A NEW COLOUR SYSTEM

PRACTICAL TELEVISION

AND TELEVISION TIMES

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EDITOR F. J. CAMM

A NEWNES PUBLICATION

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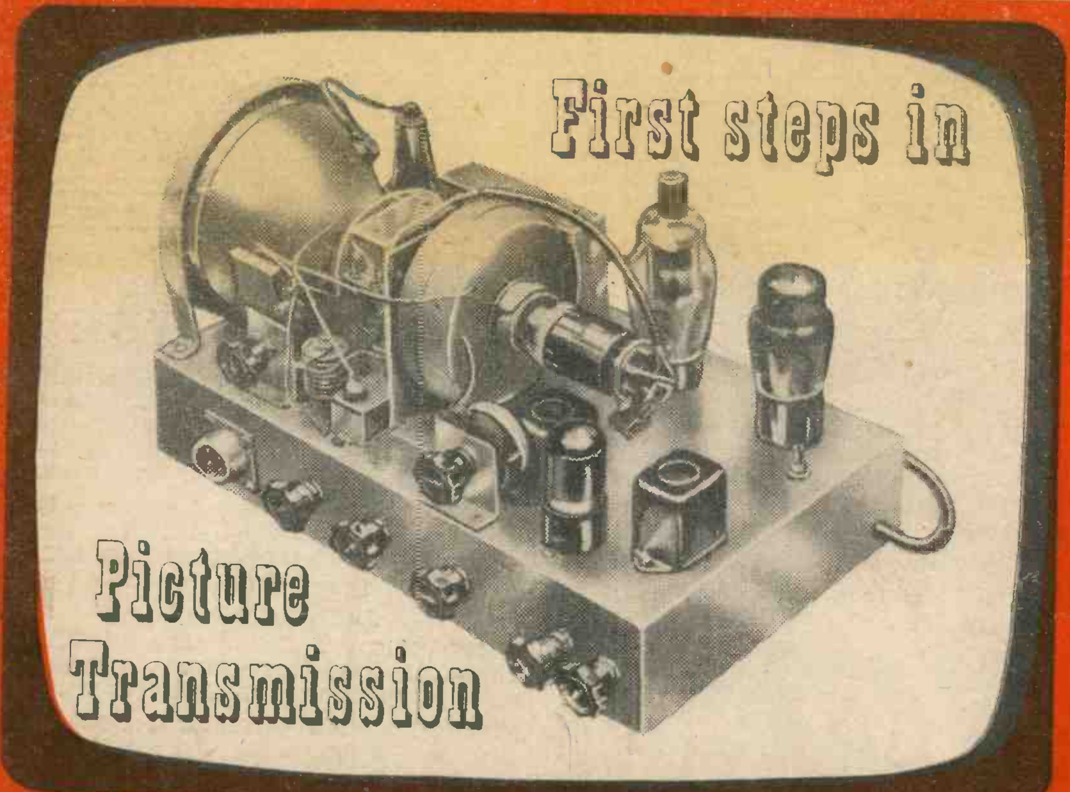

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Transitron Sync Separator
Are the 3 Mc/s Bars Necessary ?
Frame Linearity

PRACTICAL TELEVISION
& "TELEVISION TIMES"

Editor: F. J. CAMM

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TELEVIEWS

TELEVISION REDUCES CRIME

ACCORDING to the Annual Report of the West Ham Probation Officer, television is helping to reduce crime in London. The reason adduced is that leisure time is being spent less at the street corner and more in places of entertainment and education. This opinion is expressed, of course, in relation to the number of cases brought before the court in West Ham, but we do not think that this applies to the country as a whole. The gangs of so-called "Edwardians," who are in reality thugs, are on the increase. Their existence is said to be due to poor home life in homes where there is not the money nor the room for a television receiver.

Undoubtedly, television is changing the pattern of family life. We think, for the better, but there are those who for selfish reasons think otherwise. It is said that it destroys the desire for study and that children neglect their homework. The opticians imply that it damages our sight. The theatres, cinemas and public houses claim that the cause of their reduced and diminishing turnovers is the obvious fact that people remain at home watching TV programmes. Undoubtedly, TV is the cheapest form of entertainment today, and the criticisms directed against it are understandable. They must, however, be measured by the yardstick of experience of the radio industry when it was founded in 1922. Exactly the same criticisms were levelled against radio but none of the gloomy forebodings then made has been justified in the passage of 32 years of radio. Gramophone sales were to reach vanishing point, no one would require a gramophone record, the theatres, cinemas and restaurants would close up and indeed one would presume from the jeremiads of the time that radio was to be responsible for a great national cataclysm. Newspapers feared loss of sales and refused at one time to publish BBC programmes. Experience has shown that the sales of newspapers, gramophone records and gramophones have never been higher, although there was a temporary drop until the novelty of the new form of entertainment had worn off. So will it be with TV. People will become more selective in their viewing and not as now look in irrespective of the nature of the programme, merely viewing with the pride of possession and unconcerned with the quality of the programme they are viewing. People will make dates with their TV receivers.

TOOTH-PULLING ON TV

THE recent demonstration on TV of that usually painful process tooth extraction was, in our view, an error of judgment on the part of the BBC and in bad taste. Of course, the *raison d'être* of this part of the programme was to demonstrate that it is possible by hypnosis to extract teeth painlessly. Opinion is mixed regarding hypnosis and we think that some other form of demonstration would have suited. It is true that in the particular case the person concerned did not appear to suffer any great pain. In America they have for some time been telescreening major operations. We hope that that form of programme is not introduced over here. There are those who feel that hypnosis has yet to be proved. This is not the sort of programme that British listeners require and we hope that there will be no more of it.

"PRACTICAL TELEVISION CIRCUITS"

WE have recently published, at 15s., a new handbook of great value to all television enthusiasts, especially those who build their own receivers. The very first book on the subject, it contains in its 288 pages, illustrated by 156 practical diagrams and photographs, details of a number of highly efficient TV receivers, from a midget 3in. tube TV, which may be built for £9, to a 17in. tube receiver which may be built for half the price of a similar type of commercial receiver. There are designs for an A.C./D.C. and a combined TV and broadcast receiver, as well as designs for pre-amplifiers, spot wobblers, E.H.T. generators, a Pattern Generator and a Telesquare. Instructions for Building the Argus, the Super-Visor, and other PRACTICAL TELEVISION receivers are included. Builders of these receivers will wish to have constructional and operating details in this more permanent form. The volume is a companion to our "Practical Wireless Circuits."—F. J. C.

NOISE—Internal and External

A DETAILED EXPLANATION OF HOW VARIOUS FORMS OF NOISE ARE GENERATED

By M. Harknett

THE many different origins of electrical noise are described with special consideration given to the type of noise which limits picture quality in fringe television areas.

The most common forms of noise are listed below and the origin of each will be described in turn.

Internal noise		*External noise*
Thermal Agitation (or Johnson noise)		Man-made
Shot	Valve noise	Atmospheric
Partition	Valve noise	Galactic
Flicker	Valve noise	
Ion	Valve noise	
Current		
Circuit		

Internal Noise

Thermal Agitation Noise. This form of noise manifests itself in the very first circuits following the pick-up device in an amplifier, e.g., the tuned-grid circuit following the aerial of a television receiver, or in the first grid resistance of an audio amplifier.

Note: Where the word amplifier is used in the following descriptions this can mean an audio amplifier or an R.F. receiving circuit, e.g., TV receiver.

This noise is actually produced inside the tuned circuit or resistance itself, therefore, nothing external to the circuit can be done to reduce it, also this noise voltage is followed by the full gain of the amplifier and, therefore, determines the minimum signal level which can be used.

For a clear understanding of this form of noise the atomic theory of matter must be considered. This theory postulates that atoms are composed of one or more electrons revolving in orbits about a heavier nucleus which has a positive charge equal to the negative charge of the orbital electrons.

In a conductor these electrons are not all bound to stay with any one nucleus and one electron may change places with another electron in a neighbouring atom. Such electrons are called free electrons and these exchanges take place in a random manner between all the atoms in the conductor. If a battery is connected across the terminals of the conductor these free electrons will change places in a certain direction and in fact as they are negative charges they will move in the general direction of the positive end of the conductor. The electrons which left their atoms at the negative end of the conductor being replaced by electrons from the negative terminal of the battery. This flow of electrons constitutes a flow of what is called conventional current and which is in fact considered to flow in the opposite direction to the electron flow.

As was stated previously, in a conductor with no potential difference supplied to its terminals, these free electrons are in continuous random motion, and since a movement of electrons constitutes a flow of current, these random fluctuations of current produce a random voltage across the ends of the conductor, since it must have resistance.

The rate at which these free electrons move about depends upon the temperature. In fact this velocity is proportional to the absolute temperature. Therefore, at absolute zero, i.e., at -273 deg. C., there is no movement of these electrons, whilst at normal room temperature, i.e., about 300 deg. C. absolute, they are moving at a very high rate.

The random voltage produced by these free electrons contains frequency components of substantially constant amplitude spreading over the whole frequency spectrum from zero up to frequencies much higher than those used for radio communication.

The magnitude of this "thermal agitation" voltage is of the order of micro-volts and can be simply calculated from the following formula which is given for room temperature.

$$e=\frac{130}{10^{12}}\sqrt{R.B.}\text{ volts.}$$

Where R is the resistance of the circuit and B the bandwidth.

This formula is derived from the basic formula:

$$e=\sqrt{4\,KTRB}\text{ volts.}$$

Where K is Boltzmann's constant $= 1.347\times10^{-23}$.
T = absolute temperature.

E.g., for a resistance of 70Ω at room temperature preceding an amplifier with a bandwidth of 4 Mc/s:

$$e=\frac{130}{10^{12}}\sqrt{70\times4\times10^{6}}$$

$2.2\ \mu V$.

From examination of the above formula we see that the voltage depends upon the temperature, resistance, and bandwidth of the circuit.

The resistance term in the formula is not confined to a physical resistance, but is the resistive component of any impedance we are considering. For example, the thermal noise developed by a condenser would be zero as its impedance does not contain any resistance. In the case of an inductance the resistive component would be the winding and skin resistance at the frequency considered. The circuit which would have the largest resistive component at radio frequencies would be a parallel tuned circuit. At resonance such a circuit would have a resistive component called dynamic resistance given by the formula:—

$$Rd=QXc\text{ ohms.}$$

Where Rd is the dynamic resistance

Xc is the reactance of the tuning condenser.

Another important resistive term in the grid circuit of an R.F. amplifier valve is the input resistance of the valve. This is usually of the order of 10,000 ohms, and the noise power produced by this resistance is about five times that produced by the same value of resistance external to the valve. This is because the effective temperature of this resistance is nearly at cathode temperature and is usually considered to be at five times room temperature.

The bandwidth term in the formula is interesting as it is independent of centre frequency. This means that the noise voltage contained in a certain bandwidth at the lowest radio frequencies would be of exactly the same amplitude as the same bandwidth of noise at television frequencies.

Note: The bandwidth term when considering a receiver is the minimum bandwidth which the noise has to encounter and this is usually the I.F. bandwidth.

Shot Noise. This is noise produced inside the valve itself. The individual electrons striking the anode arrive in an irregular manner, not in a continuous stream of one after the other at regular intervals. This gives rise to a random current, and hence a random noise voltage at the anode of the valve. If the valve has a space charge, i.e., not all the electrons emitted by the cathode are immediately drawn to the anode but leave a cloud of electrons round the cathode, then this tends to smooth out the flow and reduce the noise. This is the reason why pre-amplifier valves are normally worked with a low anode voltage.

Shot noise is of exactly the same character as thermal agitation noise, i.e., it is of uniform intensity over the frequency spectrum. It can, therefore, be represented by a resistance generating thermal agitation noise. This resistance is considered to be in series with the grid of the valve assuming to be generating no shot noise.

This resistance is called the equivalent noise resistance of the valve and is usually given in manufacturers' catalogues of valves normally used in the first stage of amplifiers. Typical values are 500 ohms for triodes, 2,000 ohms for pentodes, and 20,000 ohms for frequency changers.

The more grids there are present in a valve, the more noisy it becomes due to the electron steam dividing up between these grids. This form of shot noise is called partition noise.

We can see from this that a triode is the best valve to use in the first stage of a very low-noise amplifier, e.g., the cascode pre-amp which uses a neutralised triode as the first valve.

To find the amplitude of the shot noise voltage we merely substitute the equivalent resistance of the valve in the thermal agitation noise formula.

Flicker Noise. This is noise due to random fluctuations in the working surface of the cathode coating of the valve. The amplitude of this form of noise is only larger than shot noise at frequencies lower than 200 c/s.

Ion Noise. This is caused by gases in the valve, the electrons emitted from the cathode knock electrons off the atoms of gas, causing the atoms to be ionised. These positive ions drift towards the negatively-charged cathode, thus upsetting the space charge. This can be the reason for a valve becoming noisy—due to the valve losing its vacuum.

Current Noise. This can be very serious in low-frequency high-gain amplifiers, e.g., tape-recording amplifiers, and is produced in carbon resistances carrying a direct current, e.g., anode loads. This noise is produced by varying contact resistance between the carbon granules and has the same origin as the familiar hiss produced by a carbon microphone.

In this type of amplifier it is, therefore, advisable to use wirewound or high-stability type resistances for the anode loads of the first stages; ordinary carbon resistances cannot be used.

Circuit Noise. This type of noise is not fundamental but can be troublesome and can be avoided by care in construction and use of good components. Poor valve bases and bad joints are probably the most common offenders.

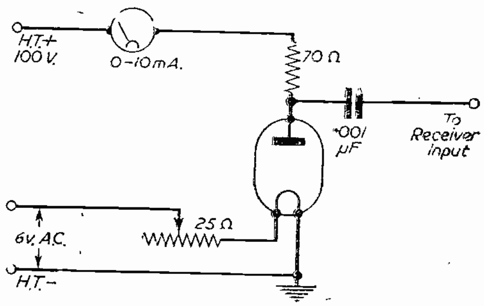
Valve Noise

All the common internal sources of noise have now been considered.

In discussing thermal and valve noise only the first stage was mentioned. This is because as long as the first stage has a power gain greater than four times, any noise produced by following stages is negligible in comparison.

This is normally the case in a reasonably well-designed first stage.

It is modern practice to use a factor called the noise factor to signify the noiselessness of an amplifier instead of the signal-to-noise ratio formerly used. Obviously, the signal-to-noise ratio depends upon the signal strength and, therefore, cannot be stated for any particular amplifier unless the signal strength is known.



Noise diode circuit.

Incidentally, the signal voltage appearing at the aerial terminals can be calculated from the formula:

$$V = G \times E \times h \ \mu V$$

Where G is the voltage gain of the aerial; E is the field strength in micro volts/metre; h is the effective height in metres.

The effective height has nothing to do with the actual physical height of the aerial, which is taken into account by the fact that the field strength is stated at a definite height, usually 30ft.

The effective height of a dipole can be calculated from the formula:

$h = \frac{\lambda}{2\pi}$ where λ is the wavelength of the signal.

For 50 Mc/s $\lambda = 6$ metres.

$\therefore h = \frac{6}{2\pi} = 1$ metre approximately.

Therefore, at television frequencies, the formula for the voltage at the aerial terminals simply becomes—

$$V = G \times E \ \mu V$$

E.g., for a field strength of 500 μV/metre, and an aerial with a gain of 6 db., i.e., a voltage gain of 2 times

$$V = 2 \times 500 = 1 \text{ mV}.$$

The noise factor of an amplifier is given by the formula—

$$N = \frac{\text{Signal-to-noise power ratio at output of amplifier}}{\text{Signal-to-noise power ratio at input of amplifier}}$$

A typical noise factor for a television receiver with a good pre-amp is 2, or this can be given in dbs., i.e., 3 db.

It is very easy to measure this noise factor using one of the special valves called noise diodes (Fig. 1).

Under temperature limited conditions (i.e., all the electrons emitted at the cathode are drawn to the anode leaving no space charge) the equivalent noise resistance is given by the formula—

$$\text{Req.} = \frac{0.05}{I}$$ Where I is the anode current in amperes.

The noise diode, is, therefore, a device which has a variable equivalent noise resistance which depends on its anode current which, in turn, can be controlled by varying the filament current, the anode voltage being kept at about 100 volts to prevent a space charge forming.

Note : The noise diode must have a tungsten filament since it is impossible to work an oxide-coated valve under temperature limited conditions ; the cathode would just disintegrate.

To make use of the noise diode an anode load is used equal to the impedance of the pick-up device which is normally fed into the amplifier. In the case of a television receiver this would be a resistance of about 70 ohms. The voltage produced across this anode load is fed into the receiver in place of the aerial voltage. The anode current of the diode is read by means of a milliameter and the filament current is varied by a rheostat. A microammeter is connected so as to read the second detector current.

The filament current of the noise diode is first switched off and the second detector current is noted. The filament current is then switched on and increased until the meter reads 40% more than it did originally. This means that the noise power has been doubled.

It can be shown that the noise factor of the receiver is then given by the formula—

$N = 20\,I\,R$ Where I is the anode current in amperes of the noise diode, and R the resistance of the anode load.

If I was found to be 3 mA and R 68 ohms.

$$\text{Then } N = \frac{20 \times 3 \times 68}{1{,}000} = 4 \text{ approx.}$$

External Noise

Man-made noise is well known to be due to electrical appliances, e.g., hair driers, vacuum cleaners, switches and car ignition systems.

It is seldom that this noise comes in via the mains lead of a receiver. It is usually radiated by the mains leads of the interfering device. This is why a suppressor should be placed as near to the electric motor as possible. This radiated noise is picked up on the aerial or down lead or in badly-designed receivers can be picked up directly in the I.F. strip.

When these sources are nearby they produce a very distinct pattern on the screen of a television receiver. As the source of noise is taken further away the pattern of this noise merges into a background of other man-made noise, and if a very large number of these distant sources are present, as they would be in a town, then this noise loses its distinctive pattern and becomes random and almost indistinguishable from thermal noise.

Atmospheric noise is due to electric storms and manifests itself on a communications receiver by a distinctive crackling noise. Atmospheric noise is negligible at television frequencies but can be serious on the long wavelengths used for radio communication.

Galactic noise as its name applies is noise arriving from the galaxies, it therefore varies in intensity hour by hour. It is only greater than thermal noise in a frequency range between about 10 and 80 Mc/s. Galactic noise can be the limiting factor, as far as signal-to-noise ratio is concerned in country areas, but as already stated man-made noise is probably the limiting factor in towns.

Limiting Factor

At normal television frequencies, if a reasonably good first stage is used, the limiting factor of picture quality in a television receiver working in a fringe area will be determined by external noise. It is therefore useless to try to improve reception by using very low noise pre-amps., e.g., the cascode pre-amp, or to place a pre-amp at the top of an aerial mast, because the noise introduced by the ordinary pre-amp will be less than the random noise picked up on the aerial. Of course, a very noisy first stage or very noisy pre-amp can produce more noise than that picked up on the aerial, but under normal conditions a conventional R.F. amplifier circuit using a low noise pentode, e.g., 6AK5, will be more than good enough.

In conclusion then, provided the noise factor of a television receiver is reasonably low the only way to improve the signal-to-noise ratio is to use as an efficient aerial system as possible, which means using a good aerial and erecting it as high as possible.

New Emitron Camera

THE BBC has placed an order with Emitron Television Ltd., for 17 latest type Emitron television cameras and associated vision channels.

This equipment will replace some of the older camera channels now in use and provide for further expansion of the BBC Television Service.

The cameras incorporate the new Emitron camera tube type 5957—the latest development in the range of Emitron tubes. The original Emitron—produced in the same laboratories of E.M.I.—was the first electronic television camera to be used in this country and helped to launch the BBC Television Service in 1936.

Higher Definition

The 5957 tube is a considerable advance on previous types : its features include improved definition and contrast range, complete stability under all operating conditions, and absence of picture distortion. It also features the traditional freedom of the Emitron from dark haloes around bright objects.

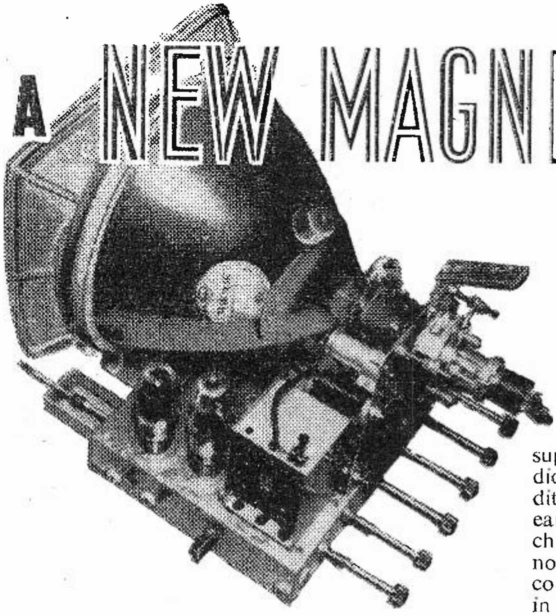
Overall picture quality provided by these new channels is comparable with the highest photographic standards.

Modifications have also been made to the mechanical design of the cameras to ensure greater ease of operation and handling in use.

They have turrets incorporating four lenses, remote controlled light density filters and improved picture monitors to simplify operation. The control units also feature improved picture monitors.

Full technical details of the new Emitron equipment will be released shortly ; delivery of the first channels to the BBC will commence in about 15 months.

A NEW MAGNETIC RECEIVER



CONSTRUCTIONAL DETAILS OF AN ECONOMICAL RECEIVER UTILISING SURPLUS COMMERCIAL RECEIVER COMPONENTS

By J. Cook

(*Continued from page 7, June issue*)

BIAS on the tube opposes the change. There are, however, two effects associated with this arrangement due to the reduction in D.C. level as there will be a tendency for the flyback lines to be more apparent whilst there will be less change between brightly illuminated and darker scenes. It will be seen under the frame time-base section that the former point is taken care of. Flyback lines are virtually eliminated by a special circuit arrangement whereby frame flyback pulses are fed into the tube biasing circuit and so arranged that the tube grid is biased back to cut-off during the flyback periods and no flyback lines are visible. The loss of D.C. component is not great and does not seriously affect any artistic effects portrayed on the screen. In any case, by removing the need for frequent readjustment the easy enjoyment of programmes is greatly enhanced, thus countering any theoretical objections. This is the essence of simplicity, but there are, of course, more complicated "gating" A.G.C. circuits which have been discussed on these pages before. Whilst such circuits are more efficient outside service areas, there is, in the author's view, no need for them under normal conditions. Even where aircraft interference is experienced there is little that can be done to counter the out-of-phase signals which arrive at the receiver and cause all the trouble, except to install an efficient aerial. In this connection, the "X" variety seems to be particularly helpful.

Vision Limiter

A vision limiter of some sort appears to be an essential item in even the quieter localities. Apart from one or two unorthodox types, such as the "black spotter," there are basically two types to choose from and one's choice does, to some extent, depend upon the average intensity of interference experienced. In Fig. 1 the cathode is connected to the anode of the video valve and the diode-anode is connected to a potentiometer (R7) across the H.T. supply. The bias is set manually by R7, so that the diode is non-conductive under normal picture conditions, but conducts and virtually short circuits to earth via C6 when interference pulses occur. The chief drawback of this arrangement is that it does not follow the brightness level of the picture and, in consequence, interference can still be fairly noticeable in the darker areas of picture. The second choice at Fig. 2 shows an arrangement whereby bias is set automatically and, therefore, does not suffer the disadvantage of the circuit. The cathode is similarly connected but a high value resistor (R6A or R7A at will) shunts the diode whose anode is taken to earth by C6A. This condenser is charged through R6A/R7A to a value determined by the peak white content of the picture but, due to the long time-constant of the combination, when interference pulses occur and the cathode is taken negative the anode is unable to follow and the diode conducts to short circuit the video output. The chief disadvantage of this arrangement is that the diode does actually conduct at all times on peak "whites"; though this is very slight, nevertheless some debasement of picture quality is bound to occur.

The author has tried both of these limiters and has favoured the former, if for no other reason than that it is reassuring to have the knowledge that by manual adjustment the picture quality will not be debased if it is so adjusted as to have no effect on peak "whites." However, as mentioned above, the latter circuit does automatically follow the D.C. level of the picture and is probably the best arrangement when interference of a heavy and continual nature is encountered and some slight loss in the "whites" becomes relatively unimportant.

Sync Separator

The simple sync separator capable of giving perfect results has not yet been devised, and once again the design depends in varying degrees upon the strength of signal received, degree of interference experienced and the accuracy of interlace desired. If located in a fringe area with bad TVI one of the more complicated types such as "flywheel" sync separation might be justified, because the line tearing experienced with the simpler types can be intolerable. But under average conditions the single pentode stage is quite adequate and, as used in this receiver in combination with a multivibrator frame oscillator, an extremely accurate and reliable interlace is obtained at the optimum setting of the frame hold control. The usual diode line pulse remover in the integrator circuit to the frame oscillator does not appear to be necessary and has not therefore been included.

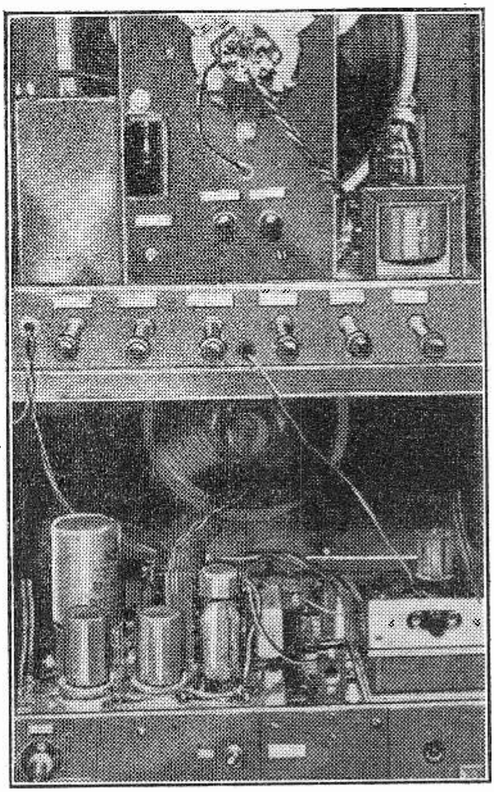
An EF50 is used in this position but almost any similar pentode in the same general category may be used. Negative-going output from the video stage is coupled via R11 and C7. The series resistance R11 is important as it limits grid current to the valve resulting in the removal of the tips of the positive sync pulses which include interference peaks. This provides more even synchronisation, particularly to the line oscillator, which is especially prone to trouble from interference. R10 is the grid leak. Positive-going sync pulses produce grid current which biases the valve into cut-off conditions, eliminating the negative-going picture modulation and effecting D.C. restoration between cathode and control grid. After amplification the locking pulses are applied via a differentiator formed by R12, C9 and R22 to the screen of the self-oscillating line output valve whilst the frame triggering pulses developed across R13 are passed via the integrator circuit comprising R14, R15 and C11 and applied to the frame oscillator via C17 and R44.

Frame Timebase

The oscillator is a double triode (6SN7/GT) multivibrator type, sometimes known as a " See-Saw " or " Flip-Flop " oscillator. The usefulness of the multivibrator arises from the fact that the frequency of oscillation is readily controlled by an injected voltage and hence it is easily triggered. It is, in effect, a two-stage resistance-coupled amplifier in which the voltage developed by the output of the second valve is applied to the input of the first valve and gives rise to sustained oscillations due to the phase shift which occurs. Effectively, each half of the oscillator is switched on and off alternately each cycle, the duration of each part-cycle being determined by the time constants of C29, R43, R44 and C32, R45, R46. Negative-going sync pulses are applied to the grid of V6A through a potential divider R43 and R44. Of the time constants, one is made variable by making R45 a variable resistance which functions as the frame locking control. Output from V6B anode is taken through C28 to the grid of the frame output valve (EL33 strapped as a triode) where the sawtooth output from the oscillator is amplified and passed through the impedance matching transformer T2 to the deflector coils. Any non-linearity present in the oscillator output and in the frame amplifier itself is corrected by operating the EL33 at a point of its characteristic curve which produces equal and inverse non-linearity and by negative feedback, both of which are variable for optimum adjustment. The advantageous portion of the EL33's Eg/Ia curve is selected by a variable cathode bias resistor R39 and primarily controls the central portion of the picture, whilst negative feedback applied from the anode to the input via C26 and variable R36 influences linearity at the top of the picture. The negative feedback is particularly necessary to offset the waveform distortion which is experienced in this, as in others, due to the difficulty in designing a transformer possessing sufficient primary inductance with reasonable economy. R38 and R37 are grid and screen stoppers respectively—probably not necessary—but fitted as an insurance against any possible parasitic oscillation which may set up. R31 across the coupling transformer (T2) secondary and deflector coil is included for the purpose of reducing the line frequency voltages set up in the deflector coil by unavoidable coupling from the line deflector coil.

One of the unusual features of this receiver is the employment of D.C. shift controls for picture centring. When picture centring is effected by physical movement of the magnet or focus coil, it invariably means that the focusing device cannot be aligned with the axis of the C.R.T. and provide uniform focus. With the alternative method used here, the focusing device can be aligned with the tube and picture centring is effected by introducing D.C. into the deflector coil, the polarity of which can be varied by means of a centre-tapped potentiometer. This potentiometer has a voltage drop across it due to the receiver H.T. supply flowing through it, thus producing the one or two volts of bias which is all that is required to deflect the picture by any reasonable degree.

Another feature associated with the secondary of the frame transformer is the device for cancelling out the flyback lines on the picture which, as explained earlier, are probably a little more prominent than would otherwise be the case due to the slight loss of D.C. component in the C.R.T. modulation feed circuit. The amplified saw-tooth pulse is tapped from one side of the frame coils as indicated, and introduced into the C.R.T. bias circuit via the brilliance control



View of the rear of receiver.

R28 causing the tube to be cut off during flyback periods. Combined with this is a tube safety circuit which eliminates the residual spot on the C.R.T. screen which might otherwise appear when the set is switched off. With this arrangement when the set is switched off the H.T. voltage applied to the video stage (and hence the cathode potential of the picture tube) decays very rapidly but because of the time constant of C19, R27 the potential of the tube grid decays at a slower rate and maintains beam current at a sufficiently high value to discharge the E.H.T. capacitor before the scanning voltages have disappeared. At some instant during this period the voltage between grid and cathode assumes a value at which grid current flows. This current is limited by R49 and prevents the grid/cathode potential exceeding a value of +1 volt which is the prescribed value for the MW31/16 picture tube.

Line Timebase

Amplified sync pulses from the anode of V3 are applied via the differentiator circuit R12, C9 and R22 to the screen of the single valve (EL38) self-oscillating line timebase section where the negative-going sync pulses lock the oscillator. In this circuit the control and screen grids of the EL38 function as a transitron oscillator and T1(b) provides the necessary loading inductance. An extension T1(a) of T1(b), on the auto-transformer principle, provides the E.H.T. voltage from the high peak voltages which occur in T1(b) during the flyback period due to the sudden collapse of anode current at the end of each cycle. Rectified by V5 and smoothed by C15, some 7 to 8 kV. is supplied to the final anode of the picture tube. With coated tubes, C15 may be the capacitance formed between the exterior Aquadag coating and the interior final anode ; otherwise it should be a separate component. Of the two secondary windings, T1(c) supplies the necessary heater voltage for the E.H.T. rectifier, which is 6.3 volts at 0.09 amps., and T1(d) couples the output from the line amplifier to the deflector coils L1/L2. As in the frame deflector coil circuit, D.C. shift controls are incorporated so that

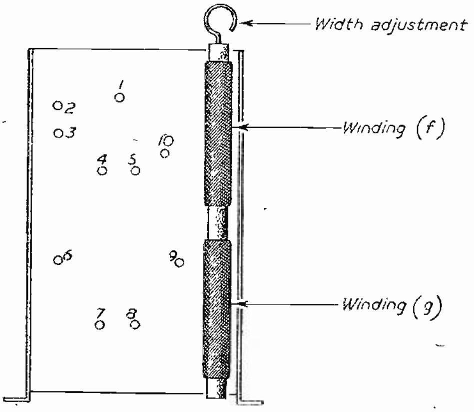


Fig. 4.—Wiring connections for line output transformer. The transformer is Plessey Type SL7 (Part No. CP 72036/2). The earlier CP72036 may be found to have tag 10 missing. In this type, the appropriate additional connection to tag 9 must be separated if the shift controls are desired. If shift controls are not desired, tag 9 (and 10 if fitted) should be returned to chassis.

the picture can be centred horizontally by means of the variable bias control already described. Strictly speaking, this particular feature is a de luxe item and may, of course, be omitted if it is desired to keep to the " no frills " lines of the rest of the receiver. A separate winding is provided on the line transformer for the control of picture width and the inductance of this is variable by means of a plunger-operated iron-dust core. Part of this variable inductance is shunted across T1(c) to form a variable load to balance the effect of adjustment of width, which would otherwise alter the loading on T1(d), T1(c) and hence vary linearity and E.H.T. Adjustment of line linearity is inter-related with the line hold control but, once the linearity is adjusted, it is unlikely to require further adjustment until the EL38 loses emission and requires replacement. The high efficiency core material used in this transformer results in low self capacitance and core losses with a consequently well-preserved waveform. With the 7-8 kV. E.H.T., ample width is available without the use of the usual efficiency diode and there is a complete absence of foldover in the left side of the raster.

Power Supply

The mains transformer is auto-wound to provide 300 volts A.C., or 260 volts D.C., at 250 mA. after rectification. The anodes of the 5U4/G rectifier (V8) are connected together via the surge-limiting resistors R33 and R34, and the rectifier is operated as a half-wave rectifier. This is necessary because of the auto-transformer, used here for cheapness. One side of the chassis is therefore connected to the mains supply and due precautions against shock should be observed. It is advised that a three-pin non-reversible power plug and socket be used for the mains input and that the neutral side of the mains should be connected to the chassis. When the set is switched off an additional precaution is to use a double-pole on/off switch, combined in the author's receiver with the volume control, so that the chassis is completely isolated from the mains.

The advantages of the transformer are : (1) a fixed value of H.T. is obtained irrespective of the mains voltage tap, and also a higher voltage than the mains is obtained because of the auto-wound extension of the transformer primary : (2) a constant voltage heater supply is provided by the transformer secondary. The transformer secondaries provide 6.3 volts for all heaters (except the E.H.T. rectifier, H.T. rectifier and C.R.T.), and a 5 volt winding supplies the H.T. rectifier heater. A separate heater transformer is provided for the picture tube only, though this might equally be an additional winding on the main transformer if such an item can be obtained. It was, in fact, a specially wound low-capacity type which the author used in order that a cheaply obtained heater/cathode shorted tube could be used. The use of such a tube is, of course, something of a gamble, and performance can only be guaranteed with a new tube. A separate winding is desirable, in any case, because the heater and cathode can then be effectively operated at the same potential by strapping them together with a resistor (R25) which is of sufficiently high value to avoid A.C. modulation of the cathode. There being no current flowing through R25, there is no voltage drop, and no breakdown between cathode and heater can occur. Thus, this most expensive item in any TV set is protected from this all too common cause of premature failure (due to the fact that many commercial TV receivers have a potential difference of 100 to 200 volts between these two points). Main H.T. smoothing is by C20, C21 and Ch.4. The values of smoothing condenser are much higher (60 plus 100 μF) than those required in normal radio practice, and this is mainly because of the high ripple current which the reservoir condenser must handle and also the requirement of the timebases for a high degree of smoothing. Whereas a small amount of hum in an ordinary radio receiver may be tolerable, especially if the speaker system is inefficient at 50 cycles, hum in a TV receiver would produce pictures with sine-wave edges and would be unacceptable. Another reason for the high value condensers is the necessity to keep the D.C. resistance of the L.F. smoothing choke, Ch.4, as low as practicable to avoid the loss of the precious H.T. volts. A low-resistance L.F. choke inevitably possesses low inductance, if it is to be economically produced, and hence higher capacities are necessary to obtain the desired degree of smoothing. These condensers should be of the special TV type capable of handling the high ripple currents, which may be something like twice the D.C. supply for the receiver, and these are mounted a respectable distance away from the rectifier and other particular sources of heat. This is because the working voltages are adversely affected by quite moderate changes of temperature from those specified by the manufacturer.

Constructors appear to be often tempted to use alternative rectifiers and, in fact, there is a variety of alternatives to the 5U4G specified. But there is a number of points to be borne in mind if it is decided to use one of them. The minimum series resistance for a 5U4G is 75 ohms to protect the valve from the high current which flows when switching on due to electrolytic surge. The transformer accounts for about 30 ohms so that two resistors of about 45 ohms are necessary in each anode lead. The minimum value varies considerably from one type of rectifier to another and, consequently, the appropriate value should be ascertained from the manufacturer's published data when using alternatives. Failure to observe this requirement may result in the early demise of the rectifier, especially in view of the high

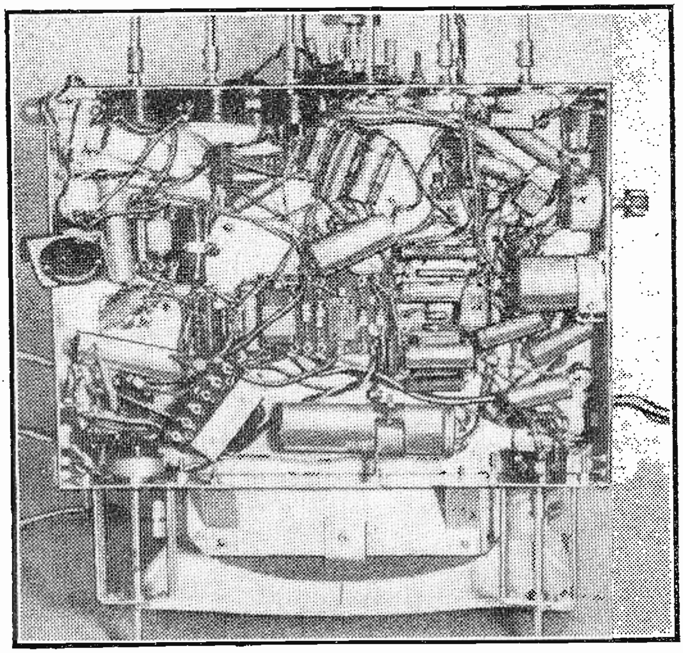


Fig. 3.—Underside view of chassis.

value of reservoir condenser necessary in this application. The other point is that it is important to maintain the H.T. rail at no greater potential than 250 to 260 volts because, since the E.H.T. rectifier draws its heater supply from the induced voltages in the secondary of the line transformer, as already described, any increase of H.T. voltage will produce a proportionately greater voltage in the secondaries of the line transformer and hence may overload the E.H.T. rectifier heater. Such an increase may occur if a rectifier other than the 5U4G is used, because the voltage drop characteristic varies from one type to another and most of the possible alternatives will drop a lesser voltage. In that event, more resistance in the form of a higher resistance L.F. smoothing choke or a series-dropping resistance would be desirable. The design of the vision/sound strip illustrated allows for a consumption of about 70 mA. (including video amplifier but not the sound output valve), which is average. Any substantial deviation from this will reflect on the load to the rectifier and hence vary the supply voltage.

If a tetrode picture tube is used, such as the MW31/16, the voltage of the H.T. rail will be inadequate to supply the 200 to 410 volts specified by the makers, as these voltages are with respect to the cathode of the tube and not to chassis, which is more customary.

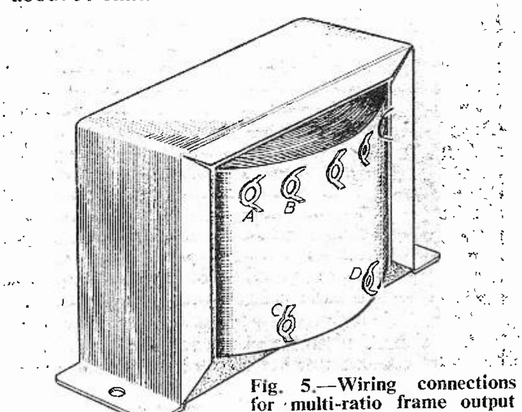


Fig. 5.—Wiring connections for multi-ratio frame output transformer.

(To be concluded.)

THE MARCONI COLOUR SYSTEM

SOME DETAILS OF A RECENT DEMONSTRATION

SOME time ago we gave details in these pages of the colour system which has been approved for use in the United States. Known as the N.T.S.C. system this is a process which permits the user of a black and white receiver to pick up the transmission in black and white with quality as good as that obtained from a normal black and white transmission. This is known as "compatibility" and obviously the same requirement must hold good with any colour system which is used in this country. Just as at the cinema there are still black and white pictures, so it is anticipated that when colour is introduced it will be a long time before all transmissions are in colour, and users of the older types of receiver must not be penalised in any way. The Marconi Company have carried out experiments at their depot at Great Baddow with a view to trying to adapt the N.T.S.C. system for the British picture standards which are, of course, vastly different from the American. In addition they have developed another system which overcomes some of the faults of the N.T.S.C. system, and which they have termed "Wide Band," and we witnessed demonstrations of both of these systems recently in London.

For the benefit of those readers who are not familiar with the N.T.S.C. system it may be briefly described as a process whereby bandwidth is saved by transmitting details only in black and white, plus *two* colour transmissions. By eliminating the third colour and transmitting detail in black and white considerable saving in bandwidth is obtained, and it is not a difficult matter to so arrange things that at the receiving end subtraction of one colour from the other will produce the third. Usually, it is found that red and blue are the actually transmitted colours, green being obtained from coding circuits.

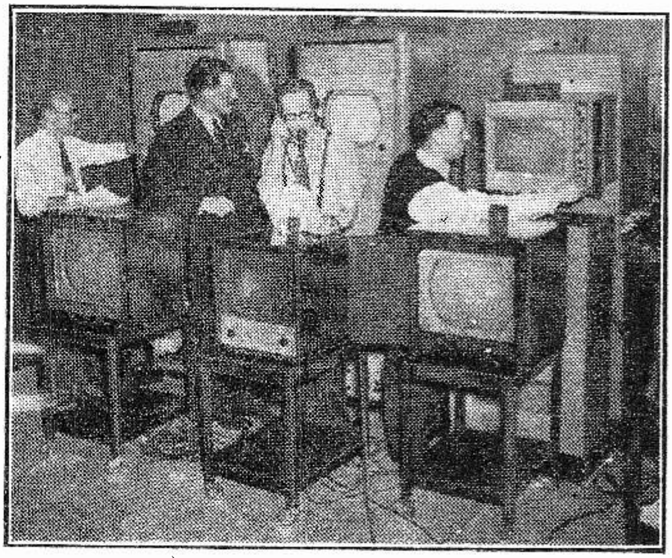
The British N.T.S.C. System

Developing the above arrangement the Marconi Company have perfected one system in which the colour video signal is designed to give three-colour presentation of the scene being scanned for video frequencies from D.C. to 0.4 Mc/s, two-colour presentation for intermediate video frequencies lying between 0.4 and 1 Mc/s, and monochrome presentation for the frequencies lying between 1 and 3 Mc/s—that is, it is all contained in a band of 3 Mc/s.

An alternative system is known as "Wide Band" and it is claimed for this that the compatibility is improved and better colour rendition obtained, but has the drawback that the bandwidth is considerably increased—a normal 3 Mc/s band being devoted to the detail alone. This could, however, be used on the proposed new commercial frequencies in Band III.

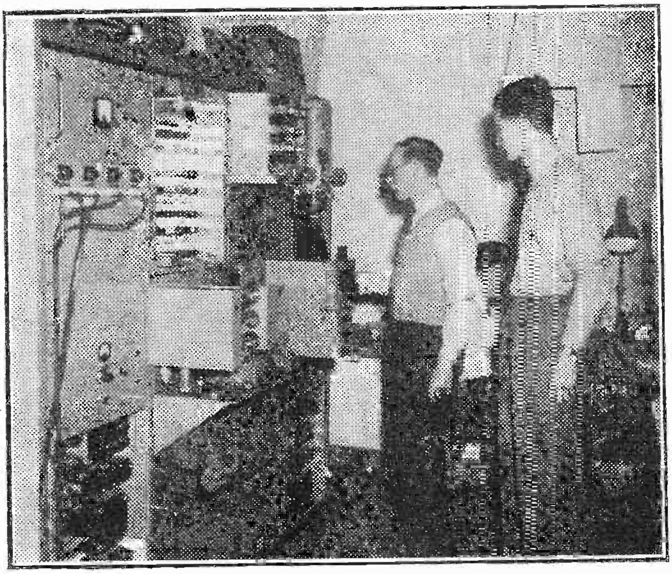
At the demonstration four colour receivers were installed, two being fitted with R.C.A. standard colour tubes—one of the metal type and one of glass, in addition to two Marconi receivers in which special projection tubes were employed. All these receivers were, of course, of the metal laboratory type and not suitable for domestic use, as they were complete with various switching circuits to enable comparisons to be made.

In the Marconi receivers three projection type tubes were employed, and these each had their own optical box. The outputs were aligned to form a single picture and it was impossible to distinguish between the registration of these, and of the grid in the American type receivers. Of course, these were laboratory instruments and no doubt the alignment was carried out by more elaborate means than could be incorporated in a domestic type of receiver, but it showed that it was possible to reduce considerably the initial cost of a receiver—a single colour tube of 15in. or 16in. diameter costing considerably more than the small tubes both initially and on the score of replacement. In the latter case it would, of course, be unlikely that the three tubes would fail at once and therefore a single tube only would need replacement at one time at a very considerably



The colour receivers and three commercial black and white receivers at the demonstration.

reduced figure compared with the large colour tube. One point which arose in this connection, however, was that each tube has to be accurately adjusted to preserve the balance in the colour picture. It may be possible, for instance, that the red tube would produce a stronger picture than the other two colours, thus giving undue emphasis to the red tones in the picture. That is, however, a matter of design and no doubt may be easily overcome in production models of a receiver of this type.



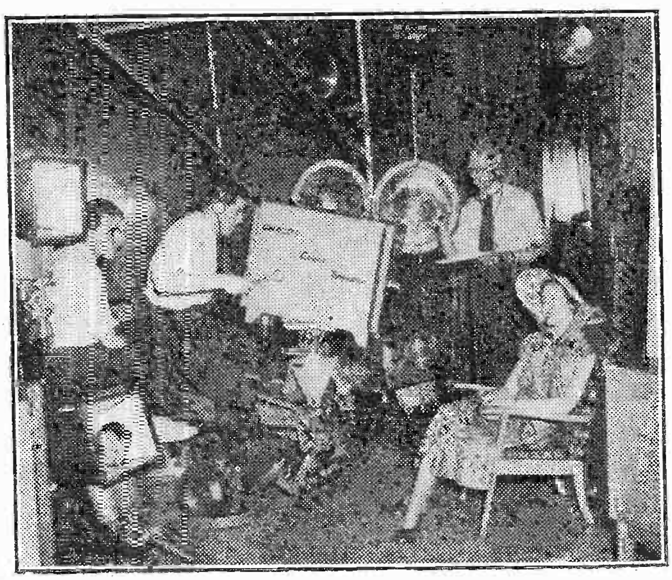
The flying spot film scanner used to show " still " images at the demonstration.

In addition to these special receivers there were half a dozen standard commercial receivers which enabled black and white pictures to be received for comparison. Indicators beneath the receivers showed what system was in use at any time, and it was possible to compare the two systems both as to colour rendition and compatibility. On the latter score the wide band system gave less colour interference, which was seen on black and white receivers as a form of "noise," the small moving dots in dark areas. From the colour point of view there was little to be said between the two systems, the stills and also the live transmissions coming over with remarkable clarity and very little trace of fringing. In view of the complexity of the installation for switching, etc., this shows that the two systems are remarkably good and on actual broadcasts should prove very satisfactory.

The actual demonstration was, of course, carried out by direct means, the receivers and transmitters being separated by only a matter of a few feet. In this " hook-up " the complexities of inter-switching so that comparisons could be made between the two systems and between black and white and colour no doubt introduced difficulties, but whether these had as much effect on the demonstration as would car and similar interference on an actual " live " transmission, we are unable to say, but it is highly probable with modern circuit design that the effects would be much less than the switching arrangements and therefore a " live " transmission should be much more reliable.

New Camera

In conjunction with this demonstration the Marconi Company were using a new type of camera in which the three tubes of the American model have been reduced to two. There are two normal types of camera, those employing three tubes and those with only one. In the former, the red, green and blue images are focused on to the three tubes and the outputs are then mixed. In the single tube either a sequential camera is employed, i.e., one with a rotating disc in front of it, and in the other a fine grid is interposed so that the three-colour signals are obtained at each individual picture point. In the new Marconi camera two tubes are used, one providing a high-definition monochrome picture of 3 Mc/s bandwidth, and the other giving two low-definition colour signals. Readers might like to be reminded that this new camera is, like the N.T.S.C. colour system, based on the fact that the human eye is unable to see fine details in colour.



The transmitting end. The new colour camera and a model.

Frame Linearity

THE MOST COMMON TROUBLES OUTLINED, AND THE REASONS EXPLAINED

By W. J. Delaney

PROBABLY the most common complaint from readers who have built their own receiver is one of poor frame linearity. This is not always recognised as the actual defect, and querists often give elaborate sketches showing the form taken by the picture and asking for assistance in overcoming the trouble. Line linearity troubles also exist, of course, but are not so often reported because they do not make a great deal of difference to the picture. Poor linearity on frame, on the other hand, results in foreshortened figures, people with big heads

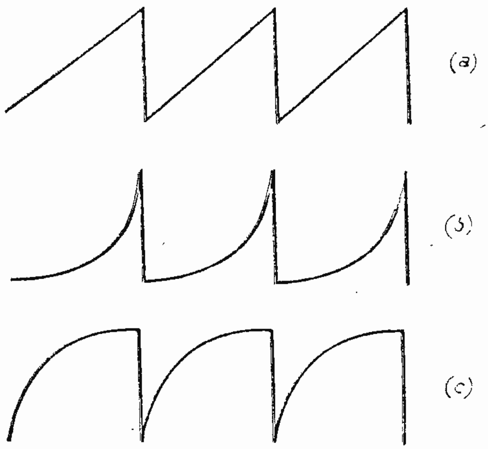


Fig. 1.—A saw-tooth and two distorted forms of it at (b) and (c).

and, in extreme cases, completely flat-topped heads or cut-off legs. In order to appreciate the causes of these troubles it is desirable to see exactly how the frame timebase operates, and the following explanation, although not technically exact, will serve to explain the rough principles and show how the troubles may be overcome. The timebase consists essentially of an oscillator and an amplifier, and the final output should be a saw-tooth waveform. This is shown in Fig. 1a, whilst two common distorted forms are shown in 1b and 1c. The oscillator produces the actual saw-tooth, and the amplifier steps up the output so that the frame coils may be fed with a sufficiently strong signal. To understand how it works let us remove the line scan, and then on the picture-tube face we should get a vertical line down the centre of the tube. If there were means for slowing-up the speed of the scan we should find that it is actually a dot travelling from the top to the bottom of the screen. When the line scan is added to this it makes the spot travel from side to side. However, let us see how this spot actually travels. If we take a perfect saw-tooth waveform and just look at the scan stroke as in Fig. 2, we can plot time along the base and then if we divide it into equal periods of time and project these to the side we find that the scan stroke pictured on the right will have travelled half-way down its stroke at half time, and so on. In other words, it progresses at a perfectly regular rate of time from top to bottom.

Distorted Waveforms

In Fig. 2b the waveform has been shown in a distorted form, and although the projected scan on the right is still exactly the same length and is not bent in any way, we find if we project the time periods that the first quarter of the stroke takes much longer to make than the next quarter. In other words, if we made this scan very slow we would find that the spot would travel very slowly down a quarter of the screen, would then speed up, and over the last quarter would be travelling very much faster than at any other part. In Fig. 2c the opposite effect would be obtained—the spot would travel very rapidly down three-quarters of the screen and would then slow up to take much longer for the last quarter. In the extreme case shown in Fig. 2c, the spot would travel slowly for a quarter of the trace,

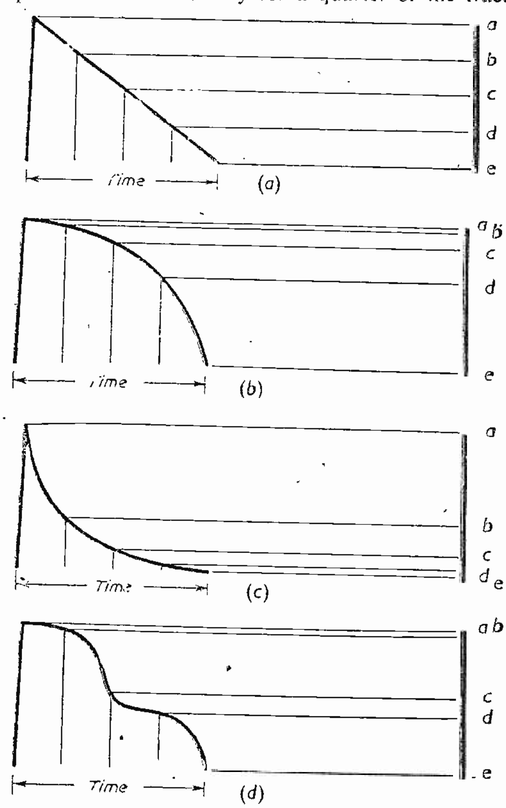


Fig. 2.—These illustrations show how a distorted waveform can result from a poor shaped saw-tooth input.

speed up and then slow up again to finish the last quarter. Obviously these variations in speed will result in the objects being distorted in the same way, and the scanning lines will be closer together where the scan is slowest and wide open where it is fast. Naturally all objects will be distorted in this form.

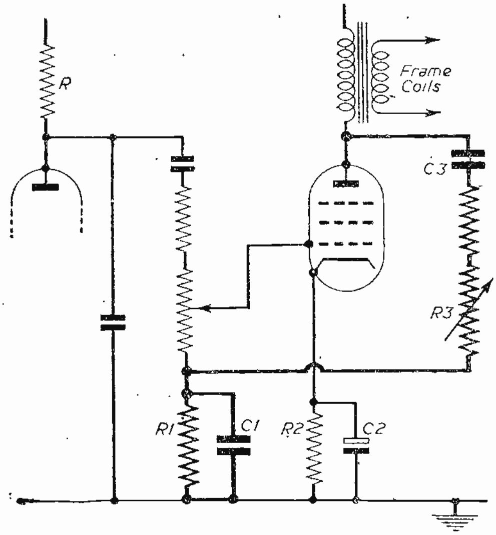


Fig. 3.—Frame timebase by Haynes. The feedback is shown in heavy lines.

From what has been said it is obvious that it is the final output which is most important, and it would be quite in order for the oscillator to deliver an output of the shape shown in Fig. 2b, so long as the amplifying valve output was distorted in the opposite manner, as then the two would cancel out and the result would be the straight line of Fig. 2a. Actually, the amplifier cannot easily be adjusted to produce a characteristic of the type shown in Fig. 2d, although by heavily biasing it we can obtain an output which rises very slowly and then speeds up, correcting an oscillator output of the type shown at Fig. 2c. Low bias will also produce a quick rise with a falling off at the top, and it will therefore be seen that the bias applied to the output stage is very important.

Feedback

As the final characteristic is the thing that matters it is obvious that any fault will have to be traced right back to the oscillator, and in the case of a design which has been published, the designer will have found the waveform which the prescribed oscillator delivers and so arranged the amplifying stage that the desired correction takes place, and therefore there are any number of components which can cause trouble by a variation from the specified value. Take, for instance, the frame timebase shown in Fig. 3. The value of the anode load resistor of the oscillator stage will affect the amplitude of the output from that stage, and if it goes high due to the use of a component of too small wattage, or to the passage of a heavy current, it will reduce the output by virtue of lowering the H.T. applied to the valve. Condenser C will also affect the output slightly. The input to the amplifying stage is in the form of a standard L.F. volume control and thus enables any desired voltage to be tapped off, thus forming an effective height control. At the lower end of this height control is a resistor and capacitor to which the output is coupled through a R.C. network. This feedback circuit is shown in heavy lines, and serves to correct the distortion in the applied waveform as already described. As an indication of the effects produced by the various components, a reduction in the value of C2 closes the top of the picture as also does a reduction of C3. However, whilst C2 controls only the top of the picture the main feedback components R3 and C3 control both top and bottom inversely. That is to say, as C3 is increased in size it closes the bottom and opens the top of the picture. By suitable choice of all the items the desired linearity may be obtained. The question of bias has already been mentioned, and therefore the value of the biasing resistor should be carefully chosen. Over-biasing by too large a value will bring the working point well along the bottom of the valve curve, whilst too small a value will result in the valve running into grid current with the result that the opposite effect will be produced.

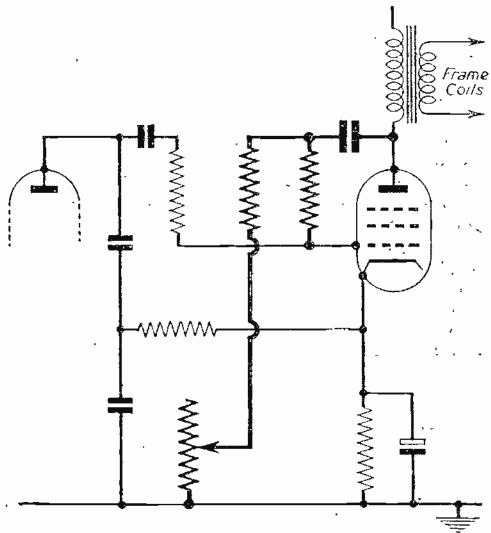


Fig. 4.—This is the Super-Visor frame timebase. Again the feedback is shown by heavy lines.

The frame circuit of the Super-Visor is shown in Fig. 4 and it will be seen that this is slightly more elaborate, but maintains the same general principles. The feedback circuit is also shown in heavy lines, whilst there is a further coupling between the input and the cathode. The most important component in this circuit is the resistor connecting this part of the circuit to the cathode.

Pages from a TELEVISION ENGINEERS Notebook

18.—VERY WIDEBAND AMPLIFIERS

ALTHOUGH the use of a video amplifier having a bandwidth greater than some 3 Mc/s is not necessary in the output of the present-day television receiver, the design and operation of amplifiers having bandwidths considerably in excess of this figure should be considered and understood by television engineers generally. Such amplifiers are used in some measuring instruments, particularly oscilloscopes dealing with the examination of extremely short pulses, and they will no doubt eventually be used in television systems.

In Part 9 of this series, the normal video amplifier stage was covered, and the various elementary formulae concerning its gain and bandwidth were considered. We shall refer back to some of these results here, where the amplifier having bandwidths up to 100 Mc/s will be dealt with. This figure is so large compared with the common 3 Mc/s of the video amplifier, that it might be thought that special valves would be necessary to cover it. This is not so, however, although special circuit techniques are necessary.

We have seen previously that the gain of a video amplifier with a resistive load R is constant up to a frequency $Fo = \frac{gmR}{\sqrt{2}}$ providing that R is small compared with the valve resistance Ra, as is always the case in practice. The important equation, however, is the gain-bandwidth product which is given by $\frac{gm}{C}$ where gm is the slope of the valve and C the total valve and circuit capacities. It can be shown that the maximum gain-bandwidth value with a four-terminal coupling is given by $\frac{0.8\ gm}{C}$ and that the value will decrease if either gm is reduced or C is increased. For the maximum gain over the greatest bandwidth, therefore, gm must be large and C small.

It is usual in video design to arrange the anode circuit capacity of the valve and the input capacity of the following valve to form a low-pass filter, the anode load R forming part of the filter termination. A simple form of this is shown in Fig. 1. The bandwidth of the system is then increased, but even in this instance if it is required to increase the width the magnitude of R, and hence the amplification, must be correspondingly decreased.

Now in order that the amplification should be greater than unity at the cut-off frequency fo, it is necessary that $\frac{gmR}{\sqrt{2}}$ should exceed 1; if gm is of the order of 7 mA per volt, R cannot be more than about 1.8 kΩ, and the limiting frequency can then be found from the equation $fo = \frac{1}{2\pi RC}$. If n such stages are connected in cascade and if the amplification of each stage is A, the total gain will be A^n, and if A is only slightly greater than unity, a great number of stages will be required to give an appreciable gain, with the resultant difficulty of maintaining stability.

An alternative system to cascaded stages is the use of valves in parallel, and this system is sometimes found in a simple form in home-built receivers. The result of connecting valves in parallel, however, is of little value when the gain-bandwidth product is considered. Valves in parallel will often give a greater gain for a given number of valves than will the cascaded amplifier; that is, the outputs are additive instead of multiplicative, or nA is greater than A^n, but this reasoning ignores the effect of input capacity. Although, when n similar valves are paralleled, the mutual conductance gm of the combination is n times that of a single valve, the total effective capacities are also increased by n, so that the criterion $\frac{gm}{C}$ becomes simply $\frac{n.gm}{nC}$ which is exactly the same as before. In actual practice, of course, the ratio is decreased as the stray capacities make the total C greater than the simple nC of the valves alone. In other words, the anode load R of the parallel valves must have a value $1/n$.th that of the load of a single stage, and this reduction exactly offsets the increase in the effective mutual inductance.

The Artificial Line

The form of wideband amplifier to be discussed depends for its action on the properties of a trans-

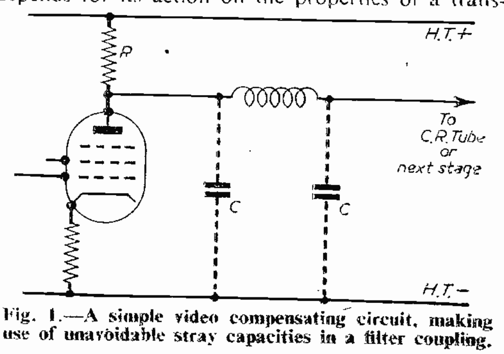


Fig. 1.—A simple video compensating circuit, making use of unavoidable stray capacities in a filter coupling.

mission line, and a few notes are given here of the main points of interest in such a line.

If we consider a length of parallel-wire feeder line, we can consider it to be made up of small inductive elements (the two wires) and shunting capacitive elements (the capacity between the wires), much as is shown in Fig. 2. There are, of course, resistive elements in the practical line, but these are normally very small and can be ignored. Now such a section

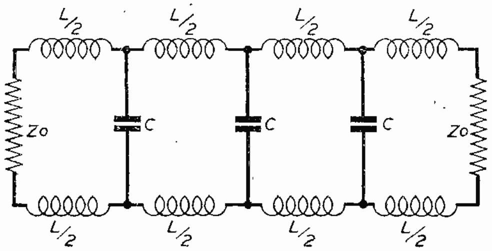


Fig. 2.—Representation of a two-wire transmission line as a series of low-pass filters.

of line made up of L and C acts as a low-pass filter, in that it will pass all frequencies from D.C. up to a limit fc without attenuation, after which attenuation will rapidly set in. The smoothing system of a power unit is a low-pass filter as is the R.F. or I.F. filter network following a detector stage. The point at which attenuation begins is known as the cut-off frequency and is given by the equation $fc=\frac{1}{\pi\sqrt{LC}}$

Further, as is well known to the television engineer, the characteristic impedance of such a line is Zo, where $Zo=\sqrt{\frac{L}{C}}$. If the feeder (of filter) is terminated by its impedance Zo at both ends, there will be no reflections along its length, and a wave travelling along it will be completely absorbed by the termination. With these facts in mind, we will now discuss the wideband, or "distributed" amplifier as it is often called.

The Distributed Amplifier

If a transmission line is represented by an actual collection of small inductances and condensers, wound to have specific values to produce a certain impedance, the circuit is known as an artificial line. In Fig. 3 is shown a number of identical valves wired in parallel, but not in the simple form directly from electrode to electrode. The grids are connected at intervals to a continuously wound coil and the anodes are similarly wired to another such coil. If this circuit as a whole is considered for a few minutes, it will be seen that the coils represent the inductive elements of an artificial line with the valve capacities providing the shunt condensers (or part of them). The lines are terminated at either end with resistive loads which form the proper impedance match. The whole circuit represents *one* stage of amplification.

The main object of this system of parallel connection is to obtain the effective gm of that of *all* the valves, while reducing the input capacity to that of a *single* valve. The criterion $\frac{gm}{C}$ can then be made very large in value and the bandwidth of the system for a given gain can be enormously increased over that obtainable from a similar number of valves wired in cascade.

Consider a wave travelling down the grid line as a result of an input voltage. On reaching the first grid, a change in the anode current of this valve occurs, and a similar signal is set up in the anode line. This signal travels in both directions along the anode line, and the same thing happens in turn in each of the succeeding valves. At the anode terminating resistances, both-direction signals will be absorbed, and there will be no reflections along the line.

The velocity at which the signals travel down the lines may be considered to be equal in both lines; if the various grid inputs are then considered in turn, together with their corresponding anode changes, it will be realised that the time taken by a signal in getting from the input socket to the output terminal will be the same no matter by which path it gets there. Thus, all signals arriving at the output will be perfectly in phase and will add together. In practice, of course, small phase differences will occur and the terminations will not absorb the whole of the signal, but the general result will be the same.

If the input voltage is Vg, each valve will contribute an anode current of Ia=gm.Vg, but this current will be divided along the line so that the effective output will be one-half of this. If there are *n* valves, therefore, and the load impedance is Zo (the line impedance), the gain of the system will be $\frac{n.gm.Vg.Zo}{2}$.

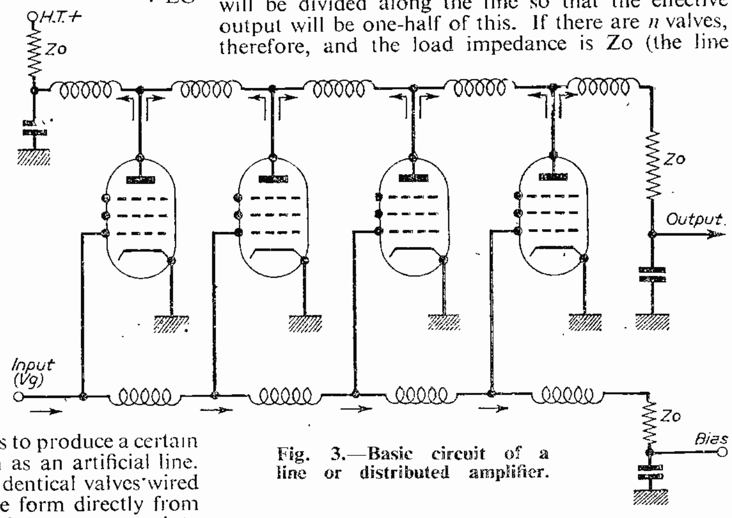


Fig. 3.—Basic circuit of a line or distributed amplifier.

It is a comparatively simple matter to get bandwidths up to several hundred megacycles by the use of the distributed amplifier system, and as the coupling is effectively D.C. throughout the low-frequency end of the range will go down to a very few cycles before falling off.

The bandwidth of such amplifiers is not limited, then, by the valve capacities as is the cascaded amplifier, but it is limited in practice by the phase error which reduces the rise time and, therefore, the effective bandwidth as the number of valves increase. It is limited further by the input losses of the valves at the higher frequencies and by the difficulty of keeping the delay error between the grid and anode lines sufficiently small for a great number of sections.

The choice of line impedance depends on many factors, one being the type of valve to be used. It must be much smaller than the valve input impedance at the highest frequency to be covered and, for the case of the EF91, 250 Mc/s is roughly the maximum bandwidth obtainable with lines of impedance up to a few hundred ohms. It is normal to make the input to such amplifiers of 70 ohms impedance.

A simple example of calculation follows to illustrate the design procedure, but it should be borne in mind that actual calculations are generally more involved than this.

Design Points

Suppose a four-valve strip is required (of the general pattern shown in Fig. 3), the valves to be used to be EF91's, and the upper frequency limit to be 75 Mc/s.

For the maximum gain, the impedance of the anode line should be a maximum (the equivalent of the normal anode load), and so the capacity should be a minimum, since for the line $Zo=\sqrt{\frac{L}{C}}$.

In the circuit of Fig. 4 is shown one stage of the proposed circuit, with the various valve capacities shown in dotted lines. For the EF91 these are approximately Cin=7 pF, and Cout=4 pF, with 2 pF added as strays.

Consider first the anode line.

$$Zo=\sqrt{\frac{L}{C}} \qquad Cmin=4+2=6\ pF$$

Since the cut-off frequency of a line is given by

$$fc=\frac{1}{\pi\sqrt{LC}}$$

we have, rewriting

$$L=\frac{1}{\pi^2 fc^2 C}$$

Substituting figures, we get L=3.1 μH.

Now to calculate the line impedance, we have

$$Zo=\sqrt{\frac{L}{C}}=\sqrt{\frac{3.1\times10^{-6}}{6\times10^{-12}}}=700\text{ ohms}$$

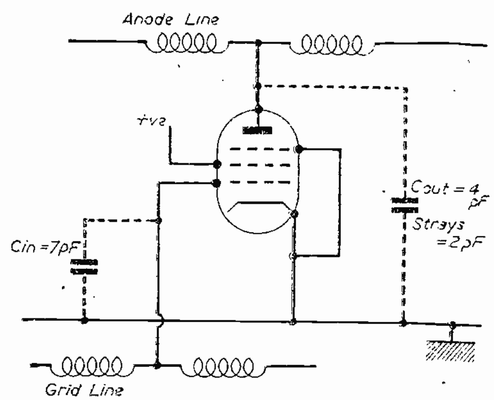


Fig. 4.—A circuit with capacities to illustrate the design procedure.

Now for the grid line, Zo=75 ohms and fc=75 Mc/s. Now to find the shunt capacity required for this line we use the formula

$$C=\frac{1}{\pi fc\ Zo}=\frac{1}{\pi.75^2}=56\ pF$$

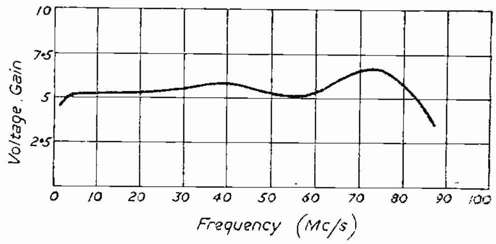


Fig. 5.—Bandwidth-gain curves of a simple four-valve single-stage amplifier.

The valve capacity is 7 pF and an additional condenser of value 49 pF must, therefore, be added across each grid input.

To find the section inductance, we have

$$L=Zo^2C=75^2.56.10^{-12}=0.315\mu H.$$

The theoretical gain of this amplifier is eight times (18 dB), but the practical curve obtained in an experiment is shown in Fig. 5. The bandwidth has been achieved, but the gain is below the theoretical maximum except at the higher frequency range.

It is hoped later on to discuss the distributed amplifier in more detail.

Canadian Orders

SPECIALISED products sold on sheer quality of technical and manufacturing skill are among the most valuable of British exports to-day, offering as they do the best opportunities for earning dollars and setting themselves a standard which tends to create respect for British goods in all overseas markets.

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Orders have been received at the same time for additional equipment for the existing Canadian transmitting and receiving stations at Drummondville and Yamachiche.

The object of the new Vancouver stations is to afford Canada a greatly improved telephone and telegraph service with Australasia and the Far East.

The Transitron Sync Separator

THE EXPERIMENTER WILL FIND MUCH TO INTEREST HIM IN THE CIRCUIT DESCRIBED HERE

By S. A. Money

FOR the sync separator stage of a television receiver most constructors use a more or less standard pentode circuit. This usually consists of a short-grid-base pentode acting as an amplitude limiter to separate the sync pulses from the picture signal; followed by integrator and differentiator networks to separate the line and frame sync pulses. Whilst this circuit will provide quite good locking it is often difficult to obtain accurate interlacing. This is because with the normal integrator circuit the pulses actually applied to the frame timebase do not have a sharp leading edge, and consequently the frame timebase does not necessarily start its sweep at the same point on each successive picture scan. One way of overcoming this defect is to use an "interlace diode circuit" to shape the frame pulses before they are applied to the frame oscillator. An alternative method is to use a transitron type sync separator from which a frame pulse with a sharp leading edge can be obtained.

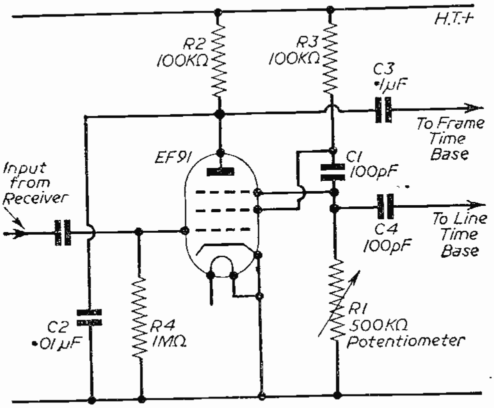

Fig. 1.—Circuit of the transitron sync separator.

TABLE OF VALUES

R1 = 500K Ω potentiometer	C1 = 100pF
R2 = 100K Ω	C2 = 0.01μF
R3 = 100K Ω	C3 = 0.1μF
R4 = 1M Ω	C4 = 100pF

V1 = EF91 or similar.

The circuit of the transitron sync separator is shown in Fig. 1. The screen and suppressor grids of the pentode are connected as a transitron oscillator and the line sync pulses are taken off from one of these grids whilst the frame sync pulse is taken from the anode.

The Circuit

The action of the transitron sync separator is as follows. When a line pulse arrives at the grid of the pentode the screen grid and anode currents will increase; thus causing the screen and anode voltages to fall. The negative pulse on the screen grid will be passed to the suppressor grid via the condenser C1, thus causing the suppressor grid to be driven negative.

As the suppressor grid is made more negative those electrons which pass through the screen are repelled back to it causing an increase in screen current and a reduction in anode current. This effect is cumulative and the anode current quickly cuts off. When the screen voltage is driven negative the condenser C1 will discharge through the resistor R1 and current will flow through R1 only whilst the condenser is discharging. Thus the negative voltage applied to the suppressor grid will be in the form of a pulse whose length will depend on the time constant of C1R1. When this pulse ends the suppressor grid voltage will fall to zero and anode current is able to flow again. If the time constant of C1R1 is made about the same as the length of a line sync pulse the anode will be cut off during the line pulses only. Since the valve is arranged to be cut off during the picture signal as for a normal sync separator the line pulses produced at the anode are very small.

When a frame pulse is applied to the grid the action becomes a little different. The leading edge of the frame pulse acts in the same manner as a line pulse. After a period of about the length of a line pulse anode current begins to flow. Since the frame sync pulse is still being applied to the control grid, in such a manner as to drive it positive, the anode current will be extremely large, thus causing the anode voltage to fall very sharply to a low value. This high anode current is initially drawn from the condenser C2 which discharges very rapidly. Thus a large frame pulse is produced at the anode.

The action of C2 is to remove the small line pulses that would normally appear at the anode and also to clean up the frame pulse. After the sharp discharge of C2 at the beginning of the frame pulse the condenser recharges through the anode load so that the back edge of the frame pulse falls off as shown in Fig. 2a. This prevents the possibility of the frame oscillator being triggered by the second frame sync pulse. One disadvantage of adding C2 is that the line pulses on the screen will be attenuated during the first two or three frame pulses so that the line timebase will run free during the frame flyback period. This effect should not interfere with the picture since the C.R. tube will be blacked out during this period and the line timebase should be locked in again by the beginning of the next picture.

Since both line and frame pulses appear at the screen grid it is necessary to use a differentiating circuit here to separate the line pulses. However, it is not necessary to add any more components since

(Concluded on page 95.)

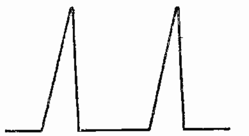

Fig. 2a. — Anode waveform.

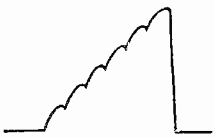

Fig. 2b. — Suppressor waveform.

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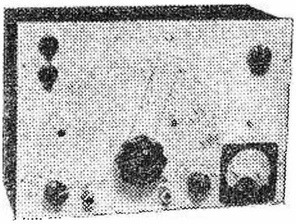

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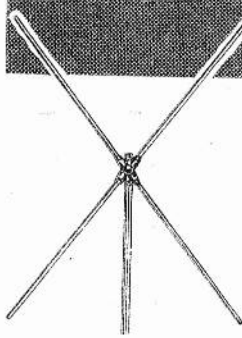

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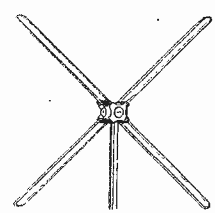

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K3/50	4,250	4,000	3,550	6,750	9,250	8/8
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Oscilloscope Gain Controls

FOR TELEVISION SERVICING A 'SCOPE REQUIRES SPECIAL CONTROLS, AS DESCRIBED HERE

By S. C. Murison

MOST readers will be aware of the deficiencies of the usual " volume control " type of gain control at the higher video frequencies. The effect of the stray capacitances is to attenuate the higher frequencies more than the lower. Fig. 1a shows the arrangement drawn in such a way as to emphasise its resemblance to an integrating circuit, while Fig. 1b shows the effect it has on a pulse controlled by it.

A common arrangement used in amateur-built oscilloscopes is controlled negative feedback in the cathode of a valve. Fig. 2a shows this arrangement. Although this method is far better than the simple volume control method, it is not without its snags. Again they arise from the effect of stray capacitances. When the gain control is short-circuited to give full gain, these have little or no effect. However, when the value of the resistance between cathode and earth is increased, not only is the gain reduced, but a high-frequency lift characteristic is given to the amplifier. At 1 Mc/s the reactance of the stray capacitance from cathode to earth in a usual layout will be about 3 kΩ. Consequently, both the gain and phase-shift will vary with frequency. Now, if the oscilloscope is only going to be used to examine sine waves this will be no real hardship. However, if complex waveforms are to be faithfully displayed, the gain must remain constant with frequency; and the time taken for a signal to pass through the amplifier must be constant regardless of the applied frequency. Neither of these conditions is met by the cathode feedback circuit when it is set to a low-gain position. Fig. 2 shows the effect of this deficiency. From this it will be seen that the stray capacitances from cathode to earth must be kept to a minimum for this method to be useful at low gain settings. In one oscilloscope seen by the writer it had been necessary to screen the lead from the bias resistor to the panel-mounted gain control resistor. While this had the desired effect of preventing the timebase waveform from getting into the Y-axis amplifier, it made the amplifier useless at gain settings less than about 80 per cent. of full gain.

A Solution

For television work where one may have to trace a complex waveform from its origin at a low amplitude to its output as a large amplitude signal, it is vital to know that the amplifier does not have either its frequency response or its phase-shift versus frequency characteristic changed by the gain control. One very satisfactory method has a strong resemblance to the " volume control " arrangement. Fig. 3 shows this method. Instead of a continuously variable potentiometer a chain of resistors is used. The real reason for the success of the method arises from the pre-set capacitors across the upper limbs of the chain. This may seem very odd, considering how keen one normally is to reduce stray capacitances.

These pre-set capacitors offset the effect of the input strays of the valve. How they do this can be looked at in two ways, each of which comes to the same thing. First, we can pretend that the resistors are not there. Then the circuit becomes a capacitive potentiometer, the lowest limb of which is the valve's input stray capacitance. Forgetting that the valve has no grid-return for the moment, this capacitive potentiometer would be a satisfactory solution. As the frequency increased, the reactance of each limb would decrease—*but each would decrease by the same proportion.* However, the valve must have a grid return resistor. Consequently, the resistors are necessary. The lowest limb has the input capacitance of the valve across it; so resistors have to be placed across the pre-set capacitors.

The other way of looking at the arrangement is based on the fact that any combination of components can be represented as a time constant. Thus C1 and R1 have a time constant, as do the upper limbs. If the time constant of C2 and R2 is the same as that of C1 and R1, the amplifier characteristics will not alter whether the switch is set to the ÷10 or ÷100 position. The same is true for the time constant of C3 and R3.

The advantages of the scheme may be discredited in the reader's mind by the thought that some special equipment is needed to set up such an input circuit. Actually, it is rather easier to set up than most video amplifiers using compensation coils. All that is needed is source of pulses—any sort of pulses will do, but the steeper their edges the better. The pulses are fed to the input with the switch set to ÷10 first. Then C2 is adjusted to make the pulse seen on the screen as near rectangular as can be.

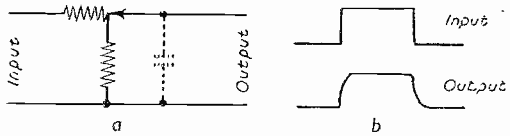


Fig. 1.—A normal volume control and its effect on the waveform.

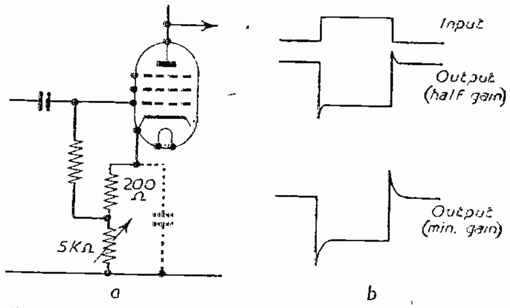
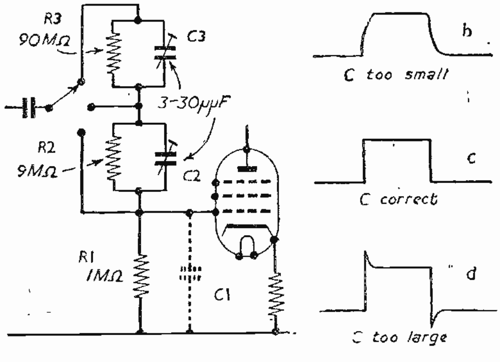


Fig. 2.—Controlled negative feedback and its effect on waveform.

Fig. 3b, c and d show the sort of results which one gets during the setting-up process. When C2 has been set, the switch is set to the ÷ 100 position and C3 is adjusted in the same way as C2 was.

Because the high values of resistors needed can be bought as 1 per cent. tolerance high stability types, the arrangement allows the amplitude of signal fed to the oscilloscope to be measured with accuracy on all three ranges of switch setting. Readers who have tried to measure the amplitude of signals with an oscilloscope having a continuously variable gain control will see the advantage of this.

To allow this accuracy to be used to its best advantage, care should be taken to keep leakage paths across the resistors and pre-set capacitors to minimum. The easiest way to achieve this is to mount R2, C2, R3, C3 all on the switch, which should be of the best insulation the constructor can get.



a

Fig. 3.—A solution. The three switch positions are, bottom 1, centre ÷ 10, top ÷ 100.

Band III, IV and V Transmitters

THE first of six V.H.F./U.H.F. transmitters for experimental work by the BBC on frequency Bands III, IV and V has recently been completed at the Mullard Research Laboratories, Redhill, Surrey. This particular transmitter is designed for operation on Band III (174-216 Mc/s). The development work on the remaining five transmitters—another for operation on Band III and two each for use on Bands IV (470-585 Mc/s) and V (610-960 Mc/s)—has also been completed and production of the final equipment is well under way. (The full frequency ranges of the transmitters are 174-265 Mc/s, 470-600 Mc/s, and 600-960 Mc/s respectively.)

These transmitters have been developed at the Mullard Research Laboratories to a specification laid down by the British Broadcasting Corporation. Although they have been designed to meet the requirements of the BBC adaptations of the equipment could possibly be used as efficient, small-power television transmitters operating anywhere within the frequency range covered by Bands III, IV and V. It is also possible that the experience gained in the development of these transmitters will be of great value when considering the design and development of unusually wide frequency range, tunable transmitters for communications and other purposes.

Design Requirements and Manner of Use

One of the main design requirements of the new transmitters is that, for reasons of economy, they should operate at relatively low powers. This means that field strengths are extremely low compared with those normally associated with broadcast transmitters, and an unusually high order of transmitter frequency stability is necessary so that narrow-band receivers of extreme sensitivity may be used. To ensure that valid propagation measurements can be made at the receiver, it is important that the stability of amplitude should also be high.

In practice, the transmission will normally be square-wave modulated. The signals, at a fundamental modulation frequency of 1,000 c/s, will be extracted in the receiver by means of filters. The amplitude of the signal will then be used to provide the propagation record. For investigations of multipath transmissions and echo effects—factors of significance when operating in the higher frequency ranges—use will be made of the pulse-modulation facility also available.

Important Development Features

Major development features of the transmitters are the wide frequency range of tuning and the fact that only one R.F. circuit is used for both pulse and square waveform conditions of modulation. This technical achievement has been made possible by using variable length, coaxial resonant lines for the output, the preceding and, in some instances, the earlier stages.

Another feature of the equipment is that it is so designed that it enables routine measurements at different frequencies to be taken by non-technical personnel. It is also interesting to note that the transmitters are intended for operation in a van. To ensure complete reliability under such conditions of service, the transmitters must be capable of coping with large variations in mains supplies. This difficulty has been overcome by so designing the power supply unit that the equipment will operate satisfactorily with single phase, A.C. supplies from 200-250 volts, 45-55 c/s, permissible fluctuations around the nominal voltage being +5 to −15 per cent. The power consumption of the equipment is about 3kVA.

Construction

The equipment, which is designed to feed into a 70-ohm aerial, comprises eight units. These are as follows: a power supply unit; a modulation waveform generator; a frequency generator and multiplier unit; a square waveform modulator; a pulse waveform modulator; a fault alarm and safety unit; R.F. drive unit; and a R.F. power amplifier/oscillator unit. These are mounted in two bays of an attractively designed cabinet, 6ft. high by 6.6in. wide by 2ft. 9in. deep. The weight of the equipment is approximately 2,000lb.

Performance

The six transmitters are designed to work at any frequency within their range and they provide for both square waveform and pulse conditions of modulation. With both types of modulation, the peak power delivered is maintained constant to better than ±½db over any two-hour period, after the lapse of a thirty-minute initial warming-up time.

way of altering the overall gain. For the video amplifier the best valves to use are the EF50, 6AC7 or any of the modern miniature pentodes, such as the EF91; the 6AG7 is also a useful valve as it gives a large output across a low load resistor. The anode loads should not exceed 5 KΩ and each stage of the video amplifier must be compensated

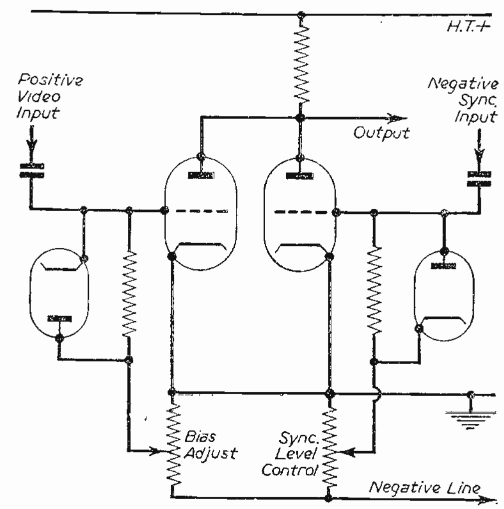


Fig. 2—The additive mixing of sync and video signals.

with an inductance in the anode circuit or by using a small by-pass condenser across the cathode resistor. The amplifier response should be flat for low frequencies, but with a rising characteristic for the higher frequencies to compensate for any persistence in the blue phosphor. Fig. 4 shows a useful circuit to achieve this R.F. peaking. It should be remembered that each stage inverts the phase of the signal and it is a good idea to incorporate a stage having unity gain which can be switched in or out to give a positive or negative picture—shades of "Puzzle Corner"! If the signal is to be fed over a cable it is usual to have a cathode follower output stage (no inversion of phase here) and a 6AG7 or 6J6 will be satisfactory. The stage should be designed to match the impedance of the cable.

Optical Equipment

As indicated in the illustrations the optical equipment can be very simple. The scanning spot should be in the plane of the transparency and a simple compromise is obtained by sticking the transparency directly on the tube face. The glass thickness may cause a loss of definition due to parallax, but if the photocell is placed at a distance of at least a foot away, quite good pictures can be obtained. If a large scanning tube is used and it is desired to scan a small picture, such as a 2in. x 2in. slide, then the raster on the tube face is focused by a lens on to the transparency, and a second lens acting as an optical condenser focuses the aperture of the first lens on to the photocell (Fig. 5). For the benefit of readers who are not familiar with optical calculations, it may be said that the reduction in size of the raster is in the ratio x : y, and the focal length of the

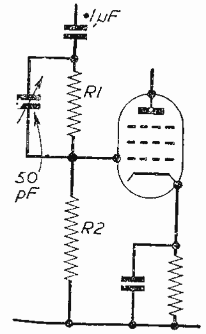


Fig. 4.—Circuit to compensate for the slight afterglow of the blue phosphor. R1 should be anything up to 100 times as big as R2.

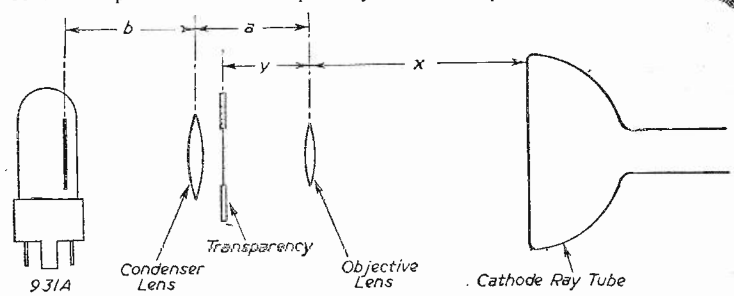
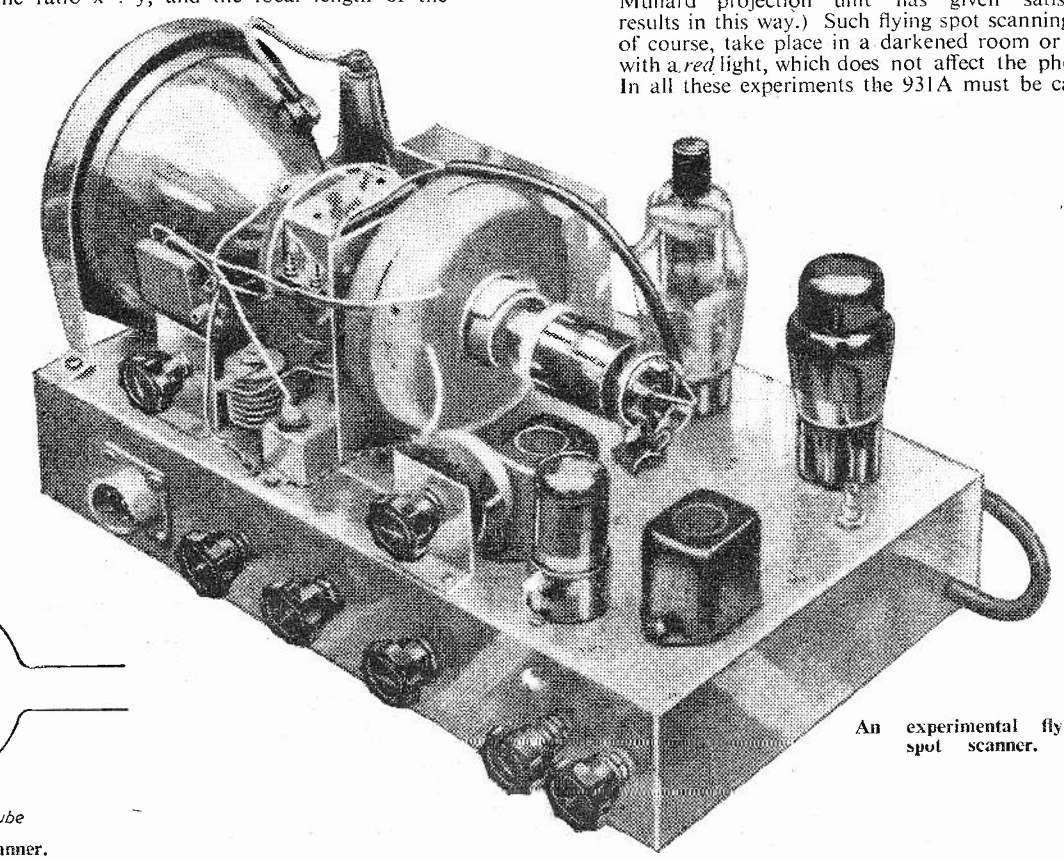


Fig. 5.—Diagram showing the optical layout of a slide scanner.



An experimental flying spot scanner.

objective lens $f(obj)=\frac{xy}{x+y}$; similarly, the focal length of the condenser lens $f(cond)=\frac{ab}{a+b}$. Thus, if the focal lengths of the lenses and the desired reduction are known, the various distances can be calculated.

As mentioned earlier, it is possible to focus the raster on to an opaque object—test card or photograph—and rely on the reflected light. If this is done, it is essential to collect as much light as possible into the photocell, and a large diameter condenser lens should be used with the cell placed at its focus; alternatively, as shown in Fig. 6, a car headlamp reflector can be cut to take the photocell. This arrangement is not so sensitive as the former one, where a transparency is used, because of the small proportion of the light which reaches the photocell, but it is well worth a trial, and can also be used to transmit head and shoulder pictures of living subjects. (The Mullard projection unit has given satisfactory results in this way.) Such flying spot scanning must, of course, take place in a darkened room or one lit with a *red* light, which does not affect the photocell. In all these experiments the 931A must be carefully screened from all light, except the scanning spot, and this calls for a darkened room or a box cover painted black inside.

Further information on this subject is available in any text book of television engineering, and a short list of references appears below. As the number of people who take up television transmission increases there will be more and more articles in PRACTICAL TELEVISION, so why not make a start now, and remember that no licence is needed for television transmission over a closed circuit.

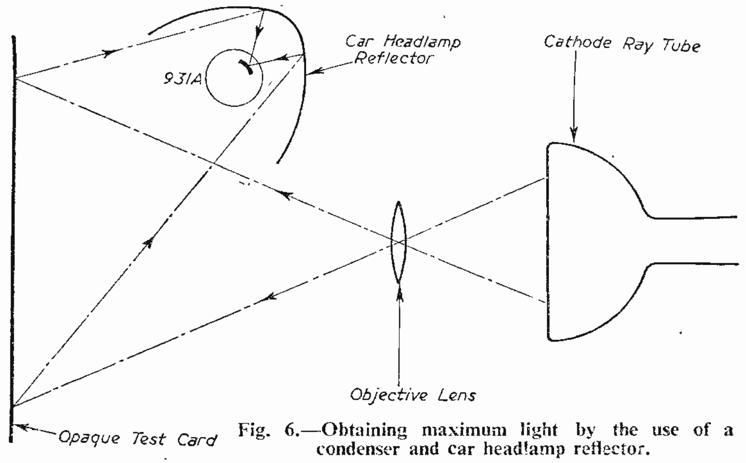


Fig. 6.—Obtaining maximum light by the use of a condenser and car headlamp reflector.

Test Cards

It is a fairly easy matter to draw a simple test card for either system. If an opaque card is required, then Indian ink can be used on white or grey paper and a grey scale drawn by shading with hard and soft pencils. For a transparency, a pattern may be drawn in Indian ink directly on to cellophane or thin celluloid. It will not be found possible to draw very accurately this small transparency type of test card and to get the best result a drawing should be made on white card to a large size and photographed.

The test card should contain a circle for checking the correct aspect ratio; a system of squares for checking line and frame linearity; and a series of ruled lines with different spacings to check the frequency response. Test Card C is, of course, ideal, but it is more interesting to have a personal test card displaying the experimenter's own name or call sign.

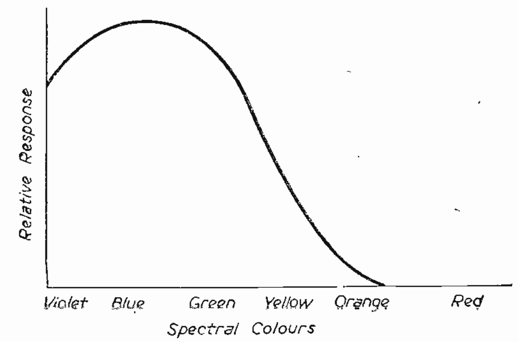


Fig. 3.—The response curve of the 931A cell.

FAULT SYMPTOMS

THE CAUSES OF COMMON FAULTS, AND METHODS OF CORRECTION

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

(*Continued from page 18, June issue*).

IT must be borne in mind that damage to the tube can result from an incorrectly set ion-trap magnet. When the optimum setting has been established, the magnet must be locked in position by means of the thumbscrew, taking care not to alter its position.

It should be noted that during initial adjustments to the magnet the brightness control must be retarded as far as possible consistent with screen illumination sufficient for examination. Excessive beam current, even though the composing electrons may be deflected from the screen by reason of the incorrectly set magnet, may impair the efficiency of the tube. A method which safeguards the tube while the magnet is being adjusted is by placing a microammeter in the tube cathode lead, and then adjusting the brightness control so that the registered beam current does not at any time exceed 50 micro-amps.

In some receivers, to facilitate mechanical layout, the ion-trap magnet may be fitted with the arrow diametrically opposite the line on the neck of the tube. In such cases the arrow must always point away from the screen, towards the base of the tube.

Although an ion-trap magnet functioning in conjunction with a tube embodying an ion-trap electrode assembly must never be adjusted to remove a shadow on the screen, certain receivers, the K.B. HF60 series, for example, use a form of ion-trap magnet as a beam-correcting device. In these receivers the picture-tube is generally an aluminised non-ion-trap type (in the K.B. range a Brimar type C17BM is sometimes used), and the magnet should be adjusted on the tube neck to eliminate shading of the picture in the corners and to give the best overall focus together with minimum geometric distortion of the raster.

As we have already noted, it is not always advisable to commence by aimlessly twisting and adjusting the ion-trap magnet when examining a receiver for lack of raster. It is desirable, first of all, to observe whether the magnet could possibly have altered in position under normal conditions. For instance, if the magnet is found to be locked securely to the neck of the tube, it would be pointless to loosen it and hope that adjustment would bring back the lost raster. The same reasoning would, of course, apply if it is obvious that the inevitable layer of dust on the tube neck has not been disturbed in the vicinity of the magnet.

It is just as well to progress along these lines, for if the magnet is shifted in an aimless endeavour to restore screen illumination the possibility is that it will not be returned to the correct position after the operation has proved unsuccessful. Clearly, this may aggravate the problem of establishing the actual reason for the blank screen.

Beam Cut-off

Just the same as a heavy negative bias applied to the control grid of an ordinary valve will result in anode current cut-off, beam current cut-off occurs in a picture-tube when the grid is made less positive than the cathode. Let us make this point clear. If, for instance, a potential of 150 volts is applied to the cathode of the tube, and a potential of 100 volts is applied to the grid, then from the tube point of view the grid is 50 volts negative with respect to cathode. This is, of course, "standard one" reasoning, but it is surprising how bewildered some experimenters become when they measure a positive grid potential relative to the chassis. They seem to forget the existence of the positive potential on the cathode.

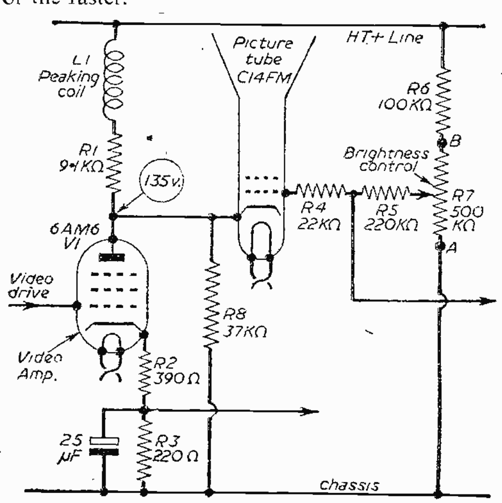


Fig. 51.—The picture-tube control network of the K.B. Model KV35.

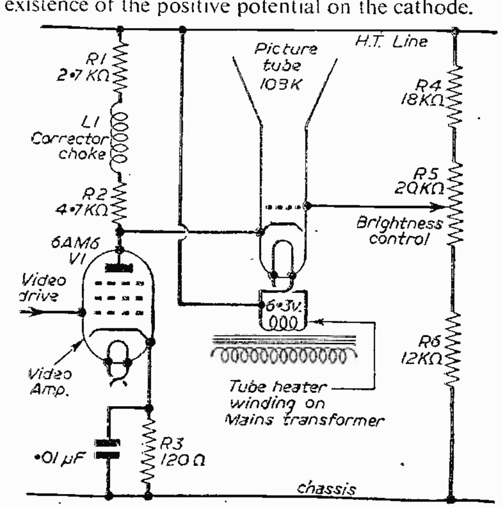
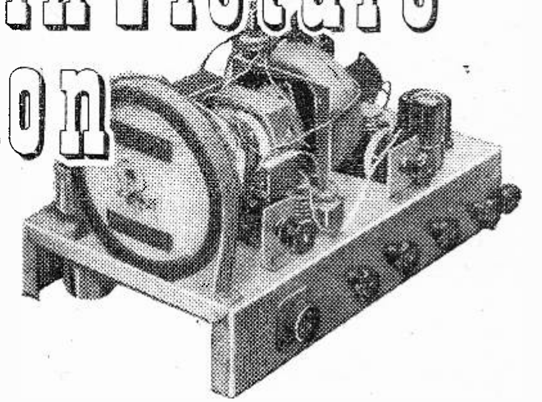


Fig. 52.—The picture-tube control arrangement as used in the Cossor Model 916-917 series.

First steps in Picture Transmission



FLYING SPOT TECHNIQUE

By C. Grant Dixon, M.A.
Chairman of the British Amateur Television Club

THERE are undoubtedly a large number of readers of PRACTICAL TELEVISION who have constructed one or more television receivers, and are now looking for fresh fields to conquer. This article is intended for such people and, assuming a working knowledge of television reception, some guidance will be offered on how to go about building a picture scanner. The video signal is composed of synchronising pulses, suppression or blank pulses, and picture content. The pulses may be produced by the excellent video generator described in PRACTICAL TELEVISION for December, 1953, and January, 1954, but for simple experiments nothing so complicated is required. The picture signal may be produced in a variety of ways :

1. Normal television camera.
2. Monoscope.
3. Flying spot teleciné scanner.
4. Flying spot scanner using reflected light.
5. Flying spot scanner using light transmitted through a still transparency.

The last of these methods is the best for the beginner, and the simplest apparatus consists of two cathode-ray tubes with common timebases (this avoids using synchronising pulses) ; to the face of one tube is stuck a transparency, and a photocell and amplifier are placed about 1ft. away. The output of the amplifier is used to modulate the second tube and the picture is reproduced on the screen. This is an excellent way to start as it enables the transmitted picture to be compared with the original, and much valuable experience can be gained in the construction of a suitable video amplifier.

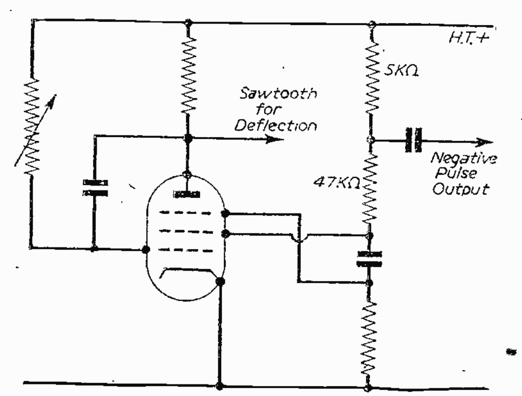


Fig. 1.—Circuit for obtaining pulses from the timebase.

If it is desired to send a picture over a single coaxial cable, then synchronising pulses must be added and a pulse generator is necessary. If economy is to be the keynote, then negative pulses may be taken from the screen of a Miller-transitron timebase (Fig. 1) and shaped in a pair of clipping stages—zero bias 6SL7—before adding the video signal. Addition of pulses and video may be performed by using two valves with a common anode load. Diodes are connected across the grid resistors, as shown in Fig. 2, to ensure that the video is positive-going and the synchronising pulses negative-going.

The Scanner

Let us return to the scanner unit. The cathode-ray tubes which have proved most useful for this work are those with a blue trace ; even if an orange or yellow afterglow is present, this is no detriment. The 5FP7 (magnetic) is popular, as is also the 3FP7 (electrostatic). The VCR516 should be satisfactory, and the ACR1 and ACR2X (white or yellow trace tubes) have been used successfully. Almost any tube with P2, P4, P7, P11 or P15 phosphor will do. The 5FP7 is quite capable of definition up to 3 Mc/s despite its small size, and an experimental scanner using this tube is shown in the illustrations. The reader may wonder why an afterglow screen does not cause a loss of definition, as the photocell must register the instantaneous light of the flying spot ; the reason is that the blue phosphor has an extremely rapid decay time, and the photocell most commonly used, the 931A, is very sensitive to blue light and practically insensitive to the yellow afterglow (Fig. 3).

The Photocell

The 931A is a photo-multiplier cell and has several stages of electron multiplication incorporated in the glass envelope, so the outgoing signal does not need more than about three further stages of amplification. The load resistor of the cell should be only about 1 KΩ, and the voltage across the divider chain supplying the cell should be kept as low as possible to avoid the generation of noise. Alteration of this voltage to the 931A is a convenient

Now let us consider a typical picture-tube control circuit. Fig. 51 shows the arrangement employed in the current K.B. receiver, Model KV35. Here we can see that the cathode of the tube is in direct contact with the positive potential at the anode of the video amplifier valve. We know that the potential at this point is dependent on the current through the series circuit comprising L1, R1, V1, R2 and R3. And that as the current through V1 increases, so the potential at V1 anode reduces. We also know that the current is a function of the video drive. In this circuit, with no drive, the anode potential settles down to the region of 135 volts.

Now to have a look at the grid circuit. This is held at a positive potential by reason of the brightness control potentiometer R7 and its associated series

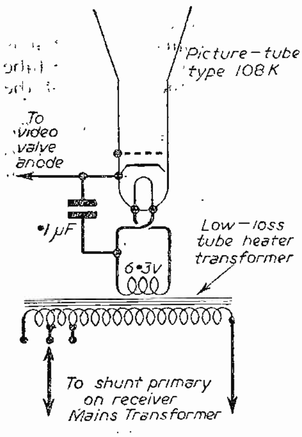


Fig. 53.—A method of restoring picture quality after a heater to cathode fault has occurred in the tube.

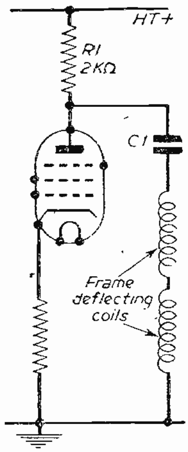


Fig. 55. — A R.C. coupled frame output stage. Note the importance of high insulation across C1.

resistor R6 being connected across the H.T. supply. For this discussion we can forget R4 and R5, since under normal working conditions they should pass no current and thus present no voltage drop.

At minimum setting of brightness the slider of the control is at point A (Fig. 51), or at zero potential. The cathode is, therefore, 135 volts positive relative to this point or, in other words, the grid is 135 volts negative, this being more than sufficient to hold the tube at beam cut-off. As the brightness control is advanced, however, the slider moves from point A towards point B, and the potential at the grid rises. The grid goes less negative with respect to cathode until it allows the passage of beam current through the tube. The electrons impinging on the fluorescent screen impart energy (see " More About the C.R.T.," Practical Television, October, 1951), which excites the phosphors and a faint raster is displayed. The raster becomes brighter as the control slider gets nearer to B and the tube grid goes even less negative.

If now the brightness control is slowly retarded again to the point where the raster just disappears the correct setting for the brightness control is established (see " Picture-Tube Control," Practical Television, August, 1953).

Leaving the brightness control at this critical position, and applying drive to the video amplifier, causes the tube cathode potential to fall below the static 135 volts to a lower potential (this, of course, is again like making the grid less negative) in sympathy with and depending on the white content of the video signal.

This effect lifts the tube out of cut-off, and modulates the beam to give a visual display on the fluorescent screen ; and, provided the scanning and timebase circuits are working correctly and synchronised, a picture is resolved.

A perusal of Fig. 51 will show that there are few fault conditions that could arise to cause the positive potential at the cathode of the picture-tube to outweigh that at the grid to provoke beam current cut-off irrespective of the position of the brightness control. From the grid aspect we can clearly see that if R6 goes high in value or open circuit the electrode will fall to a low positive potential or collapse to zero, and will therefore be relatively heavily negative with respect to cathode. A similar state of affairs may occur should the top (H.T.) end of R7 go open circuit, though in this case the defective component is clearly revealed by the screen suddenly going very bright when the control is turned to its fully clockwise setting. A break at point A of the control will, of course, have the *converse effect* when the control is rotated fully anti-clockwise.

A break or high resistance developing in one of the feed resistors, such as in R4 or R5, may not occasion a blank screen, though this defect may result in the top half of the screen being much darker than the bottom half ; and in this case a gradual shading from bottom to the top of the picture or raster is often in evidence. Furthermore, the effect of adjusting the brightness control is not immediate, since the increase or decrease in screen brightness tends to lag behind as the control is turned. This is more apparent if one of the resistors enlarges in value considerably, and in certain cases the overall brightness on the tube screen fluctuates to a definite rhythm due, of course, to an enlarging of the time constant of the brightness control network as the result of the fault.

From the picture-tube cathode viewpoint the potential here may rise clear of the potential range provided by the brightness control should the emission of V1 fail or fall off to a large degree. This is easy to realise, for under such conditions less current is passed and consequently less potential is dropped or developed across R1. The same effect would result if either R2 or R3 went high in value, or if a defect developed in the screen-grid circuit (not shown in Fig. 52), such as the associated resistor going high in value or the decoupling capacitor turning into a resistor or short-circuiting.

Although a couple of tests with a voltmeter should quickly determine the magnitude of tube bias, it is advisable to remember, when making such tests in this circuit, that voltage readings may be affected seriously by the load imposed by the test meter, and unless this is taken into consideration the readings obtained may be more fictitious than fact and bewilder more than assist the constructor. This is especially so in this case, where two separate high-impedance potentials are measured and then compared to compute the bias potential. The need is thereby illustrated of employing a voltmeter of high sensitivity, preferably one coming under the classification of a " valve-voltmeter."

Where such an instrument is not available, however, the quantitative error can be minimised by measuring the bias voltage direct from grid to cathode. An alteration of negative grid potential should ensue by function of the brightness control, and if it is possible to take this down to about the 15-25 volt region, then the fault lies elsewhere than in the biasing circuits.

Another dodge that can be used to ascertain as rapidly as possible whether the black screen is caused by excessive bias is to short-circuit the grid and cathode pins momentarily. This has the effect of cutting off completely the bias on the tube, when—if the bias circuit is defective—the tube will display a peak-white raster. The short-circuit should be performed as rapidly as possible, since there is the possibility of the tube being damaged through lack of bias and heavy beam current. If this dodge creates a raster, then we can be certain that the fault lies somewhere in the biasing circuit.

Now let us look at Fig. 52. Here the control system of the Cossor 916 series receivers is shown. The general arrangement is essentially equivalent to the previously considered example, apart from the inclusion of R6, and the tube heater winding on the mains transformer—for in the K.B. the tube heater is connected in series with the heaters of the valves to form an A.C./D.C. circuit.

The resistors R4 and R6 are arranged in value to pad the brightness control so that it provides an even rate-of-change of screen brightness over its entire range. It often happens in this receiver that one or other of these fixed resistors alters in value to a degree that prevents a raster from being created when the contrast control is at minimum or when the aerial is removed from the set. It is worthwhile to check this point on a receiver exhibiting this symptom, particularly if one of this series.

One of the problems presented to designers of TV sets is to ensure that the difference in potential between the heater and the cathode of the picture-tube does not exceed the limit stipulated by the maker. This limit varies slightly between tubes of different manufacture, and in order to keep within the recommended value many artifices are employed. In the Cossor circuit, for instance, it will be noticed that the tube heater is energised by reason of an isolated (from the D.C. point of view) winding on the common mains transformer.

In view of the fact that the manufacturers recommend a D.C. connection between tube heater and cathode, a connection is made from the heater direct to the H.T. line. This is, therefore, satisfied by virtue of the D.C. path between R1, L1 and R2; and furthermore, a low cathode-to-heater potential exists; the actual potential magnitude being the voltage difference between the H.T. line and the anode of the video valve.

Sometimes a receiver of the Cossor 916 series exhibits a symptom of intermittent loss of vision; this fault is revealed by the fact that it is not possible to resolve a raster by advancing the brightness control. Routine voltage checks will show that an intermittent tube biasing defect is responsible, but unless one is acquainted with the tube circuit (Fig. 53) it may prove a wearisome matter to establish the precise cause.

In nearly every case, however, it can be traced to an intermittent heater-to-cathode short within the picture-tube, and with the circuit at hand it is readily realised why such a symptom results; the effect being due, of course, to the fact that the potential at the tube cathode rises to that of the H.T. line, and is thus always much more positive than the potential at the grid, irrespective of the setting of the brightness control.

The effect can be eliminated by simply disconnecting the tube heater winding from the H.T. line, but, although this operation restores the tube biasing circuits to normal, unfortunately the disconcerting symptom of poor picture quality results. This is caused by capacitive and inductive losses in the mains transformer, for when the picture short occurs the higher video frequencies are severely attenuated owing to the by-passing effect produced by the transformer. If the tube defect is of an intermittent nature—which is generally the case—the poor picture quality will, of course, manifest intermittently, and the accompanying symptom of picture pulling to the left—sometimes in bands—will also make itself evident from time to time.

If the poor picture quality can be tolerated, or if some form of viewing is essential before a new tube

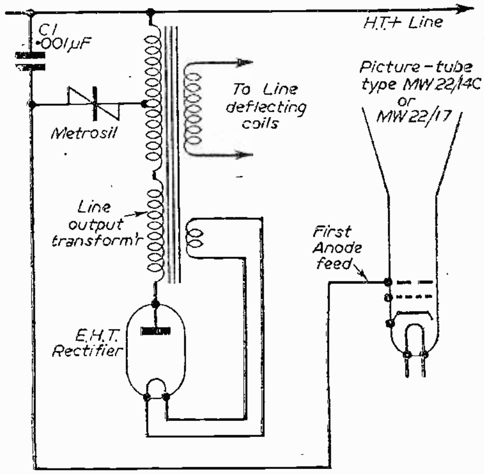


Fig. 54.—A method of obtaining picture-tube first anode potential in the Ferguson 941T.

can be purchased, the intermittent effect can be eliminated by shunting a 0.1 microfarad capacitor between the tube heater and cathode.

A special low-capacitance heater transformer can be successfully used if desired, and this method is most beneficial should the defective tube have good emission. The transformer should be connected as shown by Fig. 53. By adopting this method good picture quality can be maintained and the tube given a further lease of useful life. Transformers for this purpose can be obtained from various advertisers in these pages.

Sometimes, when the tube is a tetrode, a lack of raster is caused by a defect in the H.T. feed circuit to the first anode. A potential in the region of 200 to 300 volts should be expected here according to the type of tube, but again, allowance should be made for the load created by the test meter, for this anode is also mostly supplied through a high-resistance circuit.

A typical mode of obtaining first anode potential for a tetrode tube is shown in Fig. 54; this arrangement is used in the Ferguson 941T series receivers.

(To be continued.)

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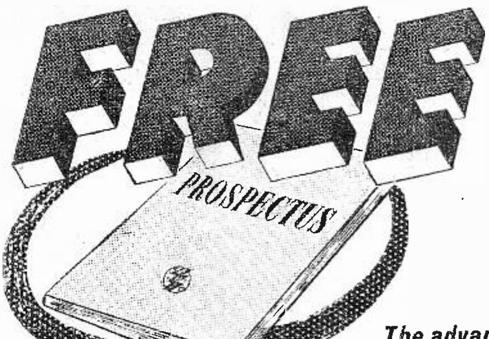

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Are the 3 Mc/s Bars Necessary?

SOME COMMENTS ON PICTURE DEFINITION

By L. B. Moore

ONE of the questions which is most frequently asked when a new televisor is presented is, " Will it resolve the 3 Mc/s bars ? "

The desire for the best resolution possible in the picture is a healthy one ; the BBC transmit a wide band of frequencies with the object of providing as good a picture as the system will allow, and the best horizontal resolution is obtained when the 3 Mc/s bars on Test Card " C " can be resolved.

Picture Quality and Definition

The " goodness " or quality of a picture is termed its definition, and by this we mean the faithfulness of the reproduction as compared with the original. We have a homely parallel in the pictures produced in periodicals. If a picture from a newspaper or magazine is closely examined with the aid of a magnifying glass, it will be seen to be constructed from a large number of elemental dots. In the dark areas the dots are very close together while in the lighter areas they are farther apart.

The dots are produced by the photographic process employed in making the plates for printing. In high-speed presses using fairly coarse paper such as newsprint the dots are larger and fewer in number ; we cannot have too many dots as the process of printing at high speed on this class of paper would clog the plate and a very blurred reproduction would result.

When the speed of printing is slower and very finely graded paper is used then the dots can be made smaller and there will be many more of them.

The practical result of this is that a picture produced on newsprint is lacking in fine detail. A head and shoulder view, for example, would not show the individual hairs on the head.

A fine art paper, on the other hand, would show these fine hairs. In the first case the dots used are larger in diameter than the width of a hair, while in the second case the dots are smaller than the width of a hair.

The important point to note is that where the dots are smaller a greater number are required to cover a given area, and the smaller the dots (or in other words the greater the number of picture elements) then the greater is the detail produced.

A similar reasoning exists in TV practice. As a homely example, a receiver which has very good definition will show the strings attached to the puppets in a puppet show such as " Muffin the Mule " ; a receiver with inferior definition will not show the strings and the viewer just does not see them ; the puppets appear to be entirely self-activated.

In order to arrive at some standard of quality it has been stated that if the horizontal resolution is equal to the vertical resolution then satisfactory definition is achieved.

The horizontal resolution will be equal to the vertical resolution if it is divided into a number of elements which is equal to the number of vertical elements.

As an example, optimum viewing distance is where the line structure merges and the background of the picture appears as a complete whole and not built up from separate lines.

It is obvious that if a black spot occurred along a line which was smaller than the width of a line, the spot would not be seen at the distance from the screen where the lines merge. It would be useless, therefore, to cater for detail which is finer than the width of a single line.

It will be seen, then, that the optimum acceptable definition will be that where a horizontal line is divided into alternate black and white squares whose sides are equal to the width of the line. This is the finest detail which the eye would resolve at the distance from the screen where the lines merge.

Estimating Bandwidth

In the 405 line system using interlaced scanning we have in each half cycle $202\frac{1}{2}$ lines. Of these lines 14 are taken up for synchronising purposes, leaving a total number of active lines containing picture intelligence of $188\frac{1}{2}$. Therefore, in each complete interlaced picture we will have a total of 377 lines containing picture intelligence.

In other words our picture is actually 377 lines high. The ratio of width to height is 4 : 3, or we can say that each line is 4/3 times as long as the height of the picture. If there are 377 lines we can say that the vertical dimension contains 377 elements and one line should therefore contain :

$$\frac{4}{3} \times 377 = 503 \text{ elements.}$$

Our line will therefore be divided into a total of 503 elements, half of which will be black and the other half white. We can represent the white squares as positive pulses and the black squares as negative pulses ; the result is an alternation which is something like a sine wave as shown below. There will, therefore, be a total of :

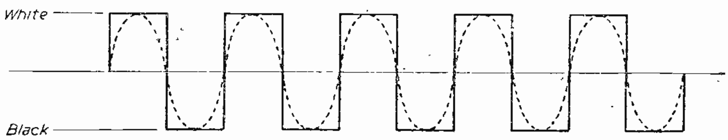
$$\tfrac{1}{2}(503) = 256\tfrac{1}{2} \text{ cycles for each line.}$$

Now there are 377 lines in the active picture so the total number of cycles in each picture is :

$$256\tfrac{1}{2} \times 377 = 96{,}700 \text{ cycles.}$$

The number of complete frames transmitted each second is 25 and there will therefore be a total of :

$$96{,}700 \times 25 = 2{,}417{,}500 \text{ cycles per sec.}$$
$$= 2.4 \text{ Mc/s approx.}$$



The square waveform and a sine wave.

From the above it will be seen that we could have adequate definition for a bandwidth of only 2.4 Mc/s.

Unfortunately there is one flaw in the argument and that is in interpreting the square-wave formation representing the black and white squares directly into a simple sine wave. In actual fact the square-topped waveform contains an infinite number of harmonics and to obtain a good approximation the bandwidth would have to be in the region of 30 Mc/s wide.

This is obviously not practical; the total number of picture elements is taken as if the whole of the lines were active lines which gives a frequency of about 2.75 Mc/s. The BBC state that they transmit all frequencies up to 3 Mc/s.

Resolving the 3 Mc/s Bars

In order to obtain the best definition from the signal transmitted by the BBC it should be possible to align the set so that the 3 Mc/s bars are visible.

For the majority of home constructors the only time available is on Saturday mornings and quite a large number of Saturdays are required before it is possible to complete the job. Usually one just arrives at a point where results are being observed when the test card is whipped away and a waiting period of a quarter of an hour ensues until it returns.

It is a fairly simple matter to resolve the 1 M/cs bars and not at all difficult to get the 1.5 Mc/s bars. The 2.0 Mc/s bars are a little more difficult and the 2.5 Mc/s bars require a great deal of patience. In the case of small tubes such as the VCR97 it is not always possible to resolve these as the spot size is larger than the width of the bars.

The 3.0 Mc/s bars are rather difficult, and while many commercial receivers will show those of 2.5 Mc/s they do not reveal the 3.0 Mc/s bars.

Factors Affecting Bandwidth

It is important to remember that there are factors other than the tuning stages which affect the bandwidth. It is possible for the tuning stages to embrace the required range of frequencies and yet the televisor still does not show the full complement of bars.

Spot size is one factor because if the diameter of the spot is larger than the width of the bar then the bar will not be seen.

Another factor is the video output stage: it is useless for the tuning stages to be broadened if the video output stage will not pass the full bandwidth.

A further factor is the aerial system. Where highly directional arrays are used as in the fringe areas the aerial itself may not provide sufficient gain at the edges of the bandwidth it is supposed to encompass.

The range of frequencies injected into the televisor by the aerial system at a fairly even level may not cover the 3 Mc/s. Much depends not only on the aerial itself but by its proximity to local objects, the type of feeder and method of injection.

It has been the author's experience that there are very few commercial televisors which will reproduce the 3 Mc/s bars in true black and white.

Vertical Versus Horizontal Definition

The figures for the bandwidth necessary for reasonable definition have been based on the vertical definition of the picture. We have assumed that the picture is divided into a number of horizontal lines, the total number of active lines being 377, and from this we have derived a figure for the required bandwidth.

One factor which has not been taken into account is that there is a certain distance between adjacent lines which is included in the aspect ratio of 4/3.

To obtain the optimum horizontal definition we must make it equal the vertical definition. The optimum viewing distance is where the horizontal lines comprising the picture just merge together so that the line structure is not observed.

This optimum viewing distance will vary with the visual accuity of the observer; a person with good sight should sit farther from the screen than one with poorer sight.

Now here is a simple experiment which you can make yourself, if your televisor will resolve the 3 Mc/s bars, or if you have access to one which will.

First check that the bars are received correctly and are not spurious due to "ringing." The best method is to count the number of bars seen in each square on Test Card "C." The 2.0 Mc/s bars should have 8 distinct black lines, those representing 2.5 Mc/s should have 10, and the 3.0 Mc/s bars should have 12.

Count the lines carefully to see that they are all there and, if necessary, adjust the focus on the bars and not on the horizontal lines. Normally, the 3.0 Mc/s bars will be reproduced at reduced contrast, but they should be distinctly observed as individual bars.

Having verified that the bars are correctly reproduced, ignore them for the moment and then move back from the screen until the *horizontal lines* merge together so that they are no longer visible as separate lines; the background of the picture should appear complete and whole.

The position in which you are now is the optimum position for viewing for yourself. At this point observe the screen closely (without falling into the temptation of moving your head forward) and endeavour to see the 3 Mc/s bars. If you cannot see them clearly then move forward towards the screen until they can be distinguished. This will be the position of optimum horizontal resolution.

Generally, you will find that to distinguish the vertical bars you will have to move forward and when you can observe them you will note that the line structure of the picture is also quite visible.

From this it follows that the optimum viewing position for horizontal resolution is not the same as for vertical resolution. As it is important that the line structure should not be observed, then if at this point the 3 Mc/s bars cannot be distinguished it is *useless making the receiving circuits wide enough to resolve them!*

Advantages of Reduced Bandwidth

Reducing the bandwidth to a lower figure has several advantages. The most important is that the gain of the receiver is increased—a not inconsiderable factor for the fringe viewer. For fringe reception 2.5 Mc/s is adequate.

The fringe viewer would do well to bear this in mind. A picture with decreased horizontal definition but increased overall clarity with absence of background mush and "snow" is much preferable to one which has a marvellous definition, but in which all action appears to take place in a snowstorm.

THE "STROLLER"

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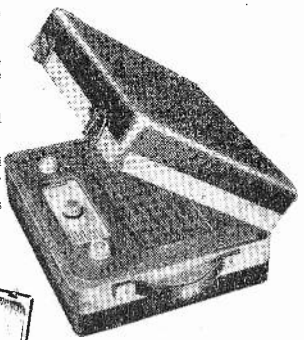

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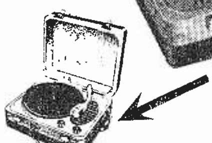
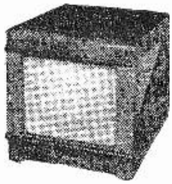


The Elpreq "Stroller" is an all-dry battery operated superhet, using frame aerial and 1.5 volt valves Type 1R5, 1T4, 1S5 and 3S4. It is particularly selective and gives powerful results on long and medium waves. Battery consumption, however, is quite low. The cabinet is ultra-modern and finished crocodile and/or lizard skin in two shades. The control board is similarly finished, and with the three-coloured dial, gives the whole a factory-built aspect.

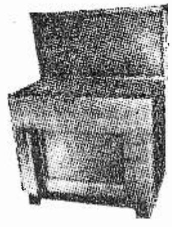
Full constructional details of this superhet and of the Picnic Player unit which, by the undoing of four screws, slips into the cabinet in place of the radio, will be found in our booklet "The Stroller," price 2/6 (returnable if parts purchased). Cost of portable cabinet and all parts for "Stroller" including valves, speaker, but not batteries, is £8. 17s. 6d. (H.P. deposit £2.19s.2d.), carriage 5/-. Cabinet available separately, price 37/6, plus 3/6 postage.



ONLY 39/6

Designed to take a 12-inch televisor chassis, this walnut veneered cabinet represents probably to-day's best cabinet bargain. Made for very famous Company. Price 39/6 only, carriage, etc., 7/6.

CONSOLE BARGAIN

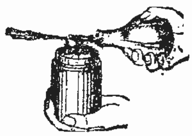


Two-tone, walnut veneered, with inlaid bands. Uncut motor board. Record storage size 2ft. 6in. x 2ft. 6in. x 1ft. 2in. Clearance to motor board 6in. Price £9.18.6. plus 15/-, carriage and insurance.

SOMWEAVE

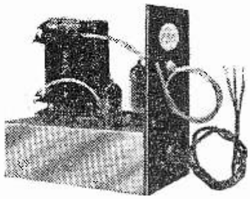
This really lovely loudspeaker fabric we offer at approximately a third of to-day's cost. It is 42in. wide and our price is 12/- per yard or panels 12in. x 12in. 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

HAND SPRAY GUN



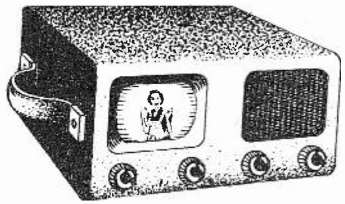
Suitable all liquids or powder. Ideal for finishing models, etc., 6/6, post 9d.

THE ELPREQ E.H.T. GENERATOR



This is a made-up unit working on the blocking oscillator overwound amplifying stage principle. It is of moderate power consumption (6.3 volt, 8 amp. filament and approx. 59 mA. H.T.) and contains three B.V.A. valves. Output obtainable ranges from 6 kV. to 9 kV. with normal H.T. rail input, but somewhat higher outputs can be obtained with higher H.T. supply. Valve rectification is employed in the output stage. The dimensions are 6½ x 4½ x 7in. Price, 69/6, post, packing, etc., 5/-.

MINIATURE PORTABLE TV.



You can probably think of many other reasons when you may need a midget televisor, but it will certainly be useful when—

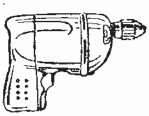
(a) Someone is ill, or confined to another room.
(b) Your big TV. fails.
(c) You want to alter or adjust your big TV.
(d) The commercial programmes start.
(e) Servicing an aerial installation.

The Elpreq Miniature Televisor uses standard conventional circuitry, employing a total of 13 valves and 2 crystal diodes. The cathode-ray tube used is a 2½in. Service type VCR139A, which has a standard equivalent and will therefore always be obtainable. The layout is extremely clean, straightforward and professional. The wiring, whilst naturally being a little more intricate due to miniaturisation, is nevertheless completely accessible, and very good results have been obtained.

The total cost, if you have to buy every part, would come to £16-£17, but you may have many of the components already in stock, as only standard conventional components are used. A carrying case, similar to the artist's illustration above, will be available shortly. Its size will be approximately 9½in. x 8in. x 6in. (internally). Full construction data, layouts, diagrams, templates, etc., running into some 50 sheets, is available, price 5/-, post free.

14 DAYS FREE TRIAL

SEND ONLY DEPOSIT REFUNDED IF TOOL NOT APPROVED



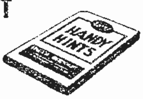
¼in. drill. ROBUST Tool with trigger switch and self-centring chuck, £5 19s. 6d. Cash, or 40/- deposit.

5in. SANDER POLISHER. A must for Housewife, Engineer and Handyman, £8 . 7s. 6d, or £2. 15s. 10d. deposit.

THE 44 ORBITAL SANDER. 10 times faster than hand sanding, £12. 10s. 0d. Cash, or £4. 3s. 4d. deposit.

All tools made by Black & Decker

FREE BOOKLET



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Personal shoppers, however, can call at :

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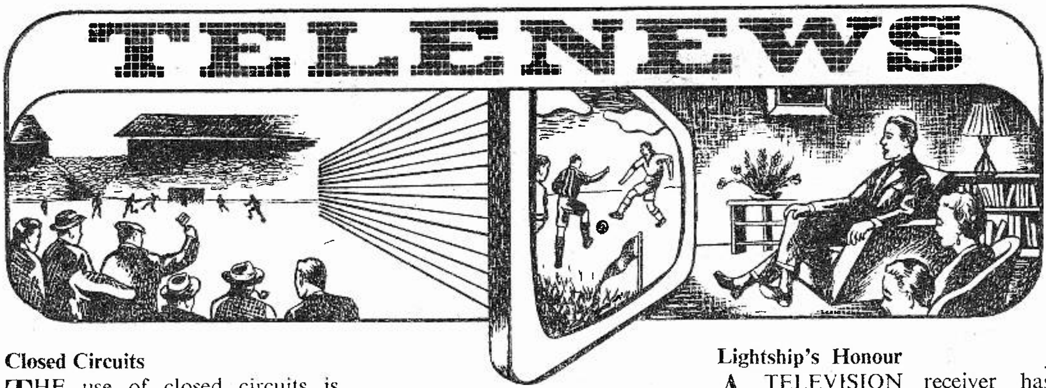


Closed Circuits

THE use of closed circuits is becoming increasingly popular in the United States and many leading companies are conducting conferences in this way.

Recently, Ford dealers in 32 cities were able to see a preview of a new car by means of television on a closed circuit and Ford have also held important sales discussions on a number of occasions.

Television Licences

THE following statement shows the approximate number of television licenses issued during the year ended April, 1954. The grand total of sound and television licences was 13,455,061.

Region	*Number*
London Postal ...	946,498
Home Counties ...	357,194
Midland	638,636
North Eastern ...	436,974
North Western ...	458,886
South Western ...	141,147
Wales and Border ...	161,851
Total England and Wales	3,141,186
Scotland	148,156
Northern Ireland ...	11,496
Grand Total	3,300,838

Low Sales in Italy

IT is reported from Milan that the output of television receivers in Italy is to be reduced because of a marked falling off in sales.

The cheapest set available costs £88.

Divis Television Station

THE BBC has placed a contract with McLaughlin and Harvey Ltd., contractors, for building work at the new medium-power television transmitting station at Divis, near Belfast.

Work is expected to begin in July.

What Are My Lines ?

A BBC engineer has devised a new method of prompting actors who " dry up " in television plays.

The script of the play is turned on a roller machine which can, when necessary, beam the lines on to a mirror which reflects them back on to plate-glass between the camera and players. The actors can see their lines but TV cameras cannot register them.

Tele-phone

AN hour before the 9,931-ton French liner *Lyautey* arrived in Casablanca recently, passengers were able to talk to friends ashore and see them on a TV screen.

Cameras transmitted pictures of friends in Casablanca to the ship and the passengers aboard saw and spoke to them although they, themselves, could only be heard and not seen by those ashore.

Lightship's Honour

A TELEVISION receiver has been installed in the Breaksea Lightship, which lies five miles from Barry in the Bristol Channel.

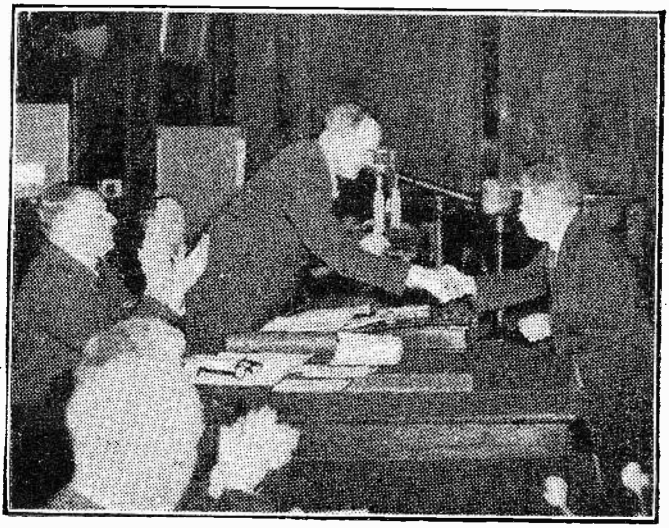
It is the first set to be operated in a European lightship and is a gift from the Mayor of Barry, Alderman T. Yeoman, who visited the master and crew of six last Christmas and saw that the monotony of their daily routine could be pleasantly broken with the aid of TV. Tests were made to see that the set would not interfere with the vessel's electrical apparatus, with satisfactory results. The crew now enjoy good quality reception.

New Comedy Series

AS Bob Monkhouse's television series has been cancelled due to his ill-health, a new series is planned to begin some time this month starring Avril Angers.

Avril first became well known to viewers in her role of Rosie Lee in Terry Thomas's shows and

A mobile outside-broadcast unit, recently completed by Marconi's Wireless Telegraph Co., Ltd., undergoes its acceptance trials before leaving for Switzerland for the televising of the World Football Championships from Berne.



Mr. M. Bishop of the BBC, president of the Institution of Electrical Engineers, is seen presenting the Faraday medal of the I.E.E. to Mr. Isaac Shoenberg of E.M.I. for his outstanding contribution to television.

on it by next year but there is a long way to go before it is an economical proposition."

Large-screen Demonstration

LARGE-SCREEN television was demonstrated for the first time in France recently by the Rank Organisation Associate Company, Cinema Television.

An audience of 3,000 were impressed by the trial showing which took place in the Palais de Chaillot for the 60th anniversary congress of the Electrical Institute.

Holland's First TV Buy

IT is reported from Holland that the Dutch Television Foundation has placed its first television order with a German firm.

The order is for a TV recording-car and German competition won through by merit of a slight difference in price.

recently played a leading part in the "Friends and Neighbours" programmes.

Commercial Too

THE report released in Canberra of the Royal Commission on Television urges the early introduction of national and commercial TV programmes in Australia.

Sweden Begins

WHEN a sponsored television service opened recently in Sweden, crowds gathered outside dealers' shops to peer curiously at sets in the windows.

Some streets were so packed that traffic was held up for long periods.

Protest to Council

A FEW days before the Queen's return journey up the Thames, over 1,200 viewers in the Abergavenny, Monmouthshire, district wrote to the local council, newspapers and the G.P.O. in protest against the fun-fair in the town, which, they claimed, would interfere with the reception of the TV broadcast from Westminster Pier.

A Post Office engineer from Cardiff visited Abergavenny but could do little other than receive a promise from the fair tenants that all generators would be run at low pressure. According to reports, the programme was received satisfactorily.

Ban on Religion

DURING a debate on the Television Bill in the House of Commons recently, Mr. D. Gammans, Assistant Postmaster-General, said that no religious organisation would be allowed to advertise or buy time on a commercial television programme.

Two Years' Wait

WHEN Sir Ian Jacob, Director-General of the BBC, returned home from America recently, he told the Press that it would be at least two years before colour television could begin in Britain.

"We are abreast of the Americans," he said, "though they may be a little earlier than us with colour TV. They may even be ready to go into mass production

No Tip for TV Pirate

G.P.O. officials recently discovered that a householder in the North was operating his TV without a licence.

On calling at the house to challenge him, two Post Office representatives were invited straight in before they could state their business so that the licence-dodger would not miss the end of a big race on television. The men remained silent and watched while the family shouted home the winning horse. "I got a tip about that one," beamed the householder. He was then told who the men were and that they had come to inquire about his TV licence. His face fell. "It never rains but it pours," he said. "I didn't get a tip about thee."

After the Pay-off

LORD MACKINTOSH, chairman of the National Savings movement, has stated that the public are saving more now that the boom in the buying of television sets, washing machines and refrigerators has declined, and all hire-purchase instalments have been paid off.

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

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

HANNEY of BATH offers:—

EDDYSTONE 740 RECEIVER. ex-stock at £42/15/-. Send for illustrated brochure. NEW Eddystone catalogue 1/2 post free.
MIKES.—Acos Mic. 22-2, **84/-**; Mic. 30, **50/-**; Mic. 33-1, **50/-**; Mic. 35-1, **25/-**; Rothermel 2AD56, **63/-**.
LOUDSPEAKERS.—Goodmans Audiom 60, **£8/12/6**; Axiom 150 Mk. II, **£10/5/6.** W.B. HIGH FIDELITY, 3 Ω coil, H.F.610, 6in. **50/6**; H.F.810 8in., **60/6**; H.F.912, 9in., **67/-**; H.F.1012, 10in., **73/6**; (15 Ω available at **73/6**).
COILS.—(State range required.)—Osmor Q, **4/-**; Weymouth H, **3/9**; Wearite P., 3/-; Denco C TRF, **8/-** pr.; Denco Maxi-Q std. or miniature, 3/11, with reaction, **4/9**; R.E.P. dual range high gain, **4/-**. OSMOR Q Coilpacks, Type HO, **48/-**; LM, **40/-**; Batt., **50/-**; TRF, **40/-**; ETA 4 Station Tuning pack, **43/8.**
I.F. TRANS. (465 Kc/s.) Denco IFT, 11, **12/-** pr.; IFT, 6, **18/4** pr.; Wearite M.800, **21/-** pr.; Weymouth P.4, **15/-** pr.; P.5, **8/6** each; P.5A, **10/-** each.
OUTPUT TRANSFORMERS.—50 watt POTTED de Luxe type to suit single or push-pull PX4, 6V6, 6L6 and KT66 valves. Optimum leads 4,000 Ω to 10,000 Ω. Eleven ratios 15½ : 1 to 78 : 1, **47/3.** Elstone MR/T 4 w. multi-ratio, **8/9**; Elstone MR/7, 7-10 w. multi-ratio, **18/9**; MR.15, 15 w. multi. **41/6**; MR.30, 30 w. multi. **49/6.** Woden Williamson, Potted, WOT25, 1.7 Ω secs., **£6/10/-.** WOT2.6, 3.6 Ω secs., **£6/18/6.**
P.W. CORONETS.—JB. SL8 Drive, **27/6**; E.2 V-Condenser, **14/-**; W.B. 8in. H.F.810 L.S. (less trans.), **60/6**; All resistors and condensers as per our General List.
TELEKING.—Constructors' Envelope, **6/-**; Coilsets, **44/6**; Chassis kit, **50/-**; T.C.C. kit, **£7/4/3**; RM4 rectifier, **21/-**; Allen Components, LO308, **40/-**; FO305, **21/-**; DC300, **39/6**; FC302, **31/-**; GL16 and GL18, **7/6** each; BT314, **15/-**; SC312, **21/-**; AT310, **30/-**; OP117, **9/-**; Dubilier Resistor/pot. kit, **81/6.**
P.T. SUPER VISOR
T.C.C. Condenser kit, **£8/6/4**; Erie resistor kit, **54/4**; 4 w/w pots, **26/-**; 7 Erie carbon pots, **35/-**; Allen coilsets, **44/6**; Allen CD/300C **39/6**; GL.16 and GL.18, **7/6** each; SC.312, **21/-**; FC.302, **31/-**; OP.117 output trans., **9/-**; Denco WA/FMA1, **21/-**; WA/LOT1, **42/-**; Denco chassis kit, **51/6**; Westinghouse WX.6, **3/10**; WG4A, **7/6**; LW.7, **26/8**; English Electric polystyrene mask, **45/8**; perspex filter, **32/8**; anti-corona ring, **6/8**; Tube sheath, **6/2**; T.901 tube, inc. carriage and insurance, **£22/14/10**; Elac IT8 ion trap, **5/-**.
WIDE ANGLE VIEWMASTER.—Instruction Envelope, **3/6.** Priced parts list available on request.
CATHODE RAY TUBES.—Mazda, CRM.121B; **£16/13/8**; CRM.123, **£17/14/6.** Mullard MW31-74, **£16/13/8**; MW36-22 & 24, **£19/9/3**; MW43-74, **£23/12/8.** Ion traps for all tubes, **5/-** each. Please add 10/- carriage and insurance on all tubes, any excess being refunded.
Send 6d. in stamps for our GENERAL LIST, which contains details of components for Viewmaster, Teleking, Magnaview, Super Visor, 'Universal' large Screen Televisor, by Mullards, Coronet Four, Williamson Amplifier, Soundmaster, etc., etc. Please add postage to orders under £2.

L. F. HANNEY 77, LOWER BRISTOL ROAD, BATH Tel.: 3311

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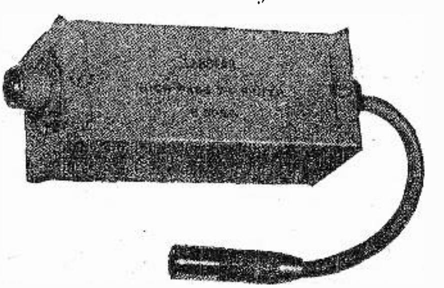
TV INTERFERENCE ELIMINATED IN SECONDS!

Announcing the latest PLUG-IN HIGH-PASS FILTER for TV Receivers



Removes interference from nearby Transmitting Stations (on 30 Mc/s or lower).

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Postage on valves 1/- up to 6.

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Selenium type, 180 volt at 40 m/A., 3/9. Metal recs., 300 v. 200 m/A. Also 200 v. 80m/A.: either at 8/9. T.V. type, new, 300 v. 200 m/A., 12/9. P. & P. on rec., 1/-.

P.M. 12" 10" SPEAKERS 8" 6"

12in. Truvox, 47/6; 10in, 25/9; 8in., 18/6; 6½in., 14/9; 5in., 13/9. All 3 ohms. Best makes. P. & P. 1/9.

SPOTLIGHTS.—8/9 Butlers, new but ex-W.D. 7½in. dia., 6½in. deep. These lights are similar to those sold for £3-£5, but finished Black. The lamp fitting is of the pre-focus type, this can be easily changed by fitting a holder from side light (1/9) post 1/3. Bulbs for above now in stock, 6 volt 36 watt, 12 volt 48 watt, 4/6 each.

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INTERFERENCE & NOISE SUPPRESSOR.—5/9. Cuts out frig., hair drier, etc., interference. Post 1/3.

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COLVERN PRE-SET WIREWOUND POTENTIOMETERS —100 ohms to 30 k., **3/2** each. Carbon pots, **2/6**, with switch, **4/-**. ¼, ½ w. resistors, **4d.** each; 1 w., **8d.** All preferred values stock.
VALVE CANS
B7G or B9A Moulded Holder and Can, **1/6.** I.O. Can (3 piece), **1/6.**
E.H.T. COILS. 6-9 kV., 15/-; 6-18 kV., **25/-**; with circuits.
SWITCHES
New Midget Type, 2 p. 2 w., 2 p. 3-way, **2/6.** 1 p. 12 w., 2 p. 6-way, 3 p. 4 w., 4 p. 3-way, **3/6.** Yaxley Standard (two bank), 2 p. 11-way, 6 p. 3-way, 4 p. 5 w., 8 p. 2 w., **7/6.**
MISCELLANEOUS
Pair of Best Quality Test Prods, **1/9** pair. Adcola Soldering Iron, **25/6**, with detachable bit **3/6.** Stand, **10/6.** Henley's New Instrument Iron, **18/9.** Tyana, **14/11.** Multicore 18 s.w.g. Solder, **5/-** per carton. Flux, **1/6.** 2 v., 6 v. or 12 v. at 2 a. Charging Transformer, **19/6.** 4 a Type, **22/6.** Ellison 60 ma. 250-0-250 v. 6.3 v. and 5 v. fully shrouded Midget Mains Transformer, **21/6.** A.E., L.S. or P.U. Socket Strips, **6d.** each; **5/-** doz. Volts Adjustment Panels, **1/2.**
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HIGH STABILITY 2% ½ **w. RESISTORS**
All values (preferred), 100 ohms to 2 mg., **1/6** each. 5% wirewound up to 7 watt, **2/3.** 10 w., **2/9.** 40 ohms to 10 k.
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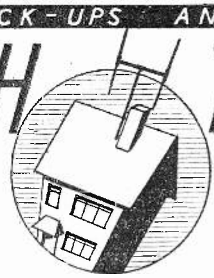
CONDENSERS
.01 5,000 v., **2/9** (oil filled). .5 400 v., **8d.**, **5/-** doz. .01, .1, .001, .002, .02, .05, **6d.**, **5/-** doz. .001 6 kV., **6/-.** .001 12½ kV., **10/-** or 15 kV., **10/-.** .01 6 kV., **7/6.** .1 7 kV., **20/-** (all T.C.C. Visconol).
VALVES
6U5 Magic Eye, **7/-.** AC6PEN, **5/-.** HVR2A, **4/6.** KTZ41 (7 pin 4 v.), **5/-.** 12SC7 (D Triode), **4/6.** 6N7, **6/6.** 6BW6, **7/6.** 6AT6, **7/6.** 6X4, **7/6.** KT36, **8/6.** All available BVA types.
ODDS AND ENDS
¼in. Polystyrene Spindle Extensions with ¼in. Panel Bush, 4in., **1/10.** 8in., **2/3.** Brass Couplers, **8d.** ¼in. Alladin Formers and Cores, **7d.** ¼in., **10d.** Denco Maxi "Q" Formers, **1/8** each.
DENCO COILPACKS
CP4/M **33/4.** CP4/L **33/4.** CP3/500 **42/8.**
S.E.A. FOR QUOTE. **6d.** FOR SURPLUS BARGAIN BOOKLET.

RADIO SERVICING CO. 82, SOUTH EALING ROAD, LONDON, W.5.
EALING 5737. Next to South Ealing Tube Station.

TELEVISION PICK-UPS AND REFLECTIONS

UNDERNEATH THE DIPOLE



By Iconos

WATCH ON REPERTORY

THE BBC's television play producers have long been watching attentively the theatrical repertory movement. In spite of strong competition from cinemas, music halls, radio and television, there are about a hundred repertory theatres in large and small towns all over the country which put on a weekly play, acted by real, live, professional actors. Many of the plays are brand new—the first efforts of budding playwrights —and in these, the TV Drama Department are particularly interested. Sometimes, of course, the boot is on the other foot and new or even established playwrights go so far as to write their plays for television, but probably with an eye on the West End or provincial theatre as the ultimate source of royalties. This is what happened some time ago with *Dial M for Murder* by Frederick Knott, a new author, and more recently with *The Man Upstairs* by Patrick Hamilton, who wrote those big play and film successes *Gas Light* and *Rope*.

"6M. 4F. ONE SET"

WHAT is the magic formula most likely to appeal to the producers of repertory? A glance at the advertising columns of a theatrical newspaper reveals that authors and their agents like to boast that a play requires only one setting and has parts in it for five or six men and three or four women. In the advertisements, the play title and the name of the author are followed, for instance, by the cryptic letters—"6M. 4F. One Set," a combination which seems to suit the majority of repertory companies—or "4M. 3F. One Set," which appeals particularly to the smaller companies. Occasionally, the figures "7½%" or "6%" appear, which indicate the royalties demanded for the performance of the play, based upon the box office takings, after entertainment tax has been deducted. Plays with many more characters and with music seem to appeal to amateur dramatic societies, for obvious reasons. But the other selling point of "One Set" is the characteristic which scares me a little, so far as television is concerned. We are having quite a lot of plays on TV which require only one set, and it seems to me that a certain amount of adaptation is desirable to give a greater variation in the background, especially for plays which run over an hour. One can understand the difficulties of repertory companies struggling with four or five sets in one play—but these difficulties surely do not apply in the case of television. The large stages at Shepherds Bush could deal with the extra sets with the greatest of ease.

"THE PROMISED YEARS" SERIES

THE LIBERATORS was the first of a group of four plays entitled *The Promised Years* by Iain MacCormick, and this was played by an excellent cast in one main setting plus an "insert" or two. The setting, designed by Roy Oxley, represented an Italian farmhouse in the last days of the war and it was in this set that almost the entire action took place. The situation of Italian partisans helping allied soldiers in operations which endangered their own families had great dramatic strength. Characterisation of Italian partisans, allied officers and men, and the Italian family in the farmhouse were rather conventional and strictly in accordance with type casting for stage plays or films. Nevertheless, the playing was excellent and moving, fine performances being registered by Maureen Beck, Paul Carpenter, Owen Holder, John Welsh and others. The camera set-ups and lighting were good, though rather on the dark side, but many of the close-ups were beautifully composed. The love scene between Lucia and Pietro was delicately acted and very well photographed, for which we must compliment also the producer, Julian Armies.

I look forward to the other three plays in this same series in which characters from *The Liberators* reappear in different surroundings.

VINTAGE FILMS

THE film industry is unwilling to co-operate with the BBC in allowing new or nearly new films to be televised. This attitude is quite understandable, yet the BBC could make greater use of films, sound and silent, which do not come under this ban. The showing of Harold Lloyd's "Movie Crazie," a silent film which must have been over twenty-five years old, was an example which could be repeated. These old silent films were theoretically photographed and projected at 16 frames per second. In practice, they were photographed at about 18 frames and projected at anything from 18 up to 24 frames per second, the latter high speed being reached on Saturdays when theatre managers often tried to get an extra half-programme through to cope with the rush of patrons. With suitable arrangements made for adjustable speed, many of the silent pictures would be worth seeing again, such as "Birth Of A Nation," "Quo Vadis," the Fairbanks pictures, Hepworth's "Alf's Button" with Leslie Henson and "The Four Horsemen Of The Apocalypse." Then there are the early blood-tub melodramas, played in a straight manner but with exaggerated gestures which now seem so very amusing especially when accompanied on the piano with a carefully worked-out "straight" arrangement. The National Film Theatre, next to the Royal Festival Hall, put on some time ago a showing of a British melodrama film "The Road To Ruin" with Arthur Dulay giving a most appropriate and expertly synchronised piano accompaniment. The serious story of the downhill path of a (somewhat elderly!) University student whose gambling and intemperate habits nearly cost him his life, is presented in the form of a dream, thereby ensuring a happy ending. The contemporary synopsis of the film states: "The climax gives opportunity for a fine piece of character acting, culminating in a scene of great power and strength." All I can say is that it has to be seen to be believed!

UNDERNEATH THE DIPOLE

(Continued from previous page)

ILLUSIONISTS ON TV

MAGICIANS, conjurors, illusionists, card manipulators, handcuff kings and the like, have always attracted attention. It is the way they do their tricks—the patter and the showmanship—which matter more than the trick itself. Houdini, Lafayette and David Devant put illusionists in the theatrical limelight many years ago and television is now producing a new generation of first-class magicians. Bill Ward put on a very good show in "Men Of Mystery" and, being a technician as well as a television producer, he was not afraid of introducing a number of camera tricks to help the magicians who appeared in this feature, particularly David Nixon, who also acted as compere. In collaboration with D. R. Campbell (the television engineer who has lectured to the Television Society and the British Kinematograph Society on many occasions), Bill Ward made great use of the "inlay" and "overlay" systems of superimposing parts of one picture upon another. David Nixon was able to make pillars of salt gradually appear and disappear in a most mystifying way, thanks to the clever electronic switching device which is the equivalent of the film studio trick known as "travelling matte." The curious thing about automatic masking methods of dove-tailing sections of one picture on top of another, is that they are easier to achieve with a colour system than in black and white. For instance, for one image of the two to be joined up or superimposed, it is possible to have an actor stood in front of a plain ultramarine back-cloth. By means of filters and prisms on one camera, two images can be reproduced. One image can be made to consist of a clear silhouette of the actor on a black background and the second image could be reproduced as a half-tone reproduction of the actor upon a white background. The electronic switch, operated by the silhouette image, can be made to fill in the white background with a third image—a real scene, a scene from a film or a still photograph. For instance, the actor can be made to look as though he is gazing at an exhibit in a museum. The museum part of the composite picture is picked up from a still photograph, and the actor, standing in front of the ultramarine backing, is superimposed upon it. No set is built at all. The BBC usually obtain the silhouette masking signal, essential for the electronic switching device, by standing the actor in front of a black background and making sure his suit (or any part of him) is not as black as the background. The contrast between the figure and the background is then forced up and used in the same way as the blue colour separation system described above. It is a complex device, though, and requires very careful adjustment. But the effects are truly amazing. No wonder the magical men are interested in all TV camera tricks.

NEW STATION EQUIPMENT

New Television Camera

THREE important new items of television equipment were recently demonstrated by Marconi's Wireless Telegraph Co. Ltd. at their research laboratories at Great Baddow, Essex.

These equipments were respectively the Marconi Mark III image orthicon camera channel, the English Electric Valve Company's 4½in. image orthicon pick-up tube, and the Marconi flying-spot telecine equipment.

Substantial orders, which have already been announced, have been received for the first two items from the BBC, Canada and Switzerland for both studio and O.B. use.

The Marconi Mark III camera channel is the only one in existence which has been specifically designed for use with the new 4½in. image orthicon pick-up tube, although it can incorporate the 3in. version if desired. This important feature has been made possible by close co-ordination between the English Electric Valve Co. and Marconi's, who are associated companies within the English Electric Group.

The entire camera channel has been designed with a view to providing the maximum possible simplicity of operation. As the same basic equipment is used for either studio or mobile work, the stocking of spares is reduced to a minimum, while the maintenance engineers have only to familiarise themselves with one set of circuitry. Extreme accessibility and the use of plug-in units give rapid servicing facilities.

The new camera is fitted with an electronic viewfinder of special design, which enables it to be set at any angle, irrespective of camera elevation.

A number of editions of the Mark III equipment are available to cover requirements for either studio or mobile use on 405-, 525-, or 625-line systems, with 50 c/s or 60 c/s mains power supplies. A version which may be completely remotely controlled is also available.

The 4½in. image orthicon pick-up tube has many advantages over the 3in. It gives a more pleasing tonal gradation and a cleaner picture. In fact, the resolution is such that it provides a far better picture than any existing television system is capable of transmitting.

Halo, edge effect and ghosting are virtually non-existent. ("Halo" is a black area surrounding picture highlights. "Edge effect" is sometimes seen as a thin white line produced immediately to the right of, and below, a sharp black-to-white transition. "Ghosting" occurs when a spurious second image is seen superimposed upon the picture.)

The 4½in. image orthicon is more sympathetic to changes of lighting, which means in practical terms that the change from dark interiors to exterior scenes can be made by the camera without major adjustments having to be carried out by its crew. This facility allows much more freedom to the producer, who can be more ambitious with his lighting effects.

The Marconi flying-spot telecine equipment, also demonstrated, has been developed to provide a television picture of exceptionally high quality from 16 m/m. film and standard 2in. by 2in. miniature film slides.

An outstanding feature of this equipment is the Marconi fast pull-down mechanism, which solves in a simple, reliable manner the problem of how to prevent the intermittent motion of the film from being seen.

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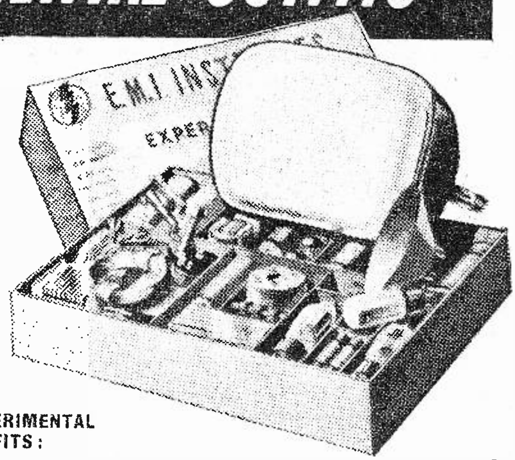

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CORRESPONDENCE

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).

TV INTERFERENCE

SIR,—Although articles have appeared on the subject of TV interference on sound radio (*re* PRACTICAL TELEVISION, January, 1953, and *Practical Wireless*, December, 1953), in my opinion not enough has been said on this subject.

Recently two old people, who virtually live for the radio, told me how their evening entertainment has been spoilt since a neighbour installed a TV set.

Can we allow this to continue without putting up some sort of fight? Obviously it is the manufacturers' fault. But I think it would do a lot of good if viewers were made to realise that they can ruin the wireless reception of many listeners living nearby. People, on purchasing new sets, would perhaps try to buy one that had been suitably screened, not forgetting an aerial filter, by the manufacturer. We might even live in hope that viewers would stop grousing about ignition interference.

This is surely a matter to be taken up by the daily newspapers, who can spread the word round the non-technically minded viewers, as well as by your excellent journals *Practical Wireless* and PRACTICAL TELEVISION.—NICHOLAS HOCKENHULL (Leeds, 6).

"VIEW MASTER" EXPERIENCE

SIR,—I read with interest the letter in your correspondence section of the March PRACTICAL TELEVISION by A. W. Lyons, of Worthing.

The iron-dust cores of my "View Master", I found, have also to be unscrewed until they are either nearly falling out or are three-quarters of their length above the chassis.

Removing a turn from one of the coils as an experiment did not have the desired effect, due maybe to the special type of coupling employed.

Can aluminium cores be obtained commercially? —G. HARRISON (Thornton Heath).

PROGRAMME REVENUE

SIR,—While much has been written and said on the subject of sponsored television and the BBC's continued state of pecuniary embarrassment, there is one source of revenue which I have not yet seen proposed.

While looking at one of the "Interlude" shots the other evening I wondered why the BBC has never taken a leaf from the cinema industry's book and screened advertisement shorts. This could be done at the beginning of programmes and during interludes. Add to this the "Normal service . . ." periods and there would seem to be a lot of time during which the BBC could be earning much needed money with shorts.

Taking the cinemas' efforts as an example, I have seen little, if anything, that could cause any objection, and it does not in any way intrude on the programme proper.

Can anyone see any objection which makes the idea impracticable? As I have not seen it mooted previously I wonder if there is not some snag of which I am not aware.—I. D. MOTTRAM (Aylesbury).

COST OF COMPONENTS

SIR,—With Mr. G. Metcalfe, I heartily agree with Mr. H. Telford in regard to the exorbitant prices of cathode ray tubes.

Dare we hope that the fact that there is a serious decline in the sale of receivers may influence manufacturers to follow the lead of one well-known firm who supply reconditioned tubes at a very considerable reduction?

Mr. Metcalfe's suggestion of the production of a set with a guaranteed quality picture is most attractive, but I fear not practical on account of such factors as poor aerial array, feeders and local conditions, etc.

His further suggestion regarding interchangeable complete electrical elements at a fixed fee is excellent, but it would be far from popular with dealers and service people!—O. DAVIES (London, S.E.12).

NO CONTRAST CONTROL

SIR,—I read in your correspondence page some time ago that a fellow reader had bought a television set that did not have any contrast control knob.

I now know what a big drawback this is, for I myself have just bought a receiver and did not pay much attention to the fact that there were only two controls —an on/off volume switch and one for reducing and increasing brightness. In theory, according to the makers I suppose, the one brightness control is intended to be sufficient—but it certainly is not. Many scenes are too black and white with greys missing and it should be possible to reduce contrast in such cases and increase ordinary brightness. On my new set this is impossible as reduction of light makes the picture too dark altogether and turning up the light control only makes it look harsh.

I am negotiating with my dealer to exchange the set. V. BARRETT (Catford).

"ZOOM" LENS

SIR,—Can you tell me what has happened to the "zoom" lens which was introduced so effectively a year or so ago?

The BBC and film newsreel companies were in the habit of employing this lens to give a more detailed view of events but I cannot recall seeing its use for some months now. Perhaps it is being put to use so expertly that I am no longer conscious of the sudden "diving down" effect that was so thrilling in the early days of its introduction to the field of news reporting.—J. JONES (Leatherhead).

SOUND QUALITY

SIR,—Since I built my receiver two years ago, I could count the number of my visits to the local cinema on one hand. Although not all the programmes are good, my wife and I derive enough pleasure from television to keep ourselves happy. There is, however, one point which I should like to make concerning the quality of the sound track of a film when it is televised. I used to be a great fan in the old days of Nelson Eddy and enjoyed his singing very much. The other afternoon I saw him on TV in one of his old films and again derived great pleasure from seeing him, but was struck by the much poorer quality of a film sound track when broadcast on television. This could prove to be a big headache to TV programme planners in the future because the public will always want to see some feature films on television.—K. S. BARR (Birmingham).

YOUR Problems SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 47 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

SYNC SEPARATOR

During the winter months I have purchased and built a kit set. The set is really quite good for the money but for one fault: it looses line sync during camera changes, also during dim scenes. The line sync is touchy, but will hold as long as the picture is bright or contains white.

I have checked condensers, resistors, valves with reliable intruments (Avo Bridge) and can guarantee that the circuit is as specified, but the fault still persists. The definition is quite good, the 2.5 Mc/s bars are visible, no pulling of whites or streaking is visible on the test card.

You will observe that the set incorporates SP61 for video and sync stages; could I expect better results if I modified the circuit to use, say, EF50s instead?

I enclose part circuit for your convenience, and would ask that perhaps you would kindly suggest the possible cause of this trouble!

I may say that two years ago I built the "Argus" and since then have had many happy hours of viewing even with a 6in. tube. Also I do enjoy reading the articles "From an Engineers Notebook."—R. G. Carter (Taunton).

The Mazda SP61 valve is of suitable type for sync separation. You may achieve enhanced performance from your circuit by (a) connecting grid 3 direct to the cathode; (b) reducing the value of the grid-leak to 470,000 ohms; (c) try the effect of modifying the screen potential-divider ratio.

VCR517C DETAILS

Could you please supply the following information? What are the working voltages for the VCR517C, i.e. max. E.H.T., beam current, etc.? Is there any reason for stating that the VCR517C must not be used in the "Simplex" receiver?—J. H. Turner (Manchester).

The normal working voltages for the VCR517C are about the same as those for the VCR97 and the data for the latter can be used with the exception of the fact that the X plate sensitivity is lower.

We do not recommend the VCR517C for the "Simplex" as in our opinion it is not suitable for TV. It suffers from long persistence of screen and requires more power in the line timebase to obtain full width.

CLOCKWISE OR ANTI-CLOCKWISE

In winding the coils of the "Simplex," it is stated all coils are wound in a clockwise direction. In Fig. 2, details of the coils, starting from pin 7 (VI)—it appears to be anti-clockwise. Do I wind as in Fig. 2? —C. E. Baker (Slade Green).

The direction of winding depends upon whether the coils are viewed from the top or from the bottom. The important point is simply that all turns on one coil form must run in the same direction.

"ARGUS"—SYNC PULSE

I have at last managed to get sound and vision on my "Argus" televisor, but have been unable to clear up one or two faults.

First, before transmission when the horizontal and vertical bars are showing I find that the vertical bar is curved; can you tell me how to correct this?

Also, when receiving the picture it is found that with the height control at minimum, the picture has more height than width, almost filling the screen. Any adjustment of the control makes it worse. I have read in PRACTICAL TELEVISION that rotating the tube through ninety degrees may solve this problem, but the rewiring instructions state remove the wire on pin 8 to another position, but there are two wires in the above pin, which is rather confusing.

Lastly, I have great difficulty in holding the picture horizontally—at times it spins like a top; only by operating the sensitivity control can I get it near static, but at the same time I lose my sound.—J. N. Clarke (Carlisle).

It would appear that your line sync pulses need strengthening; to do this connect a 50 pF condenser across C58.

To increase the width try increasing C56 up to about 600 pF; further increase can be obtained by making C53 100 pF and C52 25 pF.

REPLACEMENT TRANSFORMER

I wish to replace a transformer in a Murphy television set, model A56V, but I have no idea of its type or values. In the diagram it is numbered T6—could you please inform me of a suitable replacement? —W. J. H. Sims (Woodford Green).

It is essential that the correct type replacement transformer is used in the Murphy model A56V. Such a transformer is available only from the manufacturer, and it will, therefore, be necessary for you to obtain one from this source, via your Murphy agent.

LINE TIMEBASE FAULT

Six months ago my Ultra TV started rapidly fluctuating in width for about 20 minutes when first switched on.

About three months ago, with the width control at maximum and the horizontal hold at one extreme, it settled down to a 1½in. margin each side, the right-hand side of the picture being more cramped than the left.

It will still sometimes shoot out to within ½in. of full width or, on the other hand, become even smaller and the lines tend to break up at the same time.—C. Martin (S.W.6).

Practically any component in the line timebase developing a fault could provoke the symptom you describe. For this reason, therefore, we are unable accurately to detail a precise component; to do so may demand extensive circuit analysis. As a general help, however, we would suggest that you investigate closely the line generator (SP61), and suspect an

(*Continued on page 95*)

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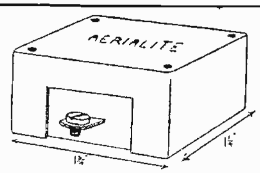

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TEST SETS TYPE 102.—Mains operated, emitting synchronising pulses of 25 and 50 cps. Amplitude calibrated 0.2 to 1.4 watts for output lamp. Provision is made for comparison of outputs by means of photometer type comparator. Housed in smart metal instrument cases 11 x 10 x 9ins. and fitted with A.C. mains 50 cps. power pack, using transformer ; Pri. 200/250 v. Sec. ; 6.3 v., 12 v., and 300 v., ½ wave selenium rectifier, double triode valve type CV18, valve type 6J5, 1 spare lamp, etc., etc. In good condition with circuit diagram. PRICE, **32/6**, carriage 4/6.

intermittently defective resistor (probably increasing in value) in the anode or screen-grid circuit. Check the line output stage in the same way (6P28 valve), and if the smaller components and valves associated with the circuit appear normal, suspect the line output transformer for short-circuited turns.

"VIEW MASTER"—USING ALTERNATIVE TUBE

I have obtained a 12in. G.E.C. cathode-ray tube type No. 7102A, and I am writing to ask if I can install it in the View Master set I have just built. If I cannot, can you give me details of the modifications required to the set in order to be able to do so? It would also be most helpful if you will tell me how to connect the tube to the set.—S. V. Ralph (S.W.18).

The G.E.C. cathode-ray tube type 7012A can certainly be used with the V.M., though for best results an E.H.T. boost circuit should be adopted. The base connections are exactly the same as for the other G.E.C. tubes specified for use with the V.M.

FAILING SOUND AND VISION

"On switching on I get a good picture, set quiet. Seven minutes later, picture started to darken, sound quieter. Two minutes later, picture gone, sound very quiet. Turn up contrast, picture O.K. Two minutes later, picture gone, sound nearly, plus lines bottom of picture (five or six), left to right.

I change mains lead, neon light on, and had a complete repeat of the above again, so switched off. I have no instruments. From the above, I hope you can put my finger on the spot.—H. J. Bunge (Morden).

If your vision and sound sensitivity is falling after the receiver has been operating for a few minutes, then it can only be due to a variation in the operation of V1, and therefore this stage should be examined carefully and if possible voltage measurements should be carried out. A fault of this type may be due to V1 actually being faulty or to a resistor such as R6, R7, R8 or R4 being faulty and increasing in resistance as the receiver warms up.

BRIMAR TUBE

Would be obliged if you would inform me if Brimar C12F cathode-ray tube, which I believe has scanning angle of 63 deg., is suitable for "View Master" (normal angle scanning) circuit.

In the list of recommended tubes the scanning angle appears to vary between 48 deg. and 50.55 deg., but none as wide as 63 deg.—L. Trim (Dunfermline).

We doubt very much whether a satisfactory scan would be obtained with a Brimar C12F using a normal "View Master" and it would probably be necessary to use a wide angle version with reduced H.T.

HIGH CURRENT

I have an Alba model T411 9in. tube receiver and the power rectifier FW4/500 has burnt out rather frequently of late. On checking the cathode current I found it was supplying 280 mA, but by changing certain of the electrolytics, which appeared to be leaky, I reduced this to 250 mA.

The set functions quite well, but even so I think this current consumption is still rather high. The line output valve EL38 accounts for 60 mA and the frame and sound output valves, EL33s, 30 mA each, these being measured with the other valves removed.

I haven't a circuit diagram and would be grateful if you could tell me what the current consumption should be and whether there are any other vulnerable points, such as resistance networks, which I should check. —J. C. Middleton (Wembley).

It is quite normal for the total H.T. current consumption of your television receiver to measure in the region of 250 mA. Rapid failure of the H.T. rectifier can almost certainly be attributed to defective electrolytic capacitors. Owing to the age of the set we would advise the replacement of all electrolytic type capacitors associated with the H.T. circuits.

"BRUSHING"

I should esteem it a favour if you could advise me as to what the trouble could be in a View Master I have constructed. The symptoms are, when the set is switched on it makes a noise like crumpling paper together. After a short time the lines keep showing and the picture is very thin; also, on moving objects, the picture pulls to one side; on switching the set off it makes a groaning noise. Could you please advise me what the trouble is?—P. B. Thickett (Sheffield).

It is somewhat difficult to state with certainty as to the peculiar effect in your receiver, but the noise like crumpling paper is most probably due to the E.H.T. supply, there being some brushing possibly due to a faulty component or to bad layout or soldering, and we suggest that you carefully examine this part of the receiver and endeavour to improve the wiring and soldered joints and make certain that the anode connection of your C.R.T. is clean and dry.

THE TRANSITRON SYNC SEPARATOR

(Continued from page 66)

if we take our line pulses from the suppressor grid the combination C1R1 will act as a differentiator. The time constant of C1R1 is longer than that of the normal line differentiator so the pulse produced will be longer than usual, but this makes little difference since we are only interested in the front edge of the pulse.

It will be noticed that in the circuit the resistor R1 is made variable. This is to facilitate adjustment of the time constant of C1R1 in order to get correct separation of the line and frame pulses. The best method of setting up is to look at the anode waveform on an oscilloscope and adjust the value of R1 until the line pulses disappear. If no oscilloscope is to hand R1 should be set to maximum and the frame timebase locked in. R1 can then be reduced to improve the line lock and with a little juggling it should be possible to get a steady, fully interlaced picture.

The valve specified is an EF91, but any similar pentodes with a short grid base such as the SP61 and EF50 may be used equally well.

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PRACTICAL TELEVISION, July, 1954.

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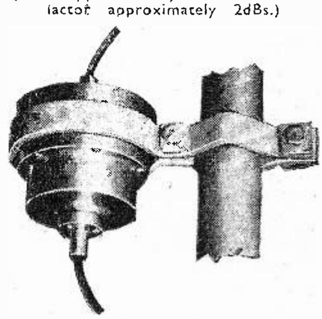

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