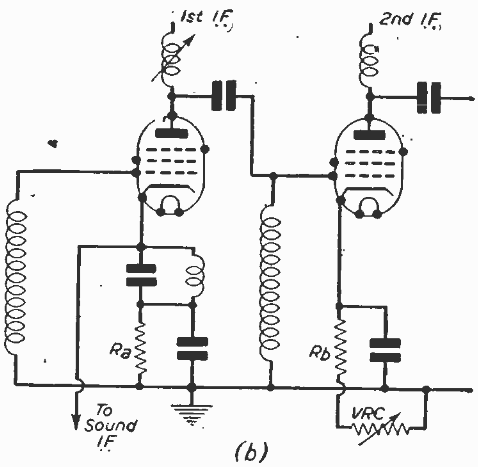



Fig. 2 (b).—Circuit as modified.

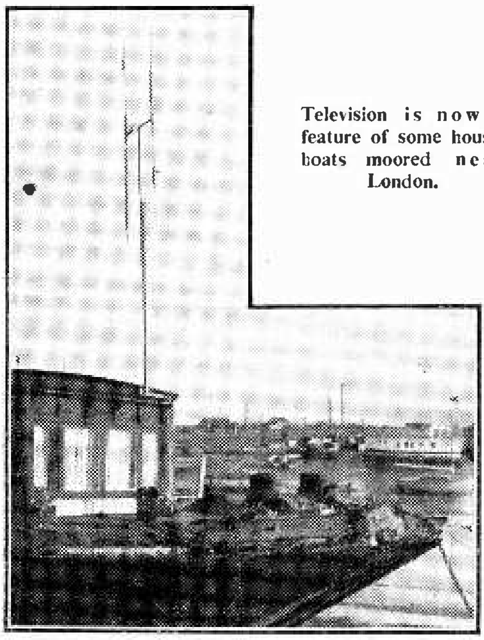
# HERE AND THERE

### Signs of the Times

WILL the familiar "H" type dipole aerial which now abounds in London, the Home Counties and the Midlands come to be regarded as a sign of the times? It is certainly a significant feature of the mid-century landscape in Britain. Perhaps just as we associate the penny-farthing bicycle and the handlebar moustache with Edwardian days so we will think of the nineteen-fifties as the "H" days, and it is almost sure that in future years they will be as rare as the penny-farthing bicycle. Already alternative types of aeriel are in use and closer to the transmitters many "invisible" indoor aerials provide satisfactory results. Really close to the transmitter the line-cord type of aerial is used which to the ordinary member of the public means no aerial at all.

It may, therefore, be interesting to record, while we can, amusing or picturesque examples of aerial installations. We invite our readers to submit photographs of television aerials *in situ*, with details as to their exact location, any significant technical facts about the installation itself, or any other points of note—for example—the highest aerial you know, or the lowest, the aerial claimed to be the farthest away from the transmitter, an unusual number of aerials, a very well concealed aerial—and so on. (See the example on page 80.)

On the left is a picture of a houseboat in Benfleet Creek between Canvey Island and the Essex mainland. The owner of the boat could well claim all home comforts! At the bottom right-hand corner of the picture, just over the mooring chain, is the mains cable so he clearly had no E.H.T. problems; but here is a successful installation almost 30 miles from Alexandra Palace and as nearly on sea level as can be, and this sign of the times makes its intrusion in a most unexpected setting.



**Television is now a feature of some house-boats moored near London.**

### Largest Cored-solder Factory

ON June 4th the Government-sponsored Hemel Hempstead New Town Corporation began the building of a new factory for Multicore Solders, Ltd. Due to be completed before the end of the year, the factory will be the second to be opened in the new town and will be the largest in the world constructed solely for the manufacture of cored solder.

Multicore staff will have the choice of accommodation from hundreds of modern houses and flats which are being built during the summer in the vicinity of the new factory.

# Television Maintenance

## Service Charges and Insurance

By S. SIMPSON

SOME time ago a proposal was set afoot to cover the cost of maintenance of television equipment by a form of insurance contracted between the purchaser and his retailer at the time of buying the televisor. The amount of the premium was to be in relation to the tube size and was to be paid to the retailer who, in turn, passed these premiums to the appropriate insurance company.

Cover included free replacement of the tube if damaged, or eventual replacement of the tube after a stipulated period if no claim should arise within that time. Normal breakdown was also covered, as was accidental damage by the user, and this included cabinet repairs. Third-party cover was another wise precaution when one bears in mind the various aerial arrays necessary in fringe areas. A " director plus folded-dipole plus reflector " can be quite a wind-break in a high wind and the liability to cause damage to neighbouring property has to be recognised.

Cases would arise, of course, where a televiewer might wish to part exchange his existing outfit for a more up-to-date model, and again the scheme was designed with this contingency catered for. The tube replacement allowance—where no previous claim had been made—was available as a deduction from the price of the new televisor, and at present-day prices this represents a considerable saving. Altogether, the scheme seemed quite promising—in more ways than one—and it is surprising that so little has been heard of it. In America, the writer understands, a similar scheme has been in successful operation for quite some time.

### Urgency

From the user's point of view insurance might appear attractive, but from the engineer's test bench the system is fast becoming imperative, and the sooner it is in force the sooner will several problems confronting the service departments of the TV retailers be less of a worry than they are at present. Repairs to television equipment are naturally more frequent and costlier than in sound broadcast receivers. There is far more " in the box " to go wrong and engineers are finding that very small variations in values of components which would probably pass unnoticed in sound can cause intolerable performance in vision. These faults take a lot of finding, unless one has had plenty of experience of television servicing work —which condition can only apply to a very small proportion of the total of radio engineers engaged in servicing. A " lot of finding " means a lot of time for which the customer is asked to pay, i.e., problem No. 1.

Secondly, television test equipment is rapidly approaching laboratory standards of precision. The initial cost is high and the gear must be maintained in its initial condition to be of reliable service. This means time and money, which must naturally come out of the income from the service department. The amount of gear is also rising and is already greater than is reasonably required in sound, so one can multiply the maintenance costs by approximately three times that for sound. This represents a standing overhead charge on television repairs—and who pays ?

### Overtime

There is also the user who, new to his equipment, creates a fault by maladjustment ; it takes a visit from the serviceman, however, to put things right, and very probably outside normal working hours, so as to give the user further instruction in the proper use of " the knobs." If overtime is paid, then again, who pays ? On these three factors alone, there seems reasonable grounds for some scheme which would go at least part of the way towards meeting the cost of maintenance, if not all of it.

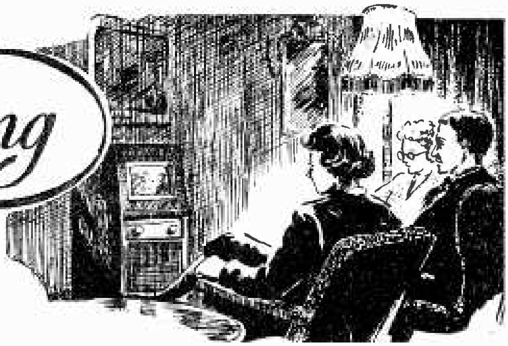
The scheme might, with advantage, be extended to give cover to the retailer for equipment under repair or testing in his workshop. The writer has in mind the crowded department and inexperienced engineer—and the ease with which a time base can be " killed," resulting in a burned tube, if no deflection trap is fitted. Cabinet scratches, that ever-present bogy, would be much less of a worry if one knew that the services of an expert french-polisher were available under insurance. Admittedly, there are snags in the idea, but perhaps here is food for thought for our insurance experts ?

### Personal Cover

Another form of insurance which, so far, has not been met by the writer, is that of cover for accident to the service engineer. When one considers the dangerous item a big C.R.T. becomes when removed from its chassis (risk of implosion), the engineer has to take a fair risk now and then, safety glasses or no, and eyesight is not easily paid for, especially by the " small man." Happily, we are meeting far less of deadly E.H.T. now the flyback and oscillator methods have been developed, but 25,000 volts is still no trifle to meet unexpectedly, especially to a person of indifferent health.

On top of all this we now have an added risk apparently—that of X-ray radiation from projection type C.R.T.s which extends to some 40in. from the front end of these tubes. As far as the user is concerned, this needn't worry him, as the tube is placed in the cabinet in such a way that no harm can arise, but when working on the tube outside the cabinet we are now recommended to work from behind a lead-glass screen. (" Why " is obvious, but " How " is not so clear !) The important point, however, is that " radiation " is another liability the employer has to consider. Summing up the foregoing, the retailer's first line of insurance is to employ only a reliable, qualified man as his serviceman. There is still the sheer accident which even the best of us encounter, and there seems no denying that some form of cover should be considered which will afford the retailer a measure of security against these unfortunate events.

# THE Art of Viewing



## Some Important Factors Influencing its Attainment

THE first experimental pictures obtained by television were about the size of a large postage stamp. They were dull, poorly defined, orange-coloured images which, despite the scientific marvel and the novelty of their production, could by no means be said to afford any real pleasure and ease in viewing.

Nowadays, however, thanks to the modern high-definition system of transmission, the average television image compares favourably in brightness and in general clarity and crispness with the picture projected on the average cinema screen. Comfortable viewing is no longer a factor to be vainly hoped for and anticipated. It can be obtained by almost any viewer using present-day equipment; so much so, indeed, that easy viewing is now taken very much for granted by every set-owner within effective range of a television transmission aerial.

The comfortable viewing of television pictures—from a purely optical or visual standpoint—depends on a number of factors, the majority of which are more or less under the direct control of the transmitting station.

### Brilliance and Brightness

In the first place, a televised image must be a brilliant one. And here let it be stressed that brilliance is not quite the same thing as brightness. Brilliance is, rather, a function of brightness. A picture can be exceedingly well illumined and yet, at the same time, it may remain "flat" and uninteresting. At the other end of the scale, an image can be but poorly illumined and yet be fairly easy to discern.

Brilliance in a picture involves something more than mere brightness. It necessitates the factor of contrast, a factor which may be said to comprise the ratio between the various shades and tones in the picture. An image is "flat" or lacking in contrast when the highest light is a pale grey, the deepest shadow a medium grey, and when the gradations or steps between the intermediate tones are only very slight. A white object presented against a light background must necessarily give a flat picture in which the factor of contrast is absent.

On the other hand, a picture presents good contrast when its highest light is either a pure white or a very light colour, when, also, its deepest shadow is a rich black, and when these two extremes are separated by a range of well-marked, easily distinguishable tones. A chess-board image of black-and-white squares forms a picture of maximum contrast, as does also a photograph of a black object against a white background, or vice versa. Such images, however, whilst being of maximum contrast and thereby readily discernible, are not usually satisfactory. They are certainly clear images, but they are, at the same time, too harsh. They lack the range of well-defined intermediate tones which go to make up an interesting and a "comfortable" picture.

So we see that, for satisfactory television viewing, the picture presented to the observer must have neither too much contrast nor too little. Too much contrast makes for harshness; too little for flatness. In the realm of television it is better, if anything, for a picture to be too contrasty than too flat, just as it is in the case of a photograph intended for newspaper or magazine reproduction. It is for this reason that the television cameraman is so much at pains to put out "strong" pictures in which the artistes are presented against contrasty backgrounds and in which their individual features are rendered more contrasty by dint of special make-up.

As a rule, the more contrasty an object or scene is, the easier it is to televise it and, conversely the flatter the object or view the more difficult it becomes to pick it up adequately by the television camera.

### SEVEN SIMPLE RULES

(Suggested by the Association of Optical Practitioners)

(1) Never view television with the room in darkness; the contrast between the bright screen and the dark room is very tiring for the eyes. Have a comfortable amount of light, either overhead or behind you but not shining directly on the screen.

(2) Be sure your set is properly installed, with special attention to the aerial.

(3) Tune your set carefully, re-adjusting after it has warmed up thoroughly. Otherwise the picture may be unsteady and distorted and this strains the eyes.

(4) Seat yourself comfortably and do not look up at the screen. It is better to have the picture at eye level, or slightly below rather than higher.

(5) Do not concentrate on the television screen for long periods as this tends to produce eyestrain. Glance round the room occasionally, as a change of focus rests the eyes.

(6) It is advisable to sit about 6—10 feet away from the television screen.

(7) If television makes your eyes ache have them examined and wear glasses if you need them. If you are over 55 you may need special glasses for television.

(See "Editorial" in our June issue.)

### The Necessity of Contrast

For these reasons it is, as previously mentioned, ever incumbent on the television producer to give his subjects and objects adequate contrast. He is able to effect this vital requirement in a number of different ways. Usually, he selects a suitable combination of these methods. He will, in the first place, arrange for an individual facing the camera to be presented in front of a background scene which will throw him up in good contrast.

For example, a lady artiste dressed in white would always, whenever possible, be televised against a darker-hued background, or, if this were found to be impossible, a strong side-lighting would be employed for the same purpose.

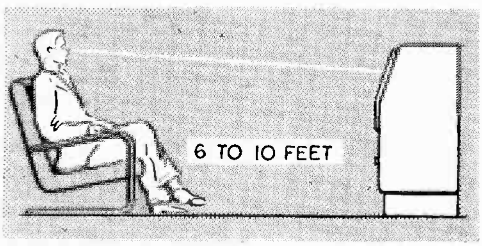
The choice of lighting is another well-known method by means of which the television producer controls the contrast of his pictures. It is a highly convenient means, too, for, by the use of modified and carefully controlled lighting, the whole aspect of a picture may be profoundly altered.

Consider, for instance, a white object—a statue is a simple example—being viewed with a front lighting. The object looks flat, uninteresting, dead and detailless simply because it reflects light rays with a nearly uniform intensity from almost every point of its surface. But if we illumine the object or scene from one side only, or, as an alternative, if we put a stronger light on the one side of it than we do on the other, the object immediately springs forth into a reality which was denied to it before. It no longer appears flat. The very inequality of its lighting causes shadows to be formed, and these, by virtue of their tone-differences, at once break up the deadly uniformity of the lighting, thereby increasing the visual contrasts of the picture.

### Tone Ranges

Here, incidentally, is the reason why an object or a scene always looks more brilliant when it is viewed in sunlight than when it is observed in ordinary daylight, for the sunlight not only increases the intensity or brightness of the illumination, but, because it illumines the view unequally, it casts innumerable shadows and thus imparts added contrasts to the object or scene under observation. The range of differences between the varying tones in a view or image is very great. It has been established that the light/shade ratio in a view seen in daylight is often of the order of 50,000 to 1, which means that such an image or view presents some 50,000 separate steps, gradations or tone-differences between the whitest white and the blackest black. Such an enormous tone-range or gradation-scale emphasises the magnificent response of the normal human eye to relative differences in light intensity. The musically-trained ear can detect exceedingly small variations in the pitch and intensity of sounds, but even the untrained eye is more sensitive than this.

The average " good " photograph has a gradation ratio of approximately 100 to 1, and a cinema film a ratio of something like 60 to 1. The best television screen reproduction can nowadays closely approximate to this ratio, although at one time it was rated at less than half that amount. Yet television and cinema screen gradations are usually quite satisfactory to us and we view them in comfort because the eye, like the ear, is, in many ways, an accommodating organ. It will put up with a decrease in the gradation of a picture without much complaint, always provided that the bright areas of the picture (the " high-lights ") are not in any way suppressed or reduced in detail. Hence, if you want a picture, photographic, screen-projected or otherwise, to look well, you must never sacrifice its high-lights. If these contain good, clear details, the shadows will, to some extent, adequately look after themselves, and the eye will, in many instances, read into them detail which, in point of fact, is actually not present.



The ideal viewing position is indicated here.

### Effect of Screen Motion

Surprising as it may seem, the effect of motion in a televised image is to improve substantially what we may call the " seeing ease " of the picture. Even a slight degree of motion in a picture usually has this effect, which is apparently due to the non-coincidence of the successive pictures which rapidly appear on the screen to make up the televised image. The same thing happens in the case of an ordinary cinema picture, the screen detail appearing rather less sharp when the film is for a moment allowed to remain stationary in the projector than it is when the film moves at its normal rate through the machine.

It is a fact, also, that the actual size of the televised picture has an influence on its clarity. The eye deals with differences of light and shade much more readily when the picture is large than when it is small. It is also dependent upon the size of the picture which the televisor is able to present. Within limits, the bigger the picture the clearer it becomes.

The same factor operates, too, in ordinary photographs, this being, in many instances, the reason why an enlargement appears to be so much clearer, brighter and altogether more adequately defined than does a small contact-print from the same negative. In all such cases, it would seem that the increased size of the picture gives the eye a better chance of recording and balancing-up the varying tone-intensities and gradations of the image, the result being an appreciable heightening or accentuating of the picture as a whole.

For easy viewing of a television picture all direct interfering light, both natural and artificial, must be cut out rigorously, so that a shaded room is still necessary for the most comfortable viewing, particularly over a lengthy period. Compared with normal daylight, the illumination of even the brightest of televised images is but dim. It is considered by some that best viewing is obtained by the eye which has been allowed to remain in the dark for some little time previously. During this time—five or six minutes, say—the iris of the shaded eye dilates, thereby increasing the size of the aperture through which light rays must pass to the retina. Such an eye is said to be " accommodated," and it is because of the gradual onset of this visual accommodation that a televised image which, to a person entering a room from daylight or bright artificial light, at first appears dim and difficult to discern, rapidly increases in apparent brightness, contrast and general clarity.

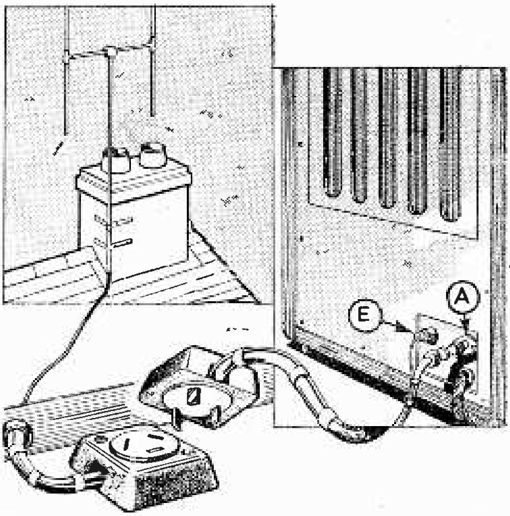
It is fortunate that the screen colour of the modern cathode-ray tube is characteristically a bluish-green hue, for this range of the spectrum is the one to which the eye is the most sensitive. In the early days of television the images were dull orange-red in colour and were never satisfactory if only because the eye is relatively insensitive to this band of colour.

When we look on a scene which is brightly illumined, the iris diaphragm of the eye automatically contracts so that too high a light-intensity may not enter the eye and thereby, perchance, damage the retina. And, vice versa, when the picture is poorly lighted, the iris opens up to its maximum extent in order to admit as much light as possible to the eye. But, as any photographer knows, the more you close down the lens-diaphragm of a camera, the sharper and the more accurately focused the image becomes. This is the reason why we see the clearest detail under conditions of bright illumination when the iris of the eye has contracted to a narrow aperture, and why, under poor illumination, our eyes, as it were, "open up" to their fullest extent and make the accurate focusing of detail more difficult for the normally-sighted individual.

### Photons and Foot-candles

The actual illumination-intensity obtained on a televisor screen is very variable. It is commonly measured in *foot-candles* or in *photons*. A foot-candle is an illumination standard which represents the intensity of illumination received at a distance of 1ft. from a "standard" candle burning approximately 120 grains of spermaceti per hour, its flame-size being about 45 mm. Good daylight is of the order of about 2,000 foot-candles, whilst a poor daylight illumination may sink as low as a mere 20 foot-candles. We can just see to read under about 3 foot-candles illumination, but the average televisor-screen intensity gives a light-strength of about 8 to 10 foot-candles. This we can view continuously in a dark or at least a shaded room without becoming visually fatigued.

There is another light-standard which is used for expressing screen-illumination intensities. This is the "photon." One photon is reckoned as the intensity of light which falls on the retina of the eye when the iris or pupil has an aperture of precisely 1 square millimetre and when the object viewed has an illumination-intensity of exactly 1 foot-candle. The photon is obviously the more accurate standard of measurement because it relates the intensity of the illumination to the aperture-size of




**Aerial installation is most important and poor pictures and synchronism can result from a badly matched aerial.**

the eye and, therefore, to the amount of light which enters the eye. Normally, some 15 to 20 photons of light entering the eye from a television receiver screen make, under normal observational conditions, for comfortable, effortless and easy viewing.

# Television Training for Dealers in Holme Moss Area

THE opening of the new B.B.C. television station at Holme Moss, Lancashire, will create an urgent need for many expertly-trained television service engineers to deal with the installation and service problems which will arise.

Owners of "His Master's Voice" and Marconiphone television receivers in the north of England will enjoy the same unequalled service facilities as are available in the London and Midlands areas.

### "On the Spot" Courses

To ensure that the supply of fully-trained personnel necessary to maintain this service is available, E.M.I. Sales & Service, Ltd.—the distributing and servicing organisation for "His Master's Voice" and Marconiphone products—are beginning a series of "on-the-spot" training courses for "His Master's Voice" and Marconiphone dealers and members of their service staffs. Premises have been taken over and suitably equipped at 109, Piccadilly, Manchester, for this purpose.

E.M.I. Institutes, Ltd.—E.M.I.'s own Electronics College—will be co-operating with E.M.I. Sales & Service, Ltd., in the running of the courses and will be providing experienced tutors and instructors.

### No Charge

These courses, which will be free of charge, will, in addition to giving a general theoretical background of television, familiarise dealers with the circuits, features and operation of all current "His Master's Voice" and Marconiphone models. Initially, courses of 14 days' duration will be arranged. Local accommodation will be found for those attending the courses.

Both E.M.I. Sales & Service, Ltd., and E.M.I. Institutes, Ltd., are part of the E.M.I. Group, whose scientists evolved the unique Emitron television system as used by the B.B.C. in this country, and in whose factories "His Master's Voice" and Marconiphone television receivers are produced.

"His Master's Voice" and Marconiphone dealers may obtain details of these courses from either the Training Division, E.M.I. Sales & Service, Ltd., Sheraton Works, Wadsworth Road, Greenford, Middlesex, or E.M.I. Institutes, Ltd., 10, Pembridge Square, London, W.2.

# X-rays on Sutton Coldfield

By THE MARQUIS OF DONEGALL

NO, I am not " terrified of heights " ! It was purely a case of laziness when Mr. Henry Whiting, Engineer-in-Charge at Sutton Coldfield, asked : " Would you like to climb up the 750ft. mast ? "

Mr. Whiting can have his mountaineering. I would still be climbing, if I had started : probably would have reached the Pearly Gates by now !

The first thing that surprised me about Sutton Coldfield was its compactness. Hardly do we expect it to look like Alexandra Palace, with its reek of Victorian melodrama, or, indeed, like Lime Grove, with its rank—all right, shoot me !—" lebensraum."

Not only is the whole set-up compact but the staff consists of only 20, and the 26 acres that it occupies leaves plenty of space for market-gardening.

The staff consists of the following : our friend, Henry Whiting, who is showing us round, and his Assistant-Engineer-in-Charge, Mr. R. C. Harman. There are two senior engineers and nine assorted technical staff. Then we have one clerk, an electrician, a rigger, a driver, a labourer, and last, but most important, two canteen ladies.

To describe Mr. Cox as a labourer—aren't we all ?—seems to be a B.B.C. understatement. Mr. Cox fixes . . . indoors or out of doors.

The rigger, whom I did not have the pleasure of meeting, looks after the two masts—Big Bear and Little Bear—and the lamps. He's the chap who regularly climbs Big Bear in 30 minutes. He has not even bothered to time himself up Little Bear. I suppose it's just a case of " That's Little Bear—that was ! "

The lift up Big Bear takes six minutes for its 600ft. That, according to my calculation, is about half the speed of the lifts in the Empire State Building. But we have the Empire State beaten because there you have to change lifts on the way up. Big Bear has the longest single-span lift in the world.

At the top of the mast there is a crow's-nest consisting of a room 6ft. in diameter. According to how many port-holes you open the wind will play you " Home Sweet Home " or " God Save the King " on its giant prefabricated penny-whistle. This requires a highly skilled musician—he has to know the exact direction of the wind to get the elements to give him the tune he wants.

Before we leave the mast, let me assert emphatically that it *does* rest on a steel ball at the base. There has been a lot of controversy about it. I have seen the ball and that is that !

### Control Room

The Control Room is most spacious compared with its counterparts in London. The theory is that the whole of Sutton Coldfield transmitting station can be operated by one expert, through the fault indicator panel in this room.

The glass windows of the Control Room look out on to the Transmitter Hall, reducing to nil the roar of the air-cooling system. Some of the valves are water-cooled, and if any large valve goes west, several hundreds of pounds go with it.

The Transmitter Hall's floor is of cork tiling and the machinery is entirely enclosed in a grey enamelled steel bank like a grey refrigerator some 40ft. long. It is impressively artistic in its external simplicity. Handles, similar to those on a refrigerator, are fitted to doors at intervals along its shining grey surface, each door having a glass inspection panel.

" I hope you won't be able to open that one ! " said Mr. Whiting, as I tried a handle.

Sure enough, I couldn't, and the theory is that it is almost impossible for a fool to electrocute himself. The door that I tried can only be opened when the current is off. This excellent idea obviates the necessity of slinging unsightly " D a n g e r " notices all over the place. In fact, I did not see any.

**SUTTON COLDFIELD**
**(Channel 4)**

| | |
|---|---|
| Height Above Sea-level .. | 550 ft. |
| Height of Mast .. .. .. | 750 ft. |
| Vision Frequency .. .. | 61.75 Mc/s |
| Sound Frequency .. .. | 58.25 Mc/s |
| Power of Vision Transmitter .. | 40 kW |
| Power of Sound Transmitter .. | 12 kW |

**Opened 17th December, 1949.**

### Separate Units

There are two transmitters, one for vision and the other for sound, operating on 61.75 Mc/s and 58.25 Mc/s respectively. The vision transmitter is capable of an output power of 40 kW. The sound transmitter has a carrier-wave power of 12 kW.

The radio-frequency section of the vision transmitter comprises five stages of amplification preceded by a drive unit which consists of a precision crystal oscillator and two stages of frequency multiplication. The output from the unit is amplified successively by a single-valve pentode stage, a push-pull tetrode stage and a push-pull earthed-grid triode stage—all in one cubicle.

It is to be the practice in all future B.B.C. television transmitting stations to give the vision transmission a symmetric sideband characteristic. For this purpose a vestigial sideboard filter is connected between the transmitter output and the feeder to the aerial.

The high-voltage power supplies for the vision transmitter are obtained from hot-cathode, mercury vapour rectifiers located in cubicles similar to those I describe as " refrigerators."

The question of load-shedding is uppermost in our minds, these days. So I asked about that.

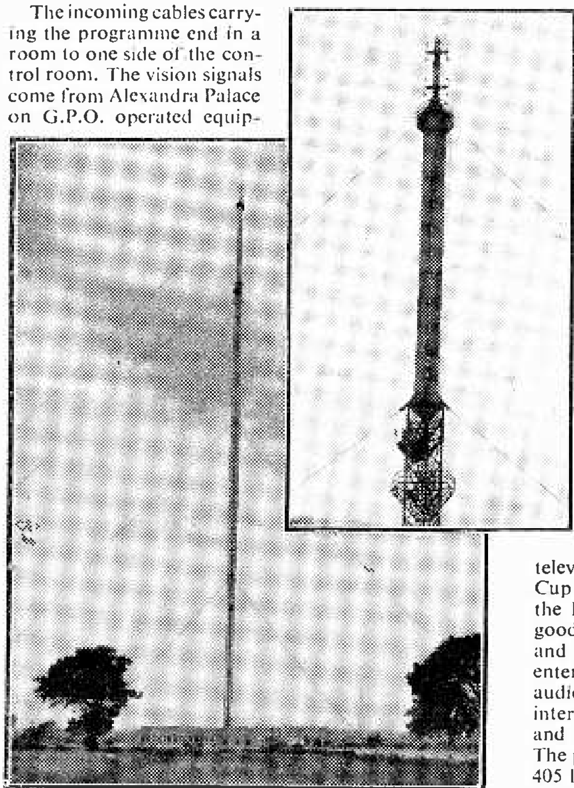
First, the phases of the 415-volt, 3rd phase, A.C. supply to the vision transmitter is stabilised and phase-balanced by moving-coil voltage regulators. Secondly, all the high-voltage supplies for which constancy of output is necessary are provided with valve stabilisers.

For the modulated radio-frequency output stage, however, where the relatively high anode current required would call for giant stabiliser valves, the smoothing circuit associated with the anode supply has been built out to have a low resistive impedance that is constant over most of the vision modulation frequency range.

Both transmitters are operated from the semi-circular desk in the control room. The central position relates to the modulator and the two wings to the sound transmitter and to the radio-frequency stages of the vision transmitter. The control for the sound transmitter is the usual, whereas the control for the vision transmitter is unusual in that the various supplies are applied to the transmitter and their voltage raised to the final value, automatically and in the right sequence, with predetermined pauses between each step in the sequence.

Near the control desk there is a high-grade picture monitor on which the picture can be shown at the input and output of the modulator and finally as radiated by the station.

The incoming cables carrying the programme end in a room to one side of the control room. The vision signals come from Alexandra Palace on G.P.O. operated equipment.



**The transmitter building at Sutton Coldfield and its 750ft. mast. The wide-band aerial at the top of the mast is shown inset.**

Until recently they were sent via Broadcasting House, over coaxial cable to the Museum Telephone Exchange, thence to Telephone House, Birmingham, over reversible radio link, and from there to Sutton Coldfield via Broadcasting House, Birmingham, by coaxial cable again. The coaxial cable from London to Birmingham is now operating.

A room on the other side of the control room contains a standby film scanner by means of which films can be televised.

Sutton Coldfield gets its power from the British Electricity Authority at 11 kV., 3 phase 50 cycles, over duplicated feeders which end on switch-gear in a separate substation nearby. Here are also two 500 kVA. outdoor transformers, one acting as standby, which provide supply at 415 volts to the low-voltage switch-room in the main building for distribution to the transmitters and auxiliary services. The switch-room also contains metal rectifiers for charging a 240-volt battery that supplies the emergency lighting system.

A single array radiates sound and vision signals. It consists of eight vertical folded dipoles arranged in two identical groups placed one above the other, and separated by a distance approximately equal to one wave length.

Each of the four dipoles in the two groups is mounted opposite one face of the topmast, the separation between the dipoles on opposite faces being approximately two-fifths of the wavelength. The dipoles are of galvanised steel strip, 10in. wide and have a device to prevent ice formation.

And, lest I mislead you at the beginning, the steel ball on which the 750ft. and 140 tons of Big Bear rests is only 2in. in diameter!

# Big Screen TV

BRITISH large-screen television is gaining world-wide prominence partly as a result of the highly successful demonstrations which have been given in Italy, South Africa and Great Britain.

An early method of projecting the television picture on to the large screen involved photographing it on to cinematograph film, after which the film was quickly processed and passed through a cinema-projector in the normal way. A more direct and satisfactory method has been made possible by the development of special television cathode-ray tubes which give a small but intensely bright image which can be projected straight on to the screen by means of an optical system. In Britain, for instance, one of these tubes was used for projecting the B.B.C. television transmission of the 1950 Association Football Cup Final on to a screen measuring 20ft. by 15ft. With the British 405-line definition, in spite of a dull day, a good bright picture was obtained with excellent details and tone gradation. The "live" character of this entertainment may be judged from the fact that the audience, which included foreign delegates attending an international television conference in London, applauded and shouted to the players as if actually at the match. The projecting equipment is not limited to working on 405 lines, but can be adapted to any of the television standards at present in use in any part of the world.

There are various ways of bringing television into the cinemas. Use could be made at first of transmissions from existing television broadcasting systems; other programmes might be taken from the studios of film companies. These would be relayed by radio links to a main transmitting station and studio centre and from there relayed to selected cinemas by beam transmission. There is no technical reason why eventually countries should not have nation-wide services of television to all their cinemas with a variety of programmes. Every country will have its own ideas about the lines along which cinema television should develop; Britain can offer the technical equipment and "know-how" now, and visitors to the Festival of Britain can see British cinema television in operation.

Also developed in Great Britain is the use on a closed circuit of large-screen television for such purposes as overflow meetings at political conferences, Mr. Churchill being among those who have been televised in this way.

# D.C. Oscilloscope Amplifier

## Zero Phase Shift is Claimed for This Test Unit

By J. S. KENDALL

THIS unit, which incorporates a unique shift feature, will amplify with absolute zero phase shift from zero frequency up to very high audio—it is, in fact, about 1 db down at 20,000 c.p.s. I have used this circuit for frequency checking by direct comparison methods with 1 volt input up to 600,000 c.p.s., but this has to be regarded as the absolute top frequency limit.

The circuit is very simple and uses three ex-W.D. valves. They are two 6SL7GT double triodes and one EF50. The EF50 is used in a voltage dividing circuit to give approximately half the H.T. line voltage from the cathode circuit. In this circuit the fraction of the H.T. line voltage is determined by the ratio of the resistors between H.T. and grid, and grid and earth. The cathode is usually 1 to 5 volts above the grid voltage depending on the load current. A sufficiently large cathode current must be drawn in order that the valve may be kept away from the bottom bend of its curve. In this circuit this is done by means of the two 47 KΩ resistors in series with the 5 KΩ potentiometer.

### The Circuit

The first stage consists of one half of a double triode with the other half used as the anode load. This gives a stage gain of 35 with a 6SL7GT. The bias resistors are not by-passed, as at very low frequencies the impedance of condensers is very high, too high to be of any use. in fact.

The anode of V1 is taken direct to the grid of one section of V2; the grid of the other section is taken to the variable part of the potentiometer. The resistance Rk has to be about 100 KΩ, the actual value being found by trial and error, as the values differ slightly from valve to valve. The circuit of the second valve is a phase-splitter circuit in which the A.C. voltage developed across Rk is fed into the second half of the valve. The A.C. from the second half of the valve very nearly cancels out the feedback from the first half.

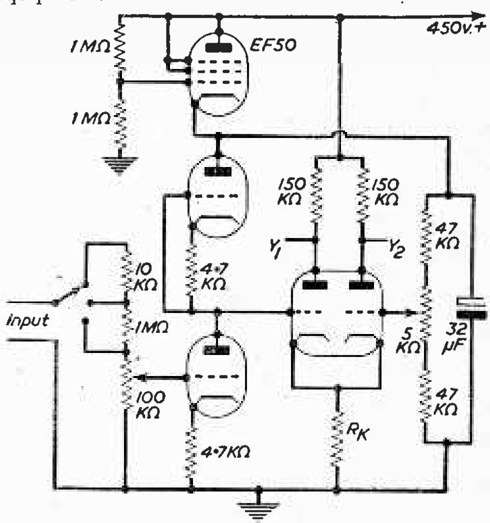
The two points marked Y1 and Y2 are taken direct to the Y plates of the cathode-ray tube, the resulting effect being that the extra 400 volts on the Y plates causes an amount of defocusing. This effect can be overcome by "earthing" the anode of the cathode-ray tube to the H.T. positive line, the now slight negative on the plates causing a much better focus and also more brilliance, which is a good thing.

The 5 KΩ variable resistor acts as a Y shift, the actual shift being effected by the variation of voltage developed across the 150 KΩ resistors. The centre of the screen at all times represents a correct bias on the valve, providing that the value of Rk is correct. When the variable grid is taken positive, the voltage of the cathodes follows it, thereby cutting off the first half of the valve. The incoming positive peaks overcome this cut off, and this phenomena allows either the positive or negative peaks to be magnified to the limit of amplification whilst they are being examined. This is the only circuit that is capable of doing this.

### Adjustments

The best method of adjusting the resistor Rk is to put a sine wave of, say, 50 cycles on to the X amplifier and on to the Y, with the input control turned well down. Any distortion due to incorrect bias will cause a bending of the horizontal of the diagonal trace on the tube. An adjustment of the shift in the "good" direction, and an increase in gain, will show that in effect the trace is misplaced by incorrect bias. First, try an increase in resistance and note in which direction the bend on the trace is moved. By trial and error it is possible to get an undistorted trace to fill the screen of a CV966 with 3,500 volts on the anode. This represents an output of about 150 volts peak-to-peak, at a voltage gain of about 3,000. To compensate for the very high gain, a voltage divider is put before the gain control, and this consists of a switch and two resistors and these are of such a value that either all, 1/11 or 1/111 of the input is fed to the gain control.

The unit was originally designed for use in a school laboratory, and is a very useful piece of apparatus for any laboratory especially when it comes to checking the shape of the frame pulses and deflection on TV receivers. The normal type of amplifier causes a large amount of phase shift at low frequencies due to the high impedance of the coupling condensers. As the gain is so high and if the amplifier is isolated by a 10μF condenser, the actual causes of instability on amplifiers and receivers can be traced and so eliminated. The unit can be made out of surplus valves and components for about £1, and is a well-worth-while piece of equipment.




*Circuit of the amplifier.*

# Television in Industry

## Some Details of the Part Television is Playing in the Commercial Field

By T. W. DRESSER

IN thinking of television the majority of people are inclined to consider it only as another form of entertainment. But in actual fact it has many other uses, particularly in industry, surgical work and science, and many leading authorities in these fields have reported with enthusiasm on the valuable assistance it has given them. Quite apart from supervising industrial processes which may be dangerous to life, it has already proved its worth in a number of directions, all utterly remote from entertainment, and therein lies great scope both for the amateur and the technician. A new profession, that of industrial television technician, will undoubtedly arise in the course of the next few years, carrying with it status similar to that of a radiologist in a hospital, and performing similar functions in analysing and interpreting the " pictures " seen on the picture screen.

### Closed Circuit

Industrial television differs from its big brother in the entertainment field in one very important respect ; that is, it always uses a " closed circuit " ; but in all aspects it employs normal methods and circuits. One interesting application is the teaching and study of surgical methods. Obviously the old way, whereby students and visiting doctors crowded the theatre during an actual operation, was limited in its scope and dangerous in that the surgeon performing the operation could have his attention distracted from his work, even if only momentarily. Modern television methods eliminate that danger and also give a clearer picture of the whole operation to a much larger number of onlookers. As a direct result the skill and accuracy of the younger generation of surgeons will show a consistently higher level as the years pass than could ever be attained by the older method. These up-to-date methods are already in use in at least one large French hospital and one or more American hospitals.

In industry, considerable use can be made of television in conducting tests on aeroplane engines, jet engines, motors and high speed machinery generally. Normally such an engine is installed in a pit or erected on a test bed and the engineers watch it from a distance.

If a fault develops in the machine under test in such circumstances it may happen that the engineer's ability to move fast is more important than his technical skill ! By employing television such hazards are cut out and at the same time the camera or a number of cameras can be concentrated on vital parts or indication meters and a much truer picture of the test obtained than by any other method.

Still another use for television can be found in industry in circumstances where excessive heat or fumes, corrosive liquids or molten metal play a part. When pouring molten metal in a foundry established practice was to observe the operation from a platform perched high above the scene, but even so this was no guarantee that the moulding would be successful. The glare from the white-hot metal and the danger from flying particles detracted from the operative's concentration and his distance from the job equally obviously qualified his judgment. With a television camera working at much closer range the technician or engineer can work calmly and more efficiently, thus doing a much better job.

Comparatively recently television was utilised in a British bank to check the signature on a cheque for a large amount and an extension of such a service is not at all unlikely in the future. Similarly in the colliery disaster which occurred some months ago and in which the primary cause was the ripping of a rubber belt, a television camera focused on some point of the belt would most probably have given due warning and either have averted the disaster or materially reduced its effect. Science, too, has made considerable use of television, one instance being to enlarge and sharpen the objects on a microscope slide.

There are many other ways in which television can serve humanity. With colour it can be an admirable advertising medium, particularly for women's wear, and has been used for this purpose by one of the leading stores in the United States of America. It is also an excellent watchman or guard over valuable property, particularly so as it does not tire or lose its efficiency over a long watch.

There are, in fact, limitless numbers of applications in industry and commerce where television can be used with advantage over older methods. In many of them black and white projection is all that is required, while with others colour is essential. In addition there is the point that, due to its portability, the camera can be utilised for a number of operations in the same factory instead of being limited to one.

For the amateur there is immense scope in devising new ways of using the medium (and the construction of a homebuilt receiver is not so much more difficult than homebuilt radio), while for the technician or dealer a huge new field opens in maintaining and servicing factory, shop and hospital television gear and in loaning out such equipment to smaller firms who require it only for limited periods at a time. This field will grow, for television both as entertainment and as a necessity in industry will undoubtedly make past radio booms seem puny by comparison.

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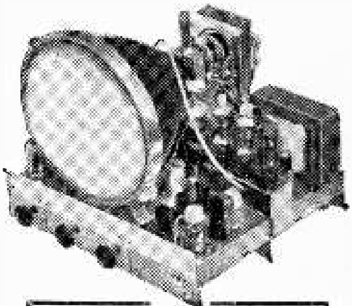

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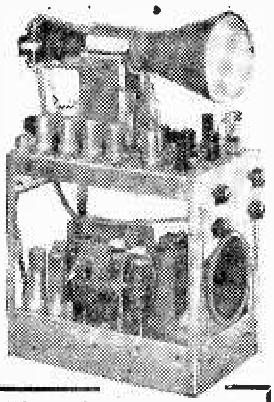

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# The Sync Separator–2

## The Separation of Frame and Line Pulses is the Subject of This Article

By W. J. DELANEY (G2FMY)

IT has been shown in the last issue how the sync pulses are separated from the picture modulation, and that there is a function probably even more critical left, namely, the isolation of the two forms of sync pulse. Without going into intricate detail as to pulse shape and duration let us content ourselves with the consideration of the fact that the individual pulses must be separated and fed to their appropriate timebase—after the sync separator, or limiter, has successfully separated them from the picture modulation. As the

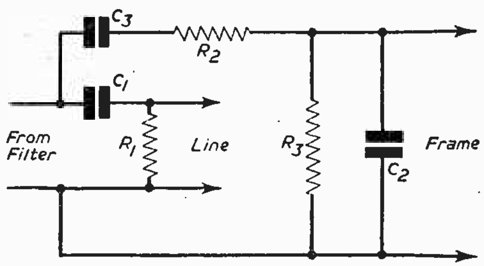



**Fig. 1.—This is the basic integrator and differentiator circuit arrangements for use in frame and pulse separation. Although such an arrangement could be used following a limiter its efficiency would be low due to a variety of reasons. Compare this with the elaborate arrangement used in Figs. 4 or 6.**

two sets of pulses are of widely different timing it is obviously possible to arrange simple circuits so that, due to their particular time constant, they only accept or pass impulses of a suitable frequency, and in its very simplest form such a circuit would take the form shown in Fig. 1. These two circuits are known as "integrating" and "differentiating" circuits, the names being self-explanatory. It should be obvious that such a simple arrangement must have some drawbacks, and in practice these are not serious provided that the circuits can be accurately set up. The actual pulses may pass to their respective timebase oscillators, but due to various defects stray pulses may also appear in one or the other, and the result would be a lock which is "soft" or insecure. That is to say, suppose one could accurately set up the frame pulse with a simple arrangement such as that shown, fluctuations in the main supply, occurring at 50 c.p.s., which is the frame frequency, may get through and trip the oscillator at the wrong moments. Similarly, peaks of interference, such as are caused by car ignition systems, could pass the limiter and affect the line pulse. Therefore such a simple scheme is not of great value where a rock-steady, perfectly interlaced picture is required.

### Commercial Interpretation

By way, however, of showing how such a simple network can be arranged to carry out its function in a satisfactory manner, Fig. 2 shows an arrangement used in certain Ferguson receivers where the integrating and differentiating circuits may be picked out quite clearly. This arrangement works quite satisfactorily and there does not appear to be any need for critical tolerances with the values given. With a very weak signal, however, some line tearing has been experienced on an experimental circuit using these constants.

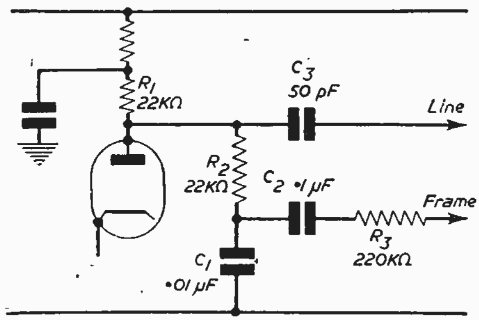



**Fig. 2.—A practical interpretation of the Fig. 1 arrangement. This is the arrangement used in certain Ferguson receivers.**

Using a diode most modern designers to-day favour some arrangement in which the frame pulses, upon which after all a successful interlace depends, are rectified or shaped. In some circuits the arrangements for doing these are referred to as the interlacing stage, and some very elaborate circuits have been produced for the purpose. As already mentioned, the line pulses, due to their very high frequency, are much easier to deal with, and in practically every case they are simply taken off the anode of the limiter through an R.C. coupling—in some cases merely through a small condenser, and an examina-

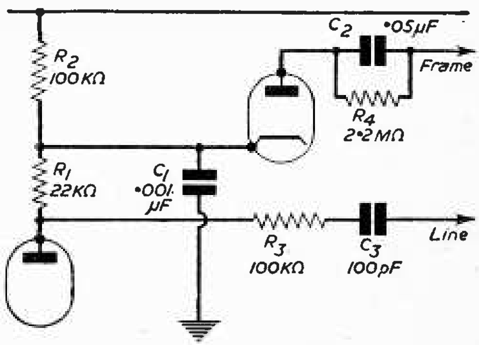



**Fig. 3.—A simple form of frame pulse selector using a diode. This arrangement is used in the "Practical Television" receiver.**

tion of the circuits accompanying this article will show the general arrangements employed.

**Rectifiers**

In the frame circuits the customary procedure is to use a diode, although in modern A.C./D.C. receivers it is becoming the practice to use metal rectifiers in order to simplify the heater supply chain. The simplest interlace circuit is that due to Haynes and shown in Fig. 3.

Here it will be seen that a normal diode is fed with the frame pulses on its cathode, the anode being connected to the frame oscillator and also the H.T.

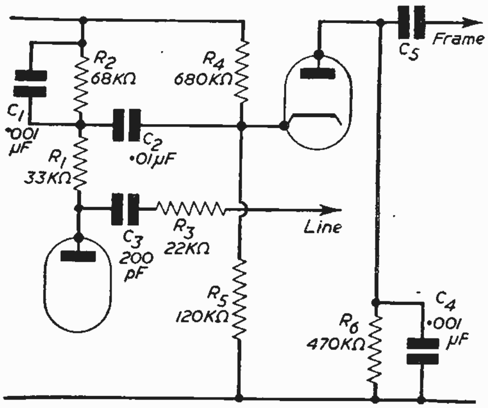



**Fig. 4.—A more elaborate circuit, but still retaining the diode. This is the G.E.C. interlace filter arrangement.**

line through an R.C. coupling. It is quite clear that the diode will conduct when the anode is positive to the cathode, but will cease to do so when the cathode is driven positive. R1, R2 and C1 all play their part in delivering an appropriate pulse to the cathode and shaping takes place through the .05 μF condenser and the 2.2 MΩ resistor.

Readers will recognise this arrangement as being that used in the PRACTICAL TELEVISION receiver, and it works admirably, without undue attention to tolerances.

A much more elaborate development of this circuit is seen in Fig. 4 and is used in the G.E.C. receivers.

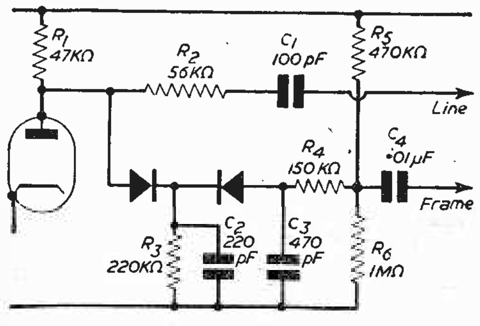



**Fig. 5.—New Pye arrangement in which two rectifiers are used in place of the double diode seen in former circuits.**

It will be seen that the anode circuit of the limiter is practically identical, the .001 μF condenser (C1) being taken to the H.T. line to assist in picking out the frame pulse. It is then fed to the diode cathode through a rather large condenser, and the cathode is provided with a fixed potential through the medium of R4 and R5. This potential is offset by the pulses and the remainder of the diode functions practically as in Fig. 3, although the resistor R6 and condenser C4 are added and appear somewhat critical as to tolerance. Practically any standard type of diode may be used in these two circuits, from an EA50 to a 6H6; and except where mentioned standard tolerance components may be used.

**Metal Rectifiers**

As an example of the use of metal rectifiers, Fig. 5 shows the arrangement used in the new Pye receivers, and it will be quite obvious that the diodes are fulfilling a somewhat similar function to those already described, with the R.C. networks added to keep the frame pulses clean and shapely. In passing it may be mentioned that some designers recommend the use of the *back* of a frame pulse to obviate certain difficulties, but all of the circuits given here have been tried out and found highly satisfactory and simple to set up.

**Three Stages**

As an example of the trouble to which some designers go to ensure a perfect interlace we give in Fig. 6 an arrangement recommended by Mullard in which synchronisation is effected in four stages. In the first stage the video signal is eliminated as was described last month. In the next stage the line pulses are fed correctly to the line timebase. Next, amplitude differentiation of the frame pulses takes place and finally the frame pulses are "sliced" and a single pulse (corresponding to the normal chain of eight frame pulses) is passed on to the frame oscillator. It will be noted that in the anode circuit of the limiter an iron-cored choke is recommended in place of the usual resistor of from 20 to 50 kΩ. This choke is rated at 1 Henry and it is claimed that this produces a very sharp leading edge on the line pulses which may then

*(Concluded on page 92)*

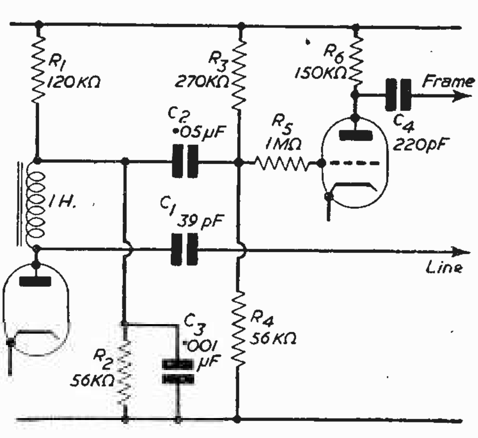



**Fig. 6.—This arrangement, recommended by Mullard, uses a triode, and an iron-cored choke in place of the resistor for the anode load on line.**

# *A Combined Television-broadcast Receiver*

## A 21-valve Circuit with Single Power Pack

By S. A. KNIGHT

THE average television receiver designed for a reasonable range of, say, 50 miles, and not built solely for "local" reception, seldom boasts less than some 20 valves. If, therefore, this number is taken as the acceptable minimum, there is no reason why the maximum use should not be made of the valves, and something additional to the television section included in the design.

In the receiver to be described an attempt has been made to include a normal broadcast receiver in addition to the actual television section, without increasing the number of valves above the stated limit and without sacrificing either efficiency or reliability. If a metal rectifier is used for the E.H.T. supply, this task has been accomplished ; if a valve rectifier is used, the total rises to 21, including the two normal H.T. rectifiers. This circuit is, therefore, quite economical in valves, and although, as designed, only medium and long wavebands are catered for in the broadcast receiver, it is a simple matter for those interested to include the two additional coils needed to cover the normal short waveband of some 12 to 50 metres.

This economy in valves is brought about by the use of a common I.F. amplifier and audio stages and, of course, a common power supply unit. Since two TV-sound I.F. stages are not unusual in a "long range" type of receiver, one of these can reasonably be common to two circuits. The only additional valve then required to make the TV receiver into a TV plus broadcast receiver is the broadcast mixer.

The problem of switching the I.F. stage from the TV frequency of 10 Mc/s to the broadcast frequency of 465 kc/s can present some difficulty if switching is considered unavoidable, but in the present design the difficulty is readily overcome by making use of the fact that an I.F. transformer of 10 Mc/s in series with an I.F. transformer of 465 kc/s is not going to make any difference to the latter's operation as such, and similarly, at 10 Mc/s, the 465 kc/s transformer will have little effect on the high-frequency circuit. Both transformers are left permanently in circuit, therefore, and the "switching" is done as a matter of course when the requisite signal appears on the scene. Some switching was necessary at the detector, however, but, in the writer's opinion, this is much less "dangerous" than a process of chopping and changing at I.F. anodes.

The intermediate frequencies of this receiver are 10 Mc/s for TV sound and 465 kc/s for broadcast sound as already stated, with a vision amplifier operating at 13.5 Mc/s and utilising the lower sideband. The vision oscillator works at 48.25 Mc/s for Sutton Coldfield or 31.5 Mc/s for London, the receiver being suitable for either transmission. The necessary coil changes are given in the appropriate list.

The complete circuit of the receiver proper is shown

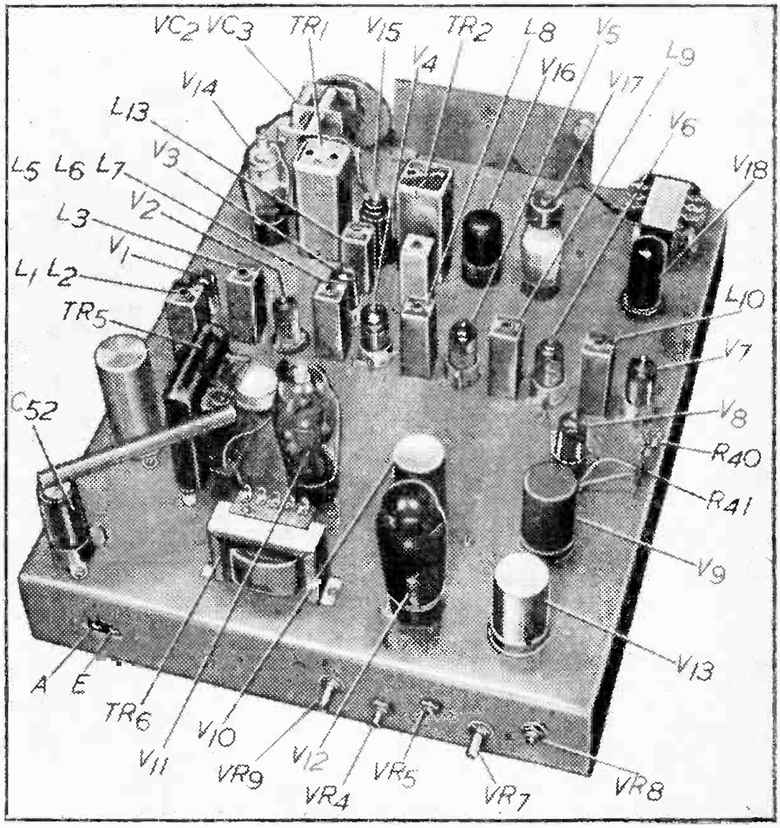



Fig. 2.—Chassis layout with essential component references.

in Fig. 1 with its practical upper-chassis equivalent in the photograph of Fig. 2. It should perhaps be pointed out at this stage that two models of this receiver have been made and the photograph shows the earlier model; one or two valve types have been changed in the second model to secure a somewhat better performance overall, and these types are those actually listed on the theoretical circuit. The layout is unchanged. The whole receiver is built on a single aluminium chassis measuring 19in. by 16in. by 3in. (power unit separate), and no under-chassis screening whatever is employed, thanks, mainly, to the use of small all-glass type valves and coils canned above chassis. Wiring below deck is consequently greatly simplified and the chassis is extremely roomy for purposes of setting up, checking and alignment.

### Circuit Detail

The aerial couples to the first tuned circuit L2 through a 1½ turn coil L1 which terminates the 80Ω coaxial input, damping being provided in the Birmingham circuit by the cable itself. The R.F. amplifier V1 is a Mullard EF42 used in a conventional circuit with its gain made variable by the cathode control VR1. This control was separated from the normal Contrast control which operates at the first vision I.F. stage because it was felt that R.F. gain should be treated as a pre-set quantity, being adjusted on site as it were, and afterwards left well alone. For reception up to some 25 miles this control is necessary to prevent mixer overloading from introducing cross modulation of vision-sound signals, but for greater ranges it may reasonably be omitted from the circuit, R5 then going directly to chassis.

The amplified signal appears across L3 in the grid circuit of the double-triode mixer V2 which is a pair of high slope, medium impedance triodes, Mullard ECC91. L3 is damped by R6. The double-triode was chosen after a number of experiments with single valve mixers as that circuit giving the best performance on the score of low noise level, gain and stability. A two valve mixer was ruled out on the score of keeping the valve number at a minimum, and although the double-triode might appear as cheating in this respect, the fact remains that only one glass envelope is used and its performance against the various forms of single pentode mixers tried out makes its use a very satisfactory compromise. Mixing is accomplished in the left-hand portion of the valve which has a standing bias developed across R11 in the cathode circuit, the coupling from the oscillator taking place through a 2 pF. capacitor C7. This small coupling is adequate and necessary; a value much in excess of this leads to some "pulling" as the oscillator is tuned. The oscillator itself is a conventional Colpitts with coarse tuning accomplished by an iron-dust slug threading L4. A 10 pF. fixed condenser loads the circuit which is finely tuned by a 10+10 pF. split stator, or small twin-gang.

Vision and sound I.F. outputs are developed across L6 which is both untuned and undamped, being wound to be flatly resonant with the estimated stray capacities

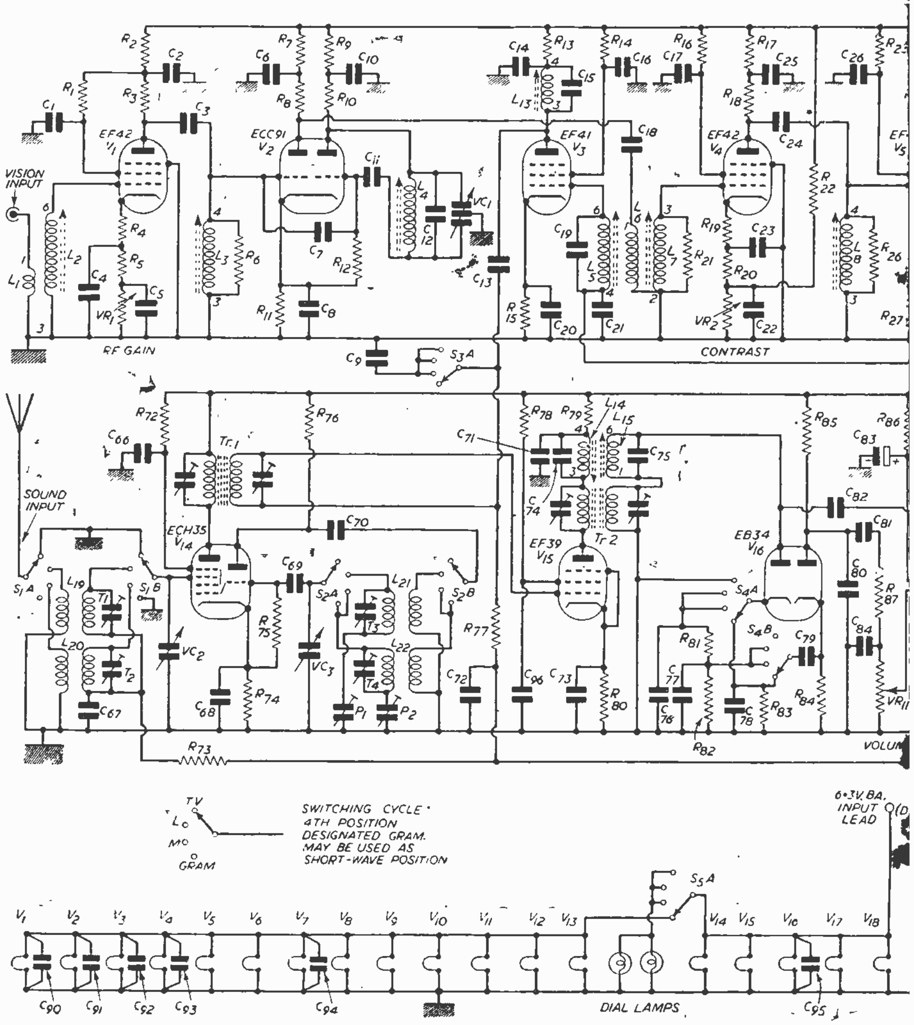


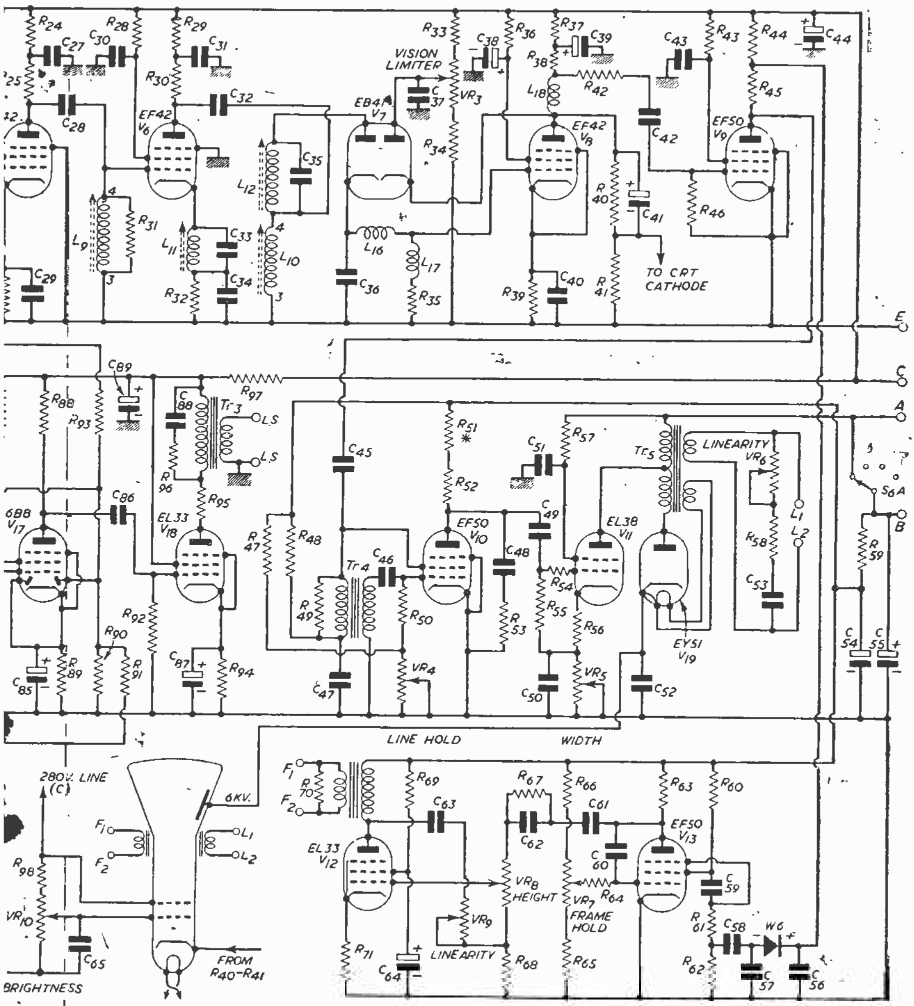

Fig. 1.—Theoretical circuit of the combined receiver,

at 12.5 Mc/s. L7 is closely coupled to L6 and forms the first tuned vision circuit resonant at 10.8 Mc/s. This coil is lightly damped by R21 and feeds directly into the grid of V4.

The sound I.F. at 10 Mc/s is taken from L6 by the coil L5 which is coupled fairly tightly to the former coil. In addition to being a sharply tuned sound acceptor, this coil also acts as the first sound rejector circuit for the vision amplifier, damping L6 heavily at sound frequency, and providing about 10 dB sound attenuation to the input of V4. L5 is loaded by C19. The sound signal is then amplified by a variable-$\mu$ R.F. pentode, Mullard EF41, the output being developed across L13 C15 in the anode circuit. This again is a sharply tuned circuit resonant at 10 Mc/s. An EF41 was chosen for the first TV-sound I.F. amplifier as it is of similar all-glass construction to the EF 42s used throughout the vision receiver proper and so "matches" well with this part of the complete circuit. Again, being variable-$\mu$, A.V.C. can be applied to the stage and so compensate for the omission of some form of gain control at this point which would almost certainly be necessary if a sharp cut-off valve was employed. The A.V.C. is applied conventionally through R93 C21, the anode decoupling being accomplished by R13 C14.

The remainder of the sound circuit calls for little comment. V15, the common I.F. amplifier, receives either the output of V3 which is developed across R77 in the "cold" secondary lead of the 465 Kc/s transformer TR1, the broadcast mixer then being inoperative, and switch S3A being open-circuited as drawn ; or it receives the normal broadcast mixer output from TR1, V3 then being switched off and S3A taking the junction of R77 and the cold secondary lead of TR1 to chassis through C9, i.e. a normal A.V.C. decoupling circuit. The broadcast mixer itself needs no comment. The appropriate signal appears in the anode of V15 and is developed across the appropriately tuned circuit, then being passed on to the double-diode detector and noise limiter stage, V16. The detector (left-hand portion of the valve) has the signal load switched by S4A and S4B to suit either the 10 Mc/s or the 465 kc/s input. A compromise value could probalby have been found for the load, but it was found that noise suppression was most effective on television when a small value of load was used ; since the broadcast output was then unnecessarily restricted a separate load of higher value was introduced, together with the usual I.F. filter. As the circuit diagram is drawn, the 10 Mc/s load is switched in circuit, and consists of R83 C78. On broadcast, the load consists of R82 C77 with the filter consisting of R81 C76. The output of the detector passes, in both cases, to the noise limiter cathode.

The noise limiter operates as a series gate, the audio output at the anode normally following the audio changes occurring at the cathode. In the presence of positive-going interference pulses at the cathode, the charge on C80 holds the anode potential steady for the period of the interfering pulse and the diode ceases to conduct. The audio stages are therefore isolated for the period




luding power pack. This will be given in the next issue.

of the noise pulse. The limiter section is left in circuit on normal broadcast reception since it does a little to cut down sharp interference even there, and in any case, switching it out of circuit is in no way justified.

V17 is the first audio amplifier, and one of its diodes is used for A.V.C. purposes. The output passes to a normal output stage, a fixed tone corrector being included across the output transformer primary winding. The power output is roughly 3 watts.

Turning back to the vision circuits, V4, V5 and V6 are pentode amplifiers with stagger-tuned, resistance-loaded grid circuits, and are, apart from tuning frequencies, identical in design. When correctly tuned, the bandwidth is 3 M/cs for 6 dB down, and is suitable for either London or Birmingham reception without alteration. It should be noticed that the screens of these valves are separately fed and decoupled by 22 kΩ resistors and 0.01 μF capacities. The gain of V4 is controllable by VR2 which is designated Contrast and forms a front panel control.

Two further sound rejectors centre around the last I.F. amplifier V6. L11 C33 form a parallel-tuned trap, the value of C being rather large ; L12 C35 is a parallel-tuned trap connected in series with the ingoing detector lead. At sound I.F. frequency L11 C33 produces heavy negative feedback in V6 by increasing the effective cathode impedance to a high value ; L12 C35 offers a high-impedance input to the detector at sound frequency which is consequently shunted to earth. Between them the two traps provide some 25-30 dB attenuation, L12 being the most effective.

The detector is one-half of an EB41 low-capacity double-diode and delivers a positive video signal (negative sync) across L17 R35 in the cathode circuit. L16 is a conventional I.F. filter and L17 provides some correction to the overall characteristic at the higher video frequencies.

V8, the video-amplifier, is biased back by R39 to receive the positive going signal input. L18 in the anode circuit provides high-frequency correction, the anode load being effectively formed of two sections, R37 and R38, with the former section shunted by C39 at the higher video frequencies. The effect is, therefore, to provide low-frequency compensation from the point at which the reactance of C39 becomes comparable with R37, that is, at frequencies approaching zero. R37 and C39 also provide normal decoupling of the video anode circuit and further, compensate for the phase shift across C42 R46 feeding the sync separator V9.

The video signal at this stage being negative, the cathode of the CRT must be modulated. This electrode is fed through a potential divider and corrector network C41 R40 R41 and the D.C. potential present at the cathode is compensated for by the Brightness control which biases the grid of the tube to a D.C. level rather less than that present at the cathode. With the values of resistance chosen for R98 and VR10, the grid of the tube cannot become positive with respect to the cathode even with maximum setting of VR10, a necessary precaution in the interests of tube life !

The second half of V7 is used as a picture interference limiter and is quite normal in type, the diode being so biased by VR3 that it becomes conductive in the presence of a negative signal at the video anode greatly in excess of normal peak white picture modulation. The values chosen for R33, VR3 and R34, which form the biasing system for this diode enable a non-critical setting to be obtained by means of VR3, and the objectionable white blobs characteristic of ignition interference are reduced to pin-point proportions without deterioration of picture definition.

The sync separator V9 is a conventional pentode amplitude discriminator operating with a low screen potential to limit the grid base and zero standing bias. R42 forms an input integrator with the normal coupling components C42 and R46 and does much to preserve the picture from line tearing under conditions of weak signal and severe interference. When the video-signal is applied to the grid of the separator, the positive synchronising pulses bias the valve back as a result of grid current, the exact extent of the swing towards cut-off being dependent upon the average value of the total applied signal. With a short grid base the valve operates close to cut-off at all times, only the positive sync signals causing anode current to flow. Negative-going sync pulses are consequently developed across R44 R45 in the anode circuit of V9. The line pulses are taken directly from the anode through C45 to the line oscillator transformer TR4, but the frame pulses are taken from a point higher up the anode load, being developed by an integrating circuit consisting of C56, C57 and a Westector type W.6. This integrator effectively removes all trace of line synchronisation and produces a somewhat better interlace than the more usual RC type of circuit not employing a rectifier element.

## Time Bases

The time bases each employ two valves, oscillator and amplifier, the oscillators being hard valve types. E.H.T. is obtained from the line fly-back effect.

The frame time base consists of a Miller-transitron oscillator V13 and pentode amplifier V12. The action of the oscillator has been described in detail previously ; suffice to remark that the saw-tooth output is very linear, though negative-going in sign. This latter fact is of little importance in the present circuit since the amplifier valve and the scanning components are indifferent to the sign of the current during the charge and discharge cycles of the sawtooth. An output transformer is used to match the output to the low-impedance scanning coils employed, but the inductance of this is insufficient to ensure frame linearity without the use of heavy negative feed-back over the output stage. This is accomplished by voltage feedback through C63 and VR9, the feedback voltage being developed across R68 in the grid circuit. VR9 controls feedback and hence linearity ; its effect is to modify the line spacing in the upper two-thirds of the picture.

The amplitude of the input to V12 is controlled by VR8, which accordingly constitutes the height control ; the frequency of the frame oscillator in the free-running condition is determined by the setting of VR7 which thus forms the Frame Hold control. In the presence of synchronising signals the time base locks in very firmly and the setting of VR7 is non-critical even with weak signal. There is one aspect of this circuit that might strike some people as a " fault," and that is the tendency of the Hold control to affect picture height as it is moved between those settings at which frame locking is effective. The effect of stretching the height is small, however, and a quickly obtained choice of Hold and Height control settings enables a perfectly interlaced and steady picture to be obtained.

The screen of the amplifier is separately decoupled by R69 and C64 to avoid slight bottom folding which cannot be corrected otherwise by the linearity control. The cathode resistance is unbypassed.

The line time base consists of a blocking oscillator V10, followed by an amplifier stage V11. A Miller-transitron was at first considered for the design of the oscillator, but the negative-going output is not suitable for direct feed to the output stage when fly-back E.H.T. is required. To avoid the use of a further stage for reversal purposes, a blocking oscillator was decided upon which would then produce the required positive-going sawtooth from a negative synchronising trigger.

The actual oscillatory circuit utilises the cathode, grid and screen of V10, with the frequency being controlled by the setting of VR4, in the grid circuit. The sawtooth output is developed across C48, by the charging current through R51 R52 which flows into C48 when V10 is

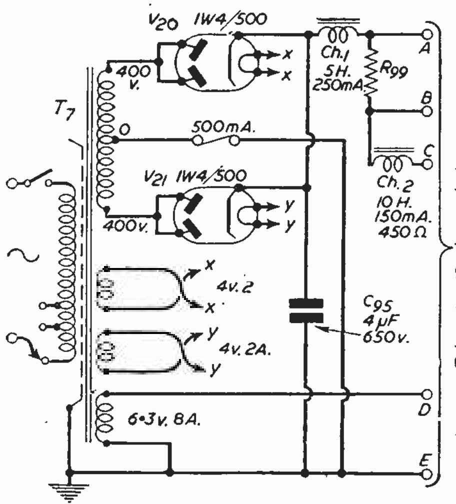



Fig. 3.—Theoretical circuit of the mains unit.

quiescent. A feed-back transformer was wound for the first model on a small closed Stalloy core, but it was then found that a suitable component was available cheaply on the constructor's market and so this was adopted for the second model as now being described. This particular transformer utilises an iron bolt as " core " and requires heavy resistance damping to ensure that the valve blocks after the positive half-cycle of oscillation and does not simply behave as a Class C sine wave oscillator ! With R49 as damping and the unknown qualities of the iron bolt through the middle of the windings, the oscillator functions excellently and is in no way critical in settings of Line Hold. Indeed, the line synchronism will hold even with the picture turned to the point of fade-out.

The line output valve V11 feeds into the auto-wound line transformer TR5, the high fly-back potential being rectified by V19 which is suspended directly in the wiring across the transformer terminals. Its heater current is supplied from a small extra winding on the transformer. The E.H.T. obtained is roughly 6 kV., the reservoir condenser being C52. A metal rectifier, Westinghouse 36 E.H.T. 100 may be used in place of V19 if desired, and such a rectifier is, in fact, shown in the photograph. The heater winding on TR5 is then ignored, the rectifier negative taking the position of the rectifier anode as drawn.

The gain of the stage and hence the picture width is controlled by VR5, which develops a feedback voltage ; the setting of this control modifies the E.H.T. slightly, but not to an extent that is noticeable on picture focus. The condenser C50 across VR5 acts to increase the grid-cathode potential during line fly-back by removing the bulk of the negative feedback and assists in a rapid and complete cut-off of V11 during this period.

The line coils are damped by a conventional R.C. arrangement consisting of VR6, R58 and C53, VR6 being the line Linearity control. This control, too, slightly affects the actual E.H.T. potential, but again to no serious effect. VR6 and R58 must be of 5 watts rating, and C53 should preferably be of the mica variety.

### Power Unit

The power unit is shown in Fig. 3 and consists of a mains transformer TR7, two 120 mA. 500 volt rectifiers, V20 and V21, two chokes and reservoir condenser C95. Resistance R99 is a high wattage component to " lose " the additional voltage when the main receiver is switched from TV to broadcast radio.

The actual system of switching is made clear by a study of Fig. 4 which shows the power unit in its actual relations to the receiver. Here switch S6A and condensers C54, C55 and C44 are shown isolated from the main receiver chassis, together with the appropriate dropper resistances R59 and R97.

When S6A is set to TV (as drawn), R99 is shorted out, and C55 becomes the main filter condenser, the various feeds being clearly shown. The vision receiver and the broadcast section are separately fed through CH2 and filtered by C44. On switching to Broadcast, R99 is inserted in circuit (the valve heaters being switched by S5A as in Fig. 1) and C55 is again the main filter condenser on the *receiver side* of R99. This last point is important, because the voltage rise on the power side of R99 is high when the current drawn by the receiver chassis is low and so approaches the peak working state of C55 (and,

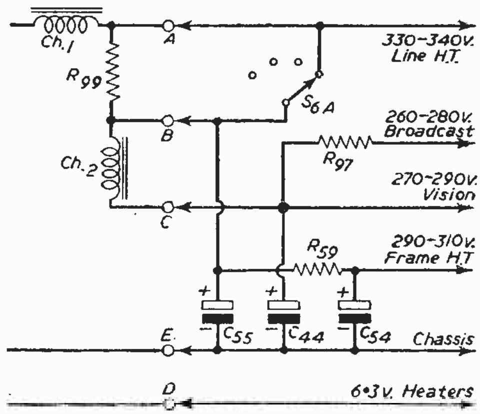



Fig. 4.—The voltage divider circuits

of course, C54). The condensers consequently work at some 300 volt potential only and are well protected.

The voltage outputs are shown in Fig. 4 and the resistance of Ch1 is chosen to give 340 volts to the main line supply. This is about right if Ch1 is of some 250Ω resistance ; the other values as given will then ensure the correct values of the other supply lines voltages. The value of R99 must be chosen so that the broadcast receiver voltage with TV off is the same as it is with TV on—some 260-270 volts ; in the present design it was 3,800Ω at 30 watts rating. Such components are cheaply available on the surplus market at present. Good ventilation is required for this resistor.

The reservoir C95 should be of paper construction and of generous voltage rating ; 650 volts should be considered the minimum permissible.

*(To be continued)*

# Television Personalities

## No. 1.—Cecil Madden

THE B.B.C. possibly hopes that the healing hand of time will cause the public to forget the shameful thing it did when it failed to promote Cecil Madden to the post of Head of Children's Programmes. The B.B.C. will be fortified in its hopes by the fact that there will be no apparent change in the quality of programmes at first because Madden will still be running them and teaching his successor her job at the same time.

The Corporation appears to have been considerably surprised at the outcry from public and Press alike when they failed to reward Madden for the magnificent work he has done. They seemed amazed to learn that they could not move him around from one job to another with as little concern as if he had been a nonentity.

A recent portrait of Mr. Madden

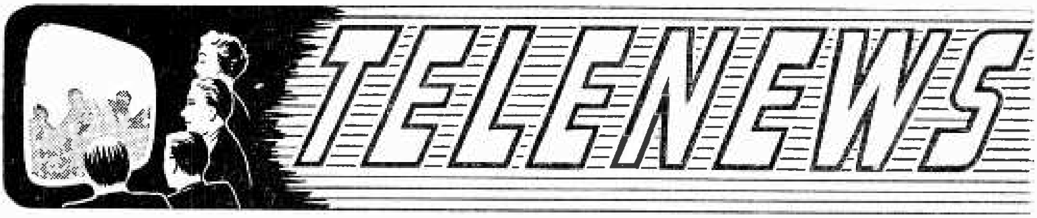
The time has, unfortunately, not yet come when there is such a wealth of television talent available that an outstanding success can be sacrificed with impunity. This is an example of the customers being better judges than the manufacturers. The customers have seen their programmes getting better and better with great rapidity and so infused with originality of thought and entertaining treatment that they are beginning to make the programmes for adult viewers appear stodgy by comparison. Yet the problems facing Madden when he took over the job a few months back were enormous and calculated to daunt a man of lesser calibre. His producers, with one exception, were without television experience and had largely to be taught by him. There were few precedents to guide you.

Madden, himself the father of two children, has nothing of the ordinary schoolmaster in him. He has never tried to educate by direct means, yet by skilful methods he has passed on learning and instruction by delightful and entertaining means so that children (and grown-ups too) have acquired greater knowledge without realising how it has come to them. As an example of this can be cited the Madden treatment of art. It would have been easy for him to engage an excellent lecturer to talk and show examples, but instead he encouraged the children themselves to paint the pictures and send them in by their thousands to be criticised and appraised by experts and the audience of children. As a result, the children have practised art, which surely is much better than listening to a lecture, no matter how brilliant.

Inquiries reveal that Madden has been a great creative force within the B.B.C. for nearly 20 years. He was largely responsible for the start of what is now the Overseas Service: during the war he worked at the Criterion Theatre and initiated many of the programmes for the Services that enjoyed enormous success (Variety Bandbox was started by him); in television he was the first man to produce a programme from Alexandra Palace.

It is incomprehensible that such a man should be superseded by a lady who is due to retire in two years. If ever there was a time when British television needed a man with creative ability it is now, when programmes have reached a general level of technical and production efficiency but with contents all too often unimaginative.

The only news about Madden's future is that he is to be given another appointment in television. The B.B.C. doubtless hopes that with this statement the matter will now rest. It will not. The future treatment of Madden will be closely watched. So, too, will be the types of programmes for children produced when the new head ultimately takes full charge. Q.




### Technical Tour by Television

A MASS of the most up-to-date television and film equipment is installed in the control-projection room of the Festival of Britain Telecinema at the South Bank Exhibition.

Part of the programme which visitors see on the cinema screen is a television tour of the control room. A mobile Marconi television camera is used to send pictures on to the large cinema screen, showing the various items of film and television equipment and their functions. The whole tour is seen by the audience while seated in the Telecinema.

A plan is at present being worked out whereby the Marconi camera will be able to televise *itself* at work.

### Broadcast Receiving Licences

STATEMENT showing the approximate numbers issued during the year ended April 30th. 1951.

| *Region* | *Number* |
|---|---|
| London Postal .. .. | 2,376,000 |
| Home Counties .. .. | 1,656,000 |
| Midland .. .. .. | 1,770,000 |
| North Eastern .. .. | 1,913,000 |
| North Western .. .. | 1,608,000 |
| South Western .. .. | 1,070,000 |
| Welsh and Border Counties | 731,000 |
| Total England and Wales | 11,124,000 |
| Scotland .. .. .. | 1,122,000 |
| Northern Ireland .. | 206,000 |
| Grand Total .. .. | 12,452,000 |

The above total includes 825,600 television licences.

In previous years the sales of television licences have declined after the Christmas peak. This year, however, sales have continued at a high rate. More than a quarter of a million new television licences have been issued since the end of November.

### Engineer I/c Holme Moss

MR. C. BUCKLE, A.M.I.E.E., has been appointed Engineer-in-Charge of the television transmitting station which is now being built at Holme Moss, near Huddersfield.

Mr. Buckle has been with the B.B.C. since 1938, when he joined the staff of the London television station at Alexandra Palace. When this station closed down in 1939 he was transferred to the transmitter department, becoming successively Engineer-in-Charge of the stations at Blackburn and Middlesbrough. In 1944 Mr. Buckle was appointed to the staff of the Engineering Training Department, as an Instructor on transmitters.

Mr. Buckle's assistant at Holme Moss will be Mr. J. P. Broadbent, who is at present one of the senior engineers at the Droitwich transmitting station.



### Mock Commercial TV

A SMALL party of politicians and scientists recently viewed a mock sponsored show on twelve television screens in the House of Commons. It was an experiment to show how commercial programmes would appear to the viewer, for although the Beveridge Report rejected all kinds of sponsored shows it was thought by some that it should be given a test in this country.

### Height Counts

IT is hoped this summer to transmit programmes from the top of the Empire State Building, New York. The unique height of the building, experts say, would enable clear pictures to be received 60 miles away—almost double the normal range.

### Back-cloth Projection

THE old moving back-cloth idea employed in film studios may be taken up by B.B.C. producers if experiments now being conducted at Lime Grove studios prove successful.

The background scene, such as a crowded station, is shot and then projected on to a screen in the studio. Thus, when the players act in front of this cloth, the impression is given that the action really does take place in a crowded station.

It would widen the producer's scope considerably.

### Three-dimensional Pictures

THREE-DIMENSIONAL TV, according to Mr. Leslie Dudley, could be introduced within a few months, provided full support was given by the B.B.C and the industry.

Mr. Dudley, who has just taken out the first patents in this country, says that special polarised glasses would not be necessary and that the only addition to the normal television set for this new way of viewing would be a special lenticular screen, costing but a few pounds, which would be fixed in front of the normal screen.

### Danger !

USERS of a magnifying glass on the front of their sets are reminded that when the glass is not actually attached to the receiver there is a danger that the sun may cause it to act as a burning glass, with possible disastrous consequences. This point is illustrated by a viewer who recently discovered a cushion smouldering due to a carelessly placed magnifier and was able to prevent a major fire—just in time !

### Holme Moss Mast

FOR eleven million, prospective viewers in the North, television has taken another step nearer to reality with the completion of the 750ft. aerial mast at Holme Moss.

Transmission, however, will not

begin until some time this summer, for although work was first begun on the mast last August, in time for transmissions in June, bad weather conditions have delayed original B.B.C. plans.

Work was speeded up considerably in the last stages of erection due to fine weather and soon all that remained to be done was the fitting of the aerial.

The mast is constructed to withstand an 80-ton wind force.

**Slump in Sales**

FOLLOWING the Budget increase of 4s. in the pound on television sets, small retailers are complaining of a big falling off in sales this month. Whilst some dealers blame the lighter evenings for this slump, the fact remains that television sales in April and May of last year continued at a steady, if slightly increasing, rate.

**New Technicolor Colour Tube**

AT Technicolor's recent annual meeting of stockholders, it was announced that the Company was to test its own specially developed television colour tube some time this month.

**B.B.C. Festival Exhibition**

TELEVIEWERS who have ever wondered how they themselves would look on a television screen will be able to satisfy their curiosity by visiting one of the stands at the B.B.C.'s own Festival Exhibition which opened recently in Piccadilly.

Visitors merely stand before a camera and are able to see themselves in the picture, which is sent through a closed circuit and shown on a monitor screen close by the camera. Surprised reactions will be recorded on a microphone.

**Hollywood Buys Up Television**

HEAVY falls in the number of cinemagoers in America, due to the immense popularity of television, has resulted in the first of what may be a series of drastic actions to be taken by Hollywood.

United Paramount Theatres have bought—at an estimated cost of £10,000,000—the American Broadcasting Company, one of the four large private companies, with a view to advertising films direct to the home or installing television screens in their chain of cinemas employing the A.B.C.'s networks.

**Evening Activities**

ACCORDING to Audience Research Charts at the B.B.C.'s Festival Exhibition in Piccadilly, only 45 per cent. of all viewers actually spend a normal evening looking-in. 15 per cent. go to bed, 15 per cent. go out, 10 per cent. listen to sound radio, while another 15 per cent. neither look- nor listen-in.

**Irish Demonstration**

RECENTLY, 200 guests in the Gresham Hotel, Dublin, saw television transmitted for the first time in Ireland. Following a dinner given by Pye (Ireland), Ltd., a special programme was relayed from the grounds of the Royal Dublin Society.

**No Support for Protest**

A RESOLUTION from Lampeter (Wales) Borough Council recently to protest against the erection of the new television station at Wenvoe, Cardiff, has received no support. The protesters claimed that the station would not serve residents of Pembroke, Cardigan and other far-flung areas.

**More Football Programmes**

FOLLOWING a report submitted to the Postmaster-General by a television sports committee, football matches may be filmed from beginning to end and shown over the air the same night. This may be one step towards solving the present deadlock which exists between the B.B.C. and sports promoters concerning the televising of sporting events, causing, according to the promoters, a considerable drop in attendances.

**Miniature Tubes**

P. T. FARNSWORTH, the well-known American radio and television engineer, predicts the introduction in the near future of cigar-size television tubes, thousands of times as bright as to-day's screens, and camera tubes a hundred times as sensitive as the human eye. He predicted that the picture tubes of the future would operate without any scanning lines, and the camera tubes would see in the infra-red region and be able to work in total darkness.

**Amateurs**

JUNE 23rd will mark the first Convention of the British Amateur Television Club. It will take place from 10 a.m. to 6 p.m., and will be held at the Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, W.C.2. It will be noted that this date coincides with the R.S.G.B. National Convention.

**SIGNS OF THE TIMES—Is this a record number of TV aerials on any one building? Our photograph of a block of flats at Westcliff-on-Sea shows only 14 of a total of over 30 aerials on the roof-top. Others are similarly situated at the further corners of the building beyond reach of the camera. Can any reader beat it? We will be happy to pay a sum of one guinea to any reader who submits an interesting "Signs of the Times" photograph showing the "H" age with full details as to location, etc., if it is suitable for publication in this journal.**

# The Noise Factor

## An Explanation of an Important Feature of R.F. Amplifiers

By D. W. THOMASSON,

PUBLISHED comments on the subject of the noise generated in a television receiver appear to be divided into two classes: simple comments by those who think that the subject is simple, and thus reveal that they know very little about it, and abstruse analytical studies by those who really understand the subject, but lack the power to pass on their knowledge to others. In consequence, there is a strong temptation to ignore noise, or allow for its effects by guesswork.

This is unfortunate, since noise plays a very important part in determining the design of television receivers. The following notes attempt to set out the more important facts and figures in simple form without trying to over-simplify the matter. If the technical purists object to the routes taken, they will at least find that the end results are sufficiently accurate.

### Noise Power

There exists in all electrical circuits a random variation of current and voltage known as "noise." The power of this "noise signal" is proportional to the bandwidth over which the power is measured, and to the absolute temperature of the circuit. To be precise, the noise power is equal to 4KTB, where B is the bandwidth, T is the temperature in degrees absolute, and K is Boltzmann's constant $=1.374 \times 10^{-23}$. With a measurement bandwidth of 4 Mc/s. and a temperature of 300 deg. A, for example, the noise power is $6.6 \times 10^{-14}$ watts, or 0.066 micro-micro-watts.

In case this seems so small that it may be neglected it should be noted that it corresponds to 2.3 microvolts signal in an 80-ohm feeder, or 16.3 microvolts in a 4,000-ohm tuned circuit.

In calculating noise power it is important to use the correct bandwidth. This is not necessarily the bandwidth of the circuit under review, nor the bandwidth between—3db points of the subsequent amplifier circuits. Again, it is not sufficient to say that the maximum video frequency is 3 Mc/s., and the bandwidth cannot be greater than this.

For single sideband reception, using the full available range of transmitted video frequencies, an effective bandwidth of 4 Mc/s. is almost inevitable. On one side of the carrier the effective bandwidth is about 3.5 Mc/s., and the remaining 0.5 Mc/s. lies on the other side of the carrier. This, remember, is "folded over" and added to the signal from the main sideband in order to obtain a flat response at low frequencies.

### Noise Factor

The noise power gives the minimum possible noise level which can be obtained in the circuit. Unfortunately, there are few cases where the minimum noise level is achieved. The noise generated in valves and certain resistors must be added to the noise power as calculated in order to find the total noise.

In order to provide a "goodness factor" which expresses the performance of a receiver or preamplifier in simple form, the degree of noise contributed by the receiver itself can be indicated by a "noise factor." This is obtained by dividing the total noise power by the theoretical minimum noise power.

The interesting point about the noise factor is that it removes all need for worry regarding the exact effective bandwidth. Since the minimum noise and the internally generated noise are both proportional to bandwidth, the noise factor is the same for all bandwidths. It gives a clear indication of the noise performance of a pre-amplifier and/or receiver in respect of noise. Perhaps that is why so few figures on noise factor are published.

The ideal noise factor is 1. It may be added that some people deduct one from the noise factor as defined above, and so obtain an ideal noise factor of zero. That is the only way in which a noise factor of "0.3" can be obtained, for the actual noise can never be less than the theoretical signal.

### Noise and Signal

Since the minimum noise level in an 80-ohm feeder is 2.3 $\mu$V. under the conditions assumed above, ~~the signal~~ voltage in the feeder must be large compared with this in order to obtain a satisfactory picture. A proportion of three per cent. noise is quite enough to produce a visible effect, so at least 75 microvolts of signal are required to overcome the minimum noise.

If the noise factor for the receiver is 2, however, the internal noise doubles the total noise power level, increasing the noise voltage by 40 per cent., and increasing the minimum usable signal level to nearly 110 microvolts. With only 75 microvolts it would still be possible to receive a picture, but the visual effect of noise would be considerably greater.

Noise factors of more than 2 are not uncommon. With a grounded-grid first stage correctly matched to the feeder, using an EC52, for example, the noise factor would not be less than 10! The dangers of assuming that a triode first stage will automatically give low noise are emphasised by the fact that the minimum usable signal has now increased to 240 microvolts, a level normally associated with relatively short-range reception.

In order to show why this particular case is so bad, it is necessary to show how the noise figure can be calculated.

### Noise Factor Calculations

It has been shown that the noise factor for a single stage of any type which is matched to its input feeder is approximately

$$2 + \frac{4R_{eq}}{R},$$

where $R_{eq}$ is the equivalent noise resistance of the valve and R is the impedance of the input circuit directly feeding the valve, i.e., the grid-earth impedance. Those who want the precise equations can find them in Proc. I.R.E. for October, 1948, in the "Notes on Noise Figures," by H. Goldberg.

The value of $R_{eq}$ can be found in the valve data for most suitable valves. For a good pentode it may be 700 ohms (EF54), while a triode may have an $R_{eq}$ of 310 ohms (EC52), the lower figure indicating that the triode gives a lower noise level.

The value of R is determined by one or both of two factors: the input circuit Q, and the input impedance of the valve. If the input impedance of the valve is 10,000 ohms (EF54) it is not possible to design for a higher value of R, while too high a value of R will lead to a restricted bandwidth response in the first tuned circuit.

For a typical case using an EF54, the values may be $R_{eq} = 700$, $R = 4200$. The noise factor is then 2.66, giving a noise voltage level 63 per cent. above the minimum possible with this type of stage. Although this case is quoted as typical, considerable care is needed to obtain this performance in practice, especially at the higher end of the television band. The residual Miller effect arising from imperfect screening between input and output and other effects may reduce the input impedance of the valve to well below 4,200 ohms unless the circuit is laid out with extreme care. The feeder is then mismatched, resulting in loss of signal power, so that the noise factor increases.

**Special Cases**

Returning to the case of the grounded-grid stage matched to the feeder, the value of R in this case is limited to a very low value by the low input impedance of the grounded-grid stage. It is approximately

$$\frac{1}{gm}$$

or 150 ohms for the EC52. The noise resistance of the EC52 is, as already quoted, 310 ohms, so that

$$\frac{R_{eq}}{R} = 2.$$

Putting this value in the noise factor equation gives a total noise factor of 10. The low input impedance of the grounded-grid stage normally makes it unsuitable for low-noise applications with a matched feeder.

If, on the other hand, the feeder can be matched directly into the input impedance of the grounded-grid stage without an impedance converter circuit, the noise factor becomes

$$1 + \frac{R_{eq}}{R},$$

or, in the present case, 3. For wideband applications the grounded-grid stage may have considerable value when used in this way.

Turning, not without reluctance and misgiving, to that much-debated circuit the cascode, it is found that the noise factor equation is, as before,

$$2 + \frac{4R_{eq}}{R}.$$

Why, then, is the cascode called a "low-noise" circuit?

The answer lies in the fact that a triode may be used in the first stage, giving a lower value of $R_{eq}$, while the input impedance may be made higher than in the average stage designed around an RF pentode. The $R_{eq}$ of the EC52, for example, can be combined with a high input impedance to obtain a noise factor of the order of 2.1. The noise level in terms of voltage is still 45 per cent. above the minimum possible, but it is about 11 per cent. lower than in the case of an ideal pentode stage, and more than 20 per cent. lower than the noise level commonly obtained in practical pentode circuits.

A variation on the cascode theme which is of interest here is the direct connection of a relatively high impedance feeder to the grid circuit, the impedance of which is deliberately reduced to a suitable value by omitting the neutralising. The noise factor can then be of the form given for the directly matched grounded-grid stage,

$$1 + \frac{R_{eq}}{R},$$

but the lower value of $R_{eq}$ is not now combined with a necessarily low value of R, and a noise factor less than 2 becomes possible.

**Consequences**

From the facts set out above emerge certain consequences, which may as well be illustrated with cases that have been mentioned recently in the pages of this journal.

First, it is difficult to obtain a noise factor which is appreciably better than 2.5 without the use of very special methods. The latter include the use of a grounded grid stage using a valve with low $g_m$ matched directly to a feeder of relatively high impedance, or a modified cascode used in the same way. Both these involve difficulties beyond the scope of this article and beyond the resources of the average experimenter.

Secondly, the minimum effective input noise which can be expected in practice is of the order of 3½-4 microvolts, assuming an 80-ohm feeder.

Turning to specific cases, it has been suggested that the first valve of a cascode serves no useful purpose, and may as well be omitted, since its gain is approximately unity. Accepting this last point with reluctance, since it is not invariably true, it is clear that the comparison lies between the noise factor of 2.1 obtainable with the full cascode and the noise factor of 10 obtainable with the grounded-grid valve alone. The function of the first valve is to raise the input impedance, thus increasing R, and decreasing noise factor.

The second point concerns neutralisation of cascode circuits. If this is carried out precisely, the input impedance is a maximum, and the best possible noise factor can be obtained. If the adjustment is not precise, but is within, say, 5 per cent. of the correct value, the input impedance may be only a quarter of the value which can be obtained. This will not necessarily be catastrophic. Suppose that the optimum condition is such that $R = 30\ R_{eq}$, giving a noise factor of 2.133. Reducing R to a quarter of this value will make the noise factor 2.53. The effective noise voltage has risen by 9 per cent., which is not as much as might be expected.

**Conclusion**

It has been stated above that as much as 3 per cent. noise can be allowed without appreciable deterioration of the picture, and this sets the minimum satisfactory signal level at 133 microvolts with a noise factor of 3. A noise performance of this order can be obtained without difficulty using the most ordinary techniques, providing that the first valve is of a suitable type, having low noise and high input impedance. It is therefore a waste of time to worry about first stage noise unduly when the signal is 200 microvolts or more.

The lowest noise factor which can be obtained allows a signal level of about 110 microvolts to give a satisfactory picture. For signals at lower levels noise-free performance cannot be expected without the use of highly specialised techniques involving changes in aerial design and other alterations.

Finally, a word of warning. If the first stage has a gain of less than 10, the noise due to the second stage may increase the noise factor appreciably. For this reason it is a good idea to design both first and second stages for low noise when especially low signals have to be handled, these being followed by another RF stage before the mixer is added. Even then, the mixer noise can increase the noise factor still more if the overall gain of the first three stages does not exceed about 100.

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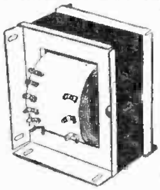

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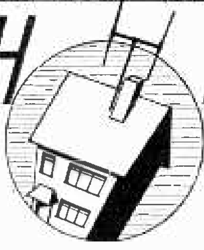


By Iconos

## THE TELEKINEMA

"NOW *is the time to put on your glasses*," came the titled exhortation from the screen at the Festival of Britain *Telekinema*. Obediently, the members of the audience extracted the special polaroid spectacles from their boxes and perched them on their noses. Then followed a demonstration of stereoscopic films, which, with big screen television, is one of the major attractions of the South Bank Exhibition.

The combination of television, stereoscopic films and stereophony has certainly attracted the crowds. The theatre's 800-odd seats have been filled at every show, and an additional daily performance has been necessary in order to accommodate the crowds. Thus, in the first eight days from the opening of the Exhibition, 26,000 persons have paid for admission. In the face of newspaper publicity of a sensational character, it may seem heretical to say that the Telekinema's justifiable claims to complete novelty are strictly limited. Nevertheless, the assembly of a number of different items, previously demonstrated separately, has a special significance for readers of this journal. The Telekinema at the South Bank Exhibition is supposed to signpost developments of the future—but if this objective has been attained, then the future of big screen television, stereoscopy and stereophony is by no means rosy.

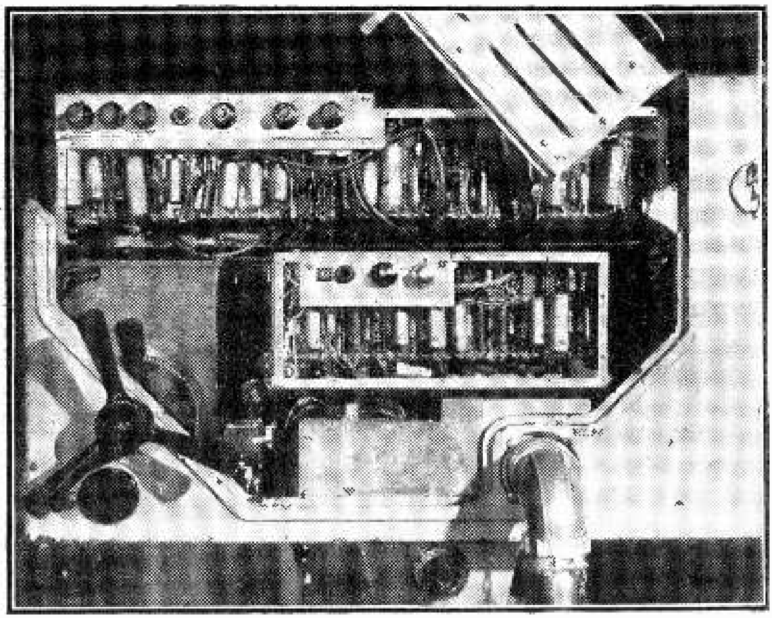
## STEREOSCOPY

THE Telekinema is certainly one of the most interesting showpieces in the Exhibition; it seems a pity that the fine technical efforts of television and film engineers should be expended upon unshowmanlike and arty-crafty demonstrations. Stereoscopic pictures were demonstrated in a film of a voyage down the Thames, and this and other stereoscopy required the wearing of special polarised spectacles. The stereoscopic system, as most readers are aware, calls for the use of two projection machines carrying films photographed simultaneously on cameras with lenses a few inches apart—2½in. being the correct distance. The resultant left-and right-hand images are projected through separate polarising filters, each adjusted at 45 degrees from one another, and viewed by the audience through spectacles with glasses similarly polarised. Thus, the right eye is allowed to see only the picture photographed on the right hand camera and the left eye is similarly associated only with the left-hand image. Viewed without the polarised glasses the picture looks blurred and out of focus.

So far, so good. The technical results demonstrated that if the necessity for wearing spectacles was accepted, stereoscopy would be a practical proposition, both for films and television.

## THE TELEKINEMA PROGRAMME

THE type of film used in the demonstration varied from the coloured Thames travelogue, already mentioned, to a rather lengthy animated design film (in which the rhythmic motions of traces on the screen of a cathode-ray tube are viewed in three dimensions, synchronised with strange electronic music) and to scenes at the Zoo, with giraffes appearing to poke their necks over the railings right out into the audience. There was a noticeable absence of anything really startling which fully exploited the possibilities of the new development. No attempt was made to horrify the audience with express trains rushing at them, fire hoses squirting at them, or to charm them with the pirouettes and



An interesting inside view of one of the modern television cameras.

entrechâts of ballet. In short, the technicians showed themselves to be well ahead of the producers. who lacked the showmanship to make use of the wonderful tools that were available.

**BIG SCREEN TELEVISION**

THE big screen TV demonstration did not include stereoscopy. On the occasion of my visit it was confined to a closed-circuit interview with a film star in the foyer. A Marconi Image Orthicon camera and associated amplifying equipment were linked with a Cintel cathode-ray projector, using the Schmidt mirror optical system. Quality was extremely good, though lacking the wide range of contrast which I have previously seen with Cintel equipment. This, however, was probably due to slight "teething troubles" which will probably be corrected. It is a pity that the demonstration of stereoscopy could not be extended to television, since members of the audience (with their polarised glasses) were all ready for it.

**LIME GROVE VISIT**

THE progress that has been made at Lime Grove Studios since the B.B.C. took over was recently demonstrated to a large party from the British Kinematograph Society. who were intrigued to see what had happened to this former home of many successful films. The visit has its significance in the friendly relations which are developing at engineering levels of the B.B.C. and the film industry, compared with the antagonism at higher levels. First impressions of former employees at the Lime Grove Studios concerned the unusual cleanliness of the premises and the ingenious manner in which the rabbit-warren of rooms surrounding the stages had been adapted to television control rooms. They were able to appreciate the complications arising from the various types of camera in use. Large banks of small tungsten lights, fed from 230 volts A.C., seemed to them to be burning at a lower colour temperature than is usual in film studios, but various spotlights, fed from the direct current plant in the basement, were brighter and whiter. The yellowness of the A.C.-fed bulbs seemed to be quite acceptable to the Lime Grove TV cameras, much to the surprise of these visitors.

**TV ENGINEERS "GRILLED"**

THE visit ended with a well-organised "Brains Trust" in which leading TV engineering executives were plied with questions by an audience of professional film technicians. Questions on colour television were parried, but on all other points the debate took a constructive form. Studio acoustics are still the same as for film making, with very low reverberations, suitable for dialogue, but not for music, and the technicians discussed possibilities of artificial echo as a temporary measure. Methods of dollying cameras about the stages without camera tracks were discussed. and the new smooth flooring. enabling small mobile cranes to be manipulated with ease. A small Vinten camera crane, motor driven, with controls at the feet of the TV camera operator, was much admired, and there is no doubt that if the film business were in a more prosperous state this fine piece of equipment would be seen on the stages of film studios. Other points which raised comment were the improved ventilation of the premises, the lack of 16 mm. film telecinè equipment and concentration on 35 mm. and the flimsy, but effective. settings. The debate ended with a graceful vote of thanks from the president of the B.K.S. and there is no doubt that the whole affair was a triumph in the gentle art of public relations, well handled by the B.B.C. television boys.

**THE SILLY SEASON**

POLITICS apart—or. possibly, including politics—the silly season of journalism is with us again. The usual Auntie Sallys are erected and the boys and girls get to work on the horrors (!) of holiday camps, the dangers (!) of beauty parades and the humiliations(!) of hot weather. Television is the latest target, and following opening volleys from Monica Dickens, recently mentioned elsewhere in this journal, *The Queen* comes out with a startling attack by Roland Wild, entitled, *Commercial Television—the Warning*. After deploring the changing habits of the American nation, resulting from the impact of television, Wild invites readers to take a tour around a typical American suburb on a bright Sunday afternoon. "The place is deserted," he says, "cars are in the garages or parked against the kerb. The children's toys lie on the sidewalks. The man at the petrol station reports a falling-off in Sunday drivers. Golf retains most of its slaves, but the young are not taking up the game. And the reason is that spindly erection of tubing on the roof of four out of every five houses in the block. For Sunday afternoon is the big day for looking at the screen. Jack Benny is on, and Jimmy Durante, and Faye Emerson and Tallulah Bankhead and Bob Hope and Bee Lillie. But it is the advertisements which really show the power of television. and the lack of control which has made the new art a paradise for the huckster and the cheapjack."

**TELEVISION A "SOCIAL EVIL"?**

THE indictment of commercial television includes the usual description of eye strain, home lessons neglected, health ruined, and all the other moans which were made thirty years or so ago against "the evils of the cinematograph."

But the article is, in fact, an unwitting testimonial to the wide appeal of competitive and sponsored television. For all the splendid efforts of the B.B.C., it suffers from the usual handicaps of a monopoly. and it will be many years before alternative B.B.C. television programmes are available. In the meantime, the only alternative to looking at such propaganda-loaded items as "Passing Show," is to *switch off*!

## British Television Viewers' Society

THE producing of "Whirligig" and similar programmes for children was explained to members of the British Television Viewers' Society at their monthly meeting at Kennard's Restaurant, Croydon, on Monday, May 7th.

The speakers were producer Michael Westmore and artist Harry Rutherford. In arranging programmes for children, peculiar problems arose owing to the age range of five to sixteen years, and both speakers emphasised the importance of presenting always the right type of material for children.

Mr. Rutherford exhibited many of the sketches which he had prepared for the Shakespeare birthday programme and spoke of his television début in 1937.

The Society has been privileged and pleased this season to welcome many B.B.C. speakers connected with children's programmes. They have done fine work under the inspiring leadership and enthusiasm of Mr. Cecil Madden and there is no doubt that these ladies and gentlemen, without exception, are fully aware of their great responsibilities where the young viewer is concerned.

# 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).**

## MILLER TIMEBASE

SIR,—Recently there has been much discussion in PRACTICAL TELEVISION of the alleged non-linearity of the Miller-transitron timebase when used for the frame scan. Some circuits have been given to improve this.

After examining the circuit values given I think it will be found that the trouble is not in a failing of the timebase but in too short a time constant in the coupling to the deflector plates.

A value of 0.1 $\mu$F has been given for the coupling condenser with 1 M$\Omega$ for the plate return resistance. This time constant is totally inadequate and will cause distortion of the raster with a perfect timebase.

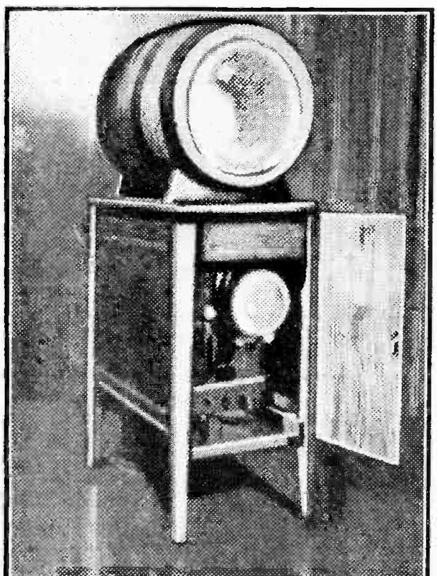
The time constant of the coupling should be not less than 50 times the duration of the saw tooth wave, or a time constant of one second. With a plate resistance of 1 M$\Omega$ a 1 $\mu$F coupling condenser will be required, or a 0.5 $\mu$F with a 2 M$\Omega$ resistance.—A. BARTHOLOMEW (Kirkcaldy).

## HOME-MADE TRANSFORMERS

SIR,—Reference your publication of my letter in the May issue on "Home-made Transformers," please note there is a misprint. Breakdown strength of grease-proof paper is given as 300 volts *per inch*; this should, of course, read *per mm.*—T. P. LYNOTT (Abingdon).

## PICTURE TUBE MOUNTING

SIR,—*Re* your article on "Picture Tube Mounting" in issue of May, 1951, the accompanying illustration shows how I overcame the problem of mounting a 12in. ex-Service tube. This is a standard firkin beer barrel with rubber draught excluder inlaid at one end, with putty and enamel for finish. French polishing the oak barrel was tiring but worth while. The base of tube is supported with sponge rubber and bungee. The cabinet was originally a pin-table. A 12-point plug enables the picture to be switched to either tube, 12in. or 6in., while controls mounted in front give full height or scan adjustment to suit either tube (CRT63 DS or 97).



**An interesting tube mounting. See Mr. Reading's letter above.**

A barrel, pin-table and some ex-radar equipment now give me television on tap less 66 per cent. P.T., and has given me many interesting hours of construction, experiment and viewing.—F. C. READING (N.W.2).

## POOR SYNC

SIR,—In connection with your answer to Mr. G. T. A. Ling, of Norwich, under the above heading, the fault Mr. Ling describes may be due to bad fundamental design. If one of the vision stages is capacity coupled, the grid of the following valve can easily block when a heavy interference pulse is received. The condenser then discharges through the grid resistor and until the valve conducts again neither picture nor sync can pass through the receiver. This particular example can easily be avoided by redesigning the circuit so that the resistor is in the anode circuit and the inductance in the grid circuit. It is not always so easy to avoid such blocking circuits, especially in frequency-changing stages. At the most, however, only 5 to 20 lines should be affected, not several frames.

Mr. N. A. Hough's letter headed "Definition Limits." In the fringe area an improvement in picture quality is possible by reduction of bandwidth. This allows a smaller quantity of thermal and galactic noise to reach the cathode ray tube. While the reduction of noise is only as the square root of the bandwidth, the few dB improvement in signal to noise ratio at the C.R.T. can be worth while. At these extreme ranges there seems to be very little point in exceeding a 2.0 to 2.25 M/cs bandwidth. From these considerations also it is better at large distances from Alexandra Palace to use a single rather than double sideband receiver.—M. E. BOND, (Ewell).

## AN AMERICAN POINT OF VIEW

SIR,—I am an Englishman now employed in Los Angeles as a top TV technician, and I thought perhaps your readers would like a general idea of how we go on in U.S.A. I am working for a large retailer and have handled hundreds of jobs. The reason I am temporarily in England is because I have been sent over to buy valves and components. However, I have not been very successful and shall be going home soon.

First, I will tell you about wages and general conditions.

Pay for a top TV engineer is round $1.75 per hour to $2.0 per hour (12s. 4d. to 14s. 3d.). A few firms pay more, but not generally. The average week is 40 hours—staggered. Say from 12 noon to 9.0 p.m., one week, and 9.0 a.m. to 5.0 p.m. the next week, and so on. Staggered working is only to catch the householder at home and not because of lack of programmes. Channels 13 and nine kick off at 9.0 a.m. and eight channels are working all day, mostly—some right up to midnight.

There is plenty of overtime. It is not difficult to earn 100 dollars (£35) weekly, regularly, without blood, sweat and tears. A car allowance of six cents per mile is paid to television service men using their own cars.

There are in U.S.A. as well as in England a lot of people who *think* they are TV engineers, and these people are just as much a nuisance in U.S.A. as in England. Again, as in England, I do not think TV engineering is treated as high a trade as it should be treated. Compare wages: a carpenter gets $2.95 (£1 1s.) per hour; a plasterer gets $3.25 (£1 3s.) per hour; a waiter gets $1.65 (12s.) per hour, and yet we stick it and would not leave the game.

While I have been in England I have been employed in the TV business and I have no hesitation in saying that American sets are much easier from every point of view to service than English sets. Almost every American TV chassis will come out of its cabinet *complete* in two minutes. Also English valves—Z this, X that, W this—and every firm using a different name or number!! What a headache!

English viewers, of course, are fully aware that all U.S.A. TV sets are designed to switch in to any one of a dozen programmes. I have often been asked do these tuners cause trouble. I have no hesitation in saying that they are practically trouble-free over two years constant working.

Series connecting of valve filaments has given a lot of work, owing to interfering with "Taught Diagnosis." In other words, if valves are in series, all your schematics giving possible faults are subject to *all* valves being O.K., and not just the relevant valve in schematic and so cause a lot of wasted time. A lot of U.S.A. manufacturers are going back to the L.T. transformer.

TV outside service men are expected to do six calls a day at least (eight with some outfits).

Picture tubes are lasting into their third year without any marked falling off in emission.—AMERICAN ENGINEER (name and address supplied).

## D.C. RESTORATION

SIR,—*Re* the controversy between Bernard Barnard and J. C. Howells on the subject of current (or electron) flow in a parallel diode rectifier circuit, I feel it necessary that J. C. Howells' criticism should be supported by someone, as Mr. Barnard tries to condemn it as unfounded.

The first points are minor ones, but the last point regarding a circulating current in a closed circuit is a most important one, if readers are not to get a false idea about the action of the circuit. There is definitely no E.M.F. *within* this closed circuit and therefore no circulating current. The E.M.F. which Mr. Barnard refers to, namely, the incoming signal, is applied to the valve and resistor *in parallel*, and therefore any current which flows must be in the same direction in each branch.

Surely this basic principle is one which calls for a final comment by the Editor, so that readers who are comparative beginners do not have to guess which writer is correct?—T. H. J. WATSON (Plumstead).

[*There are two schools of thought in this matter. Can any reader furnish a real solution to the problem—with proofs?*—ED.]

## PHYSIOTHERAPY RADIATIONS

SIR,—I was interested to see an item in the "Telenews" section of the June issue. I refer to the "signals" reported to be from Holme Moss that I said may be due to a sub-harmonic from an aircraft beacon.

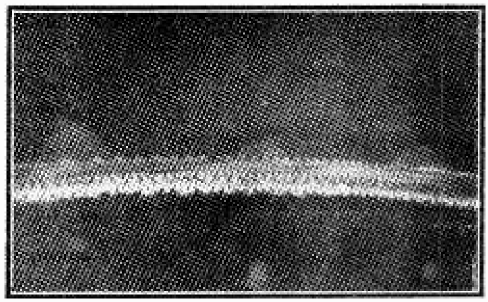
It has now been found that the signal came from the local hospital's physiotherapy equipment which is tuned to about 50 M/cs. In our hospital the gear is in screened cubicles to prevent radiation, but the doors were never closed, now after tests with the hospital the doors will always be closed and the signals have vanished.

We were amused when a well-known London firm's TV representative told us quite definitely that signals were being received all over the north from Holme Moss. He was rather dumbfounded when we, with the hospital's co-operation, put on a show for him and we suggested that where dealers receive this signal they contact their hospital and do some checking up, otherwise TV viewers may be upset with the interference.—ARTHUR YATES (G3LB) (Ripon).

## LAMP INTERFERENCE

SIR,—With reference to the paragraph concerning television interference, at Littlehampton, in your May issue. I should like to point out that the interference complaint should not be sent to the P.M.G., but to the local P.O. Telephone Manager, whose Interference Officer will quickly track the source down.

Since the opening of the Sutton Coldfield transmitter,



**Although difficult to reproduce, this illustration gives an idea of the pattern produced by the lamp interference as mentioned by Mr. Rimmel.**

I have in the course of my duty in this section dealt with numerous cases of this nature and suspect, from the description given, that the source is a rough service type lamp/s, or one of the old cage filament types.

An illustration of the interference caused by these lamps is given and may be of interest.—D. F. RIMMEL (Post Office Interference Dept.) (Cheltenham).

## TRANSFORMER ECONOMY

SIR,—The following economy may be of interest to some readers when it is considered that the present cost of good TV mains transformers is so high. Some surplus stores are selling American 115-volt 60-cycle mains transformers. I selected two of these with the following ratings:

Primary .. .. 115 volt 1.4 Amp.
Secondary H.T. .. 840 volt .115 Amp. (centre tapped)
Secondary L.T. .. 6.5 volt 7 Amps.

These transformers are of the potted type with porcelain insulators. The centre taps of the H.T. windings in my transformers are internally connected to the metal casing. The American thread-securing bolts attached to the transformers, unfortunately, were without the necessary nuts, and being unable to obtain any the transformers were secured to the power pack by means of a metal plate fixed across the top and held down by thin rods tapped at the ends to accommodate nuts. Although the various windings are numbered, it was felt safer to rely upon a test at low voltage to ascertain the phasing of the various windings, and accordingly the L.T. charger winding of an old eliminator was used to supply a low voltage to the primaries.

There are two reasons for this precaution and the first is that the centre-tapped H.T. windings produce peak voltages in the region of 1.2 kV with serious personal danger when they are connected to the mains, and the second reason is that if the windings are connected out of phase, the windings are most likely to burn out.

On no account must the 115-volt primaries of the transformers be connected across the mains except in series. The secondaries may be phased in parallel or used separately if desired, but the former method is to be preferred when a single rectifier like the 5U4 will suffice for practically all H.T. demands of home-constructed TV sets. With the low input used (about 8 to 10 volts) it was a simple matter to ascertain the correct wiring of the secondaries. The centre taps were first connected together and, using an old D.C. ammeter and rectifier, the pairs of connectors giving no readings were connected together. If an A.C. voltmeter is available, so much the better. It is advisable to check across all the transformer connectors of the H.T. windings to make sure that an output is present. The L.T. windings cannot be phased until a higher voltage is put through the primary, and in my case they have been left separate, one supplying all the valve heaters and the other feeding a home-wound isolating transformer which is used to run the 5U4 heater and a thermal delay switch. The isolating transformer was made up from an old transformer as follows :

| | |
|---|---|
| Centre limb of core .. | 1in x 1in (approx.) |
| Primary (6.3v.) .. | 51 turns 16 s.w.g. enamel. |
| Secondary (5v.) .. .. | 42 turns 17 s.w.g. plastic-covered. |
| ,, (4v.) tapped .. | 34 turns 17 s.w.g. plastic-covered. |
| ,, (2v.) ,, .. | 17 turns 17 s.w.g. plastic-covered. |

Across the 4-volt tapping a 4-volt thermal delay switch was connected to delay application of the H.T. to the receiver (including the surge and smoothing capacitors), and the full 5-volt winding is used to heat the 5U4 rectifier. The result is all that can be desired, the power pack supplying power to the whole of a VCR97 receiver (except E.H.T.), and under load the H.T. supplied to the time bases is 480 volts which, in this case, has proved ample to scan the tube in both x and y axes, using cathode-coupled 6SN7 amplifiers.—L. A. BARKER (Liverpool, 12).

### "BLACK SPOTTER"

SIR,—Although he does not include me among the "expert readers," I think that Mr. Jobbling (June issue) may find the following idea for noise suppression of value in his very unfavourable receiving site. It represents a complete breakaway from normal noise-suppressor practice, and I have found it very useful.

Briefly, the idea is to remove the offending white spot from the raster completely. There are several ways of applying the idea, according to the type of cathode-ray tube and deflection circuits in use, but in all cases the operating signal is derived from the video signal through a diode. This only passes those parts of the signal which are above "peak white" level, the level at which the diode conducts being adjusted by applying a bias voltage.

The signal from the diode is amplified and applied as an auxiliary vertical deflection signal to the tube. With electrostatic deflection it can be fed into the vertical amplifier, but in the case of electromagnetic deflection a completely separate drive amplifier and deflection coil simplifies matters. In either case, the deflection system must have a very rapid response.

This is what happens. While the video signal remains below peak white, all continues as usual. An interference pulse exceeding the peak white level makes the diode conduct, and the spot on the screen is deflected rapidly away from its normal position. It should start to move immediately the diode conducts, and this movement alone reduces the spot intensity. By the time it reached the maximum intensity, the pulse should have driven the trace clear of the screen. At the end of the pulse the trace falls back into its normal place in the raster.

This is a more complicated arrangement than the usual type of noise-suppressor circuit, but it is much more satisfactory. It can be arranged so that the actual video signal fed to the cathode-ray tube is not affected in any way, thus ensuring against after-effects of large pulses. It also removes the offending white splash entirely. That is no loss, since it conveys no useful picture information.—D. W. THOMASSON (Exeter).

### OPTICIAN'S VIEWS

SIR,—I was rather surprised by your remarks on the television leaflets published by my Association. Complaints about eye strain and aching eyes after viewing television are extremely common, particularly when the people start viewing for the first time. The object of the publication of the leaflets was to reassure the public and to point out that television is *not* harmful to sight. The last of the seven rules to which you took such strong exception refers to the fact that when a person is about 55 their eyes have little depth of focus remaining and therefore a person may find it very difficult to see television comfortably through his reading glasses or through his distance glasses, if worn. For this reason certain people may require intermediate focus glasses.

However, it is not often necessary to have these made specially since very often an old pair of reading glasses suit admirably.—S. BLACK (Director, Information Bureau, Association of Optical Practitioners, London, W.1).

[*This letter does not cause us to depart from the views we previously expressed.*—ED.]

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# THE SYNC SEPARATOR—2

(*Continued from page* 70).

be fed through a very low value capacity to the line oscillator. This had to be small to prevent line pulses being fed back and so into the frame circuits.

The differentiated waveform is passed to a triode instead of to a diode, as has already been described. Resistors R3 and R4 provide a positive bias to the grid of this triode and grid current consequently flows. The critical components here are C2 and R3 and R4, and these are so chosen that their time constant renders all the negative peaks practically level. The positive bias on the grid is not affected by any incoming impulse unless it is sufficiently large, and thus only the frame pulses take the grid below the cathode potential, and as the anode voltage is low, due to the value of R6, the first frame pulse drives the grid beyond cut-off. The amplitude of the chain of frame pulses is such that the valve remains cut off for a short period and a rectangular waveform is produced at the anode. This waveform is fed to the frame oscillator in the usual way and it will be noted that a very low value condenser is used.

**HANNEY OF BATH OFFERS:** A complete service for the TV constructor:—P.W. & P.T. Televisor set of coils with VF choke. **16/6** L'don, **18/-** B'ham (inc. extra rejector coil); Alladin Formers with core, **10d.** ea.; also all other components by Erie, Morganite, Colvern, TCC, Dubilier, Haynes, Elac, etc. Send now for a complete list. E.E. Televisor: Vision Chassis, **22/6**; Sound Chassis, **18/9**; Time-base Chassis, **17/6**; Power Unit Chassis, **25/-** (all the above Chassis are complete with valve holders, screens, coil formers and sockets, etc.) Complete stocks of TCC Condensers, Erie and Morganite Resistors, Colvern Pots, etc., etc. Viewmaster Televisor: Send for a complete list now; everything in stock; anything supplied from one resistor or condenser to a complete kit. Wireless World Televisor: Complete set of coils for this superhet receiver, wound exactly to specification. **45/-**, L'don or B'ham. Polystyrene formers, 1½in. x ⅜in. tapped OBA for slug, **1/-** ea.; 2¼in. x ⅜in., **8d.**; Paxolin formers, 1½in. x ⅜in. tapped OBT, **9d.**; 1½in. or 2in. x ½in., **8d.**; 1⅜in. x ⅜in., **9d.**; Polystyrene Varnish, large bottle, **1/10**; OBA Screwed Rod, brass **1/-** ft., copper **2/-** ft. We can give you a return of post service on all components for this receiver. Send 3d. stamp for lists of all the above Receivers. Retail only. L. F. HANNEY, 77, Lower Bristol Road, Bath. (Tel.: 3811.)

**NEW BOXED VALVES:** 6V6G **10/-**, 5Z4G **8/6**, 6K7G **6/6**, 6K6GT **7/6**, 6F6G **8/6**, VR92 **3/6**, 9D2 **5/-**, 6X5 **9/-**. Large range of B.V.A. types. Order C.O.D. Speakers, 3½in. **14/-**, 5in. **14/6**, 6in. **14/11**, 8in. **16/-**, 10in. **25/-**, 12in. **55/-**. O/trans., Pentode **4/6**, H/duty **5/9**. 0-100 Mil/amp Meters, 2½in. dial, **12/6**. 0-300v Meter, square, **7/6**. 0-40 amp, 2in. rnd., **6/6**. 0-500 microamp, **7/6**. 80 ohm Co-ax, **14/-** doz. yds. Special offer: V/controls, 1 meg, L/sw. L/spin, 3 for **6/-**; ½ meg and 50K semi-midget, **2/9**; Amplion semi-midget guaranteed controls, **4/-**; SP/sw, **5/9**; DP/sw, **6/6**; range 10K to 2 meg. Alum screened chassis, ideal for pre-amp, contains Int/hldrs, resistors, condensers, etc, **4/6**, post free. RADIO UNLIMITED, Elm Rd., London, E.17. (Phone: KEY 4813.)

**"VIEWMASTER"** Valves, as specified, all guaranteed brand new and boxed, comprising 5 EF50, 2 KT61, 1 EBC33, 1 EB91, set of 9, **87/6**. New, boxed, EF50 (VR91), **7/-** each; 6AL5, EB91, **7/6**; 6AM6, EF91, **9/-**; EY51, **18/6**; EBC33, EF39, HVR2A, 6K7GT, **7/6** each. 6K7G, KT2, 7C5, 7Y4, EF8, 9D2, **6/9**. All guaranteed brand new and boxed. P.M. Speakers, less transformer, 2½in. **14/6**, 5in. **14/6**, 6½in. **15/6**, 8in. **17/-**. All by leading makers. C.W.O. Post paid 20/-. READERS RADIO, 24, Colberg Place, Stamford Hill, London, N.16.

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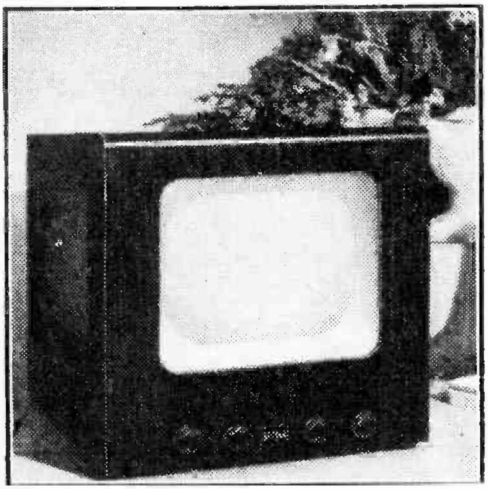
# TRADE TOPICS

### Stella Television

STELLA RADIO AND TELEVISION CO., LTD., Oxford House, 9-15, Oxford Street, London, W.1, announce the first TV models of their range. Distribution will be exclusively through a limited number of wholesale distributors.

Of the two television receivers, Model ST.1522U (illustrated) is a superhet (vision and sound) table model with a 12in. C.R. Tube. It is designed for use on A.C. mains (50 c.p.s.) between 200 and 245 volts or on D.C. mains between 200 and 245 volts. This receiver has been specially designed to take up the minimum of space in the home and yet allow 12in. screen viewing. A.V.C. and negative feed-back for sound are also incorporated. The four controls are: 1. Focus. 2. Brightness. 3. Contrast. 4. On/off switch and volume control. The cabinet is walnut. Available as from June 1st.



The new Stella Model ST. 1522U

Model ST.1480U is a console version of the table model ST.1522U. The screen is at the right height from the ground to afford very comfortable viewing. Doors for the projection of the screen are an additional advantage, and are folded back when the set is in use. The cabinet is of grained walnut. Also available as from June 1st.

### Marconiphone Model VT83DA

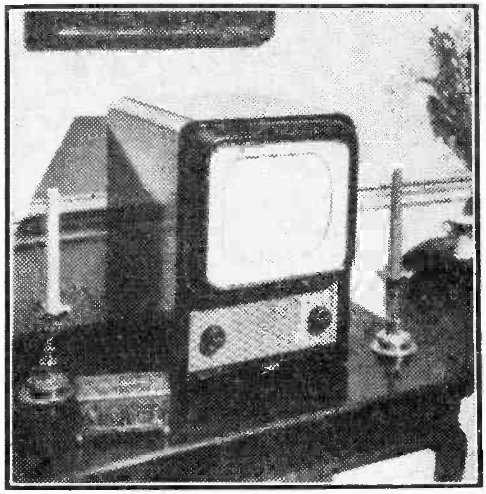
THE first Marconiphone television receiver available for use on the Northern Station Frequency is Model VT83DA, a high-performance table receiver with a 10in. Emiscope tube.

Apart from its operation on the Northern Station Frequency it is identical in performance and appearance to the existing Marconiphone Models VT53DA (London) and VT73DA (Midlands).

### R.G.D. Model 1800

A NEW R.G.D. console television receiver was released for sale on June 1st.

It has a 17-valve (plus metal rectifier) superheterodyne circuit and incorporates a 12in. aluminised cathode-ray



Marconiphone Model VT83DA

tube. A 10in. permanent magnet loudspeaker is used and built-in suppressors are fitted for both sound and vision.

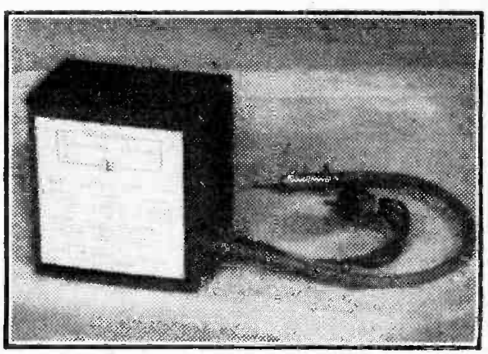
The cabinet is of selected walnut with substantial castors, and has full-length doors which conceal the tube face, loudspeaker grille and controls when the instrument is not in use. Dimensions are 34in. high by 20in. wide by 18in. deep and the weight is 84lb.

The retail price of the Model 1800 is £112 7s., plus £51 2s. 5d. purchase tax; a total of £163 9s. 5d.

### New Ekcovision Pre-amplifier

A NEW Ekcovision pre-amplifier tunable to any of the transmission channels so far announced by the B.B.C. has been introduced by E. K. Cole, Ltd., and is shown below.

Supplied with three or four pins this amplifier is usable with any Ekcovision receiver introduced since midsummer 1949. Available in three-pin or four-pin type, the price is £2.



The neat new Ekco Pre-amplifier

# 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. If a postal reply is required a stamped and addressed envelope must be enclosed.*

## E.H.T. VOLTAGE

**"I have built a more or less home-designed television receiver, taking as a guide both the Viewmaster and your own receiver. I have made my own E.H.T. unit as well as several other parts, and although I get a very good picture, I cannot fill the 9in. tube screen. The proportions are O.K., and I have changed the amplifier in the time-bases, but although I can open up the frame to nearly full height, the width is not much more than half of the area. Linearity is good. Do you think the coils are faulty? If not, can you suggest the cause of my failure to get a big enough picture, as I want to use a 12in. tube soon."—B. V. Verity (Edgware).**

Without a circuit or more complete details it is difficult to state definitely the cause of your trouble, but the most likely thing would be excessive E.H.T. It will be appreciated that the power required in the time-base output stages is dependent upon the strength of the electron beam in the tube, and this in turn is controlled by the E.H.T. voltage. If you do not possess a suitable voltmeter for measuring the E.H.T., you can check it by including a *good* current meter in series with a bleeder chain of 40/100 megohms across the output of the E.H.T. unit. Include the meter between the end of the chain and the earth line. You can then calculate the E.H.T. voltage by means of Ohm's Law. In many cases you can reduce the E.H.T. down to 4,000 volts or so and still have sufficient brilliancy for normal use.

## HOLME MOSS TESTS?

**"For some weeks now we have been getting a signal up here which appears to be experimental signals from Holme Moss. There is obviously a frame sync pulse as this locks, but line does not hold. Sometimes there are just two wide lines, one black and one white, and other times four separate white squares. I should be glad if you could tell us whether this is an experimental signal by the B.B.C. and supply details of times, etc."—G. Robertson (Middlesbrough).**

No experimental transmissions have yet commenced from Holme Moss and the signals you are receiving are probably radar impulses from some nearby Service station or harmonics from such a transmitter. We understand that the signals are being seen over a wide area, and the G.P.O. are investigating the matter.

## SAFETY PRECAUTIONS

**"Could you publish a safety device for shorting condensers in television power packs? This might save beginners some nasty shocks."—E. Wells (York).**

There should be no difficulty in arranging for the safety measure mentioned. If a high value bleeder resistance (made up of a number of the specially designed resistors and totalling about 100 megohms) is connected across the E.H.T. source (if this is A.C. or the R.F. type), this will speedily discharge the low-value condensers which are connected across it. Other condensers may be short-circuited to remove the charge if it is desired to handle them soon after switching off. This short-circuiting should not be done with a screwdriver or similar instrument as it may damage the component. A special tool should be made up consisting of a high-value resistor mounted on a handle, with the leads arranged so that both terminals of a condenser may be contacted and the resistor will limit the discharge and avoid damage to the condenser.

## TUBE HEATER SUPPLY

**"I have constructed the 'Practical Television' Receiver and have provided for 6/10kV E.H.T. by using the Haynes new line timebase circuit. This is so that a 12in. aluminised tube can be used later. I should be obliged if you would let me know where I can get details of a 6.3 volt tube of this type, or alternatively, what I could do to obtain a two-volt heater voltage for the tube should this be necessary as in the case of the Brimar."—G. Riggs (Whitley Bay).**

The most satisfactory solution to your problem is to purchase one of the small heater transformers which are now readily available and which are tapped for 2 or 6.3 volts. This may be mounted on the power unit and the leads for the heater taken to the tube base. This is actually a better idea than using a common heater, as you may leave the heaters "in the air"—that is, not connected to earth but just to the transformer secondary winding, and then by connecting a 1kΩ resistor between one of the heater pins and the cathode you reduce risk of heater-cathode insulation breakdown which is present when cathode modulation of the tube is employed.

## VIDEO VALVE

**"I have been interested in the recent correspondence on the merits of the 6AG7 and the EF55 valve as a video output valve and find that neither of these valves appears in the valve data which I have. I wonder if you could give me the essential data of these two valves for comparison."—G. Francies (N.W.5).**

The first is, of course, an American valve and the second a Mullard. The 6AG7 has an octal base but the EF55 has a B9G base (the same as the popular EF50). Both have a 6.3 volt heater, the American being rated at .65 amp. and the Mullard at 1 amp. Normal characteristics for the EF55 are: Va 250V; Vg2 250V; Vg1 −4.5V; Ia 40 mA; Ig2 5.5 mA; Rk 100Ω; gm 12; Ra 55 kΩ. For the 6AG7 the figures are: Va 300V; Vg2 150V; Vg1 −3V; Ia 30 mA; Ig2 7 mA; Rk 81Ω; gm 11; Ra 10 kΩ.

## AERIAL CONNECTIONS

**"In an article recently in your pages you stated that when connecting a coaxial cable to a dipole aerial the inner wire should be joined to the upper part of the dipole, and the outer screening cable to the lower part. In a book I have just bought on television it states just the opposite, namely that the screening is joined to the upper part. I should be glad if you would confirm which is correct as I am making an aerial and it will not be very convenient to take down the aerial to try alternative connections."—S. Straker (St. Albans).**

This also appears to be a controversial point, some makers joining the inner wire to the top and some to the lower part. General tests and an examination of results with different types would appear to support the view that it is preferable to connect the inner wire to the upper part and the outer screening to the lower, and this is the method we recommend.

### SWITCHING OFF

**"A friend has recently purchased a television receiver and I was rather alarmed to see him switch this straight off without reducing the brilliance, hence producing the stationary spot. When I told him about the danger of this spot he said that his dealer had told him always to switch it off in that way and that it would not damage the tube in any way. A further point is that on reducing the brilliance the spot is still visible after switching off. I should be pleased to have your opinion on this."—A. H. Morris (Birmingham, 23).**

There appears to be some controversy about the wisdom or otherwise of switching off without first blanking out the raster. Our opinion is that it is preferable to incorporate the on/off switch with the brilliance control so that the picture is first blacked out and then the tube switched off. Similarly, on switching on, the switch is operated and a short time allowed to lapse before turning up the brilliance, thereby allowing all voltages to level off before adjusting the bias on the tube. This control will not affect the stationary spot, which is due to the particular design of the receiver. With an R.F. or fly-back E.H.T. system with low values of condenser and certain forms of timebase, the moment the set is switched off the E.H.T. collapses and the condensers are rapidly discharged, with, in some cases, the residual spot deflected off the screen.

### LINE LINEARITY

**"I have recently taken delivery of a television receiver which seems to give very good pictures, but the other night I switched on early when the clock-tuning signal was on and could not see the borders round the frame as shown in your recent picture. I adjusted the line and frame amplitude controls as instructed in the manual with the set and got them in, but on the left there are no alternate black and white blocks, just a white-ruled line straight down. Does this mean there is something wrong or does my particular set produce this effect?"—G. Ashburton (Bristol, 3).**

It should be possible to adjust to produce the alternate black and white sections all round the picture, and if these are not produced the picture will be distorted, although perhaps not sufficiently to notice on most transmissions. Usually, if the border is not present on the left it is because the linearity control (line) is not properly adjusted, and you should find in your condition that the left-hand tone section is shorter than that on the right-hand side of the clock face. You should therefore adjust line linearity and amplitude together on this picture so that you get all borders equal, and you will then find that the clock is perfectly round and the two-tone designs on each side of the clock will be equal in size.

### CUTTING COSTS

**"I am anxious to build a receiver, but find that the cost of the parts is rather high at the moment. I have studied the various circuits you have published and have obtained copies of the Viewmaster and your booklet. It would appear that I could save quite a bit by eliminating the mains transformer and using the mains direct with an appropriate rectifier. Is there anything against this, as I think it is more or less standard radio practice?"—K. Young (Battersea).**

There is nothing theoretically against the idea, as the high voltages now required in certain parts of a modern television circuit may be obtained by boosting arrangements, and a half-wave or full-wave rectifier may be fed direct from the mains or from an auto-transformer. The only point to be watched is that one side of the circuit will be at mains potential and in direct contact with the mains, and therefore the usual precautions should be observed as with any standard A.C./D.C. equipment.

### SUPERHET v. T.R.F.

**"I notice that the majority of home-constructed TV receivers which have been published all make use of the straight circuit. Could you state any particular reason for this? I always understood that the superhet was better for range, noise value, and so on, and as I shall shortly be constructing a receiver I should like to know a little more about the vision reception side."—H. Gardner (N.W.9).**

This problem is a little complicated. A straight receiver is more difficult to arrange where high gain and stability are required, and consequently as a general rule the gain is kept low. A superhet, on the other hand, is generally a stable arrangement and capable of higher gain. Against these points, however, must be set the difficulty of lining up. In a straight receiver the coils may be tuned without any additional apparatus and all adjustments carried out on a received picture. The superhet, however, calls for a signal generator if the I.F.s are to be lined up accurately. Further, the straight receiver is usually adjusted for single sideband reception in order to get good detail, as double sideband calls for rejector circuits to keep out the sound signals. I.F.s may be constructed to give a full 3 Mc/s bandwidth of truly "square" form and no problems of sound rejection arise. Finally, the straight receiver is not liable to radiate and cause interference with neighbouring receivers as may be experienced with superhets.

### ELIMINATING INTERFERENCE

**"I am in some difficulty regarding interference which is definitely picked up with the signal. I have tried one or two ideas unsuccessfully, and wonder if you can suggest any way of improving picture quality. I have tried adjustable interference suppressors in the circuit, and the only thing they do is to weaken the picture. The set is home-made, single dipole aerial, main road 400yds. from my house in the direction of the transmitter."—J. Trent (Twickenham).**

This is a common difficulty and it has been found that the most satisfactory plan is to increase the strength of the signal—not the interference. Obviously, the only way in which this can be done in a case such as yours is to use a very efficient aerial, accurately adjusted to the vision frequency. A multi-element array is suggested, and although this will pick up the interference also, the fact that the aerial is tuned will mean that the signal will be increased in greater proportion than the interference. A good attenuator should then be interposed between the lead-in and the receiver, and adjusted to weaken the signal to a level which calls for almost maximum gain in the receiver (contrast and sensitivity controls at maximum). It will then be found that the selective tuning will result in the interference being considerably reduced, and it should not be too troublesome. Interference-suppressing circuits should be left in the receiver, but should not be adjusted to the point where whites suffer.

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