MAKING TV AERIALS

# Practical Television

1'6

AND TELEVISION TIMES

JANUARY 1960

CONTENTS

# Just Right for your pocket !

## THE MULTIMINOR

### 19 Ranges

**D.C. Voltage :** 0-1,000V in 7 ranges
**A.C. Voltage :** 0-1,000V in 5 ranges
**D.C. Current :** 0-1A in 5 ranges
**Resistance :** 0-20,000 Ω, 0-2M Ω.

Pocket Size : 5⅝ x 3⅝ x 1⅜ inches.
Weight : 1 lb. approx.

*List Price* **£9 : 10s.**

*Complete with Test Leads and Clips. Leather Case if required 32/6.*

**Sensitivity :**
10,000 ohms per volt on D.C. voltage ranges. 1,000 ohms per volt on A.C. voltage ranges.

**Accuracy :**
On D.C. 3% of full scale value.
On A.C. 4% of full scale value.

To meet special requirements, instruments can be supplied to a higher degree of accuracy for a small additional charge.

This splendid AVO instrument has been developed to meet a definite demand for a sturdy pocket-size multi-range test meter at a modest price, suitable for use on modern electronic apparatus as well as for radio and television receivers, motor vehicles, and all kinds of domestic appliances and workshop equipment.

Readings are obtainable quickly and easily on a very open scale, and range selection is by means of a robust, clearly marked rotary switch of the characteristic AvoMeter type. Measurements of A.C. and D.C. Voltage D.C. Current and Resistance are made by means of only two connection sockets.

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*Telephone : VICtoria 3404 (12 lines)*

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| 3V4 | 7/6 | 6J6 | 5/6 | 10P13 | 15/6 | 30PL1 | 11/6 | CCH35 | 23/3 | ECC81 | 8/- | FC13C | 26/6 | PEN4DD | | U25 | 13/6 | VP13C | 7/- |
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| 6AM6 | 5/6 | 6P1 | 19/3 | 12J5GT | 4/6 | 72 | 4/6 | DF91 | 6/- | EF36 | 6/- | | 19/3 | PL38 | 26/6 | U301 | 23/3 | X42 | 15/- |
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| 6B7 | 10/6 | 6R7G | 10/- | 12Q7GT | 6/6 | 83 | 15/- | DH63(Met) | | EF42 | 11/6 | KK32 | 21/11 | PL820 | 18/7 | U801 | 29/10 | X66 | 12/6 |
| 6B8G | 4/6 | 6SA7GT | 8/6 | 12SA7 | 8/6 | 83V | 12/6 | | 17/6 | EF50(A) | 7/- | KL35 | 8/6 | PM2B | 12/6 | U4020 | 16/7 | X76M | 14/- |
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| 6BJ6 | 7/6 | 6SL7GT | 8/- | 12SQ7 | 12/6 | 305 | 10/6 | DK40 | 21/3 | EF86 | 12/6 | KT44 | 15/- | PY31 | 16/7 | UBF80 | 9/- | XFG1 | 18/- |
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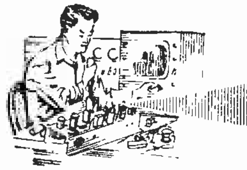
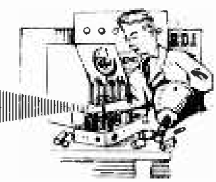
| DRM-1B | 15/4 | RM-1 | 7/- | WX3 | 3/6 | 14A100 | 27/- | 14RA 1-2-8-2 | 17/6 | 16RE 2-1-8-1 | 8/6 |
| DRM-2B | 16/2 | RM-2 | 9/- | WX4 | 3/6 | 14A124 | 28/- | 14RA 1-2-8-3 | 21/- | 18RA 1-1-8-1 | 4/6 |
| DRM-3B | 23/3 | RM-3 | 9/6 | WX6 | 3/6 | 14A163 | 38/- | 14RA 2-1-16-1 | 21/- | 18RA 1-1-16-1 | 6/6 |
| LW7 | 21/- | RM-4 | 16/- | 14A86 | 17/6 | 14B130 | 35/- | 16RC 1-1-16-1 | 8/6 | 18RA 1-2-8-1 | 11/- |
| RM-0 | 7/11 | RM-5 | 19/6 | 14A97 | 25/- | 14B261 | 11/6 | 16RD 2-2-8-1 | 12/- | 18RD 2-2-8-1 | 15/- |

| VOLUME CONTROLS | ELECTROLYTIC CONDENSERS Standard Can | | Wire-ended Tubular | |
|---|---|---|---|---|
| All with long spindle and | 8 x 8 x 8 mfd., 400 v. 3/6 | 100 x 400 mfd., 275 v. 12/6 | 32 mfd., 350 v. 2/6 | 8 x 8 mfd., 450 v. 3/- |
| double-pole switch, 4/6 each. | 32 x 32 mfd., 450 v. 5/9 | 100 mfd., 275 v. 2/6 | 8 mfd., 450 v. 1/9 | 16 x 16 mfd., 450 v. 4/- |
| 10K, 25K, 50K, 100K. | 64 x 120 mfd., 350 v. 8/3 | 200 mfd., 275 v. 3/6 | 16 mfd., 450 v. 2/9 | 32 x 32 mfd., 350 v. 4/- |
| ½ meg. ¼ meg. 1 meg. 2 meg. | 60 x 250 mfd., 275 v. 9/6 | 100 x 200 mfd., 275 v. 9/6 | 32 mfd., 450 v. 3/9 | 8 x 16 mfd., 450 v. 3/9 |

TERMS OF BUSINESS: CASH WITH ORDER OR C.O.D. ONLY. POST/PACKING CHARGES 6d. PER ITEM ; C.O.D. 2/6 EXTRA. ORDERS VALUE £3 UPWARDS POST FREE. ALL VALVES BOXED, FULLY GUARANTEED, AND SPECIALLY SELECTED FROM THE WORLD'S FINEST MANUFACTURERS. PERSONAL SHOPPERS WELCOME FROM 8.30 to 5.30, SATURDAYS 1 p.m. CATALOGUE OF OVER 1,000 DIFFERENT VALVES, WITH FULL TERMS OF BUSINESS PRICE 6d. PLEASE ENQUIRE FOR ANY ITEM NOT LISTED WITH S.A.E.



# Practical Television



## & TELEVISION TIMES

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

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



# INDEPENDENT TELEVISION

THE latest report of the Independent Television Authority (1958-59) was issued recently. It is now five years since the 1954 Television Act and five years before the Act is due to expire.

When the ITV was first established there were two schools of thought ; one that ITV would provide a low standard of entertainment and one that the competition between BBC and ITV would give rise to a better overall standard of television. This latter supposition has proved to be correct.

During the initial five years of the Authority there have been several periods when its policy concerning advertisements has been adversely criticised. It has often been said in the Press that the advertisements inserted in the programmes are too long and too frequent. In this latest report, the Authority replies in detail to these criticisms. It states that before transmissions began in 1955 the Authority had fully considered how to give effect in precise terms to the general duty placed upon it by the Television Act of securing that :

"The amount of time given to advertising in the programmes shall not be so great as to detract from the value of the programmes as a medium of entertainment, instruction and information."

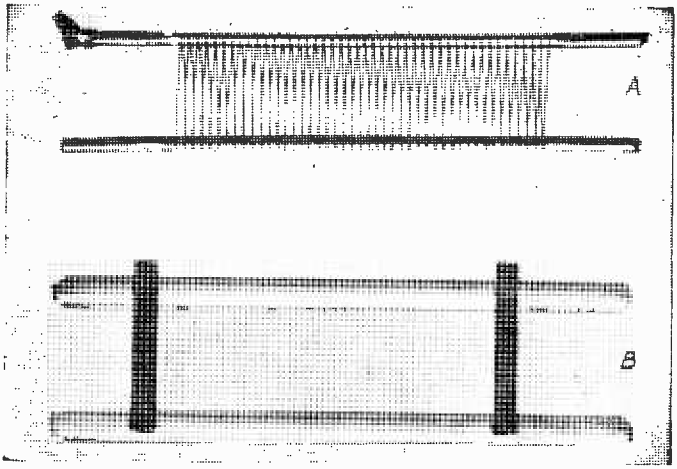
In the report for 1954-55, the Authority decided that the time given to "spot" advertising should not exceed six minutes an hour averaged over the day's broadcasting. Advertising magazines and features being excluded from this time limitation.

When the Authority was criticised for permitting what was described as an excessive quantity of advertising there was not in its view "any persuasive evidence that advertising was spoiling the programmes for viewers in general." The Authority says that "on the contrary, there was available week by week the simple, though certainly not decisive, test of the relative number of viewers able to choose between the two television services. Though a programme entirely free from advertising was always available at the turn of a switch, viewers as a whole in the 7,000,000 homes able to choose regularly tuned their sets to the programme with advertisements for 70 per cent. of the time." The Authority also states that ITV's share of the audience was rather higher than average during periods when there was most advertising. This attempt to prove that viewers did not think the amount of advertising excessive can only confuse ; it could well be that the generally lighter programmes put out by ITV were preferred by most viewers in preference to those of the BBC in spite of the inclusion of advertisements. The widespread criticism of the advertising policy of ITV cannot have been founded upon a myth and the Authority should remember that it was constituted as a public guardian rather than a public relations officer for the programme companies.

*Our next issue, dated February, will be published on January 22nd*

# Frame Grid Valves

## THE LATEST ADDITION TO THE RANGE OF VALVES FOR DOMESTIC TELEVISION



**At A is illustrated a conventional grid and at B a frame grid. Both are shown magnified.**

ONE of the latest developments in the field of television has been the introduction of frame grid valves. Frame grids are not new, and their use is not limited to receiving valves. Fully fledged frame grids were used as far back as 1943, and recognisable ancestors can be found in the suppressor grids of some pre-war screened pentodes. Some present-day types use ring-like frames; and the Mullard QQV02-6, a double tetrode transmitting valve, has two separate frame grids (one for each tetrode) mounted on opposite sides of the shared cathode. Some manufacturers have used either punched plates or one-piece boxes and have thus eliminated the need for welding.

A discussion of the relative merits of the various kinds of frame, as well as a great deal of background information, can be found in the *Bell System Technical Journal* for October, 1951.

*This article first appeared in Mullard "Outlook" and will be of especial interest to readers living in the fringe areas of television transmitters.*

The variety of devices which go under the name of valve is immense: variety not only of size and shape (for example, the subminiature pentode and and the klystron), but also of structural detail. If one looks, for instance, at bases, there is a bewildering array which takes in "pee-wee" and "super-jumbo" and a multitude of arrangements of leads and lugs.

### Grids

Grids, perhaps, are even more diverse, with little but their general function of "control" in common. There is not much physical similarity between the fanned-out structure of loops which was used in certain very early receiving valves, the straight rods of the octode, the beam plates of the power tetrode, the stiff hairpin of some small thyratrons, the perforated disc of larger types, the elegant structure of almost invisible wires in the first disc-seal valves (such as the wartime CV90), and the familiar cage—round, rectangular, lozenge-shaped — of conventional receiving types. Yet these structures are all known as grids.

In recent years the control grid of the receiving valve has had to meet a number of new demands, and it has undergone—in certain valve types—a further change of shape. The new requirements, which occur mainly in "professional" equipment (computers, telephone carrier systems, radar, and so on), are: a much enhanced degree of uniformity between valves of a particular type, so that valves can be interchanged or replaced without upsetting the operation of a critically adjusted circuit; a high "figure of merit"; and mechanical rigidity.

### Figure of Merit

This is a term which has had a number of different definitions. In R.F. circuits it is used as an indication of the bandwidth over which the required amplification of the stage can be obtained. So far as valve characteristics are concerned the requirement is that the ratio of slope to interelectrode capacitance shall be as favourable as possible, so that each mA/V of slope shall be obtained at the lowest possible cost in capacitive loading. In practical valve design a favourable ratio is achieved by pushing up the slope to a high value, even though the means used to achieve a high slope may, in fact, also produce some increase in capacitance.

### High Slope

The slope of a valve is determined very largely by the control grid. It is a measure of the efficiency with which the grid controls the flow of electrons. A relatively "inefficient" grid can be found in the television picture tube, in which the grid (a plate with a simple circular hole) requires something like $-100$ volts to reduce a current of two or three hundred micro-amps to zero. The slope of a C.R.T. may be of the order of $50\mu A/V$, which is sufficient for its purpose.

At the other extreme is the Mullard E180F, which is an R.F. pentode for use in wideband amplifiers in telephone carrier systems, radar sets, and measuring equipment. A 40mA anode current is reduced to zero by only −3 volts, and the slope at working point is 16.5mA/V. The E88CC, a double triode for use in cascode circuits and as a multivibrator and cathode follower in computers, has a slope of 12.5mA/V. A similar slope is given by the PCC89, a new double triode cascode R.F. amplifier for television receivers.

### *Frame Grids*

The three types just mentioned achieve their high slopes (and high figures of merit) by means of the frame grid. An efficient grid implies a small grid-to-cathode spacing, and a close mesh of very thin wires. Broadly speaking, the smaller the grid-to-cathode gap, the higher the figure of merit. Thus the problem becomes a question of structural design.

A typical frame grid for a receiving valve consists of two stout rods of molybdenum which are held rigidly apart by stiff cross-pieces. The dimensions of this frame are very closely controlled. For example, the main rods are drawn to size within limits of ±0.005mm. The grid wire is wound on the frame under tension (about 15 grams) and is anchored to the frame at each end. The tension of the wire is sufficient to maintain the accurate spacing of the windings. Gold-plating of the entire structure may be used as a precaution against grid emission.

### *Parallel Meshes*

A frame grid thus consists of two exactly parallel flat meshes of taut wire. The grid is threaded over the cathode in the usual way. Since the distance between the two meshes can be accurately predetermined by a suitable choice of rod size, the clearances between the meshes and the two faces of the cathode are also accurately controlled. The flatness and rigidity of the meshes allow very small grid-to-cathode clearances to be used; and the thin wires (which in a normal grid structure would not be self-supporting) allow the grid to have the greatest electrical effect with the least physical obstacle High slopes are possible without risk of grid-to-cathode short-circuits. Also the valve characteristics are better determined than would otherwise be possible.

The input capacitance of the valve may be higher with this technique; but the great increase in slope more than outweighs it, and an increased figure of merit is obtained.

### *Structural Accuracy*

Accuracy in the grid structure implies, of course, accuracy in other components—notably the cathode and the spacing micas. Much use is made in frame-grid valve manufacture of optical techniques, such as assembly and inspection under the microscope, and projection of large images of components on to a carefully dimensioned blown-up drawing.

When frame grid valves are used in R.F. amplifiers, frequency changers, and I.F. stages, their greatly improved characteristics result in a substantial increase in gain in each of the successive stages; therefore much more efficient front ends can be built. A television front end with frame grids throughout can have an overall sensitivity which is six or eight times better than with ordinary valves.

In the normal reception areas a far better performance is obtained for a given signal at the aerial. There is also a reduction in the risk of sound-on-vision. In fringe areas the improved performance can mean that specially modified receivers and elaborate aerials will often be unnecessary.

### *Introduction of PCC89*

Within the last few years, frame grid valves have become firmly established in a wide range of "professional" and industrial applications—computers, and so forth—where efficient and high-grade performance is a *sine qua non*. Mullard are now introducing the frame grid into the domestic television valve range.

The first frame grid valve for television is the Mullard PCC89—a double triode for use in cascode R.F. stages. It has a slope of 12mA/V, which is just twice the slope of the PCC84. In a practical tuner a noise factor of 5dB at 200Mc/s can be achieved; this compares favourably with 6½dB for the PCC84. The valve underlines all the well-known virtues of the cascode R.F. amplifier. In particular, it ensures a high signal level at the grid of the mixer, so that the noise generated in the frequency changer stage is of little significance.

### *Future Progress*

The PCC89 is already being widely used in the latest receivers. Development work on other types, and on the improved circuits in which they will be used, is well advanced. Mullard hope to be able to announce shortly a triode-pentode frequency changer, and also a pentode I.F. amplifier, each showing advantages of the same order as those given by the PCC89.

**COMPARATIVE TABLE**

| | A | B | C |
|---|---|---|---|
| R.F. cascode amplifier | PCC84 | **PCC89** | **PCC89** |
| Frequency changer | PCF80 | PCF80 | **PCF86** |
| First i.f. (sound & vision) | EF85 | **EF183** | **EF183** |
| Second i.f. (sound) | EF80<br>½EB91 | **EF183**<br>½EB91 | EF80<br>½EB91 |
| Second i.f. (vision) | EF80<br>OA70 | **EF183**<br>OA70 | EF80<br>OA70 |

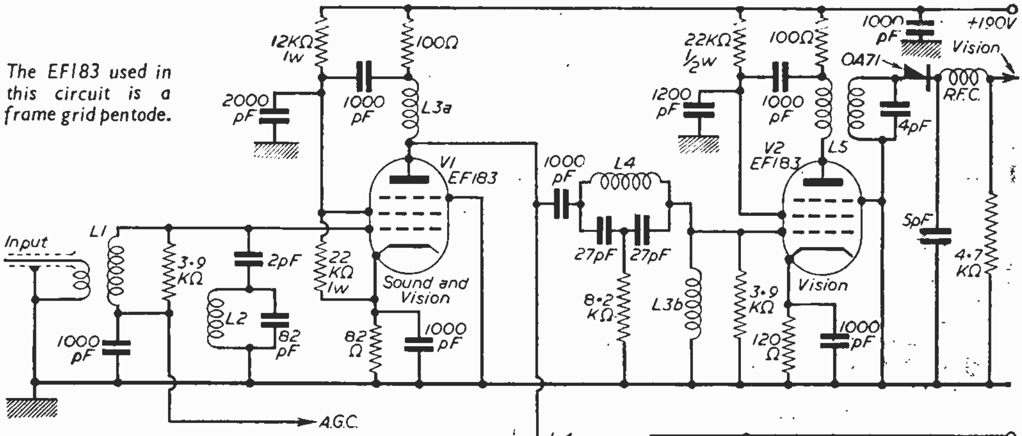
The introduction of frame grid valves into television receivers is a significant and substantial advance. It is the latest step in the course of continuous development which has marked the valve manufacturer and receiver design from the very beginning.

### *Circuit Comparison*

The advantages provided by the frame grid can be illustrated by a comparison of two receivers having the valve line-ups shown as "A" and "B" in the table above. Frame grid valves are indicated by heavy type.

With a typical good quality tuner operating in

*The EF183 used in this circuit is a frame grid pentode.*



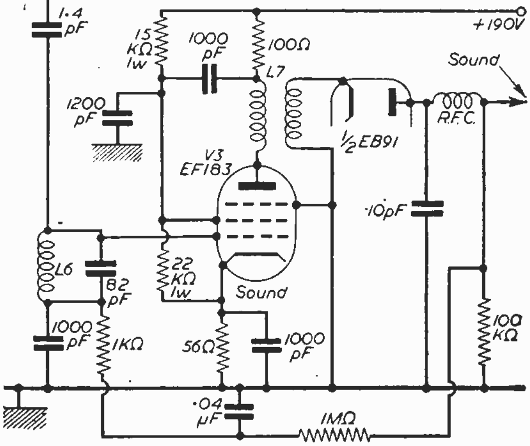




**Fig. 1.—Circuit of an I.F. strip for a fringe area receiver.**

Band III, and a D.C. output of 2.0V peak white from the detector, the signal required at the aerial is 63$\mu$V r.m.s. for the conventional receiver "A" but only 11$\mu$V for the frame grid receiver "B."

This remarkable increase in sensitivity, with its favourable implications for fringe area reception, is achieved in the following way:

Replacement of the PCC84 by the PCC89 gives a slope increase of 6dB and a gain increase of 5dB. The EF183 replaces the EF85 and EF80. It has similar input and output capacities to these two types. but its slope is 12.5mA/V instead of 6.0mA/V (EF85) and 7.4mA/V (EF80); and the improvement of gain in the first and second I.F. stages is 6dB and 4dB respectively. The overall improvement with frame grid valves is 15dB.

## *Mixer*

It will be noticed that receiver "B" uses the same conventional mixer valve as receiver "A", namely the PCF80. The reason is that receiver "B", as it stands, meets all requirements. However, a frame grid mixer, the PCF86, is available, and it can be substituted for the PCF80. Its conversion conductance is 4.5mA/V instead of 2.1mA/V, and it doubles the mixer conversion gain. If the PCF86 is used the EF183 is not necessary in the second I.F. stages. Indeed, frame grid valves throughout the tuner and I.F. stages of a 405-line receiver would give far more gain than can be usefully employed. With the line-up for receiver "C" the required signal at the aerial for 2.0V peak white is 9$\mu$V on Band III or 5$\mu$V on Band I.

For Band III reception the maximum sensitivity required of a fringe area receiver is 20$\mu$V for a picture of normal contrast level. Even for signals weaker than 20$\mu$V a receiver of this sensitivity will give the best picture possible. (A higher sensitivity would produce excessive noise on the screen.) The Band I requirement is slightly less stringent and will in practice be easily met in a receiver which satisfies the requirements for Band III.

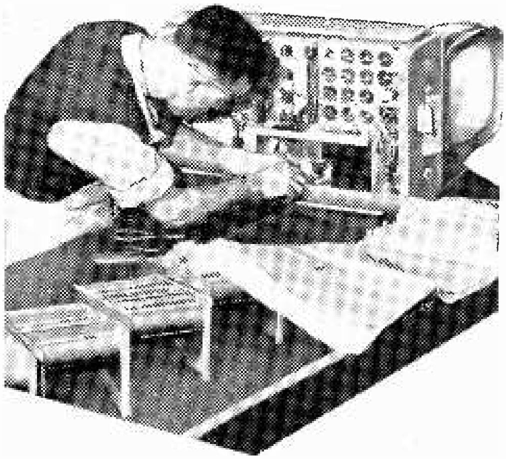
Thus, for operation in fringe areas on Band III the receiver must have sufficient gain to give 2.0V peak white at any signal level down to 20$\mu$V. Receiver "A" falls far short of this requirement with its sensitivity of 63$\mu$V, and an additional I.F. stage would be needed in fringe areas. Receivers "B" and "C" satisfy the requirement with only two vision I.F. stages, and have a margin in hand to cover production tolerances.

## *Circuit Changes*

The new valve types, with their doubled slopes, obviously make necessary some changes in component values. They cannot simply be plugged into an existing receiver. In any event, the pinning of the PCF86 has been changed from that of the PCF80 to give optimum input impedance.

Only one change from normal practice is required in the I.F. stages. This is the use of the close-tolerance decoupling capacitor common to the anode and screen grid of the EF183. The neutralisation provided by this capacitor (which must be of ±10 per cent. tolerance) ensures adequate stability of the I.F. stages.

(*Continued on page 208*)



# Analysing and Servicing TV Receivers

## No. 12—ELECTROSTATIC DEFLECTION AND RECEIVER POWER SUPPLIES

IN the previous article the operation of a Miller Transitron timebase was described and a circuit given in Fig. 50. (See page 147 of the December, 1959, issue.)

For those readers who are contemplating changing over from an electrostatic to a magnetic tube, the negative going output from V1 is unsuitable for feeding into a line amplifier where scanning coils are employed. A positive-going output on scan is therefore required and it will be negative-going on flyback. Let us assume the output from V1 was fed into the grid of a line amplifier which employs scanning coils and flyback EHT. The output waveform at the amplifier anode would be positive-going on scan and negative-going on flyback. Because flyback EHT requires a positive-going pulse, this would be the wrong polarity and, apart from this, damage may take place to the line components. Therefore, at the amplifier input, the waveform must be positive-going on scan and negative-going on flyback and its output at the anode will be the reverse, namely, negative scan, positive flyback. However, there is no need to scrap the timebase. The positive-going output from the oscillator V1 can be achieved by transferring the width control and condenser C3 from the anode to the cathode circuit as in Fig. 52 and altering their values. This circuit will scan a 12in. tube. If a greater scan is required a phase reversing valve can be employed as given in Fig. 53. It will then be possible to use a magnetic tube without disturbing the oscillator wiring.

### *Faults in Electrostatic Receivers*

There are still many experimenters using electrostatic tubes such as the VCR97 and other ex-government types with the Miller transitron timebases and this section will be of particular interest.

*Non-linearity and Foldover.*

Check the sync output condenser and resistor feeding into the generator suppressor grid. Check the flyback condenser fitted across the screen grid and suppressor grid of the generator, and the resistor from the suppressor grid to chassis. The above faults apply to both line and frame.

*No Hold or Multiple Pictures.*

Check the H.T. and generator valve and the charging condenser across the anode and control grid. Check the anode and suppressor grid resistors and, if the trouble still persists, alter the control grid resistors. If this fault appears on both line and frame after the set has been working satisfactorily, attention should be paid to the sync separator stage. A common complaint on the frame is multiple pictures with the top rolled over or the bottom rolled up (short bodies, no legs, large heads, etc). The charging condenser should be checked for loss of capacity first, then the feedback condenser. Vertical cramping all over the picture could be due to hum in the timebase.

*Raster Darker on One Side Than the Other.*

If a push-pull output is used, such as 6SN7, etc., the two sections are not balanced. Check

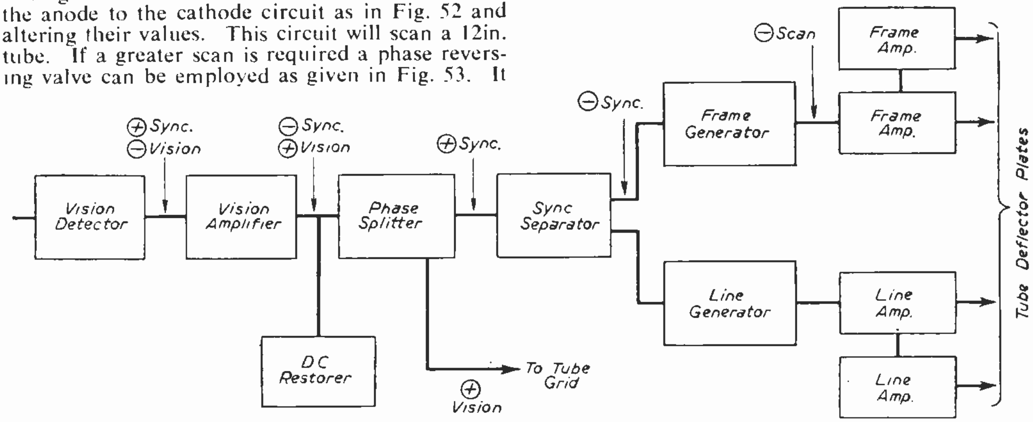



**Fig. 51.—Block diagram of a receiver employing electrostatic deflection.**

all the components in this stage. (Note that part of the raster may not be in focus.)

*The Whole Raster Drifts Sideways.*

The condensers feeding the tube deflector plates are leaky. These condensers must be perfect. Hum will also cause this fault; check the smoothing if the raster waves. Increasing the brilliance will sometimes remove the whole raster, leaving the screen blank.

*Intermittent Interlace.*

This may occur if the signal is strong or if the contrast is set at maximum. The fault is that the picture signal is breaking through to the frame generator. Check the sync integrating circuit feeding into the frame generator.

*Prominent Flyback Lines.*

Check the D.C. restorer diode and its components. Shadowing of the raster on the right can also be the cause of faulty D.C. restoration.

*Hum and Waving Raster.*

This fault is also common in home-built electrostatic receivers. Faulty or inadequate smoothing is the cause. This was more fully dealt with in the line and frame faults section.

*Raster Collapsed to Line.*

The frame timebase is at fault if the line is horizontal. If the line is vertical, the line timebase is not working. No particular component can be pin-pointed here. Check the H.T. and valves first, the charging condenser and components generally. Keep the brilliance low.

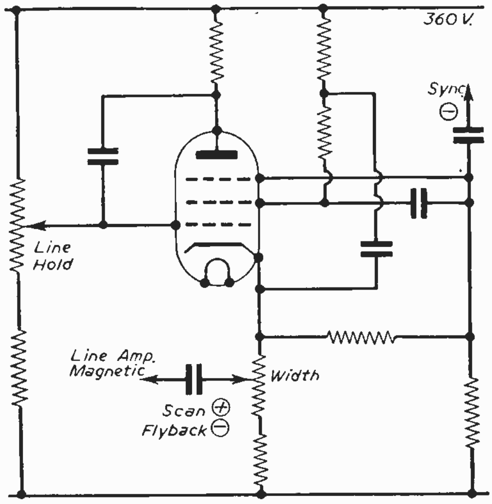



**Fig. 52.—Miller transitron timebase.**

*No Raster. Only a Bright Spot.*

Turn down the brilliance to save burning the tube face. Both the timebases are out of action. Check the H.T. and the L.T. supply.

*Lack of width or Height.*

Check the timebase valves for low emission, low H.T., excessive EHT. check the value of the charging condenser and the coupling condenser from the generator to the amplifier, examine the value of the anode resistors.

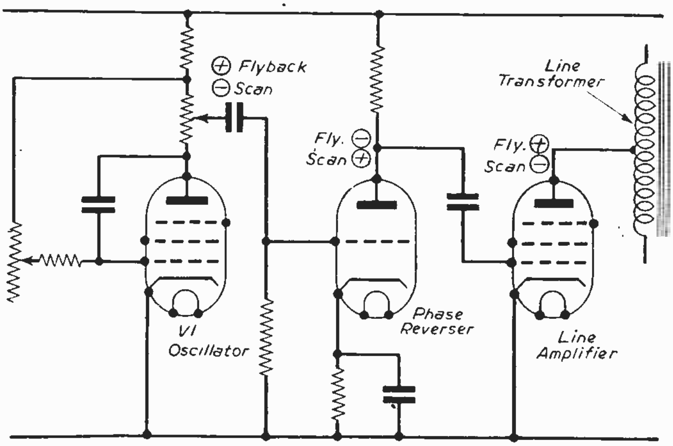



**Fig. 53.—Incorporating a phase-reversing valve when changing from electrostatic deflection to magnetic deflection.**

*Picture is Left to Right.*

Captions read as though viewed through a mirror. Reverse the connections to the two line deflecting plates on the tube.

*Picture Upside Down.*

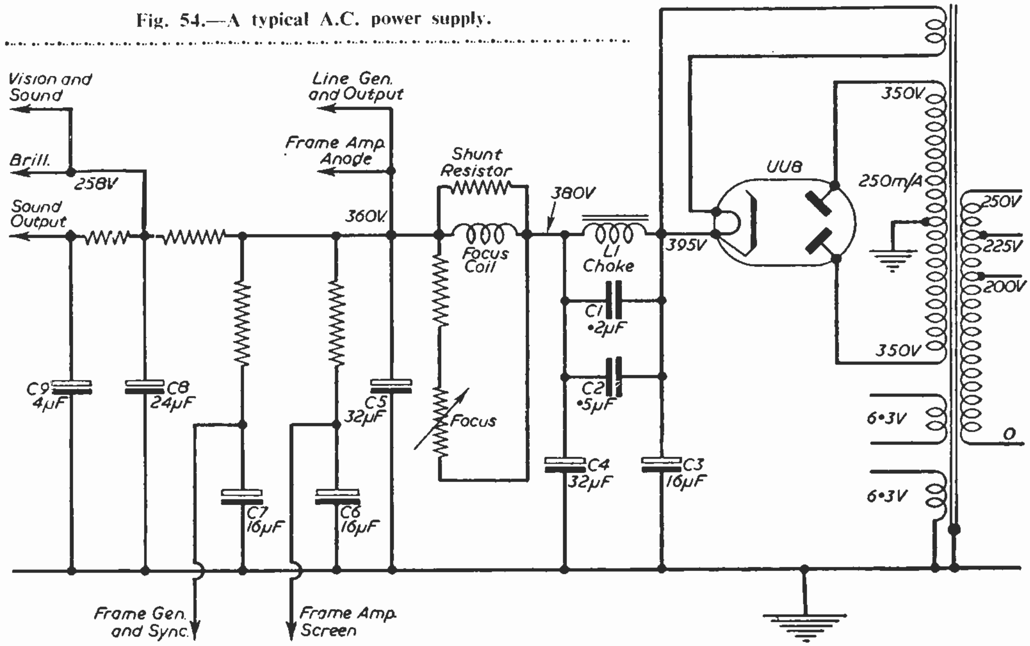
Reverse the two wires feeding the frame deflecting plates on the tube.

*The phase splitter* is not likely to give any trouble and the rest of the electrostatic receiver can be serviced in the same way as a commercial magnetic model. A phase splitter with D.C. restorer suitable for an electrostatic working grid modulated tube was shown in Fig. 37 C.R.T. section.

### The Power Supply

There is nothing unusual about a television H.T. and L.T. power supply. It is similar to a radio receiver A.C. or A.C./D.C. supply except that higher H.T. voltages were used in the older T.V. receivers and the current consumption was at least three times as much as a radio. To-day, with valves specially designed for A.C./D.C. work where the H.T. voltage is limited, the H.T. voltage has dropped to 200 or less and the H.T. current has risen even higher in some designs owing to the greater scanning power required on the line and frame for wide angle tubes. A typical power supply of about ten years ago is shown in Fig. 54. Many are still giving excellent service to-day owing to their reliability. C1 and C2 are optional, but they tune the smoothing choke L1 to a frequency of 100c/s. C3 is the

Fig. 54.—A typical A.C. power supply.




reservoir condenser and C4 and C5 are the smoothing capacitors. Notice the care taken to ensure adequate decoupling between stages to prevent any interaction or feedback along the H.T. line and to ensure a smoothed, ripple-free D.C. supply. The decoupling capacitors are C6, 7, 8, 9. The function of the focus coil has been discussed in a previous article. Transformer fed parallel heaters are shown in Fig. 55.

### Auto-transformer

In Fig. 56 is the circuit of another type of A.C. supply; the transformer is auto-wound. The extension of the primary winding steps up the voltage to 350V and no H.T. secondary winding is therefore required, but the natural impedance provided by the secondary winding of Fig. 54 is missing. Therefore, to limit the peak cathode current to a safe value, surge limiting resistors must be fitted to the rectifier anodes, these are shown as R1 and R2. It will be noticed that the chassis is no longer isolated from the mains, a procedure which is now common practice. Figs. 57 and 58 show the present-day trend in H.T. and

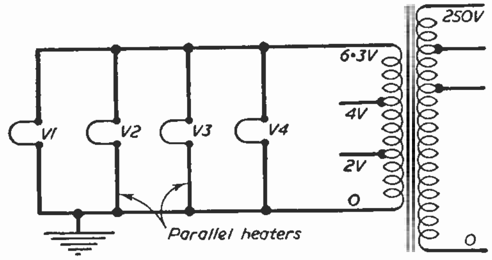



Fig. 55.—Parallel heater circuit.

L.T. power supplies. In Fig. 57, two rectifiers are used in parallel to give the required current output without being overloaded, although a metal rectifier can be used in this position if required (as shown dotted). In Fig. 58, a series heater

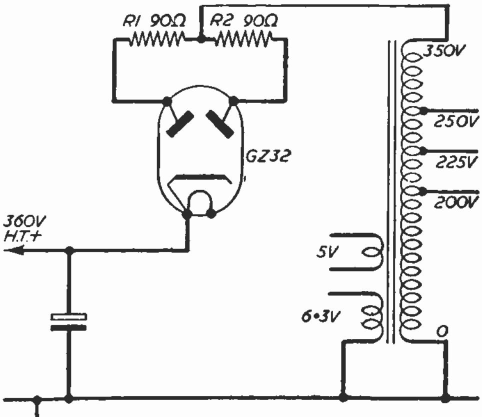



Fig. 56.—Auto-transformer A.C. supply.

arrangement with thermistor and mains voltage dropper is shown. The thermistor has a negative temperature coefficient of resistance and has the appearance of a 1W resistor. Its function is to limit surges; when it is cold its resistance has the high value of 4,800Ω, but, as the valves begin to draw current, the temperature of the thermistor rises and its resistance value falls until the valves are drawing 0.3A when the resistor value is 44Ω. This 44Ω must be allowed for when calculating the value of the mains dropper. The thermistor nearly always has a shunt resistor across it, partly to cut down the time the valves take to warm up to their operating temperature and more important to prevent excessive current flow through the thermistor when first switching on. Valves with high heater to cathode insulation are always placed at the "hot" end of the chain and the valves with lower insulation such as detectors at the "earthy" end. The tube is placed at the

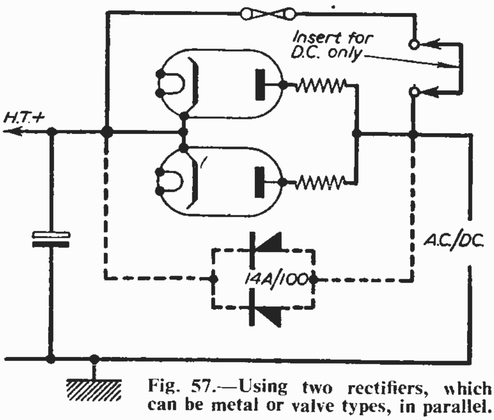



**Fig. 57.—Using two rectifiers, which can be metal or valve types, in parallel.**

earthy end of the chain in most receivers, but not in all. In the case of parallel heaters, never remove the video output valve with the set switched on, otherwise the tube cathode may receive voltage in excess of its rated maximum which is usually between 150V and 200V, but was only 50V to 100V in some of the earlier tubes.

It seems to be common practice to leave the set switched on while changing valves. In a series-connected heater circuit this is not a good practice; the set should be switched off before a valve is removed. In the case of an open-circuited heater, each valve should be removed in turn and its heater tested for continuity, or use a resistance meter along the heater chain with the valves in position until the break is found, with the set disconnected, of course.

When a break in the heater chain occurs as indicated in Fig. 59, although none of the valves are alight, a high voltage at nearly mains potential will be present at the heaters of the four valves on the right as no current is being consumed, and as some of their cathodes are at or near earth potential, the strain of 200V or more between heater and cathode is inviting further valve breakdowns.

The surge limiting resistors referred to in Fig.

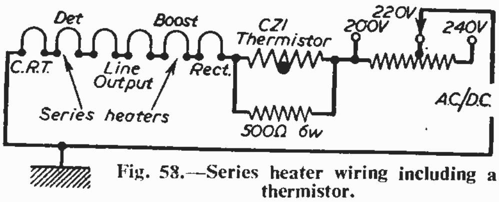



**Fig. 58.—Series heater wiring including a thermistor.**

56. are ordinary resistors and should not be confused with the surge limiting resistor of Fig. 58.

### No Valves Alight in A.C./D.C. Heater Chain

After examining the fuses check the heaters for open circuit or high resistance and the thermistor for the same fault as it may be damaged. In some circuits, the thermistor may be shunted with a resistor which may have gone open circuit and the mains dropper should also be checked. If some of the valves light up very bright and others seem dead, check the adjacent valves in the chain for heater to cathode shorts and examine the heater by-pass condensers for shorts. If all the valves light up, but certain parts of the set refuse to work, see that both heaters of any twin valves are alight (valves such as the EB91, 6SN7, B36, and H.T. rectifiers, etc.).

### Tracing H.T. Faults

When a receiver is known to be working correctly, before switching on take a resistance reading across the H.T. line at the rectifier and other H.T. points if you wish, the black or negative test prod to H.T+of course, and the red or positive prod to chassis. The reading may take a minute to settle down. Switch on and check the H.T. current consumption at the rectifier cathode and also the voltage at the same point and keep these readings for reference. When a fault occurs such as lack of height and lack of width, check the H.T. voltage and if it is found to be low, measure the current consumption and if it is higher than previously measured, switch off and measure the resistance as above. If it is lower than expected there is a leakage somewhere. More often than not a condenser is faulty and

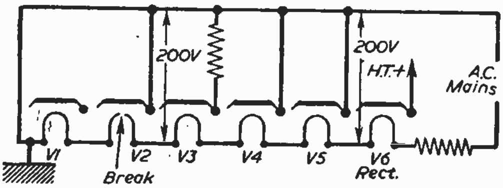



**Fig. 59.—An open-circuit heater chain.**

replacement will reduce the consumption, raise the voltage and probably save unnecessary valve buying. Here are a few examples.

### Low H.T. volts, Low Current Consumption, Resistance Normal

The fault is low emission of the rectifier or dried up reservoir capacitor.

### Low H.T., High Current, Resistance Normal

Check valve current consumption, especially the oscillators and line output valve. Line output valves not oscillating properly or receiving sufficient drive from the previous stage (if a separate generator is used) will consume excessive current thereby causing a voltage drop. Check also for soft valves.

(*Continued on page 185*)

# EHT Supplies

## No. 3.—INDEPENDENT SUPPLIES WITH PULSE OPERATION

*(Continued from p. 120 of the December, 1959, issue)*

By W. Cleland

LAST month's article dealt with obtaining EHT from the line output circuits of the TV receiver, but in some sets, EHT generation, although on the pulse principle, is made the work of a separate valve, and the damping arrangement used in the line output circuit is not duplicated in the EHT generator. As a result, instead of a series of pulses, there is a series of bursts of decreasing oscillations. If these are synchronised with line frequency, the repetition rate will be 10,125c/s, but it is possible to employ some other frequency.

Because, owing to the absence of a damping diode, the oscillations are not abbreviated to single fly-back pulses, the inverse voltage on the EHT rectifier is nearly twice as large for the same EHT voltage. On the other hand, the negative half-cycle can be used, with an additional rectifier, for voltage doubling, although it is of lower amplitude than the initial positive half-cycle of the burst of oscillation. The succeeding half-cycles cannot be used as they are of still lower amplitude, and will not make the rectifiers conduct, so their energy is lost.

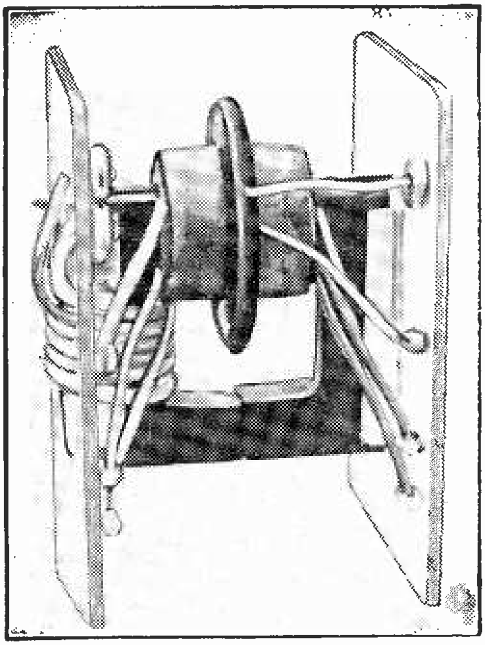
### *Anode Coil*

The anode coil used in this type of circuit may be described as a choke, that is, a coil with a high L/C ratio, but it will be necessary to connect the anode to a tapping on it, and to use a step-up ratio, in order to avoid exceeding the peak pulse rating of the valve.

As a separate pulse circuit does not have to supply a precisely defined current wave for scanning purposes, the grid input waveform can be varied. The requirements are that the valve should be switched on for a period to enable the current in the anode coil to rise to a high value, and then suddenly switched off, leaving the anode circuit free to produce its train of diminishing oscillations. If a saw-tooth input is used, the length of the conducting period will depend upon the value of grid bias and upon the amplitude of the saw-tooth, but the current in the choke will not be a complete saw-tooth wave as with a line-output circuit. Instead, it will consist of a saw-tooth pulse followed by a sinusoidal wave which will have subsided by the time the next saw-tooth pulse arrives.

### *Current Surge*

On the termination of a saw-tooth pulse, the current of the inductance surges at an increasing rate into the stray capacitance until a peak voltage is reached at zero current, many times larger than the initial voltage drop across the circuit when the energy was being supplied.



A home-constructed line-output transformer.

Each succeeding peak of the oscillation is smaller than the preceding one owing to circuit losses, but as only the first positive and first negative pulses can be used, the circuit does not require a high Q-value.

The value of EHT potential produced will depend upon the peak current reached in the anode circuit, and can be varied by applying bias to either the control grid or screen grid. Regulator circuits can thus be added without difficulty, deriving the control voltage either from the EHT output itself via a potential divider, or from a separate rectifier working at a lower voltage. The regulator circuit is made more effective by subtracting a fixed reference voltage, so enabling the control circuit to tap a higher proportion of the variations occurring in the EHT output.

### *Insulation*

Air ceases to be a good insulator when the humidity is high, or when ionisation occurs in regions of steep potential gradient, e.g., in the neighbourhood of a pointed electrode. An EHT unit is more reliable when air as an insulator is supplemented by other materials, especially if dust accumulations and the ingress of moisture can be prevented.

When very high voltages are required (e.g., 25kV for a projection receiver), the coil, rectifiers and condensers are immersed in petroleum jelly, and special precautions are taken to exclude moisture. Damp conditions always involve risk when a line transformer is not adequately protected, and if persistent sparking occurs it may be necessary to apply a suitable insulating paste.

### *Breakdown*

Dielectric breakdown is thermal in nature. The heat losses increase with voltage and with frequency, making low-loss material necessary, especially at radio frequency. Breakdown is more liable to occur after a television set has been switched on for some time and has become heated. A breakdown might only be a small puncture of the insulation, but sparking at this point will prevent the peak voltage from being reached. Occasionally more extensive damage can occur.

Care has to be taken not to apply excessive H.T. voltages to EHT units. as the margin of safety for a line output transformer or R.F. coil, and for EHT rectifiers, is not very large, and the production of an excessive EHT potential invites considerable risk of component failure. Conditions under which this mistake is likely are an experimental arrangement, with only part of the receiver on the supply. The lightly-loaded H.T. line will then be at a higher voltage than normal.

### *Screening*

Because of the likelihood of producing radio interference, line output stages and EHT units should be in screened compartments. Adequate spacing has to be provided, and sufficient insulation to avoid the bluish haze called corona which makes it easy for brush discharges to occur. (This is accompanied by the smell of ozone.) It is not at all beneficial to breathe large amounts of ozone as it is poisonous. It is in fact, a powerful chemical agent, which can cause the breakdown of insulating materials.

Brush discharges and sparking cause radiation of noise and may affect the picture. The picture will also be very much impaired if a break should occur in the fine wire lead from the EHT coil as the EHT voltage may still be produced, but with sparking occurring at this point.

### *Corona*

The bluish haze of corona can be seen in the dark around high voltage conductors, even when these are too well insulated for arcing to occur. Ions in the air are accelerated to collide with molecules, so producing further ions. The effect increases with frequency.

### *EHT Measurements*

Instruments for measuring EHT voltages, have to impose little or no additional load at the setting at which the reading is taken, as any appreciable current drawn would result in a low reading. An electrostatic voltmeter is the closest approach to the ideal, drawing no energy from a direct voltage supply except for leakage, and the small initial surge during the movement of the pointer. Meters of this type have a simple construction consisting of a moving vane swinging between fixed vanes, plus an air damping arrangement. Their application, however, is limited to potentials below 10kV, because of corona formation. Special electrostatic voltmeters, on the attracted disc principle, are used for higher voltages, but are unlikely to be used in servicing television receivers.

Standards have been laid down for measurement by spark gaps, but are intended principally for 50c/s alternating voltages (up to 900kV) much higher than the EHT direct voltages used in television sets, at which the lengths of the spark gaps are too small to give readings of high accuracy. A gap of about $\frac{1}{8}$in is all that can be expected at 12kV, and to read this with accuracy calls for micrometer precision. Moreover, the

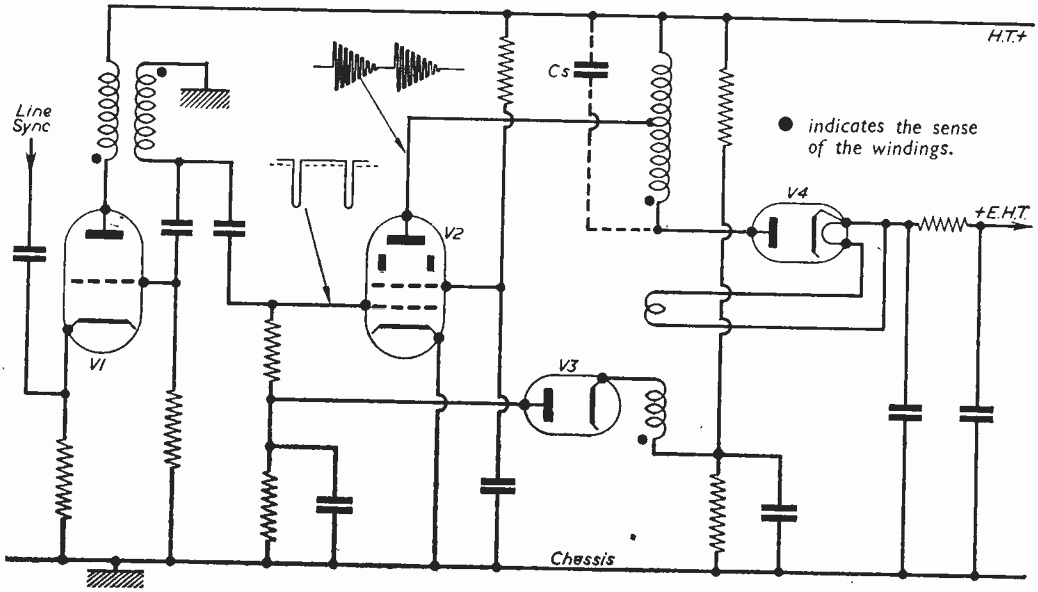



**Fig. 9.—Pulse-type EHT supply. A series of negative pulses from the blocking oscillator, V1, releases burst of free oscillation in the anode circuit of V2. The regulation is improved by V3 which supplies a control bias to V2 from a separate winding.**

electrodes must be perfectly clean. Grease or moisture on their surfaces will cause large errors. A resistance (of about 1 kilohm per kilovolt) should be used in series with a spark gap to limit the maximum current, although the use of a very high resistance would reduce the current of

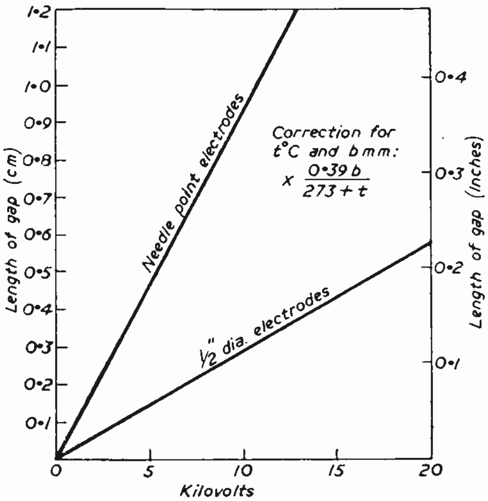



**Fig. 10.—Spark gap lengths in air at 760 mm. Hg pressure and at 25 deg. C.**

the spark too much and make it almost invisible. The resistance should be long enough to avoid flash-over.

### *Needle Points*

The gap for a given voltage may be increased more than three times by replacing the sphere electrodes by needle points, but variation in the sharpness of the points gives rise to errors, in addition to the instability caused by the formation of corona owing to the concentration of the charge at the points. Sphere gaps are more reliable, although also affected to as much as 5 per cent. in setting by daily changes in air pressure and temperature. Accurate measurements can, however, be made by applying corrections for these.

Another instrument which draws very little current is a vacuum tube voltmeter fed from a potential divider. This requires a very high series resistance which is reliable at high voltages. A suitable resistance costs several pounds, and the cost is increased by the need for it to be housed in an insulated probe. The unusually high cost of such resistances is due to the difficulty in manufacturing them, since their long tracks of thin resistive coating must be uniform and trustworthy. The voltage drop along them has to be uniform, and the resistor has to be able to withstand surges.

### *Home-made Resistances*

A home-made resistance of the pencilled-line type will burn out with a few surges, and it is difficult to know how much reliance can be placed upon improvised resistors such as a batten of dry wood with two nails driven into it, or a length of ferrite rod of a certain grade.

Measurements at a few kilovolts with a current of, say, 1mA can, of course, be carried out by using a number of ordinary precision resistors in series with a milliammeter as the load on the supply. If a microammeter is used, it may be wise to protect it against surges by connecting a large capacitance across it.

There is also the possibility of measuring the actual pulse voltage at the anode of the EHT rectifier, which will be approximately equal to the rectified voltage. The most practical method would be the use of a capacitive potential divider with a very small series capacitance, feeding a high impedance indicator such as a vacuum tube voltmeter. A neon lamp could be used, the capacitance across the lamp being a variable one adjusted until its value is just high enough to extinguish the lamp.

### *Rectifier Anode Measurements*

Owing to the high leakage inductance of the EHT winding in a line output transformer, the rectifier anode connection is very sensitive to any increased capacitive loading, and there is also the possibility of introducing feedback and radiation. It is doubtful whether accurate measurements could be made by this method except with a very small series capacitance.

A good picture of adequate brightness is usually accepted as indicating that the EHT voltage is correct, and with experience a spark drawn by a well-insulated screwdriver can provide a rough check in doubtful cases.

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## *Books Received*

**THE TELEVISION ANNUAL, 1960. Edited by Kenneth Baily, 160 pp. 6in. × 9in. More than 170 half-tone illustrations. Published by Odhams Press Ltd., Long Acre, London, W.C.2. Price 10s. 6d.**

This latest edition of the Television Annual follows the same popular style as its predecessors. Many popular television personalities have contributed articles and there are pen-portraits of many others. The book is lavishly illustrated, presented artistically and should prove popular with all television viewers.

**TV REPAIR AND MAINTENANCE. By Robert Hertzberg. Published by Fawcett Books, Greenwich, Connecticut, U.S.A., and available from Frederick Muller Ltd., Ludgate House, 110, Fleet Street, London, E.C.4. 144 pp. 6½in. × 9¼in. Price 5s.**

This is an American publication and is written in the chatty style popular in the U.S.A. Naturally, it is written from the American point of view and thus not completely applicable to British television, particularly the sections on the television signal and line and frame scanning. The sections on V.H.F. TV will also be unfamiliar, but nevertheless much TV servicing practice is common to both sides of the Atlantic and the book, which illustrates almost every procedure mentioned, will be of use to many enthusiasts.

# Making Television Aerials

## PRACTICAL DETAILS OF YAGI ARRAYS

By R. E. F. Street

THE function of a receiving aerial for television is much the same as that of the aerial used for reception of sound broadcasts on the domestic radio receiver; namely, to collect a strong enough signal to operate the set satisfactorily. Of course, the situation is somewhat different on the medium and long waves commonly used for broadcasting; signals travel

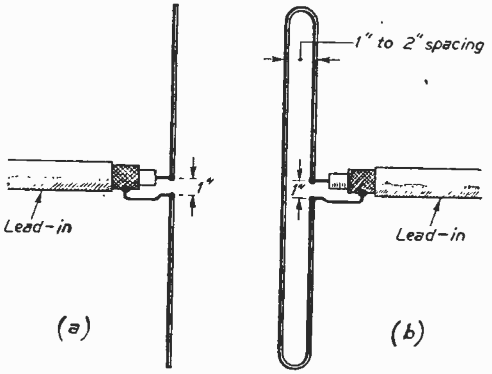


**Fig. 1a (left).—The construction of a simple dipole. Fig. 1b (right).—The construction of a folded dipole.**

large distances and are still easily picked up by a simple aerial such as a short length of wire. However, on the short wavelengths, or high frequencies, used for television, the signals do not travel so far and consequently more efficient aerials are required for television than for ordinary broadcast reception. As the frequency employed is raised, the range of the transmitter tends towards what is known as the "optical" range. The meaning of this expression is clear if one imagines that the transmitter is replaced by a very powerful light: all the area illuminated receives signals,

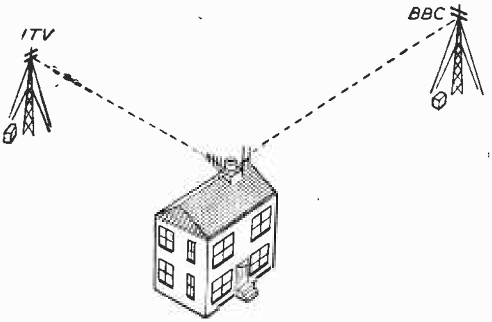


**Fig. 2.—Yagi aerials are directional and must be pointed towards the transmitter.**

the brightest parts. or areas of good reception being nearest the transmitter. Those parts in shadow, behind a hill, mountain. or other large object, are out of sight of the transmitter, and there, reception is either impossible or extremely difficult.

### *Signal Strength*

Many different kinds of aerial are employed for television reception and which type is employed in a particular location depends largely upon the strength of the signal received there. In general, the stronger the signal, the simpler the aerial. However, it is not possible to prophesy which type of aerial will be the "best" one for a given location as so much depends on local conditions. This fact is often illustrated; sometimes an indoor aerial suffices in one house while across the road a five element array is required to secure an acceptable picture. Thus, the selection of the aerial is only possible by a combination of experience, trial and error. This

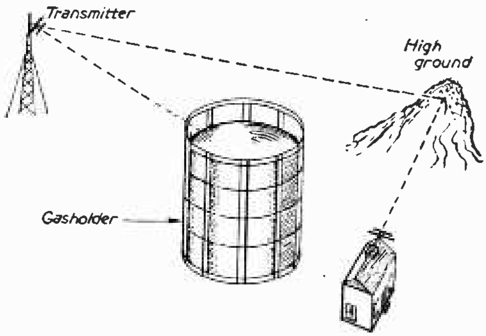


**Fig. 3.—If there is an obstacle between the transmitter and the receiving aerial, a reflected signal can sometimes be utilised.**

fact is rarely appreciated and should therefore be noted carefully.

For first experiments. at least, therefore, the aerial design selected must be such that the aerial can be modified to give better results if necessary. A design which fulfils this requirement is the Yagi aerial. named after a Japanese engineer who carried out much of the early work on this type of aerial. Yagi aerials are often termed "arrays" and vary in complexity from the two element (BBC "H" aerial) to the 9 or 10 element (ITV "toast-rack") type.

### *Dipoles*

When discussing Yagi aerials. it is necessary to know what is meant by a dipole. A simple dipole is therefore illustrated (Fig. 1a) and consists of two lengths of metal rod or tube separated by a gap of about one inch. The connections to the downlead are made as shown. The cable illustrated is known as "coaxial" cable. This name is derived from the construction of the cable; the outer braiding forms a tube of conducting material around the inner wire which is therefore coaxial with the braiding. Most television receivers have a coaxial socket for the aerial lead and are intended for use with this type of cable. It is important to use cable having a characteristic impedance of around 80ohms. although the meaning of this term need not concern us here.

Aerials and receiver aerial inputs possess a characteristic impedance, too, also measured in ohms. It is necessary that the impedances of the aerial. cable and receiver are approximately equal for satisfactory operation. Now, the impedance of a simple dipole (Fig. 1a) is around 80ohms and therefore matches the coaxial feeder. The manufacturer of the set adjusts the input impedance to about 80ohms and thus the condition given above is satisfied the aerial matches the cable and the cable matches the set.

### *Folded Dipoles*

However, as the aerial becomes more complicated and develops into a "toast-rack", the impedance of the aerial becomes lower and no longer matches that of the cable. The aerial impedance has to be increased and this is achieved by employing a "folded" dipole (Fig. 1b) which consists of a metal rod or tube bent so as to form a flat loop. A gap of about 1in. is left between the ends (to which the coaxial cable is connected as shown). The distance between the sides of the loop is about 1in. to 2in. as is also indicated in Fig. 1b. The impedance of a folded dipole is four times that of a dipole and thus if an array is made in which the impedance of the dipole is lowered to 20ohms. folding the dipole increases the impedance to 80ohms and thus matches the cable. It should now be apparent why "H" aerials use a simple dipole and

**TABLE Ia.—BBC TELEVISION TRANSMITTING STATIONS**

| Channel | Station | Frequencies (Mc/s) | | Effective Radiated Vision Power (kW) | Polarisation |
|---|---|---|---|---|---|
| | | Sound | Vision | | |
| 1 | Crystal Palace | 41.50 | 45.00 | 200 | V |
| | Divis | — | — | 12 | H |
| 2 | Holme Moss | 48.25 | 51.75 | 100 | V |
| | Dover | — | — | 0.25-1 | V |
| | North Hessary Tor | — | — | 1-15 | V |
| | Truleigh Hill | — | — | 0.2 | V |
| | Rosemarkie | — | — | 1 | H |
| 3 | Kirk o' Shotts | 53.25 | 56.75 | 100 | V |
| | Rowridge | — | — | 1-32 | V |
| | Norwich | — | — | 1-10 | H |
| | Blaen-plwyf | — | — | 1 | H |
| 4 | Sutton Coldfield | 58.25 | 61.75 | 100 | V |
| | Sandale | — | — | 16 | H |
| | Folkestone | — | — | 0.007 (maximum) | H |
| | Les Platons | — | — | 1 | H |
| | Meldrum | — | — | 4-17 | H |
| 5 | Wenvoe | 63.25 | 66.75 | 100 | V |
| | Pontop Pike | — | — | 12 | H |
| | Douglas, I.O.M. | — | — | 0.25-2.8 | V |

**TABLE Ib.—ITV TRANSMITTING STATIONS**

| Channel | Station | Frequencies (Mc/s) | | Effective Radiated Vision Power (kW) | Polarisation |
|---|---|---|---|---|---|
| | | Sound | Vision | | |
| 8 | Burnhope | 186.27 | 189.75675 | 100 | H |
| | Lichfield | 186.25 | 189.75 | 200 | V |
| 9 | Black Mountain | 191.230 | 194.74325 | 100 | H |
| | Croydon | 191.27 | 194.75675 | 120 | V |
| | Winter Hill | 191.25 | 194.75 | 100 | V |
| 10 | Black Hill | *196.2395 | 199.7305 | 475 | V |
| | Emley Moor | 196.2605 | 199.7372 | 200 | V |
| | St. Hilary | 196.2395 | 199.7305 | 200 | V |
| 11 | Chillerton Down | 201.25 | 204.75 | 100 | V |
| | Mendlesham | 201.23 | 204.74325 | 200 | H |

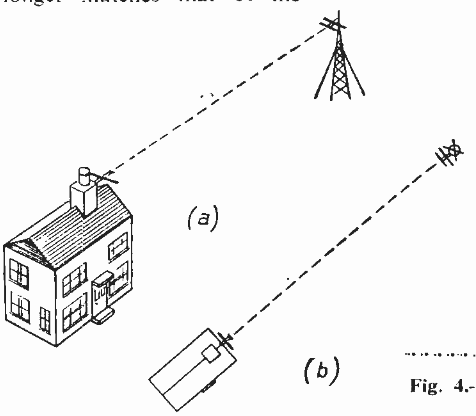


**Fig. 4.—Unlike vertical dipoles, horizontal dipoles are directional and need to be positioned broadside on to the transmitter.**

multi-element arrays a folded dipole; it is to ensure that the dipole impedance matches the cable impedance.

### *Aerial Dimensions*

The length of the various elements employed in a Yagi aerial depends on the frequencies at which it is to be used; the higher the frequency, the shorter the elements become. ITV stations operate in Band III on frequencies considerably higher than those employed by the BBC which lie in Band I and thus ITV aerials are not so large as BBC aerials. This difference in size enables more complicated arrays to be used for ITV reception because the larger the aerial, the more difficult it is to support it; the weight of a multi-element BBC aerial is so great that only very rarely can even a three element type be erected and supported from a chimney stack while the mounting of even a ten or twelve element ITV aerial is comparatively easy. As was previously stated, the higher the frequencies employed, the shorter the range of the transmitter and the more complicated the aerial required. Thus, luckily, where the complicated arrays are required (on the higher frequencies) it is easier to construct them.

### *Polarisation*

One more factor needs to be taken into account; the polarisation of the waves from the transmitter. This governs whether the receiving aerial needs to be placed with the plane of the elements vertical or horizontal. The quickest way of determining the correct mounting is to inspect the aerials on your neighbours' houses to see whether they are horizontal or vertical. Table I gives details of the BBC and ITV transmitters and the polarisation is indicated; V for vertical and H for horizontal.

Aerials are often said to be "directional." This means that, when mounted, they have to be moved or rotated until the signal received is as strong as possible. Generally, they are then pointing towards the station (see Fig. 2) but, sometimes, a signal is reflected from an obstacle and this reflected signal is stronger than the direct signal and then the aerial is pointed to receive the reflected signal (see Fig. 3). It should be noted that a simple, *vertical*, dipole is not directional and receives signals equally well from any direction. However, a *horizontal* dipole is directional and must be arranged for best reception, generally broadside on to the direction of the station (see Fig. 4). It must be stressed that arrays do not necessarily have to be pointed direct at the station; much depends on local conditions and the only method is to move the aerial to point in different directions until best results are obtained.

### *Type of Array*

It is often stated that to secure good results in fringe areas or areas of weak signal strength, it is necessary to use the most complicated array that can be devised. This is rarely the best policy; as the array becomes more complicated, its length increases and approaches a wavelength. Reflection effects become more troublesome and better results may be obtained with a simpler array. In difficult situations, moving the array a few feet, or raising it slightly, will often enable a good picture to be obtained.

It should now be clear that in areas known for their poor reception, and in other districts too, the best way of obtaining good results is trial and error. Although the difficulties may seem formidable in the light of what has been said above, in the majority of instances there is no difficulty in obtaining good results at the first attempt.

### *Construction*

The materials used in the construction of the aerial depend on the location of the aerial; near the transmitter, the crudest materials—wire and wood—suffice, while where signal strength is low, and every precaution must be taken to prevent loss of strength, better quality materials must be employed. Copper-plated rod can often be purchased cheaply and the "real thing"—aluminium or duralumin rod or tube—may be

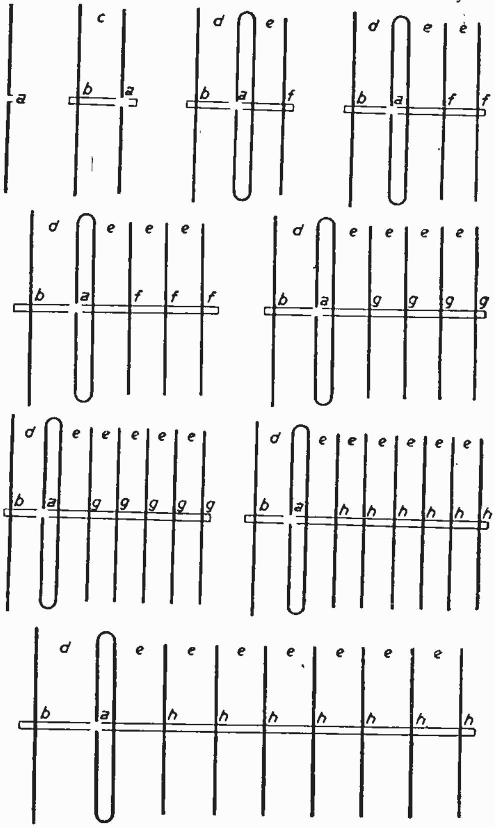

Fig. 5.—Various aerials ranging from a simple dipole to a 9-element Yagi. The letters "a" to "h" refer to the lengths of the elements or to their spacings, e.g., "a" is the length of the dipole, "b" the length of the reflector.

As it is not practicable to construct multi-element BBC aerials, dimensions "g" and "h" for channels 1 to 5 are not given in the table on the next page.

used for ambitious arrays. If the array is to be used outside. then. of course. construction is more difficult as the insulation needs to be good and the array must weather any storms. etc. On the whole, it is advisable for the majority of amateurs only to construct indoor aerials as. without extensive facilities. the construction of sound, outside aerials is extremely difficult. tedious and often disappointing.

In Fig. 5 are illustrated various types of Yagi aerial with their dimensions indicated by letters. Table II gives the dimensions required for reception of the various BBC and ITV stations. It will be noted that no details are given of BBC aerials with more elements than three. As mentioned, such aerials would be very large and impossible to mount or accommodate.

**TABLE II.—DIMENSIONS OF THE AERIALS ILLUSTRATED IN FIG. 5.**

| Channel | a ft. in. | b ft. in. | c ft. in. | d ft. in. | e ft. in. | f ft. in. | g ft. in. | h ft. in. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 7 | 10 11 | 5 7 | 2 9½ | 7 7 | 9 9 | * | * |
| 2 | 9 2 | 9 8 | 4 10 | 2 5 | 6 7 | 8 5 | * | * |
| 3 | 8 4 | 8 9 | 4 5 | 2 2½ | 6 0 | 7 8 | * | * |
| 4 | 7 8 | 8 1 | 4 0 | 2 0 | 5 6 | 7 1 | * | * |
| 5 | 7 1 | 7 5 | 3 9½ | 1 10½ | 5 1 | 6 6 | * | * |
| 8 | 2 5½ | 2 7 | 1 3½ | 7¾ | 1 9½ | 2 3½ | 2 3 | 2 2 |
| 9 | 2 5 | 2 6½ | 1 3 | 7½ | 1 8½ | 2 2½ | 2 2 | 2 1½ |
| 10 | 2 4 | 2 5½ | 1 3 | 7½ | 1 8 | 2 2 | 2 1½ | 2 1 |
| 11 | 2 3½ | 2 5 | 1 2½ | 7¼ | 1 7½ | 2 1 | 2 0½ | 2 0 |

### *Directors and Reactors*

The illustrations in Fig. 5 proceed from a simple dipole. through the "H" aerial to complicated multi-element arrays. The element added to form the H aerial is called a reflector and, broadly speaking. it increases the signal from the aerial. In each case, the transmitter is assumed to be to the right of the array and the reflector is seen always to be the element furthest from the transmitter. The elements progressively added in front of the dipole are called directors and increasing their number increases the signal picked up and makes the array more directional. Adding more reflectors. however. is found to make little improvement and thus only one is used, even in the nine-element array.

### *Insulation*

The various elements do not need to be insulated from the supporting cross bar, provided they are mounted or bolted at their mid-points. The cross bar can be made of wood or metal depending on the weathering qualities required.

From the information given. it should be possible to construct an aerial suitable for most locations and the procedure is to choose the design from Fig. 5 and then to determine the dimensions from Table II. The dimensions have been calculated to give good results: it is very unlikely that they will be the same as those employed by commercial aerial manufacturers or those mentioned in other publications. This fact should be borne in mind if any comparisons of element lengths and spacings are made.

## ANALYSING AND SERVICING TV RECEIVERS—(*Continued from page 178*)

### *Low H.T., High Current, Resistance Low*

Leakages across H.T. supply. usually capacitors. or speaker transformer or transformers in the timebases have leakages from windings to core.

### *High H.T., Low Current, Resistance Normal*

Could be high or open circuit anode and screen resistors or a transformer primary o/c.

### *The Fuses Blow on Replacement*

It is futile to keep replacing fuses in a set that has an intermittent short circuit. This can be an expensive business. When this fault occurs, it is useful to know the correct circuit resistance. Check the resistance and if this is normal. the fault is probably arcing in the rectifier. If the rectifier is at fault. do not forget to check the anode surge resistors. if fitted. One of these going open circuit can cause one half of the rectifier to be overloaded. The same applies if two rectifiers are in parallel.

If lack of width is experienced. check the value of the surge resistors as they have been known to go "high" on load. If no short is apparent (resistance normal) with the set off, watch the valves carefully when warming up especially the line output or booster diode for arcing over. But if the resistance is very low or zero. it could be any coil, condenser. or transformer insulation breakdown causing a dead short to develop.

### *Pyramid Shaped Raster with Lines Wide Apart*

Check the smoothing condenser for open circuit or loss of capacity.

### *Line and Frame Cramping*

When this occurs in both timebases simultaneously the fault is nearly always low H.T. voltage or dried up smoothing capacitor.

When overhauling a receiver it is wise to check all resistors over the value of 100kΩ especially the ¼W type. These often increase in value; a 330k often rises to 1M and 1M rises to 2M. This increase is often the cause of that common fault of no line or frame lock.

# FOLD-OVER

## THE CAUSES AND CURE OF THIS FAULT WHICH IS OFTEN CONFUSED WITH INCORRECT LINE-LOCK

MANY of the letters we receive seeking our advice on faulty receivers refer to the faults of line and frame foldover. It is clear from this correspondence that the nature of these faults is not completely understood and this article was prepared to make matters clear.

Foldover is where the edge of the raster is folded back on itself like the fold of a curtain. In the line timebase it usually occurs at the left-hand edge and in the frame timebase at the top.

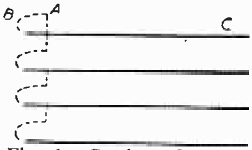


**Fig. 1.—Section of raster showing foldover on line.**

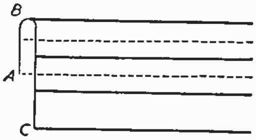


**Fig. 2.—Foldover on the frame scan.**

In order not to confuse the issue we will deal with the horizontal (line-scan) case first.

### *Appearance*

The most obvious evidence of foldover is that there is a bright band of light on the left-hand edge of the raster. The bright *band* must not be confused with a bright line due to insufficient damping; in the latter case, the line exists at a point from the left-hand edge, while foldover exists from the very edge and inwards.

The width of the band varies with the degree of flyback delay and can stretch for an inch or more in bad cases to a mere strip in mild cases.

If the raster is observed closely, the edge will be seen to be folded back on itself like the fold of a curtain. Fig. 1 gives an enlarged view of a small section of the raster showing the fold.

The fault can be most easily recognised when a figure (or lettering) is entering from the left side of the picture. The figure will be seen to start from A, move to B (i.e., to the left) and then to the right towards C. In a picture not suffering from foldover, the figure would appear to start from B and move to C.

The movement from A to B is in reverse; for example, if the letter E was travelling across the screen from the right to the left (this is the usual direction of travel for wording), then it would appear as an E until it got to the left-hand edge and then would appear reversed as Ǝ as it travelled from B to A.

When foldover occurs in the frame circuit, the top of the raster is partially folded back, as in Fig. 2. In this case, supposing a letter Y was travelling from the bottom to the top of the screen, then from C to B it would appear as Y, but from B to A it would appear upside down: ⅄.

Foldover must not be confused with cramping, though sometimes the two appear together. Cramping in the frame circuit, for example, would cause the Y to shrink suddenly as it got to the top, but would not cause it to start travelling back down the screen again upside down.

The fault must not be confused with false frame or line lock. There is a certain type of false line lock which makes *part* of the picture appear as a very much elongated wraith superimposed backwards on top of the main picture. Too fast a frame speed will give a somewhat similar condition, part of the picture being superimposed on the other part (example, the full figure of a man would appear as in two halves, the waist upwards being superimposed on the waist downwards so that his head appears between his legs!).

The cause of foldover is quite simple to understand. Let us consider a single line of picture: when the line is due to commence the bias on

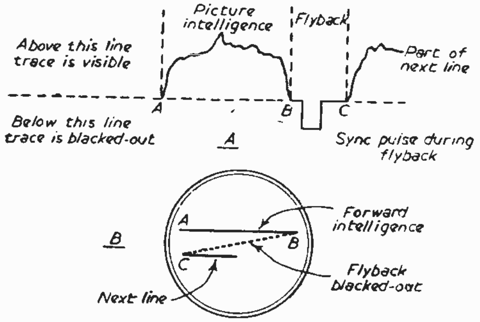


**Fig. 3.—Waveform for one line.**

the picture tube is reduced. The spot appears and moves from left to right, but we do not see it as a travelling spot but as a continuous line.

When the extreme right-hand edge has been reached the TV signal causes the bias on the tube to increase so much that the spot is blacked out. The line sync pulse is then applied and the line oscillator is triggered so that the blacked-out spot flies back to the left-hand side of the screen ready to start the next line. Fig. 3 shows the conditions existing for one line.

If the flyback time is longer than the duration of the blacked-out period, then the spot will not reach the left-hand edge before the intelligence of the next line is received.

(*Continued on page 189*)

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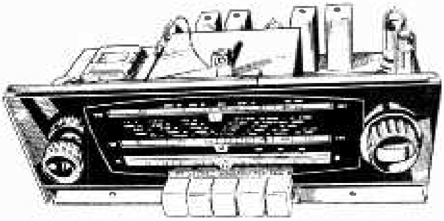

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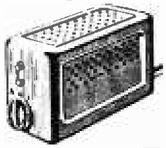

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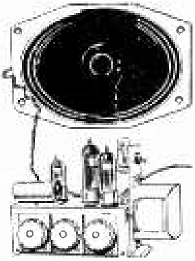

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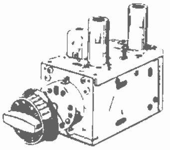

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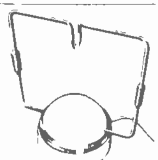

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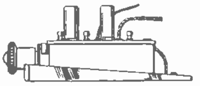

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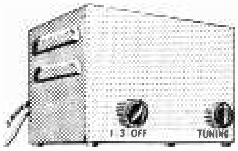


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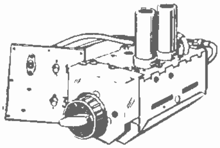

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In Fig. 4 we have the conditions existing when the flyback time is prolonged and it will be seen that the flyback period extends into the next line. The practical result is shown in the tube face as in Fig. 4B.

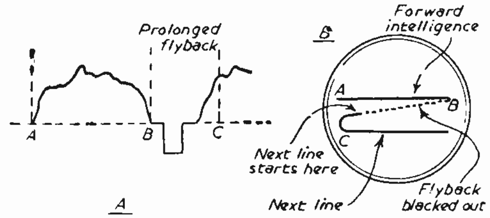



Fig. 4.—Waveform when flyback is late.

In the simple case the cure of the fault is obvious: reduce the flyback period by reducing the value of the condenser or resistance in the flyback circuit.

With electrostatic circuits this will usually effect a cure. With electromagnetic circuits, however, the fault is not so easy to remedy.

One common cause of the trouble in home-constructed circuits is the overdamping of the line coils. Fig. 5 shows a typical circuit, where C and R damp the oscillations which result from the return of the spot to the left of the picture. Too low a value of R or too high a value of C will overdamp the circuit and foldover will be experienced.

### *Critical Values*

The value of C and R must be so chosen that neither overdamping nor underdamping is caused and for this reason R is usually separated into two parts—a fixed component and a variable component, the latter being labelled " Line Linearity."

Too little damping will cause the left-hand edge to be stretched and in the limit will show as a

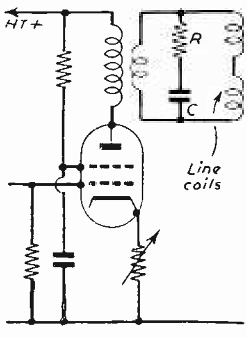



Fig. 5.—Line output stage with damping components.

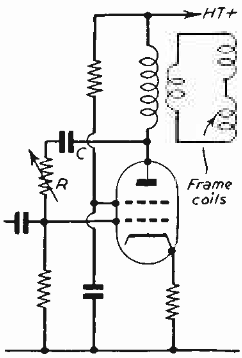



Fig. 6.—Frame output stage with feedback.

broad white band, set in a little from the edge of the picture.

Too high a bias on the output valve will also cause foldover. In this case the valve will not start its forward drive soon enough, due to overbiasing, and so picture intelligence will commence before the output valve becomes operative.

In this case the cure is to reduce the bias, but care must be taken in home-constructed circuits to check that this is the real cause and not to risk under-running the valve.

If the screening grid voltage is too low the results will be similar, but once again the position should be checked carefully. The screening grid of the output valve should not be run red-hot or the valve will be damaged.

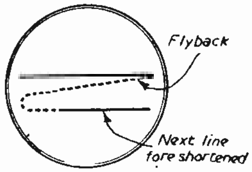
Self-driven timebases can suffer from foldover, especially where the flyback pulse is used for production of EHT. It is essential to ensure that the valve is working on the correct portion of its curve to prevent foldover.

Where a circuit of this nature has been functioning satisfactorily previously then the development of foldover is usually due to a fall in emission of the valve, or a loss of voltage on the H.T. line.

### *Foldover at the Right*

This fault is not so common as foldover at the left. When the fault occurs on the right it is usually accompanied by cramping.

Fig. 7.—Effect of the flyback being too fast.




At the extreme right the output valve is delivering its maximum power. If the fault develops in what was previously a good picture, then the most likely cause is falling emission of the output valve.

In a newly-built circuit attention should be paid to the biasing of the output valve to ensure that the full drive is available.

The trouble can also originate in excess driver valve output, if one is used, or in the employment of incorrect values in the linearity circuit.

Where a recovery diode is used to supplement the H.T. it should be checked for loss of emission.

### *Foldover at the Top*

Fig. 6 shows a typical frame output stage. Correction of linearity is usually effected by a feed-back circuit as shown by C and R.

When foldover occurs at the top, the valve is on the anode-cut-off portion of its curve and any variation due to low H.T. volts, incorrect bias, or loss of emission will cause the trouble.

The bias should be checked and if a new circuit has been built, then suspect overbiasing of the valve.

Too low a screen voltage will have a similar effect by shifting the operating point of the valve on its characteristic curve. Note also in this case that the screen voltage must not be made too high and it must never be run red-hot.

### *Foldover at the Bottom*

Some correction here is usually gained by the linearity correction arrangements. The cause is similar to cramping at the top and the two faults often accompany one another.

# Safety with Series Heaters

CIRCUITS FOR OPERATION ON A.C. OR D.C. MAINS MAY BE DANGEROUS UNLESS PRECAUTIONS ARE TAKEN

By J. Gray

BECAUSE of the large number of valves in a TV receiver, series operation of the heaters is often employed. The elimination of the mains transformer, and the isolation from mains currents which it provides when present, introduces a particular element of danger—that of the "live" chassis. Shocks from this cause are quite likely when current is drawn from a reversible plug or adaptor, or if the on/off switch has been placed in the wrong side of the circuit.

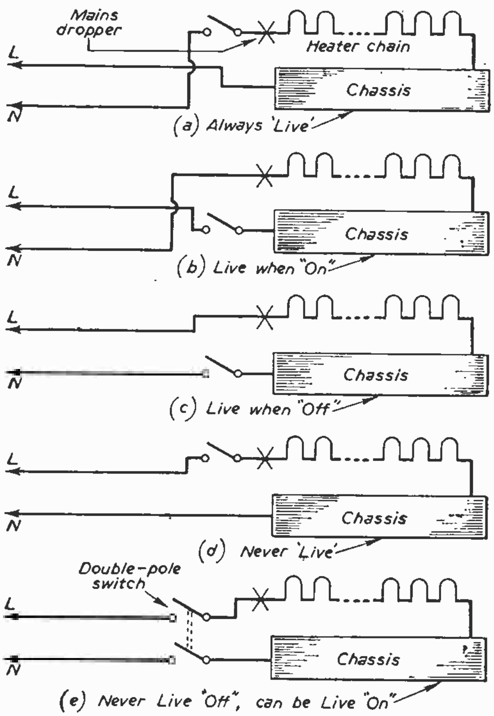



**Fig. 1.—Results of various methods of connecting the mains.**

## *Danger*

Fig. 1 shows ways in which the switch, heater chain and chassis may be connected to the mains supply. At "A" the situation is at its worst, the chassis being wired directly to the "L" main, which is at mains voltage above earth. A mains shock can thus be expected if the chassis or any other metal parts fixed to it or connected with it are handled, even with the receiver switched off.

At "B" the switch is in the "L" circuit, as it should be, but is returned to chassis. With the switch open, the chassis is connected to the neutral main "N" via the heaters. But with the switch closed, the chassis is alive.

With circuit "C" the chassis is safe to touch when the set is switched on, but becomes alive through the heater chain when the switch is opened.

At "D" the chassis is returned directly to the neutral main, and the switch is in the "L" side of the circuit. This method of connection affords maximum safety with a single-pole switch.

A double-pole switch is sometimes used, as at "E." When opened, this switch completely disconnects the receiver. But when the set is on, the chassis *can* be alive if the chassis side of the circuit chances to go to the "L" main instead of to neutral.

For these reasons, it is wise to use a non-reversible (polarised) plug, and in all cases the chassis can then be wired to the "N" main. Circuits such as those at "B" or "C" should also be modified, the switch being included in the "L" side of the circuit.

A single fuse is occasionally included, and if this has been included in the neutral side of the circuit in error, the receiver may be alive when the fuse blows, though it was safe with the fuse intact. A single fuse should thus always be in the same side of the circuit as the switch, that is, so as to disconnect the "L" main.

## *Other Precautions*

It is not wise to assume that the correct mains connections will always be employed. A non-reversible plug may be removed and an adaptor or reversible 2-pin plug may be substituted. It will then be purely a matter of chance whether the receiver chassis is safe to handle or not. Or the power supply cord may be lengthened with twin flex by someone who ignores the correct method of connecting up the receiver. If so, the chassis may again be taken to the live main, as at "A" in Fig. 1.

For these reasons it should not be possible for the user to touch any metal item which is in

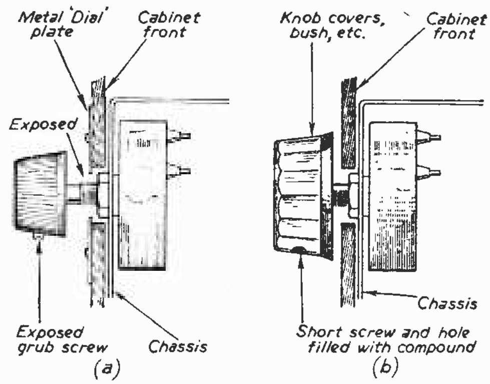



**Fig. 2.—The danger of exposed metal parts.**

contact with the chassis, or wired to it. It is not unusual for danger to arise at the control knobs, especially in home constructed sets. A metal indicator or dial plate may be used, as shown at "a" in Fig. 2, and may be in contact with the bush or holding nut of a component. If no plates are used, a small knob, or long spindle, may allow the fingers to touch the spindle, bush, or nut. Even if this is not possible, the grub screw may be insufficiently sunk, so that shocks are likely when operating the controls.

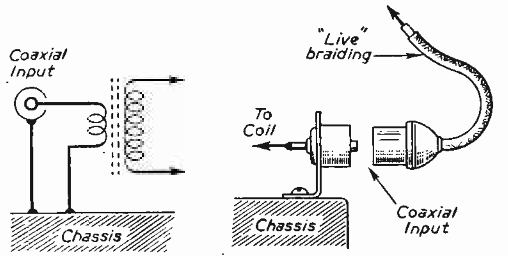



Fig. 3.—How the aerial connection may be "live".

### *Precautions*

These dangers can be eliminated by cutting down the spindle if necessary, and using a knob which fits near the panel, so that it is impossible to touch the bush, etc. A knob of this type is shown at "b" in Fig. 2. Spring-loaded knobs which grip a flat on the component spindle are best, but ordinary knobs are satisfactory if the grub screw is well sunk, and the hole filled with insulating compound. Metal indicator plates which may be in contact with the component bush are not recommended in any circumstances.

A check should also be made that no other metal parts which may be reached from the outside can possibly be in contact with the chassis. Metal gauze used to cover a speaker opening may sometimes be in contact with the chassis, or with a speaker having its frame returned to the chassis. Brackets should not be fixed to the chassis to hold a back on the cabinet, or the bolt heads may be alive. It should, in fact, be impossible to touch any metal which may become alive when the receiver is correctly fitted to its cabinet, with the back in position.

### *Aerial Circuit*

The danger of a live aerial connection is also sometimes overlooked, and the aerial may be returned directly to the chassis, as in Fig. 3. If a screened feeder with bare braiding is used, this error can be very dangerous. Both sides of the aerial socket or sockets should be insulated from the chassis, and isolating condensers of high quality and 500V or 750V rating should be wired from socket or sockets to the receiver coil circuit. Screened feeders should also have an outer insulated sheath, and wire with bare braiding should never be pressed into service for aerial connections of this kind.

It will thus be seen that there are two points to bear in mind if a receiver of this type is to be as safe as possible. First, it should be so connected that the chassis and other parts will not become alive at mains voltage from the "live" side of the supply. And, secondly, construction and fitting should be such as to safeguard the user from contact with metal parts which *may* be alive from changed mains connections.

# *BBC TV in Caithness and Orkney*

AS a result of the good progress made, and the special steps taken with the installation of the temporary BBC stations at Netherbutton, in the Orkneys, and at Thrumster, near Wick, the Thrumster station was brought into service on December 15, and transmits on Channel 1 (vision 45Mc/s, sound 41.5Mc/s). The Orkney station was opened a week later, on December 22, and transmits on Channel 5 (vision 66.75Mc/s, sound 63.25Mc/s). Both transmissions use vertical polarisation, which means that receiving aerials will need to be mounted in the vertical position.

### *Tests*

There are regular test transmissions from the new stations between 10 a.m. and 1 p.m. each weekday. These tests will be of assistance to the radio trade in installing receivers and aerials, but as they are primarily for engineering purposes they are subject to interruption and variation in power without notice.

Because of their lower power and temporary aerials the coverage of the temporary stations is not as great as that to be provided later by the permanent stations. The temporary stations will serve the towns of Kirkwall and Wick and their immediate surroundings. In their permanent form the two stations are expected to serve almost the whole of the Orkney Islands and Caithness, with a total population coverage of some 43,000.

### *Links*

The Thrumster station receives its programmes by radio from the BBC's television station at Meldrum and in turn transmits these programmes to the Orkney station. As Thrumster in its temporary reduced-power condition cannot be received direct in the Orkneys, it has been necessary to set up a relaying station. This is on the high ground at Brabstermire, a few miles north of Wick, where the signals from Thrumster are picked up and conveyed to the Orkneys by a microwave radio link. With this arrangement, which has enabled the Orkney station to be brought into operation much earlier than would otherwise have been possible, there may be short periods when adverse radio propagation conditions affect the quality of the transmissions, but it is expected that the pictures will be of a satisfactory standard for the greater part of the time.

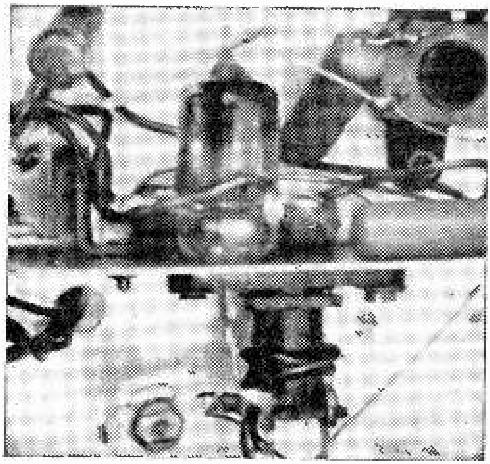
# An Acorn Valve TV Bo

*THE cheap surplus acorn pentode is a very efficient amplifier at V.H.F. and a stage using this type of valve will be found to give a worthwhile increase in sensitivity. It is capable of allowing satisfactory picture reception in circumstances when no picture at all can be received without the extra stage.*

If normal reception is obtained without the booster, it can still prove of occasional utility in providing satisfactory results with an indoor aerial, so that the receiver can be moved temporarily into another room, even if the usual outdoor aerial feeder cannot be changed so suit. The booster will, however, generally be most useful in fringe areas or localities where signal strength is poor.

### Circuit

The circuit is shown in Fig. 1, and is intended for operation with an A.C. receiver only, where the extra 0.15A can be drawn from a 6.3V heater circuit. The H.T. consumption is only about 8mA at 250V. If the H.T. line is of higher voltage than this, a resistor must be wired in series with the H.T. positive connection to the booster. For a 300V H.T. circuit, a 6.8k resistor is suitable. If necessary, the booster will operate successfully with its own power pack. One heater lead should then be wired to H.T. negative.



This view shows clearly the method of mounting the valve to protrude through the sub-chassis.

Valve connections are shown in Fig. 2. The long end of the valve carries the anode pin, and when the valve is viewed from this end other pin connections are as in Fig. 2. Viewing the valve from the grid end will give wrong suppressor grid and screen grid connections.

Leads are soldered directly to the tips of the pins. The iron should be really hot, and should be removed *immediately* the joint has formed. Keeping the iron in contact with the pin may fracture the glass seal of the valve.

### Coils

It will be found that the dimensions of these are in no way critical because turns can be added or removed, if necessary, to obtain resonance. Formers ⅜in., ½in. and ¾in. in diameter, plain or ribbed, were found to be satisfactory. It was also found satisfactory to omit the trimmers, and tune the coils by means of their cores alone, or to use air-cored coils, with pre-set trimmers.

With tuning by cores alone, and using ¾in. diameter formers, 11 turns will serve for Channel

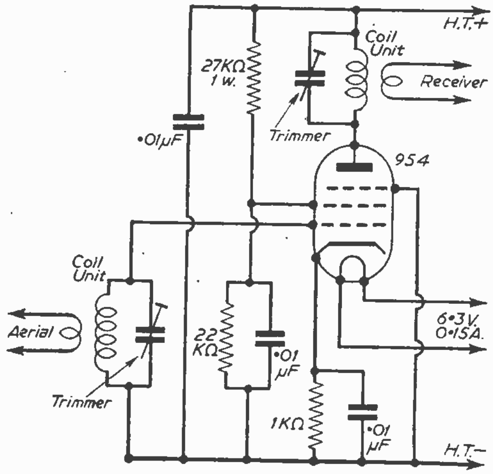



**Fig. 1.—The circuit diagram. Power is obtained from the H.T. and L.T. supplies of the receiver.**

**COMPONENTS LIST**

**Resistors : 27k 1W**
**22k.**
**1k.**
**6.8k 1W (H.T. dropper, if needed).**
**Condensers :**
**3 0.01 μF 25 V.W**
**2 " beehive " trimmers (10 or 30 pF maximum).**
**954 acorn valve.**
**Aluminium for sub-chassis (4½in. x 3½in. approx.).**
**Aluminium chassis (4½in. x 3½in. x 1¾in. approx.).**
**Tag strip, wire, solder, etc.**

# ster

*A useful unit for obtaining better results in fringe areas or receiving distant stations. By F. G. Rayer.*

1, 10 turns for Channel 2, 9 turns for Channel 3, and 8 turns for Channel 4 or Channel 5. The tuned winding is of 24s.w.g. or similar wire, with turns slightly spaced. A 2-turn coupling loop of insulated connecting wire or flex is placed on top of the tuned section, as in Fig. 2.

As the coils are tuned, picture brilliance will increase considerably. If this effect is not achieved, the number of turns on the coils should be modified. When tuning by cores alone, the exact value of stray circuit capacity has considerable effect on the frequency, but it should generally be easy to find the correct tuning point. If tuning is by pre-set condensers, these should be of the beehive type, with a low minimum capacity, and one turn should be removed from the coils. It is best to use sufficient turns so that resonance is obtained with the trimmers near minimum capacity.

### Construction

The booster is completely wired up on a chassis about 4½in. long, with two flanges each about 1¾in. wide. This can be made by taking a piece of aluminium 4½in. × 3½in. and bending it at right angles down the middle. When finished, the unit fits inside a box, case or outside chassis approximately 4½in. × 3½in. × 1¾in. deep.

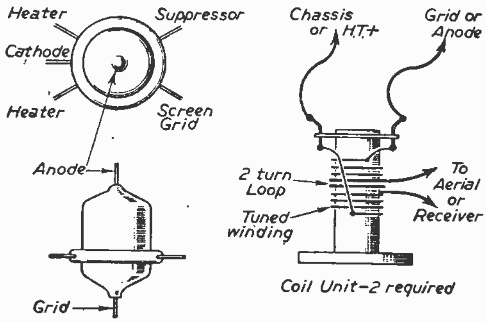
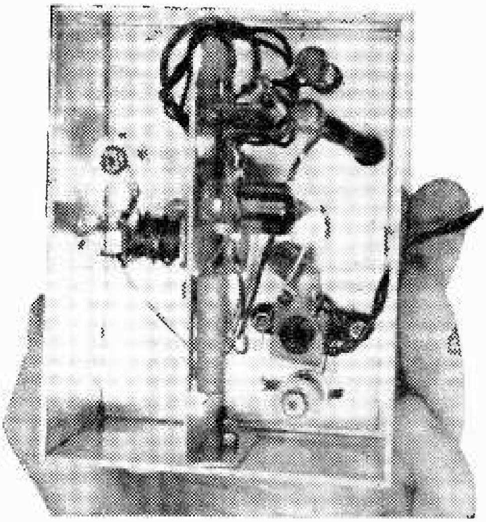



**Fig. 2.—Coil and valve data. Note that the pin connections for the valve are only correct when it is viewed from the anode end.**

Layout and wiring are shown in Fig. 3. The grid pin of the valve projects through a ¼in. dia. hole, to reach the aerial coil. The valve is held by short, stiff leads going to the coils, etc. Wiring will be easier if heater leads and cathode and suppressor pins are connected before fitting the valve in place.

A small tag strip held by a bracket holds the 22k and 27k resistors secure, and forms connecting points for the H.T. leads.

All leads should be short and rigid. This is particularly important with trimmer, coil and valve connections. The point "M.C." consists of two tags tightly bolted to the chassis.



The completed booster.

### Tuning

For tuning, an insulated tool is necessary. This may be a piece of ebonite rod or similar insulated material, filed to engage with the slot in the cores. Or, if trimmers are used, a piece of ebonite or similar material can be filed to engage with the hexagonal top of the trimmers.

When the unit is completed, it is placed in the outer chassis described. To hold it, the two bolts securing the anode coil are removed, and passed through outer chassis, booster chassis, and coil feet. A small flange or bracket on the vertical portion of the chassis may also be bolted to the side of the outer chassis.

### Size

As can be seen from the illustration above, the finished unit is of small dimensions and, in many television receivers, it should be possible to accommodate it within the cabinet. Care should be taken, however, that the unit is not sited above the H.T. rectifier valve or similar source of heat otherwise tuning drift will occur.

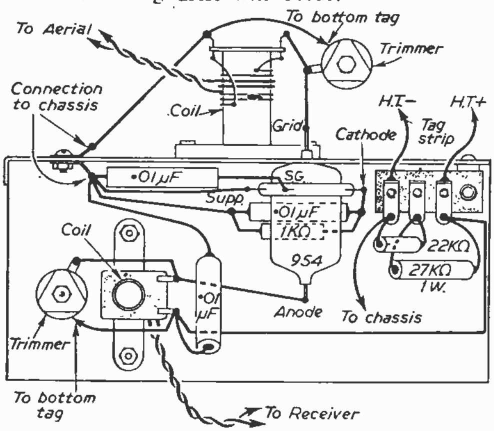
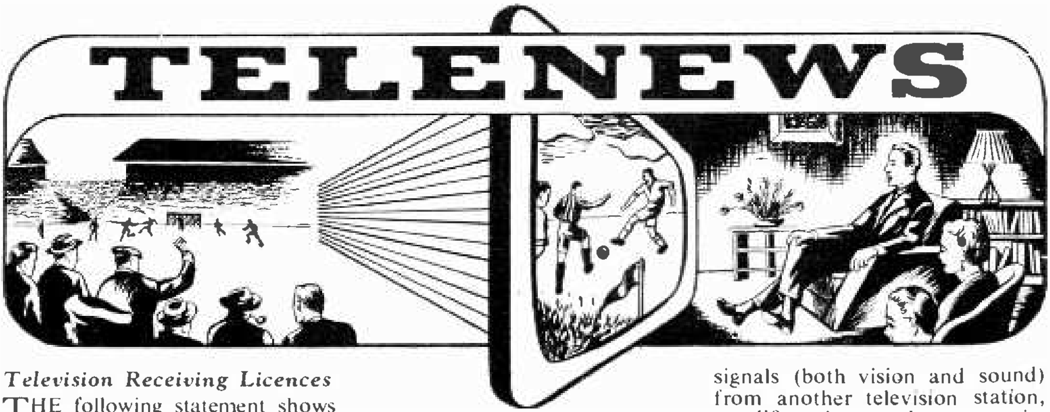



**Fig. 3.—Chassis layout and wiring diagram.**




### *Television Receiving Licences*

THE following statement shows the approximate number of Television Receiving Licences in force at the end of October, 1959, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

| *Region* | *Total* |
|---|---|
| London Postal ... ... ... | 1,747,921 |
| Home Counties ... ... | 1,297,314 |
| Midland ... ... ... | 1,516,923 |
| North Eastern ... ... | 1,606,956 |
| North Western ... ... | 1,328,133 |
| South Western ... ... ... | 814,116 |
| Wales and Border Counties ... | 587,685 |
| Total England and Wales ... | 8,899,048 |
| Scotland ... ... ... | 822,425 |
| Northern Ireland ... ... | 122,892 |
| Grand Total ... ... ... | 9,844,365 |

### *First African TV Network*

CAMERAMEN and technicians in white dinner jackets spun dials and pushed buttons as WNTV, Africa's first television network, went on the air in Western Nigeria on October 31.

The Western Nigerian Premier, Obafemi Awolowo, whose Action Group Government was the guiding force behind the creation of the TV network, described the new medium as one which can "help transform Nigeria into a more modern and prosperous nation."

All of Western Nigeria's top officials plus 500 prominent guests turned out for the resoundingly successful two-hour opening ceremonies, which included excerpts from WNTV's coming attractions, at Ibadan's Western Hall.

Sir James Robertson, Governor-General of Nigeria, said that although he had had serious doubts that the network could be ready so soon he now has high hopes that it will play a useful part in the education of the younger Nigerian generation.

### *Translators*

THE BBC has placed a contract to the approximate value of £115,000 with Marconi's Wireless Telegraph Co. Ltd., for the supply of television translators, low power television transmitters and amplifiers, and frequency - modulated sound translators and amplifiers.

These equipments will be used to extend the coverage of the BBC television and V.H.F. sound broadcasting services to areas where reception is at present non-existent or unsatisfactory.

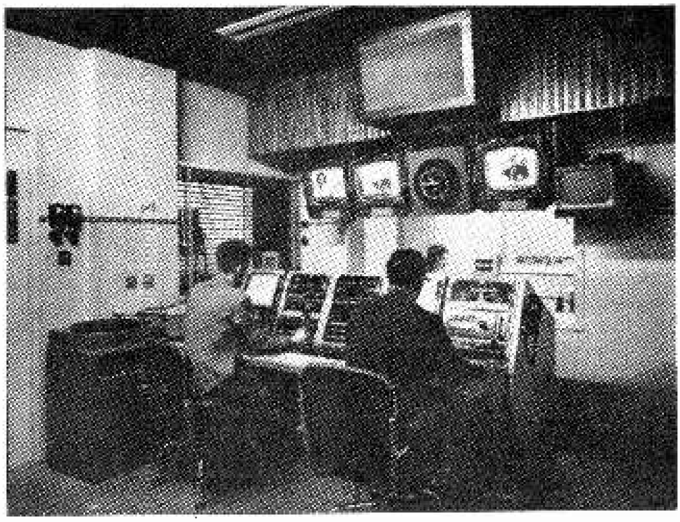
A television translator is an equipment which picks up the signals (both vision and sound) from another television station, amplifies them and re-transmits them on new frequencies.

The low-power transmitters are used where direct pick-up from an existing station is not possible. These accept the vision and sound signals at video and audio frequencies—usually over coaxial cable—and transmit them from a point within the area of indifferent reception.

The frequency - modulated translators will carry out a similar function to their TV counterparts, but for the BBC's V.H.F. sound service.

### *I.T.A.'s Dover Station*

THE Authority regrets that it is not yet able to give a date for the start of programme transmissions from its new



**Independent television came to Northern Ireland on October 31st, 1959, when I.T.A.'s transmitting station at Black Mountain, near Belfast, came into full programme service. The illustration shows the Master Control Room. (See "TV in Northern Ireland.")**

station at Church Hougham, near Dover. An opening before the end of 1959 cannot now be expected. This is because special tests are likely to be required in order to establish that the signal from the main directional aerial system will not cause an unacceptable degree of interference in the service areas of certain existing television stations on the Continent. A further announcement about these tests will be made as soon as possible.

### *North-eastern ITV*

SATISFACTORY reception of programmes screened from the I.T.A. Burnhope transmitter is noted in parts of the counties of Berwick and Roxburgh, says Television Audience Measurement Limited in a report on their latest boundary survey.

The survey, which was carried out in September and October, 1959, showed that Burnhope ITV transmissions were being received satisfactorily in areas both north and west of the I.T.A. 250$\mu$V/m contour line which was previously regarded as being the provisional boundary of the North East ITV area. In the south, however, it was established that Burnhope transmissions were not being received satisfactorily as far south as the I.T.A. contour line.

The revised TAM ITV area extends as far north as St. Abb's Head and includes a broad sweep of rising country to the north of the Tweed, beyond the Cheviots, from Gordon to Reston and including Duns and Kelso. Relay services bring in Eyemouth and Berwick while Jedburgh owes its inclusion to a communal aerial system.

### *TV in Northern Ireland*

THE Independent Television Authority's new transmitting station at Black Mountain, near Belfast, which came into full programme service on October 31st, is estimated to have brought over a million more people within range of Independent Television.

All the main transmitting equipment and the greater proportion of the associated studio equipment for this station has been supplied and installed by Marconi's and includes two 4kW vision transmitters and two sound transmitters together with combining units, programme input equipment, flying spot caption scanner, control desk and test equipment.

The duplication of transmitters follows established practice; in this particular instance one vision and one sound transmitter will carry the programme service, with the remaining pair immediately available as stand-by, although if the requirement ever arose the vision transmitters could be operated in parallel (as also could the sound transmitters) to double their respective output powers.

### *I.T.A. Mast at Mendlesham*

FOR the new I.T.A. service for East Anglia a stayed aerial mast 1,000ft. high and weighing 140 tons has been erected at Mendlesham, Suffolk. It is the highest man-made structure of any kind in this country. The design and erection of the mast were carried out by British Insulated Callender's Construction Co. Ltd. to the requirements of the I.T.A. and their main contractor, E.M.I. Electronics Ltd. The steelwork was fabricated and galvanised by Painter Bros. Ltd., of Hereford, and the transmitting aerial was supplied by E.M.I. The mast is a three-sided structure, each side being 8ft. 6in. across and is built up of three solid round steel legs braced together with angle steel lattice work. The mast foundation is a solid concrete block 23ft. 6in. square on which a steel pedestal rests to carry the mast. The mast is supported by steel wire stays, the heaviest of which is made up of 259 wires, has a diameter of 2¼in. and weighs nearly 5 tons. The mast was erected in ten weeks.

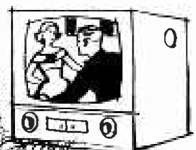
**A group of interested visitors examine an "S" band power distribution board engineered in high Q triplate strip transmission line and exhibited at the 1959 Farnborough Air Show. The double-sided board, designed by Cossor Radar and Electronics, Ltd., was printed and etched to extremely fine limits by Printed Circuits, Ltd., of Borehamwood. It houses 32 "S" band components consisting of branch arm and proximity couplers, cross-over network matched loads, and variable attenuators.**

### *Appointment*

THE Plessey Company Limited announce the appointment of Mr. R. E. Verguson, M.S.M.A., as Commercial Manager of a new grouping which includes the Sheet Metal Division and the Amar Tool and Gauge Company Limited with the Industrial Hydraulics Division, at Cheney Manor, Swindon.

Mr. Verguson, who is well known in the Swindon area, served as a navigator with the Royal Air Force during the war. He joined Plessey in 1946, and has held senior sales and commercial appointments in several of the Company's divisions. He has been Sales Manager of the Industrial Hydraulics Division since its inception.

# PUNGENT POINTERS



## DANGER CAN OFTEN BE SENSED

By L. E. Higgs

THE engineer in radio and television to-day is quite literally finding his nose a very useful accessory in tracing short cuts to damaged, or about to be damaged, components in the complex assortment of equipment that finds itself on the benches of the repair trade.

The collection of "symptom smells" in the memory of any practical serviceman is greater than many of us realise, and their source can quickly be pinpointed.

### *Soldering Iron*

Many materials are, in their normal state, inert from the point of view of odour, but most of them give forth some vapour when touched with the magic wand of the workshop; the soldering iron. The welter of smells produced by an apprentice (and others) with an iron one size too large when replacing a line output transformer in a cramped layout has to be experienced to be believed; acrid rubber, sweet sickly P.V.C., burnt bitumastic compound and the occasional waft of melted condenser wax all mark the progress through the job to anyone standing a few feet away.

The soldering iron, even when used properly, can claim many casualties when laid down; the coax aerial lead, the mains lead (a blown fuse or flash out often precedes the smell) and even the bench top, lino or rubber. Burnt cardboard tells us another service manual has suffered and we are all concerned about our clothes when the dreaded smell of scorched wool assails our nostrils. A deep iron stand or many of them scattered about the benches could help here but they need to be used with staff ingrained with the habit of keeping to them.

### *Transformers*

Probably the mains transformer is our first memorable smell, unmistakable when the charred varnish of complete destruction is sensed, but the smell of overheated impregnation wax tells the man who can differentiate between them that all is not lost and an off-load run when cool, with rectifier out, shows the transformer still to be serviceable after the external circuit short is cleared.

The worst of them all is generally agreed to be the flashing selenium rectifier; an object of disgrace and disgust with a characteristic odour sometimes described as "putrid organic" although most of us have a more apt workshop name.

The printed circuit receiver has again brought to the fore the mixture of burnt phenolic resin sheet and running wax. Usually a safe bet is that a red hot screen resistor is burning its associated decoupling capacitor.

Another symptom that tells us how a circuit is behaving is the ozone from brushing EHT—out lights for this one. The steaming cloud from a cement-coated volts dropper on switching on for the first time after storage in a damp place (usually while awaiting parts) is also well known. In this category, red hot wire-wounds can be detected before being seen, and the smell from a heater current thermistor tells us that the current is on before the valves light.

Anyone who has seen the result of an over-excited electrolytic capacitor with the garlands of aluminium foil surrounding a gaping upright cylinder, cotton gauze and a splatter of white, steaming spots all over the cabinet interior cannot fail to forget the delicate aroma of aluminium borate that accompanies it; or the older smell from an overloaded one watt resistor of the solid, uninsulated carbon type as its cellulose paint bubbles off—sometimes with flames.

### *Hazards*

Working on the carpet in the customer's home has brought a particularly new danger when the chassis is out of its slim line cabinet—the unnoticed volts dropper lying on dense layers of snow white hearth rug. Here again, the dangers of the soldering iron are apparent. A useful aid to the outside man is the safe, quickly heating transformer iron of which the safety outweighs the clumsiness.

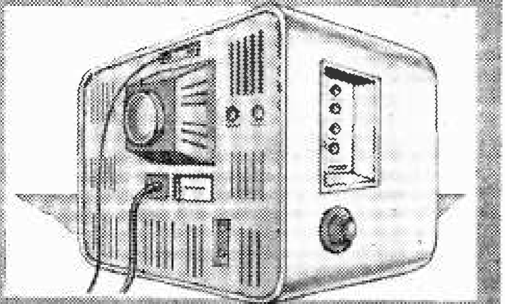
Many smells are not necessarily a sign of fault, but are worth remembering. New receivers often give off traces of hot varnish and plastic when first switched on and one in particular can be relied upon to produce smoke or steam in a gently drifting cloud, and yet all be normal.

When high temperature valves are plugged in for the first time their labels are often detected as is the new paint on a replaced selenium rectifier. Resin-covered solder, switch cleaner and cabinet polishes, too, have a niche in the serviceman's memory.

Some of the less often occurring odours are from the older days and many can remember accumulator acid, soldering fluxes, pitch tops from H.T. and G.B. batteries and, the oldest of the plastics, the rubbery, full strength of ebonite when an odd piece was thrown on a fire.

Just as ears are part of a driver's senses on the road, so even more in working on radio and television, an intelligent, often instinctive, appreciation of smells by the engineer, in conjunction with ears, eyes, and mental following of circuit processes, help him to build up a quicker diagnosis, and lead to more efficient working.

# Servicing Television Receivers



No. 51.—THE PHILCO A1497, A1800 AND A1810 By L. Lawry-Johns

(*Continued from page 129 of the December 1959 issue*)

THE details given last month should enable most faults in the power-pack circuits to be remedied easily. We shall now deal with faults in the line timebase and EHT circuits. When testing for the presence of EHT, a handy tool to use is a spark-plug tester which is sold in many stores and is a small screwdriver with a high voltage neon in the handle. When the blade is advanced to the R12 the neon will glow vividly. It is unnecessary actually to touch the anode or single-wire end with the blade. The presence of EHT at the anode causes the vivid glow and thus absence of glow denotes that the required voltage is not reaching the R12 and that something is wrong in an earlier stage.

### *Line Whistle*

In actual fact the absence or partial absence of the normal line whistle would have already betrayed this but it is worth while mentioning.

Assuming that the spark or glow is produced at the R12 anode, move the screwdriver over to the right-hand side or double wire end. If the R12 is lighting up, a thin blue spark should be drawn from here but of much reduced violence and a neon of the type mentioned will intermittently glow. It will not glow steadily as at the anode as the voltage is now rectified. If the R12 is out and the spark is absent or much subdued, turn the brilliance down to zero and

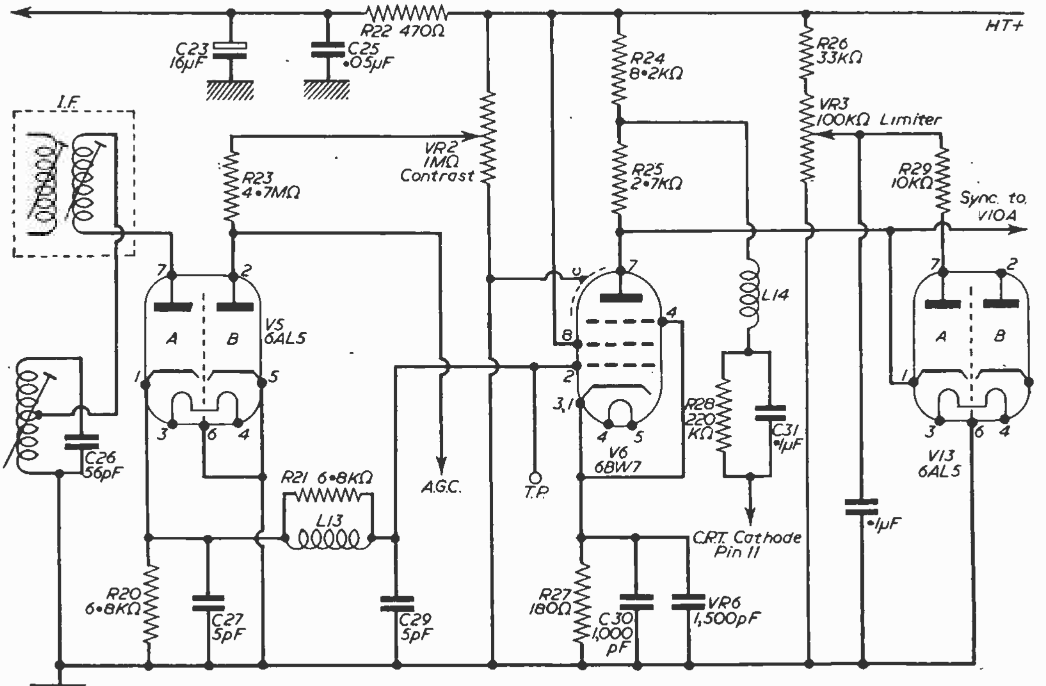



Fig. 5.—Vision detector, AGC diode, video amplifier, vision limiter and H.T. feed (via R22) to early stages.

observe the effect on the R12. If it now glows, turn up the brilliance half-way or so and check the adjustment of the ion-trap magnet. If the magnet is clamped firm and has not been altered, however, check V11, V12 and V15, then VC5, etc.

### C.R.T. Cathode Voltage

Also check C.R.T. cathode voltage (pin 11) 115V is approximately correct. If absent, check tube for heater-cathode short; also V13 and resistor R24.

Assuming, however, that the R12 is well and truly out it can be assumed that its heater is o.c. and a new valve should be soldered in position.

### Dull Picture

Advance contrast and, or, brilliance. If the picture merely blurs and turns negative, it can be assumed that the tube emission is low and a new or rebuilt tube is required. If advancing the brilliance brings up a fairly bright raster, however, make a thorough check of the video amplifier stage (V6) including R20 and R24, V5, V6 and V13 and, of course, the setting of VR3. If the picture will not stand an increase of contrast or brilliance and merely defocuses and fades out, expanding as it goes, check the ion-trap magnet setting and then change the R12 (V14).

### Bright Raster. No Picture. Sound O.K.

Assuming the sound is in order and that the brilliance VR8 produces a raster but no picture signal, check V4, V5 and V6. Then, if these are in order, check the feed resistor to pin 8 of V4. If this is charred, check the 0.003$\mu$F decoupling capacitor. If this has shorted, replace it; replace the 1.5k$\Omega$ feed resistor and see that R22 has not been damaged. The above assumes that the brightness is controllable. Sometimes the symptoms are that the brightness control does not alter the raster at all; it remains bright. Again, the control may work in reverse.

In all cases of this nature, the proper procedure is to find out what has disturbed the working conditions of the tube. As already stated the cathode voltage should approximate to 115V. This is at pin 11. The voltage at pin 2 is dependent upon the setting of the brilliance control and should swing from zero to 150V at maximum.

### Video Load

The voltage at pin 11 is dependent upon the voltage drop across R24 (as this is the load resistor of the video amplifier). There are many posible causes of a low voltage at this point and the possibility of oscillation in the I.F. stage should not be overlooked. If this is suspected, short pin 2 of V6 to chassis, i.e., link "test point" to chassis. This should restore normal anode voltage if oscillation is the cause. If not, check V6.VC6 and C30 for shorts, ensuring that about 2V is dropped across R27 (pins 1, 3 or 9 to chassis) under no load conditions. Then check R25, R24, V13 (heater/cathode short in section A) and the tube itself.

### Lack of Height

In all cases of lack of height and frame distortion, e.g., picture compressed at bottom, stretched at top, the ECL80, V11, should be checked, then V10. If these are not at fault, attention may be turned to C45, R41, C46 and C47. Only if these are passed without fault should C42 and 44 be suspected.

### Frame Hold

If VR4 it at one end for optimum lock, check R40. If VR5 (*height*) exercises undue influence upon the hold, check C40. If the frame revolves either way (up or down) with no positive lock, check V13 and the components associated with section B, R37, etc. If both line and frame pulses are weak, check R31 (2.2M$\Omega$).

### Poor Gain

If there is a weak and ragged picture, more particularly on Band III, check tuner unit valves, especially PCC84, then V3 but ensure that the aerial system is in order. If all else is in order check tuner unit components, particularly the 47k connected to pin 2 of the PCC84.

### Low and Distorted Sound

Check V7, V8 and V9. Then check 270k$\Omega$ resistor to pin 7 of the 6AT6 and the 3.3M to the limiter metal rectifier (WG5B). The 270k is coloured red, violet, yellow, the 3.3M is coloured orange, orange, green.

## "P.T." and "P.W." FILM SHOW

ANOTHER film show, sponsored by this journal and our companion journal *Practical Wireless*, is to be held at Caxton Hall, Westminster, on Friday, January 22nd, 1960, at 7.30 p.m., when the Editor will take the chair, admission will be by ticket only. The event, which has proved so popular in previous years, is being arranged in conjunction with Mullard Ltd.

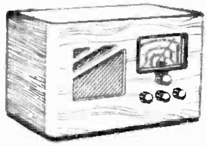
### Films

The films are entitled "Photo Emission," "From us to View" and "Mirror in the Sky." The latter film deals with events leading up to the experiments by Sir Edward Appleton to confirm the existence of the Heaviside layer, and continues with the discovery of the Appleton layer and the developments of the pulse techniques which became the basis of radar. The film concludes with one of the latest scientific achievements—the radio telescope.

### Tickets

Applications for tickets should be made now. Please mark your envelopes "Caxton Hall" in the top left-hand corner and send a stamped, addressed envelope for the tickets. All applications will be dealt with in strict rotation.

***Pay weekly at rates which you can easily afford*—AND INTEREST FREE, TOO!**



## HOME RADIO

**5/1** *(Initial Payment)*

BALANCE PAYABLE AT 3/11 OVER A PERIOD OF 19 WEEKS.

AC/DC. Universal mains 5 valve octal superhet 3 waveband receiver can be adapted to gram p.u. In attractive wooden cabinet 9¾ x 18¼ x 11¾in. Ins. carr. 4/6.

Cash price **79/6.**

## TRANSFORMERS

**MAINS TRANSFORMER 5/9** Primary 200-250. Secondary 0-100-250 150 mA. Suitable for small amplifier with .I series valves. 2¾in. x 1½in. P. & P. 1/9.

**OUTPUT TRANSFORMER & SMOOTHING CHOKE COMBINED 4/9** 2¾in. x 1¾in. Suitable for EL84s in single or push/pull output. P. & P. 1/9.

**MAINS TRANSFORMER 7/9** Primary 200-250. Secondary 300-0-300. 6 v. 3.3 amps. P. & P. 1/9.

## 17" T/V *for only* 11/1 *a week*

**for 36 weeks (4 weeks payment in advance) or over a shorter period if so desired.**

Beautiful latest finish cabinet in contemporary style covered and washable.

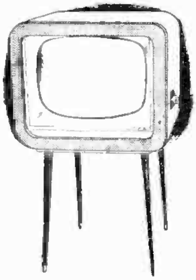
Polished legs, 18in. optional extra for 25/-.

17in. Rectangular Tube. Guaranteed fully for 12 months.

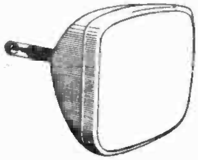
12 channels. "Turret Tuned"—ITV/BBC. Extra coils at only 7/6 a pair (with order).

Chassis. 14 B.V.A. Valves. Salvaged but reconditioned and guaranteed 3 months.

Due to overwhelming orders, some delay may occur. Please enquire when ordering.



CASH PRICE **19 GNS.** Carr. & Ins., 30/-.



## RE-BUILT T/V TUBES

IF GOODS ARE BOUGHT ON TERMS, CARRIAGE & INSURANCE MUST BE SENT WITH INITIAL PAYMENT.

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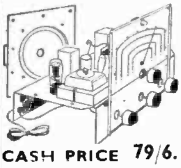

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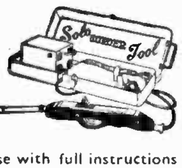

110 v., 6 v. or 12 v. (special adaptor for 200/250 v. 10/- extra). Automatic solder feed, including a 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use. Post 3/6.

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De luxe model. Printed circuit. Latest design. Dimensions 7in. x 2¼in. x 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve. giving higher undistorted output. Volume, treble and bass control. Knobs 3/6 extra. P. & P. 3/6.

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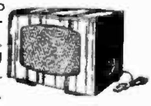

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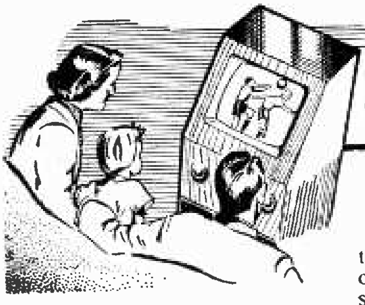


# UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

**By Iconos**

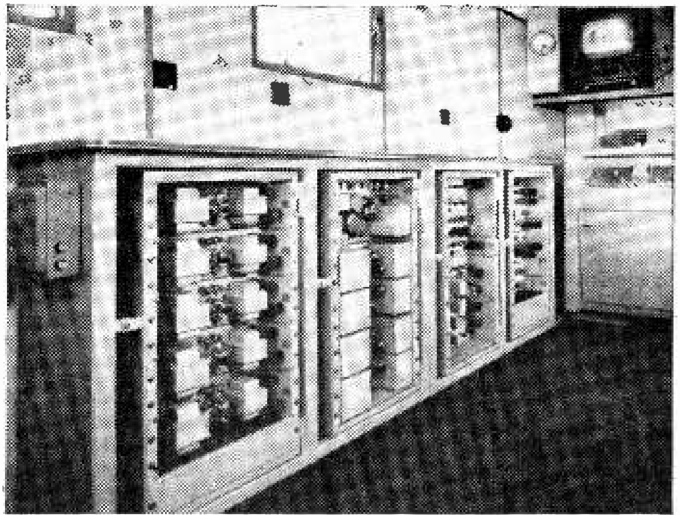
SOME of the best and most popular items on BBC and I.T.A. programmes have been films made specially for television in film studios and on exterior location. *Wagon Train*, *Robin Hood*, and several series of Westerns and "whodunits" have scored high audience ratings, with TAM and Nielsen's over a long period, both here and in the U.S.A. These are all films made with traditional cinema techniques in scripting, direction, photography and editing. Next come the television films made with a technique more akin to live television, with multiple cine cameras photographing on film (35mm or 16mm) long, staged sequences for such items as *I Love Lucy*, *Burns and Allen* and various quiz shows. This type of production is almost the same as telerecording from live television cameras on to film or videotape, and its use is increasing as fast as suitable subjects and script material becomes available.

## *A Slump?*

WHILE *Wagon Train*, *Sea Hunt* and other American and British cinema technique series continue to register popularity, very few new series of this type seem to be appearing. Making a film series involves quite a large investment, and it is usual to make a pilot episode for showing to the networks for securing contracts. During the last few months, over 200 such pilot films made in America were shown to executives of American networks by independent producing companies, but only about 10 per cent. made the grade, and were actually booked. The quality of the scripts, production, star values and technical gloss is becoming so important and the competition is so fierce, that this type of production has become highly speculative. Costs of production have risen very considerably and it is now essential for a series to be sold to networks in America as well as Britain, before the production of No. 2 and subsequent episodes up to the usual total of 39 is commenced. Film studio lighting and techniques are in the main outdated when it comes down to high-speed work, turning out a half-hour film in about 2½ days. In this short time, there is no leeway to allow for script revisions, changes of artists, breakdowns of equipment and all the other normal hazards of film production. Slow speed of production at Shepperton studios and overtime bans very nearly brought to a halt the elaborate and glossy *Third Man* series, which is being made partly in England and partly in Hollywood. Happily, management and union executives got together and production was resumed on this ambitious series, a co-operative venture of the BBC, with the NTA organisation of America. A-TV have entered into a similar co-operative deal with Independent Telefilm Corporation of America, for making top-class television film in London and Hollywood. All of these factors, together with the failures of the smaller companies making these cinema-style television films, point to the fact that this type of production will be mainly carried out by the larger organisations, who are able more easily to recover the high production costs.

## *Transatlantic Telerecording*

GRANADA made great use of their video tape line standard converter during President Eisenhower's visit to Britain, as already reported in this journal. Two Ampex video tape machines were mounted on trucks and taken



The first mobile Ampex Videotape recording unit to be mounted in a specially designed vehicle is being put into operation by TWW. The view above shows the interior of the van; all equipment is mounted in four low-level racks topped by a working area and in the background is the record monitor and part of the Ampex console.

from Granada's Manchester H.Q. to London Airport for making magnetic transfer on the spot, in time to catch planes to America at almost the last minute! American viewers were thus able to see their President's progress on their home screens a few hours earlier than they would if the usual all-film method, with its processing and printing had been carried out.

The speediest way of all, so far as transatlantic operations are concerned, is the BBC method of using the transatlantic telephone cable system. At this end, a very slow-speed flying spot telecine scans the film every other frame, sequentially, at 200 lines. At the Canadian end, at Montreal, a similar flying spot equipment, converted into a telerecorder, records the impulses at the same rate and speed on film. It takes about fifty minutes to transmit 30 seconds of film material in this manner, and results are said to be good. The slow speed, reduced line standards and alternate film frame methods are necessary to contain the signal information within the 4.5kc/s bandwidth available on the transatlantic cable. Naturally, the quality is inferior to the video tape recording, but for red-hot news it is still considered worth while.

### TV *Studios*

IT is interesting to note that both A-TV studios at Elstree and Teddington have had a very long connection with show business. One of the existing stages at the Elstree plant was constructed in about 1913 and was the first brick-built film studio to be erected in England, from which daylight was excluded and photography relied upon artificial lighting. This stage—about 70ft. × 30ft.—had its effective height raised by lowering the floor level by about 5ft., a tricky undertaking which was carried out in 1928. The original silent film stage at Teddington, also built in 1913, was all-glass, in which daylight was supplemented by enclosed arc lamps similar to those used at that time for shop-fronts and street lighting. Later on, this greenhouse type of stage was converted into a brick and breeze-block dark studio and it was in continuous use for many years, with a fine large modern extra stage added. Later, the Teddington studio became an aeroplane factory. However, a few months ago ABC-TV took it over and, once more, it is back in show business.

### *"Busy" Titles*

I HEARD the news that the BBC were proposing to use 21in. monitors with some misgiving. While it is true that there are large numbers of viewers who possess 21in. television receivers, there are also very many who still have 14in. or even 12in. screens. These viewers already have some difficulty in reading the titles and credits on some of the BBC programmes, in which the lettering is small and the background picture "busy." It has seemed to me that the caption writers and directors at the BBC are inclined to become a little too arty-crafty with their titles, which might be acceptable on 21in. screens and yet are not at all satisfactory on the small screens. The I.T.A. programme contractors, who also used large monitor screens in those regional control rooms laid out in the American style, seem to have avoided falling into this trap. Generally, the style of type is solid and clear, easily readable, just as the commercials are. But a fault common to both I.T.A. and BBC titling is excessive speed on the roll-up or creeper titles at the end of subjects. Sometimes these creep up the screen at an alarming rate which slows up and comes to a stop for an excessive time on the name of the producer! I put this down to the speed control on the caption machine being manipulated as a means of contracting or stretching the programme time to the exact second. Personally, I dislike roll-up or creeper titles, which are hard on the eyes and most inartistic. I prefer the end credit titles to be a series of cards held quite still and dissolved from one to another.

### *Anglia Opens*

NEW regional stations in East Anglia and Ulster are now in operation. Anglia began with an ambitious play, *The Violent Years*, starring Lawrence Harvey and Hildegard Neff, which had been pre-recorded on videotape. This was a very well produced drama with varying exterior backgrounds, first-class interior sets, well handled cameras and expert cutting—in short, it had the professional polish one might expect of a crew that had worked together for months. It traced the career of a boy and man through his stormy life, starting in Austria during the first world war. Dramatic situations were excellently handled by the director, Peter Graham Scott—and there were plenty of them. This kind of opening to a regional station was much more effective, I thought, than the conventional hotch-potch usually served up on these occasions. Anglia avoided the obvious.

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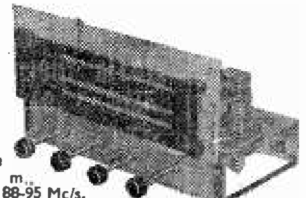

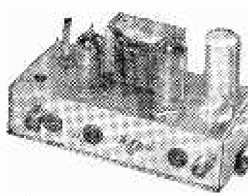

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**£13.10.0** *Carr. and Ins. 5/-. Complete with 4 knobs walnut or ivory to choice.*

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**Mk. 2 Model.** Latest cascode circuit using ECC84 and EF80 valves. 18db gain over standard circuits. Built-in Power Supply 200-250 v. A.C. Size 6½in. x 3in. x 4in. Simple to fit—only external plug-in connections. Wired and aligned ready to use. Only 79/6. P. & P. 2/6.
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**Band 3 Aerials.** Single Dipole with 4 yds. cable, 13/9, 3 Element Beam, 25/-, 5 Element, 32/6, etc. B1-B3 Crossover Units, 7/6.

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**BSR—UA8 Model.—4-speed** autochanger with **crystal turnover** cartridge, etc., wired for stereo, **Bargain £6.19.6.**

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**SPEAKER FRET.**—Expanded Bronze anodised metal 8 x 8in., 2/3; 12 x 8in., 3/-; 12 x 12in., 4/6; 12 x 15in., 6/-; 24 x 12in., 9/-, etc.

Listed above are only a few items from our very large stock. Send 3d. stamp today for Complete Bargain List.

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Stand ¼in. diam. Low Loss Semi-Air Spaced Aeraxial.

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20 yds. 12/6, p. & p. 1/6; 60 yds. 32/6, p. & p. 3/-; 40 yds. 22/6, p. & p. 2/6; All other lengths 8d. per yard.
Coax Plugs 1/-, Sockets 1/-, Couplers 1/3, Cable End Sockets 1/6, Outlet Boxes 4/6.

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*New Improved types—mains prim. 200/250 v. tapped.*

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# Letters to the Editor

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

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

## *TELEVISION IN SHETLAND*

SIR,—Television in Shetland is only in its infancy. Only a few people have sets as the only signals we can receive come from Medrum, about 180 miles away. Sometimes the pictures are as clear as received in Aberdeen but mostly the signals come and go in a most frustrating manner. It all depends on the weather conditions and the temperature. We hope that when the power of the Orkney station is increased we will get better reception.

One of the pioneers in Shetland is a Mr. Mustard who is a very keen experimenter. Sometimes he receives pictures from Belgium. He said that the effects of the Aurora Borealis could be seen in the pictures. I obtained a second-hand set and found that it was possible; not only can you see the effect but you can actually hear the Aurora Borealis.

I was interested in the article on "A Closed Circuit Colour TV System." I have an article written in 1893 on a closed circuit colour TV system entitled "Seeing by Wire."—A. HARCUS (Shetland).

## *BBC MONITORING*

SIR,—I wonder if the BBC have any standard of monitoring the News Bulletins. Repeatedly I have found that in some cases, there are large white areas with all detail completely missing, in spite of adjustments to my brightness and contrast controls. As scenes change, so does the contrast and I have not found this on the London I.T.A. station, where the adjustment from scene to scene appears to be much more consistent. I appreciate that different scenes have different lighting levels, but is there no way in which the transmitter can be monitored so that the level can be adjusted to suit the majority of commercial sets ? After all, most of us have commercial sets with round about 2Mc/s detail and it seems to me from much of the BBC transmission that the level is set for those with 3Mc/s sets.—G. R. CADMAN (Holloway).

## *AERIAL CHOICE*

SIR,—It seems that you have previously mentioned the possibility of our houses eventually becoming overburdened with aerials. I.T.A., F.M. and BBC now present quite an array and I think it is time something was done to find some arrangement which will cover all eventualities in this direction. I know that in theory the aerial must resonate to the frequency being received, but surely manufacturers do not make separate aerials for each station in the country. Do not they cut the aerial so that it resonates in the middle of the BBC band or in the middle of Band III ? I appreciate that if this is done, there is a compromise in the bandwidth of reception, but I have read that in the U.S.A. special wide-band aerials are now made to ensure extremely wide reception and they use 6Mc/s bandwidth. We do not see any "Bow tie" or similar aerials here, and I would have thought that now was the time to introduce something of this type to avoid the unsightly and perhaps dangerous erections appearing on our roof tops.—F. R. TIERNEY (Peterborough).

[*The article in this issue on aerial design will no doubt have an especial appeal to you, and we should be glad to hear from any readers who have tried to make a single aerial to cover I.T.A., F.M. and BBC channels satisfactorily.*—ED.].

## *A TV OSCILLOSCOPE*

SIR,—I recently built a 'scope described in your issues. and in case any other readers are building this and run into difficulties I should like to point out a slip which was made in the circuit given on page 499 of the May issue. In this the two lower half-wave units shown next to the words "C.R.T. Heater Winding" are incorrectly drawn and should be reversed. Otherwise I have found this a most useful unit.—R. BEVINS (York).

## *A PECULIAR FAULT*

SIR,—I recently had much correspondence with you concerning trouble in my set. You made several very helpful suggestions. but none of them proved effective in overcoming the trouble. Eventually I decided it was kill or cure, so I took the chassis right out and settled down one evening to a very complete examination. After nearly an hour I solved the mystery and pass on the information in case it may be of help to others who have an apparently insurmountable difficulty. The valveholders were of a type having a *flat* metal clip inserted in the bakelite moulding and in practice the metal legs of the valves should go down between the metal edges of the clip—the two parts of the clip being diametrically opposite each other on the valve leg. What had happened was that the leg had become slightly bent and as the valve legs went into the holder one of them (actually G2) pushed the two parts of the clip so that owing to its springiness the two parts jumped away from the short valve leg. Raising it slightly enabled it to make contact. but pushing it right home removed contact. To avoid buying a new valveholder and going to all the trouble of rewiring. I just placed a thin piece of cardbord beneath the valve so that it could not be pushed right down.—D. R. WAITE (Edmonton).

### *625 LINE DEFINITION*

SIR.—Since the announcement that there may be at some time a system available in this country on the 625 line system, I have been toying with the idea of making an experimental set, and owing to lack of a suitable transmission on which to base my experiments I wonder if any of your readers living on the S.E. coast may have access to French or other continental transmissions and have made any tests. The main thing I am interested in is how to switch the frame and line timebases to cover the increased detail. It seems not too difficult if a multivibrator is used, to switch the essential parts so that the frequency will cover either the present low definition or the new high one, and the turret tuner could easily be modified to cover the necessary channel. Presumably the bandwidth would be widened to 4 or even 6Mc/s and I think this could be accomplished by shunting the I.F. circuits and other coils. whilst the F.M. set which most of us now use could be employed for the sound channel. The big snag appears to be in the switching. Could we have the benefit of the result of experiments which readers may have carried out ?—G. JENKINS (Bath).

### *RECTIFIER REPLACEMENT*

SIR.—In the November issue, I read that one of your readers is having trouble in replacing the U25 EHT rectifier in a Murphy V240. I overcame this difficulty two years ago. I took the complete unit out of the set and with a small blade of a penknife I carefully turned the metal lip back and then poured out the oil. Then I lifted the complete transformer out of the can. After replacing the valve in the usual way I refilled the can with the oil and put the transformer back, pressing the metal lip down with a screwdriver blade. taking care to see that the rubber top was strapped all the way round. After that with the aid of a soldering iron and some bitumen from an old battery, I made an excellent seal good enough to hold the oil without leaking. I put the unit back and I have had no trouble since.—B. W. RODGERS (Sheffield).

[*In re-assembly the oil should be introduced into the transformer hot, with the bright metal bung in the rubber top removed. If this is then replaced after the can has been sealed, whilst it is still hot, an airtight seal may result. We hesitate to suggest that readers try this method without some knowledge of their facilities or skill.*—ED.]

## FRAME GRID VALVES

(*Continued from page 174*)

### *Sound Take-off*

In fringe areas it is particularly necessary to have a high gain A.G.C. system on both vision and sound signals. Vision A.G.C. must be given priority, since variations of sound level are more tolerable than picture variations.

The vision A.G.C. is normally fed to the R.F. stage and to the first vision I.F. stage, thus giving a substantially constant vision I.F. voltage at the anode of this latter stage. The sound I.F. signal can be taken off from this point. and the sound A.G.C. will then have to handle only the fluctuations of sound-to-vision ratio. The alternative arrangement is to take off the sound I.F. before the first vision I.F. stage. If this is done. then the sound A.G.C. will need to have a control range even greater than that of the first vision I.F valve.

For this reason it is preferable to use the earlier of these arrangements, in which the first I.F. stage is common to sound and vision.

### *Fringe Receiver I.F. Strip*

The circuit diagram (on page 174) shows an I.F. strip for a fringe area receiver. It consists of a common I.F. stage for sound and vision, followed by separate second I.F. stages. All three stages use the frame grid EF183. The strip would be used with the frame grid PCC89 in the R.F. stage and the conventional PCF80 mixer. It is, in fact, a realisation of receiver "B." Receiver "C" would consist of a PCC89 R.F. stage, PCF86 frame grid mixer, EF183 first I.F., and the separate sound and vision I.F. stages modified to take the conventional EF80.

"The "B" version as shown has one or two special features. The screen-grid potential divider currents of V1 and V3 are fed into the cathode resistors of these two valves. giving an improved initial grid control rate (that is, change of gain with change of grid potential). The 1.5V grid bias of V3 is partly cathode bias and partly a voltage of about $-0.4$ produced in the grid circuit by the contact potential of the EB91. There is no $22\Omega$ compensating resistor in the cathode lead of V3. since the 82pF capacitor on the grid effectively swamps any change of grid-to-cathode capacitance brought about by gain control. Neutralisation is provided by the $\pm 10$ per cent. capacitors which are shown.

### *Performance*

The adequate gain provided by the "B" and "C" receivers has already been discussed. In both receivers the first I.F. stage handles large signals without causing cross-modulation. The sound I.F. stage has adequate A.G.C. to handle normal variations of sound-to-vision ratio; and simultaneous fading of sound and vision is eliminated by the vision A.G.C. Receiver "B" using the I.F. strip as shown and a PCF80 in the mixer stage is slightly better than the "C" version for signal-handling ability and sound A.G.C. Receiver "C," with PCF86 mixer and I.F. strip modified to take the EF80 in the separate sound and vision stages. provides rather more gain. The differences, however. are not very great in comparison with the superiority of both circuits over the conventional receiver "A."

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## MURPHY V200A

**A fault has appeared and I shall be very glad of your advice. Most of the valves have only recently been tested—V3, 9 and 10 are new. The fault, which is intermittent, causes the whole picture to appear out-of-focus. Similarly, "bands" of the picture about 1in. wide will appear out-of-focus, the part of the picture affected appearing to move aside approximately 1/16in. C32 and C39 have been replaced by new ones. C34 and 57, C61, C49 and 64 have been tested. C65 and 66 have been replaced—the power factor on test being poor, but the new replacement has not affected the slightest improvement in the picture.—R. D. Rapley (Hayes, Middx).**

Your fault is a heater-cathode leakage on the C.R.T. This may be cleared by fitting a 2 volt low capacity C.R.T. transformer instead of the present heater supply. Remove the existing heater and other wiring before connecting the 2 volt secondary of the transformer to the C.R.T. base and use chassis and the top end of the mains fuse as useful points to obtain a switched mains supply. The transformer should mount on the two holes at the bottom of the rear hoop holding the chassis.

## G.E.C. BT5145

**A few seconds after the picture comes through it begins to break up from the top and is quickly blotted out by horizontal lines about ¼in. apart, very similar to sound on vision but permanent. If I switch off then on again after a few seconds, the same thing happens. It seems a perfect picture for those few seconds. Also the focusing magnet has to be set at an acute angle to get the picture in centre. Is this likely to cause any trouble ?—T. Sherliker (Kings Heath, Birmingham).**

The break-up of the picture may well be caused by a drift in the line oscillator valve as it warms up. You would be advised to check this valve by substitution.

No harm will result from having the focus magnet set as described. The reason for this could be in the tube itself—this may have a gun assembly which is twisted—or a faulty magnet producing an incorrect field on the tube axis.

## MARCONI VT3DA

**Could you please let me know the following: Vision I.F. frequency, sound I.F. frequency, C.R.T. heater volts and current.—M. Nevill (Welling, Kent).**

The I.F. is sound 10.5Mc/s, vision 14Mc/s. The tube is an Emitron 14KP4 (Mullard equivalent MW3624) which has a 6.3V, 0.3A heater.

## FERGUSON 997T

**For the past 10 days or so the whole picture shakes sideways, only a very small amount and very quickly. Apart from this the picture and sound are good. I have read all the servicing information on this set published in your journal and I have tried everything I can think of including valve substitution (renewal of EY51), checking screening can to chassis, etc. When the trouble first started I put it down to atmospherics. I will be grateful for any suggestions you can offer.—A. Leslie (Sutton, Surrey).**

This fault is caused by trouble in the line flywheel circuits. In most cases the trouble is the result of a fault in V15, V16 or V17, these being the two EF80's situated either side of the line oscillator transformer in the near left-hand corner of the chassis when viewing from cabinet rear, and the EB91 directly behind the transformer. Check with valves known to be in good order.

Another cause is alteration in value of the 0.01$\mu$F capacitors (2) across the windings of the line oscillator transformer. They are contained in the screening can.

## FERRANTI 14T3/D (Converted)

**The above set was given to me with sound O.K. on both channels. The raster is working, but there is no picture. I have tried all appropriate valves by substitution, but now have no raster and the sound is completely dead although all valves light up except EY51. Your comments would be appreciated.—L. Ramsey (Streatham, S.W.16).**

The original fault may be caused by breakdown of a decoupling capacitor and resistor in one of the vision I.F. stages. A close study of the components will reveal the burnt resistor. The capacitor should also be replaced.

The additional fault is caused by failure of the line oscillator. You may have instigated a short-circuit during your previous tests, or the line output transformer may have broken down.

## COSSOR 930

**I should be pleased if you would tell me how to connect the Philco turret tuner No. A1747 to the above set. The arrangement appears different from standard and I have no circuit diagram of the tuner. I enclose a copy of the instructions. I have already altered the leads on the turret tuner plug to correspond to the 6BX6 socket**

**of the Cossor.—A. C. Wildsmith (Nevilles Cross, Durham).**

We suggest you proceed as follows: Short R7, remove C11 and take the H.T. end of R12 to chassis. Remove V1 and V2 and plug in the two plugs from the tuner. The V2 plug should be amended so that the wire which went to pin 1 goes to pin 7, the wire which went to pin 2 stays there. The wire which went to pin 3 goes to s and 1, the wire which went to pin 6 goes to 8, and the wires to pins 7 and 8 are taken to s and 1.

The heater wires now go between 4 and 5, instead of between 9 and 4 and 5 joined. L4 will now take the place of T5 in the instructions.

## *PYE FV1*

**The EHT on this set suddenly ceased. I fitted a new EY51, but still no EHT. I then examined the line output transformer and found a short on the heater winding. I fitted a new transformer, improved type with anti-corona cup, but still no EHT. The EY51 heater does not light. I have changed the frame and line oscillator valves, the line H.T. volts are only 125 volts but should be 200. I have changed the rectifier and the main condenser, but the H.T. volts are still 125.—J. Macey (Barking, Essex).**

Your low H.T. is associated with your present trouble, and the metal H.T. rectifier or 100$\mu$F section of the smoothing condenser are usually the culprits. Check these two items again and ensure that you have 230V A.C. on the mains side of the metal rectifier.

If overheating takes place you may have an H.T. short, and if this coincides with the disappearance of your EHT we advise you to suspect the deflector coils. These may be checked by disconnecting their line coil feeds. If they are faulty this action will restore EHT.

## *MARCONIPHONE VT53DA*

**The picture "jitters" so that there are two pictures, vertically. Frame linearity and vertical hold will remove fault, but adjustment is critical, and the vertical hold is at extreme setting so that the picture is liable to roll. Please can you advise me as to the trouble?—R. F. Angel (Potters Bar, Middx).**

Sharply tap KT33C valve to see if this is causing the jitter, then check the small red and black rectifier (WX6) which is on the long tag strip under the chassis (interlace diode) and the associated 330pF filter capacitor.

## *ULTRA Y73*

**Can I use a Mazda C.R.M. 171in. tube in an Ultra Y73 combined TV and radio receiver? I note in the data booklet, the scanning angles are given as 51deg. for C.R.M. 151 and 69deg. for C.R.M. 171 tubes. I can overcome the tube mounting difficulties and also heater supply, but will the present line timebase have sufficient power to scan the C.R.M. 171 tube?—J. Roe (Brighton 6).**

Although the C.R.M. 171 can be fitted you may find the line power insufficient to scan the tube horizontally. However, the resultant lack of width will not be severe. It is corner shadows which may prove most troublesome. As far as the heater is concerned, the 2V supply will have to be removed and a 12.6V transformer installed. The required first anode supply for pin 10 may be derived from the junction of the width and linearity coils.

## *FERGUSON 989*

**I have a Ferguson 989 which I would like to convert to receive Channel 10 STV. I have a 13 channel tuner, but I do not know what stages to cut-out or what other connections to make. I have a circuit diagram for the set.—A. Cameron (Whiteinch, Glasgow).**

The tuner unit must have an I.F. output of 16-19.5Mc/s, oscillator high, and must have series heaters (PCC84/PCF80). You must identify the various tags or leads such as the two heater tags (L.T.), the H.T. tag, the I.F. output and the cathode and grid tags (if any). You should remove the rear right side EF80 (V1) and the next EF80 (to its right) which is V2. Join pins 4 and 5 on V2 socket together. Connect the tuner heater leads to pins 4 and 5 of the V1 socket. Join the H.T. lead to pin 8 of the V1 socket. Join the I.F. output (inner) to pin 7 of the V2 base with the screening of the coaxial cable joined to pin 3. Join the cathode connection (if any) of the tuner to pin 3 of the V1 base and the grid connection (if any) direct to chassis (of the tuner). Connect the metal of the tuner to the receiver chassis with a length of braiding to ensure good contact.

## *AMBASSADOR CONSOLE*

**I have a 2V output and boost isolation transformer with which I wish to boost a 2V tube in an Ambassador (15in. round tube) console set, the tube being a Mazda C.R.M. 1523.—D. Walters (Alfreton, Derby).**

As you do not quote the receiver model number we must assume this to be TV10C. When fitting the transformer, first remove the existing heater leads to pins 1 and 12 on either side of the keyway. These leads must be separately taped, not joined. The secondary leads from the transformer are soldered to pins 1 and 12 in their place, leaving the 100kilohm resistor in position. The primary leads are taken, one to chassis, one to the 230V mains tap or to the on/off switch. If desired both leads may be connected to the on/off switch.

## *ALBA T744*

**Quite recently my 17in. television set has been giving trouble. On switching the set on in the evening, the picture is very good and full size, but after a while it is reduced in size by a black section along the bottom and right-hand side. This section cannot be cleared by any of the controls. If a particularly light coloured picture is shown, a black semi-circle appears at the top of the screen, and gradually blots out the whole picture. A slight turn of the contrast control, to darken the picture, and the picture immediately appears although, of course, darker than at first.**

*(Continued on page 215)*

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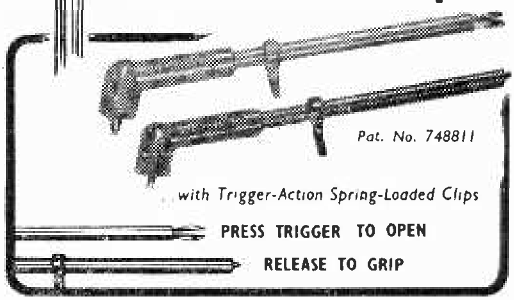


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**If the set is left completely alone, the picture only appears again if a darker scene is shown. As this darkening of the screen only occurs during certain programmes, I cannot think that there is much wrong with the set, and would very much appreciate your help in rectifying this fault. —J. T. Stonehouse (Bradford, Yorks).**

We would advise you to change the PY82 H.T. rectifier, centre the picture by means of the shift lever on the focus assembly and set the ion trap magnet on the rear of the tube neck for maximum brilliance. If the picture still fades in bright scenes, change the EY86 EHT rectifier valve.

### *G.E.C. BT2747*

**Please can you give me details for replacing C.R.T. 7401A in the above model?—J. Ridgway (Newcastle, Staffs).**

Remove the back, cabinet internal screening lead and two screws holding cabinet chassis. The cabinet can now be removed. Do not forget the knobs. Detach EHT connector and base connector of tube with ion trap magnet if fitted. Release two clips securing strap round tube and, supporting tube with one hand on flare and other hand on coil assembly, draw tube slowly forward until clear. Do not tilt tube as the neck may break. To replace reverse the procedure.

### *McMICHAEL T.M.51*

**This set was out of use for a long time and on trying it, it operated normally for about 30 minutes and then the EHT failed. The EY51 was replaced without success and the line output valve was tested and found O.K. All H.T. voltages appear to be correct, D.C. resistances of line output transformer and associated components are correct. It was noticed that the line transformer was rather warm and insulation was melting. I removed EHT heater winding, which consisted of about 10 turns of varnished copper wire which appeared to be in order. I have rewound with polythene covered aerial wire and although there is a hefty spark at anode of EY51 there is still no life at heater end of this valve. Disconnected EHT smoothing condensor, removed tube anode clip but still no life. There appears to be a faint sound of oscillation which varies with line hold control. Width and line coils checked for continuity.—R. Davies (East Keswick, nr. Leeds).**

Our only suggestion is that the line transformer is at fault and was from the start. The only cure is a replacement or a rewind. The one fitted by McMichael now is a modified and more efficient one.

### *BANNER BT117*

**Although there is a very good picture on both channels and the aerial is the same as when set was new five years ago, the scan lines appear to continually vibrate causing background flicker on the screen although picture is perfectly locked.—S. Edwards (Spool 5).**

You should try the effect of adding to the existing H.T. smoothing. Try connecting a 200$\mu$F, 275V.W. capacitor across the H.T. line. The flicker may be caused by non-standard mains.

### *SPENCER WEST MODEL 174*

**The vision on both the BBC and I.T.A. is perfect, but the only sound is a tuneable hum. Is the fault in the turret tuner or in the other part of the set?—F. Mather (Leigh, Lancs).**

The fact that a tuneable hum is received shows that the sound stages are in order and that the fault is in the turret. The PCF80 is likely to be at fault.

### *DECCA MODEL D17*

**What is the method of picture shift for the above model?—R. Angell (Codnor).**

The picture shift controls on the Decca D17 provide a small amount of D.C. through the line or frame scanning coils. The effect of the current is to move the picture in accordance with the direction of the current flow. This is a development of the system used on the earlier Plessey Mk. II chassis (as in the Regentone Big 12, etc.).

### *INVICTA T112*

**My set is completely dead and I suspect short or open circuit in power transformer. I also find sparking in middle of central rectifier and I am wondering if this could indicate a further fault in the set. I should be obliged if you could tell me the type of transformer I require for a replacement.—R. Robertson (Falkirk, Stirlingshire).**

There is no mains transformer in the T112. It is an A.C./D.C. receiver with series connected valves. If there is no sign of life at all, this is probably due to a flashover—the metal rectifier blowing the fuse(s). Check the fuse(s), see that the on/off switch is working and establish continuity of the mains dropper resistor, if the fuses are in order. Then check the heater chain (checking the valve heaters in turn).

### COSSOR 944

**The trouble is lack of brightness, very poor contrast, out of focus and distortion. When the room is in complete darkness and I turn the brightness very low there is nothing wrong with the picture quality at all. At all times the picture remains the same size.—H. Marks (Ponders End, Middx).**

Your symptoms are those of a low emission on C.R. tube. Before discarding it, try readjusting the ion trap magnet, which may have slipped from the setting of maximum brightness.

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PRACTICAL TELEVISION, JANUARY, 1960.

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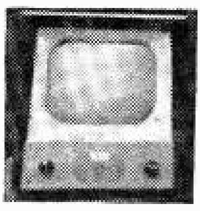

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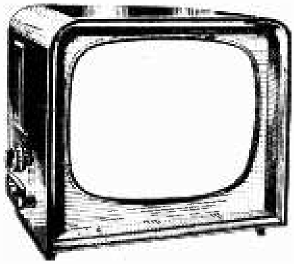

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