## BAND III PROBLEMS

# PRACTICAL TELEVISION

AND TELEVISION TIMES

1/-

EDITOR
F. J. CAMM

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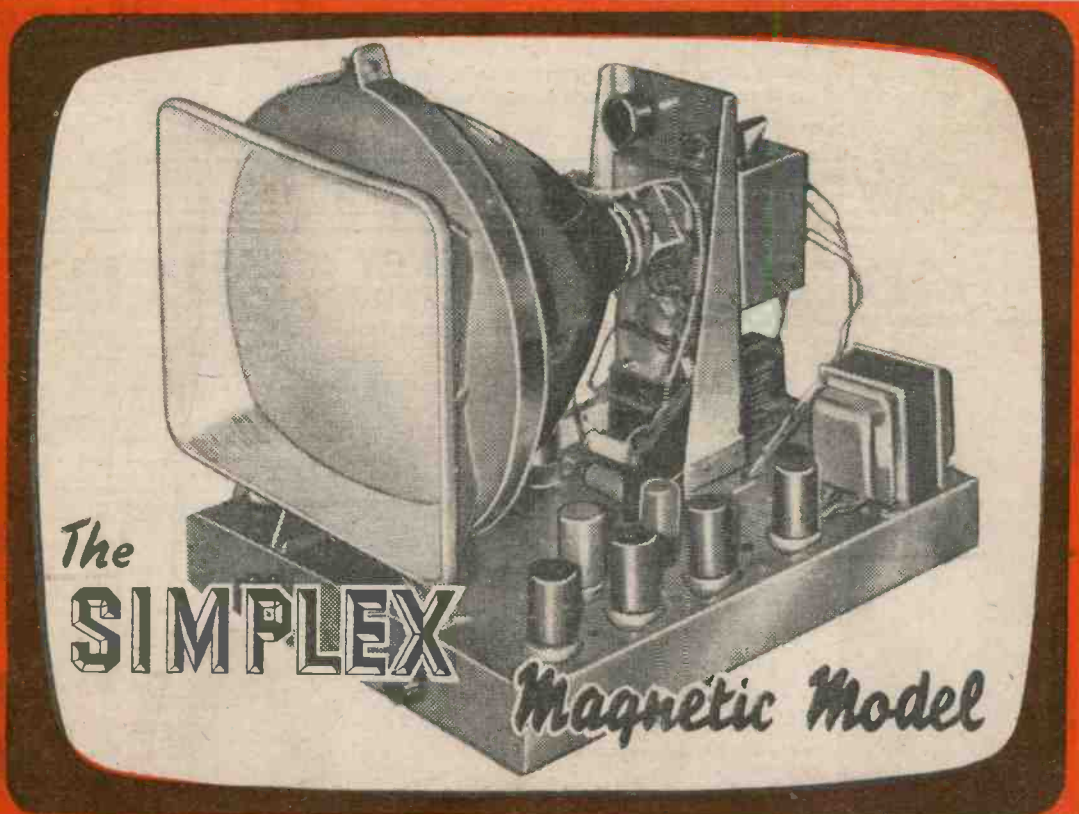


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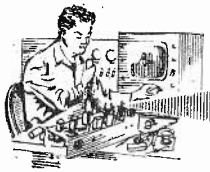
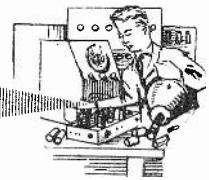


# Practical Television



## & TELEVISION TIMES

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# Televiews

### TUBE SIZE

THERE is one feature of receiver specification which is causing great confusion in the public mind. It is the manufacturers' method of designating tube size. We will give a case in point, but it is typical of all makers. The manufacturer's catalogue deals with a 17in. rectangular face tube. An examination of a scale drawing of the tube shows that the overall dimensions are 15.375in. and 10.75in. respectively, the screen diagonal being 15.375in. Screen sizes are now given in relation to the *diagonal*. Why? It is utterly misleading and gives the public the impression that it is obtaining a larger tube than is actually the case. In any case, in the example which we have quoted *no dimension equals 17in.* We suggest that the B.V.A. rationalises tube size nomenclature, and stipulates that its members advertise their tubes according to their rectangular width and depth. To designate a tube according to its diagonal, especially when even that figure is incorrect, is ridiculous and cannot be supported on any logical grounds.

### COMMERCIAL TELEVISION

IN view of the confusion in the minds of some members of the public, caused by various statements regarding modifications to sets necessary to receive commercial TV, the Radio and Television Retailers' Association state that the simple position is that the sets intended to receive additional programmes will need to have additional components included. This means additional cost whether the set is manufactured to include the additional part or whether the additional components are supplied in the form of an adaptor for fixing to existing sets.

It is important to remember that commercial TV will only cover a small part of the country during the first few years of its existence, and those about to purchase a receiver should enquire whether they are within the TV commercial service area and if not how soon it will be before they are. If it is likely to be some years they may save themselves some money by purchasing a receiver not adapted to receive the additional programme. A nation-wide commercial TV coverage will not occur for several years, and even in London where the first commercial TV station is to be put into operation, it must not be assumed that the range of the station will be that of the BBC. It will probably be less.

The association adds that "Whilst this Association supports competitive television, and feels the public will wish to have alternative programmes when possible, it is of the opinion that it is not fair to the public upon whom the industry depends, to sell only sets which will receive commercial stations, because to do so would, in very many cases, be compelling the public to buy sets only part of which would be usable. It is, therefore, stressed that the public will be at no disadvantage by buying sets which can be altered if and when required."

### THE DETECTOR CAR

ACCORDING to a statement from the General Post Office, results of the efforts of nine new television detector cars, seeking persons operating sets without a licence, have been "astonishing." In the first four days, 522 television licences and 388 sound licences were taken out and 371 sound licences were exchanged for television, a total of 1,281 against a normal week of 60. The presence of these cars should have a stimulating effect in Birmingham, where the number of wireless licences bought in the first week was doubled, and Brighton, Reading, Hastings and Luton reported an increase of 100 per cent.

The North-East region reported that licences taken out in three days exceeded those taken out during three days the previous week at Newcastle upon Tyne by 240, at Leeds by 259, at Sheffield by 86, and at Middlesbrough by 261. The South-Western region reported that in seven towns 200 licences more than usual were issued during the week.—F. J. C.

# BAND III PROBLEMS

## A DISCUSSION OF SOME OF THE DIFFICULTIES LIKELY TO BE ENCOUNTERED

By A. Thompson

WHEN we come to consider the requirements for the R.F. stages in TV receivers for the proposed Band III frequencies, it is essential that a low-noise factor and a high gain are obtainable. In Band III, which covers frequencies from 174 to 216 Mc/s, two channels 8 and 9 have been made available between 186 and 208 Mc/s.

Very little noise is contributed by the aerial circuits at these frequencies. The main noise contribution is supplied by the first valve, and it is to this circuit that we must pay particular attention.

In R.F. circuits for Band I (40 to 68 Mc/s) we use an R.F. pentode, but the use of a pentode in Band III will give a rather high noise level due to partition effect, that is, the noise caused by the random division of the electron stream between the screen grid and the anode. Valve noise is, therefore, a very important factor in the first stages of a V.H.F. receiver. The signal voltages in this stage, which are not as yet amplified, have come direct from the aerial system and are, therefore, of magnitudes comparable with the noise voltages. Therefore, it can be seen that any noise introduced in the first stage will be amplified by the following stages. It is essential that noise be kept to a minimum in these first stages.

As all radio experimenters know it is impossible to eliminate noise altogether, even a standard resistor introducing noise owing to thermal vibration of its electrons. (This is one of the reasons we use high-stability resistors in high-gain amplifiers such as for magnetic tape recorders, etc.)

A valve has a heated cathode which emits electrons. These electrons arrive at the grid and anode in a more or less random fashion and not as a continuous stream. The arrival of these electrons at the anode causes a current to flow. The anode current is referred to as a steady current but this really means an average current. So, in effect, each electron arrives individually at the grid or anode. We can almost liken it to pebbles being tipped from a cart, they don't fall to the ground as one, they fall individually.

The noise which is created by these electrons has no definite frequency, as the electrons arrive completely in random fashion and, therefore, their noise extends practically over all frequencies. A wide-band receiver such as a TV set is inherently more noisy than one having narrow band working. "Shot effect" is the term applied to this type of noise and it is rather fortunate that it is masked by the space charge, which forms a cloud around the cathode, this space charge acting as a sort of electron reservoir and buffer. This type of noise is always present and it is the noise that is left after all other sources of noise have been eliminated. There is no known remedy for this type.

When we were discussing the pentode we referred to "partition noise," and this is one type of noise which we can take steps to reduce. This is done mainly by mutual alignment of the grids, particularly the control and screen grid; thus the electron stream is directed through the spaces between the grid wires, and it is only the stray electrons which ever reach the screen grid.

R.F. pentodes specially designed for use in the first stages of TV receivers, such as the EF80 and the EF95, made it possible to obtain a high gain coupled with stability. Therefore, the use of these pentodes for Band I receivers was ideal, but the pentode set a limit to the sensitivity of the receiver.

As we are bringing more services into the V.H.F. bands, and this is the TV expansion area also FM broadcasting, we must use techniques which are suited to these V.H.F. bands. Components for use in the R.F. and frequency changer stages have to be specially designed, capacitors and inductors must possess as little as possible of the properties of each other. In the end, it is the valve which is the limiting factor. In Band I many problems were created but they were overcome, and a great deal of the credit must go to the valve manufacturers who gave us specialised valves. Now we go to Band III for TV, and meet frequencies in the region of 200 Mc/s and a totally different set of conditions regarding the design of the R.F. stages, but once again the valve manufacturers have given us specialised valves for the job, such as the Mullard PCC84 and PCF82.

### Triodes

A much lower noise level can be obtained by using a triode valve, but due to internal feedback that takes

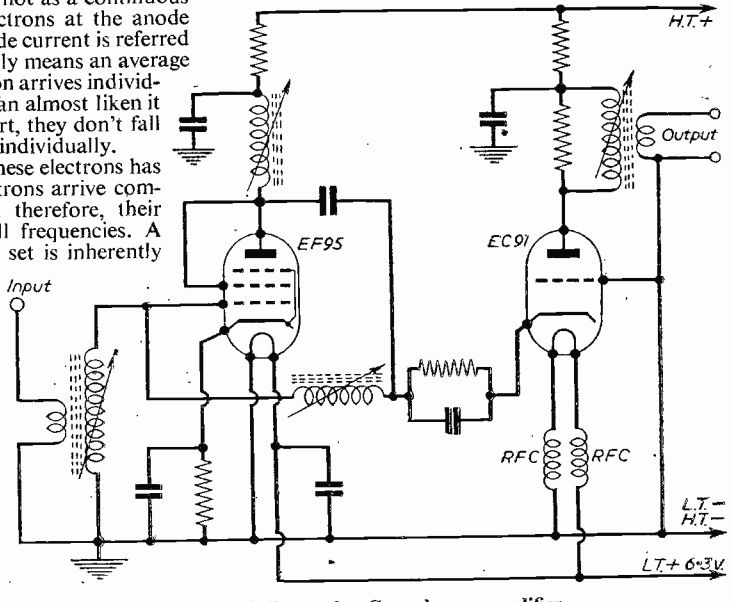



Fig. 1.—A Low-noise Cascode pre-amplifier.

place via the anode to grid capacitance of the valve, the gain of the stage is seriously reduced. Therefore, we must depart from the conventional triode circuit and look for other types of circuit in which we can take full advantage of the triode valve.

In V.H.F. work a circuit often employed uses the grounded grid technique, and this type of circuit operates most efficiently to high up in the frequency spectrum. An example of earthed grid circuitry is shown in Figs. 1 and 2. It is also being used a great deal for FM broadcast receiver design as it allows an efficient R.F. stage with a low noise level. By earthing the grid and allowing the cathode potential to vary according to the input signal we have in effect a screen between cathode and anode. From this it will be gathered that the capacitance between anode and cathode is very small, but what is more important is that the anode voltage is in phase with the cathode voltage, so that such " Miller effect " as exists tends to reduce the input capacitance rather than to increase it. It is this fact, and also the inherent possibility of reducing transit time effects in a triode much more than in a pentode, that makes the earthed grid triode an amplifier of great use in V.H.F. work. The valve manufacturers have given us special triodes for this type of circuit. The EC91 is a special valve for use in earthed grid circuits and this valve is shown in Fig. 1 where it is used in a low noise pre-amplifier for TV work. The latest valve for this type of work is the PCC84, which is shown in Fig. 2 in the R.F. stages of a multi-band TV receiver. The PCC84 has a high mutual conductance, very thorough internal screening between triodes, low inter-electrode capacities, etc., and designers of V.H.F. equipment have not been lacking in employing these valves for Band III TV receivers. Another valve worthy of note here is the ECC85 and the 12AT7 which are being used extensively as earthed grid R.F. amplifiers in the FM broadcast receivers.

**Cascode**

Fig. 1 shows a type of circuit that has been developed over the past few years and is known as the " Cascode " amplifier. This type of amplifier has been used extensively on Band I television, and also on 144 Mc/s by our colleagues in the amateur radio field. The EF95 is strapped as a neutralised triode, and the EC91 as a grounded grid amplifier. This type of circuit has the advantage of a low noise level and a high gain, thus giving the low noise level of a triode with the high gain and stability of a pentode.

Fig. 2 shows a cascode amplifier as developed for Band III TV receivers. It will be noted that the H.T. voltage is applied across the two sections in series, therefore each triode is running at half the total H.T. supply voltage. The average H.T. rail in the modern TV receiver is approximately 180 volts which means that only 90 volts is applied to each anode. However, despite this low anode voltage which is the result of series working, the mutual conductance of each triode is 6.0 ma/V (with a grid voltage of −1.5 volts). It will be seen from this circuit that the first triode in the D.C. series connected cascode circuit is a neutralised grounded cathode amplifier. The second triode is a grounded grid amplifier with the grid earthed capacitively by means of a lead-through capacitor. It can be shown that the noise factor of this arrangement is virtually that of the first triode alone, the noise contribution of the second triode being negligible.

It should always be remembered when constructing or designing the R.F. stages of a V.H.F. receiver,

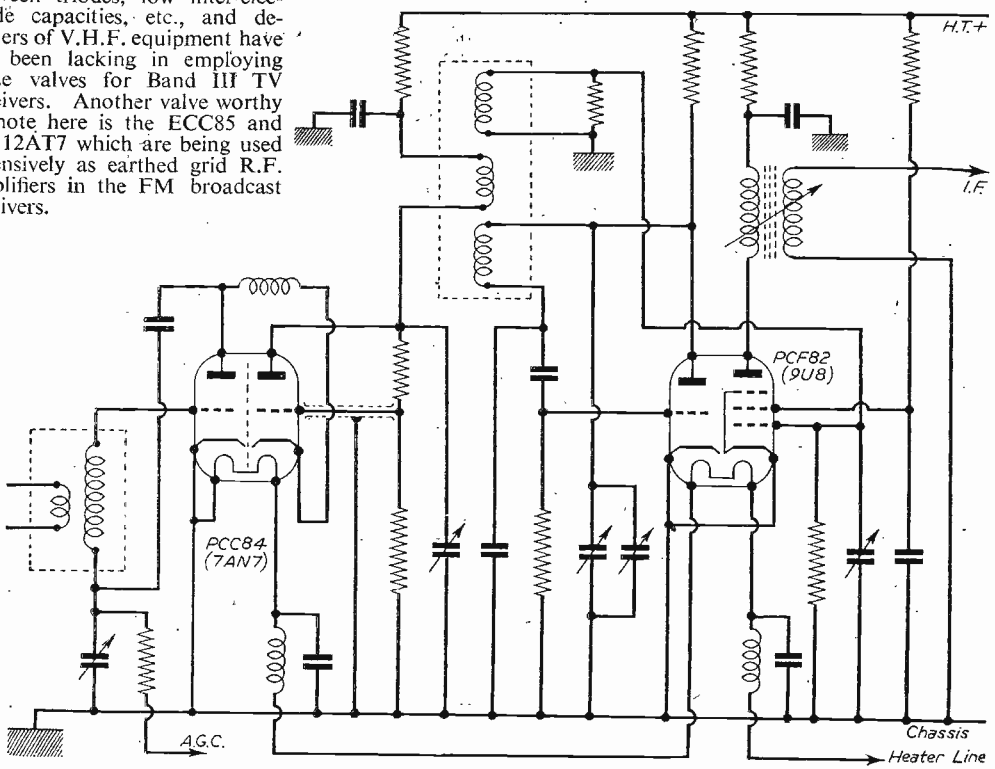



**Fig. 2.—The cascode circuit as used in the latest KB receivers.**

whether it be for TV or FM, that one must take into account the invisible factors or components which are formed by the stray capacities, the self-capacity and inductances of coils and condensers. The physical layout, lengths of wiring, placement of components, etc., all affect performance. It is therefore essential that once a layout has been found that is stable it should not be altered. This is evident in some of the latest 12-channel TV receivers employing rotary turrets. The final adjustment of alignment for each channel is done by altering the end turns of the coils and if these are mishandled it follows that the set will be put out of alignment on that channel.

**Frequency Changer**

Another valve which has been developed for specific use in the front ends of multi-channel TV receivers is the Mullard PCF82 and the circuit employed for frequency changer is shown in Fig. 2. The triode section of the PCF82 is employed as the local oscillator working in a Colpitts circuit. It will be noted that the triode and pentode sections are not internally connected in any way. It is recommended that inductive coupling be employed for the injection of the local oscillator ; however, many manufacturers seem to favour capacitive coupling and both methods appear to function very well. When capacitive coupling is employed it is necessary to arrange alternative capacitors for different frequency bands. There is a danger with capacitive coupling that a value of capacitance may be chosen to give optimum drive at a low frequency, and when the set is tuned to a higher frequency there may be serious overdrive. On the other hand, in inductive coupling which is employed in practically all turret-type tuners, each coupling coil is adjusted to give the best value of mixer drive on each frequency band, also making the whole of the oscillator coil available for the induction of an oscillator voltage into the grid circuit.

One of the greatest factors in any V.H.F. receiver is the stability of the oscillator circuits and from this point of view the PCF82 is very stable when used under the recommended operating conditions. Most of the local oscillator circuits in the multi-band TV receivers make use of negative temperature coefficient condensers, and it is essential that should these condensers require replacement during servicing that they are replaced with exact types.

As only channels 8 and 9 have so far been allocated for alternative TV programmes, most of the turret type tuners are fitted with coils for these channels. When other channels are announced, coils for fitting to these tuners will be made available by the respective manufacturers. The local oscillator coil is fitted with a brass slug and this enables the oscillator to be tuned. Also, in most cases, a trimmer is fitted for fine tuning of the oscillator circuit. The turret is well screened and access to these slugs is usually via a hole in the front of the turret. Once again it must be stressed that the spacing between turns on the coils must not be altered, as this will affect the alignment of the receiver.

**Intermediate Frequency**

It appears that most manufacturers seem to favour an I.F. of 35 Mc/s for vision and 38.5 Mc/s for sound. The number of I.F. stages has been increased in many instances to three and practically all sets have some form of A.G.C. or picture control. For sets used within the service areas of a powerful transmitter this A.G.C. takes the form of a sampling of average picture brightness. In the special fringe area versions, a more elaborate system using gated controls is employed.

A greater signal strength will, of course, be required for Band III than is required on Band I. If a Band I receiver has a sensitivity of, say, 20 micro-volts for vision and 15 micro-volts for sound, then when used on Band III with the same I.F. stages, etc., the sensitivity will now be approx. 60 micro-volts for vision and 45 micro-volts for sound. Studying these sensitivity figures it will be seen that we require three times the signal strength for Band III as we do for Band I, and therefore we must pay due care and attention to the aerial system. Where at present we are using two and three element arrays for the alternative programmes we may have to use four, five or six element arrays ; also, as the overall size will be smaller than Band I aerials, it is likely that a great many stacked arrays will be seen in the fringe areas. A good many examples of Band III aerials were shown at the National Radio Show ranging from multi Yagi types to a slot aerial.

As there are something like three million TV receivers in use that are not fitted for receiving Band III transmissions, it is not surprising that a great many inquiries are coming in as to what can be done to make these sets suitable for the new transmissions in Band III. Most of the manufacturers are catering for their own models and it seems that most sets will be catered for in this respect. Where we have a " single channel only " set, it seems that the easiest plan is to make a convertor that will use the channel of the set as an I.F. The trouble with this method is that we have two oscillators and they set up patterning. Also, it is possible that the station on one channel will also break through and cause further trouble from pattern effects. It seems that the only real satisfactory answer is to make a complete tuner unit incorporating Band I and Band III and feed this straight into the receiver I.F. stages. By using this method we can get away from the patterning effect and all the complication of having two oscillators functioning at once.

Many manufacturers are supplying these tuner units now for adding to present sets when a station opens near the viewer, and the cost of these units appears to be approximately 6 guineas.


## No. 3.—BUSH MODELS TV22 AND T24

By L. Lawry-Johns

THESE are very reliable receivers but nevertheless still have their "usual" faults, fortunately comparatively few in number. The first is undoubtedly the PZ30; this is located in the screening box on the "top deck" chassis right-hand side.

The first thing to remember is that this valve is not only used as the H.T. rectifier, but one half is used as a booster diode; hence a defective valve can give some rather misleading symptoms. Those possessing a receiver of this type are advised to keep a spare PZ30. If, after the failure of one of these valves and when a new one has been fitted, a slight hum is present on sound, especially in the "minimum" position, and there is evidence of frame non-linearity, the 38 ohm resistor, in series with the reservoir capacitor, should be examined. The reason for this is, in the event of an internal short in the PZ30, A.C. is present on this capacitor, causing a heavy flow of current through it, thus burning out the series resistor.

When the "going off" of one of these sets is accompanied by a trace of smoke, or by a smell of burning, this is what has happened, and a new PZ30 and a new resistor will normally be the "size" of the repair.

The diagram will show clearly the position of this resistor in the circuit.

### Line Output Transformer

The line output transformer is another source of likely trouble. However, failure of the line timebase is not the signal for a new transformer to be fitted. A defective PZ30 could also cause it, and the following points should also be suspected. A leaky C20 470 pF condenser (linearity correcting) wired across the T4 transformer (see diagram) will result in (a) no raster, (b) very small spark at anode of the EY51 (the valve not lighting up at all) and very weak line whistle. An internal short in the EY51 or an internal short (may be intermittent) in the tube. To check the tube remove the E.H.T. cap from the tube anode and check the operation of the timebase and E.H.T. with it, suspended safely away from any near-by chassis member.

The faults mentioned are due to overloading of the timebase, not to its non-operation, which may be caused by a leaky coupling condenser to the control grid of the line output valve, an open circuited resistor in series with the line hold control or failure of the valve itself.

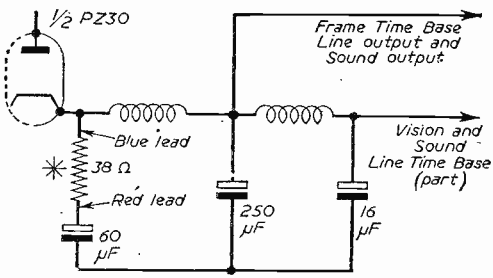
### Variable Gain

A frequent fault is variations in the gain of both sound and vision, and this is usually due to the 50 $\mu$F, 25 volt electrolytic condenser which is across the contrast control. It is a metal-cased type, and no difficulty should be found in locating it. A small drop in its efficiency causes large variations of gain. Another fault encountered several times on this model is a defective 100 pF coupling condenser on to the grid of V2 the mixer EF91. Depending upon the extent of the leak the symptoms may vary from a ragged picture with a small leak, to "snow storm" effects as the leak gets worse. When the condenser shorts out completely the picture vanishes with the mixer ceasing to operate. The position in the circuit is shown in the diagram and is marked with a star.

### Other Models

Some variation may be found in these notes and in the circuit diagrams as they are designed to encompass the TV22a, TV24a and the console variants. Most variation will be found in the line timebase and the types of valve fitted, e.g. PL81 for PL38, etc., but there is little variation in the actual circuit of the supply and sound/vision strips.

A hum on these sets has often been traced to a loose 4 B.A. nut and bolt on the rear of the chassis. This holds the earthing clip of the audio output stage and also the tag to which the main fuse is earthed.




*This resistor is mounted on the end of a paxolin panel on the left side of the upper chassis.

**Fig. 1.—Showing how the series resistor and the 60$\mu$F condenser are wired direct to the PZ30 cathode.**

It is situated just under the fuse-holder and should be inspected for tightness should hum be present. The first time this fault came in, it caused some heartaches and shows how the most baffling problems have the most simple answers sometimes.

If, after having repaired some fault on the receiver, and upon switching on no picture or a very weak

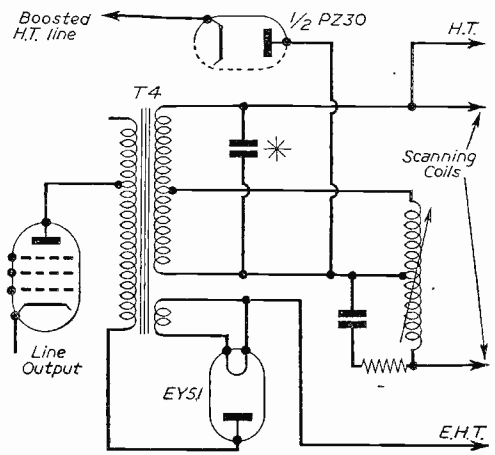



**Fig. 2.—The condenser marked * is 470pF and is C20 referred to in the article.**

raster is obtained, or the tube shows every sign of having lost its emission, remember the ion trap. The way these little items can work loose or be accidentally moved and cause momentary confusion is remarkable. Once again look for the simple things.

**Further Notes on the HMV 1807 and Pye B18T**

If the tube face of the HMV or Marconi receivers, dealt with in the first article in this series, shows hum bars, i.e. no picture with wide dark and light bands, the trouble can usually be located in the D77 video detector valve. This is the last in the vision strip and is located at the rear of the chassis in the most accessible position. The valve will probably have a heater-to-cathode leak or short-circuit and should be replaced.

If on the Pye a rather more "contrasty" picture, accompanied by intermittent or complete loss of sync is experienced, the trouble will almost certainly be the 12 $\mu$F video anode decoupling condenser having

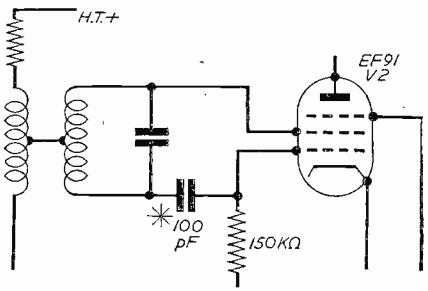



**Fig. 3.—Frequency changer V2. This diagram shows how a leak in the 100 pF condenser can cause the symptoms described.**

gone O.C. This is located under the chassis at the rear. It is connected to the junction of two 1 watt resistors and is of the white cardboard covered type. Usually the frame sync is affected most, the line may only "zip" occasionally.

# Advances in Colour TV

THREE new major developments in colour television were recently demonstrated by the Radio Corporation of America, opening the way to early mass production of colour television sets at costs within the reach of the consuming public.

Described as milestones in the march toward commercial colour television, the three new developments were :—

1. A new 21in. R.C.A. colour picture tube with 250 square inches of viewing area—22 per cent. more than any other colour tube yet produced.

2. A magnetic field equaliser called the "Colour Equaliser." This is a significant new R.C.A. invention—not previously announced—which guarantees improved colour set performance and makes possible a reduction in manufacturing costs.

3. A new simplified colour television receiver, which reduces circuitry by one-third and enables a substantial reduction in production costs to be effected.

Each of these developments represents "years of scientific and engineering endeavour telescoped into a memorable few months," according to E. C. Anderson, Executive Vice-President, R.C.A. Commercial Department.

**R.C.A. Timetable for Production of Tubes and Sets**

"The R.C.A. timetable," Mr. Anderson continued, "calls for industry sampling of the 21in. colour tube starting on November 1st, and for the appearance in the market of our first 21in. colour sets before the end of this year, with production in quantity by early 1955.

"While we have not yet established a suggested retail price for our 21in. colour set, I can tell you to-day that it will be between $800 and $900."

At a special Press showing, which preceded demonstrations for representatives of virtually the entire television manufacturing industry, Mr. Anderson said, "When R.C.A. first tackled colour television we were aware of the importance of creating an entire system, not just isolated elements of one. . . .

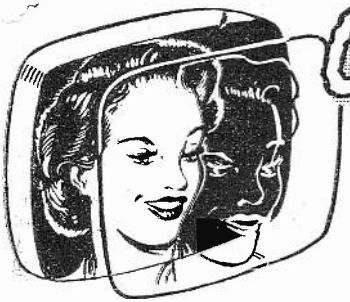
**The 21in. Colour Tube**

"The 21in. tube, which holds the spotlight to-day, was only eight short months ago in our development laboratories. But the progress we had made with it was so good that we determined not to go ahead with our 19in. tube. We concentrated our efforts on a 21in colour tube—the preferred size—without introducing any intermediate smaller sizes. . . .

**Receiver Circuitry is Simplified**

"We have also given much attention to reducing the cost and increasing the stability of colour receiver circuitry and components. Approximately a one-third reduction in receiver circuitry has been achieved, without any loss of performance. Substantial cost savings are inherent in the results of this work.

"While the simplified circuit receiver uses 11 tubes less than the modified receiver, nevertheless their performance is the same."



# Ghost Reception

SOME NOTES ON ITS CAUSES, EFFECTS, AND SOME SUGGESTED CURES

By B. L. Morley

THE appearance of a ghost picture on the screen often spoils what would otherwise be a very good picture; it occurs in the fringe area and also well within the service area of the transmitter and there are certain spots in Britain covered by the high-powered stations in which reception is almost impossible due to ghost troubles.

A ghost picture is actually a second picture, usually fainter than the main picture but displaced to the right of it. The amount of displacement will vary according to the origin of the ghost and it is possible to receive one which is practically on top of the main picture and hardly distinguishable as such, or to have one which is well separated from the main image.

Fig. 1 shows a typical case and it will be observed that the clock is repeated just to the right of the main image.

A ghost can be negative or positive. A negative ghost is one in which the blacks and whites of the picture are reversed like a photographic negative, while a positive ghost has the same relationship of black and white as the main image.

It is possible to have more than one ghost—in fact in bad areas a whole host of them can be present on the screen with some providing a positive image and some a negative image.

Ghosts which occur almost on top of the original picture are very difficult to diagnose as the only symptom may be a slightly blurred image although the raster lines are clearly focused. This fault can be confused with lack of bandwidth in the vision receiver which gives a similar effect.

## Causes of Ghost Images

There are two main causes of ghost images; the first is due to reflections in the feeder line from the aerial, and the second due to reflections from surrounding objects such as hillsides, steel-framed buildings, etc.

There is another source of ghosts which is not often encountered and this is within the televisor itself. It is caused by certain of the tuned circuits "ringing" and is more often observed in badly adjusted superhets than in straight receivers.

## Feeder Reflections

If the feeder from the aerial to the televisor is very badly matched at either end it is possible to have reflections taking place throughout its length. The trouble is more likely to occur with long feeders than with short ones though the writer has observed

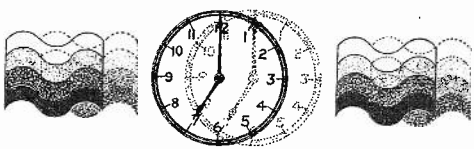


**Fig. 1.—A ghost shown on the Tuning Signal.**

a series of ghosts (five in all) caused by severe mismatch in a feeder only 60ft. long!

The reason for the reflection is not difficult to understand. Imagine a case where the end of the feeder line is open-circuited, the current wave will travel down the line until it comes to the end; at this point it can travel no farther and will collapse to zero. The consequent collapsing magnetic field associated with the current will induce a current and voltage in the opposite direction which will then travel back to the source.

When the returning wave reaches its originating point an out-of-balance condition will result as it will not be in phase with the waves originating from the source. It will, so to speak, be turned back on itself and will, therefore, return to the far end of the line.

On each journey a certain amount of power is consumed due to the impedance of the line and a certain amount of power is also dissipated in radiation so that after a few journeys up and down the line the current is reduced to zero. Nevertheless the waves will "stand" upon the line and the transmitting engineer usually refers to them as standing waves.

The same principles apply if the line is short-circuited at its distant end. In this case the current wave reaching the short-circuit will suddenly increase to a maximum; the voltage will obviously fall to zero and the consequent sudden change in the magnetic field will induce currents and voltages in the opposite direction which will travel back to the source.

It is not strictly necessary to have a completely

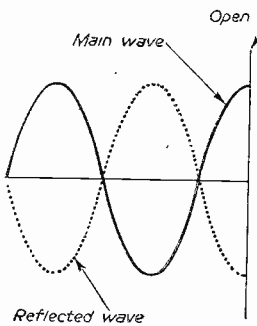



**Fig. 2.—The reflected wave.**

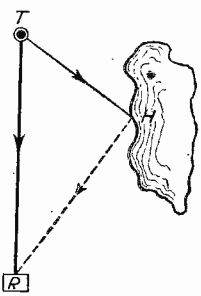



**Fig. 3.—Reception of one ghost.**

short-circuited or open-circuited line; the termination can be of any value between these two extremes and reflection will take place. No reflection will take place if the line is terminated with its characteristic impedance; for example, if an 80-ohm TV coaxial cable is terminated with an impedance of 80 ohms no reflection will take place. A terminating value other than that of the characteristic impedance will

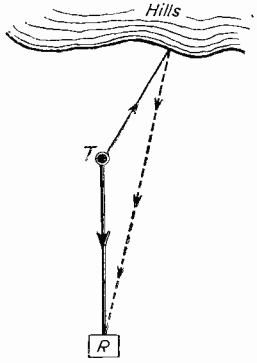



**Fig. 4. — Diagram illustrating the result of reflection from an object behind the actual transmitter.**

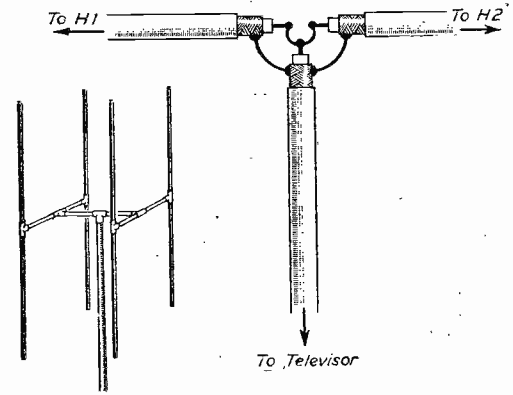
cause reflection, the amount of reflection depending upon the deviation from that impedance.

Note the characteristic impedance of a line is the impedance which the line would have if it were extended to infinity. In all transmission work where power is sent along a line it is necessary to terminate each end with the line's characteristic impedance in order to keep down the losses and to avoid reflections.

It will be seen how necessary it is to ensure that the line is correctly matched. At the televisor end a transformer is used to ensure that the input impedance of the televisor is made the same as that of the line.

Note that a transformer will not only transform voltage and current, it will also transform impedance. In transmission of audio frequencies transformers are frequently used solely for this purpose.

The turns ratio of a transformer has a direct relation to the impedance ratio. The voltage ratio of a transformer is the same as the turns ratio; a transformer having a turns ratio of 1 : 3 will therefore have a voltage ratio of 1 : 3; the voltage at the output will be three times that of the input.




**Figs. 6 and 7.—A double "H" aerial and the cable connections for a double "H."**

The impedance ratio of a transformer is the square of the turns ratio. A transformer with a turns ratio of 1 : 3 will therefore have an impedance ratio of $1 : 3^2 = 1 : 9$. This means that the impedance of the output will be nine times the impedance of the input.

This explains the reasons why it is possible to match correctly an 80-ohm feeder line into the television input circuit, by the use of a small coupling coil or a tap on the main coil.

It will be obvious that not only must the feeder match into the televisor input but it must also match the aerial output. A small amount of mismatch is allowable and because of this it is possible to use an *H* aerial with a centre impedance of about 60 ohms with a coaxial line of about 80 ohms. If the mismatch is greater than this then reflections may occur with the production of ghost images.

It is important, therefore, that where a high gain aerial is used in the fringe areas, correct matching is employed not only to ensure the greatest transfer of signals but also to avoid the production of ghost signals.

### Reflections from Solid Objects

The very high frequencies employed in TV can be reflected by solid objects such as hills, tall buildings,

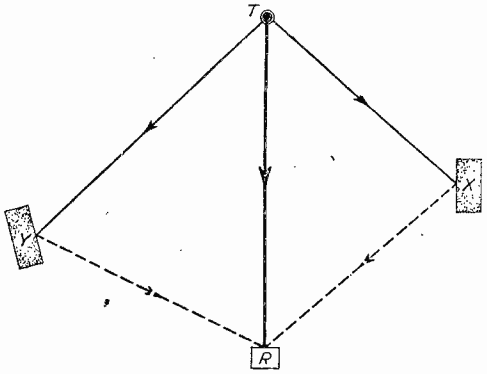



**Fig. 5.—Reflection from two sources.**

gasometers, etc. Fig. 3 shows typical conditions where reflection can take place.

At the receiving point *R* a direct signal is received from the transmitter at *T*. This is the main signal and provides the picture. The electromagnetic waves radiate from the transmitter in all directions and some of them will strike the side of the steep hill at *H*. Here a certain amount of absorption will take place, but a large percentage of the signal will be reflected towards the receiving point and will therefore be picked up by the aerial at *R*.

It will be appreciated that the distance from *T* to *R* is much shorter than from *T* through *H* to *R*; the signals from the second path will therefore arrive a short time after the signal from the main path; in the meantime the spot on the C.R.T. has moved from the left towards the right and the second signal will therefore show itself on the screen a little to the right of the main image.

Clearly the longer the path of the reflected image, then the greater will be the displacement to the right of the ghost image.

It is possible for the point of reflection to be at such a distance that the reflected image only just

commences on the extreme right of the tube and is continued on the left.

The reflection may be positive or negative according to the reflecting medium and the time of arrival. It is possible for the arrival time to be such that a complete reversal of phase takes place and the whites and blacks are reversed.

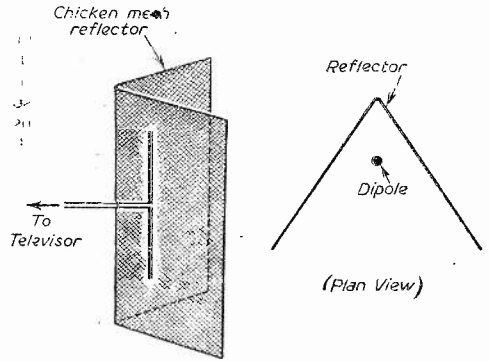



Fig. 8.—The corner reflector.

It is not necessary for the reflecting medium to be placed at one side as shown in the diagram, it can be at the rear of the receiving point and can even be in front of the receiving point. A typical case of the latter is shown in Fig. 4. The main signal reaches the aerial direct and the ghost image is received by reflection from hills behind the transmitter. This type of reflection is the most difficult to cure.

It is possible to have more than one reflection. Fig. 5 shows a typical case of the reception of two reflected images. First, we have the main signal from $T$ to $R$, then a reflected image from $T$ through $X$ to $R$, and then a second reflection from $T$ through $Y$ to $R$.

The path $T$, $X$, $R$ is rather shorter than $T$, $Y$, $R$ and therefore the image from the latter will be displaced more to the right than the image from the former.

In very bad areas a large number of reflections takes place and we have certain notorious localities such as Hebden Bridge, certain areas of Bath and the Welsh valleys working on Wenvoe.

The reception of a double or multiple image is not the only bad effect caused by reflections, but where the reflection is quite strong then it is possible for the sync pulses contained in the reflected signal to trigger the timebases and lead to loss of or intermittent operation of synchronisation.

Before leaving the subject of causes of ghosts, it should be mentioned that it is possible to have reflected images which sometimes entirely disappear. Cases have been reported where ghost images are received for a few days only every week, and the trouble has usually been traced to reflection from a nearby gasometer, the height of the container being considerably reduced when the gas supply was low!

In some cases it is possible to have a variation between summer and winter due to reflections taking place from belts of trees which shed their leaves during the winter.

**Band III**

The higher the frequency of the electromagnetic wave the more does its behaviour resemble that of light, and the rather high frequencies which will be employed on Band III are likely to be reflected to a greater degree than those on Band I. This will be especially true in built-up areas where tall, steel-framed buildings are common, and the installation engineer will have to devote considerable attention to the layout of the aerial system.

**The Cure of Ghosts**

The most obvious answer to the ghost problem is to shield the receiving aerial from the reflecting source. In the simple case an $H$ type of aerial will be of appreciable assistance; this aerial operates over quite a wide arc with little fall in the strength of the signal picked up. It is possible to move it over an arc of $\pm 30$ to 40 degrees without decreasing the signal strength too much. It can therefore be aligned so that the point of minimum pick-up—the rear of the aerial—is pointed in the direction of the reflected signals and while there may be some small loss in forward gain the ratio of direct signal to reflected signal is greatly increased; the contrast control can be adjusted so that the ghost is not then visible on the screen.

Where reflection takes place from more than one source then matters are a little more difficult. It is beneficial in these cases to use a high gain aerial because of its directional properties. A high gain array has a narrow pick-up area and the strength of signals falls off rapidly either side of the forward direction.

It is possible that such an array will pick up too great a signal and the first stages of the receiver may be overloaded. It is possible to overcome this defect by using attenuators before the first R.F. valve.

One disadvantage of highly directional arrays is that the radiation pattern may contain subsidiary lobes, so that there is appreciable pick-up at certain definite angles, and if this should coincide with the direction of the reflection, then no benefit will result.

Another solution to the problem is to use a double

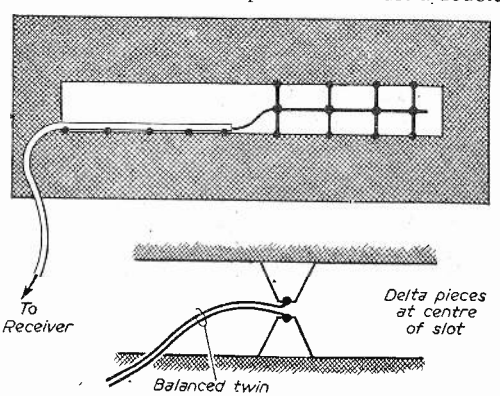



Fig. 9.—Details of the slot aerial.

array and it will be found that a double $H$ aerial is generally satisfactory.

The double $H$ does not have twice the gain of a single $H$; it is more than a single $H$, however and, what is more important, it has a high front-to-back ratio. It has proved very successful where ghost reception is troublesome.

Fig. 6 shows the scheme. The two $H$ aerials are

mounted in parallel with each other $\frac{1}{4}\lambda$ apart. It is important to note that the feeder from each *H* must be exactly the same length. The simplest method of connection is to run a coaxial lead from the dipole of one *H* to the crossboom where it joins the supporting mast; an *identical* length of cable is then run from this point to the other dipole. The feeder down to the televisor is taken to the same central point and all three cables are connected in parallel as shown in Fig. 7.

If 80-ohm cable is used for each dipole and the feeder is 50-ohm cable there will be a certain amount of mismatch, but not a serious amount. If the connections are made sound and enclosed so as to be weatherproof, then no trouble should be experienced.

**Corner Reflector**

Where space allows it and it is found that the reflection occurs mostly from the rear, then a corner reflector is worth while. It has an extremely high front-to-back ratio and is not affected by signals arriving from the rear.

Fig. 8 shows the scheme. The reflector can be made of chicken-wire netting of about $\frac{1}{2}$in. mesh supported on a wooden or metal cage. The centre impedance of the dipole falls rather low in this arrangement and it is necessary to fit some form of matching device. Perhaps the best matching method is to fold the dipole.

An aerial in this form not only has a high front-to-back ratio, but it has a good forward gain and gains in the region of 10-12 db. can be expected.

**The Slot Aerial**

Perhaps the most successful aerial to combat ghost trouble is the slot aerial; it has been proved very successful in all sorts of diffieult localities.

It is easy to construct, is very inexpensive and can be mounted in a loft which has very little headroom.

Chicken wire netting can be used for its construction and a mesh of $\frac{1}{2}$in. is recommended.

It can be supported in the loft by strings tied to the rafters and should face in the direction of the transmitter.

Fig. 9 shows the arrangement and the method of feeding with coaxial cable.

Balanced twin cable can be used if desired and if the televisor is designed for this type of input. In this case the cable is connected to the centre of the slot by means of delta-shaped pieces. (100$\Omega$ cable.)

The slot should be about 1ft. wide and the length should be that of the complementary dipole for the particular channel it is desired to receive.

The width of the netting should be a minimum of $0.2\lambda$ for successful operation.

A reflector can be fitted if desired and this can be either a slot reflector or a straight reflector of chicken wire netting.

It is important to realise that the slot aerial must be mounted in the reverse position to the ordinary dipole. Where the transmissions are vertically polarised the slot aerial must be mounted horizontally and where the transmissions are horizontally polarised the slot aerial must be mounted vertically.

The reason for this is to counteract the change in electric and magnetic fields which takes place in the slot aerial.

Where a slot reflector is used it must be mounted in a similar manner to the aerial proper, but if a plain reflector is employed then it should be mounted in the vertical direction for vertically polarised transmissions and horizontally for horizontally polarised transmissions.

When fitting an aerial of this description in the loft it is advisable to keep it as clear as possible of the surrounding objects, paying particular attention to the proximity of electric wiring which may be carrying interference.

**Conclusion**

In the foregoing paragraphs we have endeavoured to outline the main causes of ghost reception and to suggest a cure. It is not possible to cater for every situation and there are bound to be certain areas where complete elimination is not possible.

One factor which should be remembered is that it is possible for the ghost signal to be stronger than the original and the aerial can be oriented so that it is pointed towards the reflecting source rather than towards the transmitter. This is not always successful, however, for it is possible for the reflected image to become distorted so as to be useless, but it is worth while trying.

Each case must be decided on its merits and the home constructor is advised to experiment for himself with the suggested methods so as to arrive at the best solution for his own particular locality.

# BOOK RECEIVED

**"Radio Laboratory Handbook," by M. G. Scroggie, B.Sc., M.I.E.E., sixth edition. Published on 23rd August, 1954, at 25s. net (postage 1s. 3d.), for "Wireless World," by Iliffe & Sons Ltd. Size 8$\frac{3}{4}$in. x 5$\frac{1}{2}$in. 436 pages, 299 illustrations. Cloth bound with jacket.**

THIS standard reference book on laboratory electronic techniques, written by a well-known consulting engineer, is intended for both professional engineers and amateurs. It first describes the layout and furnishing of an up-to-date laboratory, and then the various types of apparatus available. Both commercial instruments and improvised equipment are covered. Later chapters deal in detail with methods of making measurements and tests of every kind. Finally, a large section is devoted to general principles and reference material of everyday use to the radio engineer.

The large amount of information contained in the volume has been presented as concisely as possible and made easily accessible by the very comprehensive system of cross-references, table of contents and index. A special feature is the many carefully selected references to further information.

"Radio Laboratory Handbook" was originally published in 1938, and quickly gained recognition as a lucid and not-too-solemn practical manual filling the gap between "popular" home experimenters' literature and the advanced professional textbooks. In the intervening period, there have been extensive developments in techniques and equipment, with which subsequent editions have kept pace. This sixth edition has been almost entirely rewritten and greatly enlarged and is now presented in a new format. The usefulness of the text is enhanced by some 300 photographs, drawings and circuit diagrams.

# The 931A Photomultiplier Cell

## SOME INTERESTING DATA FOR THE AMATEUR TELEVISION TRANSMITTER

By C. Grant Dixon

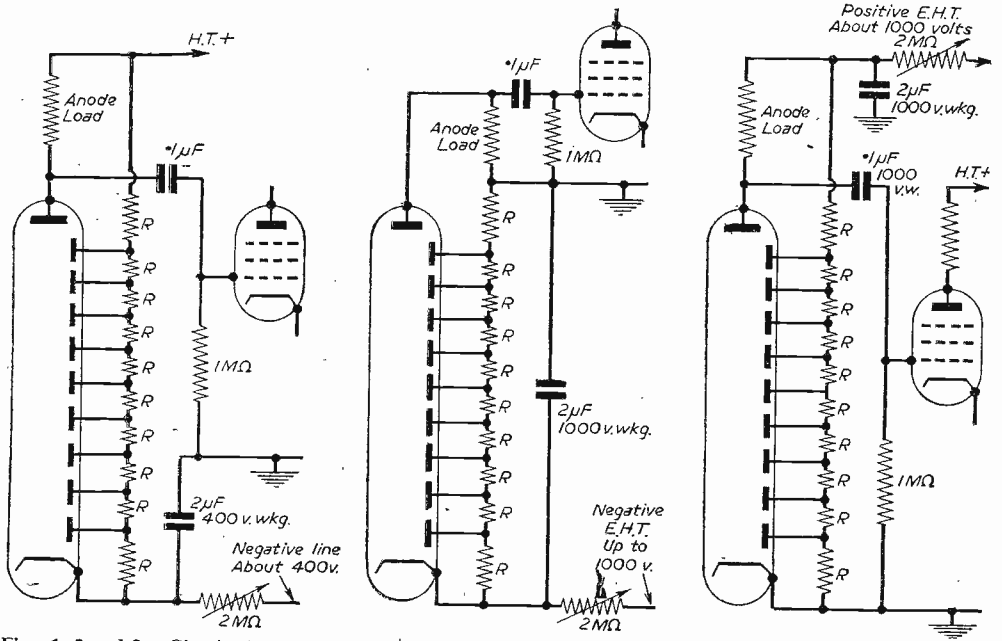
THE 931A is an extremely sensitive photo-electric cell which achieves its sensitivity by electron multiplication. Consider an ordinary photocell; when light is incident on the cathode, electrons are liberated and these are collected by the anode, the entire current through the cell is due to these photoelectrons. In the 931A the electrons emitted by the cathode are caused to strike an electrode called a dynode, which has a special coating that favours secondary emission; this means that each electron striking the dynode may cause the emission of two or more electrons. This process of electron multiplication is repeated as the electrons bounce from one dynode to another and the final current is collected at the anode. Each dynode is kept at a higher potential than the preceding one and this means that the electrons are caused to follow a zig-zag path around the tube as shown in Fig. 4.

The sensitivity of the cell is enormous, being about 10 mA. per lumen when the potential between dynodes is 50 volts, and about 1 amp per lumen when operated at its maximum rating of 100 volts between the dynodes. This may be compared with a figure of 70 $\mu$A. per lumen for a typical cell with no electron multiplication. It should be clearly understood, however, that these are sensitivity figures and the actual current flowing through the cell is much less; the cathode current, in fact, should not exceed 10 $\mu$A. To ensure that this condition is observed, it is essential to operate the cell with comparatively low illumination when the voltages are applied to the electrodes.

As will be seen from the diagrams, the dynodes are supplied from a tapped potentiometer across the E.H.T. supply. This usually takes the form of a chain of equal resistors, soldered from pin to pin of the special 11-pin socket. These resistors can be $\frac{1}{4}$ or even $\frac{1}{8}$ watt and any value between 10 K and 50 K will be satisfactory, provided they are all equal. A convenient way of controlling the gain of the cell is by varying the total potential across the resistor chain, and this can easily be done by connecting a 2 M potentiometer in series with the chain as shown in the diagrams.

### Noise

The 931A is usually employed to feed an amplifier and there are several suitable input circuits depending on whether positive or negative E.H.T. supply is available. As there are 10 stages of multiplication and each requires up to 100 volts, this might seem to imply a total E.H.T. of 1,000 volts, but for most purposes about half this value is sufficient and it is found that there is less "noise" if the cell is worked at a lower voltage. The most satisfactory arrangement is to half-wave rectify one H.T. secondary winding of the mains transformer to give an H.T. line, which is negative with respect to earth, and use the potential difference between this line and the usual H.T. positive line. For the sake of completeness, circuits are also given for those cases where a separate high voltage supply is available.




**Figs. 1, 2 and 3.—Circuits for the 931A. In these diagrams the cell has been shown elongated for convenience in showing the voltage supplies to the dynodes.**

**Small Current**

As the current drawn from the E.H.T. supply is small, there is not likely to be any trouble with hum or ripple and the 2$\mu$F. condenser shown in the diagrams should be sufficient. It should never be necessary to decouple the dynodes, and stabilisation of the cell voltage is only undertaken where the cell is used for precision measurement as in a photometer. As the electrons are directed on their path by means of electrostatic fields, it is obviously important to keep out stray electrostatic fields by efficient screening. The line timebase of a scanning tube has been known to cause trouble in this way.

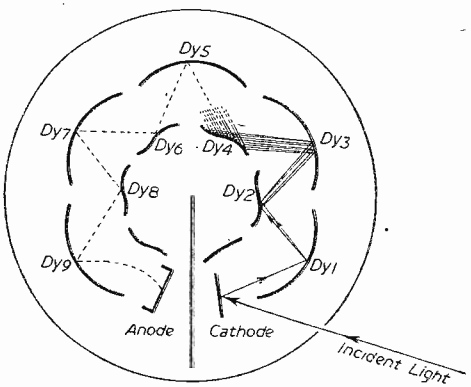



**Fig. 4.—Diagram of the electrode structure of the 931A showing electron multiplication and the approximate path of the electrons through the tube.**

The 931A has become very popular as a pick-up tube from a flying spot scanner. (See previous article in PRACTICAL TELEVISION, July, 1954.) It has a markedly greater response in the blue region of the spectrum and with a scanning tube such as the 5FP7 this is an advantage. In order to obtain the frequency response desirable for television transmission, the anode load should be kept to a low value and in some circuits 1 K has been specified, though the writer has obtained good results with a 6.8 K load with a suitable peaking inductance. The video amplifier should always be fed from a very low impedance power supply ; preferably one using electronic stabilisation with a series valve, or alternatively a smoothing condenser, having a value in the region of 150 $\mu$F may be used. If this is not done, some trouble may be experienced with very low frequency oscillation.

**An Experiment**

Whilst on the subject of the 931A and amateur television applications, the following suggestion is offered as it may interest some readers who are looking for something unusual to do. If a couple of old 30-line scanning discs and motors can be obtained it is a comparatively easy matter to rig one up as a " live " camera and the other as a monitor. Of course, 30-line pictures are of historic rather than of practical value, but it is very satisfying to build up one's own TV. camera, of whatever definition. The scene to be televised is focused on the rotating disc and a lens gathers in the light and concentrates it on the 931A. The frequency response need not exceed 20 kc/s if the old 30-line standards are adhered to, and this means that a comparatively simple amplifier will serve to modulate the neon tube behind the receiver disc. Of course, there will be many readers to whom the last few sentences convey nothing, they are those who have missed the days of real pioneer TV reception, but the principles of 30-line reception can be easily grasped by reference to books and magazines of the 1930-35 period.

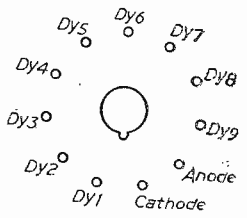



**Fig. 5.—Base connections for the 931A cell.**

Another use for the 931A is the measurement, or rather the comparison, of the "D.C." value of very low light levels as in a spectrophotometer. For this purpose a toothed wheel is interposed between the light and the 931A to convert the steady light into a varying one. This " chopped " light beam, when incident on the 931A, gives rise to an alternating voltage across the load and this is usually amplified by a narrow bandwidth, tuned, amplifier and, after rectification, is used to give an indication on a sensitive milliammeter. For this application " noise " is of little importance and the cell can be worked at its maximum voltage with a high anode load, thus giving an extremely sensitive device.

In conclusion it should be pointed out that the 931A shows its superiority over the conventional photocell only when dealing with very low light levels, and it is interesting to note that photo-multiplier cells of more advanced design are becoming increasingly used for detecting the scintillations produced by alpha particles.

# Final Thoughts on the Show

## A VISITOR REVIEWS SOME OF THE EXHIBITS

By The Marquis of Donegall

THE National Radio and Television Show came of age this year and proved highly worthy of adult status.

Before touring the Earls Court exhibition let us mention a few highlights that struck the visitor.

On the whole prices have not come down since last year, but this is compensated for by the fact that general improvement in performance has necessitated more complicated—and in some cases more costly—insides. Better value for much the same money was, I would say, the keynote of the show.

The word novelty best describes the demonstration on a closed circuit of 3-D television by Messrs. Pye. The effect of depth is achieved by throwing two images on to a screen, but I refuse to be unduly impressed by any process, either in cinema or television, that requires the use of spectacles by the audience. At least this experimental 3-D television is viewed on a flat screen and not—a scientific absurdity—by trying to make a flat surface out of the curved wrong-end of a cathode-ray tube.

Condemned as we still are to the optical gymnastics of direct viewing by the overwhelming majority of manufacturers, the 17in. picture rules the day as opposed to the 14in. picture in the majority last year. I shed a metaphorical tear for the death and burial of the 9in. tube: it was such a conveniently portable little set and one unkind critic remarked on its passing that 9in. was, if anything, too big a picture for most of our television programmes. Contrariwise, the portable gramophone that you wind up with a handle is still selling in incredible quantities.

E.M.I. announced with deafening fanfare that the ever-patient public may now buy copies of master-tapes from which the gramophone records of the group are made. I tried the Menuhin and Joe Loss tapes on my own tape recorder and it must be admitted that the reproduction from the speaker placed at the top of my staircase to the living room downstairs was quite uncanny in fidelity. Ever patient, however, is the operative word so far as the public is concerned because, 17 years ago, I undertook to demonstrate in my home a "radiogram" which played tape instead of records. It was never marketed because the interested parties were unable to find sufficient well-known artistes and orchestras that were not under contract to the various gramophone companies.

### Appearance

The outside appearance of radio and television sets having just about reached the zenith of craftsmanship, design and material, there is little to be said that contrasts with last year except that there was even greater variety and, surely, a set to suit every taste, from that of Madame de Pompadour to that of Diogenes. (As a matter of fact, there was a radio-controlled beer-barrel—appropriately just outside the Press Room—that rolled itself about and dispensed beer to the multitude.)

The outstanding major development emerging at this year's show concerns the opening of the BBC's V.H.F./F.M. broadcasting stations next year. Although they are not yet available there were some radiograms and TV sets capable of receiving these new stations which are of special interest to those living in bad reception areas and within 50 miles range.

Sundry historic exhibits were fascinating. These included Marconi's diary and the set that enabled Crippen to be apprehended in mid-Atlantic.

On the Baird stand they showed the earliest television set that first functioned in 1932. But the first tube to produce colour television had special interest for me. It was in December, 1940, that Baird asked me to bring something red or blue to his house near the Crystal Palace and I arrived with Miss Paddie Naismith, a flaming redhead, dressed in bright blue. Paddie was duly televised in colour from Baird's house to an outhouse some 50 yards away on a 3ft. x 4ft. screen. The quality of the colour reproduction astounded Baird's guests—14 years ago.

The Royal Navy showed under-water television and included among its exhibits the TV camera which they used to find the Comet that disintegrated near the island of Elba.

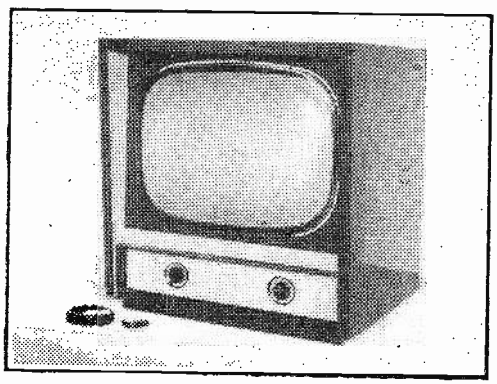
The Army provided a look into the future by demonstrating battlefield television, which it has not so far used.

The Royal Air Force demonstrated most lucidly the important part played by radio in forecasting the weather. There was a typical Meteorological Forecasting Office with Radio Sonde and Sferic Radio Director Finder that tracks down thunderstorms in remote places.

### Contrasts

Now for a few contrasts. Vidor's "Lady Margaret"—8in. by 4in., weighing 6¼lb.—was said to be the smallest battery set. And the largest TV screen in the world, measuring 21ft. by 16ft., was a Cintel installation in the BBC arena.

The smallest TV camera was to be seen on the Pye stand. It is an industrial type-of which one was recently installed in a whaling ship. As a gadget



**The Murphy V250 Table Model.**

maniac I was, of course, delighted with the H.M.V., Philips and Ekco novelty radios that put you to sleep, wake you up, cook your breakfast, switch your light on and, for all I know, take the dog for a walk!

Champion have produced table-radiograms at 42 and 33 guineas. The most expensive radiogram that I found was on the R.G.D. stand at £611.

The smallest three-wave mains receiver, 8in. by 4¾in. by 4¼in., was shown by Alba; and Roberts, whose portables I have long regarded as among the finest in the world, have produced a "baby" at 15 guineas. It is a battery set for medium and long wave with a 5in.-moving coil loudspeaker having a field flux density of 11,000 gauss.

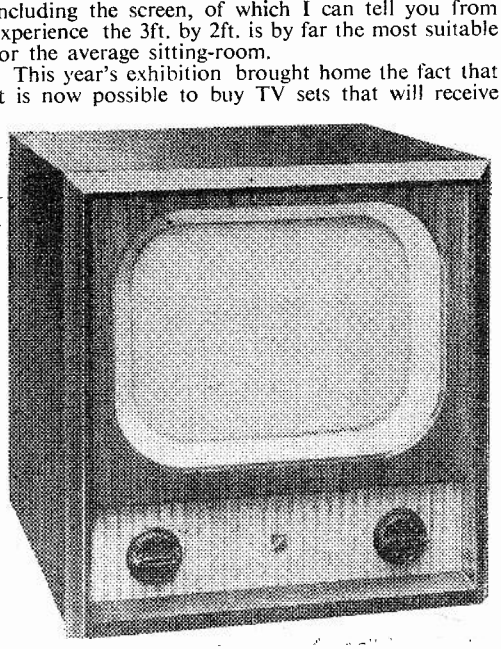
The H.M.V. portable radiogram (model 2001), priced at 22 guineas, is a very neat job that copes with all sizes of records and all three speeds. It has a rotatable dual-headed pick-up and a 10½in. elliptical loudspeaker. In this field Decca compete with their Deccamatic II with a Collaro turnover pick-up at 19 guineas. Personally I use a Deccalian of which the new model is numbered 81 and is priced at £34 18s. 10d. On the Deccalian, Decca still favour interchangeable ffrr magnetic pick-up heads with sapphire styli. Their technicians unequivocally assert that comparable fidelity cannot be achieved with a rotatable pick-up head.

Innumerable makers show record-players to cope with all speeds and sizes of records through existing radios or radiograms. Twelve guineas seemed to be an average price for these.

My American friends never cease to be amazed when they see my Decca projection set in operation and generally begin by mistaking the picture on my screen for home-movies.

"We don't have that in the United States," they usually remark. And I refrain from pointing out that neither did they have a television service at all in 1936. The new projection model costs £165, including the screen, of which I can tell you from experience the 3ft. by 2ft. is by far the most suitable for the average sitting-room.

This year's exhibition brought home the fact that it is now possible to buy TV sets that will receive the commercial programme when it becomes available.



**This is the Alba Model T321—a 14in. tunable receiver.**

Television receivers working on one of the frequencies to be allotted to the Independent Television Authority were demonstrated by superimposing a Band III signal from a special transmitter in the R.I.C. control-room so that it was possible to switch from the BBC band to the other. This alternative "programme" was obviously not designed for entertainment. It consisted of fish swimming in an aquarium with the caption "This receiver is now operating on an alternative programme wavelength." Other firms showed TV sets that at present can only receive the BBC, but are readily convertible. What it amounts to is that these cost 5 or 6 guineas less and you pay that sum when the time comes to have the set adapted to commercial TV.

**Turret Tuning**

Most firms have adopted the 12-position turret tuner. This gives tuning to any of the five BBC Band I channels and to the two channels so far allocated to commercial TV in Band III. Bush, however, use a two-position band switch plus two continuously variable tuning-knobs, each tuning over one of the bands. And Regentone use a two-band switch system combined with continuous tuning. The band switch is operated automatically by the tuning-knob. Nearly every set is designed for the easy addition of a tuner. For instance, the Vidor 14in. and 17in. models already provide the necessary space and fixing studs. The English Electric "Rotomatic" can also be adapted by using only one's bare hands.

To sum up on TV, focus at the edges of the screen has improved and I would say that the "scan" is more uniform. Interference suppression circuits are often adjustable to local conditions. The all-round result is sharper, steadier and brighter pictures. Much attention has been concentrated on catering for the fringe areas.

Finally, Ferguson found their "Halo Light," which is a luminous screen surround that produces the illusion of a larger picture, such a success that they have now incorporated it on four new models. Some makers, of which one is Ekco (TC209), provide frequency-modulated sound reception. It is noteworthy that few TV sets incorporate a radio. The Philco A1718 is an exception and the price is 106 guineas.

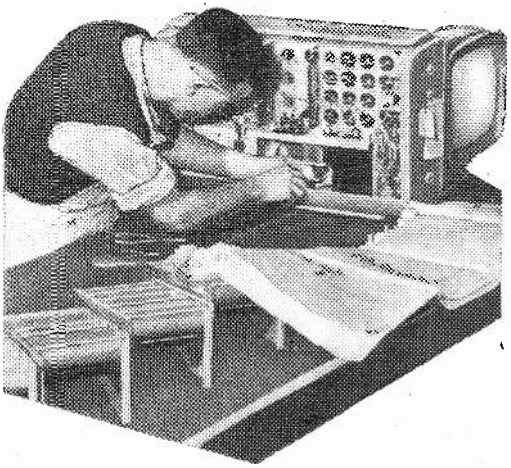
The Ferrite rod aerial of Pilot and Champion sets was a novelty to me, as was the incorporation of a built-in aerial in an Invicta receiver.

The 21in. rectangular tube—Kolster-Brandes table model, Philco and Ferguson consoles—was also a novelty; but the H.M.V. 1820 has a round 21in. tube.

Twelve-inch speakers, notably by Goodman, make their appearance in several radiograms, including the Ferranti 1045 and the Regentone ARG88. Philco have produced a push-button short-wave converter that can be added to any make of car radio. They also make two six-valve and two eight-valve car radios.

Let me end this little account of a highly impressive and thoroughly enjoyable 21st birthday National Radio and Television Exhibition by saying, as did Sir Miles Thomas in his opening speech, that this year's show was "a striking testimony to the achievements of a great industry."

# PAGES FROM A TELEVISION ENGINEER'S NOTEBOOK



## 22.—FURTHER SWEEP CIRCUITS

As we have already seen, it is not possible to get a linear frequency change with a linear motion on either the rotating condenser or coaxial plunger tuning systems. On the basis of a lumped circuit for the oscillator tuning elements, the frequency is inversely proportional to the square root of the total capacity ; if this capacity is in the form of a parallel plate condenser, it will be inversely proportional to the separation of the plates, so that the frequency will then be directly proportional to the square root of the plate separation which is assumed to be varied linearly by the mechanical drive.

If the capacity is made up of the form of a coaxial condenser with a reciprocating plunger, it will be directly proportional to the depth of penetration, and consequently the frequency will now be inversely proportional to the square root of the penetration, which again is assumed to vary linearly. Both systems, therefore, give a non-linear variation of frequency with electrode displacement, and to a similar degree. The result is obviously unaffected by any fixed capacity shunting the mechanical system.

This is added to amplify the remarks of last month on mechanical systems, and must be borne in mind by the experimenter who is working on mechanical systems. For true frequency linearity, more complex condenser arrangements are necessary. The coaxial form has, however, the property that the rate of change of capacity with penetration is independent of the initial depth (which is equivalent to a fixed shunting capacity) and is therefore unaffected by mechanical distortions arising from the motions imparted to the plunger. This system is the better for the experimenter, but usually calls for better engineering from a mechanical point of view than the rotating condenser form.

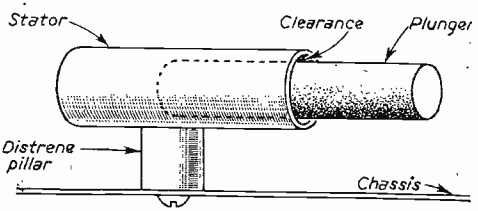



**Fig. 1. — Mounting of a co-axial tuning system. The stator is best split to form a split-stator condenser.**

### Practical Hints

As was outlined last month, a plunger form of condenser can be operated from an old loudspeaker cone movement, but the exact form the set-up will take obviously depends upon the constructor. Referring to Fig. 1, the important points are the mounting of the fixed tube (stator) and the clearance between it and the plunger (moving plate). The tube can be readily mounted off the chassis on a distrene pillar, which must be without shake, however ; but

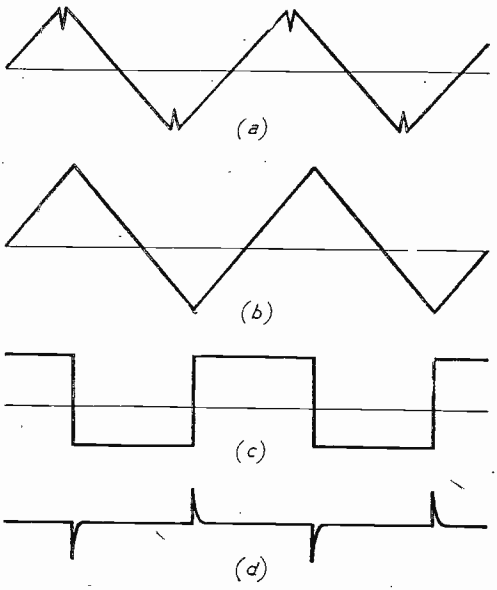



**Fig. 2. —Waveforms associated with a plunger driven by a speaker cone adaption.**

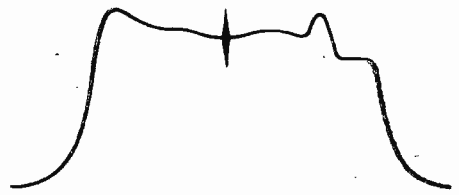


**Fig. 4. — Appearance of marker pip from signal generator.**

the fitting of the plunger to the speaker cone movement, or cam associated with a small motor, will have to be tackled in a way best dictated by the shape and size, etc., of the actual pieces being used.

The clearance cannot be very small unless very precise work can be undertaken and the proper tools are to hand, but normally a spacing of 1/16in. is quite reasonable from this point of view, and also allows a reasonable capacity change to be obtained without a very long plunger movement, a thing to be avoided. A 3/16in. plunger moving in a ¼in. tube has a capacity change of about 0.5 pF per ⅛in. movement. At 100 Mc/s a change of 2 pF is normally sufficient to give a frequency change of 6 Mc/s with the proper inductance and fixed tuning values, and when used in a mixer system, as outlined in the previous article, will provide this sweep of frequency over the television bands.

To get a linear backward and forward motion on the plunger when operated from a speaker system, it is necessary to produce a driving current in the speech coil that is shaped as shown in Fig. 2(a). The actual motion will then be as shown at (b). Such a waveform can be derived from a square wave, which is first integrated into a triangular wave and also differentiated (see (c) and (d)). A combination of these two waveforms will then produce that of (a).

### Simple Circuit

A simple circuit is shown in Fig. 3. Here the oscillator $V_1$ operates at 110 Mc/s by the tuned circuit LC. C is mechanically operated to give a change of 3 Mc/s on either side of 110 Mc/s, the resultant output being buffered and amplified by $V_2$. The exact form of the mechanical control matters little provided this change is achieved, but the timebase of the oscilloscope with which the circuit is to be used must be triggered in synchronism with the capacity change. Normally, a switch system can be readily set up for this, the beam being blanked off during the return trace at the same time.

$V_3$ is a mixer with $V_4$ as the variable oscillator. $V_4$ is tunable over the range 115 to 185 Mc/s, and details of the coils, etc., are given in the figure. Mixing takes place in the cathode of $V_3$, and the output at the anode is taken to the set under examination. A simple attenuator may be inserted at this point if necessary.

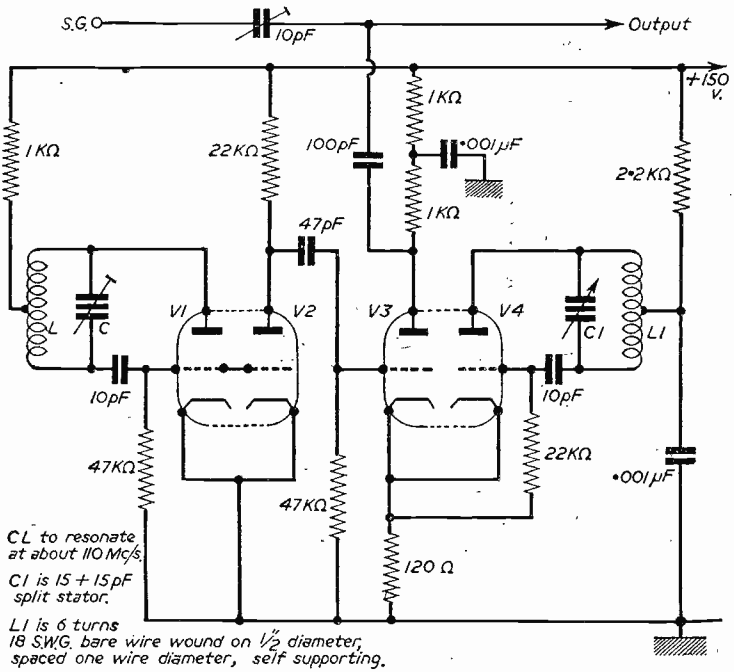



**Fig. 3. — A simple sweep circuit.**

If a signal generator c.w. output is applied to the output simultaneously (as shown), a pip will appear on the response curve as depicted in Fig. 4. A ready means of determining frequency, read from the signal generator, is then available. The signal generator output should be adjusted so that the pip is small.

The valves may be double triodes such as ECC81's.

### Electronic Sweeping

Electronic sweeping may appeal more to the home experimenter than the mechanical systems just discussed, and a basic circuit is shown in Fig. 5. Here the valve V takes the place of the mechanical tuning set up, the remainder of the circuit being similar to that of Fig. 4.

A linear sawtooth is applied from the timebase to potentiometer $R_1$, and a portion of this is therefore applied to the grid of the reactance valve V. This alters the mutual conductance of the stage and also the apparent capacity which is wired across the first oscillator circuit.

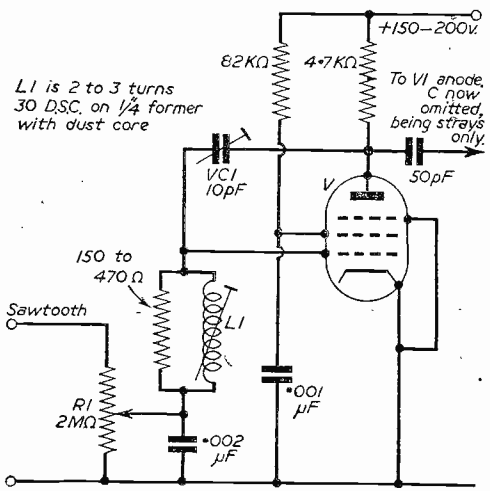



**Fig. 5. — Electronic equivalent of the mechanical tuning systems.**

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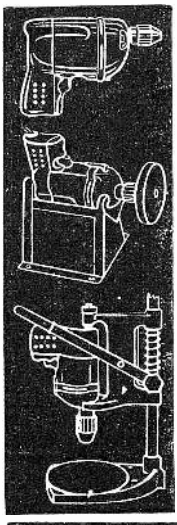

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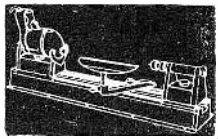


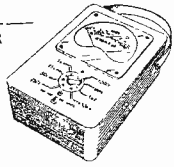
**£5. 5. 0,** or 20/- deposit. Carriage and Packing 5/-.

The four items **£15. 9. 6,** or **£3** deposit.

## HANDY BATTERY THREE

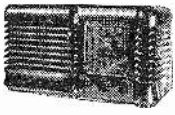
Constructional data showing how to make useful portable loudspeaker set (total cost **70/-**, including cabinet) is available. Price **1/6.**

## MULTI-METER KIT

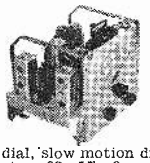


The Multi-meter illustrated measures D.C. volts, D.C. m/amps and ohms. It has a sensitivity of 500 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 3in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick on range indicator and full instructions for making are available as a kit, price **15/-** plus 9d. post and packing.

## MAKE A RADIO

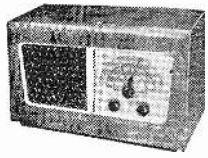


Using our parts in one evening you can make an all mains 4 valve radio with bakelite case, then you will be giving a £12 present which costs you only **£5.15.0,** or **£2** deposit. (Carr. and insurance 5/-.) Data book **1/6.**



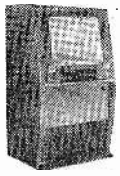
## BEETHOVEN 5-VALVE SUPERHET

Complete with valves and Rola loudspeaker, ready to work off A.C. mains—three waves (L. M. and S.)—large dial, slow motion drive, dust cored coils, etc. **£8. 17. 6,** or **£2** deposit (balance over 12 months), carr. 7/6.



Fine walnut veneered and polished cabinet to take the Beethoven 5-valve Superhet with 6½in. loudspeaker, thus making a really excellent table model—worth **£18-£20.** Price **49/6,** carr. and packing 5/- extra. If bought with the Beethoven chassis, the hire purchase deposit is **£3,** carr. 10/-.

## THE SUPERIOR 15in.



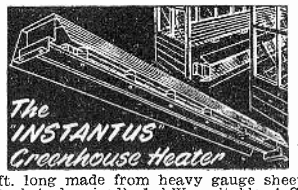
**up to the minute big picture TV for only £37. 10. 0.** A 20-valve televisor for the amateur constructor, all components, valves and 15in. Cossor Cathode Ray Tube costs **£37.10.0,** plus £1 carriage and insurance or **£12. 10. 0** deposit and 12 monthly payments of **£2. 11. 6.** Constructor's envelope giving full details and blueprint, 7/6. Returnable within 14 days if you think you cannot make the set.

## MAINS MIDGET RADIO

This is an excellent little radio in an attractive cabinet to which can be affixed transfers, thus making it extra suitable for nursery or child's bedroom. The circuit is a T.R.F. for A.C. mains operation. All the parts — bakelite cabinet, valves, knobs, back—in fact everything will cost you only **£3.15.0.** plus 2/6 postage. Construction data free with the parts or available separately at **1/6.**

## REBUILT T.V. TUBES

All sizes completely rebuilt as new. Cost approx. half-price. Call or write for list of types in stock.




4ft. long made from heavy gauge sheet steel (galvanised). 1 kW. suitable A.C. or D.C. Price **£2.** or with thermostat **£3.15.0.** Note: The thermostat mounts separately and will control up to three heaters.

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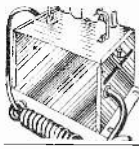

Gives 1½ amp. charge—uses everlasting metal rectifier and robust double wound mains transformer—in metal carrying case with leads and croc. clips. Price, 6 volt **29/6.** 6 to 12 volts, **39/6.** post 2/6.

## ELECTRIC CLOTHES HORSE

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Complete kit comprises battery control unit, starter lamp, lamp holders, clips and wiring diagram. Price less tube **22/6,** plus 1/6 post, with tube **30/-,** carriage and insurance 3/6. Tubes 7/6 each carr. free, minimum quantity 6.

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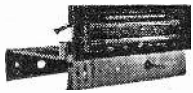

3 colour, 3 waveband scale covering standard Long, Medium, and Short wavebands, scale pan, chassis punched for standard 5 valve superhet, pulley, driving head, springs, etc., to suit. Scale size 14¼in. x 3¼in. Chassis size, 15in. x 5in. x 2in. deep. Price **15/-,** plus 1/6 post.

**Note:** We have a really excellent walnut veneered cabinet for this, price only **37/6.**

## AUTO RADIOGRAM

**From 25 gns.**

Good assortment of cabinets, chassis, and auto changers, available at all branches—total cost from **25 gns.**

## ADJUSTABLE THERMOSTAT

250 v. heavy silver contacts can be adjusted to operate between 70 deg.-300 deg. F. These are suitable for aquarium heaters, electric blankets, etc., etc.
1 Amp. Model, **3/6.** 2 Amp. Model, **5/6.** 5 Amp Model, **8/6.** Post, etc., 6d. extra.

## CONNECTING WIRE SNIP

P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, **2/9** each. Colours available: Black, Brown, Red, Orange, Pink, Yellow, White, Transparent. 4 coils for **10/-.**

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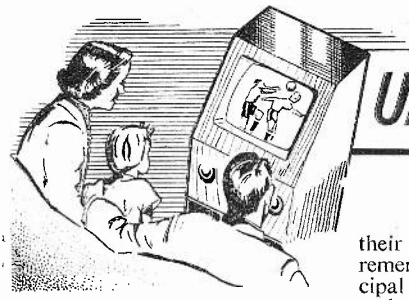


# UNDERNEATH THE DIPOLE

By Iconos

## THE I.T.A.

THE passing of the Act which gave birth to the Independent Television Authority has by no means ended the most popular controversy of 1953—sponsored television programmes: to be or not to be. Many viewers, members of the radio industry and newspaper commentators watched with misgivings the gradual formation of a compromise solution which seemed to them to combine the weakest features of both nationalisation and private enterprise, tied together with a full measure of red tape. Their apprehensions were increased when the names of the members of the governing council were announced: worthy and well-meaning individuals who, for the most part, excelled in their own particular non-television fields. Sections of the national press began to be alarmed and dubbed the I.T.A. as being neither fish, fowl nor good red-herring. Then came the appointments of Sir Kenneth Clarke and Sir Robert Brown Fraser as Chairman and Director-General, respectively, and their dismay began to turn to anger. "Good men—but bad appointments" wailed one critic. "A political appointment" wrote another, "for which the Postmaster-General deserves severe censure." The radio industry, grateful for relaxation of the hire-purchase restrictions, pressed on with the production of more and more TV sets; but at the same time prepared themselves for a long, long wait for sponsored programmes to be produced with a cultural background of Arts Council, Whitehall and a tug-of-war between the political parties.

Let us hope that Sir Kenneth and Sir Robert will confound the dismal prophesies of the critics. Otherwise, the only people they will please will be the moguls of the theatre and film worlds—together with the TV Executives of their rivals, the BBC. It is well to remember that the I.T.A.'s principal practical function is to own and operate a chain of TV transmitting stations, leaving the programme arrangement and organisation to others. That being the case, one would have thought that the I.T.A.'s chief executives would have some kind of engineering background. When the original British Broadcasting Company Limited was formed, the Board (under Lord Gainsford) looked to engineering for its chief executives and selected J. C. W. (now Lord) Reith and P. P. Eckersley, both of them engineers as well as administrators. This valuable precedent has been ignored.

## TV STARS

THE power of TV as a star-maker increases week by week. Already we have Gilbert Harding, Elizabeth Allen, Benny Hill, David Nixon and scrores of others who are now well established and top bills at variety houses, feature in films or perform on political platforms in brains trusts. Two or three successful TV appearances—and their names are made! It is just as simple as that. "What's My Line" and its variations have already created more star names in Britain than a couple of decades of sound radio or fifty years of music hall. Latest passengers on the BBC's star-making wagon are Eunice Gayson, another "What's My Line"-er, and Peter Cushing, actor in TV costume plays—followed up by Helen Bailey, a new expert panellist, whose gentle charm is allied to a brilliant brain.

## NEW STYLE OPERA

I MUST admit that self-conscious arty-crafty entertainment leaves me stone cold. I don't just dislike it; I despise it. Therefore, the idea of "Three's Company," an opera with three singers and one piano, with a musical score by a new young composer, Antony Hopkins, did not attract me very much. However, I decided to get "into training" for a typical example of what some people allege sponsored TV will give us—and I enjoyed it. This was not the usual hotch-potch of cheap gibes at established customs. "Three's Company" had all the wit and sparkle that West-End theatregoers glean from half-a-dozen intimate revues—caviar for the sophisticates and honest British humour for everyman. The music, written and played by Antony Hopkins revealed an unusual coherency in this age of obscure impressionistic musical composition. It gave admirable point to Michael Flander's libretto. The basic plot of this surprise packet was enacted in flash-back form and concerned the rivalry of two business men for their secretary. Mr. Three (Eric Shilling) is the sharp business man who rules the firm belonging to his dullard partner Mr. Love (Stephen Manton) under the terms of Mr. Lowe senior's will. Miss Honey (Elizabeth Boyd) is the woman in the case. The musical treatment on highly original lines intermingled arias of the traditional Verdi or Puccini flavour, but in Latin-American tempo, with Flanagan and Allen-type duets and an impressive baritone solo in a blues idiom. The outstanding artist was Stephen Manton, well-known on sound radio as a tenor of distinction but now revealed as a new singing clown whose mime and sense of timing are first rate. "Three's Company" was an enjoyable experiment for a late night spot—all the more enjoyable for confounding my gloomy expectations.

## RIVERSIDE STUDIOS

THE rumours about the acquisition of the Riverside Studios, Hammersmith, by the BBC for television have been persistent during the last few weeks, and if negotiations are finalised, valuable stage space and facilities will have been tied up in the face of probable I.T.A. competition. These studios are situated on the

bank of the Thames, near Hammersmith Bridge, and actually possess a quay where barges can be moored. It comprises two main stages 105ft. x 75ft. and 80ft. x 60ft., a musical scoring stage large enough to hold a symphony orchestra, excellent plaster, carpenters and other workshops, theatres and dressing-room accommodation. The sound recording installation by R.C.A. is first-class, comprising several optical and magnetic recorders of the latest type. Mitchell and Newall cameras and Mole-Richardson lighting are used, together with back-projection and other devices for trick photography. There is a 250kw. motor generator set for providing direct current for arc lights plus alternating current for "inkies." The Riverside Studios were originally the warehouse of a large motor accessory firm. It became a film studio in about 1933, when it was run by the Triumph Film Company. Two or three years later it was taken over by the Twickenham Studios, after a fire at the latter had destroyed one of its stages. But, it was not until after the war that films of any real consequence were made at Riverside, the most successful being "The Seventh Veil" and "Reluctant Heroes." It is interesting to note that this studio plant, originally improvised out of a warehouse, was so well planned in the structural alterations of 1933 as to lend itself readily to additions to plant and premises, without becoming a rabbit warren like Lime Grove.

### FILMING TV SHOWS IN U.S.A.

THE proportion of live TV shows in America continues to decrease. Photographing and recording of all special features and plays is now the rule rather than the exception and the standard half-hour television feature is shot in two or three days. The McCadden Corporation, which makes the weekly Burns and Allen show as well as the Jack Benny and Bing Crosby TV shows, has evolved a system of working which enables one of these programmes to be completely photographed and recorded in one eight-hour day. Phil Tannura, a lighting cameraman who photographed many British films some years ago, has developed a system of lighting, coupled with a layout of sets on one stage and the introduction of specialised equipment, which makes this possible. A new type of lighting unit, known as the "cone" is used. This consists of a large cone-shaped housing in which is mounted a 5 kw. incandescent lamp behind a baffle which reflects the light back toward the white reflecting surface of the interior of the lamp. This surface is a soft matt white and the indirect light so reflected gives a non-shadow producing quality similar to natural north light. This reduces troublesome shadows from one artiste to another, from set props and from suspended microphones. Other special gadgets include a silent all-ways camera dolly and variable resistance controls of all banks of lamps. The lighting can be varied during lengthy shots. Some of these ideas will shortly be in use over here.

# A Diamond Aerial

By R. Pinkney

THE usual requirements of a television aerial are that it is easy to make, easy to erect, gives satisfactory results and does not cost too much. I think the Diamond fulfils all these.

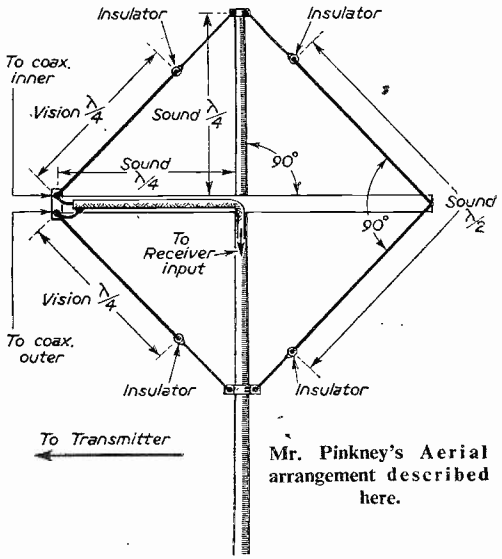
Its performance is better than either the "H" or the "X" and it is more directional.

It has an impedance of about 70 ohms and matches into the ordinary coaxial cable.

**Constructional Details**

Rods can be used to make this aerial, but I found flexible, multi-strand copper aerial wire of the type used for ordinary broadcast reception, twisted double, was easier to work with and gave adequate bandwidth. One quarter sound wavelength from the top of a wood or metal pole a spreader, one half sound wavelength long, is secured by its centre at right angles to the pole. A piece of wood, 1in. wide by ½in. thick, should do as it has to take little strain. A metal spreader can be used.

At the dipole end, which is the end pointing towards the television station, fasten a small block of Paxolin about 2in. square with a hole at the top and bottom for securing the inner ends of the dipole. From the top hole, one half of the dipole, one quarter vision wavelength long, is stretched towards the top of the pole, where it is secured to an insulator which in turn is secured to the top of the pole by a piece of strong cord. The lower half of the dipole stretches from the block towards a point one quarter sound wavelength below the centre of the spreader and secured to the pole by insulator and cord. The inner core of the feeder is connected to the top half of the dipole at the insulating block and the outer screen to the lower half. The feeder is taken along the spreader to the centre and then down the pole.

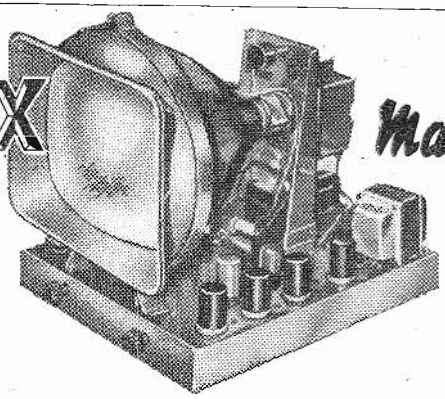



**Mr. Pinkney's Aerial arrangement described here.**

The copper wire reflector is taken from an insulator at the top of the pole over the rear end of the spreader and secured to an insulator at the same point as the lower end of the dipole cord. The reflector should be one half sound wavelength long. The whole thing should now be diamond shaped.

There is very little weight in the aerial itself and only a lightweight pole is required.

# The SIMPLEX Magnetic Model



DETAILS FOR CONVERTING THE SIMPLEX TO MAGNETIC TUBE

*The concluding article will appear next month*

WHEN we published the first details of our £16 television receiver—the Simplex—we stated that a long-term view had been taken with the design so that the televisor could be converted from the smaller electrostatic C.R.T. to a larger tube at a later stage.

The reason for this is that many home constructors get their first introduction to television by building a television receiver using one of the small ex-Govt. cathode-ray tubes, and after a year or so feel they would like to change over to a larger tube.

The original intention was to produce the data for the conversion at a rather later date ; however, we have received so many requests for the data that the design was put on hand and is therefore now published at a much earlier date than was originally anticipated.

Those Simplex owners who do not wish to change at the present time can keep the data for use at a later date.

There are many problems in such a conversion : it often means the wholesale scrapping of the original timebase. We have avoided this and but for a few modifications the Simplex timebase has been retained, the outputs being fed into an amplifying stage for direct application to the C.R.T.

Two extra valves only are required, and one rectifier.

### Design Features

It should be emphasised at the outset that this is not a purely magnetic receiver ; it is *conversion data* to change from an electrostatic tube to a magnetic tube and, therefore, contains several features which would not normally be found in a televisor designed originally for magnetic working. As an example, instead of having one main power supply there are two supplies and this has been arranged so that the present Simplex owner does not have to scrap his existing power supply.

We have retained as many of the original parts as possible. There are bound to be some items which are used in electrostatic working which are not suitable for magnetic working such as the C.R.T. holder, bleeder network, E.H.T. condensers, etc., but most of the existing timebase has been retained.

The method of working in stages has been adhered to. In order to cater for those who will be converting their televisors and also those who will be building this model directly, two shopping lists have been prepared. The first list is for the additional items required for the conversion of the existing timebase, and the second is for the total number of items required for timebase and C.R.T. network.

Another important feature of the design is that we have adhered to standard components which are available in the normal market. It would have been possible to reduce the overall cost by employing some of those surplus parts which become available from time to time such as line output transformers, etc., but as such supplies are very irregular their use has not been contemplated.

The new circuit can be used with either a 12in. or 9in. C.R.T. There are available on the market from time to time cathode-ray tubes with cathode-heater shorts. These tubes have had some use but generally have a fairly useful life left, but due to short circuits developing between cathode and heater they have become unworkable in many commercially designed receivers. By employing grid modulation these tubes can be used in the new Simplex model without recourse to special low-capacity heater transformers. A considerable saving can be effected in cost by this method.

If the constructor should purchase such a tube it is advisable to test it immediately. Some of them have a rather low emission and are useless. Do not buy a tube which has been "reconditioned" as the life

### COMPLETE LIST OF CONDENSERS, RESISTANCES, ETC.

**(This list comprises those items of the new model which are not listed in the original data in the April, 1954, issue of "Practical Television.")**

**Resistances :**

All ½ watt unless stated otherwise
RM1—2M Ω
RM2—1M Ω
RM3—100 K Ω 2w.
RM4—330 ohms 1w.
RM5—47K Ω 1w.
RM6—220 ohms
RM7—330 K Ω
RM8—4.7 K Ω 2w.
RM9—100 ohms 1w.
RM10—47 K Ω 1w.
RM11—15 K Ω 1w.
RM12—470 K Ω
RM13—330 K Ω
RM14—100 K Ω
RM15—5 K Ω 10w.
RM16—2.2 K Ω 2w.
RM17—470 ohms.

**Potentiometers (pre-set)**

VRM1—2 K ww.
VRM2—1 M
VRM3—250 K
VRM4—2 K ww.
VRM5—25 K

**Condensers :**

All 350 v. wkg. unless stated otherwise
CM1—.005 μF
CM2—100 pF
CM3—.002 μF
CM4—.1 μF
CM5—.1 μF
CM6—25 μF 25v.
CM7—.01 μF
CM8—.001 μF 6-7 Kv.
CM9—.01 μF
CM10—.02 μF
CM11—25 μF 50 v. wkg.
CM12—4 μF
CM13—32 μF tubular
CM14a 8 μF } both
CM14b 16 μF } 450 v. tubular
CM15—.01 μF 450 v.
CM16—.01 μF 450 v.
CM17—.002 μF

**Valves :**

V14—EL38
V15—6V6
V16—5U4G

cannot be expected to be more than a few months. (We are not referring here, of course, to the scheme of the English Electric Company which have an exchange service for their 16in. tubes.)

In conversion design there are two rather important problems which have to be considered. The first is that the usual Miller Integrator and Transitron oscillator such as has been used in the original Simplex is not suitable for direct amplification in the line timebase as it is negative-going on scan. A positive-going sawtooth waveform is required for correct operation of the line amplifier and a phase reversal stage must therefore be inserted. This is accomplished by employing the original V13 line amplifier as a phase reversal stage.

The problem does not arise in the frame circuit as the flyback period is so very much longer and the extremely high flyback voltages generated in the line circuit are absent in the frame amplifier. Direct amplification can therefore be used providing the biasing conditions of the amplifier are adjusted accordingly.

In the frame circuit the main problem is that at the low frequency for frame operation the Miller circuit does not have the excellent linearity which it possesses at the higher line frequency; further, the flyback is inclined to be rather prolonged and this is likely to affect the few top lines of the picture.

A simple solution to the problem would be to redesign the oscillator as a blocking oscillator but as this would entail drastic alterations in the original design and the scrapping of some useful components it was decided to adhere to the original scheme and to apply correction in the following amplifier circuit.

Under working conditions the linearity is quite satisfactory; the clock in the tuning-in signal can be made perfectly round and the only criticism is that unless the linearity controls are very carefully set there is a tendency for the top three or four lines to fold over.

We mentioned earlier that the new design caters for both those who wish to convert their existing televisors and for those who wish to build the present version from scratch. The method to be followed in each case follows.

To convert the original Simplex to the new one obtain the new components. Convert the existing timebase by following the details given in the paragraphs under the heading "Conversion Details." After this, parts for Stage IV (M), V (M) and VI (M) should be purchased and the various stages completed. Each stage can be built separately and the parts for that stage bought separately.

To build the magnetic Simplex version directly the original Simplex data will be required. Stage I is built, followed by Stage II (M), III (M), IV (M), V (M) and VI (M). The original Stages 2, 3 and 4 are not built.

It will be noted that Stages IV (M), V (M) and VI (M) are common to both constructions.

### Circuit Description

The circuit diagram of the timebase amplifiers and C.R.T. network is given in Fig. 1. The vision and sound sections have been given previously in the original Simplex, but in order to assist constructors a complete circuit diagram of the new version has been prepared.

The output from the frame oscillator is fed into V15 and the coupling condenser and the resistance network RM12, VRM2, RM13 add correction. Further correction is obtained from the feedback circuit via CM10, VRM3 and RM14. VRM being made variable allows control over linearity to be

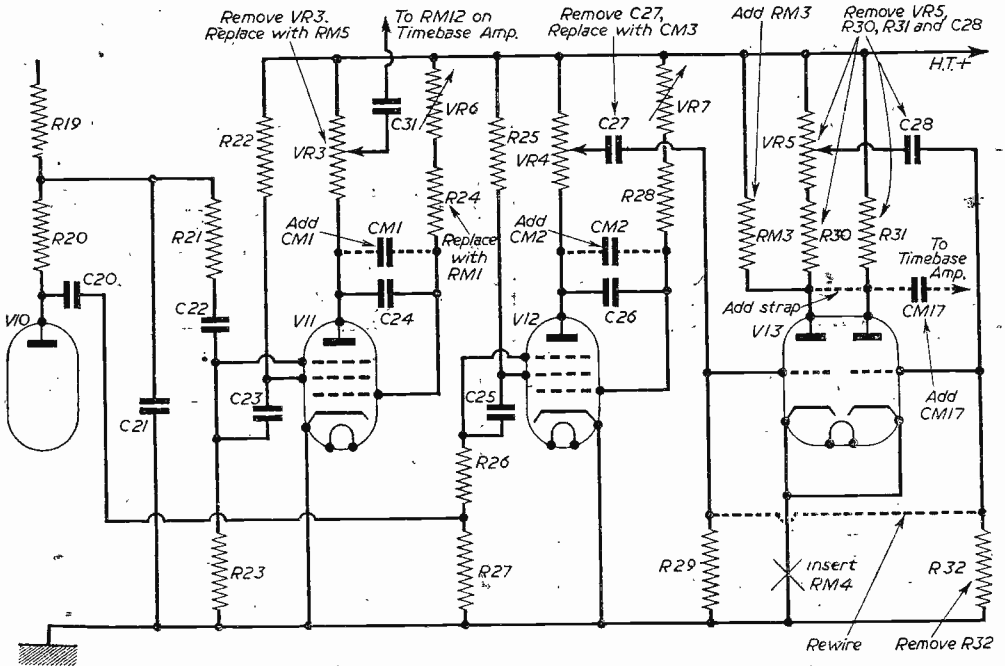



Fig. 2.—Modifying the existing timebase. R28 is replaced by RM2.

exercised and this control will be found to affect mainly the top portion of the picture.

It will be noted that the biasing resistor of the 6V6 frame amplifier is made variable; this ensures that the valve works over the correct portion of its curve and it will be found that the control varies the linearity at the bottom of the picture.

Output from the frame amplifier is fed to the frame output transformer via an R.C. network comprising RM15 and CM13. The use of this method applies a certain amount of correction to the waveform and also obviates having to feed D.C. through the primary of the coupling transformer.

CM13 should be of the tubular type (Hunts or Drilytic) and the can must *not* be earthed.

Damping of the frame flyback is accomplished by RM17.

**The Line Amplifier**

V13 of the original circuit is converted to a phase reversal stage and its output is fed into the line amplifier an EL38.

Sufficient drive is obtained to overscan a 12in. tube with adequate E.H.T. The width of the scan is controlled by the variable inductance in series with the scan coils, the advantage being that the width becomes separated from the main drive and does not therefore affect E.H.T.

Linearity at the extreme left is controlled by VRM1 and CM7.

The original width control has been left and it becomes a further linearity control.

An efficiency diode circuit using a metal rectifier RM6 has been included to provide additional power to the scan and to ensure efficient absorption of the flyback.

E.H.T. is derived from the step-up of voltages from the flyback pulse in the overwinding of the transformer. The voltage is rectified by two K3/40 rectifiers in series, which were used in the original E.H.T. circuit.

Note that it is important to connect CM6, MR6 and the width control correctly and care must be taken to ensure that the Z and Y terminal connections are as given in the diagram.

Although the tube is grid modulated the coupling is obtained from the phase splitter V9 of the original timebase, and it is therefore practically at earth potential. The difficulties associated with providing sufficient positive voltage on the cathode for adequate control of brilliance is thereby avoided, and the simple potential divider RM10, VRM5 and RM11 is sufficient.

**Power Supply**

A standard type of transformer has been employed in an orthodox full-wave rectifying circuit. It was considered that the use of the transformer was justified so that the difficulties associated with a "live" chassis could be avoided.

One important feature is the provision of a filter network in the mains supply.

The object of the network is two-fold. Firstly, it assists in keeping mains-borne interference from the televisor, and equally important it prevents re-radiation of the line frequency via the mains.

This is the first time, to our knowledge, that such an arrangement has been incorporated in a home-constructed televisor and we hope that other designers will follow our lead. Television receiver owners suffer appreciably from unsuppressed electrical apparatus and car ignition circuits and appeals are made from time to time for owners to fit suppression devices. It is only fair that we in turn suppress our

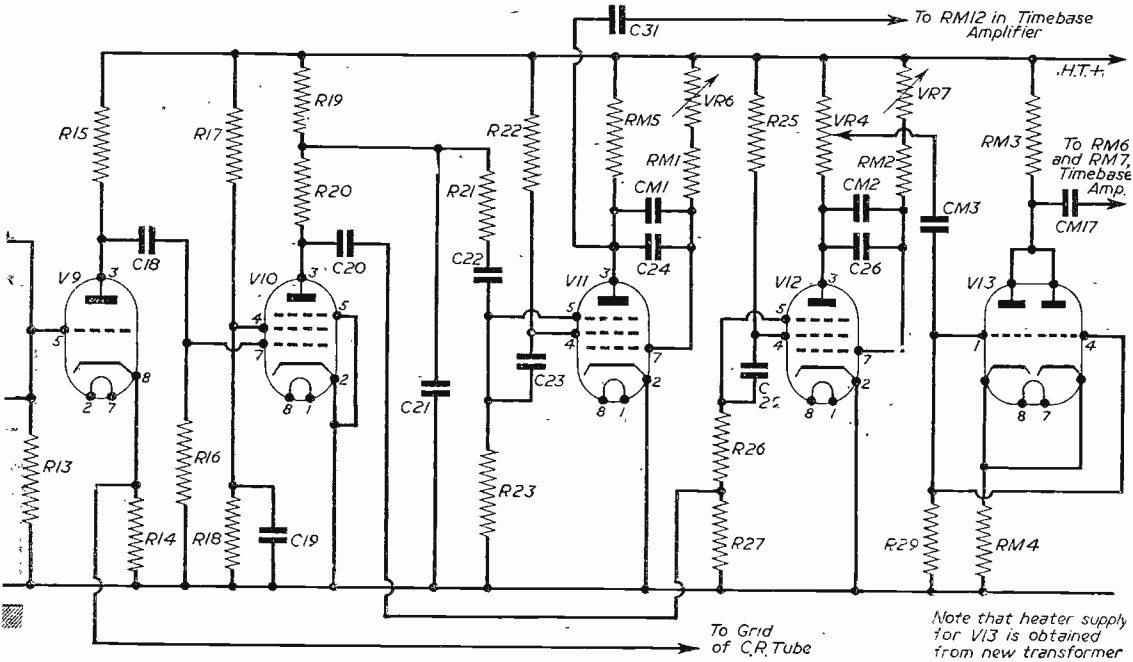



Fig. 3.—The complete existing timebase as modified Stage II (M).

own televisors to prevent re-radiation. In many localities it has become impossible to listen to the light programme on the long wavelength due to the whistle produced from television receivers.

A great deal of the radiation takes place over the mains and the use of the suppression circuit effectively reduces this source. When the televisor is completed it should be put into a cabinet and we recommend that the sides, top and bottom and back of the cabinet be covered with copper mesh, which is earthed.

It is suggested that a three-pin plug and socket be used even if the normal household sockets are two-pin, so that effective earthing can be made.

## CONVERSION DETAILS

This section should be studied by those who are converting the original model into the magnetic. Those who are building the latter version directly should build Stage I as given in the original data and then study Stage II (M) and Stage III (M) given later.

### Mechanical Arrangements

The following items should be removed from the chassis in the order mentioned :

Front C.R.T. mounting ; rear C.R.T. mounting with R40, 41 ; MR1, 2 and C34 ; R38, 39, C39 ; C29, 30, 31 (C31 can be used in its original circuit position but placed under the chassis later) ; VR8, 9, R34, 35, 33, 36, 37, 32, 30, 31, C28 ; C27 is replaced with an 0.002 $\mu$F.

On the rear of the chassis there should now be the original width control, the line-hold control, the frame-hold control, and on its panel above the brilliance and focus controls ; these latter can now be removed.

The timebase should be almost complete (except for the slight modifications to follow) up to the grid of V13. *(To be continued.)*

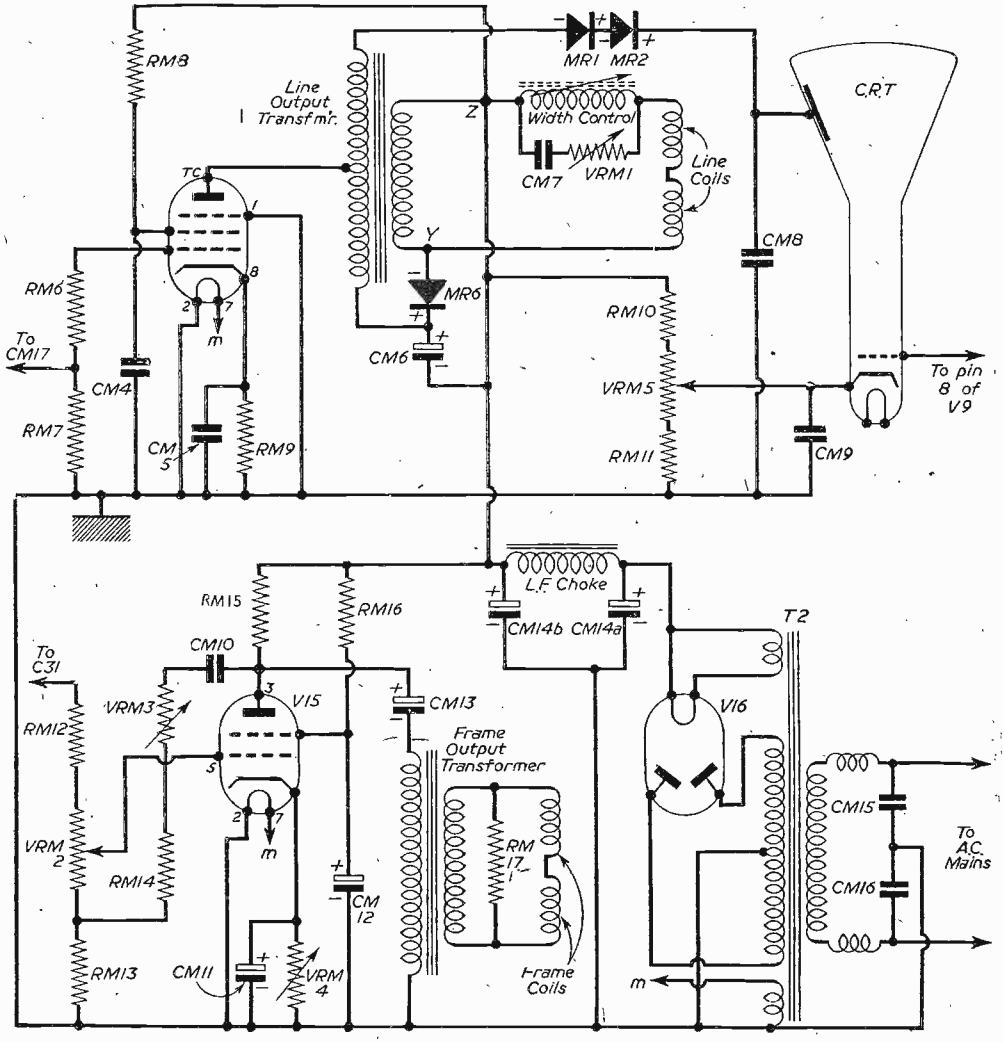
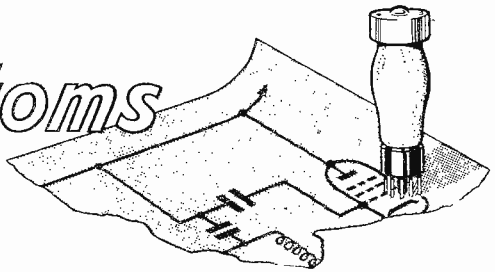



**Fig. 1.—The timebase amplifier.**

# Fault Symptoms



THE CAUSES OF COMMON FAULTS, AND METHODS OF CORRECTION

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

(*Continued from page* 201, *October issue.*)

**The Vision Interference Limiter**

FIGURE 67 depicts a typical vision interference limiter—or spotter—circuit. This in itself is quite simple and straightforward to follow, for essentially it boils down to a diode (sometimes a crystal diode is used) the potentials on which are arranged to hold it just off conduction at the potential corresponding to a peak-white picture signal. Any spurious impulsive signals exceeding this level are, therefore, suppressed, or partially damped, by reason of the diode becoming conductive.

The potential at the diode cathode follows the pattern of the vision signal since this electrode is in direct connection with the cathode of the picture-tube. We must remember, of course, that the picture signal voltage here is working in a less positive direction ; this means that the cathode potential falls less positive corresponding to the white content of the picture.

The anode of the diode is maintained at a predetermined positive potential, and, so far as the circuit of Fig. 67 is concerned, this is achieved by the potential divider comprising R1 and R2. Under normal operating conditions the diode cathode is slightly more positive than the anode, and when the fluctuating potential at the cathode falls to that representing a peak-white picture element, the potential at the cathode equals that at the anode.

Now impulsive interference —such as that created by the ignition system of petrol engines — picked-up and accepted by the receiver in the usual way takes the form of a sharp pulse which sits on the top of the vision signal waveform as illustrated by Fig. 67 (b). Clearly, then, since an interference pulse of this nature causes the diode cathode potential to fall below that induced by a peak-white picture signal, the cathode becomes less positive than the anode ; or, in other words, during a burst of interference the anode of the diode is more positive than the cathode. This, of course, causes the diode to conduct and limit the interference voltage applied to the picture-tube.

Although we are still looking at the signal applied to the tube from the cathode aspect, we must always bear in mind when considering a transient reduction in tube cathode potential, that the potential from the viewpoint of the tube grid is a mirror image of that at the cathode, but rising—going more positive—in value, instead of falling more negative. Looking at the problem in this light enables us to realise more readily that, without the inclusion of an interference limiter circuit, an interference pulse can drive the tube grid extremely positive. This may result in excessive beam current, coupled with a probable drop in E.H.T. volts, and it is such a combination which provokes the display of the relatively large defocused spots of light on the picture corresponding to the interference pulses.

From this reasoning, therefore, we can better understand why a simple spotter circuit does not eliminate the interference effect completely, but at best reduces the size of the spots and keeps them in focus by reason of preventing the tube grid from swinging any more positive than allowed by a peak-white picture element.

**Undesirable Operation of the Vision Interference Limiter**

During the normal life of a tube the brilliance of the picture or raster gradually diminishes until a stage is reached when the tube is considered no longer serviceable (see " Dim Picture " symptom). Flyback lines generally become prominent towards the end of

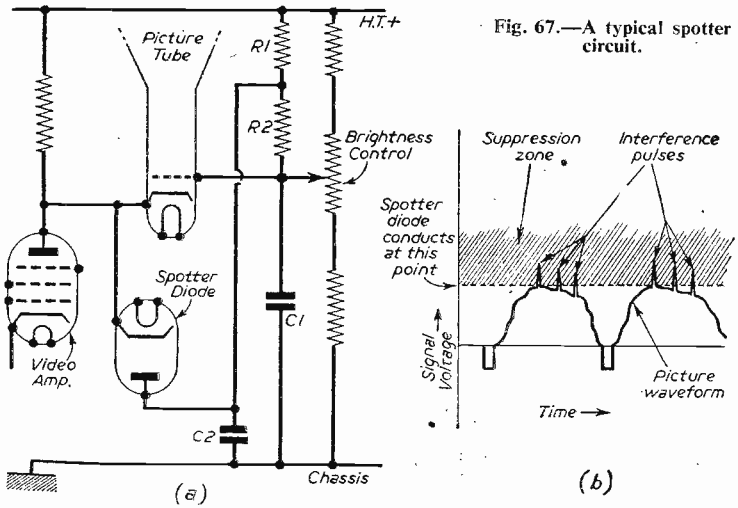



**Fig. 67.—A typical spotter circuit.**

its useful life, and quite probably it is found that viewing can be done successfully only in total darkness. One is very often tempted, when using a tube in this condition, to exceed the optimum brightness control setting in an endeavour to combat ambient

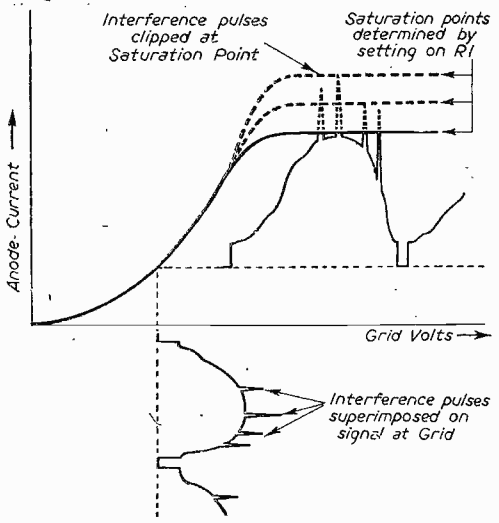



**Fig. 68.—Grid volts—anode current characteristics of video amplifier in Fig. 69. Note how the valve is run into saturation current during interference pulses above peak-white, while the peak-white signal is just below the saturation level.**

illumination falling on the screen. This procedure is, of course, incorrect, but since the brightness of the picture reduces very gradually a progressively advanced setting on the brightness control is usually unwittingly performed. Apart from exaggerating the display of flyback lines, defocusing on whites and the symptoms of poor E.H.T. regulation become apparent, due to the increased load across the E.H.T. system. As revealed by our Query Service, many experimenters are under the impression that such effects are symptomatic of E.H.T. circuit defects. They might be so in certain cases, though in a large number of instances tube replacement has solved all the problems!

In order to maintain correct contrast balance on a worn tube, the increase in brightness control setting demands more tube drive, or a higher contrast setting, and as the tube continues to decline in brightness a point is reached when it is severely over-driven. This is often indicated by the picture appearing "flat," or—in severe cases—in negative form. This undesirable symptom is often aggravated—when a tube is dying—due to the vision interference limiter diode conducting during a peak-white signal level. Premature diode conduction is, of course, provoked by the heavy outbalancing video signal applied to the tube and diode cathodes, and is often little alleviated, under this condition, by retarding the limiter control, if one happens to be fitted.

Fixed limiting is shown in the circuit of Fig. 67, but sometimes R2 is made adjustable, and labelled "limiter control"; this allows—within a fixed limit—an adjustable bias potential to be applied to the diode anode, and thus determines its conduction level.

It will also be seen that the resistor R2 is returned to the slider of the brightness control, and this means that as the brightness control is advanced, the diode anode will go even more positive, thereby assisting further diode conduction during a potential level corresponding to peak-white picture signals or less.

This reasoning clearly illustrates how the action of the vision interference limiter often exaggerates the symptom of an ageing tube, for since both factors are of a synonymous nature it can readily be seen that the overall effect will possibly be stimulated. When a tube begins to wear in this way, and excessive drive is necessary to resolve an image of viewable brightness, it is often desirable to disconnect the limiter circuit, and let the tube itself perform the limiting function!

**Limiting in the Video Amplifier**

It must always be borne in mind that unless the video amplifier stage is capable of providing the extra drive demanded by a worn tube, the associated valve may give rise to a limiting action, for a state is bound to occur when further drive has little effect on the valve anode current. In the case of a cathode modulated tube, for instance, a positive going signal is applied from the vision detector to the signal grid of the valve, and if we consider this in relation to the grid-volts/anode-current characteristic (Fig. 68), we can clearly see how an excessive grid signal would readily run the video valve into saturation current during peak-white signal components.

As a form of artifice this is, in fact, used for the purpose of suppressing impulse interferences in

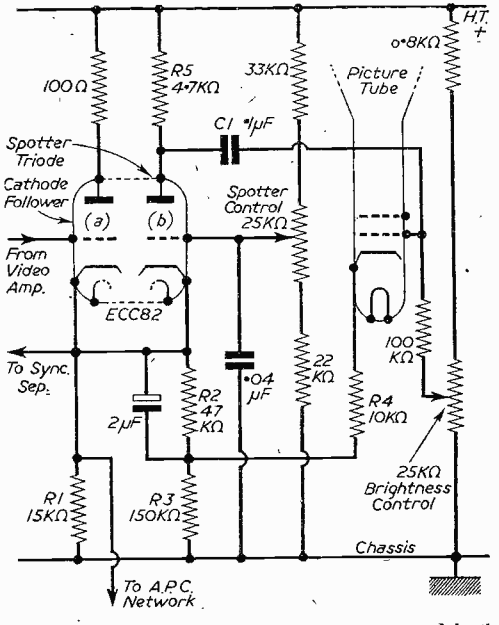



**Fig. 70.—Circuit of white spot suppressor as used in the Pye V4 series.**

the Philips 1100U series receivers. Fig. 69 depicts the relevant circuit details, from which it will be seen that fundamentally the system relies on the variable potential at the suppressor grid. This potential is picked up between the H.T. line and a negative potential in the frame timebase circuit, and is developed

across the limiter control R1. From this it is tapped off and applied to the suppressor grid via the 10 megohm resistor.

Altering the suppressor grid bias has the effect of moving the saturation current level of the video amplifier valve as shown diagramatically in Fig. 68. Under normal operating conditions the limiter control is adjusted so that the valve is run into saturation current during interference pulses above peak-white, while the peak-white signal is just below the saturation level.

### The Pye White Spot Suppressor

The white spot suppressor, or spot inverter circuit, used in the Pye V4 series receiver is worthy of note while on the subject of vision interference limiter networks. Fig. 70 shows the general circuit arrangement, built round a double-triode (type ECC82) valve.

The first section of the valve—section (a)—operates as a cathode-follower, and is energised directly from the video amplifier. The picture signal which is thus developed across the cathode load—R1—is conveyed directly to the cathode of triode section (b). It will also be noticed that the picture signal is applied to the cathode of the picture-tube in a fairly conventional way, via the potential divider R2 R3, and the series resistor R4.

Under normal operating conditions the grid-cathode potential of triode (b) is arranged so that only peaks of interference pulses fed to the cathode cause the valve to conduct. The somewhat amplified negative going interference pulses developed across the anode load resistor R5 are applied through C1 to the grid of the picture-tube.

As these are in the same phase but of greater amplitude than the pulses appearing with the vision signal at the tube cathode, the beam current is reduced and the interference is manifested as black or grey spots, instead of the disconcerting defocused white blobs.

The conducting level of triode (b) is varied by the spotter control potentiometer, and should be adjusted on a picture of correct contrast balance until the interference spots just disappear—a too far advanced setting will cause the white parts of the picture to shade black in a most unusual manner.

Some of our readers will probably recall the description of a circuit of similar nature (see " Interference Suppression," PRACTICAL TELEVISION, November, 1951) developed by the General Electric Company in the form of a unit (type BT151) for inclusion to the then current G.E.C. receiver series BT1091.

Apart from valve trouble—mainly heater to cathode shorts, the symptom of which we have already considered—and over-limiting due to excessive video drive, very few faults occur in vision interference limiter networks to bewilder the experimenter. In any case, once the function of the circuit is well understood, the effect of an alteration in component value, or the effect of a failing part will be readily realised. If the circuit caters for a fixed degree of suppression only—such as that shown in Fig. 68—a rise in the value of a resistor may tend to provoke diode conduction at picture signal levels below peak-white, and give rise to a " flat " picture lacking in highlights. If a variable limiting control is fitted, however, quite large tolerances in component values can be counterbalanced, and the circuit is much less critical in this respect.

A picture interference limiter circuit similar to that in Fig. 67 is used in G.E.C. BT1091 series receivers. In this set resistor R2 is of rather critical value and should really be assessed by adjusting its value in steps until a compromise between maximum picture brightness and the greatest reduction in interference is achieved—sometimes the use of a 100,000 ohm variable resistor in place of R2 assists with this opera-

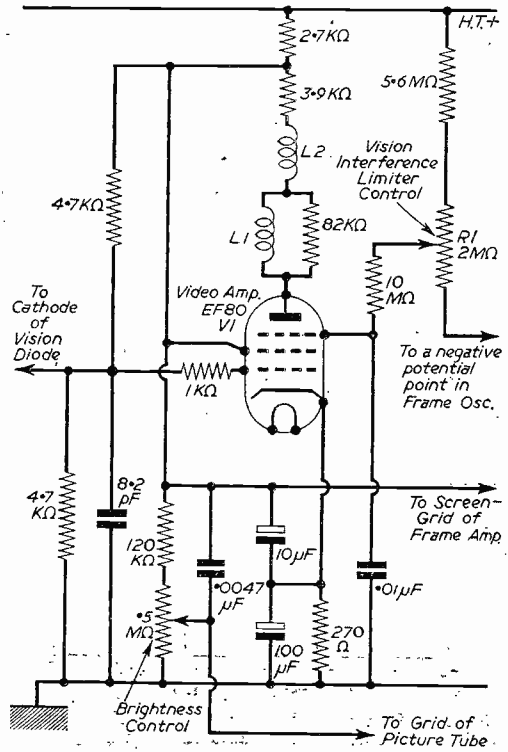



**Fig. 69. — Circuit of the video amplifier stage of the Philips 1100U Series, showing vision interference limiter network.**

tion. In practice R2 consists of a 22,000 ohm resistor, and a 47,000 ohm resistor connected in series, and a shorting wire can then be employed to exclude both resistors, or bring into circuit one or other of them, depending on the precise characteristics of the picture-tube. In this way, as the tube wears, the resistor providing optimum limiting can be selected by the serviceman.

### Picture Contrast Adjustment

As revealed by our query service quite a number of constructors and experimenters tend to conclude that a defect must exist in the contrast control circuit of a receiver exhibiting a sudden burst of screen illumination—possibly wiping the picture off the screen completely or subjecting it to excessive patterning—when the contrast control is advanced to a critical point, usually just before its maximum position.

It will be as well to examine the basic principles of contrast control adjustment, and consider several typical circuits used commercially for this purpose.

It is well known that as the volume control is turned up so more audio signal is applied to the

sound output valve control grid, and an increasing magnitude of sound emits from the loudspeaker. Not so well known, however, is the fact that the contrast control performs a very similar function so far as the vision, or video, signal is concerned. As this control is turned from minimum towards maximum so an increasing video signal is applied to the picture-tube. This, of course, creates a greater ratio of voltage change represented by picture signals between black and peak-white, and in this way has a direct bearing on the contrast (black:white) ratio of the picture.

It is usual practice to position the volume control so that it provides variable attenuation to the sound signal *after* it has been demodulated by the detector. From the vision aspect, only one or two manufacturers adopt this scheme; mainly, the video drive is controlled through the medium of a variable R.F. or I.F. attenuator. This latter method renders circuit design less critical in maintaining a low level of frequency distortion unaffected by the setting of the contrast control.

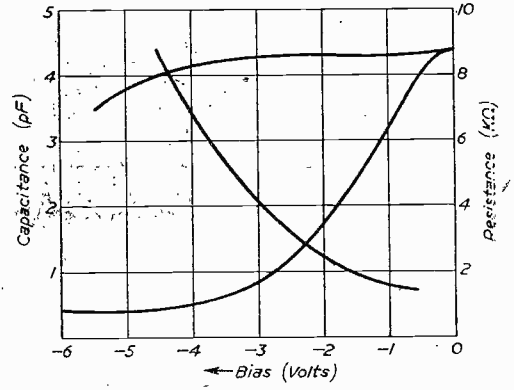



**Fig. 71. — Curves (a) and (b) respectively show how the input capacitance and resistance change with grid bias potential. Curve (c) shows how the capacitance change is reduced when both control and suppressor grids are biased.**

It is accepted practice to provide a means of altering the bias potential on the R.F. and/or I.F. valves, and in this way institute variable gain over the associated stages. Owing to the fact that a variation in control grid potential also provokes a variation in the valve's input capacitance and resistance, it is essential to arrange the circuit in such a way as to provide a sufficient degree of attenuation without severely modifying the circuit constants.

For let it be remembered that the input capacitance of an R.F. or I.F. amplifier valve represents a large proportion of the grid-circuit tuning capacitance, which, if happened to alter while adjustments were being made to the picture contrast, would obviously present a very undesirable feature.

Furthermore, the valve's input resistance is a contributory constant to the tuned-circuit damping and has a marked controlling effect on the bandwidth of the circuit associated with the valve. It would certainly be most disturbing if, apart from an alteration in picture definition, certain tuned circuits went out of alignment every time the contrast control was adjusted!

Fortunately it is quite a straightforward matter to reduce these undesirable effects simply by arranging the contrast circuit to bias negative both the control and suppressor grids. This artifice will not severely modify the desirable change in the valve's mutual-conductance (a factor associated with gain), but it will reduce drastically the change in input capacitance.

This is brought to light in Fig. 71 which shows at curve (a) the change of control-grid capacitance and curve (b) the change of input resistance with bias. Curve (c) illustrates how the change in capacitance is reduced when both control and suppressor grids are biased.

In practice it is found that the suppressor grid needs approximately 12 times as much bias as the control grid. This, again, is readily catered for as will be realised by studying the typical contrast control circuit at Fig. 72. Here the variable resistor (contrast control) R1 passes the cathode current of the valve and thus gives rise to a voltage drop—making the cathode positive with respect to chassis—according to the current and resistance values.

This volts drop is applied across the potential divider R2 R3, the junction of which is in direct contact with the control grid through L1. Now, since the suppressor grid (grid 3) of the valve is returned direct to chassis, the full voltage (VR1) existing across R1 will bias grid 3 negatively (this is so because the cathode of the valve is VR1 positive with respect to grid 3, which, of course, is exactly the same thing as grid 3 being VR1 negative with respect to cathode). The negative potential at the control grid (grid 1) is something less than VR1, depending on the ratio $\frac{R2}{R3}$. The precise value being equivalent to $\frac{R3 \times VR1}{R3 \times R2}$.

Control of a single valve does not generally permit sufficient range of contrast adjustment, and for this reason it is customary to control 2, or sometimes 3, stages. Even so, the inclusion of an aerial attenuator is often demanded in areas of high signal strength.

Some sets also embody an independent gain control—generally known as a sensitivity control. Such a facility may be found to obviate the need of an aerial attenuator, that is provided it is possible to achieve a picture of correct contrast ratio by adjusting the sensitivity control when the contrast control is approximately two-thirds on—if, under this condition, the sensitivity control is fully off, then an aerial attenuator should be used.

Another point worth mentioning here, and one which often provokes the TV owner to contact our Query Department, is that contrast control adjustment—on certain sets—will also affect the volume of sound. The same applies so far as sensitivity control adjustment is concerned. This is quite normal and should cause no alarm; it simply means that the contrast control operates the gain of a stage that is common to both sound and vision.

*(To be continued.)*

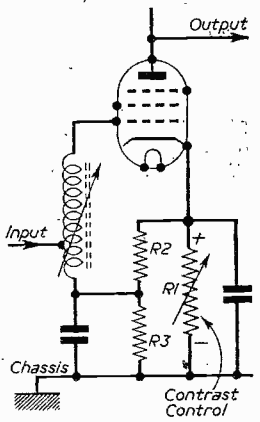



**Fig. 72.—A typical contrast control circuit.**

# TELENEWS

### Education in Stockport

THE Stockport Borough Council decided recently to go ahead with plans to install TV in Stockport schools.

### Television Licences

THE following statement shows the approximate number of television licences issued during the year ended August, 1954. The grand total of sound and television licences was 13,421,629.

| *Region* | *Number* |
|---|---|
| London Postal ... ... | 973,090 |
| Home Counties ... ... | 378,498 |
| Midland ... ... ... | 679,707 |
| North Eastern ... ... | 485,465 |
| North Western ... ... | 502,682 |
| South Western ... ... | 157,437 |
| Wales and Border Counties | 178,588 |
| Total England & Wales | 3,355,467 |
| Scotland ... ... .... | 164,407 |
| Northern Ireland ... | 13,824 |
| Grand Total ... | 3,533,698 |

### Top Priority

AT the recent annual conference of the National Association of Women's Clubs held in London, Miss Rosalind Chambers, a lecturer in sociology, said that most of the tenants of houses on a new estate had told her that they regarded a television set just as necessary as the daily supply of milk.

The average wage earned on the estate was £7 a week. "We discovered," she said, "that the ambition of everyone was to have a TV set."

### TV v. Cinema

MR. J. ARTHUR RANK, head of the Rank Organisation, believes that, after a bitter three-year struggle, the cinema's battle against TV is nearing an end and that "the menace has been beaten off." Patrons, even though most of them own a TV receiver, are coming back to the cinema not only because films are better but because they have finished paying for their sets.

"Television is no longer a bogy for us," states Mr. Rank. "We have got its measure — it is no longer the threat it was."

### Licence Scare

WHEN a G.P.O. radio detector van toured the streets of St. John's Wood and Marylebone, London, recently local inhabitants thought that the big chase had at last reached the area. Post offices in the district soon reported a substantial increase in applications for television licences.

It was later revealed by an official, however, that the detector van was not in working condition but was merely on the road for tests. There certainly seems to be something in the theory that the vans are worth a lot in "scare value."

### Russian TV Station

A SOVIET news agency has reported that construction of a very large TV transmitting station at Kharkov is completed and that it is expected to begin operating almost immediately.

### Eric Barker

MR. ERIC BARKER, star of TV and radio, thinks that it would be too great a demand on his material and his talents for him to appear on television more than six times a year and refuses to exceed that number.

### For Darker Evenings

WE learn from Scotland that many dealers there are extremely thankful now that the clocks have been put back an hour and the evenings are closing in by teatime. They hope that when turning their thoughts to the dreary winter months that lie ahead people will decide that television is the best home entertainment value for their money.

Summer sales figures are down on last year. In June and July only 3,997 new licences were taken out at Scottish post offices compared with 12,780 in the same period last year. The July total this year of 1,550 was the lowest monthly figure for two years.

### I.T.A. Order Television Transmitters

THE Independent Television Authority has placed an order for six television transmitters, three vision and three sound, with Marconi's Wireless Telegraph Company Limited.

**A line-up of the G.P.O. detector vans visiting different parts of the country in an effort to round up "television pirates." In the foreground is the Scottish Region van and next to it the one serving Northern Ireland.**

The vision transmitters have an output power of 10 kW. and the sound transmitters, which are amplitude modulated, an output power of 2½ kW. These transmitters are generally similar to those produced by Marconi's for export, but modified to suit the transmission standards peculiar to the U.K. They will operate in the Frequency Band III.

**Illuminations Rendered Harmless**

THE Sunderland Corporation, following a complaint of TV interference, fitted suppressors to the lighting strips that were part of the Seaburn illuminations this year. They stretched along eight miles of sea front.

**New Form of "Piracy"**

WE hear of a new kind of TV "pirate" who manages to view television programmes regularly without paying out a penny.

He is a Londoner who uses a strong pair of field glasses to peer across the road, focusing them on the set in the drawing-room of the house opposite. Evidently, the only "interference" met with is the occasional drawing of the blinds.

**British Firms in Baghdad**

TELEVISION was demonstrated for the first time in Baghdad last month when twelve prominent British companies, supported by the British Radio Equipment Manufacturers' Association, sent exhibits to the British Fair.

A transmitter was supplied by Pye Limited and King Feisal was televised as he declared the exhibition open. Receivers were set up in many public places for the inquisitive crowds and a receiver was also installed in the palace for King Feisal's own private use.


**"In the News," an unrehearsed discussion on topics of the week, returned to the TV screen in October. This picture was taken during one of the final sessions in the last series. Noel Annan is seen in the rôle of Chairman.**

**Most Sets in Midlands**

AT a Press conference in Birmingham recently, Mr. H. J. Dunkerley, controller of the Midland Region of the BBC, said that there is a higher proportion of TV sets in the Midlands than in any other area in the country.

**Contact with Files**

A BRIGHTON firm has equipped its filing rooms with a television system so that records may be examined speedily even though the main offices are three miles away.

**New Mobile Unit**

THE Midland Region is to have its own mobile TV unit next March. At present, the area is forced to share a unit with the Northern Region.

**Tubes on H.P.**

IT has been announced from the trade that cathode ray tubes are to be made available on hire-purchase terms.

**Less Fiction Read**

IN 1953-54 the number of fiction books borrowed from Lancashire county libraries dropped by more than 174,000. The county library report blames the decrease on to the growth of television-watching.

**Export to Italy**

ANOTHER contract for television equipment has been placed by Radio Audizone Italiana through Marconi Italiana for two further TV outside broadcast units, the equipping of another two-camera studio and a large quantity of monitoring apparatus.

**Peterborough Exhibition**

THE Peterborough Radio and Scientific Society recently held its eighth television and radio exhibition in the Town Hall. The show was open to the public for three days.

**Quick Detection**

FIFTY minutes after Mr. Leslie Crook, of Brixton, had bought his television, two G.P.O. detector van officials knocked at his door demanding to see his licence.

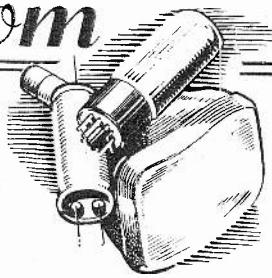
**American Sales**

TELEVISION retail sales in the United States reached a record level in July.

*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.*

# News From the Trade

## SUB-MINIATURE VALVE MOUNTINGS



TWO new mounting devices suitable for certain types of sub-miniature valves have been developed by the Plessey Co., Ltd. One of these is a simple universal clip available in two sizes for pentodes and diodes. While occupying very little space it is designed to give constant spring tension without being too severe on the valve envelope and allows for any variations in size found in subminiature valves.

The pentode clip is made of 0.010in. and the diode clip of .006in. beryllium copper, heat treated to spring temper and finished in oxidised matt black. This finish, together with the intimate contact between the valve and clip, results in very favourable heat radiation characteristics and some degree of screening. Small projections are provided which may be used as earthing points to facilitate wiring. The pentode clip as supplied holds two valves, but can easily be divided into two separate clips by snapping along a tool impression mark provided for that purpose, whereas the diode clip is available in two forms to hold either one or two valves.

In the other mounting device the valve is held in a small spring clip attached to the chassis by means of a support with a very high copper content which acts as an excellent thermal conductor. A base ring made of P.T.F.E. or high grade bonded phenol resin in which tags are moulded is fixed into the chassis beneath the clip. The wire leads of the valve are soldered directly to the tags.

It has been the experience of many production engineers that, especially in sub-miniature equipment, the use of semi-skilled labour may give rise to circuit faults, particularly in intermediate stages of assembly. Much of the expense of fault location in finished equipment can be avoided by this mounting. This connection method also offers an advantage in that a contact point is available for intermediate testing of equipment prior to the installation of valves.

In addition to its electrical advantages this system also offers a rational form of chassis layout in assembly, and allows valves to be removed without disturbing the circuit. It has the further obvious advantage in that it combines the reliability of the wired-in circuit with conventional chassis construction.

It will be found that this device makes it easier to replace valves which fail in service, as well as facilitating and quickening line assembly processes. —Plessey Co., Ltd., Ilford, Essex.

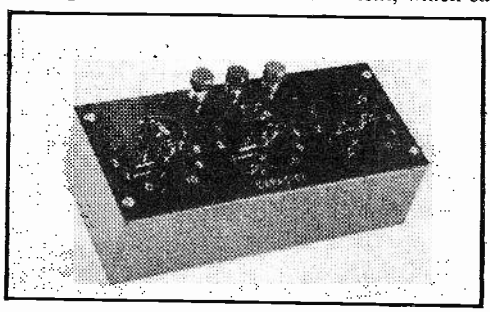
## CORE LOCKING MATERIAL

ONE of the major difficulties met with by the home-constructor of TV coils is fixing the small powder-iron cores. Elastic string is available but tends to twist up, and furthermore, is easily lost if the cores are removed. Vibration can result in shifting of the cores with the necessity for retuning. These troubles are overcome by using some form of adhesive, but ordinary paints, cellulose and similar materials, often advised for the purpose, may affect the properties of the core, and in many cases will prevent subsequent removal without breaking the cores or the formers. A special adhesive has been produced, however, known as 8G Core Locking Material. It is supplied in a small collapsible tube with a long tapering nozzle which just fits inside the standard coil formers, and to use it the core is removed, the nozzle inserted in the former, and the tube pressed slightly. A few seconds should be allowed to elapse before the tube is removed, as the material is rather thick and takes a moment or two to leave the tube. On withdrawal a "blob" of the material should be inside the former and when the core is inserted it will spread and hold the core very firmly. It does not harden and remains firm and tacky almost indefinitely. The price is 4s. 6d. a tube, plus 3d. postage.—TV Replacements, 134-136, Lewisham Way, New Cross, S.E.14.

## DECADE CAPACITOR BOX

FACED with the problem of considerable expenditure on decade capacitor boxes for a large research and development programme, two development engineers at Winston Electronics, Ltd., investigated the design of these instruments.

By designing a new type of eleven-position switch —now patented—a great saving in bulk and manufacturing costs was made. An instrument, which can be sold at a lower price than the cost of constructing home-made apparatus in either the factory or laboratory resulted, and is now being marketed.



**The Winston Decade Capacitor Box.**

Already the Decade Capacitor Box has proved useful in servicing deaf aids; but it should find wide application in electronic circuit designing and building, production control and testing, research and technical laboratories.

The service engineer in electronics, television or radio, will find this small size, extremely light and portable instrument particularly useful.

**Technical Specification**

*Range :* 0.001 $\mu$F to 1.11 $\mu$F in 0.001 $\mu$F steps.
*Stray Capacitance :* Less than 15 pF per decade.
*Working Potentials :* 500 volts D.C., except the 0.1 $\mu$F range, where it is 350 volts D.C.

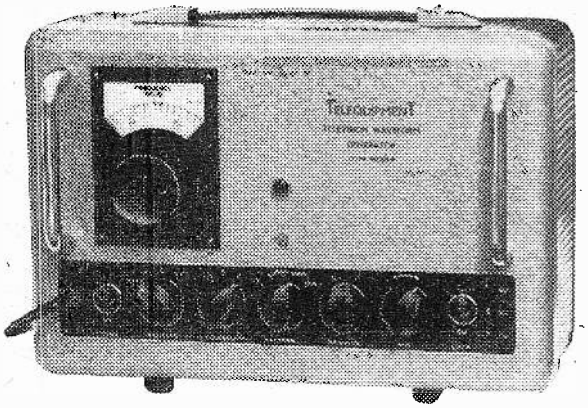
*Switching :* Positive and firm. No play.
*Controls :* Firm, finger-ready.
*Finish :* Facia Panel : Photo-etched. Box : Steel, grey hammer-tone enamel.
*Dimensions :* 8in. x 3¾in. x 3in. (20.3cm. x 8.4cm. x 7.6cm.).
*Weight :* 32 ozs. (0.9 kilos). *Price :* £10 15s.
Winstone Electronics Ltd., Park Road, Hampton Hill, Middx.

### TWO-BAND PATTERN GENERATOR

VARIOUS aids to the lining-up of television receivers are available, and one of the most useful which we have seen is the WG/44 Telequipment Unit. This is designed for use on both Band I and Band III and gives a choice of five patterns. When connected to a receiver it will modulate the frame giving a horizontal pattern with five levels of brightness from black to peak white, upon which may be superimposed, if desired, a fine ruled grating locked to the line timebase. This enables picture gradation, height, width, line and frame linearity, ringing, pulse response and other factors to be examined in the set under test. Alternatively, the raster may be made to provide a regular cross-hatch pattern for checking astigmatism, and this pattern may be opened by means of a small pre-set adjustment in the centre of the panel (with the aid of a screwdriver) so that other forms of line distortion may be checked. A strip running up the centre of the screen may be made to produce, with a grey back-ground over the rest of the raster, definition bars of 1.5, 2, 2.5 or 3 Mc/s detail for checking frequency response and ringing. The output is continuously variable from 10 $\mu$V to mV and the instrument is extremely compact—measuring 11½in. x 8in. x 5¾in. The price is £62.—Telequipment Ltd., 1319A, High Rd.;Whetstone, N.20.

### 3D-2D SUNGLASS SPECTACLES

UNDER this name, Dennis Searle of Croydon has produced a pair of spectacles made from a polarised material with movable lenses. In use they may be employed for watching 3D films, or the lenses may be rotated so that they are both polarised in the same direction, when they may be used as anti-dazzle sunglasses or for reducing eye strain when viewing television. The lenses are made from laminated safety glass, not plastic, and they will find many uses—even returning a 3D film to 2D without blurring if one gets tired of the three-dimensional effect. The price is 2 gns. from D. Searle, 626, Brighton Road, South Croydon, Surrey.



The Telequipment two-band pattern generator.

# The British Amateur TV Club

THE club was founded in 1949 to co-ordinate the activities of amateur radio enthusiasts experimenting with television transmission, and to liaise with other enthusiasts overseas similarly engaged. The club is affiliated to the Radio Society of Great Britain.

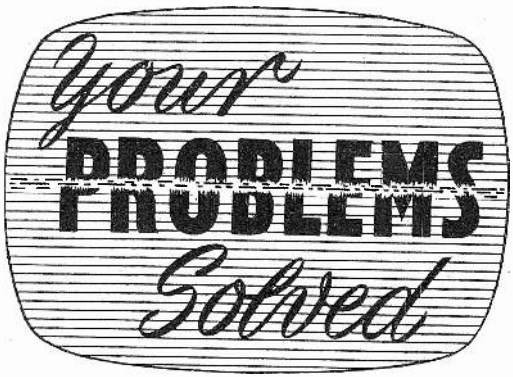
Experiments carried out by B.A.T.C. members have been mainly in two directions, viz., video and R.F. Very few members have the resources to build both sorts of equipment. On the video side, the standards recommended are such that any normal BBC television receiver can be used as a monitor, i.e., 200-line 50 pictures per second sequential, or 405-line 25 pictures per second double interlaced, positive modulation, and waveform similar to that of the BBC. For interchangeability, club members are recommended to arrange all outputs at the one-volt level, low-impedance picture positive, syncs negative. Belling-Lee plugs and sockets are preferred.

On the radio side, the experimenter must hold a G.P.O. amateur vision licence, costing £2 per annum, under which the holder may now transmit messages by telephony or morse without a separate licence, provided that these messages are concerned with the technical matter of the visual transmission. Operation is permitted in the 70 cm. amateur band and on shorter wavelengths. Full details can be obtained from the G.P.O. To date some eight stations have been on the air in this country.

For a camera, the only tube available at the moment is a Vidicon type, rejected by the manufacturer for minor blemishes and costing £25. Occasionally, other types of tube become available also ; Monoscopes are available at £7 10s., but these offers are only valid for members resident in the United Kingdom. Very satisfactory results can be obtained with much less costly equipment ; a flying spot scanner using a 5FP7 scanner and 931A photocell can be built for as little as £10, with a resolution of 2.5 Mc/s. Such units can also be easily converted for telecine work.

There is very little literature of value to the amateur, and so the club issues a quarterly magazine, "CQ-TV," free to members, containing circuits and notes not to be found elsewhere. A few back copies are available at 1s. 6d. each. Also available are headed notepaper, membership certificates, QSL cards and lapel badges. Loans of equipment, films, posters, photos, tapes and lecture notes can be arranged for demonstration purposes.

Membership costs 5s. per annum, payable on the first of January. New members are asked to enclose 6d. per month remaining of the old year plus 5s. for the following year. Further details are available from the Hon. Secretary, B.A.T.C., 56, Burlington Gardens, Chadwell Heath, Essex (Seven Kings 1051).




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

## FAULTY SOUND

**A friend of mine has a Raymond television (table model) F.60, Ref. A/C No. A13257, which has the peculiar habit after a short period of use of dropping in volume to a very low level of sound.**

**It is noticeable that if the contrast control is over-advanced it generally corrects it for a further short period.**

**The PL.83 was found to be low and replaced, but this trouble still persists on sound only, as the vision is remarkably excellent in quality.—E. J. Wall (Coventry).**

This symptom frequently indicates a resistor or capacitor defect in the sound detector/noise limiter or sound output stages. You should endeavour to prove whether the fault occurs in the output stages or in the detector stage by listening to the sound signal in a pair of headphones connected to the control grid of the sound output valve and chassis. If, when the symptom becomes evident from the loudspeaker, the signal in the phones remains constant, the fault must lie in the output stage where normal testing methods should soon reveal the defective part.

## TYPE 26 UNIT

**I would be greatly obliged if you could help solve a problem I have come up against. I am using a 1355 I.F. unit for vision and since replacing the R.F. unit type 25 with type 26 the fly-back lines are unduly prominent and there is sometimes a white vertical band down the screen near the centre. The half-lines at the bottom are shaped more like matchsticks with blobs on the end, otherwise I get a splendid picture. The tube is the VCR97.—W. Farrell (Blackburn).**

The use of the RF26 as against the RF25 should make no difference to the appearance of the raster. The RF unit is more powerful than its predecessor and that is all.

If the actual raster is the same as before then it is possible that you have a fault in the video output stage and we suggest you check the biasing arrangements on the valve, paying particular attention to the decoupling condenser.

The receiver should always be operated with the brilliance reduced so that when no picture is being transmitted no raster is seen on the screen.

## DETAILS OF VCR511

**I shall be most grateful if you can give me the following information on VCR511, an ex-Government cathode ray tube :**

**(a) Base connections.**

**(b) Filament voltage and current.**

**(c) Final anode voltage.**

**(d) Deflection voltage for full width of screen.—J. R. Crane (Bell Heath, Worcs).**

(a) The base connections are as for VCR97 but grid and cathode are reversed.

(b) The heater voltage is 4 at a current of about 1.2 amp.

(c) The maximum final anode voltage is 5 kV.

(d) Deflection voltage for line is 1.170 volts and for frame 887 volts.

## "SIMPLEX"—SOUND OUTPUT STAGE

**I am making up your "Simplex" TV. In the sound section I see you use a Pen 45. I have a transformer where I could use 6V6. Can this be used ? If so, what are the modifications for this valve ? What is the object of Pen 45 ? Thanking you for a reply.—A. E. Wareham (Portsmouth).**

The reason for using the Pen 45 was simply that it has a 4-volt heater and a 4-volt potential was available from the same supply on the mains transformer as the C.R.T. It was not possible to use a 6,3-volt valve as the existing 6.3-volt line is fully loaded without the power valve.

You can use the 6-volt valve provided you have a suitable winding on the transformer.

The following modification is recommended : Remove RS5 and place it in RS2 position ; move VR2 to RS5 position, taking the slider to the grid of the output valve ; connect the now free end of RS1 to chassis and the free end of C15 to pin 6 of the EBC33.

## FAULTY MAINS TRANSFORMER ?

**I have a TV set, Ekco TS46, which has worked well for over five years.**

**It was working well until I went on holiday for a fortnight, but on returning I switched on the set and after about 30 seconds a distinct smell of burning came from the back with slight smoke.**

**I instantly switched off and removed back.**

**On switching on again I noted that the filaments of valves came on but again after about 30 seconds I noted smoke coming from the mains transformer immediately behind the E.H.T. screened section. It was hot to the touch.**

**I switched off at once in case of further damage.**

**It appears that as the valve filaments glow, the transformer appears in order and I'd be grateful if you can tell me what other component can be at fault ? I have no instruments for testing.—B. W. Himes (S.E.9).**

The fact that the valve heaters light up does not conclusively indicate that the mains transformer is free from defect. Indeed, since it has actually been burning it is now almost certainly in need of replacement. The H.T. secondary winding has probably overheated either as a result of insulation failure

or due to a short-circuit on the H.T. line—the chief cause in this respect being electrolytic smoothing capacitor failure.

## EKCO T.161 LINE FAULT

**My television set, which was bought in November, 1951, is an Ekco table model, Type T.161.**

**We have had perfect reception until a week ago, when two pairs of black wavy lines appeared across the screen, these flickered up and down the screen for a few seconds and then the picture became blank and, although sound remains perfect, no picture comes at all. Up till the moment of the lines appearing the picture was perfect.**

**The screen went completely blank, suddenly, no fading of the picture or any changing, and the receding bright spot which we have always seen when turning off the set was not present.—F. J. Burch (Keston).**

We feel certain that the cause of the symptom described lies in the line timebase section. It is a typical symptom of a sudden failure of the line output transformer—probably a collapse of the winding insulation.

In the first place, we would advise that you check for E.H.T. pulse voltage at the anode of the U25 E.H.T. rectifier valve—holding the blade of an adequately insulated screwdriver close to the anode lead should result in an arc at least $\frac{1}{4}$in. long.

You will probably discover that this will not occur, but before contemplating transformer replacement, it may be a good idea to have the emission of the 20P1 line output valve tested.

Incidentally, if you are able to draw an arc from the E.H.T. valve anode lead you should suspect the U25 for low emission or open-circuit heater.

## TESTING BEAM CURRENT

**Would you advise me how I can test the beam current in C.R.T., both for tetrode and triode tubes? The points which I should most like clarified are—Is beam current taken with modulation on tube—and what should be the setting of the brightness control?—N. Rego (Harrogate).**

The actual value of beam current varies widely from tube to tube, and is also dependent on the value of grid bias. In turn, the value of grid bias is, of course, set by reason of the brightness control itself.

The cathode current can be measured by inserting a microammeter in series with the lead to the tube cathode pin, and adjusting the grid voltage according to the figures given in the tube makers' data sheet to give an expected beam current of 20-30 $\mu$A. If the tube is in order and the ion-trap magnet is correctly set, a raster should be obtained on the screen under these conditions.

Beam current is not normally taken with the tube working under signal conditions.

## R1355 AND SIMPLEX

**I am already converting a 1355 plus RF25 to sound and vision. It will consist of 9 VR65, 1 VR92, 1 6V6 and 1 VR55 valves.**

**What I wish to know is, can I get the power supply from the "Simplex" power supply, and use the "Simplex" timebase and "Simplex" cathode-ray tube circuit as laid down in your articles?**

**I want to save myself the expense of building three separate power packs.—H. Calladine (Manchester).**

It is not possible to employ the method of power supply which you suggest as the heater current is far too heavy. It is possible to construct a single power supply for the whole televisor, but the difficulty is in the supply of a transformer with sufficient heater current. The most economical method is to use a transformer giving the necessary H.T. and to supplement this with a heater transformer, feeding the heaters on split loading.

## BUSH TV24A—WIDTH TROUBLE

**I have a Bush TV24A (12in. screen). A few weeks ago I discovered that the width control did not travel its full course. I found that the 30 K$\Omega$ variable resistor had overheated to such an extent that the plastic casing had melted and locked the spindle. I replaced the resistor and the same thing has happened again. The resistor does not burn right out but only gets very hot—the resulting deformation of the casing, of course, locks the spindle and prevents any adjustment.**

**I would be grateful if you could suggest a remedy for this fault.—J. Howe (S.E.26).**

The resistor to which you refer, together with an 80 pF 5,000 volt working capacitor connected in series, forms a damping circuit across the deflector coil output. Considerable line pulse energy is thus dissipated across the resistor in the form of heat—this is quite normal. We assume that your replacement resistor is of the correct type and wattage rating—this is most important, of course.

If the trouble persists, however, you may find it advisable to use a control rated slightly higher than the original.

## VIDOR CN4216—VISION INSTABILITY

**I have a Vidor 12in. TV, model CN4216 and it has developed an intermittent fault and would like your help to try to rectify this fault.**

**Its symptoms are as follows: after the set has been on about 30 minutes, a pattern rather like a honeycomb comes over the whole screen, this lasts for a second or two and then the whole picture breaks up with the effect of faulty horizontal hold control, this lasts for about three or four seconds and then returns to normal. The whole process repeats after a few minutes. The foregoing effect lasted throughout one evening's viewing and on switching off and being left to cool down, after switching on again, it took about seven minutes for the fault to develop.**

**After the evening referred to there was no further trouble for four or five weeks. The second time the fault developed in much the same way, but with an interval between of about 30 minutes.**

**I would like you to give me an indication where to look for the fault and would mention that I have the service sheet for the set.—J. Thompson (Glasgow).**

Since you mention that the vision disturbance can be temporarily corrected by letting the receiver cool-off, and since your remarks indicate that the sound is unaffected, we feel that one of the valves associated with the vision channel may develop a fault to provoke instability. You should endeavour to prove this possibility by substituting, in turn, the valves concerned. A valve for this purpose can probably be obtained from the sound channel provided it is of the same type, which should, of course, be replaced with one of the valves in the vision channel. You should make a note of the original valve positions, for it is not desirable to interchange valves permanently, even though they are of the same type.

**COMPLETE T.V. AERIALS** with chimney lashings, "H" type, **£3**; single dipole, **£2**; 3-element folded dipole with 10ft. pole, **£5/15/-**; all prices carr. pd. GLADSTONE RADIO, Gladstone Place, Newton Abbot, Devon.

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**THE CHEAPEST** Blank Ali. Chassis, made in bright 18g. ali, with sides and narrow end turned in and down ½in. for maximum strength and rigidity.

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| 7 x 4 x 2, **3/4** | 9 x 5 x 2½, **4/-** |
| 10 x 6 x 2½, **4/6** | 10 x 8 x 2½, **5/-** |
| 12 x 8 x 2½, **5/6** | 12 x 9 x 2½, **6/-** |
| 14 x 9 x 2½, **6/6** | 15 x 9 x 2½, **6/9** |
| 16 x 8 x 2½, **6/9** | 16 x 10 x 2½, **7/3** |
| 17 x 9 x 2½, **7/3** | 17 x 12 x 2½, **8/6** |

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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).

## SERVICING—HMV1807

SIR,—I was interested in your new item "Servicing TV Receivers."

A few additional points occur to me with respect to the "1807" and I wonder if it might not help to get a better coverage if other authors were invited to contribute comments in advance, the lot being collated together as an article, which would be more complete and therefore of even more value. For the "1807," for example, I could add, among others, the following:

(1) The queer effects of an intermittent O/C line hold slider (and also notes on the necessity to handle the sliders with great care).

(2) The cure of sound on vision.

(3) Although you cover the fault of the sync separator screen resistor going "high," the makers advise its replacement with a 1 watt, not a ½ watt.

(4) Hum from H/K leaks in Z77 valves.

(5) Mention that the EA50 is replaced by a metal rectifier in many sets.

(6) Varying focus and width is often due to the .001 μF condenser from the end of the .33 MΩ in the grid circuit of the line oscillator going slightly leaky.—D. E. WALDRONS (Gravesend).

## THE SIMPLEX—AMATEUR RESULTS

SIR,—I notice in the September issue of PRACTICAL TELEVISION that Mr. J. Ward, of Southampton, is contemplating building the Simplex, but being a novice is wondering whether his efforts will be successful. May I be allowed to help to set his mind at rest?

I also am a novice, never having built even a wireless, but I have now built the Simplex and am very pleased with the results. As a matter of fact, the set is working at the present time with a single dipole aerial just propped up against my living-room wall, until I get a length of co-ax. long enough to reach to the roof.

I did have a spot of trouble getting the picture centralised on the screen, but I wrote to you and you suggested altering the values of a resistor and condenser, and that cured it.

If Mr. Ward wishes to contact me I will be only too pleased to give him any information that I can, and I hope he gets as much pleasure out of building his own TV as I have.—JAMES F. PILLING (Bury).

## ENGINEER'S NOTEBOOK—A.C./D.C. HEATER WIRING

SIR,—In looking through your August edition of PRACTICAL TELEVISION I see that in your article on "Heater Wiring in A.C./D.C. Receivers," page 107, in Fig. 3 a heater chain of 10P14, 10P14, 10F1, 10F1, and U801, 20P1, 20L1, 20D1, 20D1 are put down as 150 mA valves, whereas the 10P14 and 10F1 valves are .1 amp. valves and the U801, 20P1, 20D1 are of the .2 amp. type. I suggest that if these valves were used with the suggested currents of 150 mA, serious damage will be done to the valves.

Although the total heater current of these chains if run under correct conditions will pass .3 amp., this is suitable for running the 12AT7. —CHAS. R. BOCKING (Enfield).

(The author states: The error here is entirely mine. The ratings of the individual valve strips are, as Mr. Bocking points out, 0.1 amp. and 0.2 amp. respectively, and the error arose through carelessly referring to a rough sketch of the system before current values were inserted.

No damage would result to an actual set-up, of course, as the dropper values given are quite correct. The 12AT7 current at 0.3 amp. is unaffected.)

## MODIFYING THE R3118 AND ZC8931

SIR,—I read with great interest in the September issue of PRACTICAL TELEVISION Mr. George Twist's letter on the ZC8931. From his description of the above unit, also the fact that the code APW 4790 appears on it, I should say that it is the same unit as the Admiralty pattern W4790A responser unit Design A.

A careful study of the R3118 circuit up to the fourth IF stage, and the W4790A unit will reveal that they are similar, but various condensers and resistors are of different values, and only one R.F. stage.

I have a W4790A unit which at present I am modifying on the lines of B. L. Morley's articles on the R3118 up to the fourth IF. From that I am trying out circuitry to suit the unit, and am certain this will prove a most useful unit to the experimenter. —WM. ROBERTSON (Fife).

SIR,—Your correspondent George Twist of Liverpool, whose letter appears in the September PRACTICAL TELEVISION, is quite right regarding the ZC8931. I have two of these sets and they have not the circuit of the R3118 you published. In my sets there are 10 valves each and the description of Mr. Twist's tallies with mine. I purchased these from a firm who supplied modification data.

The sets are extremely powerful and I can receive a strong signal on an indoor cage aerial with them. However, my picture has never been sharp and I have been hoping that PRACTICAL TELEVISION would publish an article on it.

I have the modification data as supplied with the unit. I am using one for vision and one for sound.—F. J. BUSH (Exmouth).



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