# Practical TELEVISION

SEPTEMBER 1968 2/6

## CONSTRUCT THE P.T. VALVE TESTER


ALSO INSIDE

DEALING WITH CHAIN-REACTION FAULTS

## BIG REDUCTIONS OF LINE OUTPUT TRANSFORMERS

**ALBA** 655, 656, 77/6.
**DYNATRON** TV30, TV35 **40/-**, TV36 **56/6**.
**EKCO** T231, T284, TC267, T283, T293, T311, T326, T327, T330 **40/-**. TMB272 **68/6**. T344, T344F, T345, TP347, T348, T348F, TC347, TC349, TC356, T368, T370, TC369, T371, T372, TP373, TC374, T377A, T380, T380F, T381, T382, TC386, T393, T394, all at **70/-**.
**FERGUSON** 306T, 308T **40/-** each. 406T, 408T, 416, 436, 438, 506, 508 516, 518, 536. 546, 604, 606, 608, 616, 619, 636, 646, 648, 725, 726 727, 3600, 3601, 3602, 3604, 3611, 3612, 3614, 3617, 3618, 3619, 3620, 3621, 3622, 3623, 3624, 3625, 3626, 3627, 3629 **£2-16-6**.
**FERRANTI** T1001, T1002, T1002/1, T1004, T1005 **40/-**. T1023, T1024, T1027, T1027F, TP1026, T1057, T1057F, T1058, T1061, T1063, T1063F, T1068, T1068F, T1071, T1072 **70/-**.
**G.E.C.** BT302, BT304 **62/6**.
**H.M.V.** 1865, 1869 **40/-**. 1870, 1872, 1874, 1876, 1890, 1892, 1894, 1896 **56/6**.
**PILOT** PT450, 452, 455, 650, PT651, P60, P60A, P61 **82/6**.
**PHILCO** 1962, 1967, 1967M, 1019, 1020, 1021 **82/6**. 1029, 1030, 1035, 1036, 1040, 1050, 1060 **82/6**.
**PYE** V200, V400, 200LB, 210, 220, 300F, 300S, 310, 310S, 410 **55/-**. 11U, etc. Please state part No. **60/-**.
**ULTRA** 1770, 2170, 1772, 1782, 2172, 1771, 2171, 1775, 2175, 1774, 2174, 1773, 2137, 1980c, 1984c, 100c, 200c, 2380, 2384, 1984, 1985, 1986, 1980, 1980a, 1780, 2180, 2181, 2183, 2182, 1781, 1783 **62/6**.

**LINE OUTPUT TRANSFORMER INSERTS**

**BUSH** TV53, TV56, T57, TV57, TUG58, M59, TUG59, TV62, TV63, TV66, TV67, TUG68, M69, TUG69 **27/6**.
**EMERSON** E700, E701, E704, E707, E708, E709, E710, E711, Portarama **32/6**.
**FERGUSON** 204T, 205T, 206T, 214T, 235T, 236T, 244T, 245T, 246T **30/-**.
**FERRANTI** 14T2, 14T3, 14T3F, 14T4, 14T4F, 14T5, 14T6, 17K3, 17K3F, 17T3, 17T3F, 17K4F, 17K6, 17SK6, 17T4, 17T4F, 17T5, 17T6, 21K6, 21K6V **32/6**.
**INVICTA** T118, T119, T120 **40/-**.
**K.B.** PV40, MV100, OF100, PV100, NV40, NF70, OV30, QV10, QV30 **32/6** pair.
**PETO SCOTT** 1416, 1418, 1419, 1422, 1423, 1716, 1719, 1720, 1722, 1723, 1724, 1725 **29/6**.
**PYE** V4, V7, VT4, VT7, CTM4, TCM7 **40/-**.
**REGENTONE** 10-4, 10-6, 1017, 1021, **30/-**. T176, TT7, 191, 192 **32/6**.
**R.G.D.** Deep 17, The 17, 600, 590 **32/6**.

**Guarantee.** *Post and Package 4/6. C.O.D. 6/-.*

All new components inserts are guaranteed for three months from the date of invoice subject to the breakdown being due to faulty manufacture or materials.

**D. & B. TELEVISION (Wimbledon) LTD**
**131 KINGSTON ROAD, WIMBLEDON**
**01 540 3513 S.W.19 01 540 3955**

# TRADER SERVICE SHEETS

**5/- each plus postage**

We can supply Trader Service Sheets and Manufacturer's Manuals for most makes and types of Radios and Television and Tape Recorders

*Please complete order form for your Service Sheet to be sent by return. To:*

**OAKFIELD ENTERPRISES**
LIMITED
**30 Craven Street**
**Strand**
**London WC2**

s.a.e. with enquiries please.

MAIL ORDER ONLY
PT.).

| Make | Model | Radio/TV |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

1968 List available at 2 - plus postage

If list is required indicate with X

From ..............................
Address ..............................
..............................
..............................
I enclose remittance of..................
(and a stamped addressed envelope)

# Learn at home... First Class Radio and TV Courses


After brief, intensely interesting study —undertaken at home in your spare time **YOU** can secure a recognised qualification or extend your knowledge of Radio and TV. Let us show you how.

**FREE GUIDE**
The New Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. Chambers College provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & C. Telecoms., A.M.I.E.R.E. Guide also gives details of range of certificate courses in Radio/TV Servicing. Electronics and other branches of engineering, together with particulars of our remarkable terms of **'Satisfaction or Refund of Fee'**.

*Write now for your copy of this valuable publication. It may well prove to be the turning point in your career.*

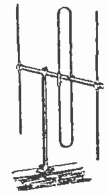
**Founded 1885—Over 150,000 successes**

**CHAMBERS COLLEGE**
(Incorp. National Inst. of Engineering)
**(Dept. 844V), 148 Holborn, London, E.C.1.**

# NEW RANGE BBC 2 AERIALS

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.
**Loft Mounting Arrays.** 7 element. **37/6.** 11 element. **45/-.** 14 element. **52/6.** 18 element. **60/-.** **Wall Mounting with Cranked Arm.** 7 element. **60/-.** 11 element. **67/-.** 14 element. **75/-.** 18 element, **82/6.** **Mast Mounting with 2in. clamp.** 7 element. **42/6.** 11 element. **55/-.** 14 element. **62/-.** 18 element. **70/-.** **Chimney Mounting Arrays. Complete.** 7 element. **72/6.** 11 element. **80/-.** 14 element. **87/6.** 18 element. **95/-.** Complete assembly instructions with every unit. **Low Loss Cable. 1/6** yd. **U.H.F. Preamps** from **75/-.** State clearly channel number required on all orders.

**BBC - ITV AERIALS**



**BBC (Band 1).** Telescopic loft. **25/-.** External S/D. **30/-.** "H". **£2.15.0.** **ITV (BAND 3).** 3 element loft array. **30/-.** 5 element. **40/-.** 7 element. **50/-.** Wall mounting. 3 element. **47/6.** 5 element. **52/6.**
**Combined BBC/ITV** Loft 1+3. **40/-.** 1+5. **50/-.** 1+7. **60/-.** Wall Mounting 1+3. **57/6.** 1+5. **67/6.** Chimney 1+3. **67/6.** 1+5. **75/-.** **VHF** transistor preamps. **75/-.**
**COMBINED BBC1 - ITV - BBC2 AERIALS.** 1+3+9. **70/-.** 1+5+9. **80/-.** 1+5+14. **90/-.** 1+7+14. **100/-.** Loft mounting only.
**F.M. (Band 2).** Loft S/D. **15/-.** "H". **32/6.** 3 element. **55/-.** External units available. Co-ax. cable. **8d.** yd. Co-ax. plugs. **1/4.** Outlet boxes. **5/-.** Diplexer Crossover Boxes. **13/6.** C.W.O. or C.O.D. P. & P. **5/-.** Send **6d.** stamps for illustrated lists.

*Callers welcomed. Open all day Saturdays.*

**K.V.A. ELECTRONICS (Dept.P.T.)**
**27 Central Parade. New Addington. Surrey CRO-OJB (LODGE HILL) 2266**

# Practical Television

SEPTEMBER 1968
VOL. 18 No. 12
*issue* 216

## Cost of Viewing

ASSUMING that there are no backsliders, you will all now be putting the odd pennies in the sock so that you will have the pleasure of handing over an extra pound to the PMG when next your TV licence renewal becomes due.

No doubt, too, you have all read (and probably forgotten) the somewhat feverish press reports following the announcement in the House. Headlines like " Fury over £6 TV fee" were backed up by statements from heated MPs containing more enthusiasm than reasoned criticism, plus examples of what passes for wit in the Mother of Parliaments. Most of this consisted of eminently predictable verbiage, both Government and Opposition backbenchers spouting conventional party lines.

Of course, no one wants licence fees to go up, but one has to be realistic. If the BBC has to operate as a public corporation and is required not only to improve existing services (e.g. coverage) but also to pioneer extra services (e.g. colour TV and f.m. radio) it is difficult to see how it can do this in a world dogged by inflation without having more money.

Assuming all this, the point would seem to move to the question of how the money should be raised. On the face of it the various schemes suggested for licence fees graded according to services (or lack of them) available appear reasonable. Why, for instance, should a viewer in a difficult reception area help to pay for services he cannot receive? But the trouble here is where to draw the necessarily arbitrary lines? Such schemes are not really practicable.

It would be equally unfair to finance the BBC through the Treasury, since taxpayers who do not own TV sets would be subsidising those who do, and although some regard broadcasting in all its forms as an essential public service, many might disagree.

The BBC could, of course, accept advertising, but even putting aside the controversial element of the suggestion such a move would destroy the balance so carefully devised of one commercial and one public service broadcasting organisation.

One aspect comparatively undebated is the intended crumb of compensation—an increase in TV broadcasting hours. Some of this time will be used for repeats of soap opera serials, as if we don't already have enough. Rather better, perhaps, would be to reduce the hours and improve the standard of programmes generally!

W. N. STEVENS, *Editor*.

THIS MONTH



**THE NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPTEMBER 20**

# TELETOPICS

## *British colour TV engineering achievement*

PETER RAINGER of the BBC Designs Department has received an Emmy, the International Award given by the U.S. Academy of Arts and Sciences, for outstanding television engineering achievements. Mr. Rainger was the leader of the team which, in August 1967, developed the converter for use between American and British colour television systems, thus enabling Europe to take colour pictures direct by satellite from America. This is the machine which will enable Britain and the whole of Europe to see next Autumn's Mexican Olympic Games live in colour.

## HUNGERFORD BBC-1 RELAY STATION

THE BBC has placed orders for the building and aerial tower for the new BBC-1 television relay station which is being built at New Hayward Farm, 1½ miles north of Hungerford. The building will be erected by J. T. Gibbs & Company Limited, of Hungerford, and the 120-ft. aerial tower by the Cornubian Construction Company Limited, of Danbury, Essex.

BBC-1 television will be transmitted from Hungerford on channel 4, with horizontal polarization. The service is expected to start in the autumn.

## IEETE MEMBERSHIP QUALIFICATIONS

THE IEETE Council have decided to accept the City and Guilds of London Institute's Electrical Technicians' Certificate (Regulations 57) with two Endorsement Certificates as satisfying the technical education requirements for election to the class of Graduate. The endorsements may be a Group A and a Group B subject, or both may be Group A.

In deciding to accept one Group A and one Group B endorsement certificate, the IEETE Council were influenced by the fact that City and Guilds of London Institute moderate the question papers and assess the students' answers. Nine years of experience has demonstrated that Group A and Group B subjects are comparable in standard.

### TV service from Llangollen

The BBC-Wales TV service from the relay station at Barber's Hill, Llangollen, began on July 8. The transmissions are on Channel 1 and horizontally polarized.

## EMI AT "NAVEX"

Educational TV equipment was exhibited by EMI Electronics at the National Audio-Visual Aids Exhibition held recently at Whitelands College, London, S.W.15. The BC920 and BC930 cameras were demonstrated. BC930 employs the EMI ½ in. vidicon tube.

### BBC-2 RELAY STATION AT FENHAM, NEWCASTLE-UPON-TYNE

THE BBC has placed an order with J. L. Eve Construction Company Limited, of Morden, Surrey, for the construction of the 150-ft. aerial tower for the u.h.f. relay station which is being built at Fenham Reservoir, Newcastle-Upon-Tyne. This station will transmit BBC-2 television on channel 27, with vertical polarization and will serve the area along the south bank of the Tyne Valley from Blaydon to Felling. Within Newcastle-Upon-Tyne, Fenham will also offer improved reception for some viewers screened locally from the main BBC-2 transmitter at Pontop Pike.

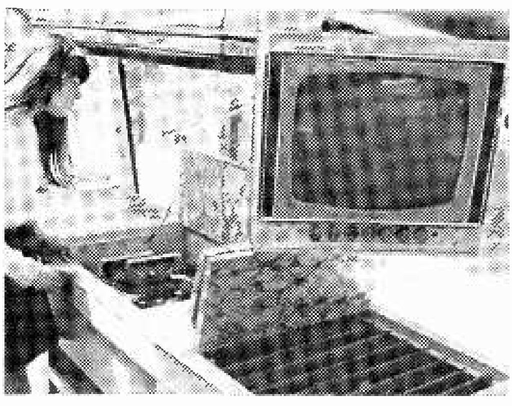
It is expected that the Fenham relay station will start service in the spring of 1969. Later it will also transmit BBC-1 and ITV programmes, when these are duplicated on 625 lines.

## *Brimar Industrial C.R.T. Brochure*

Brimar have published a 1968/69 edition of their abridged data brochure on Industrial cathode ray tubes.

Free copies may be obtained from Brimar Industrial Distributors, Brimar valve representatives, or direct from Brimar Publicity Department, Thorn-AEI Radio Valves and Tubes Ltd., 7 Soho Square, London, W1V 6DN.

## TELEVISION IN NEW SUPERBUS



*"Quicksilver", the latest in Evan Evan's fleet of executive coaches, was built at a cost of £15,000 as the ultimate in coach travel for conveying parties of V.I.P. visitors to conferences and such social events as Glyndebourne and Ascot.*

*"Quicksilver" is also provided with a closed circuit television system operated from a Shibaden video tape recorder, by which means promotion, informative or general interest films can be screened during the journey. The television is linked to the radio and public address system which is controlled direct from the driver's position.*

*The closed circuit television system and its ancillary electronics were designed and installed especially for "Quicksilver" by Closed Circuit Television Hire of 93 Greenfield Road, London, E.1.*

## PAL for Czechoslovakia

Czechoslovakia has decided to adopt the PAL system of colour TV in preference to the French SECAM system. The Czechs claim that, because of technical and economic reasons, PAL is best suited to their requirements.

### "The school to the pupil"

Rediffusion are bringing the school to the pupil in a new and unusual training project.

A conventional 46-seater single decker bus has been transformed into a mobile classroom which is touring the U.K. regional companies to provide training as well as colour refresher courses for Rediffusion television service engineers, technicians and apprentices throughout the country.

Offering the same courses as those at the company's Poulton-le-Fylde, Lancashire, training school, hitherto the company's main training centre, the classroom can accommodate eight pupils on each two week course and can be adapted for both practical and lecture purposes.

## TV FOR THE CHURCH

A full range of TV equipment for the new technical block and studio of the Catholic Radio & TV Training Centre at Hatch End is being supplied by Peto-Scott in association with Pye TVT Ltd.

Camera channels will be based on the Philips monochrome Plumbicon tube broadcast camera.

### *British Amateur Television Club 1968 Convention*

On Saturday, September 14, the B.A.T.C. are holding their 1968 Convention at the ITA Conference Suite, 70 Brompton Rd., London, S.W.3. It starts at 10 a.m. and goes on till 6 p.m. and admission is free. There is a General Meeting for members only at 3 p.m. for approximately half an hour and lectures on Topics of Amateur TV interest from 3.30 p.m. to 4.30 p.m.

The Convention is open to non-members who will be able to attend a Film Show while the General Meeting takes place. For further details contact D. S. Reid, 71a Rose Valley, Brentwood, Essex.

## FRANCE & RUSSIA CO-OPERATE ON TELEVISION

MR. ALEXEI RAPOKHIN, vice-president of the U.S.S.R. Radio and Television Committee, said at the Soviet Scientific and Technological Society for Radio-Engineering and Telecommunication that Soviet-French co-operation in colour television holds great promise for both countries. The Soviet-French *Secam-3* system compares favourably with those adopted in the United States and West Germany for its relative simplicity, easier video-tape recording and greater colour stability in transmitting over great distances.

Colour transmissions were started simultaneously in Moscow and Paris on October 1, last year.

This year, he said, 15,000 colour TV sets would be produced in the Soviet Union, and the figure would be brought up to 200,000 in 1970.

In three years time, Moscow television programmes will be bounced to all Soviet TV stations. At present, the transmitting television network has over 900 TV centres and relay stations.

An extensive network of *Orbita* ground receiving stations has been set up in the Soviet Union in the three years since the launching of the first Soviet communications satellite of the *Molniya-1* series. It has brought Moscow programmes to 20 million televiewers in the Far North and eastern regions of the country.

The *Orbita* network will soon begin transmitting Moscow newspaper matrices, meteorological maps and other information.

## *BBC-1 AT NEWHAVEN*

NEWHAVEN relay station will transmit BBC-1 on Channel 8, vertically polarized. It is expected to be brought into service during the coming winter and will serve Newhaven, Seaford, Peacehaven, and Denton. The ITA also intend to install a v.h.f. TV relay station on the Newhaven site.

## Radio Rentals take over

RADIO Rentals Wired Systems have taken over Llanelli Traders Television Relay Limited, which had a franchise to operate a v.h.f. television relay in Llanelli.

For 2s. 6d. a week, viewers will be able to receive six TV channels, including colour (BBC 1, 2 and Wales, ITV West, Harlech and Teledu Cymru) and five radio programmes (BBC 1, 2, 3, 4 and Luxembourg).

A Llanelli contractor has already built the relay station, and the 100 ft. mast has just been erected on nearby Bigyn Hill by the Cheltenham firm (Francis and Lewis) who made it.

The wide band v.h.f. system is fully transistorised on a coaxial cable.

## *Another £100,000 contract for Mullard*

Thames Television, the London week-day independent television programme company, have placed a contract worth more than £100,000 with Mullard Ltd. for the supply of "Plumbicon" television camera tubes. This is the second contract of its kind to be placed with Mullard by an independent television company. In April this year a similar contract was placed by Yorkshire Television.

Thames Television, which started programme transmission on July 30, has spent about £2m on equipping for colour.

### 625-Lines for Granada TV

Granada's central control room at the £7m Manchester TV centre is being re-equipped with £3m worth of equipment for the change, next year, to 625-line working.

Two groups of 25 inputs can be accepted in their new assignment switcher which is designed to feed two TV transmitters with either different or the same signals. This switcher also provides programme pre-selection which is said to reduce the complex switching when the station is on the air.

In 1967, the Manchester control room staff handled 2,500 hours of programmes, and now that the station has begun seven day operation, this goes up to 3,500 programme-hours.

# DEALING WITH CHAIN-REACTION FAULTS

## by Vivian Capel

THE television receiver being the complex piece of equipment that it is many of the circuits and components are inter-dependent upon each other. It is not surprising therefore that a defective component can lead to conditions that will produce a fault in another component. This in turn may have an effect on yet a further part so that in the end the original breakdown has caused a number of component failures.

In many cases the relation between these failures is fairly obvious but in others it may be rather more obscure. These chain-reaction faults are quite familiar to the experienced professional engineer and having found one he will anticipate and check for the others. Those less practised may however have the unhappy experience of replacing a defective part only to find that it too is damaged after a short period of operation. Even if this does not occur time can be wasted checking faults as if they were separate and unconnected with each other and some general rules with a few workshop examples should help to avoid this.

One frequently encountered example is found when investigating a defective output stage. It is common to find that the cathode resistor is low in value and that physically it bears signs of burning or overheating. This may be replaced in the confident expectation that the fault has been run to earth. On switching on some improvement may be found in performance but it is soon evident that trouble remains. The newly fitted resistor is running very hot. It may be thought that there is some trouble with the valve and a new one may be fitted. This makes matters worse and the cathode resistor runs hotter than ever.

Before allowing things to get to this stage the experienced engineer will have checked for positive voltage on the grid of the valve. He knows that overheated resistors mean excess current and that this in turn must be attributable to some further fault. More often than not a positive voltage will be found on the control grid and this is likely to be due to a leak in the coupling capacitor from the preceding stage (see Fig. 1).

It is very likely that if the valve has been overrun in this manner for any length of time it will have lost emission. Fitting a new valve with full emission will mean that even more current will flow and so the resistor will, as just mentioned, overheat still further. In some cases the fault could be due to a leak between the control grid and screen grid of the valve itself so that replacing the valve effects a cure. A skilled engineer will not guess at this however: he will check the coupling capacitor before fitting a replacement valve.

This brings us to a similar chain of events often encountered in the line output stages of television receivers. It is sometimes found that in cases of poor width or where there is no line scan at all a new line output valve effects a cure. The set functions well for a period—for weeks or perhaps even months—and then the fault is repeated and a further line output valve becomes necessary to restore normal working. Here again the professional engineer will take a look at the screen resistor before fitting a new line output valve. It sometimes happens that a screen grid to control grid leak in such a valve will cause heavy current to flow through the screen grid resistor and if this is of the carbon type will cause overheating and a reduction in value. Thus, although the original cause of the trouble is removed when the valve is replaced, the low-value screen resistor will cause the replacement valve to be considerably overrun due to excessive screen current. The replacement valve will thus have a short life as will any further substitution that may be made until the screen resistor is replaced. If the resistor is one of the wire-wound variety the engineer would not check it as these resistors do not go low in value.

In the case of the video output stage it is the anode load resistor that usually manifests overheating effects and low-resistance readings as it is of low value and a high current normally flows through it. Once more any of these signs will cause the engineer to look elsewhere for faults that are likely to produce excess current through the video output stage. He will check to see whether the correct bias is to be found on the cathode: a possible cause of incorrect bias here could be a short-circuit in one of the bypass capacitors in the cathode circuit.

If all is in order here he will again check the control grid for positive voltage. Slight positive voltage may be found due to rectification of the signal by the video detector, but it should be well below the cathode bias voltage. It is not uncommon to find a

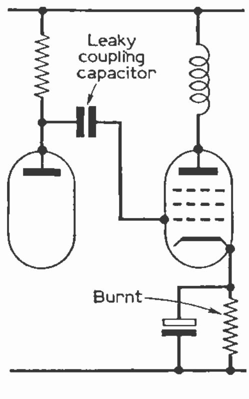



*Fig. 1: An overheated cathode resistor may be caused by a leaky coupling capacitor.*

large positive control grid voltage which by testing the valve is proved not to be due to a leak to the screen grid. Further tests and measurements reveal that it is in fact coming from the vision detector. This is found to be rectifying a mysterious powerful signal which is present even with the aerial disconnected. The answer is instability, and the cause is usually traced to one of the screen grid decoupling capacitors associated with the i.f. stages (Fig. 2). Thus a burnt video anode load resistor is the effect of an open-circuit i.f. screen grid decoupler. This illustrates how faults may be connected although they may appear to be remote.

While on the subject of video anode loads an interesting sequence of faults occurred recently in the workshop on a dual-standard receiver. The complaint was no vision and a quick investigation revealed that the anode load was open-circuit. This was a wire-wound component and as these resistors sometimes go open-circuit for no apparent reason and the resistor had not shown any signs of stress it was replaced without any further checking. There was still no vision although a disturbance signal injected at the grid of the video valve produced an effect on the raster. Working back from there soon revealed that the video detector diode was open-circuit. This too was replaced and a normal picture was restored on v.h.f. Switching over to the 625-line standard, however, produced no results. Past experience with this symptom lead to replacement of the video output valve itself and then a normal picture was obtained on both standards. The old valve was tested and found to have a high-resistance control-grid to screen-grid leak.

It was then that the sequence of events became evident. The removal of voltage from the anode due to the load resistor going open-circuit had caused the screen dissipation to greatly increase. This caused it to overheat and produced a leak between it and the control grid. Under these conditions the leak was a low-resistance one which caused h.t. voltage to be applied to the detector diode resulting in its destruction. When the anode load resistor was replaced screen dissipation returned to normal and the low-resistance leak disappeared but a high-resistance leak remained. Hence when the diode was replaced the stage functioned normally on v.h.f., the slight positive voltage on the grid due to the high-resistance leak being "killed" by the low-impedance grid circuit. On 625 lines, however, the grid circuit is capacitively instead of directly coupled to the detector and the leak was sufficient to prevent the stage from working.

## Open-circuit Faults

As already mentioned, wire-wound resistors often go open-circuit without any external reason. On the other hand they too can be affected by excess current. If the resistor has in fact overheated, then usually it bears telltale signs of it. The external coating may be cracked or flaking, or it may be of a lighter colour over the wire where it has been heating than at the ends of the resistor. Whenever a wire-wound resistor is found to be open-circuit it is wise to give the component a visual examination to determine whether or not excess current was the cause. As

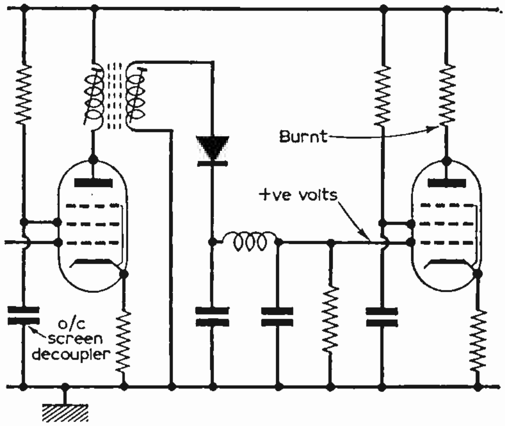



*Fig. 2: An overheated video amplifier anode load resistor may be caused by an open-circuit i.f. amplifier screen decoupling capacitor.*

they will usually stand a reasonable overload for a short period it is as well if in doubt to insert a meter in order to measure the actual current flowing.

One recent case shows the wisdom of this precaution. The receiver was completely dead and an examination revealed that one of the surge-limiting resistors in the h.t. supply circuit was open-circuit. There were distinct signs of distress, so a meter was connected in series with the replacement when the receiver was switched on. As anticipated the current was much heavier than that given in the maker's service manual although the receiver seemed to operate normally.

A careful visual examination for further signs of overheating was made in order to find a clue as to where the trouble may be located. During this it was noted that the line output valve was glowing a dull cherry red. A check was made in the line circuit and it was found that there was insufficient line drive to the control grid. The trouble was eventually traced to a low-emission line-oscillator valve. The width of the raster seemed unaffected, possibly due to the lower e.h.t. which would have increased the deflection sensitivity of the cathode-ray tube. A new line-oscillator valve resulted in a brighter, sharper picture, as well as bringing the h.t. current back to normal. The limiter could easily have been replaced without further investigation when the set was found to be functioning reasonably well and returned to the owner only, no doubt, to have developed further trouble later.

Mains droppers and thermistors are also prone to going open-circuit. Normally these components operate at a high temperature so it is not always easy to determine whether or not they have become defective due to an internal defect or some external fault. Before switching on after making a replacement it is always wise to make a cold chassis test of the heater chain. The condition to look for is a heater-cathode leak in any of the valves as this will effectively short-circuit part of the chain and draw excessive current through the dropper and thermistor.

A resistance reading from the top of the chain to chassis will not convey very much as the heater-cathode leak path may be through a cathode resistor which will thus be added to the resistance of the valve heaters. The best way to check is to take a reading and with the meter still connected open-circuit the bottom of the chain by removing the base from the cathode-ray tube. A reading of infinity should now be obtained: if not, then a heater-cathode leakage is present somewhere along the chain. (A reading may however be obtained in this way back through the metal rectifier if one is used and through the bleeder resistors and electrolytic capacitors on the h.t. line: if a reading is obtained in these circumstances, reverse the meter leads.)

If no leakage reading is obtained this does not mean that a heater-cathode leakage does not exist as it may only occur when the valve is warm. Here the ability of wire-wound resistors to stand short overloads is once more a help. The set should be switched on and a careful lookout made to see that all the valve heaters are glowing normally. If any do not light or if some light abnormally brightly then the set should be switched off and individual valves tested in a valve tester to determine which one is at fault.

## *Unconventional Circuits*

Sometimes unusual circuit arrangements can make a chain reaction of faults difficult to spot. For example the Ferguson Model 3638 has four valve heaters wired in series with the negative side of the h.t. supply (see Fig. 3). They are shunted by two resistors, one of which is a preset variable in order to adjust the heater current

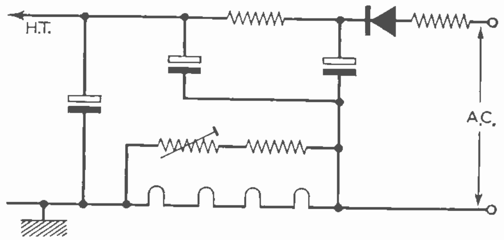



*Fig. 3: In the Ferguson Model 3638 four of the valve heaters are incorporated in the negative h.t. line*

flowing through them. Cases have been encountered where the set was dead and examination has shown that the heater-current adjusting potentiometer has burnt out. Probing further it has been found that one of the heaters has gone open-circuit, thereby forcing all the current through the parallel adjuster. The matter has not ended there because replacement of both the valve and the preset has shown up the fact that the valves were considerably overrun. High h.t. current has been found to be flowing, the cause of this being a defective line-output transformer. More than one case of this fault has been known and it illustrates that with an unconventional circuit the chain of faults can follow an unusual and unsuspected path.

*—continued on page 556*

# THE ABC OF colour TV

## PART 4

G. P. WESTLAND

### Purity

Purity is the attribute whereby the electrons from a particular gun in a shadowmask c.r.t. fall only upon the phosphor of the appropriate colour. For example, electrons from the red gun must only land on the red phosphor dots. If they spill over upon the neighbouring green and blue phosphor dots a red signal will not give a pure red light output, but one distorted by the presence of green and blue light. Purity is achieved by correct orientation of the beams of electrons through the holes in the shadowmask by means of a magnetic field.

### Quadrature

This simply means "at right angles". Currents and/or voltages are in quadrature if they have a phase difference of 90°; i.e., one leads or lags on the other by a quarter of a cycle of a sinewave. The most important example of quadrature components in colour television is the way in which the R-Y and B-Y signals are modulated on to the luminance signal with a phase difference of 90° between them. The significance of this technique lies in the fact that if we synchronously detect, say, the R-Y signal at the instant when it is a maximum (i.e., in R-Y phase on the conventional vector diagram) we shall get no B-Y output even if a B-Y signal happens to be present. See Fig. 17. Quadrature modulation therefore gives a very useful measure of isolation between two signal components, and makes it much easier to extract one without the other—less crosstalk.

### Reference Oscillator

Also known as a subcarrier regenerator, or local oscillator. As mentioned earlier, the process of synchronous detection consists of inspecting the signal at the correct instant in time on each cycle in order to measure its amplitude and to find out whether it is positive or negative going. This is not possible unless we have a timing device to control the inspection (detection) process, and this task is carried out by the 4.43361875Mc/s carrier of constant phase, frequency, and amplitude provided by the decoder's reference oscillator.

The oscillator itself is controlled to very strict limits by the 10c/s of burst transmitted each line during the backporch interval. Oscillators are usually crystal controlled, and form part of a feedback loop (a.p.c. loop) analagous to a line flywheel circuit. The pull-in range is commonly of the order of ±0·5kc/s to cater for oscillator drift with ageing and changes of temperature, and for the inevitable small errors of a.p.c. loop alignment.

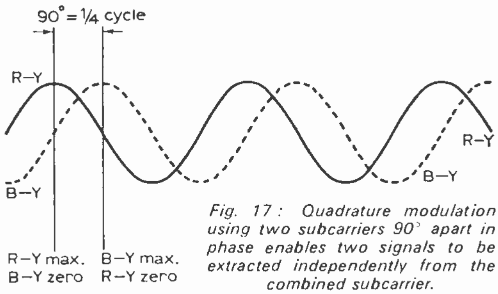



*Fig. 17: Quadrature modulation using two subcarriers 90° apart in phase enables two signals to be extracted independently from the combined subcarrier.*

### Saturation

The saturation of a colour depends upon how much white light has been added to it. For example, if a lot of white is added to a small amount of pure red we get pale pink, and this is red light at low saturation. Conversely, pure red light containing no white light is 100% saturated.

Fully saturated colours seldom occur in nature, and in any case they can only be reproduced in complete darkness because any ambient light falling on the picture desaturates it. This is why it is always better to operate a colour receiver in subdued lighting, as otherwise the saturation control has to be turned up to a point where the shadowmask tube is being driven hard, and the spot quality is less good. Also, of course, the ambient lighting is not likely to be illuminant C, and so it will distort the hues.

The saturation control is simply a gain control in the chrominance channel which alters the proportion of luminance drive to colour-difference drive.

### SECAM

This is the French colour TV system which has been described—unkindly perhaps—as "Something Essentially Contrary to the American Method".

Certainly there was a fair old load of propaganda about it by its vociferous proponents: even extending to advertisements in the daily press. It is a perfectly good system, although probably not quite as good as PAL.

SECAM is similar to NTSC and PAL in that it transmits separate luminance and colour-difference signals. The colour-difference signals, however, are coded sequentially on alternate lines, and the modulation is f.m. instead of phase+amplitude. A delay line is needed in the receiver in order to store up the signals for one line period so that both colour-difference signals are always available.

## Shadowmask

The shadowmask itself consists of a thin steel sheet perforated with an enormous number of holes and spaced about one centimeter from the screen of the c.r.t. When the electron beams are correctly aligned by means of the purity magnets any electrons passing through the holes can only land on phosphor dots of the appropriate colour, and so correct purity is obtained. See Fig. 18. Electrons which hit the mask form a current in the steel sheet and most of their energy is transformed into heat. In point of fact about 80% of the energy in the electron beams is wasted in this way, and only about 20% is available for activating the phosphors. This is a pity because it reduces the light output, but it is inherent in the process.

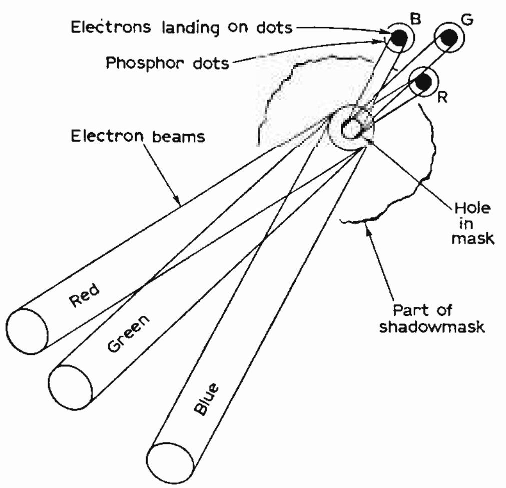



*Fig. 18: Purity is obtained by correct alignment of the electron beams so that they strike the centre of the phosphor dots on the screen.*

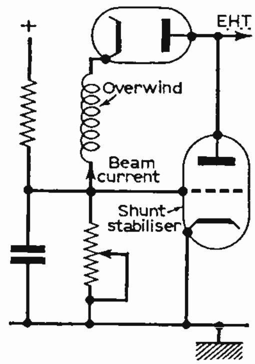
The mask has to be very carefully mounted in the c.r.t. so that when it expands under the influence of the heating effect of the electron beams it is free to do so evenly without causing misregistration of beam landings and hence impurity.

Even so at high brightness levels corresponding to an overload condition it is sometimes possible to see the highlight colour slowly change from white to pink over a period of a minute or two. This experiment is best avoided because of the possibility of damaging the e.h.t. diode by excessive mean current.

## Shunt Stabiliser

This term is used in all sorts of applications but in colour television it normally refers to the triode valve generally used to stabilise the e.h.t. voltage. It is very important that the e.h.t. should remain constant with changes of beam current caused by changes in picture content; or to express it differently the e.h.t. must have a low source impedance. If it does not the scan amplitudes, convergence, grey-scale tracking, and focus quality will all vary and the picture will be seriously degraded.

*Fig. 19: Basic triode e.h.t. shunt stabiliser circuit. The e.h.t current is shared between the tube and the shunt stabiliser triode. As the tube current falls that through the triode increases as its grid voltage becomes less negative, and vice versa, thus keeping the current drain and the e.h.t. reasonably steady.*




It is interesting to consider the range of loading that the line output stage has to handle. On an all-black raster the beam current is zero and the e.h.t. source delivers no energy to the c.r.t. At full drive corresponding to 1·2mA mean current at 25kV on a 25in. tube the e.h.t. energy is 25,000×1·2/1000=30 watts.

An all-valve output stage commonly has a source impedance of about 5MΩ, and at a current of 1·2mA the e.h.t. drop is 6kV. By adding a shunt stabiliser in a circuit such as that shown in Fig. 19 the source impedance can be reduced to perhaps 0·5MΩ and the drop in e.h.t. is only 0·6kV which is quite acceptable.

Voltage trippler circuits for generating e.h.t. have a low source impedance and a shunt stabiliser is not necessary.

## Synchronous Detector

Another name for "demodulator": see *Demodulators*. It is used for detecting the R-Y, B-Y, and burst signals at the appropriate phase angles. Synchronous detectors have two inputs, the signal input and a reference signal input, and provide an output which is controlled by the timing of the reference signal.

## Transcoding

This is a process carried out by the broadcaster to convert a signal coded on one colour-TV system to a different system, both of them having the same number of lines and fields. In time to

*—continued on page 542*

# INSIDE tv TODAY

## PART II M. D. BENEDICT

THE use of these engineering facilties is the responsibility of presentation department. When a programme has been allocated a duration and a transmission period and date it is added to a running order prepared for each day. This shows each programme in the order of transmission along with other relevant data such as reference number, duration and so on. The Radio Times uses this as the basis of its information and Presentation prepare links between programmes for the announcer and trails to advertise forthcoming programmes. Other departments are informed so that the necessary lines, video-tape recorders, telecines and any other facility can be arranged with plenty of time to spare.

Timekeeping is not usually too important within the BBC, but a check is kept. Each programme is allocated an exact duration. Recorded programmes report their actual duration to Presentation who will make any alteration. Live programmes too, have a desired duration but it is not easy to come out exactly on time. It is the duty of the Network Director to decide whether to allow an overrun or to cut the programme off early. His decision is influenced by the programme following.

At 5.50 on BBC-1 the National News must start on time as this is followed by regional opt-outs for the regional news programmes—*Points West, Look North, Town and Around* and others. These programmes start when the National News finishes and each regional or sub-regional news studio switches its local transmitters from network to their own output. At the end all must finish their programmes to switch back into network during the two seconds of blank screen that are allowed before the next network programme starts at 6.20 p.m. Exact timekeeping is the only way such a procedure can be successfully performed without excessive pauses or cutting off the end of a programme.

Other times when exact timing is important are before party political broadcasts when the same programme is broadcast simultaneously on BBC-1, BBC-2 and ITV. To do this the party political broadcast must start exactly on time so that all preceding programmes must run to time.

Regional opt-outs sometimes occur at other times, in particular BBC Wales which transmits Welsh language programmes for a considerable part of the evening. Timing is not usually so tight in these cases as only one region has to opt-in at a time, and liaison with Presentation in London allows a smooth opt-in at the end of the regional programme.

### ITV Timekeeping

Accurate timekeeping within the Independent Network is always exact. All ITV programmes are timed to the half second. This is necessary as each programme contractor puts out its own items interspersed with items networked by other operators. One Wednesday a few months ago the following schedules were planned for the early evening:

| | | |
|---|---|---|
| *Rediffusion, London* | 6.33 | Londoners |
| | 7.00 | University Challenge |
| | 7.30 | Coronation Street |
| | 8.00 | Dickie Henderson Show |
| *ATV Midlands* | 6.35 | Crossroads |
| | 7.00 | Double Your Money |
| | 7.30 | Coronation Street |
| | 8.00 | Man in a Suitcase |
| *Granada* | 6.10 | Tarzan |
| | 7.00 | Double Your Money |
| | 7.30 | Coronation Street |
| | 8.00 | Man in a Suitcase (Different episode from the ATV and Southern programmes) |
| *Southern ITV* | 6.35 | Mad Movies |
| | 7.00 | Double Your Money |
| | 7.30 | Coronation Street |
| | 8.00 | Man in a Suitcase |

Westward and Anglia took *Crossroads* at 6.35 but at 7.00 they ran *Treasure Hunt* and *Try for Ten* respectively. Both took *Coronation Street* at 7.30 but instead of *Man in a Suitcase* at 8.00 they took *Garrisons' Gorillas*. Other companies took variations on the above programmes, plus *The Avengers* for Grampian viewers. Thus it is obvious that with all contractors taking *Coronation Street* at 7.30 all must be ready to start at this time. All the programmes are shorter than the time would indicate, the half hour programmes being about 25 minutes.

Adverts are used to fill in the gaps and to round off the duration of the complete programme and adverts to the desired timing. This need not be done within one programme. Although previous programmes were planned to finish in all areas at

7.00, as only Rediffusion were putting out *University Challenge* at that time it meant that some leeway could be allowed with *Londoners*, which preceded it, provided it could be corrected by the critical 7.30 point. In fact all previous programmes, whether distributed to various parts of the network (*Double Your Money*) or going to only one (*Londoners*, *Try for Ten* and *Treasure Hunt*), would have, with their final commercials, to finish at an agreed time to within a second or two. At these times and when networking, either partially or nationally, all programmes must finish at nearly the same time. This can only be done by accurate timekeeping and careful planning.

## Programme Planning

ITV programme planning starts with a meeting of senior executives from each contractor and representatives of the ITA. Each company offers programmes for networking and a basic schedule is worked out. This shows which programmes will be fully networked direct and those that are partially networked. An operational sub-committee work on this to check that the lines are available and the routing of signals to be used. At the same time sales representatives of each company work out the space available for adverts and adjust the number and duration of the adverts to fill the gap left between and during programmes. By using adverts it is possible to fill any gap to an accuracy of five seconds. Hence even with local programmes starting at the same time but of different durations it is possible to fill them out ready to start the next programme at the correct time. Advertising is limited by ITA regulations governing the maximum of advertising in any one hour (7 minutes) as well as other factors. Thus if there is too large a gap a promotion spot for a forthcoming programme may be used to fill in.

All these points are hammered out and alternative arrangements may be made. If ATV for example do not want a programme at the time that most other contractors want it they may record it as it is networked (or previously if they wish it to run before or only slightly after general networking). On the Wednesday previously mentioned several areas saw *University Challenge* at 9.00 p.m. Dickie Henderson was seen at 8.55 p.m. by Southern ITV viewers but at 9.00 p.m. in Grampian's area. Alternatively the company originating the programme may put it out at several different times to suit various contractors' schedules. Other gaps are filled by programmes originating locally, films or local interest programmes in particular. When all this juggling of times and durations has been completed it is possible to set out a complete schedule showing all programmes for each day in every area. From this schedule the gaps available for adverts can be seen and the salesmen set about slotting in each advert so as to realise the maximum revenue yet remain within the regulations laid down.

## Timing Errors

This technique is all very well in theory but in practice it may be a very different matter. Three types of mistakes may occur. First the clocks in the master control rooms may be in error. To avoid this crystal-controlled clocks are used to maintain a very high standard of accuracy. These are checked regularly with the G.P.O. TIM service. Unfortunately there is no guarantee that a programme from video tape will run at the correct speed, i.e. that at which it was recorded, in particular if the mains frequency is low on replay, as it often is during the winter, and the recording studio's pulse generator was referred to crystal control. Errors of ten to twenty seconds can arise due to this cause and nothing can be done about it as by the time it has occurred it is usually too late.

The next type of error is one of timekeeping. Recorded programmes of a desired duration have some margin for error, 15 seconds either way with a half-hour programme. When the recording is complete, the exact time is passed on to allow the planners to fill in this duration on the schedules and plan exactly the commercial breaks. Live programmes have a much tighter duration—they are required to be accurate to within half a second.

With programmes using music at the end the music is started at a fixed time irrespective of whether the end of the show has been reached or not. When it is reached the music is faded up and the caption sequence taken at a rate suitable for the remaining time.

## Overruns

If an overrun is unavoidable, a system of red telephones which link all master control rooms allows the originating contractor to discuss an overrun with all concerned. Assuming that there are no major switching times later in the evening it might be agreed that the overrun is possible so that the programme is allowed to run on. However it must come out on an exact number of minutes after the offered time, thus obviating complex maths involving adding and subtracting odd seconds when replanning the rest of the evening's programmes.

Naturally if half the network is taking a different programme or a single contractor is running its own programme it is not possible to overrun unless there are no more networked programmes to be taken by all concerned or alternative arrangements can be made to take up the time overrun by reducing trailers or adverts. Another possibility is if the area not taking the overrunning programme can expand its programme or adverts to bring everyone back into step. All these points must be considered and agreed before the overrun can be sanctioned.

## Newsflashes

As well as altering all the timings for following programmes each contractor has to inform the local Post Office switching centre to maintain the lines until after the overrun. It is the responsibility of the Post Office to provide all lines for distribution of the ITA Network as well as switching and routing the signal. Much of the switching

*Right: View of the control area during an ATV transmission. Presentation control with its studio at the rear, network control in the foreground. In the background telecine facilities can be seen.*

of the independent network is done automatically on a time clock principle, so a warning of any changes is essential.

Newsflashes and last minute programmes also affect schedules. It is possible to rework the schedules to provide for most last minute programmes such as ministerial broadcasts as they are usually fully networked so that all following programmes are delayed. With newsflashes, however, a more complex production is undertaken. ITN contact the London contractor, ATV or Rediffusion, who are nominated by the rest of the network to represent the contractors. If they, on behalf of the network, accept the newsflash, all other contractors are contacted via the red telephone system. It is usual to try and insert the shorter newsflashes during a commercial break but as these may not coincide all over the network it may be necessary for ITN to put out the same newsflash two or three times so that all contractors can take it. If one contractor does not take the flash a large amount of reworking is needed. Adverts may have to be dropped but this is one of the last things that a contractor wants as it cuts his revenue. In spite of this ITN newsflashes often beat the BBC newsflash. If the newsflash is very important or serious the nominated contractor (Rediffusion or ATV) would network a suitable programme after the flash.

In order to simplify the lines situation if the flash is to take place during or following a networked programme ITN sends signals to the originating contractor who puts it out to the rest of the network. This technique requires only one extra line to be booked, from ITN to the originating contractor, rather than a complex changeover.

## Operational Techniques

Operational techniques in ITV are affected by the completely different networking techniques. For a programme to go on the air the originating contractor arranges that the film or tape is with the telecine or video-tape recording channel at the correct time. The machine is laced up and signals offered to c.a.r. who in turn offer an ident on the outgoing line to the local G.P.O. switching centre. From then on it is the responsibility of the G.P.O. to ensure that the programme is routed to its correct source. It is common for the same line to be used for consecutive programmes from different areas, switching being done at an exact time when adverts are being run, thus covering the switch. It is then essential to inform the G.P.O. of all changes agreed. It is rare to get the line from the next contributor for more than 15 seconds before the programme is due to start so no positive check can be made that the programme will reach its destination (BBC practice is to check and double check with lines available usually half an hour before use). Most studios have an identifying test card which may be of use but this is usually removed one minute or 30 seconds before the machine is run. For a receiving master control room the first warning is when the machine (video-tape recorder or telecine) starts its rundown. The only responsibility of the contributor is to ensure that his programme starts at the correct time and is sent out of the building to the nearest G.P.O. centre. Even if a contractor's previous programme is over-running the next programme must be networked at the agreed time.

Naturally facilities within ITV are spread further than those of the BBC as there is no one central "heart" corresponding to the BBC's c.a.r. Each contractor has a master control room fulfilling a similar function to the BBC's network control rooms, as well as limited presentation facilities in many cases. In charge is the network director who is responsible for the smooth running of programmes as well as ensuring that the commercials go out. It is his decision whether to take newsflashes and accept overruns and he must work out the ensuing problems.

When necessary ITV can act as a single network just as the BBC regions can opt out of national programmes. Usually ITN would act as the central control point as they are best equipped for this both geographically, being in London, and temperamentally. For example ITN acts as a standards conversion centre for international programmes, although the BBC can and do provide this service, as well as a liaison service with foreign countries through its international control room.

## International Links

Eurovision is the international link set up by the European Broadcasting Union for exchanging programmes and providing facilities in foreign countries. Any broadcasting organisation can book lines and facilities in any European country and, via Intervision, many Communist bloc countries. ITN and the BBC's International Control Room (i.c.r.) work direct to Brussels, the technical centre for Eurovision, and can set up links to almost any country so that news film can be exchanged and interview and reporting facilities provided.

America is reached by satellite, Eurovision being involved as it is usual to use two ground receiving stations to increase the reliability of the links. Japan and Australia can also be reached via America and a second satellite.

Eurovision allows even the smallest programme contractor to use facilities half way round the world by providing the know how and making the necessary arrangements. In many respects the television links are far stronger and certainly more influential than a good many political links. Most of Europe watched the funeral arrangements of the Indian Prime Minister Shastri taking place 8,000 miles behind the Iron Curtain. Although technically possible the U.S.A. did not take a direct feed since due to the time difference it was after midnight in that country, but recordings were shown the next day.

## Transmitters

Naturally the final link in the chain is the transmitter, usually placed on top of a lonely hill far away from the nearest town. The staff of these transmitters are in some respects electronic "lighthouse keepers". Transmitters vary tremendously in power but in all cases special aerial arrays increase the gain and in effect the radiated power. Adjustment of the aerial's directional characteristics reduces the effects of co-channel interference between transmitters on the same frequency. These are usually spaced as far apart as possible but, under freak propagation conditions, the signal may get much farther than intended and cause interference on domestic receivers. Precision offset, a technique developed by the BBC, holds a very accurate carrier frequency with each transmitter on the same channel two-thirds of line frequency offset from other transmitters. This reduces the visibility of interference.

Transmitters vary in size and power from 100kW main transmitters to three-watt boosters which receive and re-transmit signals on a different channel and cover only a small town. With such a range of power operations on Bands I, III, IV and V it is not surprising that there are many different types of transmitters. All are equipped with special monitoring signals which warn the staff of fault conditions and all but the smallest offer standby facilities. In many cases two transmitters feed the same area so that should one break down the signal is merely transferred and no complete break occurs.

Staff usually work on a shift basis on all but the smallest transmitters, but with BBC-2 u.h.f. transmitters designed for unattended operation fewer operational adjustments are needed and the operation takes on more of a maintenance role. Many people find the peace and quiet of a transmitter far more to their liking than the hurly-burly of the activity to be found in and around a television studio.

TO BE CONTINUED

# ABC OF COLOUR TV

*—continued from page 538*

come it will probably be commonplace to carry out PAL/SECAM and SECAM/PAL transcoding in order to exchange programmes with France. NTSC/PAL transcoding involves an extra operation in order to adjust the number of fields from 60 to 50.

### X-ray Radiation

There has been a lot of publicity in the U.S.A. about X-ray radiation, and to a lesser extent over here. It may have been justified in the U.S.A. because it has been alleged that some of the setmakers have been careless in their safety precautions and have produced receivers that emit excessive amounts of radiation. In Britain, however, all setmakers take care to conform to the recommendations laid down in BS415, and so no member of the public will be exposed to any radiation hazards. This is a responsible attitude which deserves recognition.

X-ray radiation is an inevitable by-product of the e.h.t. rectification and c.r.t. display systems. When a beam of electrons accelerated by a voltage of the order of 15kV or more hits an anode structure it is inevitable that a certain amount of radiation will be produced. Furthermore, the output increases greatly with increase of e.h.t. In the case of the c.r.t. the radiation is below the internationally accepted safe limit provided the line timebase is carefully designed and adjusted, and so no special problem arises. An e.h.t. diode however is a possible hazard and so is a shunt stabiliser triode, so these valves are surrounded by metal screening which X rays cannot penetrate. It is important therefore that service engineers do not operate a line timebase with the screening removed without first consulting the setmakers' service manual. It is also important to adjust the boost voltage correctly, when required, after carrying out service operations on the line-output stage. Otherwise the e.h.t. may be unduly high and more X-ray radiation will be emitted.

If service engineers take simple precautions of this kind they will come to no harm even if they work on line-output stages full time.

### Conclusion

This then is the language of colour television. Familiar stuff to some of us, new to others, and (one hopes) interesting to all. Behind the simple terminology lies a wealth of meaning that everyone can explore to the limits of their enthusiasm, time, and ability. The words themselves do not matter much—they are simply a convenient form of shorthand, as we remarked at the beginning. What does matter is the range of problems inherent in the process of getting good grey-scale tracking, for example, or the significance of errors in chrominance matrixing. The terminology helps us to describe the problems, but the real fun comes in understanding and solving them. Not all of us have the opportunity of doing practical work, but we can all use our brains. Keep at it!

# Servicing TELEVISION Receivers

## No. 149 - THORN 900 CHASSIS
*continued*

*by L. Lawry-Johns*

Returning to the complete loss of scan, it may be found that all the voltages are in order. In this event check the continuity of the field deflection coils and note the effect of shorting across the thermistor X2 (deflection assembly).

### Vertical Hold

If difficulty is experienced in locking the picture check R99 and if this is at one end R98 and C80. If the sync pulses are weak and there is evidence of line pulling check C35 in the video circuit, the PFL200 valve, C41 and C44. C35 is in the cathode circuit of the video amplifier, C41 is the screen decoupler and C44 is the screen decoupler of the sync separator section of the PFL200. Further checks should include C43 (0·1μF) and the PFL200 resistors.

### Video Stage

Having mentioned the PFL200 as having an influence upon the sync pulses we would hasten to point out that it has many other influences. One of the most common of these is the tendency of the valve to run into grid current when its bias conditions are altered; as when switched to 625. This causes the picture to become much lighter until very little picture is left at all and the 625-standard sound is also affected. Hum on BBC-2 sound, although the picture may not appear to be affected, can be caused by a faulty PFL200. In situations where BBC-2 is not received or not required these early warning symptoms are not given and the first intimation that something is wrong may be the appearance of hum bars and poor sync on the 405-standard picture only. This condition could vary from light shading to very light and dark bars across the screen.

### Loss of signals

If the raster is normal but there are no sound or vision signals check the V3 EF183 and stage feed resistors, tuner unit supplies and valves. If

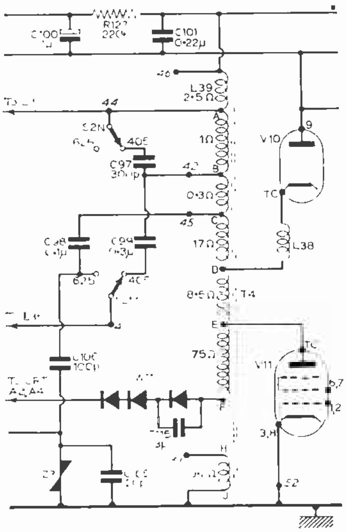



*Fig. 5: Modifications to the line output stage when a jelly-pot transformer and selenium e.h.t. rectifier are used. R66 is 620kΩ with jelly-pot transformer.*

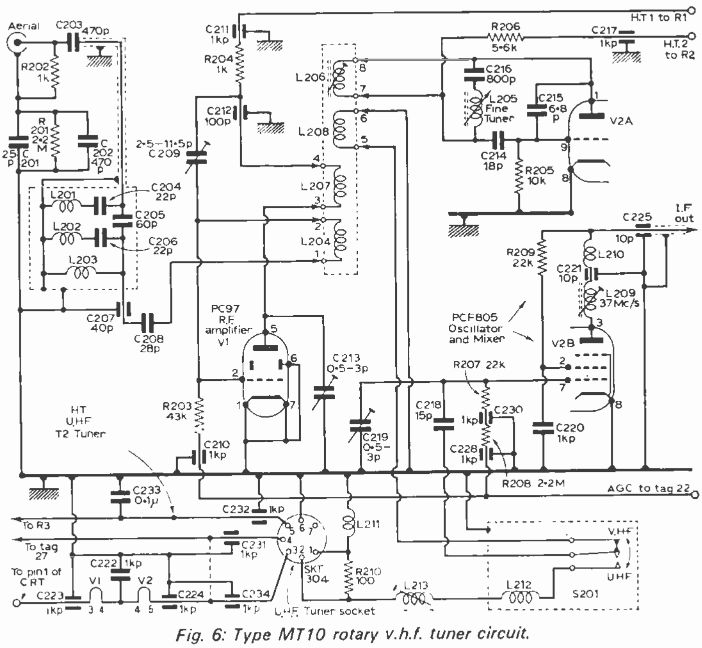



*Fig. 6: Type MT10 rotary v.h.f. tuner circuit.*

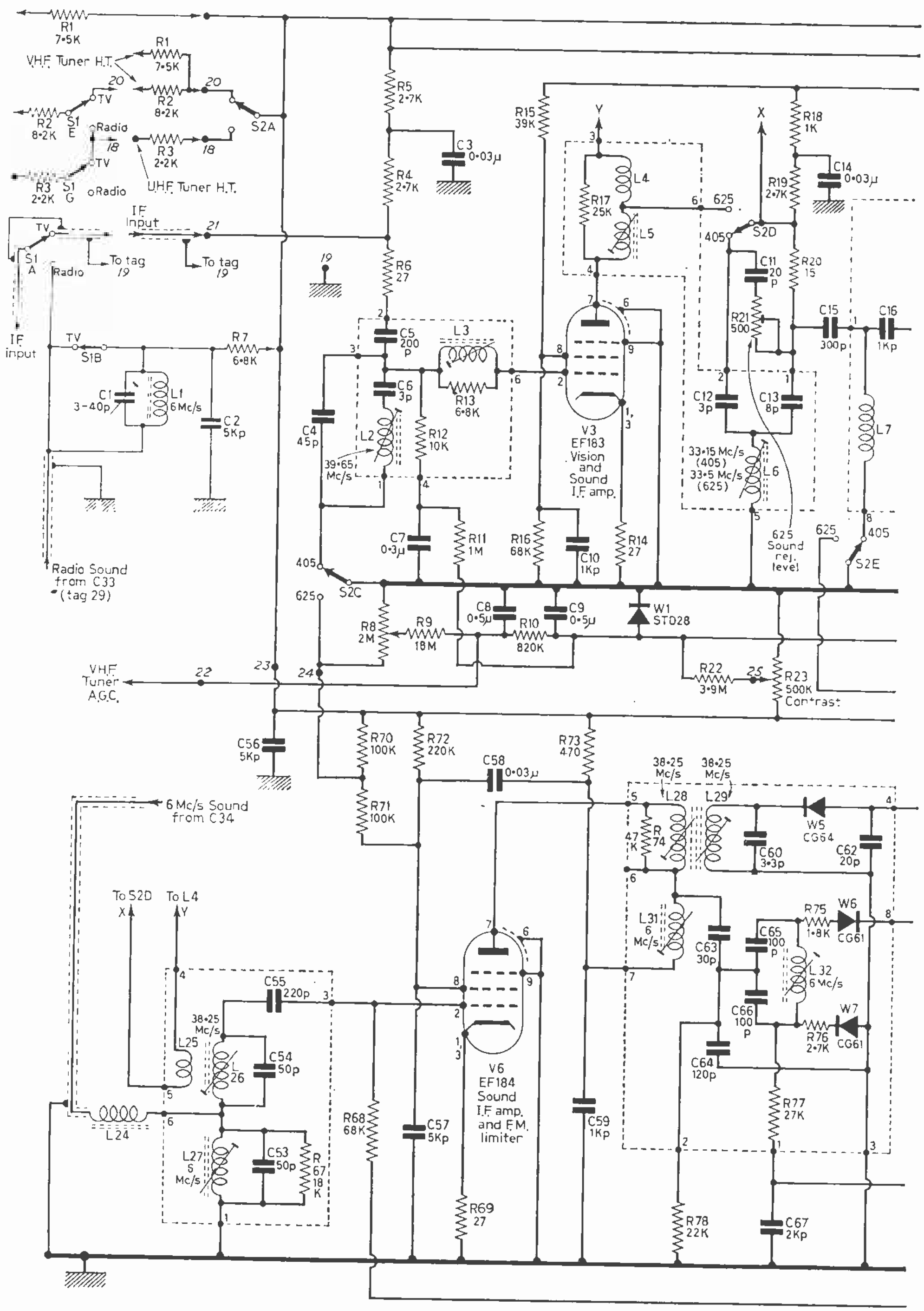
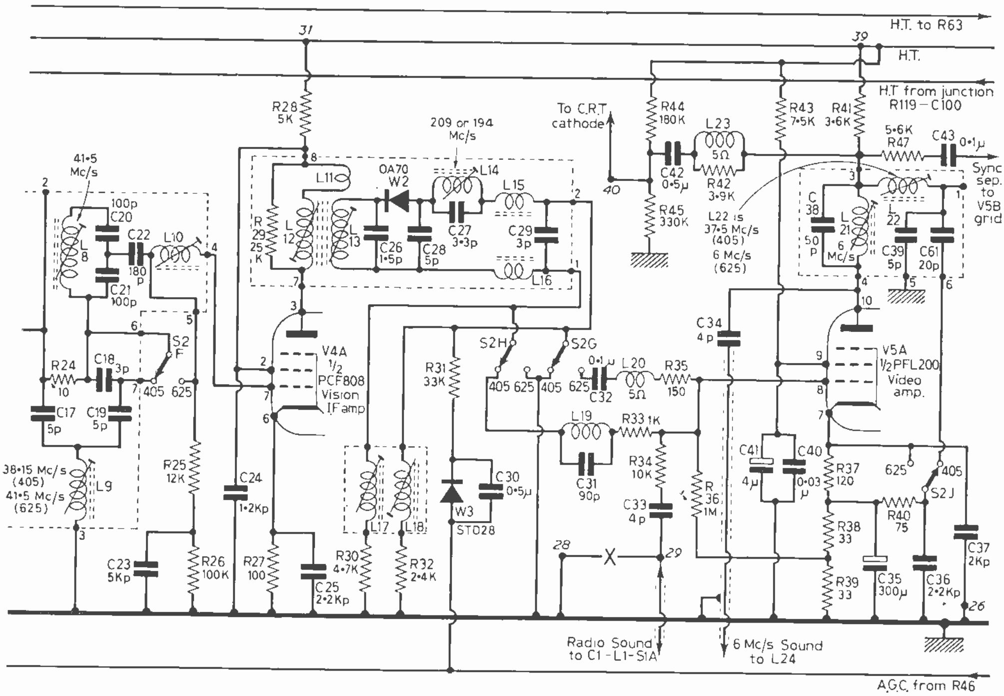
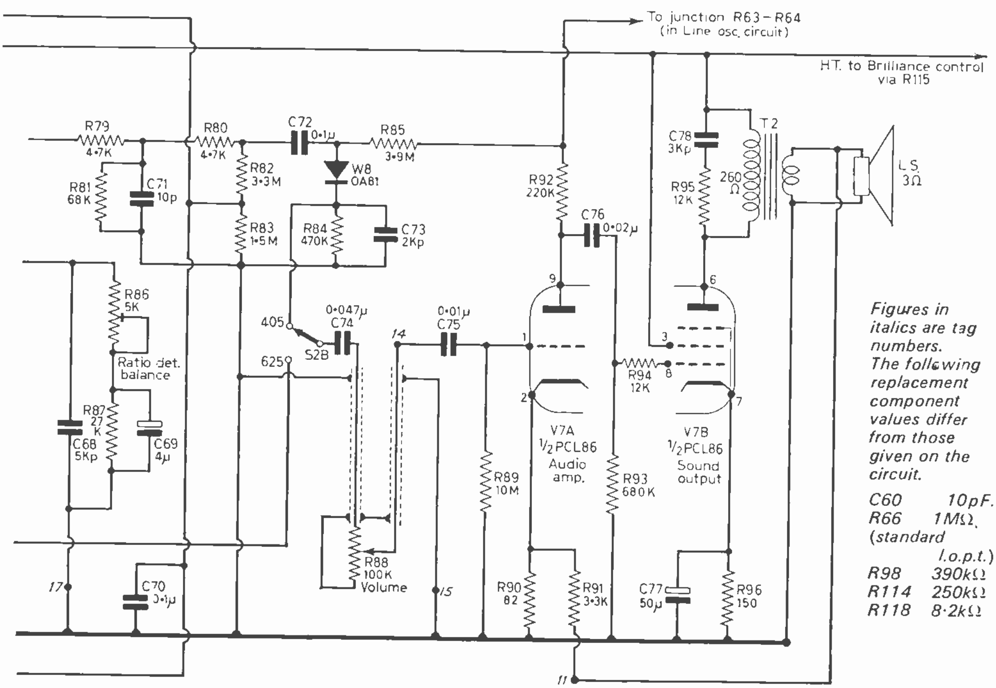



*Fig. 7: Circuit of the receiver sections, Thorn 900 chassis.*

both standards are out of action the PC97 on the v.h.f. tuner (rotary) is not likely to be at fault. The PCF805 could well be however as this also functions as an i.f. amplifier for the u.h.f. signals.




*Figures in italics are tag numbers. The following replacement component values differ from those given on the circuit.*

| | |
|---|---|
| *C60* | *10pF.* |
| *R66* | *1MΩ. (standard l.o.p.t.)* |
| *R98* | *390kΩ* |
| *R114* | *250kΩ* |
| *R118* | *8·2kΩ* |

*Points marked X are connected on TV only versions, open-circuit on radio-TV versions.*

Note that the push-button tuner unit (v.h.f.) uses a PCC89 and PCF801. If the supplies are present and the valves are not at fault check the 22kΩ screen feed resistor to pin 2 of the PCF805 as

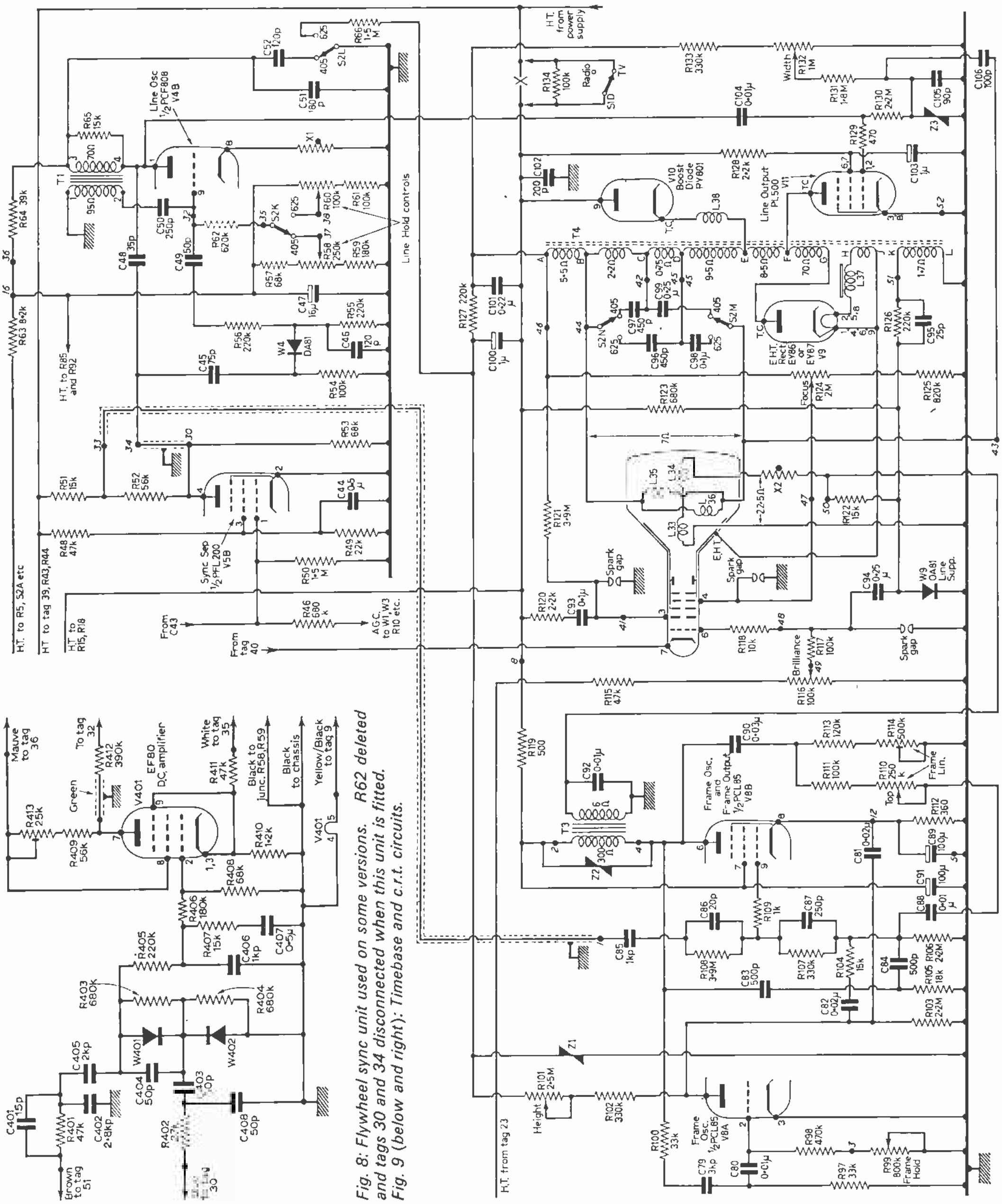


*Fig. 8: Flywheel sync unit used on some versions. R62 deleted and tags 30 and 34 disconnected when this unit is fitted. Fig. 9 (below and right): Timebase and c.r.t. circuits.*

this can go high, and make sure the system switch is working.

If the BBC-2 signals are still in order it means that the fault is confined to the oscillator or r.f. sections of the v.h.f. tuner. Check the PC97 (or PCC89) and the PCF805 (or PCF801) and the 5·6kΩ oscillator load resistor R206 (or R263 12kΩ and R264 2·2kΩ on the push-button tuner). Make sure the coil biscuits are in position and have not been tampered with and of course check the aerial input, socket, plug, coaxial leads and ends inside and outside the set.

## Inability to select channels reliably

This means that although signals are received they vary on operating the channel selector and necessitate constant operation of the fine tuner. This normally affects only the small turret-type of

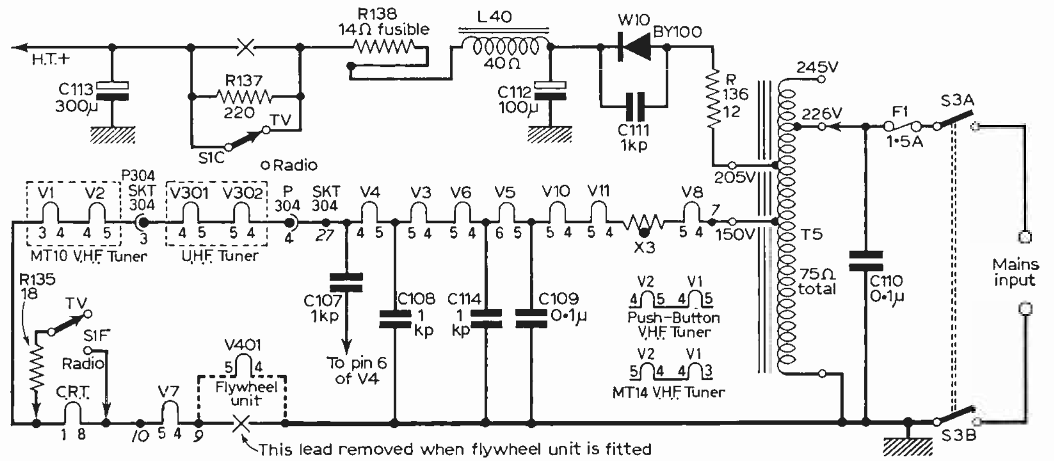



*Fig. 10: H.T. supply and heater chain circuits.*

| Valve | Anode volts | | Screen volts | | Cathode volts | |
|---|---|---|---|---|---|---|
| | 405 | 625 | 405 | 625 | 405 | 625 |
| V3 EF183 | 194 | 191 | 52 | 51·5 | — | — |
| V4A } PCF808 | 146 | 144 | 150 | 146 | 2 | 2 |
| V4B } PCF808 | 158 | 135 | — | — | — | — |
| V5A } PFL200 | 158 | 112 | 203 | 175 | 4·5 | 4·4 |
| V5B } PFL200 | 70 | 40 | 65 | 61 | — | — |
| V6 EF184 | 227 | 222 | 62 | 31 | — | — |
| V7A } PCL86 | 102 | 98 | — | — | — | — |
| V7B } PCL86 | 221 | 215 | 230 | 225 | 5·5 | 5·5 |
| V8A } PCL85 | 76 | 74 | — | — | — | — |
| V8B } PCL85 | 109 | 184 | 205 | 198 | 17 | 17 |
| V10 PY801 | 231 | 224 | — | — | — | — |
| V11 PL500 | — | — | 210 | 201 | — | — |

tuner. Observation will show a drum of sprockets on the front of the tuner. The fine tuner rotates the sprocket to the preset position and this operates on the push-bar which determines the position of the fine tuner core. If the drum is loose on the main spindle the correct sprocket will not engage for each switch position. The drum is secured by a grub screw and an access slot is provided. Use a small Allan key for tightening once the drum has been correctly located on the spindle. Then retune the fine tuner finally upon reassembly.

This should not be confused with poor switch contacts which will respond to cleaning in the usual way. A fractured fine tuner core could however give very similar symptoms.

## Loss of gain on BBC-2

If the v.h.f. signals are good but the u.h.f. reception has deteriorated it will probably be found that the PC88 on the u.h.f. tuner is in need of replacement. The PC86 could be at fault but this usually causes drift due to frequency change as the emission falls. Check the tuner for dry joints without disturbing the wiring if the valves are not at fault.

## Voltage and current data

Total h.t. current 325mA (405), 355mA (625). Voltage on main h.t. line (junction R138/C113) 231V (405), 224V (625). Voltage at junction W10/L40 250V (405), 245V (625). E.H.T. 16·5kV. Boost voltage (junction R127/C101) 609V (405), 690V (625). H.T. to u.h.f. tuner (valve) 165V. V.H.F. tuner h.t. at R1 136V (405), 0V (625); at R2 143V (405), 0V (625).

## Brief fault-finding guide

**Receiver not functioning:** Check mains to 1·5A fuse. If absent check mains supply and on-off switch. If the fuse has failed check for shorts and observe behaviour when receiver is switched on with a new fuse fitted. If valve heaters do not light up evenly, i.e. some are very bright,

*—continued on page 561*

# Pulse and Pattern generator

by J. E. KASSER

## Part 2

THE checkerboard pattern generator is the most complex of the generators and is really what the other units were building up to. In order to produce bars on the screen we need a pulse frequency several times that of the sync frequency. If the pulse repetition frequency (p.r.f.) is a multiple of the field frequency horizontal bars will be seen, while if the p.r.f. is a multiple of the line frequency vertical bars will be seen. Thus two generators are required, one for the vertical signal and one for the horizontal. When these two signals are added together a grating is seen on the screen (Figs. 9, 10 and 11).

In order to produce a checkerboard pattern, instead of plain addition of the pulse streams in an or gate, which produces a grating pattern, the two streams, let us call them A and B, must be gated together as shown in Fig. 12. As can be seen, every so many lines the waveform changes phase, i.e., is inverted. This occurs every half-cycle on the B waveform (i.e., at the end of every horizontal bar). We must next consider the gating logic required to give this result. Fig. 13 shows the logic truth table drawn to show what is taking place. Thus we can see that for an output, V,

$$V = (\bar{A}.\bar{B}) + (A.B) \text{———(1)}$$

i.e., V = not A and not B (0) or A and B (where $\bar{A}$ means not A, i.e., inverse of A). This would entail the use of two and gates and one or gate. But consider $\bar{V}$,

$$\bar{V} = (A.\bar{B}) + (B.\bar{A})$$
$$\text{or } (A + \bar{B}) + (\bar{A} + B) \text{———(2)}$$

which is known as an exclusive-or function and is simpler to build, an or gate being a very simple thing (see Tr9 and Tr10, Fig. 4). If the output waveform is then inverted the resultant output is V our checkerboard pattern video signal. The logic diagram is shown in Fig. 14.

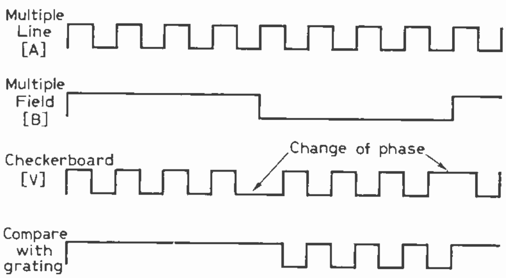
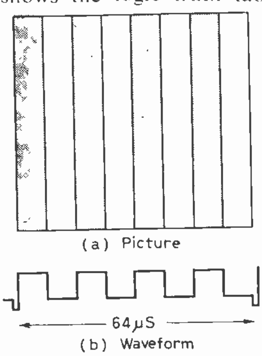
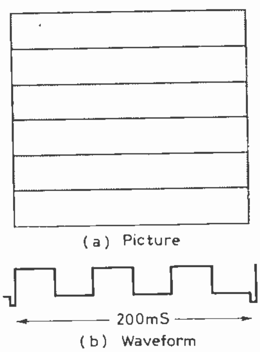



*Fig. 12: Building up a checkerboard pattern. Note change of phase in pulse trains.*

Equation (1) was neglected and equation (2) used so that Fairchild integrated circuits could be used. Ordinary transistor gates may be built but the use of integrated circuits saves space and is cheaper too if all the components have to be purchased.



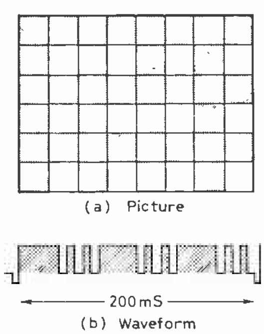



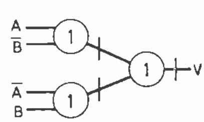

*Fig. 9 (top left): Multiple line pulse train gives vertical bar display.*
*Fig. 10 (top right): Multiple field pulse train gives horizontal bar display.*
*Fig. 11 (left): Grating pattern obtained from combined multiple line and field pulse waveform.*

### *Bar Generators*

The bar generators have their time constants set to give multiple line and field pulses. These generators are shown in Figs. 15 and 16, both being identical except for the coupling capacitor values which govern the time constants. In Fig. 15, the multiple line or vertical bar generator, Tr30 and Tr31 form an astable multivibrator identical to those used in the sync pulse generators. This pulse generator is free-running and even if its output was made an exact multiple of the line

*Figs. 13 and 14 (right): Truth table for V (on the left): logic circuit for V using NOR circuits (on the right).*

| A | B | V |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |



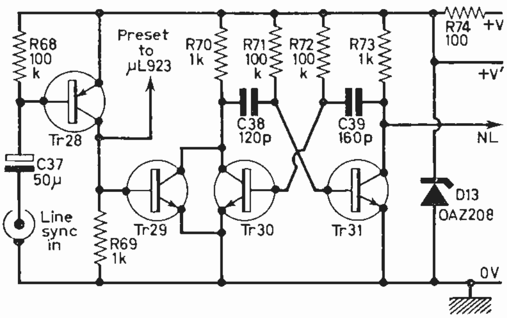



*Fig. 15: Multiple line (vertical bar) generator.*

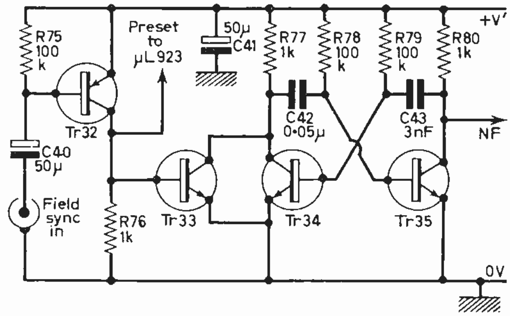



*Fig. 16: Multiple field (horizontal bar) generator.*

frequency in the course of time the frequency would change so that the generator would go out of sync with the sync pulses and the observed pattern on the screen would break up. This multivibrator must thus be synchronised to the line frequency. One way is to lock the line frequency to this oscillator by applying shaped pulses from this pulse generator to the line sync multivibrator, thus locking the line waveform to this oscillator. If this is done this astable multivibrator becomes in fact the master line oscillator. If the sync source is internal this is fair enough; however, if another sync pulse generator is to be used, what then? The answer is to lock this multivibrator to the line pulses.

Tr29 is connected across Tr30. Blanking pulses are inverted by Tr28 and fed into Tr29. When Tr29 is switched on its collector and that of Tr30 are held effectively at zero potential and the astable multivibrator is held switched in one position. When the blanking pulse is over, Tr29 switches off and the astable action commences. After 64μS Tr29 is again switched on by a blanking pulse and then the multivibrator stops: once again when the blanking period is over the astable or free-running action commences.

Thus the ouput from the astable multivibrator (Tr30 and Tr31) is always the same. Zener diode D13 keeps the supply voltage constant so that changes in the timing due to voltage variations are minimised. It will be seen that the time-constants of the off and on periods are not equal. This is because variations in component values as time passes may change the ratio if it was set to be equal and the pattern seen on the screen would not show squares but oblongs. The resulting pulse output (NL) is shaped (see Fig. 17) by a μL900 integrated circuit and then divided by two in a bistable multivibrator which also uses an integrated circuit, type μL923, a JK flip-flop. This bistable multivibrator gives a one cycle output with equal mark-space ratio for a two cycle input of any mark-space ratio. The field circuits are identical to the line circuits and are shown in Fig. 16.

The interconnections of the logic system are shown in Fig. 17. The incoming pulse streams are shaped in the μL900 inverters and divided in the flip-flops (μL923), the two outputs of the μL923 i.c.s being the two phases of signal (A or $\bar{A}$, B or $\bar{B}$ as discussed above). These are gated in a μL914 i.c., which has two, 2-input or gates, the output from these two gates being gated in a further μL914. This gives the video (V) checkerboard pattern signal. Inverted mixed blanking (here it is obtained from the half-line generator Fig. 7 in order to save the cost of one transistor; a separate inverter may however be used) is then gated with this waveform in the second gate in the same μL914 to give the video waveform already blanked.

If vertical or horizontal bars are required as well as the checkerboard pattern they may be taken off at one output of the relevant μL923 flip-flop element.

Preset signals are applied to the two μL923 i.c.s so that when the divided-by-two action takes place there is no remainder left over that would change the phase of the video pattern every line or field. This did occur in the prototype so the blanking pulse is used to reset the toggle back into the original position for each line.

## Sync Addition

A different method of adding sync was tried in each pattern generator. In Fig. 6 the sawtooth

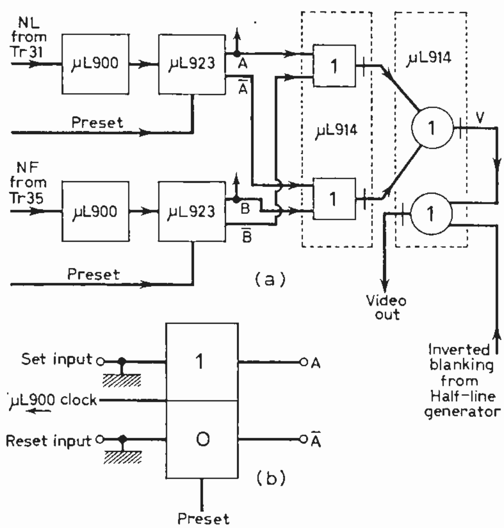



*Fig. 17: Practical logic circuit (a); μL923 connections (b).*

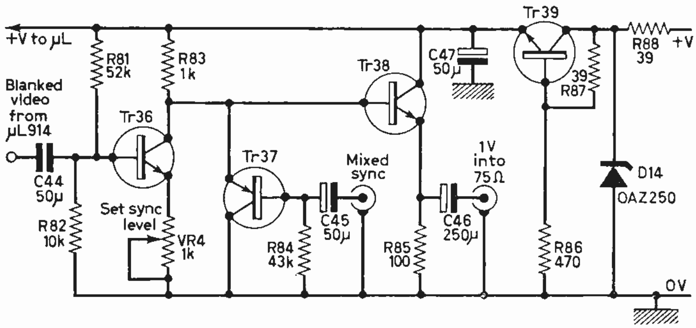
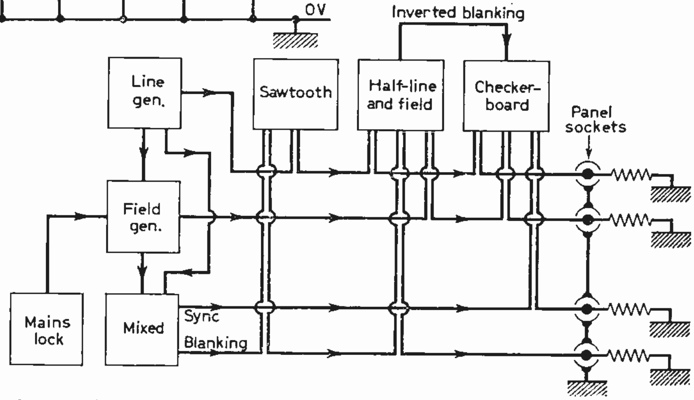


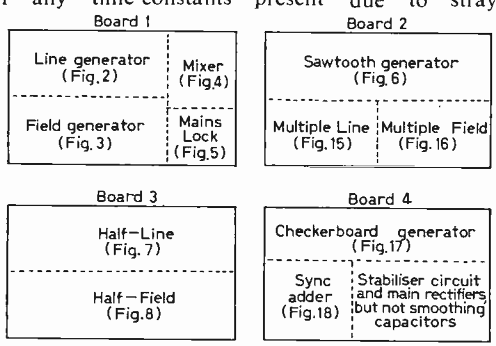

*Fig. 18 (left): Sync adder circuit and supply stabiliser arrangements.*

*Fig. 19 (below): Pulse interconnections between the various subcircuits forming the pulse and pattern generator.*




generator inverted sync is arithmetically added to the sawtooth in an ordinary audio-type mixer circuit. The signals are mixed in Tr16 which is connected as an inverting amplifier with negative feedback, driving Tr17 the emitter-follower output stage to give 1V into 75Ω.

In the half-line and half-field generators the video and sync pulse trains are passed through diodes to an inverter (Tr21) via a high-impedance potential divider R47, R48, the voltage needed to make Tr21 conduct being low compared to the voltage available from D9 and D10. The high-impedance potential divider tends to give a better waveform due to the lengthening of any time-constants present due to stray capacitance. Tr22 is a direct-coupled emitter-follower giving an output signal of 1V into 75Ω.



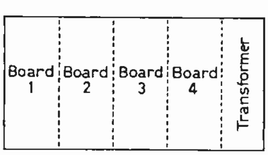
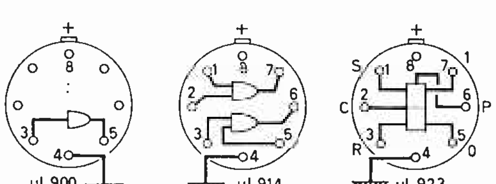




*Fig. 20: Positions of the various circuits on the perforated boards and (below) pin connections of the integrated circuits (the flat is adjacent to pin 8).*




Although the above methods have been used their results were not felt to be entirely satisfactory so for the checkerboard pattern output the circuit shown in Fig. 18 was developed. Here video causes Tr36 to conduct and amplify, but as there is a resistance (VR4) in the emitter circuit the transistor collector potential can only fall to approximately $V_E$, and thus the resulting output signal ranges between +V and $V_E$. When mixed sync pulses appear at Tr37 base, however, this transistor switches on and conducts heavily, reducing the signal to 0V. Thus the waveform at the base of Tr38 is a composite signal, with the video signal of level +V to $V_E$ and the sync level $V_E$ to 0V. If $V_E$ is changed by adjusting VR4 the level of the video signal with respect to the sync pulse amplitude is changed and thus this resistor effectively acts as a sync gain control or set sync level. Tr38 is a standard emitter-follower supplying 1V into 75Ω output.

Fig. 18 also shows the stabilised power supply used to power the sync adder circuit and the micrologic elements. The base of Tr39 is held at 3·6-4·0V by the potential divider R86, R87 across the zener diode D14 to control the potential at the emitter in the standard method used in regulated power units. This voltage drop is necessary because Fairchild state in the specifications for their µL micrologic series that the supply range for these i.c.s is 3·6V+10% over the range +15°C to +55°C.

Fig. 19 shows the interconnections between the pattern generators. The synchronising pulses are looped through the system and finally terminated at the end of the run.

# BUSH-MURPHY FEATURE I.C.s IN NEW COLOUR RECEIVERS

A BRITISH technical breakthrough was recently announced by Rank-Bush-Murphy when they demonstrated to the press two new colour receivers incorporating an integrated circuit. RBM director of engineering Paul Goff stressed that this was not simply a matter of using a s.i.c. purely as a means to reduce space, itself not a vital consideration. The RBM design team made a careful and intensive study to determine which sections of a colour receiver would best benefit from the expected additional reliability and long-term stability to be achieved by the introduction of a s.i.c.

The answer they came up with was the colour-signal processing stages and from that decision the RBM designers devised and prepared the masks for the integrated circuit (system and circuit design at RBM Chiswick, chip circuit design and master artwork at RBM Plymouth). At this stage the work was passed on to the Plessey Swindon plant which processed and produced the 20-lead in-line devices.

The s.i.c. provides both linear and switching operations; it is used in the PAL decoder for demodulation, amplification and matrixing. A new feedback regulator which achieves black-level regulation to within 0·5% is a feature of the circuit. Fig. 1 shows the main operations performed in block-diagram form. PAL (R-Y) switching is carried out in the chrominance channel.

The device replaces a conventional circuit board of 36 square inches and containing 65 conventional components. With this s.i.c. the more usual colour-difference drive system in which the final matrixing is done in the c.r.t. is avoided and the RGB drive system used instead (at the moment only Thorn receivers use this but with conventional components). To the advantage of RGB colour drive can be added the elimination of some of the preset controls (which are often interdependent) and a gain in stability and reliability.

The new receivers, to be released in September, are the Bush CTV174D and the Murphy CV2210D which will be publicised respectively as featuring "Colour Lock" and "Constant Colour Circuit." Although prices are not yet finalised we understand that the incorporation of the s.i.c.s will not result in any additional increase in the retail prices.

Although one or two American receivers use integrated circuits these are only found at present in stages such as the i.f. and sound sections and are not devices *specifically designed* for the particular job. The RBM device is particularly noteworthy in that it was specified and designed by the setmakers themselves to fulfill particular requirements where the benefits of using a s.i.c. would be worthwhile. We have no definite information as yet but from comments made we assume that the company is continuing its work along these lines to produce further innovations. Logically we would assume that the next step would be a second chip to operate as the sub-carrier regenerator.

RBM have exclusive rights for the device and it is interesting to note that while it was designed to function in a PAL receiver circuit it can also be used in NTSC receivers opening up prospects of important export possibilities.

The new RBM receivers will also feature the new 22in. "squared-off" picture tubes which have an aspect ratio of 5:4 and are claimed to diminish the "eye" effect of the receiver and provide a greater proportionate viewing area. ■

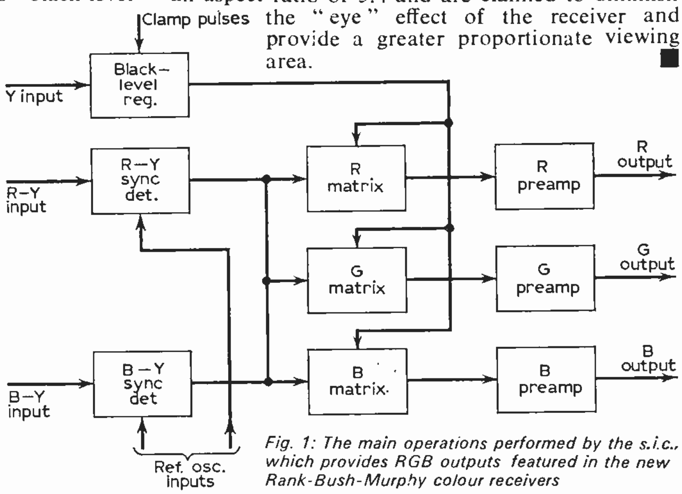
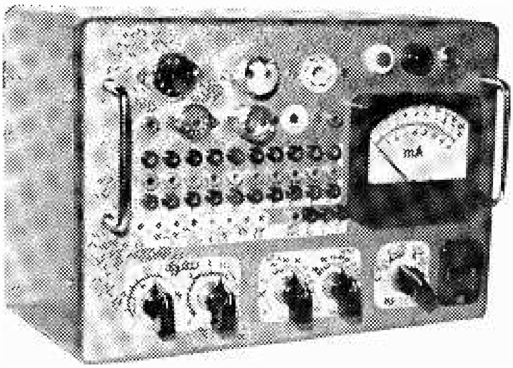



*Fig. 1: The main operations performed by the s.i.c., which provides RGB outputs featured in the new Rank-Bush-Murphy colour receivers*




# THE PRACTI

# VALV

IN PRINCIPLE a valve tester is merely a suitable power pack to supply nominal test voltages to the electrodes of a valve and a meter to read the currents drawn. These currents are compared with the nominal ratings to assess the condition of the valve. Some form of insulation testing facility is also required to detect shorts or leakages between the electrodes of a valve. Short-circuits are more frequently encountered on a power pack used for valve testing and a resettable overload trip is preferable to a fuse for giving the necessary protection. A fuse should be rated and positioned so that it blows only if serious internal faults develop. It is also necessary to give the overload trip a small time delay so that it will not operate on the switch-on surges of electrolytics in an external experimental circuit.

It is economical to make the voltages available also for external use in any application for which an h.t. power pack is normally needed. With this approach the outlay for full h.t. stabilisation is well worthwhile. With stabilisation the voltage setting controls may be provided with pointer knobs and scales calibrated directly in volts since the settings are independent of the actual currents drawn by the valve or load circuit (within the maximum ratings). This obviates the need for a voltmeter. Conventional valve testers with only nominal data testing facilities possess only a current meter. This is still sufficient in our design, even for plotting voltage/current characteristics of valves, when calibrated stabilised voltages are provided. If meter readings of voltage are desired too an ordinary multimeter may be connected to the output sockets or the meter switch can be given additional positions to bring appropriate series multipliers into circuit in the conventional manner. The basic meter movement must then be chosen with a higher sensitivity, e.g. 1mA f.s.d. The specified robust 10mA movement is hardly suitable for taking voltage readings. A more sensitive meter movement will have to be fitted with different shunts to restore the same current ranges.

## *VOLTAGE RANGES*

An h.t. power pack used for valve testing must be capable of providing a continuous range of voltages from high values around 300V right down to low values approaching zero. The same percentage accuracy is called for at all settings, which becomes a problem particularly at low voltages.

The low voltages are required because some nominal settings involve electrode voltages near zero. These *nominal test settings* need not correspond to any normal operating point, but rather represent conditions which are very sensitive to deterioration of the valve and thus best suited for revealing any drop in performance. For example the nominal test settings for the heptode section of an ECH84, which is used in the time-base and sync circuits of some TV chassis, are +135V on the anode, zero volts on the two control grids and only +14V on the screens. Under these conditions a good specimen should draw 1·7mA anode current, 0·9mA at the screens and the slope should be 2·2mA/V. Very low supply voltages are required not only for screen grids but often also for small triodes. Thus the nominal test settings for the triode section of the ECH84 are +50V on the anode and zero at the control grid when the anode current should be 3mA and the slope 3·7mA/V.

Tables of nominal test settings are published in books or may be obtained from manufacturers. Do not be confused if the values given for the same valve differ greatly in different tables since a number of self-consistent groups of settings and nominal readings are usually equally satisfactory for testing a particular type of valve.

## *OUTPUTS*

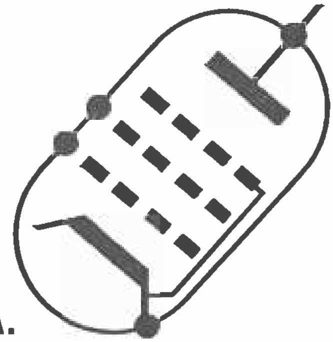
Two separately adjustable positive h.t. outputs are needed since the nominal test settings for multigrid valves do not necessarily use the same voltage for screen and anode. The majority of requirements can be met with a high current (maximum 100mA) stabilised output which is continuously variable between +150V and +300V, and a medium current (maximum 40mA) stabilised output which is continuously variable between +30V and +200V. The 40mA maximum current rating of the lower voltage supply is adequate for all screen grids and for small triodes tested with low anode voltages.

## *ZENER CABLES*

The two h.t. output ranges just specified are conveniently provided by the circuit used for this

AL TV

# TESTER



by Martin L. Michaelis, M.A.

valve tester design. It is difficult to extend these ranges directly without adding appreciable circuit complexity. There are two approaches which can be taken when these output ranges do not cover the nominal test settings for a particular valve. The nearest actually available settings not exceeding the nominal currents and power dissipation may be used and the associated nominal currents and slope determined with a specimen of the valve which is known to be good. These figures are then entered into the tables for future use. Alternatively, zener cables can be employed.

The voltage outputs of our valve tester are taken to insulated wanderplug sockets on the front panel. The test valveholders and their corresponding rows of insulated wanderplug sockets are also mounted on the front panel. For testing a particular valve the voltage output sockets must be linked to the valveholder sockets according to the pin connections of the particular valve. This is normally done by short pieces of insulated wire with an insulated wanderplug at each end. If certain valve types are tested very frequently in a large service shop it is convenient to cut perspex panels covering the entire array of wanderplug sockets: each panel is fitted with contact pins engaging the required wanderplug sockets and the interconnections are wired permanently on the panel. The panels are fitted with two handles for easy insertion and withdrawal and labelled stating the valve type, nominal test settings and nominal readings.

A power zener diode may be inserted in series with the connections to the screen and/or anode. The diode cathode must always go to the supply socket and its anode to the valve electrode socket. The actual voltage at the valve electrode is then equal to the supply voltage less the zener voltage of the diode. Two such zener cables suffice to meet all requirements with separate connecting wires. One cable should contain a 30V 40mA zener diode and the other a 50V 100mA zener diode. If these current ratings are not available, use two or more zener diodes in series with the sum of the zener voltages equal to the required value and individual current ratings equal to the specified rating.

Two examples will make clear how these zener cables are used. First of all consider again the heptode section of an ECH84, requiring +135V on the anode and +14V on the screens. The low h.t. output is connected to the screens via the 30V zener cable. The actual voltage at the screens is then 30V less than the voltage control setting so that this must be made +44V. Similarly the high h.t. output is connected to the anode via the 50V zener cable and set to +185V.

As a second example consider a PL36 for which +100V nominal test setting is specified for both screen and anode. The screen can be fed direct from the low h.t. output set to +100V whilst the anode will be fed from the high h.t. output via the 50V zener cable with the high h.t. output set to its bottom limit of +150V. The test bias setting is here −8·2V at the control grid when the nominal anode and screen currents are 100mA and 7mA respectively with a slope of 14mA/V.

Note carefully that it is not possible in this case to strap screen and anode together and run them off the low h.t. output set to 100V because the total current is too large for this output. Such strapping is permissible for either output only when the total current is within limits, but screen and anode current readings are then no longer possible separately. The meter indicates their sum, which is normally adequate for comparison with the nominal sum.

Short of including the two zener diodes inside the valve tester with switching to bring them into circuit when required there is no simple way of extending the output voltage ranges. If the zener diodes are incorporated internally make sure that their anodes go to the output sockets on the front panel (their cathodes to the output sockets when they are used in external cables).

## *GRID BIAS VOLTAGES*

Grid bias voltages are always specified negative or zero for nominal test settings. It is unusual to specify cathode bias in a nominal test setting because this introduces current negative feedback tending to mask any deterioration of the valve. However if some special test settings or experimental requirements demand cathode bias, strap the grid to a chassis socket and plug in a resistor of the specified value between the cathode socket and a chassis socket. Two chassis sockets are provided on the front panel. Normal test settings call for chassis connection of the cathode and a specified negative bias voltage fed to the grid, or earthing of the grid too. To apply a negative bias

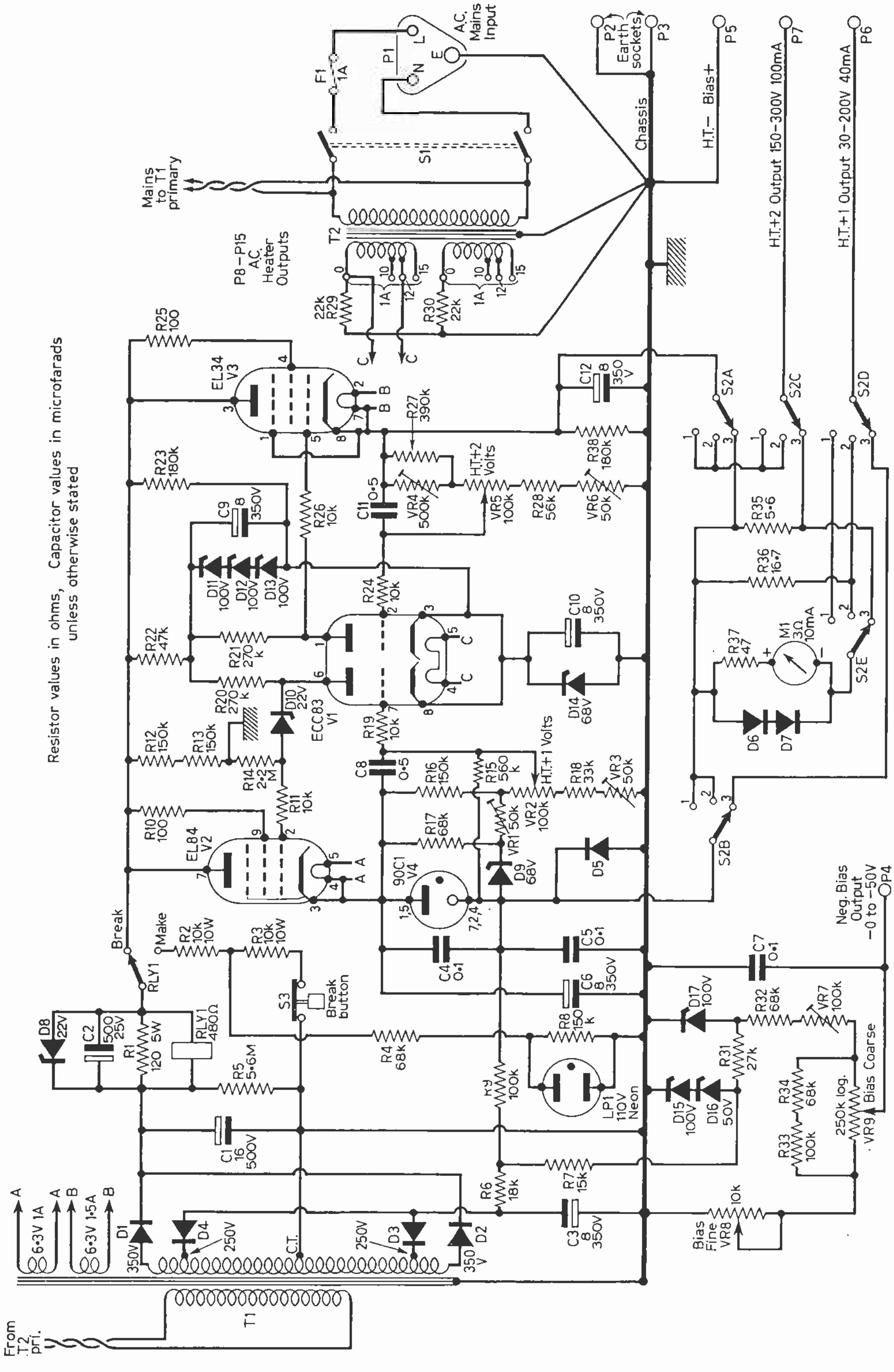



*Fig. 1 : Complete circuit of the Practical TV valve tester.*

## COMPONENTS LIST

### Resistors:

| | | | |
|---|---|---|---|
| R1 | 120Ω 5W W.W. | R21 | 270kΩ 1W |
| R2 | 10kΩ 10W W.W. | R22 | 47kΩ 1W |
| R3 | 10kΩ 10W W.W. | R23 | 180kΩ 2W |
| R4 | 68kΩ ½W | R24 | 10kΩ ½W |
| R5 | 5·6MΩ 1W | R25 | 100Ω ½W |
| R6 | 18kΩ 2W | R26 | 10kΩ ½W |
| R7 | 15kΩ 2W | R27 | 390kΩ 1W |
| R8 | 150kΩ ½W | R28 | 56kΩ 1W |
| R9 | 100kΩ 2W | R29 | 22kΩ 1W |
| R10 | 100Ω ½W | R30 | 22kΩ 1W |
| R11 | 10kΩ ½W | R31 | 27kΩ 1W |
| R12 | 150kΩ 1W | R32 | 68kΩ ½W |
| R13 | 150kΩ 1W | R33 | 100kΩ ½W |
| R14 | 2·2MΩ 1W | R34 | 68kΩ ½W |
| R15 | 560kΩ 1W | R35 | 5·6Ω* |
| R16 | 150kΩ 1W | R36 | 16·7Ω* |
| R17 | 68kΩ ½W | R37 | 47Ω* |
| R18 | 33kΩ 1W | R38 | 180kΩ 1W |
| R19 | 10kΩ ½W | R39-R48 | 100Ω ½W |
| R20 | 270kΩ 1W | R49-R58 | 27kΩ ½W |

* See text

All 10% carbon unless otherwise stated

### Variable resistors:

| | |
|---|---|
| VR1 | 50kΩ lin. preset |
| VR2 | 100kΩ lin. pot. with knob |
| VR3 | 50kΩ lin. preset |
| VR4 | 500kΩ lin. preset |
| VR5 | 100kΩ lin. pot. with knob |
| VR6 | 50kΩ lin. preset |
| VR7 | 100kΩ lin. preset |
| VR8 | 10kΩ lin. pot. with knob |
| VR9 | 250kΩ log. pot. with knob |

### Semiconductor diodes:

| | |
|---|---|
| D1, D2 | Silicon h.t. rectifiers, ½A 1kV p.i.v. |
| D3, D4, D5 | Silicon h.t. rectifiers, ½A 750V p.i.v. |
| D6, D7 | Silicon l.t. rectifiers, 1A, 100V p.i.v. |
| D8 | 22V power zener |
| D9 | 68V power zener |
| D10 | 22V miniature zener |
| D11, D12, D13 | 100V power zener |
| D14 | 68V power zener |
| D15 | 100V power zener |
| D16 | 50V power zener |
| D17 | 100V power zener |

### Valves:

| | |
|---|---|
| V1 | ECC83 |
| V2 | EL84 |
| V3 | EL34 |
| V4 | 90C1 |

with holders

### Capacitors:

| | |
|---|---|
| C1 | 16μF 500V electrolytic |
| C2 | 500μF 25V electrolytic |
| C3 | 8μF 350V electrolytic |
| C4 | 0·1μF 500V paper |
| C5 | 0·1μF 500V paper |
| C6 | 8μF 350V electrolytic |
| C7 | 0·1μF 500V paper |
| C8 | 0·5μF 500V paper |
| C9 | 8μF 350V electrolytic |
| C10 | 8μF 350V electrolytic |
| C11 | 0·5μF 500V paper |
| C12 | 8μF 500V electrolytic |
| C13-C22 | 0·1μF 500V miniature foil |

### Miscellaneous:

| | |
|---|---|
| F1 | 1A medium delay |
| LP1 | Panel mounting 110V a.c. nominal neon |
| M1 | Meter 3Ω 10mA (see text for alternatives) |
| P1 | 3-pin mains connector |
| P2, P3 | Green — Insulated wanderplug sockets (Hirschmann Bil20) |
| P4 | Blue — Insulated wanderplug sockets (Hirschmann Bil20) |
| P5 | Black — Insulated wanderplug sockets (Hirschmann Bil20) |
| P6, P7 | Red — Insulated wanderplug sockets (Hirschmann Bil20) |
| P8-P15 | White — Insulated wanderplug sockets (Hirschmann Bil20) |
| P16 | Octal valveholder |
| P17 | Loctal valveholder |
| P18 | Magnoval valveholder |
| P19 | Decal valveholder |
| P20 | B7G valveholder |
| P21 | Noval valveholder |
| P22-P31 | Red — Insulated wanderplug sockets (Hirschmann Bil20) |
| P32-P41 | Blue — Insulated wanderplug sockets (Hirschmann Bil20) |
| P42-P51 | Black — Insulated wanderplug sockets (Hirschmann Bil20) |
| Rly1 | Relay 480Ω 24V nominal; pull-in at 30mA, 16V (see text); two changeover contacts, 380V a.c. nominal, 1A (connect in parallel) e.g. Siemens Wedge relay Type Trls152aTBV63016/63d/24VDC |
| S1 | Double-pole on-off mains toggle switch |
| S2 | 5- or 6-pole 3-way ceramic wafer switch with knob (see text) |
| S3 | Push-button switch with one breaker contact |
| T1 | Mains transformer 350/250/0/250/350V 150mA, 6·3V 1A, 6·3V 1·5A or close equivalent |
| T2 | Heater transformer. Two secondaries each 15V 1A tapped at 10V and 12V. Rewind secondaries of normal 6·3V 5A heater transformer, see text |

Material for case, wiring, etc.

to the grid strap the grid bias output socket to the grid connection and set the bias voltage controls as described later in conjunction with the circuit description (see Part 3).

## *BIAS CONTROLS*

The bias output is not called upon to deliver appreciable current but voltages from zero to 50V must be available with constant accuracy. It must also be possible to *change* the setting *accurately* by one volt or a fraction of a volt at any absolute setting in order to determine the slope of the valve These requirements are met with a linear fine control running from zero to −4V and a logarithmic coarse control running from zero to −50V. Operation will be explained in Part 3.

Nominal test settings mostly involve quite small bias voltages but high ones are sometimes called for. For example the nominal test settings for a PL81 are +200V on the screen and anode and −28V on the grid to give an anode current of 40mA, a screen current of 2·8mA and a slope of 6mA/V. Negative bias voltages up to −50V are necessary for plotting complete families of valve characteristics and for the input to bias bleeders in experimental circuits.

## *DETERMINING SLOPE*

The slope of a valve is defined as the change of anode current in mA produced by 1V change of grid voltage *at the given operating point*. In general the greater the negative bias the smaller the slope until eventually the slope drops to zero at the cut-off point. If the standing bias is small at the specified operating point the variation should be from about 0·1V below to 0·1V above the nominal value and the resulting total change of anode current multiplied by five to obtain the slope. If the standing bias is high it suffices to make it exactly 1V more negative, noting the resulting drop in anode current which gives the slope directly.

Unless otherwise stated the slope of a valve refers to the change of anode current for a 1V change of grid bias voltage with constant screen and anode voltage. The change of screen current is thus of no interest. This brings out the need for a properly stabilised h.t. supply since accurate slope measurements are impossible if a change in load current causes the output voltage of the power pack to change too. If we apply a more negative bias voltage to a valve running on an unstabilised power supply the reduction of anode current will cause a voltage rise tending to increase anode current again. The actual drop of anode current will thus be less than it should be. Conversely if we apply a less negative bias the anode current will rise but this will be accompanied by a voltage drop tending to reduce the anode current. The actual change of anode current will be smaller than it should be here too. Thus an unstabilised h.t. supply leads to low slope readings which may suggest that a good valve is poor.

A slope measurement is usually the most important step when testing a valve because the slope best reflects the cathode emission efficiency, failure of which is the most likely fault to develop in a valve after long service. The slope is also a good parameter for assessing the gain which the valve can give in a practical circuit, but the measurement must then of course be made with settings corresponding to the intended operating point. Current readings and a slope measurement are both necessary for any complete test of a valve, because other faults may be present apart from the commonest one of failing cathode emission.

If the slope reads more or less normal but there are large current discrepancies the vacuum may have deteriorated or there is an electrode insulation fault present. Darken the room and observe whether there are fluorescent glows inside the valve, particularly with high applied h.t. voltages and correspondingly large bias voltages to restrict the current. (Do not exceed the maximum ratings in such tests.) Such glows, usually blue or greenish on the glass envelope, are typical of poor vacuum but may be normal and do not necessarily imply a vacuum fault. A further symptom generally indicating poor vacuum is a tendency to show more or less normal currents with large bias values, with progressively greater discrepancies as the bias and h.t. voltage are both reduced to maintain the same approximate currents. Poor vacuum produces ions which can be collected by the grid and thus shift the internal bias value; this influence is obviously greatest when the applied bias voltage is small or zero. It is chiefly for this reason that many nominal test settings specify very small anode and screen voltages, since these are necessary to restrict the currents within permissible limits whilst permitting low or zero bias voltages to give good sensitivity to vacuum deterioration. In this sense a bias supply with fairly high internal impedance is very desirable for testing valves, since the described ionic effects due to poor vacuum are tantamount to grid current with negative voltages, which can exert a perceptible influence only with a high-impedance bias supply. A healthy valve should never draw appreciable grid current with negative bias voltages.

How leakages and electrode shorts can be detected and measured will be described in Part 3.

**TO BE CONTINUED**

## CHAIN-REACTION FAULTS

*—continued from page 536*

From all this it can be seen that it is never wise just to replace a defective component and let it go at that. Should there be signs of overheating, causes of excess current must be considered and investigated. Before replacing any component the following questions should be asked: what caused the failure, was it an internal fault in the component or was it due to some external circuit failure, and what other components could possibly affect the failed one?

It may be that the faulty part may not have been damaged by some other component but may have altered circuit conditions so that another component is affected. If then replacing the part in question does not bring the performance of the receiver back to normal, instead of starting at the beginning with normal fault-finding procedure to find the cause of the further trouble ask: what else is it that could possibly be affected by the fault in this component? Circuit diagrams are always helpful in making an analysis such as this and if available should always be consulted. Especially is this so where unconventional circuits are employed.

# DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

IN my area there have been openings nearly every day, but never very good ones, and many of the European countries have been "missing" here so far this year, and in this context I quote Denmark and Rumania. I myself have only had Finland on one occasion, and I must confess that I was very pleased to have two readers' reports confirming that Rumania Bucharest R2 is still about after all; I was beginning to wonder if it had moved from Band I to Band III!

Canary Islands E3 is another one, but I have just heard that Ian Beckett did receive this on 24/6/68 at Buckingham.

I still think that this summer is going to be a poor one for Sp E, and I still wonder if there is some relationship here with the prevailing sun-spot maximum, and that we may have to wait until this has passed before Sp. E becomes more rewarding.

Here now is the usual run-down for the Sp. E period 21/6/68 to 25/7/68.

23/6/68 USSR R1, Italy IA, Spain E2 and E3.
24/6/68 Norway E2, Sweden E2 and E4, Poland R1, E. Germany E3 and Austria E2a.
25/6/68 USSR R1.
26/6/68 USSR R1, W. Germany E2, Austria E2a, Spain E2, E3 and E4, Italy IA.
27/6/68 Austria E2a, Italy IA and Hungary R1.
28/6/68 Austria E2a, Spain E2 and E3, Yugoslavia E3 and Hungary R1.
29/6/68 Portugal E2 and E3, Spain E2.
30/6/68 Italy IA and IB, Portugal E2, Spain E2, E. Germany E3 and E4, Norway E2.
1/7/68 Portugal E3, Spain E2, E3 and E4.
7/7/68 Spain E3.
8/7/68 USSR R1 and R2, Czech R1, Austria E2a, Poland R2, Sweden E2, Norway E2, E3 and E4, Spain E2, E3 and E4.
9/7/68 Czech R1, USSR R1, and Spain E2.
11/7/68 Hungary R1 and Poland R2.
13/7/68 Czech R1, Hungary R1, Poland R1, and R2, Italy IA and IB, Yugoslavia E3 and E4, W. Germany E4 and Austria E2a.
16/7/68 Czech R1, Italy IA and IB, Spain E2, E3 and E4 plus 2nd Chain Santiago E2.
18/7/68 Poland R1 and R2, Spain E2, E3 and E4.
20/7/68 USSR R1, Poland R1 and R2.
24/7/68 Czech R1.
25/7/68 Spain E2.

Even if Sp. E has been rather poor there was at least a good Tropospheric opening on the 30/6/68 when u.h.f. was wide open to W. Germany and seven new stations were logged; this is quite an event as u.h.f. is to say the least a bit difficult here.

The best one, however, was Ch. 21 Pic du Midi France, down in the Pyrenées as a second "floater" on Lille, and Brest.

## News

(1) Still more confusing Test Cards and Test Patterns!

I have seen the EBU card without thin white circle on R1 and R2; it looks like Poland to me.

(2) The above pattern has also been seen on TVE Spain Chs E2, E3 and E4! All most confusing!!

(3) I hear that the W. German Commercial TV services are apparently experiencing some financial difficulty, and because of this nine stations of the first chain based on Frankfurt will now have different programmes, and as from 1/9/68 will be closing down at 10.30 p.m. except for Fridays and Saturdays.

(4) Mr. R. P. J. Endean, of Aberystwyth, gives the following supplementary stations to our recent list for Norway:—Varanger E2 30kW and Kautokeino E3 8kW. Many thanks to him.

Still more interesting F2 news, this time from our old friend Mr. E. Baker of Blythe, Northumberland: I quote his report almost verbatim:—

Date 27/6/68, time 09.55 BST Ch. E3.

A weak, smudged video, coloured announcer in a white shirt. 10.00 BST beginning of an educational programme, a white man talking to a class of young negroes, close-up of blackboard revealed triangles, rectangles, etc.

From my TV guide I see that West Nigerian TV has "schools" at this time, so I have mailed a letter to them giving details of all pictures seen.

I am sure that this is Abafon Nigeria on E3, and I hope to get confirmation.

My second "mystery" is reception on 8/7/68 on Ch. E3 under TVE Spain: when TVE faded out there was a weak test card, strongest with aerial to NE; this consisted of a grey background with a horizontal graded bar with three stars below it in the lower right-hand corner. The signal was subject to slow fade but not "flutter."

To analyse these reports I would say that the first may well be Nigerian as he suggests, and I sincerely hope that he gets his confirmation; there are a couple of points, however; for Trans-equatorial skip the time seems early in the day, and secondly I vaguely wonder if this was RTP Portugal as they have a coloured announcer (I have a photo of this gentleman taken by Mr. D. Bowers). This *could* have been followed by a documentary on African schools.

The second report I suggest was possibly E.

*continued on page 561*

# VIDEO TAPE RECORDING

## PART 10

**H.W.HELLYER**

WHEN the novelty has worn off and we take video tape recording for granted as just another vexatious service that may occasionally go wrong the necessity for a properly designed monitor may be accepted with reasonable grace. At present—and videotape is only twelve years old!—users struggle to find ways of paring costs or justifying budgets; and the usual item to go by the board is the monitor receiver.

"Can't you tickle up my old BBC-only 12in. console?" asks the headmaster of a school that has just installed a couple of thousand-pounds' worth of v.t.r. equipment. In the early v.t.r. days we were tempted to do the necessary modifications. Even nowadays we are virtually blackmailed into repeating this undesirable exercise. Next week the author has the task of converting a certain University's Clarke and Smith 27in. receiver to add it to a closed-circuit-plus-v.t.r. system, just to allow the Science Department to keep within a curtailed budget. It can be done and shall: but the difficulties arise that performance falls beneath that of a properly-designed monitor while faults quite irrelevant to the v.t.r. system crop up and we as installers of the overall system are called upon to service an ageing set.

None of this matters to enthusiast readers. The problem in their eyes will be the matching of a television receiver to a video-tape recorder (and to a camera) to enable the picture to be displayed. As we have already seen it is not a simple matter. The signal coming from the camera is tailored to suit the v.t.r.; while the signal from the v.t.r. may depend on certain feedback properties from the monitor to maintain servo stability. We must always remember that servo lock is the prime necessity in v.t.r. systems, and locking to the field pulses may be all very well in theory, but in practice has its drawbacks. We generate pulses, dependent on the basic speed of the mechanical system, in turn dependent upon mains frequency and as this is itself variable within greater limits than an absolute rock-steady pulselock can tolerate everything else must use the servo speed as reference. Hence the closed-system now employed, which we have described, where the field pulses are beaten against generated pulses to obtain a reference rather than used as the heartbeat of the system.

Having said as much we can proceed to describe some of the methods used to save a copper or two when installing a v.t.r. system.

If a standard receiver is used as a monitor there are two ways of obtaining the picture: either from a video signal input to a post-video-detector point in the circuit or an r.f. signal fed to the aerial and processed through the receiver in the usual way. Obviously from the commercial operator's view the latter is preferable. He thus divorces himself from the monitor and if anything goes wrong with it can wash his hands of responsibility, which is very useful when the supplier, as in the author's case, runs a tape recording and hi-fi establishment rather than a TV workshop. But technically it is much more efficient to utilise a video signal. The v.t.r. is providing a video signal and all that should be necessary is a properly screened lead, a little selective switching, perhaps a buffer amplifier to achieve the correct sync direction and—most important—addition of an isolating mains transformer to overcome the abominable habit of our commercial television manufacturers to employ lethal a.c./d.c. circuits.

There should be no need to detail these methods: they depend ultimately on the circuit of the individual receiver. The real troubles come with automatic contrast control circuits, transistor receivers, and multiple video stages.

Of greater interest and perhaps a stimulus to constructors is the use of an r.f. modulator. This device takes the video signal, modulates it very roughly to a Band I frequency and couples it directly into the aerial system of the receiver, relying upon good timebase efficiency for steadiness of the monitored picture. So assuming that we have a receiver of trustworthy character we may use a basic circuit something like Fig. 34 to get what we want. We may—but in practice we do not. In the first place this circuit, which is tuneable around channels 3, 4 and 5, pumps out far too much audio and gives cross-modulation. It needs very careful construction, though the first one or two the author made up were fitted into convenient two-ounce tobacco tins with simple screened divisions down the centre and worked. But this is not good enough for industrial, educational and other commercial operators. They need something more foolproof and something which will not need adjustment every time channel switches are turned over. So the various schemes and compromises of Fig. 35 were devised. Geoffrey Horn of Oxford, one of the hard-core of hi-fi enthusiasts, came up with the first really viable r.f. modulator that could be made up, fitted within the v.t.r. (I am now talking about the Sony CV2000B machine again) and sent out with confidence to customers. Fig. 36 shows at (a) a simple power circuit and at (b) a mains-lock circuit for converting the system to closed-circuit operation. In Fig. 37 is shown a typical buffer amplifier for use with the video in/video out method of adapting a monitor.

I must confess that my own approach has been to deter would-be cheese-parers from trusting to the r.f. modulator. It interposes a link between the v.t.r. and the receiver which simply adds the possibility of trouble. Video out to video in is the real answer—and a properly designed monitor which after all is also a very good TV receiver in its own right is worth all one is asked to pay for added efficiency.

The "big boys" in the v.t.r. world will have none of this makeshift approach. Ampex, Philips, and now Rank TV have very efficient closed-circuit television systems. The last-named have launched into CCTV consultancy using the low-cost Nivico (Japanese) video-tape recorder which was until recent tax changes retailing at £360 and is a dual-standard system. Information retrieval is one of the basic functions which this system can be employed to augment, and with the TK66 camera plus the basic v.t.r. system marketed at £585 this challenge on the market cannot be ignored.

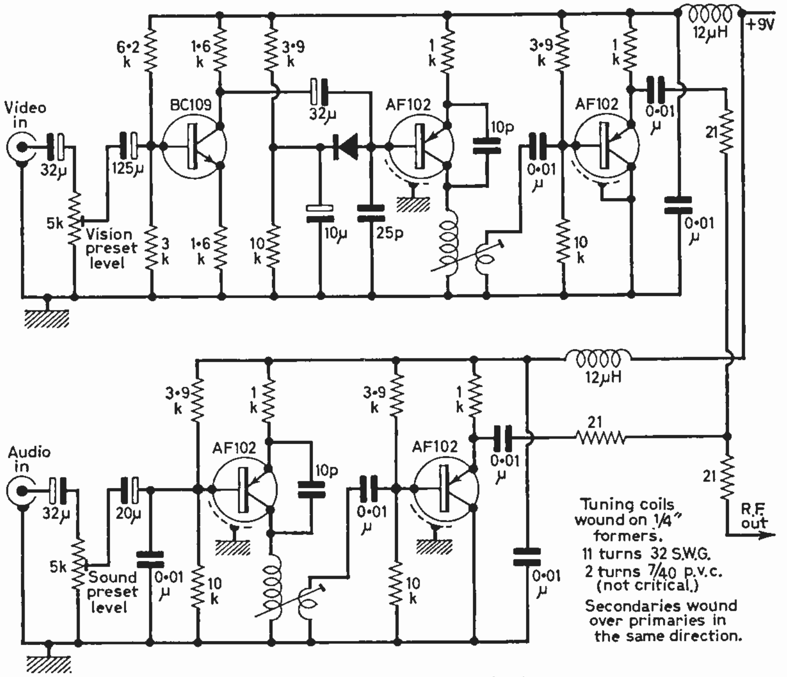



*Fig. 34: Basic r.f modulator circuit.*

## Developments

In the medical field v.t.r. needs colour and is merely an academic demonstration without it. Siemens are the latest to come up with a colour v.t.r. idea although at the moment this is only applicable as a closed-circuit television system. In conjunction with a fibrescope which is inserted in the patient's stomach via his esophagus, the colour TV camera transmits a picture of what is going on inside the stomach and portrays it on supplementary TV monitors. Certain diseased tissues can only be detected by their colour changes, which makes this new approach most valuable for medical teaching. In the Siemens system three parallel 1in. vidicon tubes are preceded by an image-dividing system resolving the light from the glass-fibre pick-up tube into the three primary colour components.

Other firms have been quick to jump on this band-wagon and we hear of a project by Closed-Circuit Television Hire which enables a complete colour closed-circuit system with engineer and cameraman to be provided for as little as £150 per day. A bit much for recording Aunt Agatha's wedding, but certainly an economic proposition for many industrial applications such as the lucrative world of television commercials.

The world of colour TV is widening rapidly and closed-circuit television companies have not been slow to develop methods of making the best of modern techniques. A year ago we heard of a projected cassette system to be inaugurated by Columbia Broadcasting of America and due to burst upon the world in 1969. We can hardly wait! In the meantime we have ascertained that the cartridge will be rather like a 7in. film spool, will give a 30 minute colour programme or two

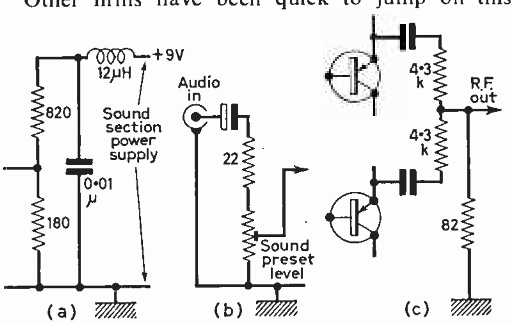



*Fig. 35: Modifications to Fig. 34 to reduce intermodulation (sound-on-vision). (a) Reduced power supply to the audio section. (b) Attenuated audio input. (c) Greater isolation at the r.f. output of the modulator.*

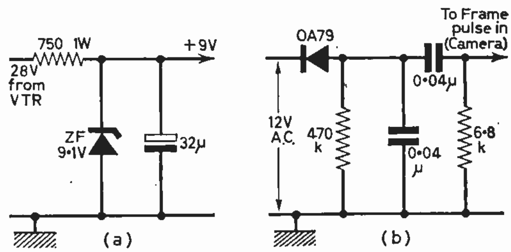



*Fig. 36: (a) Method of deriving power supply for the r.f. modulator from the v.t.r. (Sony CV2000) using a simple dropper and zener diode. (b) To convert system to closed-circuit operation a mains lock circuit must be provided: a shorting link to the pin carrying frame pulses can then be used (and externally switched if needed).*

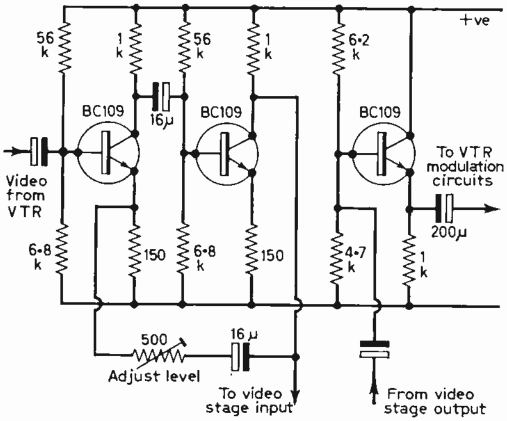



*Fig. 37: Typical buffer circuit for video in/video out method of adapting a monitor.*

such black-and-white ones and was originally costed at 7gns. The player, a Thorn development, produces a 625-line u.h.f. signal applied directly to the aerial socket of a domestic TV receiver and can be fed to several such outlets simultaneously. Frequency reponse to 4·5Mc/s has been promised with up to 6Mc/s expected eventually. The idea is that more information can be stored optically on film than magnetically on tape—a real bone of technical contention at the moment—and that the drawback of insufficient light has been overcome.

In the e.v.r. system the film moves continuously, frame take-off is electronic, and the TV set is used as a light amplifier. Pictorial images corresponding to the luminance are carried on the microfilm records, and for colour a second frame carries chrominance information thus halving the playing time. An electron beam recorder is the basis of this system. And here we are back to the project stipulated long ago by Ampex.

In 1966 we saw a report of the AMT-13 which had a tiny cathode-ray tube emitting an electron beam which was focused on a silver halidide tape coating. Scanning was vertical and horizontal, modulation of the electron intensity registering as a varying electrical charge over the area of tape being scanned. The tape is coated with a plastic film which emits light when scanned by an electron beam, the light passing through the recorded pattern to register on a photomultiplier tube. Up to 100Mc/s at a 30dB signal-to-noise ratio was then promised—and this was over two years ago, a long time in the v.t.r. time scale.

Even earlier than this we were informed of the Phonovid system which harked back to experiments carried out in 1963. Westinghouse were behind this development which promised enough information on a gramophone record to provide 40 minutes of picture and sound using a slow-scan camera and overcoming the bandwidth problem by reducing picture frequency from 25 frames per second to one "still" every six seconds. This means, mathematically, reducing bandwidth by a factor of about 150 from 2·5Mc/s to about 16kc/s, and sounds very dream-like. But the Phonovid worked under laboratory conditions and cannot be entirely discounted.

The problem always is to extend the upper frequency limit, and the only way this can be done is by an increase in the relative head-to-tape speed. There comes a point at which the signal level drops off and the signal-to-noise ratio becomes too small for high-quality vision recording, and other means have to be found to extend the bandwidth. One proposed system about which little has yet been made public was the Bell and Howell idea of modulating the tape with a square-wave signal in which the time duration between the crossover points was a function of the amplitude changes of the video signal. This is sensed by first comparing the amplitude of the video signal with a reference signal which varies in amplitude from a given starting level, the variation being a regular function with time.

Cycling of this signal depends on the relationship between the video and the reference signals; when a predetermined difference level occurs the reference signal reverts to its starting level. Thus, the "field" time can be set independent of the television signal.

A third signal is switched between two amplitude levels to be modulated with the video signal at the transition periods, and it is this signal, a series of transitions, that is recorded on to the tape. To demodulate this the intervals between the pulses are converted to pulses having amplitudes proportional to the time intervals. These are then put through a low pass filter to become replicas of the original video signal.

But if the different systems that are being investigated to beat the bandwidth problem lead one to despair of standardisation what about the lack of compatability within the narrower limits of one system, such as helical scan? Of the principal contenders, Ampex use 1in. tape at a speed of 10·4in./sec for the 405-line machine, 9·4in./sec for the 625-line version; the Philips ET2770 also uses 1in. tape but runs at 10in./sec; Loewe-Opta and the Ikegami 311E have plumped for 1in. wide tape but whereas the former runs at only 7in./sec the latter rivals the Philips at 10in./sec. The other Ikegami version, the 301, has a very odd tape width of ¾in. and a speed of 9in./sec. Sony have a ½in. tape but whereas the 405-line machine has the "standard" speed of 7½in./sec the 625-line version has been speeded up to 11½in./sec to get the necessary bandwidth. The Shibaden SV700E although using only ½in. tape runs slowest of them all at 6·7in./sec. The Nivico KV-800, about which I have very few details at the moment, is another machine that uses ½in. tape and runs at 9·45in./sec.

The last machine is interesting as a low-cost v.t.r. that is part of a package-deal offered to educational bodies etc. This is a complete two-camera system with three monitors, vision mixer, sync pulse generator and video tape recorder for less than £1,000 and is marketed by Video Ltd. of Woking, Surrey.

The vision mixer proposed by K. Wilkinson of Video Ltd. is an interesting project about which it is hoped to write more later in a separate article. Briefly it permits video signals from alternate sources, such as cameras, to be synchronised and switched directly while retaining a stable sync pulse for the video tape recorder to maintain a constant lock. Normally any change of source will disturb recording, the amount depending on the servo system operated by the v.t.r. This vision mixer is, at £250, an economic way of achieving what costs several times this amount in the television studios.

Quite apart from the need for handling an increased bandwidth colour television has brought with it several additional requirements. Defects in the system become very noticeable when multiple copies have to be made. Because of the advantages in processing that video tape offers dubbing has become the accepted technique in the television studios today. Very often the show we see is a fourth or fifth copy of the original videotape, trimmed to shape and with, it is to be hoped, the faults excised. Duplication for distribution and networking, for storage and reference, also make the need for dubbing an important factor of videotape technique. This means that the important limitations that are common to monochrome and colour v.t.r. work will have to be given special attention: such things as the low frequency signal-to-noise ratio, the transient response, linearity, especially at low frequencies, adjustments for frequency deviation and servo limits, overall attention to the mechanics to reduce the problem of dropouts, and so on.

But when making successive generations of colour dubbings some errors are accumulative. Random function errors such as noise add in terms of power but repetitive errors such as differential gain multiply with each succeeding generation. (This is, incidentally, common to monochrome also, but has less marked effect because of the signal information shaping.) Thus errors of hue and saturation can become serious before noise problems cause so much worry.

An effect that causes colour displacement (typically to the right in the Ampex system) is chrominance-luminance registration error. It is caused by group delay characteristics and is mainly a function of filter and delay-line design. Good phase response through the system is needed to keep this error within bounds. Colour signal-to-noise ratio can produce random variations in both hue and saturation. Noise generation in the head-to-tape process and especially in the f.m. process (the moiré effect) must be reduced. This often means better head systems with greater efficiency for the same tape penetration, improved tape design for smoother surfaces, and the use of "high-band" techniques.

Head design is also a vital factor in the reduction of colour saturation error, but again the use of the high-band system is an advantage. Automatic playback equalisation is increasingly being used to remove responsibility for operator attention, by measuring the amplitude of the colour burst on the horizontal lines from a given head channel and electronically adjusting the playback equalisation of that channel to compensate. By operating this system continuously and simultaneously on all four channels (of the Ampex four-head system) the chrominance gain is kept constant.

Hue errors, caused by timebase, static phase, differential phase and velocity errors, can be most troublesome in colour dubbing. Special timebase correction devices have been developed to deal with these but the problem is far from being beaten. Mechanical tolerances have just about reached their limits and now the philosophy is to develop electronic methods of controlling them. In earlier parts of this series we went into fairly close detail of the servo operation of domestic v.t.r.s. Compared with what we have discussed the professional colour v.t.r. has servo circuits of quite frightening complexity. Perhaps it is as well for all our sakes that this series of articles ends right here! ■

## SERVICING TV RECEIVERS

—continued from page 547

check for heater-cathode shorts and heater-to-adjoining tracks shorting. If fuse fails immediately check C110, C111, W10, C112.

If h.t. fusible resistor wires are parted switch off, allow to cool and join wires with a soldering iron. Switch on and note how long it takes to again overheat. If it fails almost immediately check for shorts at supply points along panel, i.e. feed to i.f. stages, to video stage, to tuner, etc. If the heating is delayed until the line timebase starts to work check PL500 and PY801.

Note: if wrap-round tags have to be undone to isolate the fault it is recommended by the makers that the wires be soldered to the tags when remaking the connections.

**No picture, no raster, sound in order:** Switch to 405 and listen for line timebase whistle. If low or unusual, check with EY86 (if fitted) top cap off. If now normal change EY86. If still absent or unusual check PL500, screen feed resistor, PY801 and PCF808. If jelly-pot transformer and e.h.t. tray is fitted release this and note difference. If e.h.t. is normal check tube base voltages at pins 3, 6 and 7.

**Raster and sound in order, no picture signal:** Check V4 and V5 with associated circuitry.

**Picture in order but no sound:** Check V6 and V7 and associated circuitry.

**Ferguson Model 3629:** This 11 in. model is fitted with a special version of the 900 chassis. R136 is replaced with two 15Ω 10W resistors in series to reduce the h.t. voltage 10%. CME1101 tube. 13·5kV e.h.t.

## DX-TV

—continued from page 557

Germany E3 from Helpterberg; the pattern is similar, but I have never seen the "stars".

Mr. R. E. Finch is a new DXer from Birmingham who has made a good start with Portugal E2 (with coloured announcer would be F2 DXers to Africa please note!), USSR, Poland, Norway and Sweden, Austria, Spain TVE 1 and TVE 2 and W. Germany already received.

Another new DXer and a near neighbour of his, Mr. H. G. Adams, also of Birmingham, has already had France, Spain, Norway, Sweden, Austria, Poland, USSR, Czechoslovakia and Finland—nice work!

Our old friend Mr. D. Kelly of Castlewellan, N.I., has just about had the lot so far this June, so I am going to pick out of his log just one item, Fyn Denmark E3 on 3rd. We are very glad to know it is about again!

# TRANSISTORISED AERIAL DISTRIBUTION SYSTEM

## Part 2

by J.W.Thompson

THE v.h.f. amplifier is broadband and the signals from the Band I, Band II and Band III aerials must be combined by means of a suitable filter network (Belling and Lee L1411) before being fed into the amplifier; if there is no Band II aerial a diplexer should be used (L1338/A). The v.h.f. section of the amplifier is very unpredictable in performance if presented with an incorrect input impedance. If there is the slightest suspicion of incorrect matching remove the triplexer from the circuit and apply the feeder from each aerial in turn to the input of the amplifier. Mismatching will become immediately obvious if the signal level on a given channel is greatly different to the level when connected via the triplexer. Experiments with different aerials may be carried out, but often the only remedy is to fit a tuned amplifier in the relevant aerial lead. Suitable for this purpose would be the preamplifier described in the July and August 1967 issues of PRACTICAL TV ("Beyond the Fringe") or alternatively a commercially manufactured amplifier could be used.

Two possible ways of feeding three receivers with v.h.f. with u.h.f. signals are shown in Fig. 8. The second arrangement is not recommended because it is always bad practice to combine v.h.f. and u.h.f. signals into one downlead due to the greater losses involved. Regrettably this procedure is often unavoidable.

As it would be inconvenient to have to drag oneself up to the loft every few weeks in order to change batteries it was decided that some form of mains power supply had to be built for the amplifier (see Fig. 1(c)). Stabilisation is not strictly necessary and readers may leave it out if they wish. Any 12V transformer will do provided that it can supply the necessary current; a bell transformer is ideal. Similarly almost any medium-power npn silicon transistor may be used in the stabilising circuit. On the prototype the stabilisation failed at a current of 50mA, so the power supply should be sufficient to run two aerial distribution amplifiers as described with a little extra in reserve. Mains voltage fluctuations of up to 30V should have no effect on the stabilised output voltage which will remain constant at 10·4V.

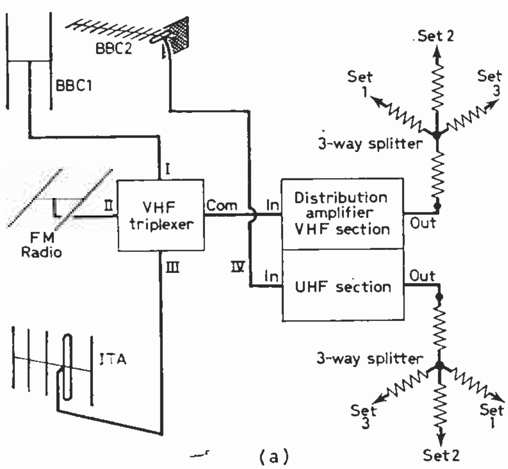
The system as described should be useful for many years until communications satellites become sufficiently powerful to beam microwave signals directly to domestic viewers. If and when this happens things will be very different!

### Developments

Since the design of the prototype aerial distribution amplifier a reasonably priced u.h.f. silicon transistor, type BF180, has become available. Its noise figure is very similar to that of the AFY42, the base connections are the same and a higher gain per stage of the amplifier will be provided. As the BF180 is an npn transistor it is necessary to reverse the polarity of the power supply connections, i.e. the chassis of the amplifier should be connected to the *positive* side of the supply, and a slight base bias adjustment is necessary. R3, R7, R11, R14 and R17 should all be changed to 3·3kΩ.

The BF180 transistor may be used throughout both sections of the amplifier, i.e. in place of both the AFY42 and the AF239, but the decision on which type of transistor to use is left to the reader. The main difference that will be noticed if silicon transistors are used is that the overall gain will be higher, particularly in the u.h.f. section. A final point concerning the use of npn transistors is that the negative side of the power supply must not under any circumstances be connected to the

—continued on page 567



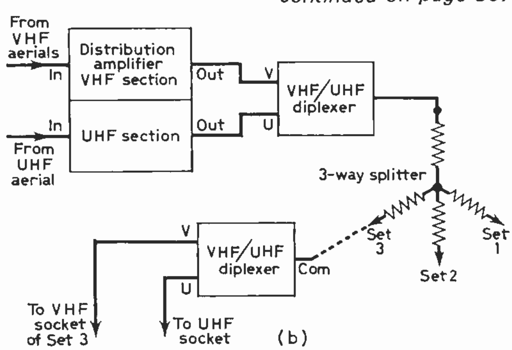




*Fig. 8: (a)-left-Recommended way of feeding three receivers with v.h.f. and u.h.f. signals. (b)-above-Alternative method.*

# fault finding FOCUS

## PART 5
## SOUND I.F. STAGES

**BY S.GEORGE**

IN contrast to vision i.f. circuitry the sound i.f. circuits of the typical dual-standard model seem simple inasmuch as there are no wave-traps, only very simple change-over switching and a straightforward a.g.c. system. However, while the v.h.f. sound i.f. is either tapped from the anode circuit of the common sound-and-vision i.f. amplifier or taken directly from the tuner output, the u.h.f. sound is handled together with the vision signal right through the u.h.f. i.f. circuit to the vision detector or more often to the video amplifier. Therefore while the sound i.f. circuits in one sense commence from these take-off points, the u.h.f. sound system really embraces the entire u.h.f. i.f. strip and in fact quite a proportion of the vision i.f. circuitry is devoted to the special requirements of the u.h.f. f.m. sound.

The v.h.f. sound system is quite straightforward, but before outlining the u.h.f. intercarrier system it is worthwhile outlining the reasons for its employment. First and most important, the use of the intercarrier system nullifies frequency drift in the receiver's local oscillator. With f.m. sound it is vital that the no-signal frequency presented to the detector stays on its allotted spot. No matter how carefully the u.h.f. tuner is designed and in spite of the inclusion of capacitors with negative and positive temperature coefficients to offset temperature changes some degree of oscillator drift is unavoidable and at u.h.f. even a very small percentage can amount to an appreciable frequency shift. Assuming a maximum shift of 100kc/s, although this would scarcely be evident on the Test Card, it could tune the sound carrier right off its "step" on the overall response curve and on to the sloping flanks to produce gross amplitude modulation as the ± 50kc/s deviations swung the carrier up and down. With the normal v.h.f. sound system, drift in the oscillator can be maintained within the bandwidth of the i.f. circuit while the a.m. detector does not require the input frequency stability of the f.m. detector. However, by employing the intercarrier system on u.h.f. local oscillator drift produces no effect on the 6Mc/s difference between the vision and sound carriers, crystal controlled at the transmitter. Reduced to essentials, therefore, the intercarrier system can be viewed as a type of double-superhet circuit with the vision signal functioning as the second local oscillator and the vision detector as the second mixer stage.

The u.h.f. tuner produces sound and vision i.f.s of 33·5Mc/s and 39·5Mc/s respectively which, after being jointly passed through the i.f. strip, produce the usual plus and minus beats at the vision detector diode since this, being a non-linear device, functions as a simple type of frequency-changer. In practice the minus beat is used and abstracted by a tuned circuit inductively or capacitively coupled to the detector output, or alternatively from the anode circuit of the video amplifier so that this stage provides some amplification of the resultant 6Mc/s sound signal. Irrespective then of tuner oscillator drift, the beat remains constant at 6Mc/s thus presenting the f.m. detector with a constant no-signal frequency.

Of course the fact that the predetector sound i.f. is handled with the vision i.f. introduces problems. The most important point is that precautions must be taken to ensure that the higher amplitude vision signal does not impress the video waveform on the sound i.f. due to cross-modulation in the i.f. stages. Secondly, as the amplitude of any beat frequency produced by a diode or frequency-changer cannot exceed the value of the weakest fundamental, and as the intercarrier local oscillator signal is not a sinewave as in normal mixer stages but an a.m. signal modulated to a high degree, the value of the latter at minimum instantaneous amplitudes must swamp the former to prevent impressing the video modulation on the f.m. carrier. Fortunately both snags can be avoided by keeping the sound i.f. at between 20 to 30dB down with respect to the vision i.f.

This immediately leads to the first major difference between the v.h.f. and u.h.f. sound circuitry. In the former, the sound i.f. must be totally prevented from reaching the video stage to avoid sound-on-vision, this being done by means of a stopper wavetrap, but on u.h.f. the sound i.f. must pass through the vision i.f. circuits but at the previously mentioned vision-to-sound signal ratio. All designs therefore include a u.h.f. co-sound wavetrap early in the circuit to depress or attenuate the signal to the required level.

In many Pye/Ekco/Ferranti models this wavetrap takes the form of an acceptor circuit shunted directly across the tuner output to immediately depress the co-sound i.f. to the desired value (Fig.

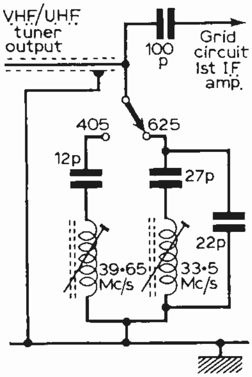



*Fig. 16 (left): U.H.F. co-sound rejector at 33·5 Mc/s and v.h.f. adjacent channel vision rejector at 39·65 Mc/s switched across the tuner output in many Pye/Ekco dual-standard models. The u.h.f. co-sound rejector is an attenuator rather than a stopper.*

*Fig. 18 (right): First sound i.f. amplifier/limiter stage in most Thorn dual-standard receivers. Limiting is achieved by lowering the screen voltage, removing the a.g.c. and allowing the valve to develop grid circuit auto-bias.*

16). In the Thorn 900 series this attenuating principle is taken a step further, a 500Ω potentiometer connected as a rheostat in series with one of the wavetrap tuning capacitors enabling the optimum degree of attenuation to be obtained compatible with adequate sound signal strength with complete freedom from cross-modulation.

Irrespective of their position in the circuit the effect of such wavetraps is clearly evident in the overall response curves of receivers on u.h.f. Fig. 17 shows the overall 625 response curve of the KB Models WV20 and WV70 and it will be seen that the response at the 33·5Mc/s co-sound i.f. is 35dB down with respect to the peak vision response and 29dB down with reference to the nominal vision i.f. of 39·5Mc/s.

U.H.F. sound being f.m., the trough at 33·5Mc/s also serves another and very important purpose, and that is to provide a reasonably flat step wide enough to accommodate the ±50kc/s deviations of the carrier without producing amplitude modulation as the a.f. signal shifts the carrier frequency each side of the quiescent frequency. Without the wavetrap if an f.m. signal was tuned to a point on the sloping flank of a receiver's response curve it would result in increasing amplitude as its frequency approached that of the response curve's peak and decrease in amplitude as it moved away. This would clearly be intolerable so the step should present as level a response as possible to the deviations of the f.m. signal.

Despite the greatest care in design, however,

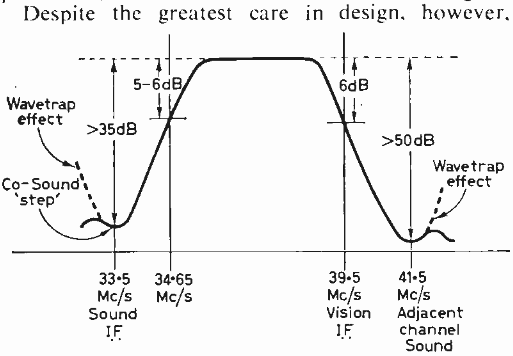
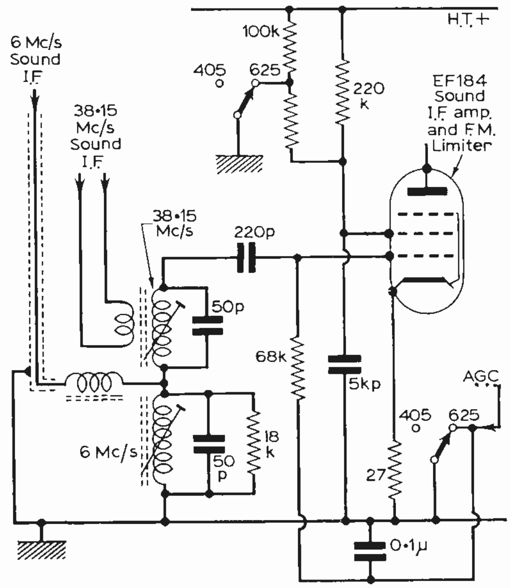



*Fig. 17: Overall 625 vision i.f. response of the K-B Model WV20. Note effect of wavetraps and stagger tuning to greatly reduce the co-sound response at 33·5 Mc/s and virtually eliminate adjacent channel sound at 41·5 Mc/s. Co-sound must be kept at a low level to prevent cross-modulation.*

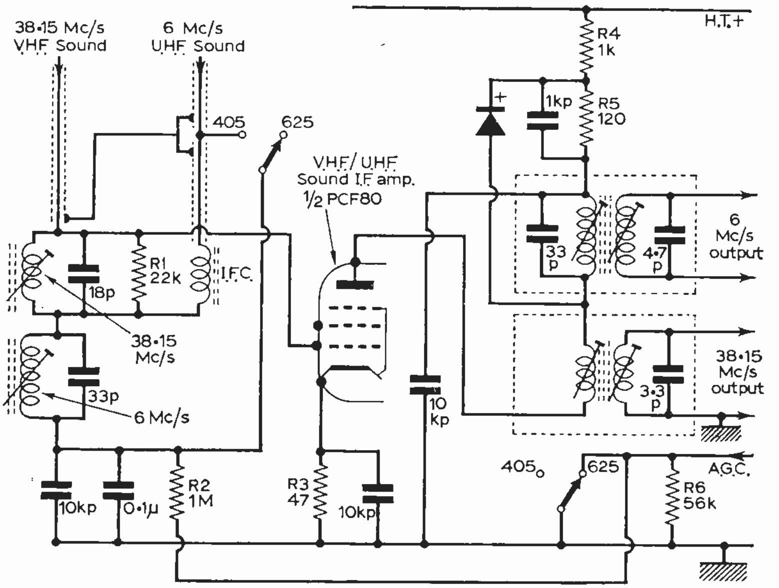



the simultaneous handling of the comparatively high-amplitude vision i.f. with the f.m. sound i.f. signal, plus the fact that this a.m. vision signal functions as the "local oscillator" in the vision detector circuit, means that it is difficult to ensure that the f.m. sound signal is completely free of amplitude modulation. Fortunately both types of f.m. detector generally used, the ratio detector and the locked-oscillator (quadrature grid) detector, have an inherent amplitude limiting characteristic, but to extend the range of operation and to remove ignition and other a.m. interference it is common practice to arrange for one of the sound i.f. amplifiers to act as an amplitude limiter. Failure to completely remove amplitude modulation of the f.m. sound signal at video frequencies results in the characteristic "vision buzz" which is impossible to tune out.

In receivers employing two sound i.f. amplifiers the first or second stage may be used as the limiter. The first is the stage to which a.g.c. is applied on v.h.f. and on system change to u.h.f. the a.g.c. feed must be removed. The limiting action is achieved by lowering the screen grid voltage by switching in an extra series or shunt feed resistor. For example, in the Thorn 950 series (see Fig. 18) the screen voltage to the EF184 sound i.f. pentode is 62V on v.h.f. but only 31V on u.h.f. while in the Decca DR121 series the screen voltage to the EF80 sound amplifier/limiter is reduced from 110V on v.h.f. to only 35V on u.h.f., in both these instances voltage reduction being achieved by switching in a shunt resistor from the screen grid to chassis. The effect of this screen voltage reduction is to give the valve a short grid-base: that is, the voltage required to drive the valve from anode current cut-off to saturation point is greatly reduced.

Two further circuit points to note are that (a) the standing bias will be only that developed across the very low-value cathode resistor—

*Fig. 19 (right): Sound i.f. amplifier stage with diode f.m. limiter as used in many Pye/Ekco dual-standard models. Limiting is accomplished by the diode acting with R5 as a variable load across the sound i.f. transformer primary.*




averaging 27Ω instead of the usual 100-150Ω—and (b) that the signal input is capacitively fed to the valve grid. This means that when fed with a signal whose positive half-cycles exceed the standing bias a negative voltage will be developed across the valve's grid leak resistor. This voltage, sometimes called self-bias or auto-bias to distinguish it from that produced by a resistor in the cathode lead, is of course the bias technique used for the local oscillator in frequency changer stages, in sync separators and with line output pentodes. The bias varies with the amplitude of the grid input, increasing signal strength increasing the negative bias with the net result that all inputs exceeding a minimum value just run the valve into grid current at peak positive values, producing outputs of fairly constant amplitude. In effect, therefore, the f.m. signal is skimmed of amplitude variations exceeding a value determined by the constants of the valve's grid circuit and the restricted working characteristics of the valve imposed by the reduced screen grid voltage.

Reducing the screen grid voltage naturally reduces the stage gain on u.h.f., but not to any material extent in view of the overall gain of the sound path from tuner to output stage.

While most makes of receiver employ a sound i.f. valve in the dual role of amplifier and limiter, a number of Pye/Ekco and Philips group models use a miniature diode to provide the main limiting action by acting as a shunt of varying value across the primary winding of the u.h.f. sound i.f. transformer. Fig. 19 shows the arrangement as found in the Pye/Ekco models, and it will be seen that additional to the 1kΩ anode decoupling resistor there is a 120Ω resistor in series with the anode feed and that the diode is shunted across the latter resistor and the i.f. transformer primary. The voltage developed across this small resistor plus the very small d.c. voltage drop across the transformer primary winding is therefore applied as forward bias to the diode which then loads the transformer's effective impedance to the signal. At low-signal levels this loading is slight but due to the diode's non-linearity (especially at low-voltage applications) rises rapidly when increases in signal amplitude produce large negative-going voltage excursions at the valve anode to thus simultaneously increase the diode's forward resistance. As with valve limiters, therefore, a skimming effect develops.

In transistorised i.f. circuits usually the second stage is arranged as the limiter as the high level of signal assists clipping action which is generally accomplished, as with valves, by restricting the operating range.

Of course not every dual-standard model employs an amplitude limiter, adequate limiting being effected by the f.m. detector employed.

The input to the first sound i.f. stage is switched between the v.h.f. tuner output or common i.f. amplifier anode and the abstraction coil in the 625 detector or video circuit, no interstage switching of the type required in the vision receiver strip being needed. The reason lies with the frequencies and bandwidths involved. On v.h.f. the vision i.f. centres on 34·65Mc/s with a bandwidth of 3Mc/s while on u.h.f. it is centred on 39·5Mc/s with a bandwidth of 5·5Mc/s, with quite different response curve requirements on both systems. Clearly there must be some switching in and out of extra tuning capacitors and wavetraps to suit these factors. However, the v.h.f. sound i.f. of 38·15Mc/s is so far removed from the 6Mc/s u.h.f. intercarrier i.f. that the i.f. transformers can simply be series connected, for on either system negligible signal will be developed across the i.f. transformer of the opposite system.

The switching at the post-detector end of the i.f. circuit is merely to transfer the u.h.f. or v.h.f. outputs to the grid of the triode a.f. amplifier or pentode output stage. Where a ratio detector is employed the a.f. circuit usually comprises a triode-pentode of the PCL86 type, but where the EH90 locked-oscillator detector is used its very high output is sufficient to directly feed the pentode without the need for a voltage-amplifying triode. On v.h.f. the EH90 is arranged to function as an a.f. amplifier in place of the triode to boost the signal level, so that there is no need for a separate a.f. amplifier.

The action of both the EH90 and ratio detectors have been previously covered in past issues, but we cannot leave the subject of sound i.f.

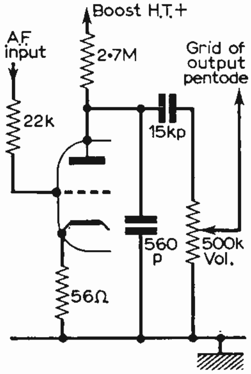
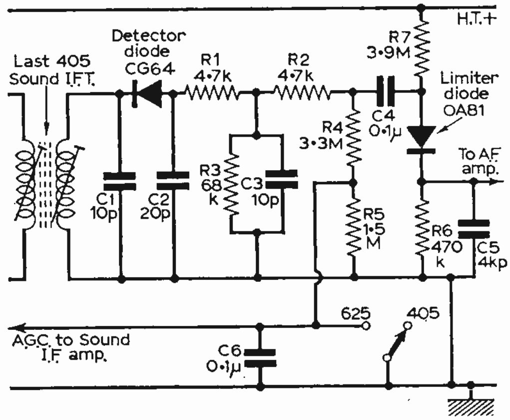



*Fig. 20 (left): Basic Philips a.f. amplifier/noise limiter circuit. Limiting occurs because of the long time-constant of the anode load resistor and 560pF capacitor to chassis, preventing the anode voltage following the noise pulse.*

*Fig. 21 (right): Diode 405 sound detector followed by "biased-diode" noise limiter circuit as used in most Thorn dual-standard models. Long time-constant of R6. C5 cuts off the limiter diode during noise pulses.*




circuitry without emphasising that the v.h.f. bandwidth is greatly in excess of that required for good a.f. reproduction. This is necessary not only to accommodate drift but also to ensure that the a.m. interference or noise limiter can operate satisfactorily. Typical bandwidths are around 200kc/s instead of the customary 10kc/s bandwidth of radio i.f. circuits, requiring a $Q$ of $(38\times10^6)/(200\times10^3)$ or 190. This is achieved without resistive loading by the $L/Cr$ ratio of the tuned circuits or transformers, and in fact it would be extremely difficult to produce a $Q$ high enough at 38Mc/s to give a narrow bandwidth.

Now because noise limiters are always built-in to the circuit and do not have a means of adjusting the clipping level as is provided in the case of vision noise limiters it is not generally realised how intolerable reception would be without them. For a demonstration, short out the noise-limiting circuit with a capacitor from detector to a.f. valve grid and note how obtrusive ignition interference can be. Unlike vision noise limiters, which are basically amplitude clippers, sound noise suppressors operate on the rate-of-change principle. The reason for the different approaches lies in the differing range and character of sound and vision frequencies. The a.f. waveform varies relatively slowly as compared to the video waveform, since the latter contains very many sudden and wide changes in amplitude at the outlines of objects and over fine detail. If an amplitude limiter was used on sound it would have two main disadvantages: (a) it would only clip the peaks of the noise pulses, and (b) it would similarly clip high-amplitude signal peaks if set for effective operation. The amplitude limiter is clearly inferior, but the rate-of-change limiter could not be used on vision because apart from design difficulties and capacitive loading it would round off the leading edge of all rapid vision signal changes.

Ignition interference, the main source of TV outside noise, takes the form of a series of high amplitude but short duration pulses, and for the rate-of-change limiter to work effectively their steep-fronted shape must be preserved. As such transients incorporate many frequencies, this requirement demands a wide bandwidth, so apart from all other considerations the sound i.f. circuits must have a response wide enough to maintain the noise pulse shape right up to the actual limiter.

Such limiters can be of two types though both work on the same principle. There is the conventional biased-diode circuit or the Philips system in which the time-constant of the triode a.f. amplifier circuit determines the clipping action.

Let us take the Philips system first since it most easily leads to an appreciation of the other system. This is shown in Fig. 20. Normally the anode load resistor of a triode a.f. amplifier is in the region of 100 to 300kΩ, but in the Philips models it is about 2·7MΩ and to prevent the heavy voltage drop reducing the anode voltage below a satisfactory figure the valve is fed from the boost h.t. rail. A 560pF capacitor is connected from the valve anode to chassis. When the grid voltage suddenly changes on the arrival of a noise pulse the anode voltage cannot instantaneously follow due to the comparatively long time constant of this $R_LC_a$ combination. In fact before the anode voltage can significantly change the 8μS noise pulse has passed and anode voltage continues to follow the relatively slowly changing audio waveform.

With the biased-diode system the negative-going output from the detector diode is capacitively fed to the anode of the limiter diode which is held conducting by a small forward bias via a high-value resistor from the h.t. rail, see Fig. 21. A $CR$ combination of long time-constant connects the diode's cathode to chassis while a further capacitor feeds the grid of the a.f. valve from this point. Normally therefore the a.f. signal conducts across the limiter diode with the anode and cathode resistors of the diode providing a small forward voltage drop across it. On arrival of a noise pulse, however, the sudden negative-going voltage instantaneously lowers the diode anode voltage below that of the cathode and conduction ceases till the potential across the time-constant capacitor can leak away through the shunting resistor to a lower value. As with the Philips system before the cathode voltage can drop sufficiently to permit effective diode conductance the pulse has passed and the capacitor recharges to its prior value.

In both cases therefore the limiting action depends on the time-constant of the circuit. Of course this limiting or attenuation of high-frequency signals in the form of rapidly changing noise pulses is exactly analagous to the attenuation of higher video frequencies across a video load resistor when the stray capacitance is unable to charge and discharge quickly enough across the load resistor. To improve gain at higher frequencies with a fixed value of stray capacitance requires that the load resistor, and therefore the time-constant of the video circuit, be reduced.

The sound i.f. circuits give little trouble in practice, with intermittent, weak, noisy or complete failure to operate generally being caused by defective valves. The miniature diodes used seldom give trouble today.

Probably the two most common complaints are "vision buzz" on 625, which really amounts to the video waveform being impressed to some extent on the f.m. signal, and vision-on-sound on 405 which is the intrusion of vision i.f. into the sound i.f. channel. These are similar effects but spring from different causes, and whereas it may be possible to greatly minimise the latter by mistuning the fine tuner from optimum vision resolution, on 625 it is generally impossible to alleviate the condition in this manner. V.H.F. vision-on-sound is most commonly caused in modern high-gain receivers by an over-advanced preset sensitivity control which, by raising the delay voltage at which a.g.c. is applied to the r.f. amplifier, leads to cross-modulation in this stage. In 90% of cases reducing the control setting will remove the effect, but if the fault persists at low gain and the fine tuner is correctly set it would appear that some realignment is required.

The extent of such realignment will depend on Test Card assessment of vision resolution, but before embarking on a major readjustment check that the symptoms are not caused by component or valve defects which can simulate actual trimmer maladjustment—see "Component Caused Alignment Faults" in the April 1966 issue and "Trimming by Test Card" in the May 1966 issue.

U.H.F. vision buzz, unless curable by the detector a.m. balance control, is usually traceable to the 33·5Mc/s sound being over favoured in the i.f. circuits and thus lowering the vision/sound ratio to less than the permitted dB difference. It should always be borne in mind, however, that local reception conditions, bad aerial siting or the use of an incorrect channel aerial can seriously affect the vision/sound signal input ratio and thus alter the receiver's overall response.

If it appears that some alignment is necessary to cure the fault it must not be attempted without the full equipment advised by the manufacturers, and the recommended alignment procedure must be followed since the u.h.f. i.f. strip covers both vision and sound, and adjustment is extremely critical. However, in minor instances of vision buzz it may be permissible to adjust the co-sound rejector on Test Card for optimum setting, but no other core should be altered and a double check from the service manual should be made to ensure that this one slug has been correctly located before the adjustment is made.

**TO BE CONTINUED**

# AERIAL DISTRIBUTION SYSTEM

*—continued from page 562*

mains earth. Connect the earth lead direct to the chassis of the amplifier (which will be positive). Do not try to use both pnp and npn transistors as they are incompatible in this design. Using silicon npn transistors it should be possible to run a slightly larger number of receivers from each section of the amplifier.

The u.h.f. section will amplify colour television signals very well as the bandwidth is quite sufficient for this. When more than one channel becomes available from each u.h.f. transmitter stagger tuning of C4 and C8 may be necessary to achieve the required bandwidth.

As certain components used in the design may be difficult to obtain, a list of suppliers' addresses follows:

Henry's Radio Ltd., 303 Edgware Road, London, W.2.

Cole Electronics Ltd., Lansdowne Road, Croydon. CR9 2HB (Siemens U.K. Agents.) (For AFY42, AF239 and BF110.)

Texas Instruments Ltd., 12 Wellcroft Road, Slough, Bucks. (For BYF51, 1N4001, 1S100 and 1S2110A.)

# *Book Review*

Beginner's Guide to Transistors.
By J. A. Reddihough. Published by The Hamlyn Group. 160 pages. Price 15s.

This text sets out in plain language that can easily be understood by the newcomer to transistor circuitry what transistors are and what they do.

The reader is first introduced to semiconductor devices, then the different types of transistors and associated devices are explained to him. Next transistor characteristics and basic transistor circuits are discussed and reference is made to transistor audio and radio frequency techniques. Also there is a section on transistors in TV receivers with some circuit examples being given.

Power supply circuits and integrated circuits are covered and a chapter is included which explains and demonstrates the applications of transistors in different types of electronic circuits. There is finally a really valuable and well-written chapter which deals with the servicing of transistor equipment.

The author has, I think, succeeded in producing a book that introduces the younger reader who intends to make a career in electronics, as well as the layman of any age who just takes an interest in the subject, to the numerous basic techniques used in the field of electronic engineering at the present time.

Non-mathematical treatment is the keynote of this book; however, a few very simple formulae are given where important relationships are indicated.

All in all, this book is yet another of those texts which, once you have bought a copy, you will wonder how you ever managed without!—*C.R.R.*

# UNDERNEATH THE DIPOLE

THE number of international conferences, conventions and courses has increased rapidly during the last two or three years for both television and films. The rapid world development of colour television, which also includes colour film as well as colour v.t.r., has speeded up the exchange of information between Britain, USA and Europe. It has led to British universities, technical colleges and schools expanding their facilities and attention to electronics. Educational events have moved so fast that the *National Film School* has become just another expensive joke.

Elsewhere down-to-earth practical and advanced theoretical courses are in operation. The Plymouth College of Technology is a good example of the right approach. Courses include full-time, sandwich and part-time ones, block release and teachers' courses. The last-named courses were evolved especially as an introduction to teachers on all subjects in the use of closed-circuit television in their own schools, colleges and universities. This fringe-type of course enables them to acquire an intimate knowledge of the proper use of audio-visual aids, whether from TV cameras, telecine films, slides, v.t.r. or other sources in class or lecture rooms, and the methods of distribution on single or multiple monitors or screens.

The Plymouth College of Technology's electronic courses are planned by Bernard Webster (Head of Electrical Engineering Department) who is also Chairman of the National Educational Closed-Circuit Television Association's Technical Committee, which meets from time to time in London. A few weeks ago Mr. Webster instituted a two-week special colour television course for top technical executives from all the ITV programme contractors, an event which just about places this university in the lead. Let us hope that he can find a way of standardising on a type of helical-scan video tape which will be compatible and available to all similar establishments in the UK. There are at present 23 different helical-scan v.t.r. standards used in educational institutions in the United Kingdom, compared with 27 in the USA. In both countries there is a trend to make use of a transfer from video tape to 16mm. film for interchange of lectures between institutions.

The annual conventions of the technical societies in various parts of the world have been comparatively parochial for many years. S.M.P.T.E.'s annual convention in Hollywood has been in existence for many years and is now moved, only a mile or so away, to Los Angeles, and added to by conventions in Chicago, Washington and New York. As previously mentioned in these columns the impact of television has increased the importance of the New York conference. Here The Royal Television Society jointly with other Societies promoted the International Broadcasting Convention last year. This will be repeated in London in September, followed by the Photokina exhibition in Cologne, long established as the most important photographic showcase in Europe.

Then there is the B.K.S.T.S. *FILM '69* convention which will be an international affair concentrating on films for cinemas, television, advertising and education. This will be in June 1969. The Royal Lancaster Hotel is being completely devoted to this.

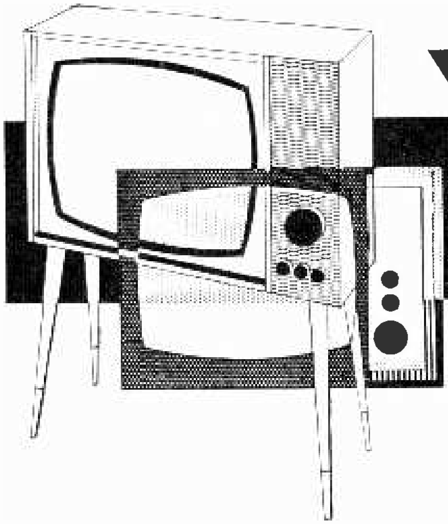
Then there are several five-day foreign conferences dealing with historic films, advertising films and TV clips, Montreux's Golden Rose, etc. The Cinematograph Exhibitors Association (C.E.A.) recently had one in Edinburgh.

## BUILDING COSTS

The increasing capital cost of building cinemas was discussed at the recent conference of the C.E.A. at Edinburgh at which an architect said that the capital cost per seat had risen from about £100 to £190. The same calculations applied to the new live theatre proposed by the Arts Council at a cost of £4 million will probably work out at about £3,000 per seat, the same as the Queen Elizabeth Hall, London, but less than the £4,000 per seat which the proposed National Theatre, London, is likely to cost.

It is interesting to compare the probable costs of the colour television and film studios now being erected in Britain—and there are several new ones in hand and partly in operation. These are far more complex than the national live theatres yet will cost less or give better value for money. In television the days of adaptations and conversions are over; purpose-built premises are considered to be the correct and proper thing whatever the cost may be. The high costs, however, have to be justified by a professional approach. The new stages now being built (and already partly completed) in Leeds by Yorkshire Television at a final cost of £5 million will represent full value for money, artistically and technically. The same will apply to the Thames TV Organisation's studios in the centre of London, near Euston and not far off Fleet Street, which will make available in late 1969 the additional space necessary to add to their facilities at Teddington, a first-class conversion from film studios. This is what happened at Boreham Wood when they bought the old four-stage British National Film Studio with its five stages varying in area from stage B (1,500 sq. ft.) to stage E (13,440 sq. ft.). The two smallest stages were demolished, one of them being the first purpose-built "dark" film studio in England—quite a historic relic. It replaced the all-glasshouse type film studios which, before 1914, used daylight as the principal light source. Other new purpose-built studios are under consideration by Scottish Television and Tyne Tees, and Southern Television is already well advanced with new stages at Southampton to replace the one rebuilt from the Plaza Cinema. There is now no need to dash around Europe to see the world's best television studios. They're all here!

Iconos



# Your Problems Solved

*Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 572 must be attached to all Queries, and a stamped and addressed envelope must be enclosed*

### *ULTRA 6624*

**About a month ago, the symptom of reduced width, about 3in. on each side with vertical stretching, but good field linearity appeared. This was accompanied by a drop in boost volts to about 300V.**

**After having changed all the valves and many of the small components the fault persisted.**

**I decided to turn my attention to a possible loss of boost in the field stages, commencing with the replacement of the PCL85. Immediately on replacement of this valve, the boost returned to 650V but there was still some reduction in width which necessitated a new PL36.**

**On this showing, the fault was caused by a faulty PL36 and PCL85. The set then ran perfectly for a month when two days ago the original fault reappeared. The PL36 and PCL85 (both being needed) were again changed and the set returned to normal. The first replacement valves (PL36 and PCL85) showed up OK on a tester, also I was able to test the PL36 on a Ferguson receiver and it gave adequate width. I have not been able to test the PCL85 similarly though.**

**Assuming it unlikely that both first replacement valves developed faults, it seemed to me that something was running these valves down although, as I have said, they both gave good emission on tests and I am more than half expecting the fault to reappear in a month's time.**

**I should mention that the cathode volts on the PCL85 were within two volts of those stated in the circuit and bottom linearity was good.—G. Doubtfire (Stanmore, Middlesex).**

We cannot reconcile the lost boost potential to the field timebase, unless, of couse, the field oscillator—being energised from the boost line—tends to take excessive current for some reason. This could put an extra load on the line output and thus result in two valve changes. In this event, check the boost feed to the generator and the feed resistors and decoupling capacitors. The field valve may be over-run. Check that the mains tapping suits the local mains voltage.

### *K-B WV60*

**The sound is distorted on BBC-1, ITV and BBC-2. I can only describe it as being harsh and clipped.**

**I have changed 6BW7 (2) PCL86. The PCL86 grows very hot and the resistor to pin 7 so I changed it but this component appears to alter the height, it being connected through a capacitor to the height control.**

**Also, on BBC-2, although there is a very good picture, now and again the picture rolls up to the top of the screen. Would this be due to a faulty PCL84 valve?—J. Carey (Monmouthshire, Wales).**

Since sound is bad on all channels, its cause probably lies in the a.f. stages. Check the coupling capacitor on the control grid of the sound output valve. This could be electrically leaky. Also, if necessary, check the resistor on the anode of the sound interference limiter diode. This going high value could have a similar effect. The slightly different effect on BBC-2 could be caused by poor intercarrier sound channel alignment or unbalance in the f.m. detector circuit. The rolling BBC-2 should lead to a check of the signal strength. Try to get more signal from the aerial by re-orientation.

### *PYE 17S*

**The sound is OK all the time and the picture is good for about two minutes. After this time, it goes completely blank and the line whistle disappears.**

**All the valves are alight except the EY86 when this occurs.—J. Alvey (Bordon, Hampshire).**

We advise you to check the line output transformer and its associated components. The deflector coils can also produce the symptoms you have described, but if this is the case, disconnecting them will produce a very loud coarse whistle.

Before replacing any of the expensive components, we would advise you to try replacing the PL81 and PCF80 valves as an initial move.

### *FERGUSON 306T*

**The picture and sound on BBC-1 are perfect, but on ITV sound and picture are absent. I have changed both the valves in the tuner unit and have purchased a new set of biscuits for ITV but no improvement has been noted.**

**I have touched no other components in the tuner unit.—C. Riseborough (Wymondham, Norfolk).**

Of course, this fault could be caused by lack of Band 3 aerial signal or a poor aerial system. If the set has never worked on ITV at your location, then make sure that the aerial system is in order before delving too deeply into the set itself. However, if the aerial is fault-free, the trouble must lie in the tuner. It is possible that the frequency changer valve fails to oscillate on Band 3 due to alteration in value of a resistor or capacitor associated with it. You should also make sure that the coil set is suitable for your local Band 3 channel.

### *ULTRA VP1772*

**This set has wide spacing between lines (vertically) at the top of the picture, narrowing gradually to close spacing at the bottom of the picture. The picture is thus distorted with characters on the screen having long heads and short bodies. Picture height and width remain normal.—K. Holliday (Basildon, Essex).**

This is the symptom of field non-linearity and is normally corrected by careful adjustment to the vertical linearity preset in conjunction with the height control, using a test card. You do not say in your letter how these controls affect the distortion. If, for instance, the linearity preset is at range-end, a component connected in the linearity feedback loop could well have altered in value. Another cause is low emission of the field output valve. Check also the capacitor on the control grid of the field valve for insulation resistance.

### *BUSH TV135RU*

**During the first half-an-hour after switching on, although the picture does not alter, the sound practically disappears intermittently. It can be restored by either turning the volume to full and back or by switching the 405/625 switch in and out.**

**After about half-an-hour, it settles down and gives no more trouble for the remainder of the evening's viewing.**

**Although the picture is strong, I have trouble in stabilising the picture vertically. This is accompanied by a column of fine white horizontal lines about an inch long.—R. Williams (Hove, Sussex).**

Since the volume control effects the condition, the defect must be in the circuit after the control. Check the seating of the PCL82 audio-output valve. Then check the soldered connections associated with this valve PCL82 (3V7) and the two 0·047$\mu$F coupling capacitors. Check the interlace diode 3MR3 if the associated components appear to be in order.

### *DECCA DR202*

**The 405-line stations are normal in every respect, but the 625-line BBC-2 has reduced width 2in. either side.**

**I note from a service sheet I have that there is an auxiliary line output transformer winding for 625 operation. Could this winding have shorted turns?—A. Phillips (Swansea, South Wales).**

While the boost voltage control should not be used to adjust the width of the picture, it is possible that this is incorrectly set, anyway, and this would give unbalance as mentioned. This should be adjusted for an e.h.t. not exceeding 16kV (boost line of about 500V).

### *PYE V430A*

**On switching on, I get a good picture and good sound on both channels. After the set has warmed up, however, upon switching from BBC-1 to ITV, there is only slight sound and raster. When switched back to BBC-1, the picture is back to normal.—J. Williams (Greenwich, London).**

The symptoms you describe suggest a faulty r.f. amplifier stage or defective tuner contacts. You could try cleaning these with solvent such as white spirit and also make sure that the 6BA nut which retains the whole rotor assembly is tight.

### *BUSH TV56*

**There is a heavy line whistle with no aerial connected. With the aerial connected there is a kind of loud hiss that distorts the sound and the picture appears to have "rain" interference.**

**The sound distortion can be tuned out slightly on the fine tuner, but there is a resulting loss of volume. All the valves have been replaced with new ones.—T. Hatton (Oxfordshire).**

Check the right side section on top of the transformer and to the side of the tube for signs of discharge. Remake connections where necessary.

### *PHILIPS 19TG111A*

**The picture has completely disappeared and the sound is only just audible when fully turned on. There is no raster present.**

**About one week previous to this, I had trouble in the shape of a thin white line across the middle of the screen and I fitted a new PCL85, making the set work perfectly.—C. Taylor (Ravenshead, Nottinghamshire).**

From your description, it seems as though the line timebase has failed this time. Listen for the line whistle with the aerial removed from the set and while the line hold control is adjusted over its range. If a slight trace of whistle is present, the trouble lies in the line output stage, and if the line output valve (and booster diode) is running very hot, shorted turns in the line output transformer could be responsible. If there is no line whistle, the oscillator may have failed, and checks should then be made in that circuit.

### *GEC BT302*

**The top of the picture seems to overlap and cramp but the bottom is stretched. I have renewed the 30P12 with no better results.—D. Moran (Sale, Cheshire).**

Top cramping signifies trouble somewhere in the feedback linearising loop of the field output stage. This goes through the linearity preset, and if you are sure that this control, worked in conjunction with the height control, will not correct the effect, then check the value of the components in this loop, connected to the preset circuit.

### *ALBA 988T*

**The e.h.t. transformer failed and was re-wound and re-fitted correctly with new capacitors and resistors. The result was a 9in. picture on a 23in. screen.**

**All wiring has been checked and valves PY32, PL81, PY81 and EY86 renewed. Voltages seem O.K. but low on pins 3 and 4 of the tube.—C. Connell (London, N.19).**

Check the h.t. voltage. Smoothed, this should be 185V. If this is low, check the 5$\mu$F electrolytic capacitor in the pin 9 circuit of the PY81.

Check the 0.25$\mu$F boost capacitor and revise the line output transformer connections if necessary.

### *ULTRA V1770*

**The BBC-1 channel is perfect both in sound and vision but the ITV Channel 8 has a wavy picture and normal use of the controls does not rectify this fault.**

**The picture on both BBC and ITV is inclined to roll after approximately one hour of use.**

**Also, can a u.h.f. tuner be fitted to this model with any success?—E. Ward (Innsworth, Gloucester).**

Your aim should be to improve the overall gain of the receiver and to improve also the ITV receiving aerial. As a first step we would suggest that you replace the PCC84 valve on the tuner unit.

The rolling could be due to a weak 30PL13 valve (inverted upper right) or an associated component.

A u.h.f. tuner cannot be fitted to this type of receiver.

## QUERIES COUPON

This coupon is available until SEPTEMBER 20, 1968, and must accompany all Queries sent in accordance with the notice on page 569

PRACTICAL TELEVISION, SEPTEMBER 1968

# TEST CASE -70

*Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.*

*? A GEC Model BT302 suffered from the symptom of over-contrast and although the contrast control had little effect on the picture it appeared not to reduce the gain of the vision channel sufficiently to allow the display of a picture of normal contrast ratio.*

*This model has the conventional vision a.g.c. system with the contrast control reflecting a positive potential on to the a.g.c. line as a means of countering the a.g.c. bias and thus increasing the gain of the controlled stages. However, even with the control at minimum setting a positive voltage could be measured at certain points on the a.g.c. line.*

*The various feeds to the a.g.c. line were removed in turn while the line voltage was being measured, and it was found that the positive voltage collapsed when the a.g.c. feed to the tuner was disconnected.*

*What was the most likely cause of this effect? See next month's* PRACTICAL TELEVISION *for the solution to this problem and for a further item in the Test Case series.*

## *SOLUTION TO TEST CASE 69*
## *Page 525 (last month)*

The field oscillator in the HMV Model 1890 is powered from the boosted h.t. supply via the height control, and the symptoms mentioned last month gave the impression that the oscillator was starved of voltage at the height control feed.

Subsequent test of the boosted line voltage showed that this was down to about 300V against the service sheet value of about 600V. The voltage was the same value across the boost reservoir capacitor (0·01$\mu$F) and even with the field supply feed disconnected the voltage was the same.

The reservoir capacitor was disconnected and a test indicated that a slight electrical leak existed across it. Replacement brought back the correct 600V boost and also the full vertical scan amplitude.

A curious factor about this fault was that it had no apparent effect on the performance of the line timebase, which is worth bearing in mind.

Published on or about the 22nd of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2, at the recommended maximum price shown on the cover. Printed in England by Fleetway Printers, 17 Sumner Street, London, S.E.1. Sole Agents for Australia and New Zealand: Gordon & Gotch (A/sia) Ltd. Subscription rate including postage for one year: To any part of the World £1 15s.

## SITUATIONS VACANT

**RADIO AND TV** Exams and Courses by Britain's finest home study School. Coaching for Brit.I.R.E., City and Guilds Amateur's Licence, R.T.E.B., P.M.G. Certificate etc. Free brochure from British National Radio School, Russell Street, Reading.

**ENGINEERS. A TECHNICAL CERTIFICATE** or qualification will bring you security and much better pay. Elem. and adv. private postal courses for C. Eng., A.M.I.E.R.E., A.M.S.E. (Mech. & Elec.). City & Guilds, A.M.I.M.I., A.I.O.B., and G.C.E. Exams. Diploma courses in all branches of Engineering—Mech., Elec., Auto, Electronics, Radio, Computers, Draughts, Buildings, etc. For full details write for FREE 132 page guide: BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, (Dept. 171K), Aldermaston Court, Aldermaston, Berks.

## TECHNICAL TRAINING

CITY & GUILDS (electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, TV, automation, etc., send for 132-page handbook—FREE. B.I.E.T. (Dept. 173K), Aldermaston Court, Aldermaston, Berks.

## EDUCATIONAL

**TV and RADIO.** A.M.I.E.R.E., City & Guilds, R.T.E.B., Certs., etc. on "Satisfaction or Refund of Fee" terms. Thousands of passes. For full details of exams and home training courses (including practical equipment) in all branches of Radio, TV, Electronics, etc., write for 132-page Handbook—FREE. Please state subject. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 172K), Aldermaston Court, Aldermaston, Berks.

**BECOME** "Technically Qualified" in your spare time, guaranteed diploma and exam. home-study courses in radio, TV servicing and maintenance. T.T.E.B. City and Guilds, etc., highly informative 120-page Guide—FREE. CHAMBERS COLLEGE (Dept.858K). 148 Holborn, London, E.C.1.

**TRAIN FOR SUCCESS WITH ICS**

Study at home for a progressive post in Radio, TV and Electronics. Expert tuition for I.E.R.E., City & Guilds (Telecoms Techn's Cert. and Radio Amateurs') R.T.E.B., etc. Many non-exam courses incl. Closed circuit TV, Numerical control & Computers. Also self-build kit courses—valve and transistor.

*Write for FREE prospectus and find out how ICS can help you in your career.*

**ICS, DEPT. 560, INTERTEXT HOUSE, LONDON, SW11.**

## FOR SALE

**500 SERVICE SHEETS.** Radio & T.V. £12 10/0 the lot, plus 10 - P. & P. Hughes, 126 London Road, Preston.

RATES: 4/- per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Television", London W.C.2.

## FOR SALE

*(continued)*

**VALVE CARTONS** at keen prices. Send 1/- for sample and list. J. & A. BOXMAKERS, 75a Godwin Street, Bradford 1.

## RECTIFIERS

**Super Silicon Rectifiers**
TV etc., 1200 PIV, 800 MA **6/-** or complete with instr. resistor, condenser **7/6.** 400PIV, HW 6A **6/-**, 200 PIV, HW, 6A, **6/-.**

**Rectifiers—Contact Cooled**
14RA1282/FC101 **13/6;** 18RD2281/FC124FW **13/6;** EC1 **12/6;** EC2 **12/6;** FC116 **7/6;** 14RA/1283 (FC31) see Silicon.

**Rectifiers—Fin Types**
Equivs. for RM4 **9/6;** 14A97 **13/6.** 14A86 **10/6;** 14A949 **19/-;** LW15 **19/-;** LW7 **19/-;** 14A100 **19/-;** 14A989 **10/-.**
FW 12V-1A **5/-;** 2A **7/-;** 4A **10/6.**

**MULTIMETERS from 32/-**
Stamped envelope for full latest selection and bargain offers in cheap meters. Radios. Baby Alarm. Inter-coms, Walkie-Talkies Sinclair, and Eagle.

**Line O.P. Trans; all 30/- each**
Murphy V350 and V230 Cossor 948. Philips 1446U/45 and 1746U/45 with EY51.

Under £1. P. & P. 6d. Over £1 Post free. NO C.O.D
MAIL ORDER ONLY.

**DURHAM SUPPLIES**
**367A KENSINGTON ST., BRADFORD 8, YORKS.**

## WANTED

**NEW VALVES WANTED.** Popular TV and Radio types. Best cash price by return. DURHAM SUPPLIES, 367A Kensington Street, Bradford 8, Yorkshire.

**DAMAGED AVO** Meters. Models 7 and 8. Also damaged Meggers, any quantity, send for packing instructions. HUGGETTS Ltd. 2/4 Pawsons Road, West Croydon.

**SERVICE SHEETS** purchased, HAMILTON RADIO, 54 London Road, Bexhill.

**WANTED**—Popular Brand New Valves—R.H.S., Stamford House, 538 Great Horton Road, Bradford 7.

**WANTED** new valves, televisions, radiograms, transistors, etc. STAN WILLETTS, 37 High Street, West Bromwich, Staffs. Tel: WES 0186.

**WANTED**—"Radio and T.V. Servicing". Vol. '59 60, and Vols. 1961 to 1965. O'Brien. 7 Combe Mews, London, SE3. Phone: 01-858 3756.

**WANTED**—Service Sheet for Ekco TC 267, £1 offered. Box Office 67.

## BOOKS & PUBLICATIONS

**R. & T.V. SERVICING,** require 1959–60, 1960-61, 1962-63, will sell or exchange five volumes 1946–56, separately if required . . . Bernard Hunt, 54 Old Road, Bromyard, Herefordshire.

## SETS & COMPONENTS

# TELEVISION TUBE SHOP

ALL THE LATEST NEW TUBES AT REDUCED PRICES

| | |
|---|---|
| **A28-14W** | **£11. 0.0** |
| **A47-11W** | **£9.19.6** |
| **A47-13W** | **£10.18.6** |
| **A47-14W** | **£7.12.6** |
| **A59-11W** | **£12.19.6** |
| **A59-13W** | **£13.10.0** |
| **A59-15W** | **£9.10.0** |
| **A59-16W** | **£13.10.0** |
| **AW21-11** | **£10.10.0** |
| **AW36-20, 21** | **£5.12.6** |
| **AW36-80** | **£5. 7.6** |
| **AW43-80** | **£6. 7.6** |
| **AW43-88, 43-89** | **£6.12.6** |
| **AW47-90, 91** | **£7.10.0** |
| **AW53-80** | **£8.12.6** |
| **AW53-88, 53-89** | **£8. 5.0** |
| **AW59-90, 59-91** | **£8.15.0** |
| **C17BM, FM, HM** | **£6. 7.6** |
| **C17LM, PM, SM** | **£6.12.6** |
| **C21HM, SM, TM** | **£7.17.6** |
| **CME1402** | **£5.17.6** |
| **CME1601** | **£10. 5.0** |
| **CME1702, 1703** | **£6.12.6** |
| **CME1705** | **£7. 7.0** |
| **CME1901, 1903** | **£7.10.0** |
| **CME2101, 2104** | **£8. 5.0** |
| **CME2301, 2302** | **£8.15.0** |
| **CME2306** | **£13.10.0** |
| **CRM93** | **£5.10.0** |
| **CRM124** | **£5.10.0** |
| **CRM141, 2, 3, 4** | **£5. 2.6** |
| **CRM171, 2, 3** | **£6. 7.6** |
| **CRM211, 212** | **£8.17.6** |
| **MW36-24, 44** | **£5. 2.6** |
| **MW43-64, 69** | **£6. 7.6** |
| **MW43-80** | **£6. 7.6** |
| **MW53-20** | **£8.17.6** |
| **MW53-80** | **£8.17.6** |
| **7405A** | **£6.12.6** |
| **TSD217, 282** | **£10.10.0** |

All tubes tested before despatch and guaranteed for 12 months.

Re-processed tubes also available at reduced prices.

**CARRIAGE** 10/-, via B.R.S. or 15/- via passenger train. Add 2/6 for Comprehensive Insurance.

*Midland Stockists:—*

**Amateur Electronics,**
**518/520 Alum Rock Road,**
**Birmingham 8**

**TELEVISION TUBE SHOP**
**48 BATTERSEA BRIDGE ROAD**
**LONDON S.W.11. BAT 6859**

WE GIVE GREEN SHIELD STAMPS

## SETS & COMPONENTS *(continued)*

# BRAND NEW TELEVISION TUBES – 2 YEAR GUARANTEE !

**(CATHODEON AND OTHER LEADING MANUFACTURERS)**

We hold a wide range of top quality tubes, why purchase rebuilt tubes? Latest 11/12/16 types available. Rimbands 19in. **170/-**, 23in. **220/-**.

| | |
|---|---|
| CRM121 2, 3 & 4; MW31-16, MW31-74; C12FM; 121K, C12/1, etc. | **£3 0 0** |
| AW36-80; MW36-24, 36-44; CRM143, 4; CME1402; C14BM; C14FM, MW41/1, etc. | **£4 15 0** |
| CRM141 2; CRM151 2, 3; 15EP4 etc. C17BM, SE14/70, AW36-20, 36-21 | **£4 15 0** |
| AW43-80, 43-88, 43-89; MW43-64, 43-69; MW43-80; CRM171, 2, 3, 4; C17FM; CME1703, 5; C17AF; C17SM | **£5 15 6** |
| AW47-90; AW47-91; CME1902; CME1903; A47-14W; CME1908, etc. | **£6 17 6** |
| C19AH; CME1901; AW53-88, 9; CME210, 4; MW53-20; MW53-80; CRM211, 2, C21AF | **£7 10 0** |
| AW59-90, 91; CME2301, 2, 3; CME2308, A59-15W | **£9 10 0** |
| 19in. Twin Panels A47-13W; CME1906 **£9.17.6** (Carriage 20/-) 23in. Twin Panels A59-13W; CME2306, A59-16W (Carriage 30/-) | **£12 10 0** |

CARRIAGE AND INSURANCE. Up to 19in. **12/-**. 21in. upwards **15/-**. Twin Panels (see above). Lists, s.a.e. please.

**ALL ENQUIRIES WELCOMED** **PHILIP H. BEARMAN, 6 Potters Road, New Barnet, Herts.** Tel. BAR 1934/7873 (Robophone) **LISTS BRITISH VALVES!**

**150 NEW ASSORTED** Capacitors, Resistors, Silvered Mica, Ceramic, etc. Carbon, Hystab, Vitreous, ¼-20 watt, 12/6. Post Free. WHITSAM ELECTRICAL, 33 Drayton Green Road, West Ealing, London, W.13.

# BARGAIN PARCELS

**Any 5—9/-, 10—14/-, 100 £5-10**

From the following:—

EBF80, EBF89, ECC82, ECL80, EB91, EF80, EF85, EF184, EY86, PCL84, PCF80, PCL82, PCL83, PCL84, PL36, PL81, PL83, PY82, PY33, PY32, PY81, PY800, PY801, U26, U191, 30F5, 30PL1, 30PL13, 30PL14, 602, 6-30L2, 30FL1, 10F1.

**ALL VALVES SET TESTED, P. & P. 1/-.**

## 3 BY 100 TYPE RECTIFIERS

with surge resistors 9s. p. & p. 6d.

**10-0·5 mfd 250v/w capacitors**

Unused (long leads) 4s. p. & p. 6d.

**3-32-32 mfd capacitors** as taken out of sets 275v/w 2s. 6d. p. & p. 8d.

# VELCO ELECTRONICS

**49 BRIDGE ST., RAMSBOTTOM, VIA BURY, LANCS.**

**TV SPARES**, all makes all sets. S.A.E. quote: U25 Ekco/Ferranti Plastic Housings 17/6 each. 4/- p. & p. KINGS, 8 Cray Parade, Main Road, St. Pauls Cray, Kent. Orpington 30566.

**BARGAIN PARCELS** of new surplus Electronic Components. 3/-, 5/-, 10/- post free. DOLPHIN ELECTRONICS, 5 Pooles Way, Briar Close, Burntwood, nr. Lichfield.

# NEW VALVES, FINEST QUALITY, MOSTLY BRITISH

NOTE.—No price increases, no postage charges set. Send stamp for full list British and Telefunken. Also huge range of tubes.

| *For example:* | | | | | | |
|---|---|---|---|---|---|---|
| | DY86/7 **7/-** | | PCC89 **11/-** | | PL81 **9/-** | |
| | ECC82 **8/-** | | PCF80 **9/-** | | PY81 **7/3** | |
| | ECL80 **7/6** | | PCL82/4 **9/-** | | U25 U26 **12/6** | |
| | EY51 **7/-** | | PCL85/6 **9/-** | | 30L15 **14/-** | |
| | EY86 **7/-** | | PL36 **11/3** | | 30P19 **11/3** | |
| | PCC84 **8/-** | | PL500/4 **15/9** | | 30PL13/4 **15/6** | |

QUANTITY DISCOUNTS. NOT THE CHEAPEST BUT FINEST VALUE!

NOTE: *Regret now 5% extra purchase tax increase!*

**PHILIP H. BEARMAN, 6 Potters Road, New Barnet, Herts.**
Tel: BAR 1934—7873 (Robophone)

**BOB'S BETTER BARGAINS.** 10 Assorted your choice. 14/6. 100 Assorted £5.10.0, post paid, PCF80, PCC84, PL81, PL36, PY81, PY800, PCL82, PCL83, EF85, U191, U301, 30F5, 30PL1, 30FL1, 30P4, 30P12, PY32, PY33, PY82, EB91, ECL80, ECC82, EBF80, EBF89, 6BW7, EY86 and EF80, 12/6 per dozen. post paid. GREEN, 2 St. James' Street, Rawtenstall, Rossendale, Lancashire.

**PM SPEAKERS** removed from Television Sets 3/6, post 2/6. WILD 19 Square Street, Ramsbottom, Lancs.

**COMPONENTS GALORE.** CRT's. Valves, Transistors. Tools Electrolube, all your service requirements. Service Engineers only S.A.E. at "Willow Vale, The Service Wholesalers", 69 Station Road, Hanwell, London, W.7. Free catalogue by return.

# TELEVISION TUBES

Large stocks of television tubes, London's leading wholesale suppliers, all tubes complete with guarantee card. By return despatch Terms: Cash with order, s.a.e. all enquiries.

| | |
|---|---|
| 14in. types, AW36/20, AW36/21, AW36/80, MW36/24, CRM141, CRM144, CME1402 etc. | **£4 17 6** |
| 17in. types. MW43/80, AW43/80, CRM173, CME1702, MW43/69, CRM172, AW43/88, AW43/89, CME1703, CME1705 etc. | **£4 17 6** |
| 19in. types. AW47/90, AW47/91, CME1901, CME1903, CME1902, C19AH | **£4 19 6** |
| 21in. types. AW53/88, AW53/89, CME2101, CME2303 | **£5 19 0** |
| MW53/80, AW53/80, MW53/20, CRM211/2 | **£8 18 10** |
| 23in. types. AW59/90, AW59/91, CME2301, CME2303 | **£6 12 0** |
| 23in. Twin Panel. CME2306, A59-16W | **£13 10 0** |
| 23in. Panorama. A59/11W etc. | **£12 0 0** |
| 19in. Twin Panel. A47-13W, CME1906 etc. | **£10 10 0** |
| 19in. Panorama. A47/11W etc. | **£9 0 0** |

Many other types in stock including G.E.C. and Brimar types. **Carriage and Packing** 12/6d. per British Road Services.
Large stocks of valves, transistors and components. Electrolube, Servisol switch cleaner, Multicore solder. Service Tools etc.

**WILLOW VALE ELECTRONICS LTD.**
**The Service Dept. Wholesalers, 4, The Broadway, Hanwell, London, W.7** Tel: 01-567 2971/5400