# Practical TELEVISION

MARCH 1965

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- TV–DX
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- D.I.Y. GUIDE TO SERVICING
- IMPROVING THE P.T. CCTV CAMERA
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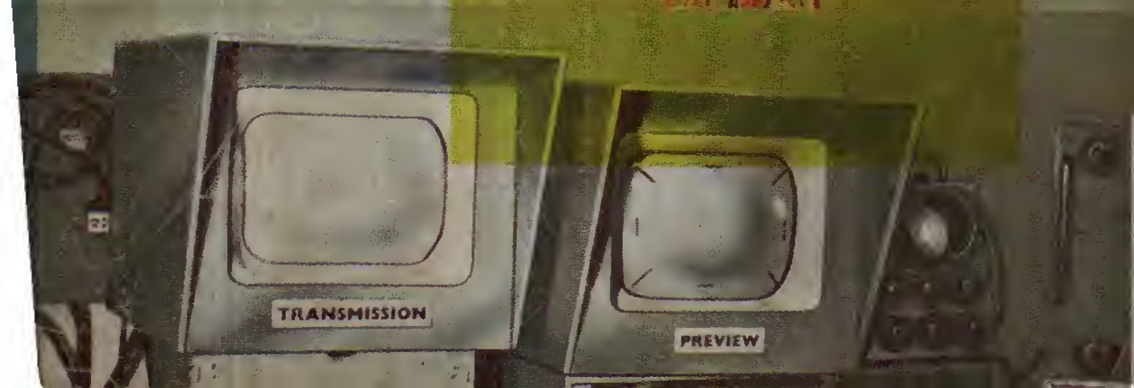

# Practical Television

AND TELEVISION TIMES

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## Contents





## A Matter of Time

A DISCUSSION on the subject of video tape recording struck a responsive chord in one venerable member of the staff. He produced a volume of PRACTICAL TELEVISION and pointed triumphantly. And there it was—an article entitled "Canned Television." The date? November 1934!

Intrigued, we continued to delve. It was an eerie experience, turning back the pages of history, becoming absorbed in a world of scanning discs, mirror drums and the undeniable atmosphere of optimistic enthusiasm which prevailed in the year 1934.

These were the vital months, when TV was in the melting pot, when the exciting prospect of a public TV service was imminent, when a Committee had already been set up to reach decisions which would set the pattern for many years to come.

Many P.T. articles were mechanical—"Building the PRACTICAL TELEVISION Visor" (cost about £5), "An Improved Viewing Funnel using a Loudspeaker Horn", etc. A TV set in those days was a curious device based on the scanning disc. The "Visor" contained the scanning apparatus which had to be used in conjunction with two receivers, one for sound (transmitted on the Midland Regional m.w. station) and one for vision (transmitted on the m.w. London National). A situation somewhat analogous to today's rather clumsy stereo experimental transmissions.

These 30-line transmissions were made from 11-11.45 p.m. Wednesdays and 4.30-5.15 Saturdays—"not the ultimate" says P.T. in a glorious understatement!

But despite the crude stage of the art we read about things like Noctovision (TV in the dark), Phonovision (a recording technique) TV Telephones and even Colour TV—modern-sounding ideas in an age still only just out of the crystal set era.

Amateur TV gets its start around this time, too. The P.M.G. announces that licences will be issued for transmissions around 10 metres. G2UF of Manchester seems to have been one of the first, putting out 30-line TV.

The method of scanning was debated at length. Scanning disc, mirror drum, film, and the c.r.t. ("it has great disadvantages"). But the talk of "high definition" grew more pronounced as we read on and at Radiolympia 1934 visitors could see "the new cathode ray tubes and televisor complete" as well as 30-line equipment exhibited by manufacturers and PRACTICAL TELEVISION.

Even so, the Television Society voted 92% in favour of carrying on with the 30-line transmissions. And all sorts of people put their foot in it, e.g.: "Television will not adversely affect the cinema", "It will be hundreds—perhaps thousands—of years before good television comes".

It makes you wonder how today's prophesies will work out. And brings us back, in a roundabout way, to video recording. The "canned" system of 1934 is amusing now, but was taken seriously at the time; how will current techniques look in the years ahead? (see page 256).

After our brief, but instructive flashback to the pioneer days we do not intend to stick our necks out at the moment, but we are pretty safe in nominating one development as a certainty—and we suggest you turn now to page 263 and you will see what we mean!

**Our next issue dated April will be published on March 18th.**

# TELETOPICS

## New President for Television Society

MR. F. N. SUTHERLAND, Deputy Chairman and Managing Director of the Marconi Company Limited, is the new President of the Television Society. The Council of the Television Society announced recently that Mr. Sutherland had accepted an invitation to become the new President of the Society, taking over from Sir Robert Fraser, the retiring President, who held office for two years.

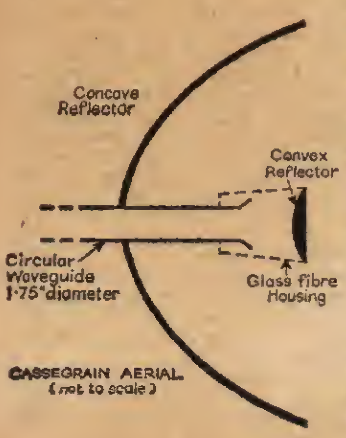
Apart from Mr. Sutherland's association with the Marconi Company, he is also one of the radio industry representatives on the Postmaster General's Television Advisory Committee. In addition, he is a member of the Council of S.B.A.C. and vice-chairman of the Conference of the Electronics Industry and president of the Electronic Engineering Association.

## Low-cost Aerial for Microwave Links

SCIENTISTS of Standard Telephones and Cables Limited, have produced a new low-cost aerial for microwave radio links.

The new aerial achieves extremely parallel and efficient beam transmissions by employing a principle of double-focusing which was originally applied to optical telescopes in 1672 by Professor Cassegrain, of Chartres University. Because they behave similarly to light beams, microwaves can be focused in the same way by the application of Professor Cassegrain's invention.

In the STC aerial, a large *concave* reflector (see diagram) directs received signals on to a small *convex* reflector. A circular waveguide then feeds the energy to receiving equipment. This system is analogous to Cassegrain's telescope in which a small convex mirror is placed near the focus of a main, large concave mirror. The received image is viewed through a hole in the large mirror, the incoming rays therefore being subjected to focusing and re-focusing.




CASSEGRAIN AERIAL (not to scale)

The STC aerial will replace, without loss of performance, the "hog-horn" aerials used on many radio towers at present which are considerably larger and more expensive. The first practical use for the aerial will be on the new TV/telephone link between London and France, now being built for the GPO.

### SPACE FEATURES HIGH IN TV CONFERENCE

"TV systems for spacecraft", "colour TV film camera chains" and "hyperstabilised tracking zoom lens" are just three of the subjects to be dealt with during the twelve sessions of the forthcoming technical conference of the Society of Motion picture and Television Engineers in Los Angeles, U.S.A.

The main theme of this conference—to be held from March 28th to April 2nd—is technological advances in motion-picture and television and a large proportion of the chosen papers have as their subject problems relating to the use of television in space research. This fact, and the proposed visit of one of the National Aeronautics and Space Administration's astronauts to the conference, probably reflects the importance attached, in the United States at least, to TV surveillance of one sort or another in space flight.

### CCTV FOR ROYAL FESTIVAL HALL

A CLOSED-CIRCUIT television system installed in London's reconstructed Royal Festival Hall will enable future latecomers to enjoy the performance on TV receivers until an interval allows them to take their seats without disturbing those already in the auditorium.

EMI Electronics Ltd., who installed one of their type 6 mini-cameras in the Circle spotlight housing, have also fitted four 23in. receivers in the foyer and in two bars.

The camera has been fitted with a wide-angle lens to take in the whole of the stage and the tube's sensitivity adjusts automatically to different ambient light conditions.

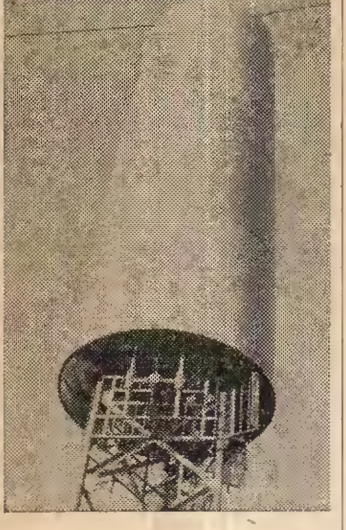
# New NTSC—Plus System of Colour TV

ON Friday, 5th February, Dr. N. Mayer of Institut fur Runfundtechnik, Munich, gave a lecture entitled "The NTSC colour Television System Using Additional Reference Transmission" in the Conference Suite of the ITA in London's Brompton Road. The announcement of the lecture from the Television Society included the following synopsis of Dr. Mayer's interesting lecture.

A small carrier of special nature is added to the NTSC signal in order to obtain an additional reference transmission (ART). In the receiver this additional carrier is separated from the chrominance signal by the aid of a delay line and is then used as a sub-carrier in the demodulators. For the reception either an NTSC receiver evaluating the normal burst or a special receiver with a delay line may be used. The NTSC transmission is thereby completely insensitive to differential phase, as far as the ART receiver is concerned.

The performance of such a conception was investigated in detail. The ART receiver shows the same sensitivity to flat noise between coder and decoder as the normal NTSC receiver. The sinusoidal interference sensitivity is also the same. The compatability is slightly worse compared with NTSC, as it is in the SECAM and PAL systems. Judging from first results, the ART reception appears to be somewhat less sensitive to multichannel reception compared with the normal NTSC reception. Further work has indicated simpler possibilities to evaluate the average differential phase error of the transmission path and to control by this the chrominance demodulation. In this case the receiver does not need the delay line, but a synchronised switch only.

## NEW TV AERIAL COMPLETES TESTS



*One of the new cylindrical aerials which have been designed by EMI Electronics Limited to take over ITA transmissions at certain stations where new, higher masts are being built. This one is destined for Bolton, Lancashire, where it will be erected at the Authority's Winter Hill station.*

*During its works tests, a rigger at EMI's Hayes laboratory (above) adjusts a distribution feeder on one half of the aerial. Soon it will be installed at a height of 700ft. on a new 1000ft high mast.*

*The aerial consists of eight rings of full-wave dipole panels which are encased in a 12ft. diameter cylinder of glass-fibre-reinforced plastics. Operation will be on channel 9 with an effective radiated power of 100kW.*

## British Firm to Equip TV Station in Australia

A NEW television station which will eventually serve the city of Perth, Western Australia with commercial programmes, will be supplied with much of its studio equipment by Pye T.V.T. Ltd., of Cambridge.

Pye were awarded a contract for the equipment by Swan Television in conjunction with Thomson Television (International) Ltd. Under the contract, telecine units, vision mixers and seven 4½in. image orthicon cameras will all be supplied.

## B.R.E.M.A. Demonstrates NTSC in Moscow

AT the request of Mr. Sergei Novakowski, head of the Moscow Radio Institute, a team of British radio engineers recently went to the Soviet capital to provide a demonstration of Britain's newest colour television techniques. The demonstrations were designed to help Russian engineers evaluate the three systems of colour TV transmission from which, in April, the C.C.I.R. will try to choose a standard for the whole of Europe. As the Soviet countries hold around 50% of the voting power of this C.C.I.R. meeting, the impressions left by the demonstrations may greatly influence the final decision.

The British team of engineers was led by Mr. Bernard Rogers, research engineer of Rank-Bush Murphy. During the demonstrations the team took part in a series of television transmissions on all three systems, NTSC, SECAM and PAL. Rank-Bush Murphy and R.C.A.-designed colour receivers were used for the NTSC tests, and a number were set up around the city within a fifteen to twenty mile radius and fed with programmes on channel 8 over land-lines.

Sponsoring all the demonstrations was the British Radio Equipment Manufacturers' Association.

## R.C.A. PRODUCE THREE MILLIONTH COLOUR TUBE

TOWARDS the end of 1964, the Radio Corporation of America produced their three millionth colour television c.r.t. This was stated in a recent RCA announcement which also revealed that the Company would produce one-and-a-half million colour tubes during 1965, making the estimated total for the year from the whole of the U.S. valve manufacturing industry, 2,200,000.

Some further notes on the

# PRACTICAL TELEVISION CCTV CAMERA

## CIRCUITS FOR IMPROVED PICTURE QUALITY

by E. McLaughlin

ALTHOUGH our closed circuit television camera design is capable of very good picture quality in its form as published, given proper adjustment of controls, certain aspects were considered worth further attention in order to produce optimum quality for such more refined applications as CCTV microscopy. The editor therefore requested the author to examine these points experimentally in conjunction with the preparation of an article on optical systems for CCTV. (**Practical Television**, Aug.—Sept., '64.) The present article represents a brief report of the experimental results regarding useful electronic improvements to the basic equipment. These largely concern matters connected with the linearity of the field scan timebase for the camera vidicon, which was recognised as being an extremly important factor influencing picture quality and stability. As far as other adjustments are concerned, it must be re-emphasised that the instructions published in the original series of articles, "A closed circuit TV Camera", by E. McLoughlin, **Practical Television**, Oct., '63—Feb. '64, should have been carried out, down to the last detail before proceeding to make use of the further information given in this article.

### *Introduction of a Frame Mask*

Fig. 8 on page 60 of PRACTICAL TELEVISION, Nov., 1963, and the associated text gave details of a front-rim connector for the vidicon target (signal electrode) in the form of a spring-fitting brass ring with circular cut-out exposing the entire front target area of the vidicon tube. This form has the advantage that slight decentering of the scanned raster on the vidicon target remains unimportant, the receiver still displaying a complete picture as long as the raster remains completely within the vidicon target area. This simplification was useful here because, as will be remembered, no alignment coil is used to centre the raster, the makers having advised against its use in simple amateur designs. However, a disadvantage of this arrangement is that no mechanical mask exposing only a rectangle (9 x 12mm) on the vidicon target is usable. It will not, in general, be possible to assure coincidence of the mask "window" and the position of the scanned raster on the target, so that part of the scanned raster will be "behind the mask" and cause shading-off of the corresponding area on the receiver screen. On the other hand, the use of such a mask is very desirable, because the scan amplitudes can be made such that the raster projects *very* slightly beyond the mask limits all round (symmetrically) on the target, therewith generating the black porches before and after all line and field (frame) pulses. These porches, as is well known, contribute greatly to sync stability, i.e. to picture lock rigidity, on the receiver.

A target connector similar to the one previously used was consequently made, but with only a rectangular cutout (9 x 12mm) positioned symmetrically over the target instead of a larger circular hole exposing the entire target area. The ring and mask were made in one piece from hard brass. The photograph shows this connector with mask cut-out in position on the front end of the vidicon.

### *Addition of Shift Controls*

With a fixed mask now in use, it was essential to provide some means of moving the scanned raster about on the vidicon target without altering its geometry, in order to centre it in relation to the mask window. This function is normally undertaken by the alignment coil in commercial units. For our present purposes, very similar results are obtained by passing small d.c. currents of the appropriate polarity through the scan coils, in addition to the normal scan waveforms. It is merely necessary to block the d.c. from the secondary of the scan transformer with a suitable capacitor, making it flow entirely through the scan coils (and a variable resistor acting as shift control) from a suitable rectifier and smoothing circuit operating off the a.c. heater line. Fig. 1a shows the simple circuit arrangement which was found to be highly successful in the prototype.

C1, C2, D1 and D2 together constitute a conventional cascade voltage doubler rectifier circuit, developing a supply of about 16V d.c. across C2.

R1 and C3 provide smoothing. VR1 enables the amount of d.c. fed to the field scan coils to be adjusted and therewith acts as vertical shift control moving the raster bodily up and down on the vidicon target without changing its geometry. If the optimum setting is too near the zero resistance setting of VR1, causing severe attenuation of the scan waveform, R1 should be reduced accordingly.

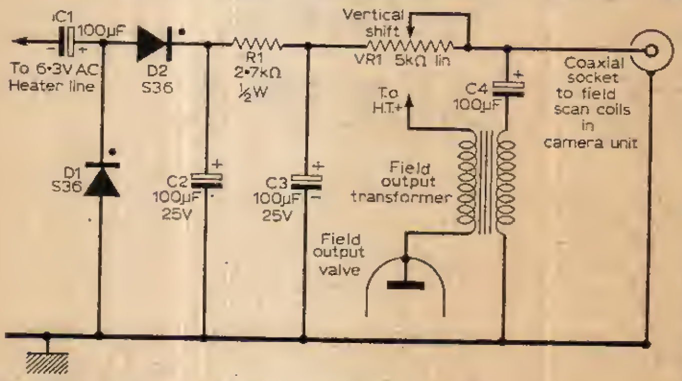
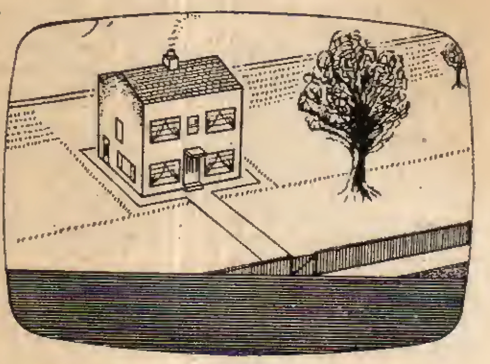



*Fig. 1a (above)—Additional vertical shift control circuitry to provide positive field shift current to correct the fault shown below.*

If a positive d.c. supply is required for the shift current (Fig. 1a; uncorrected raster sits low on the vidicon target) then this can be obtained from the main h.t. supply through a suitable series resistor. Only about 3mA d.c. shift current is normally required in the field scan coils. It might just as easily happen that the uncorrected raster sits high (Fig. 1b), requiring a negative d.c. supply for correction. This is immediately available, as shown in Fig. 1b, by reversing all four capacitors and both diodes. A negative supply could not be obtained from the main h.t. supply, but might alternatively be obtainable from the existing bias lines.

### *Poor Shift-circuit Smoothing*

If the smoothing in the shift-circuit d.c. supply is inadequate, e.g. if C3 in Fig. 1a were disconnected or of insufficient capacity, then a picture fault as shown in Fig. 2 will appear on the receiver. One half of the frame will be very slightly darker than the other, with a sharply defined horizontal



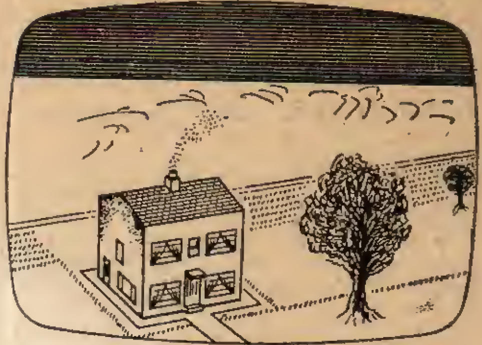


*Fig. 1b (below)—Additional circuitry for negative field shift current, to correct the picture fault above.*

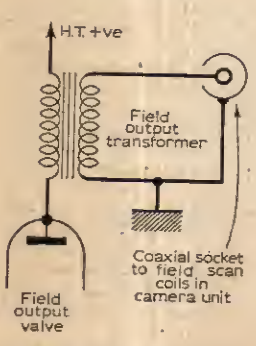
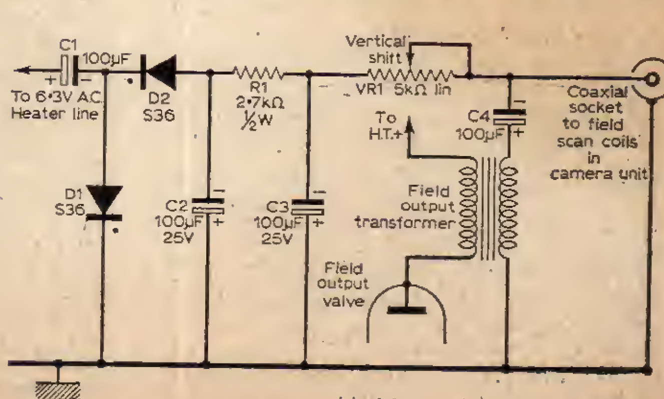



*Fig. 1c—Previous unmodified circuit—without vertical shift control.*



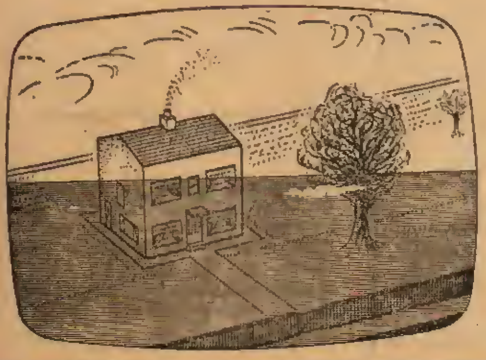
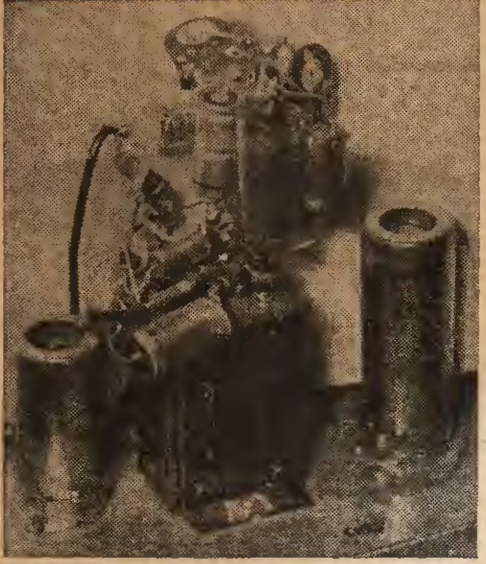


*Fig. 2—The result of insufficient smoothing in the vertical shift circuit for the vidicon (e.g. CX in Fig. 4a absent or of low capacity).*



*The completed field output transformer with additiona components mounted on the tag-strip.*

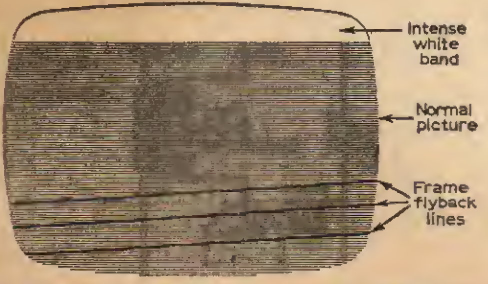



*Fig. 3—Faults due to field scan non-linearity on the vidicon target (see text).*

dividing line in the middle of the picture between the two areas.

At the start of the half-cycle during which D2 conducts, the voltage on C2 suddenly begins to rise, so that shift current suddenly begins to increase and make the actual scan suddenly go slower than in the first half of the frame. As a result, smaller areas of the vidicon target are being scanned per unit time, i.e. less charge is picked up per unit time; but the receiver screen area scanned per unit time remains the same in both frame halves. The bottom half of the picture on the receiver is therefore slightly darker than the top half. R1 and C3 in the shift circuit remove this effect, because they give the necessary smoothing to even out the shift current over an entire frame period.

### *Line Scan Shift*

It was not found necessary to make any modification to the line scan timebase circuit in our prototype after introduction of the vidicon target mask. Judicious adjustment of line amplitude and line linearity controls on the camera control unit led to satisfactory coincidence with the mask limits at the left and right thereof.

If any reader should be unable to achieve a satisfactory adjustment in this manner, the same shift circuit as used for the frame scan can be applied in an analogous manner to the line scan. The resistor values will be somewhat lower, because the line scan coils operate at lower impedance, i.e. higher current.

It is fortunate that a shift circuit was required only for the field scan, because this was readily accommodated on the existing tagstrip assembly on top of the field output transformer (see photograph), whereas the insertion of line shift components in the sub-chassis line timebase wiring would have been more awkward. If line shift should prove to be indispensable in some constructions, it may be more convenient to fit the necessary components inside the camera head instead of underneath the control unit chassis.

### *Field Linearity Faults*

Fig. 3 shows two faults on the receiver screen which appeared at various times on the camera control unit with the circuit as published. These faults could certainly be made to disappear entirely, by careful adjustment of the scan controls and the beam current control on the vidicon. It was then decided to investigate the causes of such effects more closely, with a view to removing them permanently. The symptoms were found to be the results of non-linearity of the field scan on the vidicon target.

The scan current in the field coils is always low at the start of a frame, i.e. at the top of the picture, because the field output valve is then near cut-off. After the field flyback has been completed, the current in the output valve and in the field scan coils starts to rise, reaching maximum at the end of the frame, at the bottom of the picture. If the otherwise steady rise of current throughout the field happens to start with a jump before steadying down to its mean rate of rise, a large area of the vidicon target is scanned during the jump, causing a large

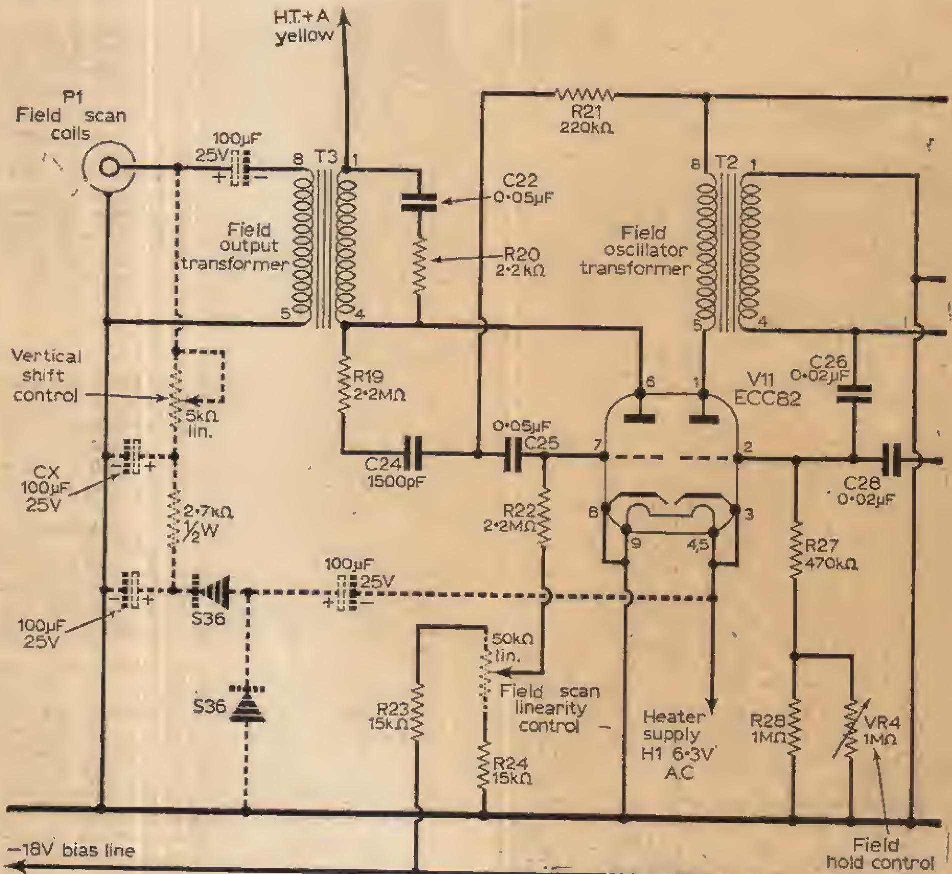



*Fig. 4a—Part of the field circuit of the CCTV camera control unit. The circuit and component numbering remains as originally published and additions and modifications are shown dotted.*

charge-collection in a short time at the signal electrode. The steady-running receiver field timebase only covers a small strip at the top of the picture in this time, which is consequently extremely bright in relation to the rest of the picture. Indeed, this sudden peak white following every field flyback in the video waveform, regardless of picture content, can easily upset the field lock if it saturates the video amplifier, as can easily happen in severe cases of this nature.

The second fault shown in Fig. 3 concerns the bottom of the picture, i.e. the end of the field stroke and the start of the field flyback, which take place when the field output valve is drawing maximum current. Referring to Fig. 4a, the field oscillator valve V11 (pins 1, 2, 3) cuts on briefly at this time to draw a heavy pulse of anode current through T2 primary which discharges the field timebase capacitor C23, therewith producing the field flyback. At the same time V12 produces the negative grid blanking pulse at P3 during the field flyback. This cuts off the beam current in the vidicon during field flyback, to prevent the returning beam from interfering with the picture charges already accumulating for the next frame. Now the vidicon beam is not cut off instantaneously; the total cable and other stray capacities operative at P3 (vidicon grid circuit) first have to discharge. This will generally take a time equal to a few line scan cycles. However, the discharge of the field timebase capacitor C23 starts without delay, so that the vidicon beam itself would start to return to the top of the field (flyback proper) immediately, before the vidicon grid has had time to cut off completely. As a result, the vidicon team is still able to discharge picture charges on the vidicon target during the first few line periods of the field return, so that the corresponding field flyback line *positions* are deficient in picture charge during the next proper frame. They are therefore visible as *black* lines over the lower region of the picture displayed on the receiver. They will generally drift about in some arbitrary **manner,**

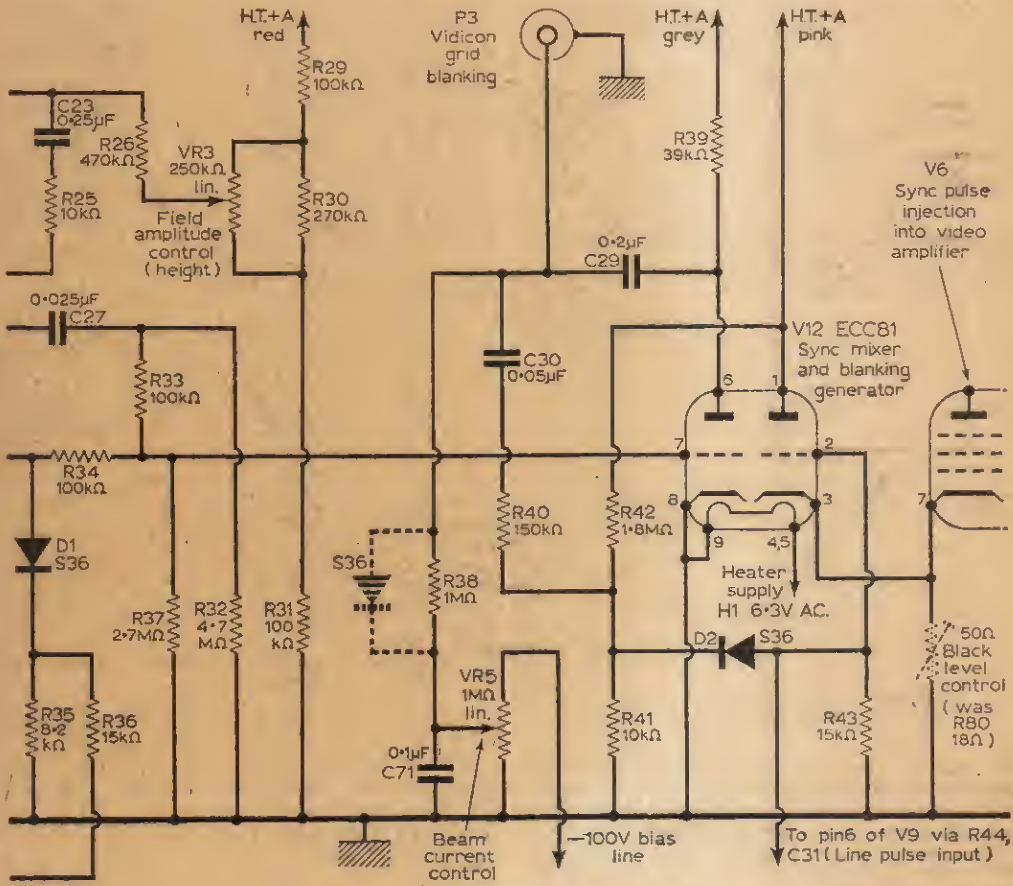



*Fig. 4b—The remainder of the field circuit.*

because no frequency or phase lock between line and field scan frequencies is used or necessary in this simplified system.

#### *Cures*

The intense white band at the top of the picture, due to a sudden commencement of scan current with a jump or rise after each field flyback, is cured by adjusting the operating point and drive applied to the field output valve such that this sudden current rise appears at the bottom bend of the characteristic, near cut-off. This " irons it out " and brings it into line with the main frame run (see Fig. 5). As far as the cause of the current rise is concerned, it may be said that this is fundamentally unavoidable. Its origin lies in the voltage drop across R25 (Fig. 4b) which suddenly re-appears after every field flyback and corresponds to the re-commencement of the steady charging current for the field timebase capacitor C23, which has to flow through R25. If R25 were absent, the field oscillator would not be able to discharge C23 properly during the field flyback, because its anode voltage would then have to fall to zero to do so. R25 is consequently essential. The resulting current rise in the field scan coils immediately following each field flyback has a slope directly proportional to the value of R25. If it is made to fall neatly on to the bottom bend of the field output valve characteristic, by suitable adjustment of drive and operating point, and the value of R25 is so adjusted as to suit the reduced slope of the valve there in relation to the slope on the linear part of the characteristic, it is possible to " iron-out " the rise almost entirely in the resulting anode-current waveform, as shown in Fig. 5. The field scan on the vidicon target is then entirely steady in this region and the intense white band at the top of the picture disappears.

The black flyback lines at the bottom of the field are caused, as we have seen, by the actual flyback on the vidicon target commencing sooner than desirable, before the field blanking pulse has fully cut-off the vidicon at its grid. We need to find a way to delay the start of the actual field return on

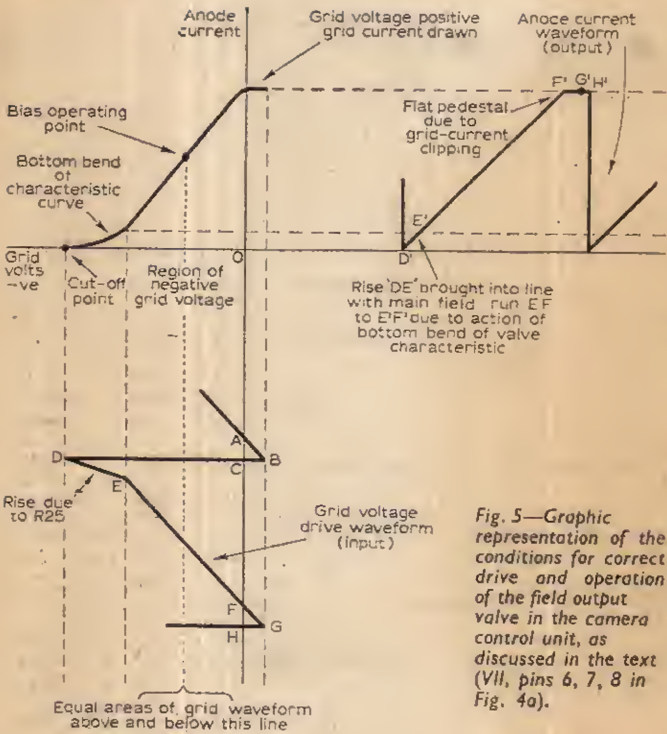
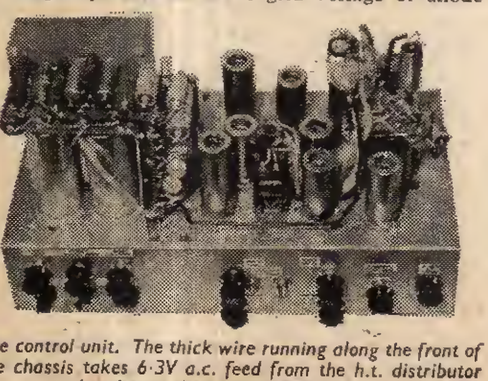



*Fig. 5—Graphic representation of the conditions for correct drive and operation of the field output valve in the camera control unit, as discussed in the text (VII, pins 6, 7, 8 in Fig. 4a).*

the vidicon target for a few line periods, even though the timebase capacitor C23 has commenced to discharge on the field flyback pulse and the vidicon grid is being driven to cut-off at P3.

The solution to this problem is to make use of grid-current in the field output valve, by applying a suitably heavy drive at its grid. The resulting action is clearly shown in Fig. 5. The last small portion of the field sawtooth at the grid, shortly before flyback (AB or FG), runs the grid of the field output valve positive, drawing grid current. R21 then immediately functions as grid-stopper, limiting any further rise of grid voltage or anode current. Now the flyback commences at points B, G on the grid waveform (Fig. 5). But the anode current cannot commence to fall, i.e. the vidicon beam cannot commence to return to the top of the scanned frame, until points C or H are reached on the grid waveform, where the applied drive starts to go negative once again and grid current ceases. The anode current, and consequently the field scan coil current, therewith rests at its maximum value during the time F'G'H', whereas the timebase capacitor is starting to discharge and the vidicon beam current is being driven to cut-off as from time G'. Provided the drive applied to the field output valve grid produces sufficiently heavy grid current excursions to make the time G'H' long enough for the vidicon grid to cut-off completely, the beam will not commence to fly back from the bottom of the raster on the vidicon target until it is completely cut off. It will then not wipe-out any lines during flyback, and all traces of the black flyback lines at the bottom of the picture will have disappeared.



*The control unit. The thick wire running along the front of the chassis takes 6·3V a.c. feed from the h.t. distributor bracket to the vertical shift circuit.*

### *Operating Conditions for the Field Output Valve*

The foregoing remarks should have made it clear that the selection of a suitable operating point and correct grid drive amplitude for the field output valve are vital factors for achieving high-class picture quality. We must therefore proceed to discuss the practical methods used to satisfy the salient conditions which we have seen to be necessary. Summing these up, it can be seen that the operating point (d.c. negative grid bias) should be at the Class A point, i.e. in the middle of the linear part of the characteristic, as shown in Fig. 5. The applied drive must be of sufficient amplitude to drive the valve round the bottom bend at the one extreme and into grid current at the other extreme, i.e. Class A1 drive is necessary, to use the standard terminology. The resulting anode current swing will be the entire swing of the mutual characteristic. If this does not happen to give just the right scan current amplitude in the field scan coils, as required to make the raster height equal to 9mm on the vidicon target, then no amount of shifting of the operating point of the field output valve will adjust the field height without destroying the Class A1 drive and producing the faults at the top and/or bottom of the picture as already described. Since it is essential to swing through the entire mutual characteristic at all times the only satisfactory way of adjusting the current amplitude is to *adjust the h.t. voltage.*

CONTINUED NEXT MONTH

# A new Do It Yourself Series

## A VIEWER'S GUIDE TO TV SERVICING

by H. Peters

*PART 1. PREPARING FOR THE BREAKDOWN*

THIS series is intended to assist the reader whose main interest in television is the keeping in good repair of the family receiver. In the fervent hope that it will not break down just yet this instalment deals with some of the preparatory work which can be done whilst the set is still running well.

This can be divided into two parts: that which involves handling the set and that which does not. To give you time to convince the family of the necessity of the former we will start with the latter.

### *Obtaining a Circuit*

This is easier said than done but is an essential preliminary to almost any sort of work on the chassis. The best circuit to work from is the maker's manual but to obtain it you need to be very lucky or have winning ways for its issue is restricted to authorised dealers who as a condition of their dealership undertake to hang on to it like grim death.

Occasionally I have heard of readers who employ a form of blackmail by refusing to buy a set unless it is accompanied by a service manual, but for most of you this is "stable door locking".

If you have no luck with your dealer, try the advertisers whose addresses can be found in the back pages of this magazine. They provide a good reliable supply of the more popular sheets at reasonable prices, but if they have been prepared from data supplied by the three trade magazines rather than the maker's manual, the circuit references may not be the same, and this fact should be remembered when ordering spares or writing to our queries service.

"I have changed C37 the 0·001μF screen grid decoupling capacitor on sound i.f. valve V5 (EF80)" takes longer to write, but helps us a lot more than "I have changed C37".

Readers who are near a large public library can usually look up details in Newnes Radio & Television Servicing, normally to be found in the reference shelves.

If your set is a "rare bird" it is worth trying to obtain the sheet for a near equivalent, a basic chassis, or the same chassis marketed under a different brand name. The tables in the recent series of "Changing Cathode Ray Tubes"* provide a rough guide to many of these equivalents.

### *Making a Rough Circuit*

Should you be unfortunate enough to have a set for which a circuit is unobtainable, try making a rough one. Our queries service can help here, for although we cannot supply circuit details, we might be able to mark up the valve types and their functions, if you send us a sketch of the chassis layout (don't forget the queries coupon and S.A.E. please!)

While you have the cabinet opened up, a worthwhile extra is to trace out the heater chain. This is nearly always in series across the mains, and a knowledge of the way it runs is a timesaver when you get heater-cathode leaks or heater fractures.

At the "live" end of the chain there is usually the ballast resistor, followed by the valves in the line output stage. At the chassis end, you should find the c.r. tube, and tuner heaters and any valve detector diodes there might be.

Some receivers have early Mazda 8-pin valves and in these there are usually two heater chains, one taking the 200mA "20" series, and the other the 100mA "10" series valves. These two chains join up just above the c.r. tube heater and tuner, both of which carry 300mA heater current.

### *Voltage Table*

If you have a voltmeter, it is extremely useful to make a table of d.c. voltage readings at the

* April—November, 1964.

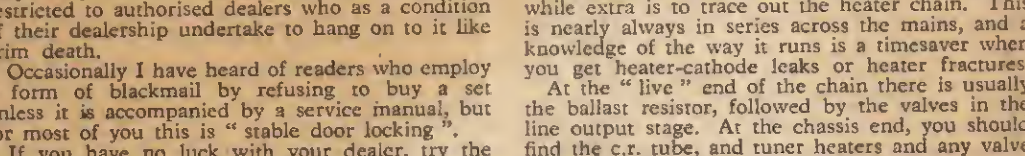



*Fig. 1—Tracing out the heater chain is a worth-while operation to carry out, for future reference.*

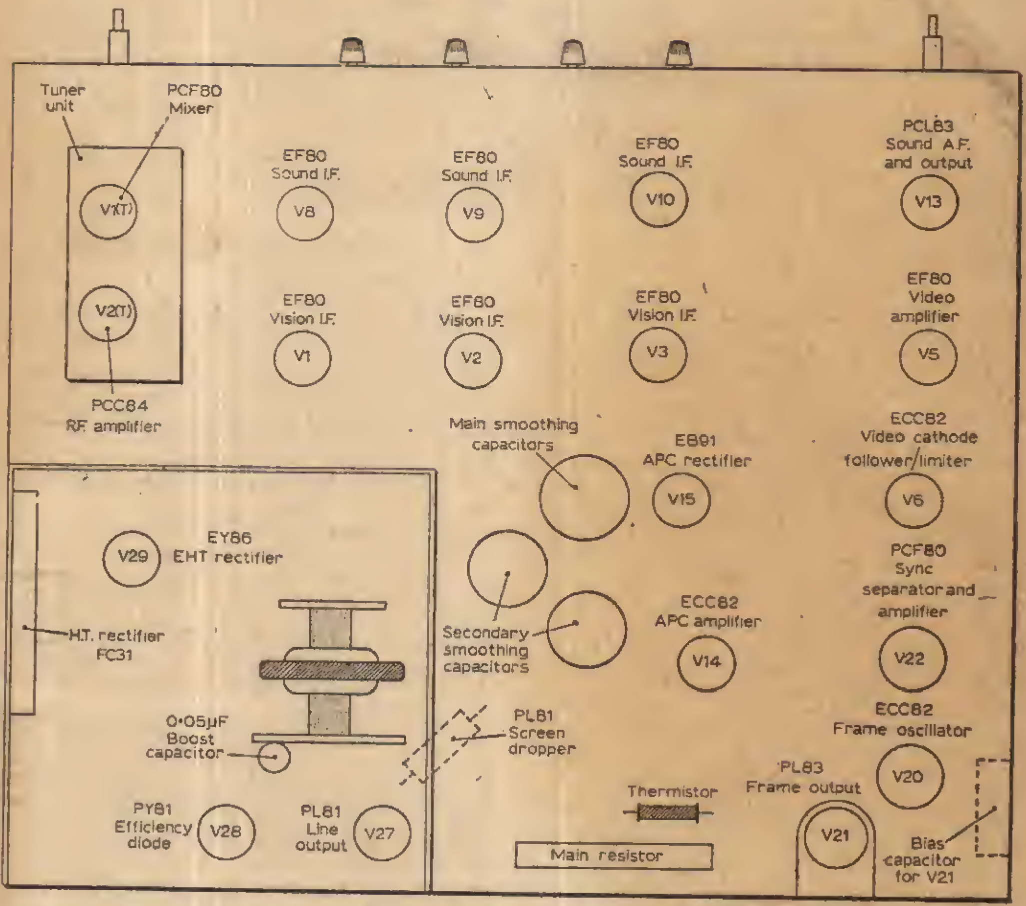



*Fig. 2—A rough chassis layout diagram like this one is a help when servicing. Our Query Service can help with valve type details.*

anode, screen, and control grids and cathode of each valve whilst the set is in going order. Fault-finding will be much easier later, and even if you have a manual, a number of voltages are frequently omitted, or made with a meter you couldn't possibly afford.

Make special note of the conditions of test, and measure the c.r.t. electrode voltages with both brightness and contrast controls fully up and down. Make a note of electrodes where the connection of the meter probe alters either the picture or the sound, and look out for negative readings. These are very useful.

At the sound detector a negative reading will indicate signal strength and in many cases the i.f.s can be tuned accurately by using this reading. The same applies to the vision a.g.c. line.

Negative voltages should also be present at the line and frame oscillator grids, indicating that the oscillator is functioning, and also at the output valve grids, indicating the presence of drive. The sync separator grid is usually heavily negative, and this voltage is frequently used to provide a.g.c.

**DO NOT MEASURE** the voltages at the top caps of the line output valve or efficiency diode, or on the scan coils. These points carry high voltage a.c. pulses, guaranteed to wreck any self-respecting meter.

### *Circuit Familiarisation*

This is a high sounding expression given to the cult of gazing at the circuit, or the chassis, or both. This can be particularly instructive if a routine train of thought is followed.

Try and find out how it takes to pieces and how much dismantling is essential to get at most components. Try and locate on the outside of the chassis (the part that is accessible by removing the cabinet back) an h.t. measuring point, the fuses, the ballast resistor, and a boosted h.t. test

*—continued on page 267*

A MONTHLY FEATURE FOR DX ENTHUSIASTS

# DX-TV

by Charles Rafarel

AS promised last month, we are going to deal with the Continental channels in Band III in the same way as we did with Band I.

You will recall that for Band I we used the various BBC/ITA stations and channels as "markers" and we noted the relative positions of the Continental channels in relation to them. This method will apply equally to Band III, the only difference being that our "marker" BBC/ITA on certain channels may be somewhat distant from our receiving point, and therefore less easily received in certain parts of the country.

It is, however, usually possible if we are DX minded to receive at least one "local" station on each channel as a B channel "marker" in Band III, and for Continental DX work it is recommended that the receiver be as carefully calibrated as possible on these "locals".

Before we proceed with details of the Band III table below a few general comments will be of use.

(1) There are many more channels in Band III than there are in Band I, and therefore the tuning is much more "critical".

(2) Cases of Sporadic E reception in Band III are very rare indeed, and therefore reception will be almost exclusively by means of Tropospheric Propagation. Signal strengths will generally be much weaker and the limits imposed by distance will be much shorter, so that East European (U.S.S.R.) will be practically impossible and our "horizon" even from the Eastern parts of the British Isles will be no further than East Germany, Poland, Denmark and Scandinavia, and these countries will only be receivable under exceptionally good conditions, as reception reports have shown. Do not, however, be in any way disheartened by all this, for DX in Band III is a much fined achievement than DX in Band I, and this should be a challenge to us all. After all, it is a relative term.

(3) French channels F5 and F6 lie very far l.f. of the lowest B channel (B7 Dublin), and are therefore not usually tuneable on British receivers without some modification to the tuner unit. But I suggest that South Coast DXers might profitably load their tuner coils with a few pF of parallel capacitance, as they will find that O.R.T.F. Rennes-Pern on F5 can give a very stable and reliable signal at times.

(4) Equally the h.f. end of Band III extends beyond the B13 channel, but in this case the propagation at these very high frequencies is poor for DX work, and the number of stations is very limited. I suggest this section be ignored except for the very advanced DXer.

### *Vision Channel Tuner Positions in Relation to B Vision Channels*

F5 lies very far l.f. of B8 and far l.f. of B7 Dublin. F6 lies very far l.f. of B8 and far l.f. of B7 Dublin and h.f. of F7. E5, ID, R6 and d lie well l.f. of B8 and l.f. of B7 Dublin. F7 lies l.f. of B7 and h.f. of E5. E6 lies l.f. of B7 and h.f. of E5 and just about one B channel 3Mc/s l.f. of B7. R7 lies l.f. of B7 and h.f. of E5 and just h.f. of E6. IE lies very slightly h.f. of R7. F8a lies just h.f. of B7 Dublin. F8 lies h.f. of B7 Dublin and just h.f. of F8a. E7 lies just l.f. of B8 F9 lies just h.f. of B8. R8 and f lie l.f. of B9 and between B8 and B9. IF lies just l.f. of B9. E8 lies just h.f. of B9. R9 lies just l.f. of B10. F10 lies just l.f. of B10 and very close to and on the h.f. side of R9. IG lies just h.f. of B10. E9 lies just l.f. of B11. F11 lies just l.f. of B11 and very close to and on the h.f. side of E9. R10 and h lie l.f. of B12. E10 and IH lie just h.f. of B12. F12 lies h.f. of B12 and l.f. of B13 and approximately midway between them. R11 lies just h.f. of B13. E11, R15 and E12 lie in rising order of frequency on the h.f. side of B13.

### *Sound Channel Tuner Positions in Relation to B Sound Channels*

F6 lies very far l.f. of B7 (this is the lowest frequency in Band III). F8a lies far l.f. of B7. F5 lies far l.f. of B7 but just h.f. of F8a sound. F8 lies far l.f. of B7 and just h.f. of F5 sound. E5 lies just l.f. of B7. R6 lies just h.f. of B7. E6 lies h.f. of B8. F7 lies approximately midway between B8 and B9. F10 lies approximately midway between B8 and B9 and just h.f. of F7 sound. IE lies a little further h.f. than F10 sound. R7 lies l.f. of B9. E7 lies h.f. of B9 and just l.f. of B10. f lies just h.f. of B10. IF and R8 lie approximately midway between B10 and B11. F9 lies just h.f. of B11. F12 lies just h.f. of B11 and F9 sound. E8 lies just h.f. of F9 sound and l.f. of B12. R9 lies just l.f. of B12. IG lies just h.f. of B12. h lies h.f. of B13. R10 lies h.f. of B13. F11 lies a little further h.f. of B13 than R10. E10, IH, j, R11, E11, R12 and E12 all lie h.f. of B13 in rising order of frequencies.

The above position details apply to 405-line receivers that have been converted for European vision reception whilst still retaining the original i.f. sound-to-vision separation, for example the converted Bush TV range of receivers as recently published, as well as other types of TV receivers.

It should be noted, however, that sound and vision will not be received at one tuner position for any channel unless the i.f. frequencies of the set are correct for the system of transmission it is desired to receive and therefore the correct vision/sound spacing is produced.

The above completes the details for logging on Band III and I suggest that you keep this list, together with that for Band I, published last month, for future reference when DX conditions once again become favourable.

Next month, with reference to the two lists now published for Bands I and III, we will be giving a list of stations that can and have been received in the British Isles at various times, and I hope that this will provide some guidance as to what to look for.

**BAND III FREQUENCIES**

| Frequency (Mc/s.) | Channel | | Frequency (Mc/s.) | Channel | |
|---|---|---|---|---|---|
| | Vision | Sound | | Vision | Sound |
| 162·25 | — | F6 | 199·70 | F10 | — |
| 164·00 | F5 | — | 199·75 | B10 | — |
| 173·40 | F6 | — | 201·25 | IG | B11 |
| 174·10 | — | F8a | 201·45 | — | F9 |
| 175·15 | — | F5 | 201·70 | — | F12 |
| 175·25 | E5 ID R6 & d | — | 201·75 | — | E8 |
| 175·40 | — | F8 | 203·25 | E9 | — |
| 177·15 | F7 | — | 203·45 | F11 | — |
| 180·75 | — | E5 & ID | 204·75 | B11 | — |
| 181·25 | — | B7 & d | 205·75 | — | R9 |
| 181·75 | — | R6 | 206·25 | — | B12 |
| 182·25 | E6 | — | 206·75 | — | IG |
| 183·25 | R7 | — | 207·25 | R10 & h | — |
| 183·75 | IE | — | 208·75 | — | E9 |
| 184·75 | B7 | — | 209·75 | B12 | — |
| 185·25 | F8a | — | 210·25 | E10 & IH | — |
| 186·25 | — | B8 | 211·25 | — | B13 |
| 186·55 | F8 | — | 212·85 | F12 | — |
| 187·75 | — | E6 | 213·25 | — | h |
| 188·30 | — | F7 | 213·75 | — | R10 |
| 188·55 | — | F10 | 214·60 | — | F11 |
| 189·25 | E7 | IE | 214·75 | B13 | — |
| 189·75 | B8 | R7 | 215·25 | R11 & j | — |
| 190·30 | F9 | — | 215·75 | — | E10 & IH |
| 191·25 | R8 & f | B9 | 217·25 | E11 & IH & I | — |
| 192·25 | IF | — | 221·25 | — | I |
| 194·75 | B9 | E7 | 221·75 | — | R11 |
| 196·25 | E8 | B10 | 222·75 | — | E11, IH & I |
| 197·25 | — | f | | | |
| 197·75 | — | IF & R8 | 223·25 | R12 | — |
| 199·25 | R9 | — | 224·25 | E12 | — |
| | | | 229·75 | — | E12 & R12 |

*Note:*

Frequencies between 162·25 and 184·75 and 214·75 and 229·75Mc/s are usually outside the tuner range of British TV receivers without modifications to the tuner coils.

The following abbreviations apply to the above list: F=France, B=Great Britain, R=East Europe, I=Italy, d, f, h, & j=Eire Republic, E=West Europe.

### *READERS' REPORTS*

Having recently stayed in the Channel Islands on business I have had an opportunity of assessing reception under very different conditions to those prevailing in my own home area on the mainland.

In Guernsey I obtained an excellent picture from Caen on F2 on the TV set in my hotel. The aerial was cut to channel B4 (Les Platons) and, of course, mounted horizontally and directed to that station, nearly 180° away from Caen, but even under winter conditions a good picture was obtained.

I also visited reader George Le Courteur at Torteval, Guernsey, but was just two days late for a very good Sporadic E opening on December 17th, when he received good signals from Sweden and the U.S.S.R.

Whilst I was there only tropospheric French reception from Caen, Brest and Lille was possible and conditions were not very good, but the Channel Islands would seem to be a dream come true for DXers because of the relative absence of local BBC/ITA interference which is always such a nuisance on the mainland. I shall really have to consider moving over there!

Before going away (end of November) I had good signals (on a number of occasions round about midday) from TVE Spain and RTP Portugal on E3, and since my return TVE E3 on January 3rd, Horby E2 and U.S.S.R. on R1 on January 5th, also on January 8th, Helsinki E2 at 0900 with test card, easily the best Finnish reception that I have had to date.

So it would seem that Sporadic E reception has been fairly active so far this winter and I hope other DXers have had even better luck.

B. D. Robinson (Southampton) has submitted a test card photograph which we can identify as of Russian origin. He also reports reception of Spain, Sweden, Cyprus, Finland, West Germany, Czechoslovakia and France—an excellent list.

Desmond Kelly (Banbridge, Northern Ireland) has been doing well with his converted Bush TV53 receiver and has submitted test card photographs for identification, amongst which were Czechoslovakia on R1 and Bydgoszcz, Poland, also on R1. He also logged Fyn, Denmark, on E3, but his best catch we identify from his photograph as DDR East Germany (Helpterburg) on E3.

For A. E. Brown (Hull) we confirm reception

*—continued on page 262*

# Video Tape Recording FOR THE HOME ENTHUSIAST

**An analysis of existing equipment and a look at the future**

**BY F. C. JUDD**

HOME television recording has for a long time been the dream of many tape recording enthusiasts and about a year ago it looked as though a breakthrough had been made with the *Telcan* video recorder. Why this did not appear on the market is another story but recently a complete kit for constructing a domestic video tape recorder has been marketed by Wesgrove Electronics Ltd. (see page 279).

It is now well known, however, that several of the big tape recorder companies are ready to market television recorders for home use. One of these is the Sony Company, of Japan, who have announced that they will have a low-priced video recorder on the British market early next year.

### Development

Meantime how will domestic video tape recording develop? What will it cost? What are the technicalities involved? What will the quality of picture reproduction be like? What standardisation, if any, will be applied? At the moment most of these questions cannot be fully answered and one can only apply a certain amount of shrewd guesswork. One thing is fairly certain—TV tape recording will develop rapidly and already a portable battery video recorder complete with camera has reached production stage.

Full details cannot be disclosed yet, in fact almost everything pertaining to domestic TV recorders is somewhat shrouded in secrecy. One can understand why, of course, for television recording at home is likely to become far more popular than sound recording ever could be and no doubt manufacturers have spent a good deal on research and development.

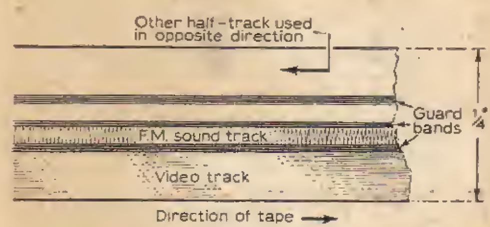



*Fig. 1—Distribution of video and sound tracks on the ¼in. tape used on the VKR500 recorder.*

### High Speeds

The technicalities are, of course, complex, for with video we are dealing with a frequency response of at least 2Mc/s. This calls for a high tape speed which in turn presents the secondary problem of recording the sound that goes with the pictures. Tape transport mechanism is of necessity more complex and must be built with a high degree of precision. This applies particularly to cross-tape scanning head systems similar to those employed in professional video tape recorders.

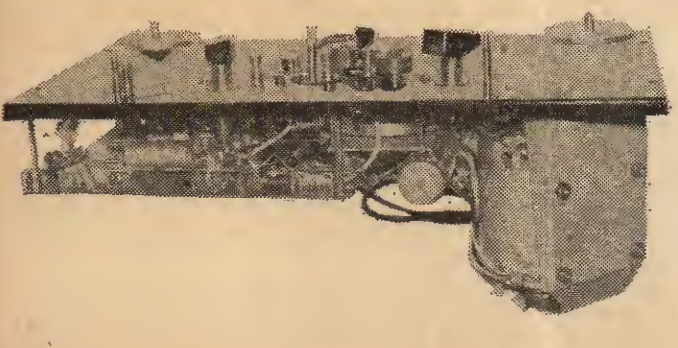


*Fig. 2—A side view of the VKR500 "un-cased" showing the deck and sub-assembly.*

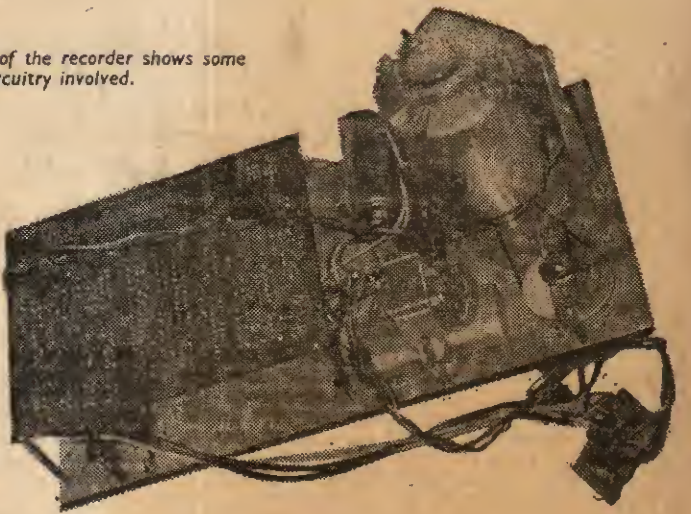


*Fig. 3—This underside view of the recorder shows some of the printed circuitry involved.*

### *Contemporary Costs*

How much is a domestic video tape recorder likely to cost? This will depend on the recording system used and whether or not a video display unit is incorporated in or with the recorder. A professional studio recorder such as those made by Ampex and R.C.A. cost around £25,000 and employ a highly complex rotating record/replay head system. Recently a portable machine was introduced, price about £3,000, and even more recently a small studio machine was marketed at £1,000. So we go down the price scale to domestic machines, in fact to the Wesgrove VKR500 which as a kit costs £97 10s. or about £150 made up.

### *Tape Speeds and Mechanism*

Picture quality depends largely on the tape speed and the video head system. It is reasonable to assume that the higher the frequency response required, the higher will probably be the cost of the tape recorder. For the present, the high-speed tape method using standard ¼in. wide tape lends itself to the design of low-priced recorders and this may well prove to be the "popular" system for the time being.

This leads, of course, to track designation with standard ¼in. wide tape and the recording system used by the VKR500, which is shown in Fig. 1, and permits two tracks, one video and one f.m. sound channel on each half-track. Using "triple play" tape a fairly long playing time is available.

The VKR500 will accommodate 11½in. diameter spools of this tape which, at a tape speed of 150 i.p.s., will provide about half an hour of continuous playing time per track. (The video and sound are carried simultaneously on a combined track occupying half the width of the tape.)

The alternative to this is the multiple head system that scans the tape vertically, or nearly vertically, thus producing a succession of tracks side by side. The tape runs through at slow speed, i.e. 7½ i.p.s., but the video tracks can be recorded at a speed of 200 i.p.s. or more, depending on the speed of the rotating video heads.

This system is costly and normally requires the use of tape 2½in. wide. It might be possible, however, to use ½in. or even ¼in. wide tape with a cross-scan recording system and one firm have in fact announced a video recorder at £300 employing this method.

### *The VKR500 Kit*

Finally a brief description of the VKR500 video recorder may be of interest since it is available as a kit. It must be stressed, however, that successful construction and operation requires a fairly extensive knowledge of electronics, television and mechanics as well as testing equipment such as an oscilloscope and multi-range meter and, of course, a TV receiver which will also require modification.

The VKR500 deck has been simplified mechanically to reduce cost as much as possible (Fig. 2). The deck functions are therefore limited to record and replay, which means that a tape cannot be rewound in the reverse direction except by reversing the spools and winding the tape back free of the heads and guides. Construction and operation of the deck calls for very careful attention to detail and workmanship.

### *Assembly and Construction*

The electronics, which include the video and sound record and replay amplifiers etc., are assembled on one printed circuit board as shown in Fig. 3. Most careful attention to soldering and the instructions regarding components and transistors is called for, since there are some 270 separate components, 20 transistors and ten diodes, aside from multi-way connectors, etc.

The basic circuits are included with the instructions but parts of the electronics are pre-assembled into "black boxes" the secret of which is known only to the manufacturers.

I have now constructed and put into operation one of these recorders which at the time of writing is about ready for preliminary tests. We hope to report on the operation and results in the near future.

**But for those with no faith in these new-fangled inventions, read on ▶**

# 30 YEARS BACK

# Canned Television

**An interesting side-line of Television which permits a permanent record being made of a transmission**

("Practical Television"—November 1934)

THE recording of TV, with the facility of playback, is not a new requirement and has occupied the minds of experimenters for almost as long as TV itself. The diagrams below are taken from a 30-year-old issue of PRACTICAL TELEVISION.

A light source passes through a scanning disc (geared to a gram motor) and impinges on the subject. The light variations actuate a bank of photocells coupled to an amplifier, the output which feeds the cutting stylus. The resultant gramophone record was played back through a standard pick-up and amplifier, as shown in Fig. 2, coupled to the TV receiver.

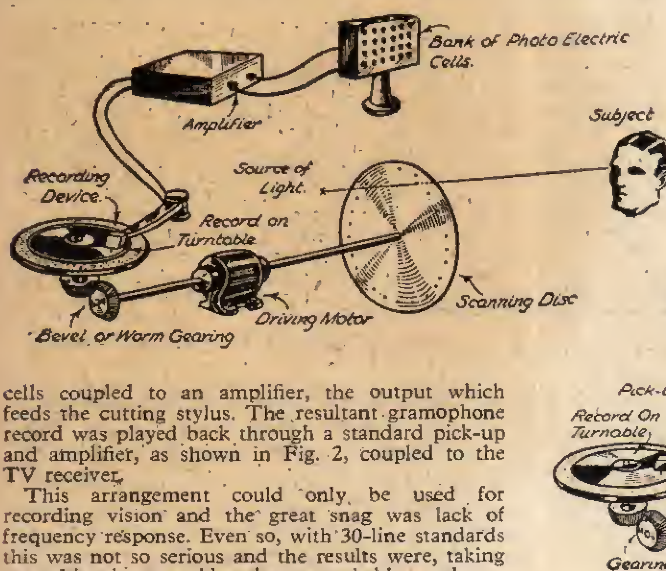
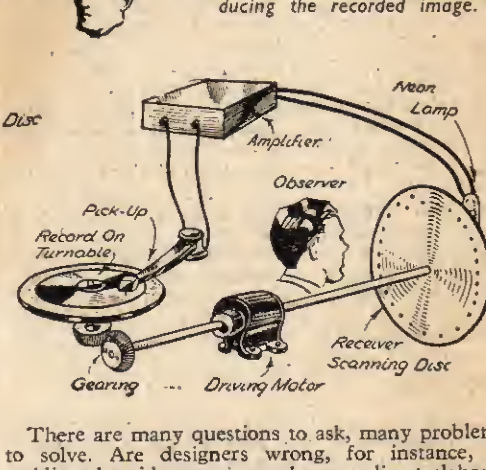



*Fig. 1 (left)—Pictorially illustrating how a record of a television transmission can be made in the studio.*

*Fig. 2 (below)—A partial duplication of Fig. 1 is undertaken when reproducing the recorded image.*




This arrangement could only be used for recording vision and the great snag was lack of frequency response. Even so, with 30-line standards this was not so serious and the results were, taking everything into consideration, remarkably good.

A sobering thought is the fact that while this system may be amusing or quaint to us today, at the time of its publication it was considered to be serious and important. We are tempted to ask ourselves what our present video recording equipment will look like viewed from a similar point in the future!

There is quite obviously a very big future in video recording but whereas it is possible to obtain superb results by building equipment costing thousands of pounds, difficulties mount up when trying to scale this type of equipment down to the sort of price range suitable for ordinary domestic use. Sound tape recording has now reached a very high general standard, even in comparatively inexpensive equipment, but video recording has a very long way to go. This is aggravated by the fact that the eye is less ready to accept inferior quality than the ear. It is perhaps fair to say that, at the moment, video recording (in the domestic sense) is at the stage that sound recording was a decade or so ago—only more so!

There are many questions to ask, many problems to solve. Are designers wrong, for instance, in tackling the video tape recorder as a direct elaboration of the conventional sound tape recorder? Does not the answer lie, in fact, in a completely different approach? We are all vitally interested in this subject, whether we are amateur enthusiasts, professional engineers, engaged in industry or in the retail trade. If you have any ideas, any thoughts, any suggestions on the subject of video tape recording, please write and let us know. The most interesting will be published.

## PART 2 — THE CAMERA

# The Elements of Closed Circuit TV

BY G. J. KING

LAST month it was shown how the television camera tube works and how this is integrated to form a major part of the television camera. In this and subsequent articles the television camera will be looked into in greater detail, and the circuits of a complete closed-circuit television system will be described.

Part 1 in this series described how the camera tube translates what it sees into electrical impulses, rather the same as the microphone translates sound waves into electrical impulses. With vision, however, the scene has to be broken down into elements, and each element has to be transmitted individually. Synchronising pulses supply the "timing" mechanism allowing the individual elements to be pieced together again in correct order at the receiver so as to give the impression of a complete, unbroken picture.

The camera of a closed-circuit television system contains not only the camera tube, but also quite a few electronic circuits. These include the basic components for the camera tube itself, an amplifier for stepping up the weak vision impulses from the tube to a level suitable for working a monitor receiver (the camera tube signal is called the video signal so the amplifier is called a video amplifier), a field timebase, a line timebase and a blanking pulse mixer and amplifier.

Either valves or transistors can be used in these circuits. Early closed-circuit cameras used valves, but the more recent models use transistors. Transistors have many advantages over valves in this application. The fact that they do not need heater power simplifies the power supply system and ensures that the camera runs cool. Transistors are also less prone to microphony (an effect in valve cameras which produces dark, horizontal lines across the picture when the camera is moved or jarred) and the newer ones are distinctly lower noise than valves. Moreover, their small size means that quite complicated camera circuits can easily be accommodated inside the camera housing while retaining a small, easily manipulative size. Valve circuits demand relatively heavy and large camera housings.

As valves are on their way out so far as the small, versatile closed-circuit camera is concerned, they will not be considered in very great detail in this series. The main emphasis will be on transistor circuits.

The camera tube is set up in the camera housing in such a way that the lens system on the front of the camera allows the scene to be focused accurately on the face-plate of the camera tube. The circuits are usually built upon small sub-assemblies or printed circuit boards and then arranged conveniently around the tube.

### *Vidicon Tube*

The camera tube mostly used in small closed-circuit systems is the Vidicon tube. A typical specimen is the Mullard type 55850. This is a one inch vidicon designed particularly with transistor circuits in mind. The cathode is indirectly heated but the heater consumes only 0·6W. Under normal lighting conditions this tube will resolve up to 900 lines. The tube comes in three grades, for normal industrial applications, for higher quality medical and industrial and for film scanner applications. The vidicon was fully described in Part 1 of this series and readers not conversant with the operation of the vidicon would be well advised to read this article.

The dimensions, base details and symbol of the tube are depicted in Fig. 7. The base is of an unusual 8-pin type, known as the "small button ditetrar", but suitable connectors are obtainable without difficulty from closed-circuit TV stockists.

The control grid (grid 1) operates from zero to a maximum of minus 125V, the first anode requires a potential of up to 350V positive, the second and third anodes up to 800V positive and the heater is rated at 6·3V 90mA.

This signal produced by the tube is not fed out at a pin but instead is developed on the signal

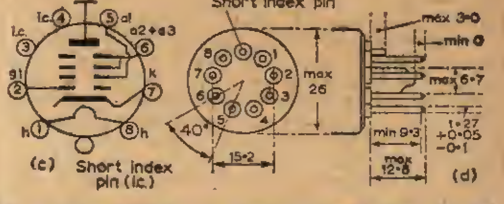



*Fig. 7—The Mullard 1in. vidicon camera tube: (a) the overall dimensions, (b) dimensions of the faceplate, (c) the camera tube symbol and pin numbers and (d) details of the base.*

electrode at the face end of the tube. Connection to this electrode is generally made by a spring contact which bears against the metal ring of the signal electrode. In many designs the spring contact forms a part of the focusing coil design.

The various elements of the tube were shown in Fig. 1 last month. This drawing also shows the horizontal and vertical deflecting coils, the beam alignment coil and the focusing coil.

The horizontal coils are fed from the line timebase, the vertical coils from the frame or field timebase and the focusing coil is energised from the power supply via a variable resistor as the focus control. The beam alignment coil is not always used on less-exacting systems.

There is usually a "fine focus" control in addition to the focus provided by the focusing coil. This is accomplished by making the potential at the second anode slightly variable by means of a potentiometer. Fig. 8 shows the feeds and the voltages applied to the vidicon electrodes.

Dealing with the vidicon and its circuits for the first time, it may not be easy to accept immediately the opposite working of the circuits and video channel. The vidicon works at the front end of the video channel to produce a video signal, this being the exact opposite to the picture tube which works at the back end of the video channel to accept a video signal and produce a picture.

The field and line timebase have nothing to do with the actual production of a picture in the receiving sense. The camera timebases simply make it possible for the vidicon to produce signal impulses corresponding to very small elements of the scene as focused upon its face-plate. Since the vidicon is not called upon to produce illumination its electrode voltages and scanning power requirements are considerably below those of the picture tube.

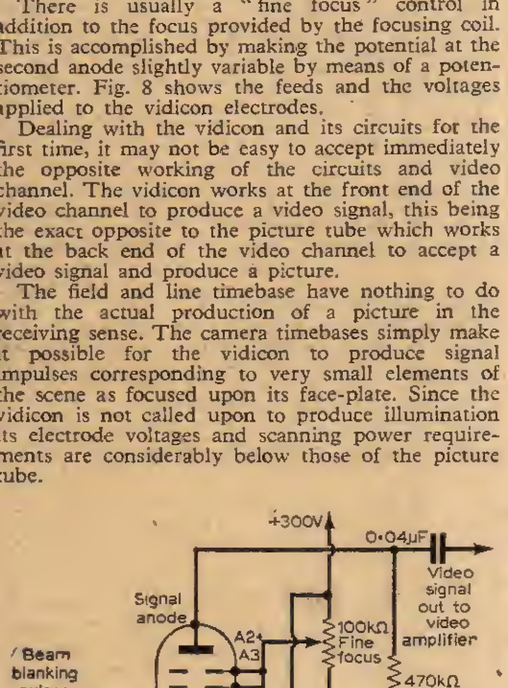



*Fig. 8—Feeds and voltages applied to the vidicon electrodes. To avoid the flybacks of the line and field scans appearing as dark lines on the picture, the beam electrons are prevented from landing on the target during the flyback periods by negative beam blanking pulses fed to the control grid. Alternatively, positive blanking pulses can be fed to the cathode.*

### Video Requirements

From what we have seen so far, then, the first requirement of the camera is to amplify the weak signal impulses present at the signal anode (or signal electrode) of the vidicon tube. The signal impulses are very weak indeed, and they are often indicated in terms of signal current, particularly in relation to tubes designed for fully-transistorised equipment. As an example, the maximum peak signal current of the Mullard one inch vidicon is 600 nanoamperes (a nanoampere—symbol nA—is $10^{-9}$ ampere). It is imperative, therefore, that the video amplifier connected to such a tube should be capable of handling signal-electrode currents of this magnitude without over-loading the amplifier or distorting the picture.

While the video amplifier in a receiver is usually of a single or two-stage circuit, the video amplifier of the camera may have three or even four stages. We must remember, of course, that the video signal at the vision detector of a receiver may be almost one volt in peak amplitude. Since the signal applied to the input of the camera video amplifier is only a very small fraction of a volt, noise becomes an important factor. If noise is added to the video signal in the early amplifier stages it will show as bad grain on the picture of the monitor receiver.

A little grain is to be expected because absolutely noise-free amplification is impossible. However, the noise should be small and grain should only show on dark scenes. That is, when the vidicon output signal is very small indeed.

The video amplifier in the camera must produce a signal in the order of one-volt peak to supply the video amplifier stage in the monitor receiver. Note here, that the camera output is a composite signal made up not only of the video signal proper but also the synchronising pulses from the timebase circuits. The sync signal is added to the pure video signal at the output of the video amplifier. We shall see how this happens later.

### Video Bandwidth

The video amplifier channel, therefore, must be capable of giving high signal gains at low noise. Moreover, to resolve a picture of 405 lines (equivalent to 300 "vertical lines") the amplifier must have a bandwidth approaching 3Mc/s. A bandwidth of over 4Mc/s is required to do full justice to a 625-line picture. This means that the amplifier must lift the level of signals almost from d.c. to several megacycles per second, all by the same amount.

The electrical impulses produced by the vidicon due to instantaneously scanned picture elements often have steep rising fronts—rather like sharply-stepped front of a square-wave. Such impulses or waves would be badly distorted and rounded at the corners if fed through an amplifier with a limited bandwidth. A wide bandwidth preserves the waveshape.

Rounding of the naturally sharp corners of the video signal when the signal is passed through a narrow-band amplifier results in the reproduced picture being very poorly defined. For instance, instead of a clear, vertical demarcation between a sudden change from black to white or from white to black on the reproduced picture there will be a fuzzy changeover from black to white and vice versa. Fine vertical detail of the picture will thus be completely lost. It may be recalled that exactly the same effect occurs when a receiver is working under restricted vision i.f. channel bandwidth as may be caused by misalignment or by a fault in the video amplifier stage.

In general, the resolution potential of a good vidicon camera tube is well in excess of the camera and monitor video amplifier bandwidth. That is to say, the resolution of this type of tube is limited by the bandwidth of the video amplifiers in the camera/receiver chain.

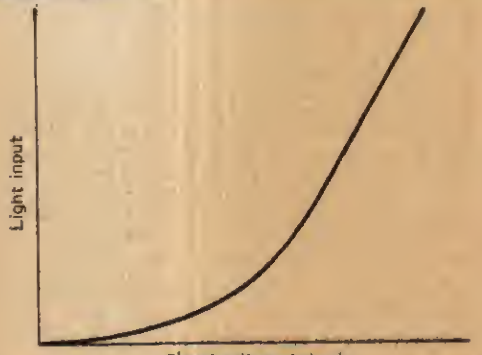



*Fig. 9—The non-linearity between signal voltage output and light input reveals the need for gamma correction.*

### Gamma Correction

The signal voltage produced at the signal anode of the vidicon does not rise linearly with light input. A power law is followed here, as shown in Fig. 9. The video amplifier normally provides some correction for this non-linearity, this being termed "gamma correction". The term "gamma" originated in photography, before television, and it refers simply to the extent of contrast expansion of the picture.

Without gamma correction in a television system, the picture would have stretched highlights and compressed shadows. A fully corrected video amplifier would have a response curve equal to the reciprocal of the curve in Fig. 9. In simple closed-circuit TV systems full gamma correction may not be applied, and there may be only an attempt towards correction.

We have seen, then, that the video amplifier in a television camera must satisfy a diversity of conditions. Let us now look at a typical camera transistorised video amplifier. Such a circuit is shown in Fig. 10.

This is, in effect, a three-stage amplifier, comprising Tr1, Tr2 and Tr3. The fourth stage, Tr4 is a collector-follower output stage, often known in transistor parlance as a common-collector stage. Here the signal is applied at the base and extracted from the emitter. It is to this stage that the sync pulses are also applied.

The first three transistors are connected in the common-emitter mode. That is, with the signal applied at the base and extracted from the collector.

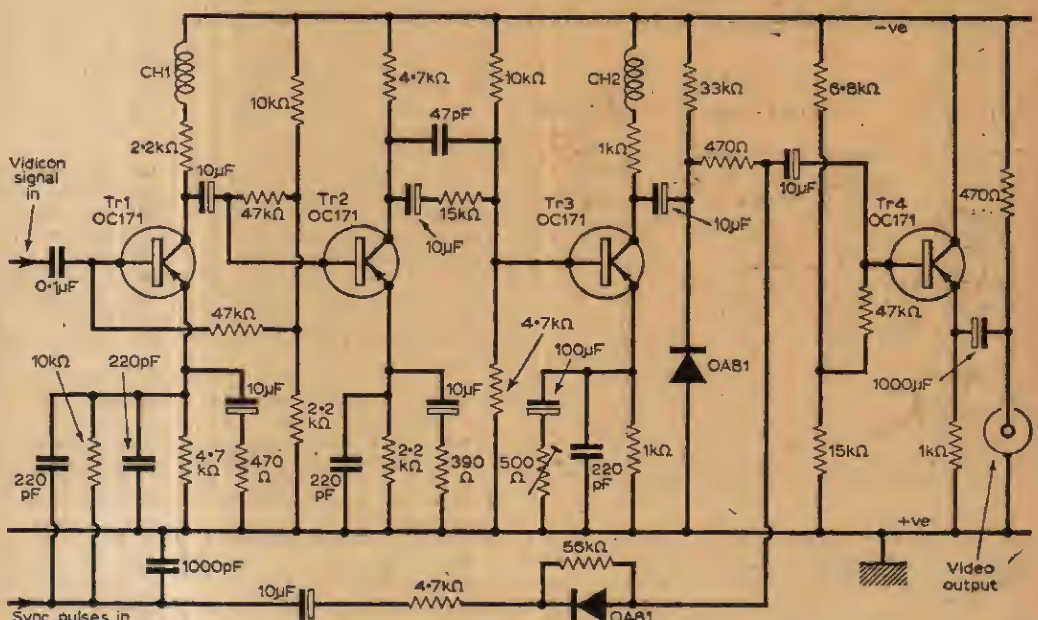



*Fig. 10—Circuit diagram of a three-stage video amplifier. The fourth stage, Tr4, is used as an emitter-follower output and to the base of this transistor the sync pulse signals are also applied.*

The bases of Tr1 and Tr2 are biased for the correct working conditions by the common potential-divider made up of the 10kΩ and 2·2kΩ resistors across the supply circuit. The junction is taken to the bases through 47kΩ resistors. The base of the third transistor is similarly biased by a 10kΩ and 4·7kΩ resistor network. Coupling of signal is accomplished by 10μF electrolytic capacitors between collector and base of the following stage.

### *Response Correction*

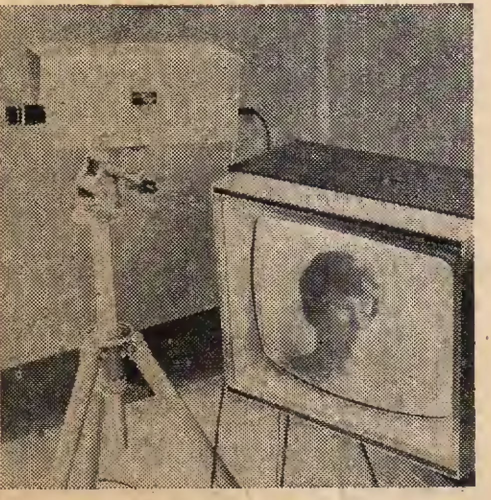
There are several artifices in the circuit designed essentially for response correction. These include the two chokes CH1 and CH2 in the collectors of Tr1 and Tr3. Their presence gives a lift of amplification towards the higher video frequencies. Further correction is provided by the resistors and capacitors in the emitter circuits of the first three transistors. In the emitter circuit of Tr3 one of the resistors is preset to allow adjustment of the overall response of the amplifier. The relative values of the R and C networks here govern the amount of feedback over the video spectrum, and thus by the choice of suitable values the response can be tailored just as required. It is here where gamma correction is applied.

The signal coupling between Tr2 and Tr3 is frequency selective, and this provides a controlled lift towards the top end of the video spectrum. A degree of feedback is also applied from the collector circuit of Tr3 to the emitter of Tr1, via the intermediate network. This feedback tends to stabilise the input impedance of Tr1. It also increases the input impedance so as to present a reasonable match to the high impedance signal anode of the vidicon tube.

The output of the video amplifier is taken via the two 10μF capacitors either side of the 470Ω resistor to the base of Tr4, this base being biased by the network comprising the 6·8kΩ and 15kΩ resistors through the 47kΩ resistor.

### *Adding Sync*

Now, it is at this point that the sync signals are "mixed" with the video signals. The diode in the sync pulse feed circuit tends to relieve the loading on Tr4 during the line scan periods. The other diode can be considered as a "modulator" or rectifier, giving the composite signal a d.c. level at the base of Tr4. The video signal thus rises above the stabilised sync pulses and the conventional video waveform appears across the emitter resistor of Tr4, as refletced from the base circuit.



*A home closed-circuit camera system working in conjunction with an ordinary domestic television set. Here the camera produces an r.f. output on a Band I channel modulated with the video signal. The camera output thus needs only to be plugged into the aerial socket of the set.*

This signal is fed out through the 1,000μF coupling electrolytic, and generally at this point represents a level of about 1V peak. This is fed to the video signal input of the monitor set.

### *Next month*

Instead of appearing as neat video, the output from some close-circuit cameras is at r.f., corresponding in frequency to a Band I television channel. We shall see next month how such a signal is obtained by very simple means. We shall also discuss the timebase circuits and have a look at the type of signals which are fed to Tr4 to constitute the sync pulses.

PART 3 NEXT MONTH

## DX-TV

*—continued from page 255*

of TVE Madrid on E2, following caption details supplied by him. This was on an unconverted British set, so the signal must have been very strong indeed.

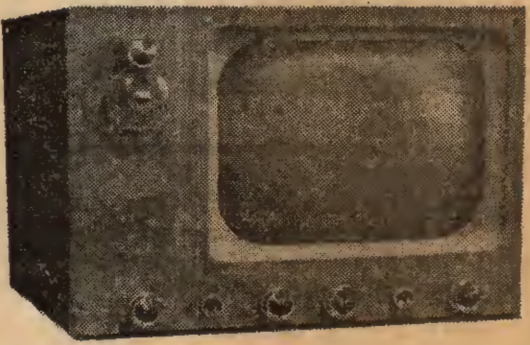
Michael Ward (Cheadle) has had Tallin on R2 confirmed by a photograph he sent us. He also sent a caption photograph bearing the word Riga received on R2. This is *not* the Riga transmitter which is on channel R3 in Band II but originates through an Intervision link, probably via Tallin when relaying Riga.

### NEWS

(1) Since January, 1965, the 819-line Belgian RTB (French language) service has ceased operating and has been replaced by a 625-line service as used by BRT (Flemish language) service now uses.

(2) DX/TV Pacific area. A Wellington (New Zealand) report for January 4th indicates that TV pictures from Hawaii appeared for some 40 minutes on local TV sets! Hawaii is some 4,000 miles distant; it is, of course, midsummer in New Zealand at the present time (Jan.), so I hope this is a good omen for 1965 summer DX/TV here!

# TRANSISTOR television



# HERE IT IS ! THE OLYMPIC II

**GREAT NEWS—TRANSISTOR TV FOR THE HOME CONSTRUCTOR !**

★ Fully transistorised, except for the c.r.t. and e.h.t. rectifier.

★ Operates from 12V car battery, Ever Ready TV1 dry battery, or a.c. mains.

★ No tiny picture—the Olympic II has a 14" 90° picture tube.

★ Unit construction for flexibility.

★ High performance using latest techniques.

★ Low noise level (better than 5dB) giving clear "snow-free" pictures.

## APRIL ISSUE OF

# PRACTICAL TELEVISION

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# OSCI
# AMPL
## HIGH-GA

H.T.KITCHE

THE author's 6in. oscilloscope has a sensitivity of 100mV/cm, which is sufficient for many purposes but not, as he recently found out, enough to enable an examination to be made of the waveforms produced by low output magnetic pick-ups and tape replay heads. These have an average output of 5mV and rarely exceed 10mV so that an attempt to examine the output waveforms produced a trace 1/20cm high, which could barely be seen let alone analysed. Obviously some extra amplification was called for and rather than modify the internal 'scope amplifier it was decided to build an external amplifier which could be easily brought into use only when required. A transistorised amplifier was considered and rejected because suitable valves were in stock, transistors were not, though the size of the finished amplifier compares favourably with some transistorised ones the author has seen.

### *Design Considerations*

Before the complete circuit is examined some of the factors that influenced the design might prove of interest, particularly to those readers who might have little experience of this type of circuit.

The very high gain may occasion some surprise, but that this is not excessive is quite easily proved if one considers an input of 1mV such as might obtain from a quiet passage on a record or tape or for any other reason for that matter. This will result in an output of 1V, causing a trace 10cms high on the 'scope, which in the author's case just about fills the usable portion of the screen. In fact if one wanted to examine such faults as waveform clipping even higher gain could be desired.

The wide frequency response is not being wasted even though the h.f. outputs of most pick-ups and tape heads rarely exceed 18 or 20kc/s. Square wave or pulse waveforms are extensively used for audio testing, the extent to which the rise and decay times are affected being the measure of goodness of the amplifier through which it is passed; an amplifier with a wide bandwidth affected the square wave less than one with a restricted bandwidth. If the oscilloscope is to display the true state of an amplifier's misbehaviour its own amplifier must be entirely above suspicion. With the amplifier being described 10kc/s square waves with a rise time of 1·5$\mu$sec. are presented as though

**Specification**

| |
|---|
| **Gain:** 60dB |
| **Frequency Response:** 10 c/s–50 kc/s ±1 dB |
| **Maximum Input for Undistorted Output:** 10 mV |
| **Power Requirements:** 350V, 3 mA and 6·3 V 0·4 A |
| **Overall Size:** 4½in. x 3½in. x 2in. |

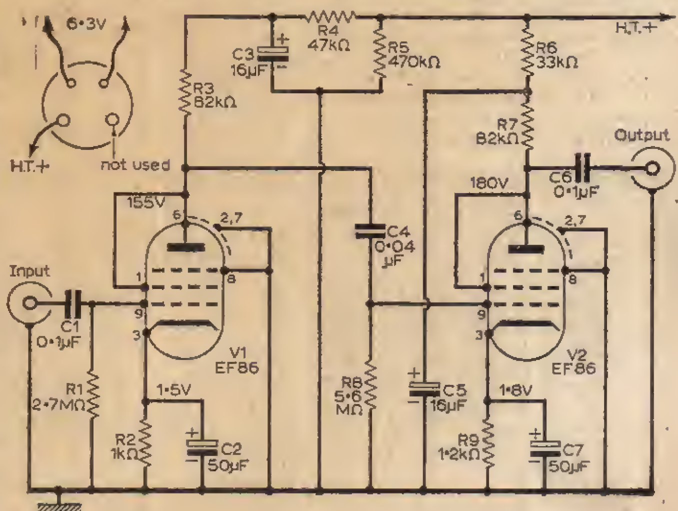



*Fig. 1—The amplifier circuit.*

# .LOSCOPE
# .IFIER
## N WIDE-BAND

they had a rise time of 2μsec., and since not many amateurs can generate such short rise time square waves this is, in the author's opinion, an acceptable error.

### *The Two-valve Circuit*

The complete circuit is given in Fig. 1, from which it will be seen that two triode connected EF186 valves are used in cascade, each providing a gain of 32 or an overall gain of approximately 1,000. The low frequency response is dependent on the series reactance of the coupling capacitors C1, C4 and C6 and the shunt impedance of the grid resistors R1, R8, C1 and C6 have a capacity of 0·1μF which at 10c/s presents a series reactance of 150kc/s, which is comparatively negligible when compared to R1, which is 2·7MΩ, and the input resistance of the 'scope, which is 1·5MΩ. Due to space limitations C4 has been reduced in value to 0·04μF with a series reactance of approximately 320kΩ, which has been balanced by increasing R8 to 5·6MΩ.

The high frequency response is dependent on shunt impedance as presented by grid leaks and stray capacities to earth. With the grid leaks made sufficiently high the problem resolves into reducing stray capacities and in this respect the cable used to couple the "work" into the amplifier and the amplifier to the 'scope should be good quality low-loss coaxial and as little of that as possible. With shunt capacitance reduced to the minimum a useful response to several hundred kc/s should obtain.

Decoupling is thorough and is provided by R4, R6 and C3, C7. The values of the capacitors can be increased with some advantage but should not be decreased as it is essential that the h.t. supply should be free from smoothing ripple voltages and feedback from V2, which could have an adverse effect upon the performance of the amplifier as a whole. Similarly the heater voltage should be centre tapped so that hum can be at a minimum. Power supplies are very modest indeed, being 3·5mA at 350V and 0·4A at 6·3V and should be easily provided by the majority of 'scopes.

### *Component Values*

In any amplifier as sensitive as the one under discussion the quality of certain components is of paramount importance. R1, R2, R3 must be high stability types if the output signal is not to contain a large percentage of self-induced noise. R7, R8, R9 should, preferably, be also high stability resistors, though in deference to economy ordinary ½W carbon resistors could be tried and, if successful, retained. In the author's experience EF86 valves have, as a rule, proved most reliable, though it is possible that some specimens may generate noise when used in the V1 position, in which case they should be tried in V2 position, being retained there if successful. In extreme cases replacement is the best and only cure. Valve-

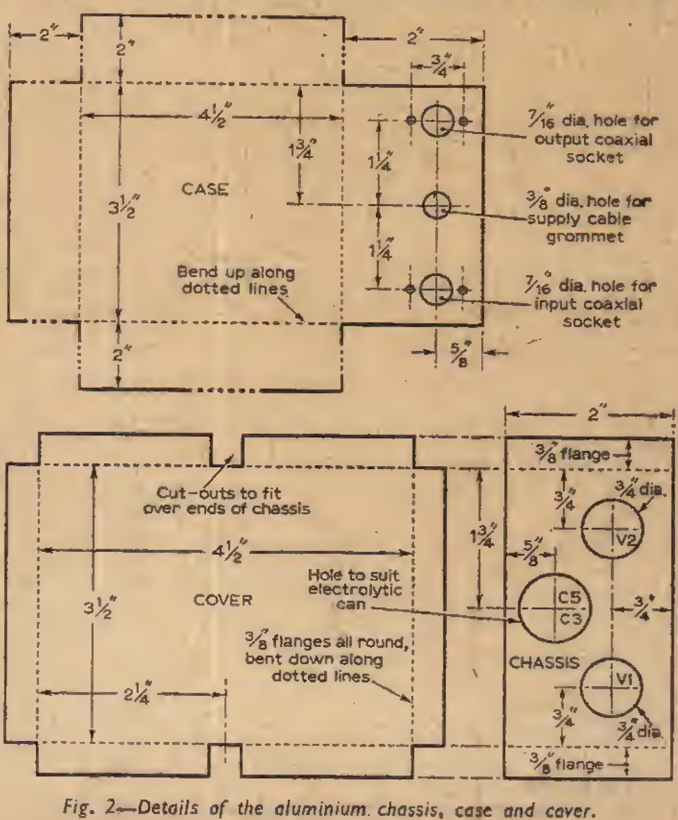



*Fig. 2—Details of the aluminium chassis, case and cover.*

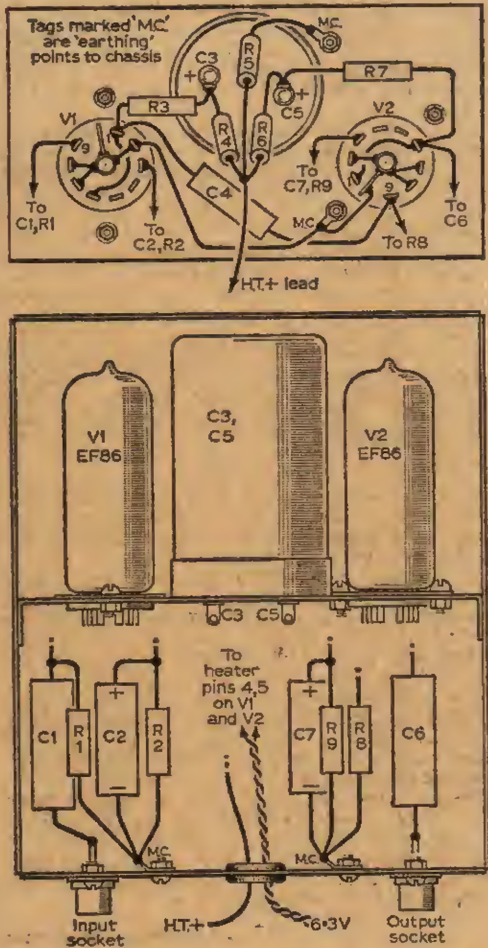



*Fig. 3 (Top)—Wiring on the underside of the chassis; (bottom)—layout inside the case and the rest of the wiring.*

holders, too, can cause trouble through leakage across adjacent pins, and the slight extra expense of ceramic or p.t.f.e. types is well worth while.

In order to exclude the possibility of earth loops which could cause hum to be induced into the amplifier, earthing should be to the 'scope by means of the braiding of the o/p lead. This means that the o/p lead must not be disconnected whilst the power plug is still connected—unless the constructor delights in death-defying acts!

### *Case and Chassis*

The metalwork consists of three pieces of aluminium, these comprising the chassis, case and cover, and are made to the dimensions of Fig. 2. Brass or tinplate could also be used with the added advantage that the corners could be soldered,

## COMPONENTS LIST

**Resistors:**

| | | | |
|---|---|---|---|
| R1 | 2·7MΩ h.s. | R6 | 33kΩ |
| R2 | 1kΩ h.s. | R7 | 82Ω h.s. |
| R3 | 82kΩ h.s. | R8 | 5·6MΩ h.s. |
| R4 | 47kΩ | R9 | 1·2kΩ h.s. |
| R5 | 470kΩ | | |

All 10% ½W carbon. h.s.=high stability

**Capacitors:**

C1 0·1μF paper 350V
C2 50μF electrolytic 15V
C3 16μF electrolytic 350V
C4 0·04μF paper 350V
C5 50μF electrolytic 15V
C6 0·1μF paper 350V
C7 16μF electrolytic 350V

**Miscellaneous:**

V1, V2 EF86 or Z729

Two B9A p.t.f.e. valveholders with two spring-type valve-retainers. Two coaxial sockets.

resulting in a neater and stronger assembly. The case should be made first and the cover and chassis made to fit. When bending the metal allowance should be made for the thickness of it. The "bending" dimensions for the case are for the inside and those for the cover and chassis for the outside.

### *Wiring-up*

Wiring should present few problems even for the beginner, since all the components can be soldered in place before the chassis is screwed into the case, all that being necessary then is the earthing of the grid and cathode components and the connecting of C1, C6 to their respective sockets. There is not much room to spare, so a fairly small component for C4 is required, this being wired directly from V1 anode to V2 grid.

R5, the 470kΩ resistor, is used to support the decoupling resistors R4, R6, the h.t. lead being soldered to their junction. It also serves to discharge C3, C7 and can be any value from about 100kΩ upwards. The power supply is obtained from the 'scope by means of a short length of three-way cable terminating in a small four-pin non-reversible plug. The heater wiring within the case should be of lightly twisted wire to minimise hum radiation.

### *Checking and Testing*

After completion the amplifier should be carefully checked for wrong components and wiring mistakes and can then be connected to the power supply and allowed ten minutes or so for warming up, after which it can undergo several tests intended to show if any defects exist. A voltage check should be carried out using, if possible, a meter of 20,000 o.p.v. to minimise loading on the anode circuits, the voltages obtained agreeing reasonably closely with those given. With a less sensitive meter a more reliable method would be to measure the cathode voltages and, if these agree with those given, the circuit can safely be assumed to be in order.

Next the o/p can be examined for self-generated noise by turning the 'scope Y amplifier to maximum gain. Without an input to the external amplifier the 'scope should display a straight line. Should noise be present its source is quite easily found, hum being particularly obvious. Valve or resistor noise is easily pin-pointed by shorting out the respective grid leaks, which will establish whether V1 circuit or V2 circuit is faulty, and from there it is but a short step to pin-pointing the actual component.

To check the amplifier gain and distortion requires either an accurate millivoltmeter or a calibrated (and accurate) attenuator on the 'scope. To check for distortion it will be necessary to couple the amplifier to the 'scope and feed a metered signal in, gradually increasing it until the waveform is seen to limit, that is, the peaks are clipped. The input is then reduced until the clipping disappears and the meter reading noted. This should be in the region of 8-12mV. The millivoltmeter is transferred to the o/p and the volts out noted from which the overall gain can be estimated.

It may well be that for many applications the overall gain is excessive, in which case it can be easily reduced by introducing negative feedback from V2 anode to V1 anode by means of a resistor the value of which will have to be experimentally determined. A resistor is preferable to a capacitor since, at the frequency concerned, it is practically frequency independent. N.F.B. has, of course, the usual beneficial effect of reducing noise and distortion.

Many other uses will occur to the experimenter for this amplifier amongst which can be numbered baby alarm (with additional o/p stage, of course), pick-up amplifier for low output magnetic pick-ups with selective feedback for equalising purposes and photocell amplifier. ■

## A VIEWER'S GUIDE TO TV SERVICING

*—continued from page 253*

point (usually the c.r. tube first anode).

Other components which it pays to locate for future reference are:—

Main smoothing capacitors.
Vision detector diode.
Sound interference limiter diode.
Sound take-off point.
Screen dropper on line output valve.
Boost line reservoir capacitor.
Frame output valve bias capacitor.

Cast also a suspicious eye at any carbon composition resistors of high wattage rating, especially if they appear discoloured. Manufacturers tend to under-rate these resistors, and if they become too hot they change value, normally going low. This enables more current to flow, making them get hotter, and consequently lower still in value.

This cumulative effect can lead in time to the destruction of the associated valves and the burn-out of the adjacent printed panel. Nip it in the bud, if you can.

Finally, listen for the whistle which emanates from the line output stage. On some sets it is louder than others, and the younger you are, the more it gets on your nerves.

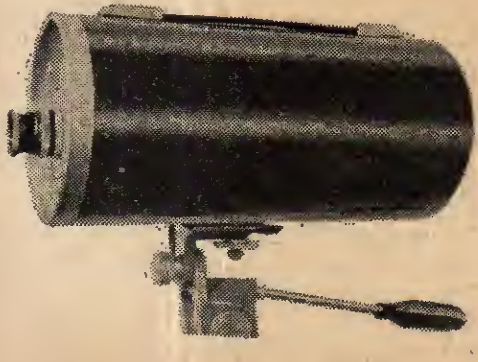
Its presence on a faulty set is reassuring, as it usually denotes a working line output stage, especially if it is shrill and healthy. Sync can be checked without a raster by rotating the line hold control and listening to the whistle. You should hear it "lock in".

The next instalment will deal with the accumulation of a useful service tool-kit without spending a fortune, and in the meantime you will no doubt have to overcome the family resentment to tinkering around with the set in viewing time.

Remind them that when the set breaks down you will be in the privileged position of being on the spot as it happens, and therefore in a better state to diagnose the fault than is the serviceman who arrives a day later. Although irrelevant this is better than no explanation at all!

*—continued next month*

## *Transistorised CCTV Camera*



FROM Fringevision comes the Vidicon 5.R.F. closed circuit television camera produced for industry. This camera (shown on the left) is fully transistorised and is designed for continuous rating conditions. It has die cast front and end panels and printed circuit construction throughout.

Power requirements are 210—240V 50c/s with a consumption of 20W. A 405-line system is used with 3Mc/s horizontal resolution and random interlace is employed. The r.f. signal output is 20mV (any channel in Band I) and the sensitivity is 0·5ft. candle target illumination.

The operation controls, provided are, electrostatic focus, target voltage control, and beam current control. The price of this camera is £91 and it can be supplied to industry on rental for complete installations etc. *Fringevision Limited, Elcot Lane, Marlborough, Wiltshire.*

# ON THE AIR
## Amateur Band Topics

# A DESCRIPTION OF AMATEUR TV STATION G3NOX/T

JEREMY ROYLE first became interested in amateur television in 1953, at a time when such devices as Vidicon Camera Tubes were unobtainable, and the only practical way the amateur could generate television pictures was by means of the flying spot scanner.

The first equipment constructed was a flying spot scanner consisting of an ex-Government Electrostatic Cathode Ray Tube, and a 931A Photo Multiplier. This simple system produced reasonable results providing the density of the slide was restricted. About a year later a low power transmitter was constructed by his father. Mr. R. L. Royle, G2WJ/T which was used to transmit the first pictures to G3GDR at Abbots Langley, near Watford, a distance of 30 miles.

The next development was the construction of a camera which used the Photicon Image Iconscope camera tube. This tube was used by the BBC during the 1950's and produced pictures of extremely high quality, although the sensitivity was low compared with modern cameras. During this period many improvements were made, such as higher power transmitters, and larger transmitting aerials together with improvements in sensitivity of the receivers.

During 1958 he obtained his present call sign G3NOX/T and commenced operating from a new site near Saffron Walden, Essex. This position is 450ft. above sea level and has proved to be an extremely good v.h.f. site ideally situated near the centre of considerable amateur television activity.

The equipment now in use at G3NOX/T consists of four vision sources, a control room and a small studio equipped with video monitor, sound circuits and lighting of various kinds.

### *Vision Sources*

These consist of:

1. 3in. Image Orthicon Camera with four lenses and electronic viewfinder mounted on a movable dolly and fitted with 100ft. of camera cable.
2. Monoscope test pattern generator with call sign inserted.
3. Sawtooth test signal for transmitter linearity check.
4. Vertical white pulse for carrying out signal to noise tests at the receiving end.

Each of these picture sources are fed into a four channel A.B. type vision mixing unit which has facilities for mixing or cutting between each source as well as adding the synchronising pulses. The output of this unit is taken via a transmission monitor to the vision transmitter.

Four video monitors are used at G3NOX/T, these are used in the following manner.

(a) Preview. This can be switched to any vision source but normally displays the monoscope test pattern.
(b) Camera Control Unit Monitor. This displays the picture produced by the camera.
(c) Radio Check Monitor, for displaying incoming amateur TV or broadcast pictures.
(d) Transmission Monitor. This displays the picture being radiated by the vision transmitter.

The transmitted waveform conforms to the standard 405 line system and can be received on any standard TV by means of a simple tuner unit. A 35-valve waveform generator provides all the waveforms used throughout the station, and all this equipment is run from electronically stabilised power units for stability.

In addition to local sources of picture signals, a video receiver is used in conjunction with a converter to enable other amateur signals to be relayed; this receiver feeds a standard 1V signal to the transmitter via a selection switch.

### *Transmitters*

The vision transmitter uses four 250B valves in the final amplifier, running 150W peak white input. This is grid modulated in the usual way with positive vision signals or with high level stabilised screen modulation for speech communication. The transmitter is crystal controlled using frequency multipliers to reach the normal carrier frequency of 436·0Mc/s.

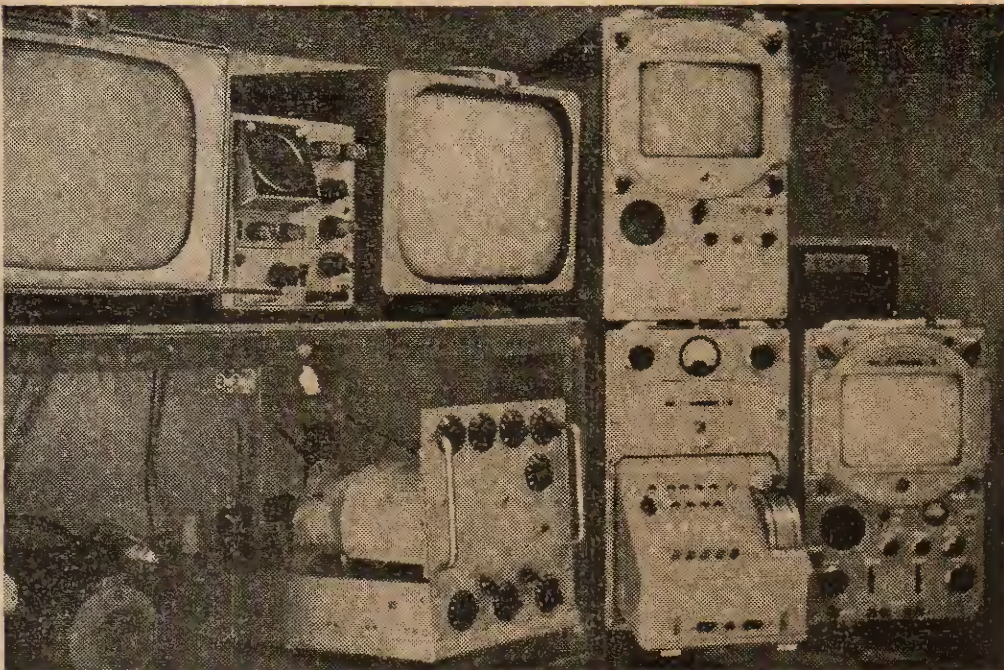
The sound transmitter runs at 30W input to a QQVO320/A also using high level screen modulation, and operates 3½Mc/s below the vision transmitter. In this way, sound and vision can be received on a standard 405 line TV receiver.

### *Aerials*

The main transmitting aerial is mounted on a 40ft. lattice tower and consists of a 64-element colinear stacked array having a gain of 18dB with adequate gain-bandwidth characteristics. This aerial which can be seen in the cover picture, gives G3NOX/T an e.r.p. (effection radiated power) of 6kW and has enabled pictures to be transmitted 200 miles under good propagation conditions. For the sound transmission a 6 over 6 slot fed aerial is used

### *Activities*

G3NOX/T operates on most evenings on a frequency of 436·0Mc/s vision, 432·5Mc/s sound,



*Amateur station G3NOX/T. The equipment shown here includes the vision monitors, camera control unit and the vision mixer.*

and welcomes tests with other amateur TV stations or those equipped with receivers only.

To G3NOX/T goes the distinction, shared with G3ILD/T of Darlington, of establishing the present world record amateur TV-DX two-way contact of 200 miles. This sound and vision QSO took place on September 3rd, 1964.

The latest development at G3NOX/T is the use of the 23 centimetre band where, of course, the ranges are more limited. However, tests have shown that this band can provide some very interesting results. ■

# Servicing TELEVISION Receivers

## No. 111: Emerson E700 and E701

by L. Lawry-Johns

CONTINUED FROM PAGE 209 OF THE FEBRUARY ISSUE

ONE of the most frequent causes of lack of e.h.t. when valves and components have been checked is undoubtedly the transformer itself, which is prone to insulation failure. However, the transformers are readily available and fitting is quite straightforward, the only awkward part being the wiring of the EY86 heater leads. The fixing is by one screw on the right side and the connections are made to the left side panel. The EY86 seems to last fairly well but when a no-picture condition obtains and the line whistle is normal, with indication of e.h.t. to the top cap of the EY86, this valve not lighting, it is reasonable to suspect an open-circuit heater.

An internal short in the EY86 results in a very ragged whistle, but this is easily checked by removing the cap from the side of the tube. The whistle becomes normal but the spark from the freed lead becomes violent, quite different from the normal thin arcs obtained when the valve is rectifying.

### Lack of Width

This can be due to a low-emission PY32, particularly if the bottom of the picture compresses at the same time. If the h.t. voltage is about 200V or more, however, the PY32 should not be suspected (h.t. checked at PY32 cathode or reservoir capacitor tag). In this case check the PL36 and the 4·7kΩ screen feed resistor. The PY81 is sometimes at fault but not often.

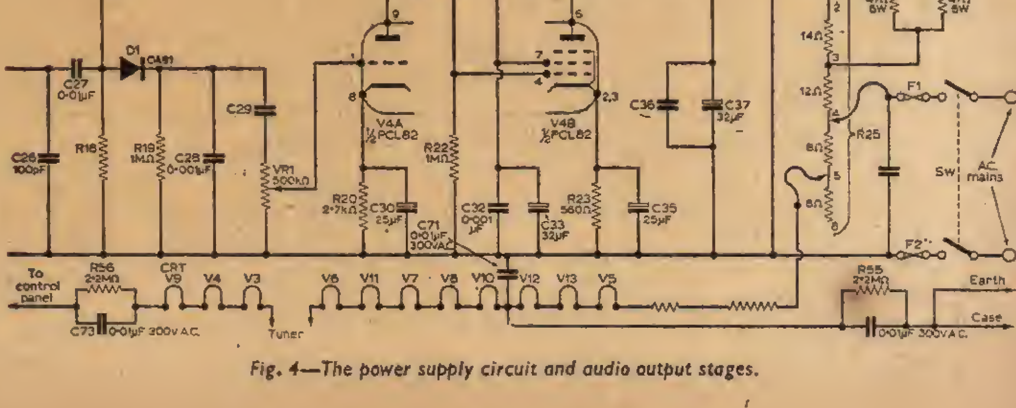



*Fig. 4—The power supply circuit and audio output stages.*

### .ine Hold

If the hold control is at the end of its travel the ?CF80 VII is usually at fault, but if this is not ;o check the PL36 and the resistors associated with ɔoth valves and C87 200pF.

### 'ield (Frame) Timebase

The valve concerned is V10 PCL82 and the :ircuit is such that there is a good deal of nteraction between the control, hold height and inearity. If the side control (hold) will not lock :he picture vertically check the setting of the rear eft side height and linearity controls. If these do

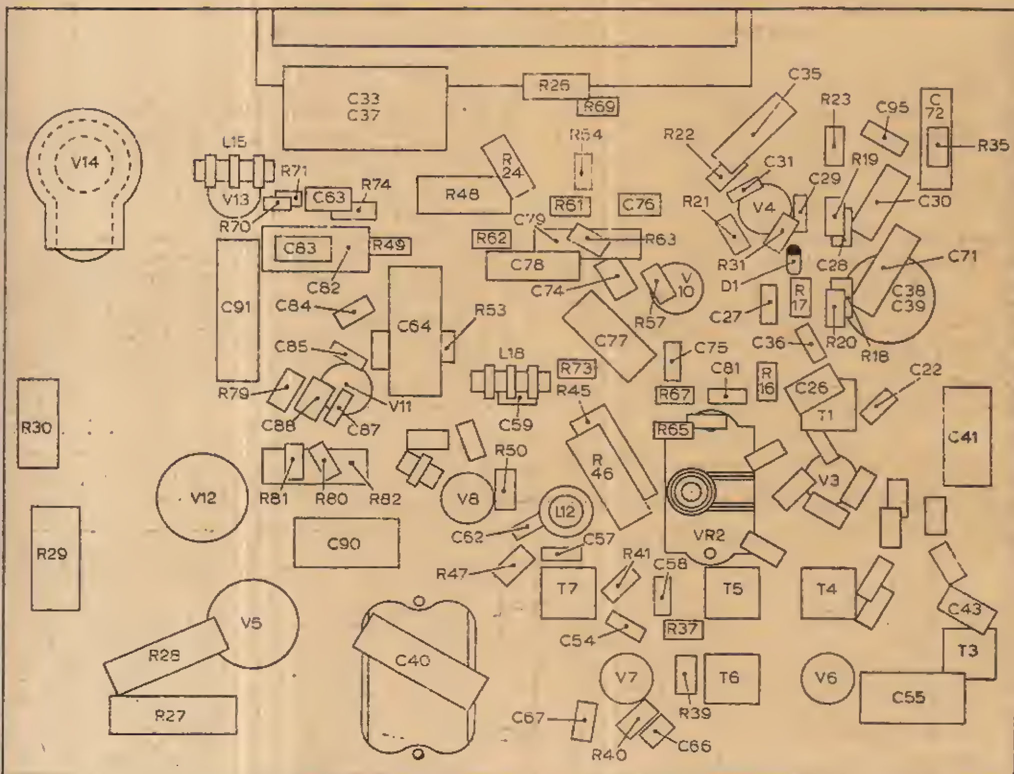



*Fig. 5—A simplified layout diagram of the components underchassis.*

ɔot help, a replacement PCL82 is usually called for. Check R59 and C74 if necessary.

### Lack of Height

If the loss is even top and bottom the resistor R57 (1MΩ) will usually be found at fault. V10 should be checked if necessary, although the bottom of the picture and the hold will call attention to this before overall lack of height is experienced.

### Picture Faults

Loss of contrast, leaving the picture thin and of weak sync but with adequate brightness, should direct attention to the vision demodulator diode OA70, the PCL84 and associated resistors. If, however, there is excessive grain the tuner unit should be inspected, checking first the PCC84. If the sync is good but the picture is extremely thin and the sound normal it is worth while checking C64 0·25μF, which is the video coupling capacitor to the c.r.t. cathode.

### No Picture Signal

If the sound is normal and the raster is quite bright but blank check R45/46 and R47, L18, C64 and C54 (0·001μF decoupling pin 8 of V7). V7 or V8 could be at fault, as could D2, and there are, of course, many other possibilities, but these are fairly common failures.

### Unusual Effects

Stubborn sound on vision, vision on sound, rippled picture, loss of sync, etc., which occur quite

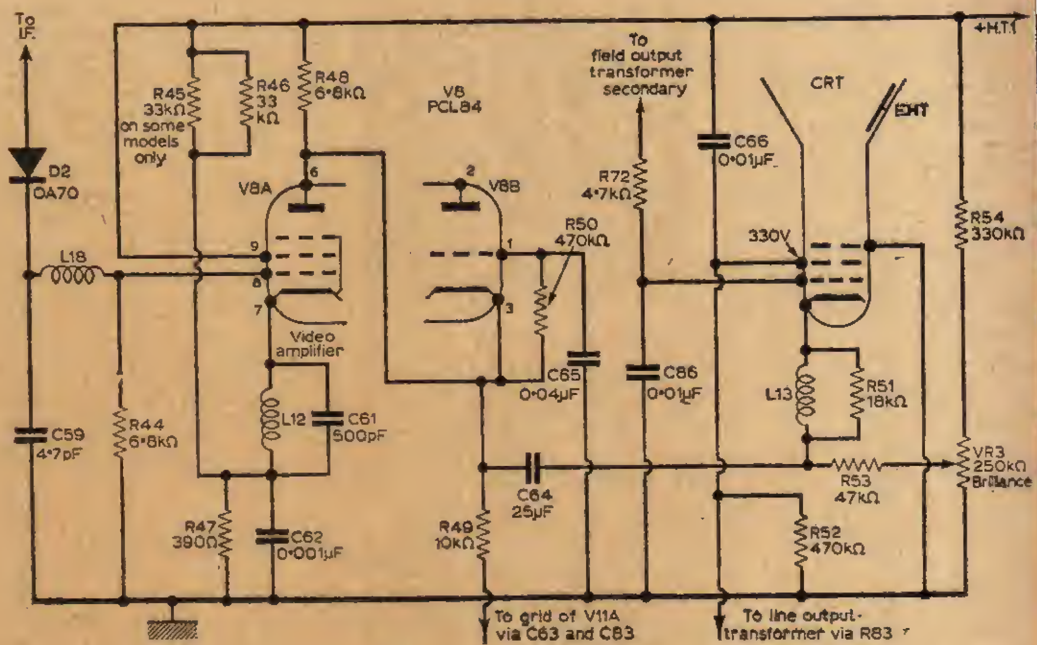



*Fig. 6—The video amplifier and c.r.t. circuits.*

suddenly, can usually be traced to defective electrolytics C33 and C37 as well as C38/C39. Loss of capacity in C39 causes low h.t. voltage, weak sound and no (or very small) picture.

### *Sound Faults*

Severely distorted sound can usually be traced to R17 10MΩ but V4 PCL82 is often at fault, running into grid circuit and damaging R23 560Ω, which should always be checked—weak sound with accentuated S's can usually be traced to R21 (220kΩ). This rises in value to something over 5MΩ before the sound fails completely. Weak but undistorted sound can often be traced to an open-circuited electrolytic C30 or C35 (both 25μF).

### *No Sound or Vision*

If when the receiver is switched with mains present at the fuseholders there is no sign of life from the valve heaters, listen for a slight tingling noise from the PY32. If there is no such tingle check the section of the mains dropper and the PY32 itself. If a slight noise is heard or the supply is traced through the dropper and PY32 the open circuit is further down chain but usually not very far. The PY81 is most commonly at fault and it is worth checking this before the chassis is removed to trace the supply through the heater chain. Note that there is a wire-wound resistor between the dropper on the top (R25) and the thermistor underneath. This is R29 120Ω 12W.

### *Associated Models*

The Emerson E704 and Beethoven B208 are associated 17in. table models.

**NEXT MONTH—BEETHOVEN B106/1 AND RAYMOND F105/1**

# UNDERNEATH THE DIPOLE

ƷOING UP! Going up! The cost of living continues to se—and so do the costs of producing television programmes. It interesting to compare the costs f producing the television programmes of today with the infinisimal budgets of the earliest re-war BBC programmes from ıe Alexandra Palace Studios. 'he scope and spectacular ualities of today's programmes aturally cost a lot more, but so o even the very simplest of ocumentary TV magazines. No 'onder BBC executives continue ) lobby MPs and others to ıcrease the price of television cences.

ITV companies also groan nder the burden of levies and ıxation of various kinds on their ıcomes from advertising. No 'onder they tend to retain and lmost perpetuate their most opular programme series, such s *Coronation Street* and *'ake Your Pick*. Fortunately ıe major ITV companies are ɒle to venture large budget items ɔr special programmes in the reat competition to keep their ɔp places in the weekly TAM ıtings.

## 'Golden Hours"

A two-hour drama programme, ) cost £100,000, was announced ı January by Lew Grade, ıanaging director of A-TV. This 'as the result of a challenge by ,ord Hill, chairman of the Indeendent Television Authority, 'ho realised the importance of ıe "Golden Hours" programme f ballet and opera presented a ear ago at the Royal Opera louse, Covent Garden by A-TV. 'hat was, you recall, a star-;udded occasion in which Dame Iargot Fonteyn, Rudolph Iureyev, Maria Callas and Tito iobbi appeared. Lord Hill ıggested that another "Golden Iours" programme could cover ärious aspects of the theatre.

A-TV responded by bringing ɔgether the greatest names in ıe British theatre in scenes ɛlected from some of their most nportant productions—and these ames included Sir Laurence 'livier, John Clements, Peter 'Toole, Dame Peggy Ashcroft, )ame Edith Evans, Maggie mith and Paul Scofield.

What a show! What a cast! And what problems for producers and technicians to overcome in presenting this type of show "live" to a brilliant invited audience in the Queen's Theatre, Shaftesbury Avenue.

## Extracts of What?

It is, of course, a "middle-brow" piece of showmanship to combine the high spots of a number of unrelated ballets, operas and excerpts from theatre drama or comedy into one show. Linking and continuity of presentation, together with audience participation, are important factors, too.

Just as important as they were in the earliest days of Edison's cylinder phonographs, when the first reproduction of selections from the operas were condensed into two minute "gems" from "Carmen", "William Tell" and/or "Barber of Seville". Thus was a form of musical culture introduced in the late nineties into log-huts in the mid-west of USA at the same time as in the fire-sides of English homes and castles.

The ghost of Thomas A. Edison appears in many places, including the pages of ICONOS, your commentator, who started scratching crystals in 1923 and has been looking into other crystals (like a clairvoyant) in these columns since 1947. In the October 1964 issue of this journal he featured Mr. Edison in a slightly satirical sketch of the activities of that great inventor, historical flaws in which were quite rightly detected by a reader in a letter to the Editor.

## Eccentricities of Edison

The whole point of the "ghost" sketch was a rather affectionate respect for the activities and eccentricities of that Grand Old Man, Edison, who assembled at New Jersey a team of technicians able to deal with a wide variety of technical developments, ranging from telegraphy, electrical power stations, phonographs, carbon filament lamps, animated photography etc., etc.

In the case of the motion picture, there have been many claimants for the original invention of the Kinematograph, including Friese-Greene, Robert Paul, the Lumière Brothers, Birt Acres, Muybridge, Demeney, all of which made individual contributions. Friese-Greene anticipated many of these developments in his 1889 patent.

Nevertheless, notwithstanding the help Friese-Greene received from Evans and Rudge, the first *practical* demonstration to a paying public was made with the Edison Kinetoscope ("What the Butler Saw") machine in *1893* and with the Lumière screen projector in 1895.

Thomas Alva Edison was a great character, an impresario who collected, directed, supervised and integrated scientific talents in a manner which has become a normal practise in this day and age. The detailed work of the Kinematograph development in Edison's laboratory in New Jersey was carried out by

W.K.L. Dickson, a Scot, who built a motion picture camera in 1892 which was capable of operating at 46 frames per second on 35mm Eastman celluloid film with perforations almost the same as the standard film perforations of today.

## Lighting Techniques

Lighting techniques for television studios, film studios, theatrical stages and still portraits vary a great deal, further complicated by the differing requirements of black-and-white and

*Thomas Alva Edison at the age of 31, with his first cylindrical phonograph.*

colour. Big improvements have been made to the equipment required for each field. The biggest advance has been made in television studios from the operational point of view, if not in the resulting end-product.

The search for—and achievement of—good portraiture of top-line stars in top-line films has always required extreme care on the part of the lighting director (formerly called the Cameraman) amounting to virtuosity. The larger the screen in the cinema, the greater are the artistic and technical demands upon him, with extended time scale.

Compare the speed operation of the film studio lighting director with his counterpart on television, and the difference is enormous. The use of multiple television cameras for simultaneous shooting of long-shots, mid-shots and close-ups, not to mention immediate changes from one scene to another, all call for speed and decision on the part of a lighting man.

Fortunately, the small television screen, the high ambient light in the viewer's sitting room, the distortions and lack of d.c. restoration on his TV set, all cover up blemishes which would not be acceptable on a big cinema screen.

The fact is, the television lighting man often accomplishes remarkably good portraiture and set lighting at incredible speed. Rapidly moving cameras rolling across dead flat lino-covered floors call for the removal of floor stands and other stage clutter. Overhead lighting units on telescopic supports, as developed by Mole Richardson (England) Limited, has made a valuable contribution to progress in this respect, but the remote control dimmer consoles of Strand Electric Company have been equally important.

Britain is well ahead of other countries in this respect. One of the main problems of overhead lighting has been the shadow effects on the eyes of the actors (and actresses) which sometimes add years to their age.

## "Bashers"

Film studio lighting men use soft low-power lights on floor stands or attached to the cameras, known as "bashers", for some unknown reason. These soft lights give good rendering of the most important part of the face—the eyes. "Bashers" are now increasingly used in television studios, attached to the image orthicon cameras and controlled for dimming at the lighting supervisor's console.

"Basher" is not the only strange name applied to the multitude of different lighting units in studios, with names which derive either from cockney rhyming slang or are more descriptive of their purpose than mere model or pattern numbers. Here is a thumb-nail glossary:

| *Type* | *Slang Name* |
|---|---|
| 500 watt spotlight | 'PUP' |
| 200 watt spotlight | 'INKY-DINKY' |
| 2-light flood | 'LOLLO' |
| 5kW soft light | 'SKY PAN' |
| 50ft/spot variable luminaire | 'TWISTER' |
| 4-light flood | 'QUADS' |
| 10kW spotlight | 'TENNER' |
| Shadow producers for lights | 'NIGGERS' 'FRENCH FLAGS' 'NETS' |
| Stray light eliminators | 'BARN DOORS' |
| MR type 1450 arcs | 'BRUTES' |
| Various types of lamp brackets | 'TURTLES' 'TROMBONES' 'SLEDS' |
| Controlled shaped soft lights | 'FOO FOOS' |
| American 1kW spot | 'KEG' |
| General flood lamps | 'SCOOP' |
| Special type semi-flood | 'SPUTNIK' |
| 5kW spot | 'CURRENT BUN' |

*A typical slang instruction:*

| | |
|---|---|
| "The backlight is too bright ('hot') on this actor's head" | (pointing) "To peasy on th loaf" |

After taking a "butchers" (i.e look) at his "bubbles" (i.e lamps), the lighting superviso climbs the "apples and pears" (i.e. stairs) to his "lost chord" (i.e. organ-console lightin dimmer). This kind of double talk may seem as clear as mud t many of us, but it carries with the virtuosity of confiden professionalism.

Iconos

# BLACK LEVEL EQUALISATION

*Improved television circuitry which may be incorporated in existing receivers*

## by K. ROYAL

RESULTING from the introduction into receivers of such things as flyback e.h.t., d.c. attenuation in the video amplifier to picture tube circuit and mean-level vision a.g.c., there has been a progressive worsening of the black-level performance of receivers over the years.

### The D.C. Component

Early designers were very critical of the black-level until it was generally agreed that some attenuation of the d.c. component of the vision signal subsequent to the vision detector was, in fact, desirable since it tended to mask certain reception shortcomings.

As a consequence, attenuation of the d.c. component was purposely introduced in a small and controlled manner by the connection of a resistive potential-divider between the video output valve and the cathode of the picture tube. Since those days a great deal of attention has not been given to the d.c. component. However, the somewhat disconcerting effects resulting in modern receivers from an excessive loss in d.c. component have in recent months led to new thoughts on the subject.

One outcome of this is a new and clever circuit evolved in the Mullard laboratories for black-level correction, not by reducing the attenuation of the d.c. component—a process which is virtually impossible in modern domestic receivers—but by feeding into the picture tube circuit an equalising voltage whose magnitude varies during a programme to correct for the change in black-level which results from the total or complete loss of the d.c. component in the video circuits.

This circuit has the advantage of being simple to design into new receivers and also, from our point of view, of being not too difficult to introduce into existing receivers with remarkable results. Before the circuit is investigated, however, we should refresh our minds on the subjects of the d.c. component of the vision signal and the need for black-level correction.

We will look at these things from the aspect of the 405-line signal which, as is well known, rises from black, positively towards white, as shown in Fig. 1(a). The principles which are about to be explained also apply to the 625-line signal, but this rises from black, negatively towards white.

### Black Level

Now, the video signal in modern sets is applied to the cathode of the picture tube. Theoretically, the picture tube is biased by adjusting the bright-

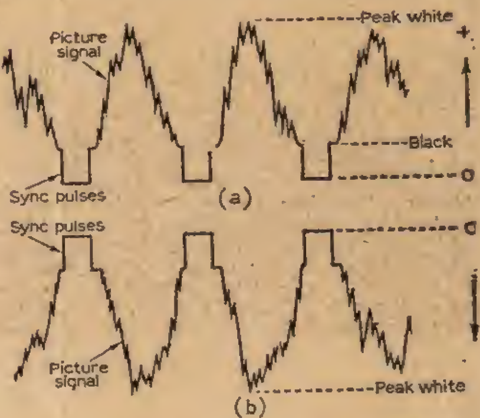



*Fig. 1—Positive-going picture signal as transmitted (a) and as present at the cathode of the picture tube, assuming a fully stabilised black-level (b).*

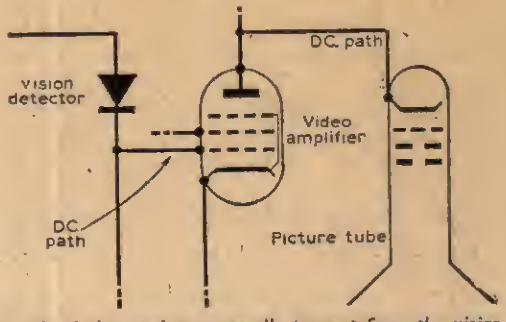



*Fig. 2—A d.c. path is generally present from the vision detector to the cathode of the picture tube, as this circuit shows.*

ness control so that a signal transmitted at black-level sets the bias to the threshold of screen illumination. This means that the screen illumination is then tied to the rises and falls of the picture signal, relative to the black-level.

From the illumination point of view, the sync pulses can be discounted since they are below the black-level.

Of course, because the picture signal is applied to the picture tube cathode, as distinct from the grid, it must rise negatively towards white, as shown in Fig. 1(b). This is achieved by connecting the vision detector to supply a positive-going picture signal to the control grid of the video output valve. At the anode of this valve the picture signal is then negative-going, due to the phase reversal effect of the valve.

The fact that the signal (shown at (b) in Fig. 1) rises negatively from *zero* means that there must exist a d.c. path right from the vision detector to the cathode of the picture tube, as shown in Fig. 2. In all 405-line receivers such a path exists though, as already mentioned, a degree of attenuation may be present between the video amplifier and the tube cathode.

However, in spite of this d.c. path, the tube may fail to respond illumination-wise from black, for the d.c. component of the vision signal can be destroyed in ways other than by lack of a d.c. path from the detector to the tube. One way results from the action of the vision a.g.c. system.

### *Mean Level A.G.C.*

Almost all modern receivers employ so-called mean-level vision a.g.c. Here the a.g.c. control bias is derived from the control grid of the sync separator valve. In effect, the negative voltage at this electrode assumes a level proportional to the mean value of the composite vision signal. Thus, if the picture signal is predominantly white, the negative control bias produced at the grid of the sync separator valve is far greater than when the signal is at black-level or when the signal corresponds to dark scenes.

The effect, then, is for the gain of the receiver to vary in a way that is dependent on the average amount of white in the picture. The gain is automatically turned down when the picture is composed of a lot of white and automatically turned up when the picture is composed of a lot of grey and black.

On the picture the effect is that of a raising of the black-level on dark scenes and of a reduction on scenes which are predominantly bright. This is similar to the brightness control being turned up when the scene goes dark and being turned down when the scene goes light.

### *Sooty-grey Background*

Of recent years the effects have become so noticeable that television producers have been forced to take them into account and to avoid televising scenes of very low illumination level. General symptoms of the loss of the d.c. component of the vision signal include streaking from captions, sooty-grey background which should really be black and a complete blacking out of objects in a dark background when the sky in the picture is particularly bright and the bottom part of the scene is in the shade. This latter symptom is particularly troublesome during the televising of ordinary films, made without thought to the black-level problems of television.

The shortcomings of mean level vision a.g.c. are removed by the use of a vision a.g.c. system which is pulsed or keyed to sample only the black-level portion of the vision signal. The resulting bias potential is then proportional to the black-level of the picture and is unaffected by the actual picture signal. Keyed or black-level vision a.g.c. systems had a period of popularity, but even when they were adopted many receiver designers continued purposely to attenuate the d.c. component to reduce the effects of aircraft flutter and the interaction between the brightness and contrast controls. As a consequence, the additional expense of the keyed system was eventually considered unncessary and the mean-level system was employed almost exclusively.

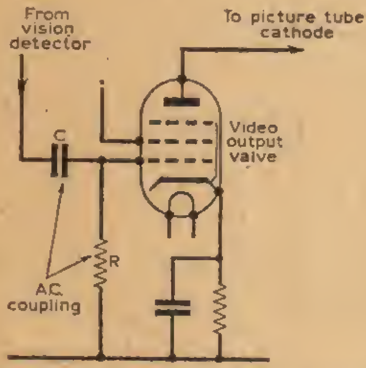



*Fig. 3—The black-level reference of the vision signal is destroyed by passing the signal through an a.c. coupling of the nature illustrated.*

If extra special care is taken to *retain* the d.c. component in receivers, it is found that the ordinary user has difficulty to establish the correct settings for the brightness and contrast controls. Not only does the setting of one control affect the other, but certain reception shortcomings are also emphasised, aircraft flutter in particular.

### *Aircraft Flutter*

The variations in strength of the signal picked up by the aerial due to signal reflections from a passing aircraft adding to and subtracting from the direct signal affect the d.c. component of the vision signal more than they affect the higher frequency video component. Thus, a set with a very good d.c. response exhibits great changes in brightness level as the reflecting aircraft passes by. Moreover, this kind of receiver is also likely to promote excessive picture tube beam currents, and it is not unusual for the tube to be forced into grid current.

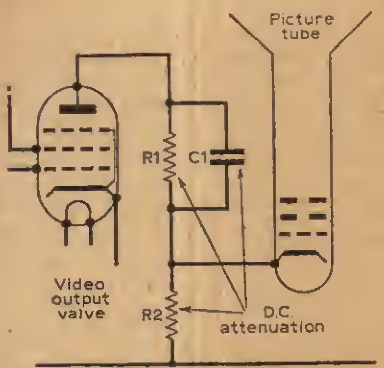



*Fig. 4—To attenuate the d.c. component as an artifice for reducing the effects of passing aircraft, the network R1, R2 and C1 is often present in modern receivers. R1/R2 also serve to keep the tube heater/cathode potential at a low value.*

### A.C. Couplings

The d.c. component of any signal is lost as soon as the signal is passed through an a.c. coupling, such as a resistor/capacitor network. Some dual-standard receivers employ an a.c. coupling between the vision detector and the video output valve either on both standards or—more often—only on the 625-line standard. Such a coupling is shown in Fig. 3.

Attenuation of the d.c. component between the video output valve and the picture tube cathode is accomplished by a network similar to that shown in Fig. 4. R1 and R2 form a resistive potential-divider and thus reduce the value of the d.c. component. The higher frequency video components are not attenuated, since the reactance of C1 "looks" to the video signals as almost a short circuit.

### Video Waveforms

In Fig. 5 are shown at (a) three video waveforms as transmitted with the black held to zero potential.

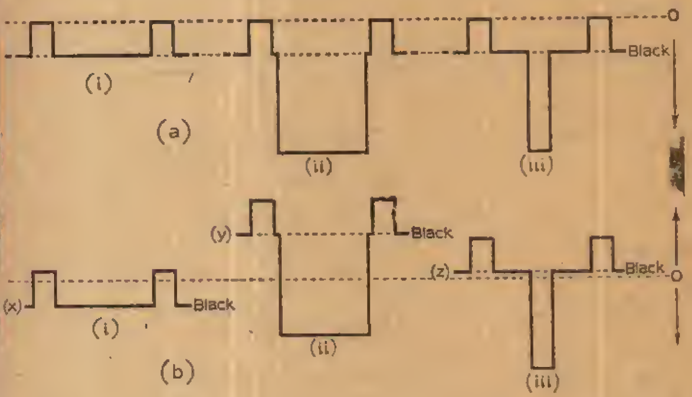



*Fig. 5—When the d.c. component of the vision signal is fully retained, the black-level remains constant irrespective of the video waveform. Three typical video waveforms are shown at (a). When the d.c. component is lost, the waveforms settle equally either side of the zero datum and the black-level rises and falls according to the make-up of the video signals, as shown at (b).*

These factors are considerably reduced by the attenuation of the d.c. component. On the one hand, therefore, complete retention of the d.c. component is desirable from the picture quality aspect, while on the other hand, it is undesirable because it shows up reception problems and makes the set more difficult to operate. Until the advent of the Mullard black-level correction circuit, there was no alternative than to design a domestic receiver for d.c. suppression. High quality monitor receivers, of course, are in a professional category, and in the main these are designed with black level vision a.g.c., stabilised power supplies and other refinements which ensure that the d.c. component is fully retained.

For accurate rendering of the grey tones of a picture, there are factors in addition to pure d.c. coupling and the use of black-level a.g.c. which need to be satisfied. These include adequate stabilisation of the picture tube potentials over the video-frequency spectrum, a constant level of video drive and a constant depth of vision modulation. Sufficient reason, therefore, why the relatively poor black-level performance of modern receivers has remained.

When such signals are passed through an a.c. coupling the d.c. black-level reference is lost completely. The waveforms then appear as at (b), with equal areas of the waveforms above and below the zero datum line. While the black-level of the waveforms (i), (ii) and (iii) at (a) is constant, at (b) in the corresponding waveforms, the black-level is a little below the zero datum at (i), well above at (ii) and a little above at (iii). In effect, then the video waveform, whatever shape it may take, balances equally either side of the datum.

All this boils down to the fact that the mean bias on the picture tube varies in accordance with the picture signal. The instantaneous bias, of course, must follow the picture signal, but the mean bias should always be tied to the black-level, as we have seen.

So far, then, we have seen that the black-level of the picture can be stabilised properly by the use of d.c. couplings throughout the video channel (that is, from the detector to the picture tube), by the use of a black-level, gated a.g.c. system and by ensuring that the power supplies, especially those associated with the picture tube and video amplifier, themselves are adequately stabilised.

We have also seen that various compromises are adopted in practice and that full stabilisation of the black-level is neither economically feasible in domestic sets nor technically desirable due to the resulting difficulty encountered in adjusting the brightness and contrast controls.

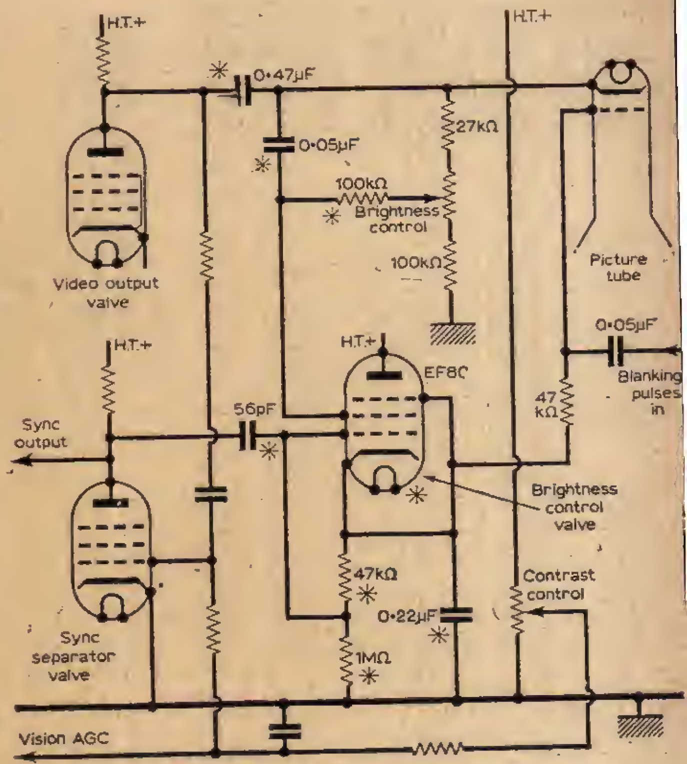



*Fig. 6—Circuit of the Mullard black-level corrector.*

***Correcting Bias Potential***

In the Mullard circuit no attempt is made to improve the basic d.c. performance of the receiver. Indeed, a.c. couplings are purposely introduced! The circuit works by feeding back into the tube bias network a potential which changes in the opposite way to the mean bias changes resulting from the video signal.

Suppose, for instance, the scene changes from light to dark. We have seen that this, due to d.c. suppression, causes a drift in the main bias on the tube so that the beam current is increased. This is, the tube bias is decreased. Under this condition, the Mullard circuit provides a correction potential that eases the bias and thus effectively restores the black-level.

Conversely, a bias increase resulting from a scene changing from a predominantly dark value to a predominantly light value is countered by the circuit producing a potential that reduces the effective tube bias. Note that the instantaneous changes in tube bias resulting from the components of the picture signal proper are unaffected by the circuit. It responds essentially to the average amount of picture illumination as a whole.

***How it Works***

The circuit is given in Fig. 6. Here is shown the ordinary video amplifier valve feeding the picture tube and the sync separator valve. The extras to an existing receiver are the EF80 "brightness control" valve and associated components. These are indicated thus*.

The EF80 is arranged as a cathode-follower. The anode is tied to h.t. positive and the cathode is loaded with a 47kΩ and a 1mΩ, across which is connected an 0·22µF capacitor, the combination forming a time-constant.

***Differentiated Pulses***

Video signal at the cathode of the picture tube is coupled through an 0·05µF capacitor to the screen grid of the EF80 and the valve is "gated" by differentiated pulses from the sync separator valve being applied to the control grid. The valve is biased so that conduction occurs only on the positive-going tips of the differential line sync pulses. As these pulses correspond in time to the back porches or black-level of the video signal, the black-level of the signal is, in effect, "sampled" and the extent of conduction of the valve is governed by the black-level value.

Thus, across the cathode resistors is developed a potential whose value is proportional to the black-level of the signal at the tube cathode. This potential is stabilised by the 0·22µF charging capacitor and is fed to the tube grid through the 47kΩ resistor. Thus, if the black-level tends to shift, say, due to a rise in mean potential at the cathode, it is restored to its correct level by the correction potential applied to the grid.

***Brightness Control Network***

The circuit is not difficult to get working. The extra components required are marked with an asterisk. Note that it is also necessary to change the brightness control network from the grid of the tube to the cathode and also to introduce a capacitor between the cathode and the anode of the video output valve. The 47kΩ resistor is generally present in the tube grid circuit as a "hold-off" for the blacking pulses fed from the frame timebase. ■

## AERIALS

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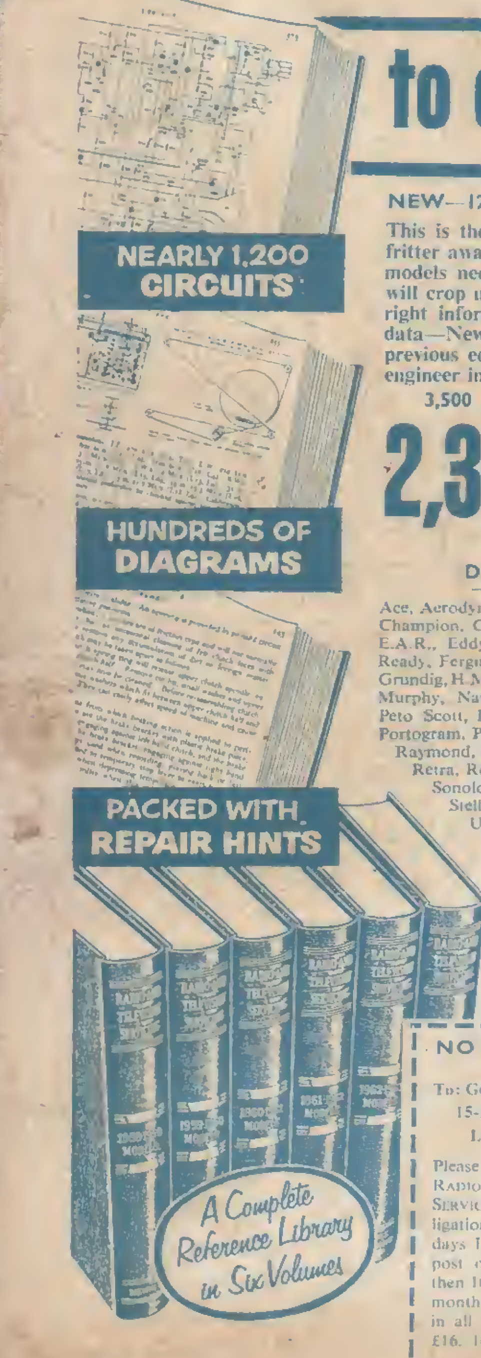


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