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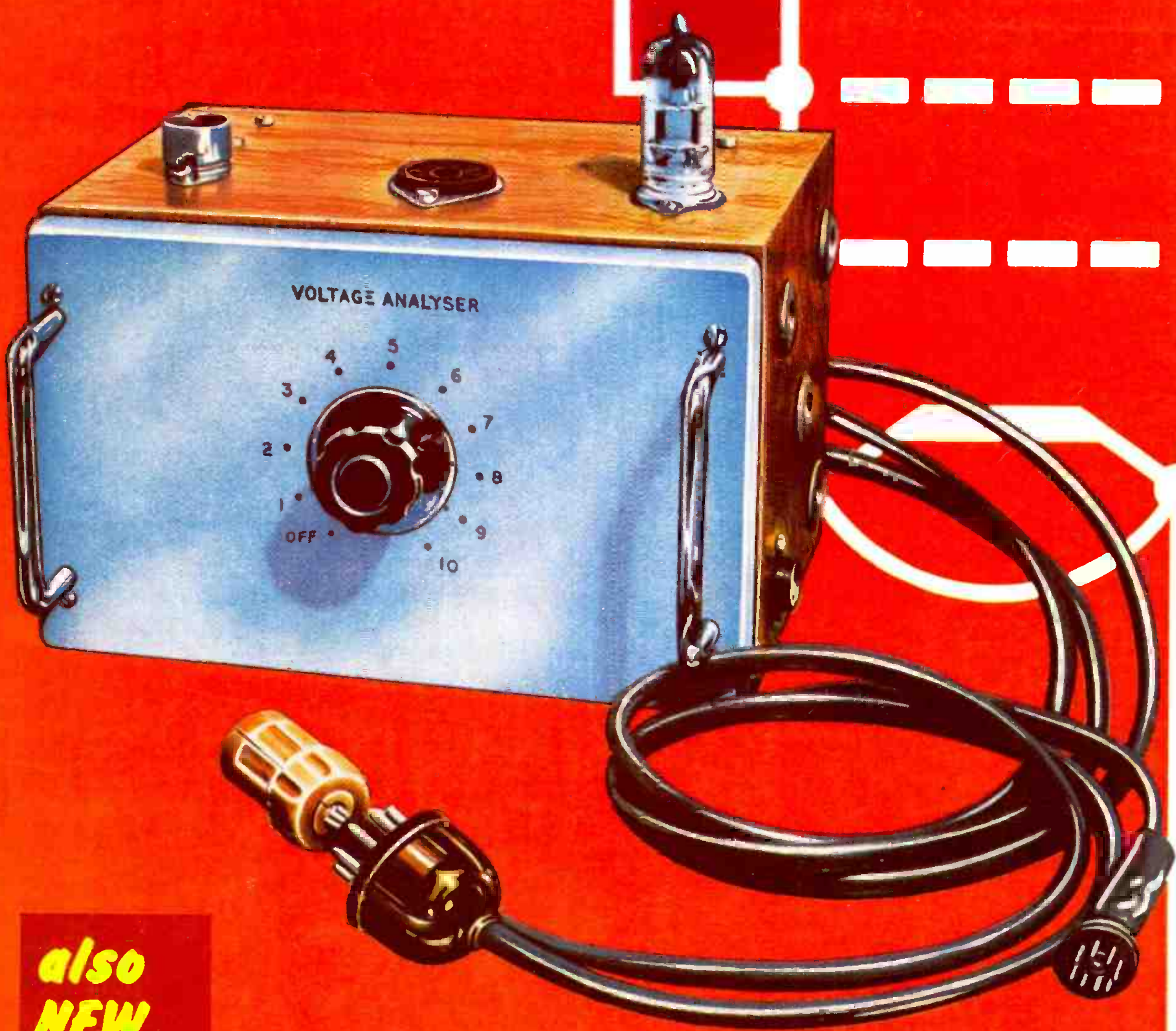

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12SK7	4/9
12SQ7GT	7/6
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PC95	8/3
PC97	8/6
PC900	8/3
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PCC88	9/9
PCC89	9/6
PCC189	9/6
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PX4	14/-
PY32	9/6
PY33	9/6
PY80	5/3
PY81	5/3
PY82	5/-
PY83	5/6
PY88	6/3
PY800	6/6
PY801	6/6
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QP21	5/-
QQVO3/10	27/6
QS75/20	10/6
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R11	19/6
R16	34/11
R17	17/6
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R19	6/6
R20	11/9
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UAF42	9/6
UB41	6/6
UBC41	7/6
UBC81	7/-
UBF80	5/9
UBF89	6/9
UBL21	9/-
UC92	5/6
UCC84	8/-
UCC85	6/6
UCF80	8/3
UCH21	9/-
UCH42	9/9
UCH81	6/6
UCL82	7/-
UCL83	10/-
UF41	9/6
UF42	9/-
UF80	6/9
UF85	6/9
UF86	9/-
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UL41	9/6
UL46	12/6
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UU12	4/6
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UY21	9/6
UY41	6/9
UY85	5/6
U10	9/-
U12/14	7/6
U16	15
U17	5/-
U18/20	10/-
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U31	6/-
U33	29/6
U35	16/6
U37	34/11
U45	15/6
U49	11/9
U50	5/6
U52	4/9
U76	4/9
U78	3/6
U107	18/3
U191	12/6
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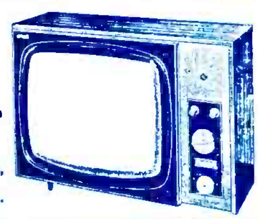

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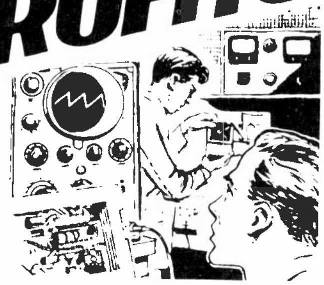

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PRACTICAL TELEVISION

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AUGUST 1969

THE CHIPS ARE DOWN

EVERY so often a new development or technique in engineering, design or technology breaks upon the scene and stimulates anything from mild academic interest to a complete upheaval of the industry. The first climactic event in practical television was the revolutionary change from mechanical to electrical scanning and since then there has been a steady series of developments shaping the future growth of TV, many of them requiring new techniques and new thinking.

The imminent introduction of single-standard receivers is destined to become one of those epic milestones after which things will never be quite the same again. For coincidental with the changeover to 625-u.h.f.-only sets, with the simplification possible by eliminating systems switching, is the stage of development in integrated circuits at which they are becoming a commercially viable proposition for TV set use.

I.C.s are appearing in American sets and already one British maker is using a chip performing the functions of colour-difference signal demodulation and matrixing to provide RGB drive signals. Sets of the future will increasingly rely on i.c. chips, resulting in the disappearance of much receiver "ironmongery" and several hundred discrete components—the whole circuit being disposed about a single printed board of modest dimensions.

We are so sure that a revolution is about to occur that a special feature will start in the next issue dealing with the background story, giving an analysis of the shape of future receivers, an indication of performance expectations and how all this will affect setmakers, service engineers and the private buyer. The article is aptly called "Chips with Everything" and will put you in touch with what will come about in the near future.

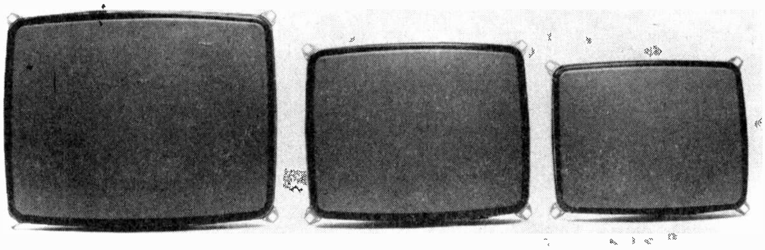
W. N. STEVENS, *Editor*.

THIS MONTH

THE NEXT ISSUE DATED SEPTEMBER WILL BE PUBLISHED AUGUST 22

TELETOPICS

NEW MAZDA COLOUR & MONOCHROME TUBES



This photograph shows the complete range of Mazda monochrome square-corner, flat-screen push-through presentation tubes. These are the CME2413R (A61-120W/R) 24in. tube, the CME2013R 20in. tube and the CME1713R (A44-120W/R) 17in. tube. All these types have Rimguard III protection and Sparkguard R bases.

New colour tubes are the 22in. type CTA2250 (A55-141X) and the 19in. type CTA1951 (A49-200X). These tubes have Rimguard III implosion protection for push-through presentation and are designed for unity current ratio (equalised beam current) operation at white output. A temperature-compensated shadowmask guards against warming-up drift of the purity and for high light output and balanced efficiency a europium-activated rare earth red phosphor is used.

APOLLO-II TRANSMISSIONS TO EARTH

The lunar module communications system that will enable the world to share in the drama of Americans landing on the Moon this month received its first manned space test during the Apollo-9 mission. The system, designed to beam everything from live TV to an astronaut's pulse rate from the Moon to Earth, will link the lunar module to ground controllers and its sister ship, the command module.

The lunar module communications system consists of v.h.f. transceivers for communications between the lunar module itself and the command service module and an S-Band system to relay all the signals from the lunar module to Earth.

THORN & RCA COMBINE OVER COLOUR TUBES

Thorn Electrical Industries and RCA of the USA have announced an agreement in principle whereby the two companies will form a joint operation to expand the manufacture of colour television picture tubes in the United Kingdom. The new company will bring together the colour tube activities of Thorn with manufacturing facilities at Brimsdown, Enfield, and RCA Colour Tubes' activities at Skelmersdale in Lancashire.

Thorn will own 51% of the shares in the colour tube company and will be responsible for the management. The name of the joint company will be Thorn Colour Tubes Limited. RCA, who invented the shadowmask tube, will be responsible for providing technical assistance to the company.

PROGRAMME COMPANIES TO LINK UP?

The increased costs with which the ITV programme companies are faced have led to discussions of "some form of association" between Yorkshire Television and Anglia Television. These talks have received the approval of the ITA. The two companies feel that as their facilities overlap to some extent economies may be possible, but any detailed proposals will have to be approved by the ITA. The main burdens facing the ITV programme companies are the increased levy and the cost of starting colour operations. There is no news to date of other companies thinking along similar lines though some of the smaller companies may well be considering whether joint operations with associates could reduce costs.

MERTHYR TYDFIL BBC-2

The Merthyr Tydfil BBC-2 relay station was brought into service on Monday, June 23, on channel 28, with vertical polarization. The correct aerial for receiving from this new relay station is one belonging to group A with vertical rods and it should be directed towards the relay station site on Incline Top. Group A aerials are suitable for the Merthyr Tydfil BBC-2 channel 28 as well as the other three channels, 22, 25 and 32, which have been assigned to this station for future u.h.f. television services.

The new relay station will provide good BBC-2 reception for virtually all Merthyr Tydfil. In the northern outskirts of the borough there is the possibility of interference on channel 28 from the Pontypridd relay station. The area in question is nevertheless well served from Wenvoe on channel 51.

SET NEWS

There have been several reports recently of cuts in the price of colour TV receivers. These are coming with the introduction of single-standard u.h.f.-only sets in which the complications of dual-standard circuitry are avoided. Although v.h.f. transmissions on Bands I and III are to be continued for many years to come, from November 15 BBC-1, BBC-2 and ITV will all be available on u.h.f., 625 lines in the London area, and it is planned to extend this duplication of the v.h.f. services on u.h.f. as soon as possible to the whole country.

Single - standard Dynatron colour models were announced in our June issue and this month **Ekco** announce two single-standard colour models. These are the 25 in. Model CT105 at £292 and the 19 in. Model CT103 at £232. They are fitted with a hybrid PAL-system chassis using 45 transistors, 53 diodes, 7 valves and an integrated circuit which acts as the 6MHz sound i.f. section.

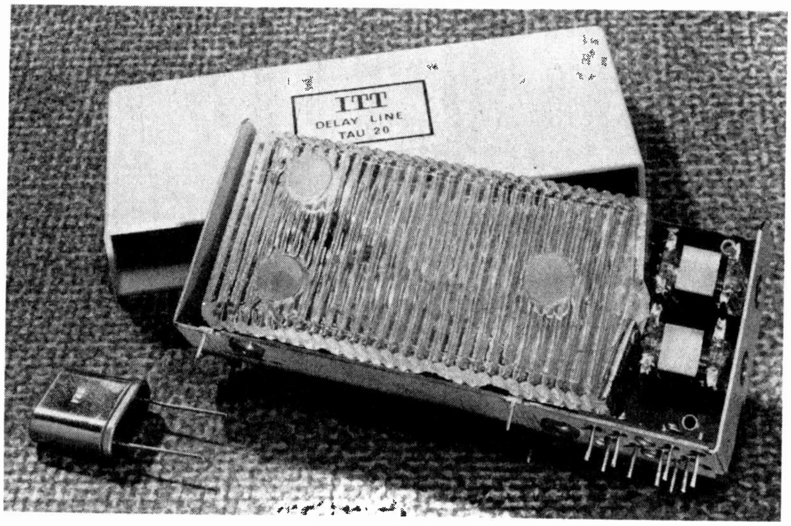
Other new sets announced this month are a 22 in. dual-standard colour receiver from **Stella,** the ST2200; and from **HMV** a 20 in. monochrome receiver, Model 2660, which is fitted with the Thorn/BRC 1400 chassis, a type CME2013R tube and features a push-button u.h.f. tuner.

Sony have announced that they plan to sell their 13 in. colour sets, using the Trinitron tube, in the UK though sales are not due to start immediately. They aim to sell at under £200.

US TV COSTS

In 1968 the prices of TV sets in the USA fell to a record low level with colour sets averaging £143 and black-and-white ones £38 10s. These are averages taking in all picture tube sizes but exclude cheap Japanese imports which have made huge inroads into the US market. But even these prices don't give a true comparison since wages are very much higher in the USA: a truer comparison of how much it costs the US household, translated into British terms, would put a colour set at under £50 and a black-and-white one at about £12.

NEW ITT COLOUR TV COMPONENTS



Our photograph above shows two newly introduced piezoelectric components for PAL decoders. The crystal type CTV on the left is for use in the reference oscillator circuit and is housed in an HC-6/U holder with flying leads. The other component, on the right, is a PAL-D line-duration delay line, type TAU20, which is complete with input and output matching transformers.

WOLSEY UHF DISTRIBUTION AMPLIFIERS & NOTCH FILTERS

The latest addition to Wolsey's range of u.h.f.-v.h.f. translators, aerials, masthead preamplifiers, distribution amplifiers and accessories is the LD49 u.h.f. distribution amplifier which caters for the four-channel u.h.f. systems planned for each area in the UK. This wideband high-gain amplifier provides two outputs (4 channels) each of 150mV mean, enabling it to be used for the distribution of the original u.h.f. frequencies in communal systems, showrooms and workshops that are larger than those catered for by the Wolsey u.h.f. distribution amplifiers types LD47 and LD48. These distribution amplifiers are for colour and monochrome working, and use solid-state circuitry. The new LD49 has a gain (minimum) of 36dB for aerial Group A and B signals and 30dB for aerial Group C signals. The units have key-hole slots at the back for wall mounting and it is recommended that they are mounted as near as possible to the aerial.

Notch filters are available for the elimination of adjacent channel or harmonic interference and have two preset controls for the critical adjustment that is necessary, a slow-motion drive variable capacitor for fine tuning to the interference frequency and a variable resistor to adjust the notch width. Model 1 covers 35-50Hz, Model 2 40-100MHz and Model 3 110-220 MHz. The attenuation provided at the notch frequency is in the order 40-46dB depending on frequency.

Further details of Wolsey equipment can be obtained from Wolsey Electronics (a division of A. B. Electronic Components Ltd.), Cymmer Road, Porth, Rhondda, Glamorgan.

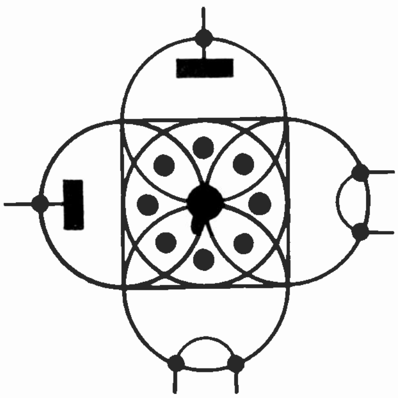
THORN ACQUIRES FULL CONTROL OF VALVE SUBSIDIARY

Thorn Electrical Industries have acquired from AEI their 50% participation in Thorn-AEI Radio Valves and Tubes so that this company will become wholly owned by Thorn. It is to be renamed Thorn Radio Valves and Tubes Limited.

RTS CHAIRMAN 1969-70

At a meeting of the Royal Television Society Council Tony Pilgrim, who is in charge of the BBC's Engineering Services in the Midlands, was elected Chairman for the 1969-70 session. Stuart Sansome, Chief Engineer of Thames Television Ltd., was elected Vice-Chairman.

VOLTAGE ANALYSER



I. OLIVER-EDWARDS

DURING my normal day's work I service various types of transmitters and receivers: v.h.f., u.h.f. and radar. Due to the bird's-nest method of constructing and wiring some of these equipments I have always found it very difficult to take voltage readings at valve bases and in some cases this is almost impossible. The voltage analyser overcomes these difficulties. To use it the valve being checked is removed from the equipment and plugged into the analyser, the analyser being connected to the socket from which the valve was removed by the appropriate plug.

Operation of the Analyser

As can be seen in Fig. 1, a simplified version of the analyser circuit, the connections at the valve base are brought into the analyser and connected to a selector switch the wiper arm of which is connected to the positive terminal of the voltmeter, the negative terminal of the meter being connected to the chassis of the equipment under test via a crocodile clip. Thus voltage readings at the valve bases of radio or TV sets or any equipment employing valves can be taken without removing the chassis from the cabinet. There are some limitations, for example you cannot test a valve position using top-cap connections, however most types of valve can be tested in this way. The object of having the valve plugged into the circuit while taking readings is to present the correct loading conditions to that particular part of the circuit.

It might be possible to use an oscilloscope in place of the voltmeter to check waveforms, but this has not yet been tried. It would probably be necessary to use a fine screened cable for the interconnecting wires between the analyser and a scope.

Construction

Construction is not difficult. A fairly thin plastic covered flexible wire was used for both the internal wiring and the interconnecting cables. Each group of wires, i.e. the six groups from the valve sockets to the tagboards, was encased in polythene sleeving. A good idea is to colour code the wiring throughout, both internal and the interconnecting cables. If for example pin 1 is brown, pin 2 red etc. following the standard resistor colour code it will be a great deal easier to wire up.

The object of using two nine-way tagstrips with bare tinned copper wire jumper bars was to allow plenty of room to solder the wires from the six valve sockets and the nine switch positions, the jumper wire being an anchor point. Layout is unimportant as only one valve socket is used at any time and then only one cable, i.e. to the electrode selected. The wiring can be grouped into looms and sleeved, or laced GPO telephone style with linen thread. Although the prototype is housed in a metal instrument case a plastic or wood case

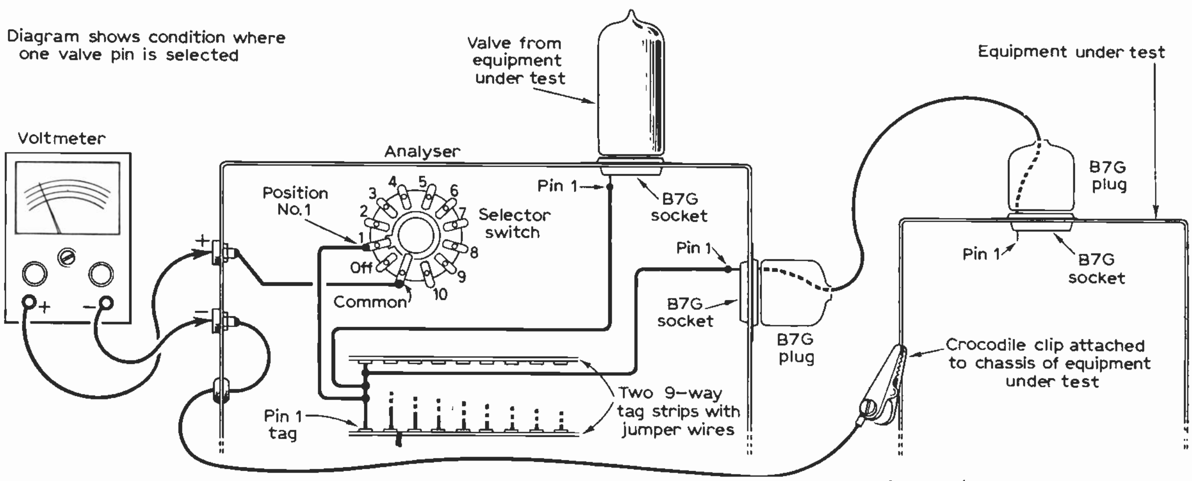


Fig. 1: Simplified circuit of the voltage analyser, showing the method of operation.

would be much more desirable: whilst there is no connection between the case and the wiring there is always a danger when a crocodile clip is connected to a.c./d.c. equipment, especially if the mains plug is wired the wrong way round.

Taking Readings

Although not shown in the circuit diagram (Fig. 2) it would be a good idea to include a spring-loaded press-to-break push-button switch in the negative lead to the meter to break this lead while passing the selector switch through heater connections when taking d.c. readings.

Great care should be taken when taking d.c. readings. You may for example have just taken a cathode reading of 2·5V then moved the selector switch from pin 2 cathode past 3 and 4 which could be heaters to position 5, anode, with 250V present. Your multimeter will not be very happy if it is still on the 0-10V range, especially if it does not have an overload trip.

A permanently built-in meter could be used, say a 0-1mA f.s.d. basic meter with suitable series resistors and rectifier. If each range is connected by a press-to-make button, spring-loaded to off, you can then move the selector switch with the meter out of circuit, then press the button to select a suitable voltage range. You could of course press the wrong button: you can't win all the time! Better however a damaged ten bob meter than your hard-come-by testmeter.

For quick reference during tests with the analyser it is useful to be able to see at a glance which electrode of the valve you are testing is in circuit. A set of cards showing pin connections, which correspond to the selector switch positions, enable this to be done.

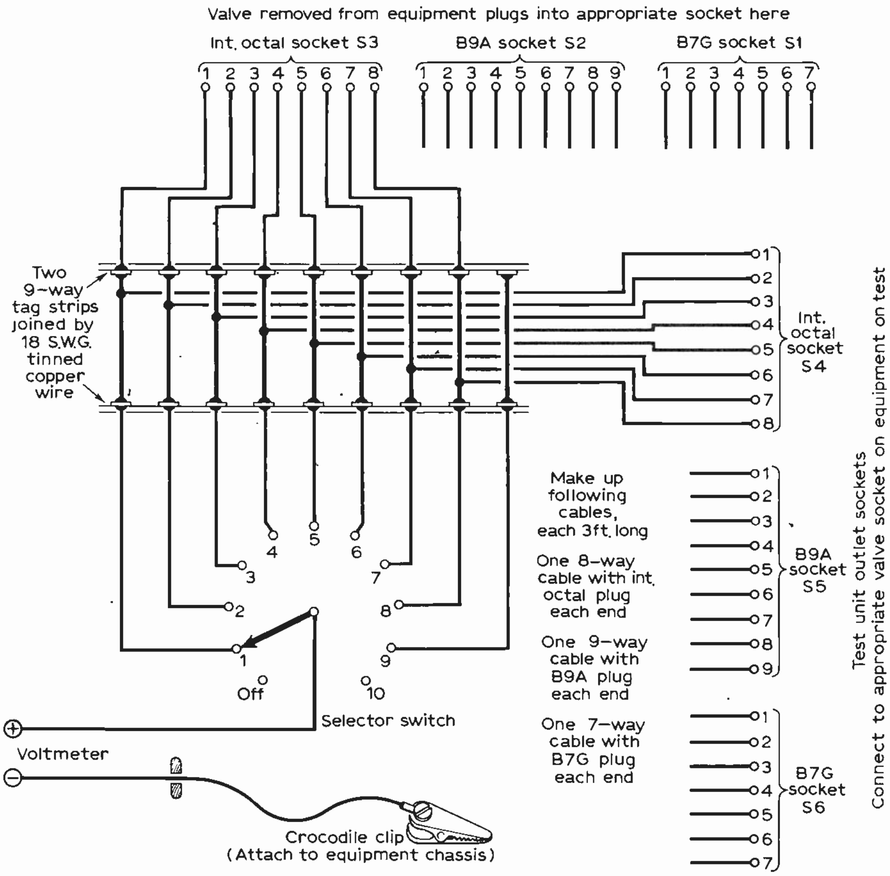
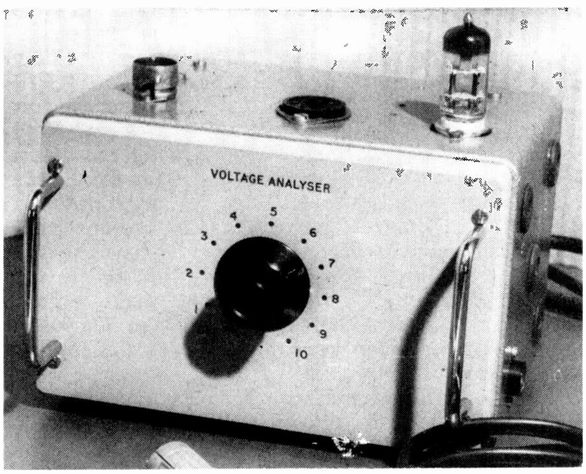


Fig. 2: Basic circuit of the voltage analyser, showing one valve socket and one output socket only connected. The switch numbers correspond to the valve plug and socket pin numbers. The two nine-way tagstrips are joined by 18 s.w.g. tinned copper wire jumpers and the 57 leads from the six sockets and the switch are soldered to these jumper leads.



The author's prototype. This is housed in a metal cabinet but in the interest of safety a wooden case is recommended.

Valve Heaters

There are many things to remember when testing with a unit of this kind. On a pure a.c. set you can take most valves out with the set still switched on with no ill effect on the other valves. This type of equipment should however be switched off when removing one of a pair of push-pull valves. You can remove a valve from a TV set when, as is nearly always the case, the valve heaters and tube are in series, but the set must be switched off if the heaters are in series-parallel banks.

This is quite a simple piece of test equipment and well worth the effort of constructing. You will be surprised at the speed and ease with which you can run through voltage points on a multi-valved piece of equipment by using it. ■

DEVELOPMENTS IN TV BROADCASTING TECHNIQUES

montreux 1969

PHILIP ROSS REPORTS

MANY new equipments and ideas for colour television made their public debut at the sixth International Television Symposium and Technical Exhibition held recently at Montreux, Switzerland, on the shores of Lake Geneva. With almost 1,000 delegates from over 30 countries and more than 50 firms taking part in the Exhibition, the 1969 event achieved its greatest success yet, bringing together many representatives from European, American, African and Asian broadcasting and from the industry.

COLOUR EQUIPMENT

As in the 1967 event the emphasis was squarely on colour studio equipment, though several of the most interesting developments were concerned with the use of lower-cost helical-scan videotape recorders used primarily for educational and CCTV applications.

Of outstanding interest was a most successful demonstration of the FAM (frequency amplitude modulation) system developed by the Institut fuer Rundfunktechnik, the joint German broadcasting research institute in Munich. This system, originally proposed as a possible system of colour broadcasting, encodes colour signals on a subcarrier modulated in amplitude and frequency, and appears remarkably insensitive to small v.t.r. timebase errors which can play havoc with the phase-conscious NTSC and PAL forms of colour encoding. The FAM system is to be marketed commercially by Ampex and will enable relatively low-cost videorecorders to give excellent results on colour.

Another colour system suitable for helical-scan recorders was shown for the first time by Orbit Communications of Geneva; this is SECAM-60 which is to be used for educational CCTV applications. The system is based on the good recording performance of helical-recorders with SECAM-encoded colour, but uses 60 fields/second rather than the more usual European 50 fields. The company is using the system in conjunction with recorded lectures by well-known scientists intended for playback in universities.

CAMERAS

A good deal of debate continues over the question of how many pick-up tubes are needed in a colour camera. Examples of cameras with one, two, three and four pick-up tubes—almost always nowadays Plumbicon tubes—were described and shown in miniature studio and OB displays mounted by such firms as EMI, Marconi, RCA, Philips, Fernseh, Thomson-CSF, IVC and Ampex.

While both EMI and Marconi continue to favour the YRGB (separate luminance plus red, green and blue) four-tube arrangement—and Fernseh and Thomson-CSF also have cameras of this type—RCA and Philips put their main emphasis on three-tube RGB cameras. Fernseh also have a foot in the three-tube camp but use a WRB system—that is white (luminance) red and blue configuration. At present the one-tube RCA camera, using a vidicon or lead-oxide pick-up tube in conjunction with a new colour-detecting optical filter and what are termed "innovative electronics", appears to be intended primarily as a low-cost telecine camera for CCTV rather than broadcast applications, but is a promising development in the struggle to reduce capital and operating costs.

Remarkably compact colour portable cameras developed by Philips and CBS in the United States use novel methods of digital control over a simple radio or coax cable link, giving a new mobility to colour outside broadcasting. A two-tube colour camera by Ampex is designed as a portable unit in conjunction with their VR3000 portable tape recorder.

FILM AND VIDEOTAPE

It is clear that the weakest link in the colour broadcasting chain arises from the severe problem of obtaining consistently good colour from old cinema film never intended for television. Much effort has been put into the BBC-developed TARIF (often translated as standing for "Tony's apparatus for the rectification of indifferent film") and both Rank Cintel and Fernseh were showing how such systems can be used in conjunction with flying-spot film scanners and punched-tape to programme a succession of different corrections for various parts of the film. Each correction setting is brought into operation by metal dots on the film. While the British approach to TARIF is to make colour corrections on R, G, B signals, IRT in Germany are developing equipment which acts on the composite encoded colour signal.

Several of the symposium speakers showed how increasing use is being made in television broadcasting of general purpose digital computers, and these are now also employed for videotape editing in the versatile Ampex random access system in which each individual field is given a discrete address code. The use of spinning magnetic discs to achieve slow-motion playback of short sections of programme material, particularly during sports events, was reflected in several equipments for this application, capable of handling colour as well as monochrome signals.

RCA showed an engineering prototype of a new and very complex equipment for playing a series of easily loaded videotape cartridge or cassettes in rapid succession, much as sound cassettes are now widely used in sound broadcasting. The machine is intended for up to three minutes recording per cartridge and allows 18 cartridges to be assembled; such a unit would be of value for news broadcasting or for screening commercials.

ADVANCED WIRED TV SYSTEM

A British paper described an advanced form of h.f. wired television now under development by Rediffusion in which the viewer would be able to select any one of a large number of television channels by means of a central "programme exchange", akin to a telephone exchange, and making it unnecessary for all the programmes to be brought simultaneously into the home. Such a system could provide a very large selection of programmes. Although it might not be economically possible for any country to provide such a large number of different programme channels, the suggestion is that by means of videotape recorders each major programme might be repeated many times during a day to suit the convenience of viewers who would thus virtually be able to dial up a choice of programmes and would not have to worry about missing those "on the other channels".

EVR TELECINE EQUIPMENT

Also intended for CCTV, education and possibly home entertainment is the new EVR low-cost telecine equipment developed by Dr. Peter Goldmark and expected to be marketed about 1970. This equipment, which has already been successfully demonstrated in the UK, allows specially produced miniature films (using electron beam recording) to be contained in compact cassettes which are simply plugged into a Teleplayer and played back on a domestic receiver. Each Teleplayer is virtually a flying-spot film scanner but is expected to cost under £200.

BAND VI AND SATELLITE TV BROADCASTING NEXT?

Several speakers described the prospects for using Band VI (12GHz or 12,000MHz) for television broadcasting, using networks of terrestrial transmitters or alternatively direct broadcasting to homes or community aerials by means of synchronous satellites. A good deal of experimental work on using 12GHz with ground-based transmitters has been going on in Germany, and the conclusion seems to be that this idea could be implemented even though total coverage of a large town would require a whole series of transmitters and considerable use of community aerial distribution systems. For 12GHz receiving aerials would have to be above the roof levels of the buildings in order to give virtually true line-of-sight reception.

Prospects for satellite broadcasting were painted bright by Dr. Fred Adler of Hughes Aircraft, the company which has pioneered synchronous satellites for communications, though here again the first applications are likely to be in conjunction with master aerials and local distribution systems. Dr. Adler revealed that Indian engineers are currently considering the experimental use of satellites to cover many village communities possibly using u.h.f. transmissions from one of the later ATS (applications technology satellites). The system is rather less attractive to countries such as the UK which have already invested in ground-based networks for u.h.f., though 12GHz satellite systems using frequency modulation would now not present any insuperable technological problems.

The European Broadcasting Union, which is responsible for the growing Eurovision inter-country relays of television programmes, is clearly anxious to set up a programme distribution network using satellites. Present proposals would be aimed at distributing two television programmes accompanied by a large number of separate sound channels to take care of the language problems involved.

CITATIONS

At each Montreux symposium four or five special citations are made to eminent engineers for their services to television. This year one of the citations went to Howard Steele, chief engineer of ITA, who thus became only the third British engineer ever to have been so honoured. Other citations this year went to Dr. Adler, Charles Hirsch (who was secretary of the committee that developed NTSC), Prof. Karolus the German television pioneer and Claude Mercier of the French ORTF broadcasting service.

ACTIVE AERIALS

During recent years there has been a good deal of controversy, especially in the United States, over the prospects of using miniature "active" receiving aerials for television. This has largely stemmed from "leaks" on the work being carried out in Munich by Professor Hans Meinke and his colleagues. At Montreux the professor himself presented a most interesting lecture on these small transistorised receiving aerials, which incorporate a transistor not only to provide signal amplification (thus providing the advantages of a mast-head pre-amplifier) but also to obtain optimum noise matching to the short aerial elements, so enabling the tiny aerials to provide good signals with excellent signal-to-noise ratios. Most of the successful aerials so far are in the form of compact, sometimes loaded, dipole elements, typically about 1ft. high for a Band I aerial or some 16cm. overall for Band III. Many of the slides showed how such aerials could be installed inconspicuously on balconies, roofs or in loft spaces. It is still too early to say whether such aerials will ever be manufactured commercially or come into wide use for television reception, but enough was said at Montreux to whet the appetite for more informa-

—continued on page 521

fault finding FOCUS

S. GEORGE

LINE OSCILLATOR STAGES

THREE interesting features of modern line generator designs are (a) the very wide use of frequency control by means of a d.c. correcting voltage from a discriminator instead of individual sync pulses, (b) the frequent use of d.c. amplifiers to boost the discriminator output and (c) the employment in many chassis, including nearly all colour ones, of sinewave oscillators with waveshaping networks.

Blocking Oscillators

Although multivibrators are at present the most widely used generators the BRC and Pye/Ekco groups use blocking oscillators in their models. Let us take a close look at a typical modern example of this type of circuit. The example shown in Fig. 1 is used in the BRC 970 series of hybrid models.

V1 is an EF80 triode-connected by having its anode and screen grid strapped. It is employed as a d.c. amplifier to magnify the output from the twin-diode a.f.c. discriminator circuit which feeds it. R1 and C1 form a grid input filter to remove extraneous impulses from the a.f.c. potential, R3 and C2 determine the grid time-constant, while R2 and R4 comprise a fixed potential divider to feed V1 grid with the voltage developed across the latter resistor. V1 output is developed across R6 and R7, the latter being variable to provide a preset line hold control since it directly varies V1 anode and hence V2 grid voltage.

The blocking oscillator V2 is quite conventional, line hold being effected by separate 405/625 potentiometers linked by R9 to V2 grid. On system change to 405 an additional charging capacitor (C6) is switched in parallel with C5 to lengthen the circuit time-constant. R8 with C3 provide h.t. decoupling, R15 damps the blocking transformer secondary while C7 couples the output to the grid of the line output pentode. The circuit is basically free-running at a frequency set by the time-constant of the oscillator grid network, C4 and its associated resistors.

The inset oscillogram shows the sawtooth nature and high peak-to-peak value of the waveform at the oscillator grid.

The Multivibrator

A clear example of a modern multivibrator type of line generator is shown in Fig. 2. This circuit is

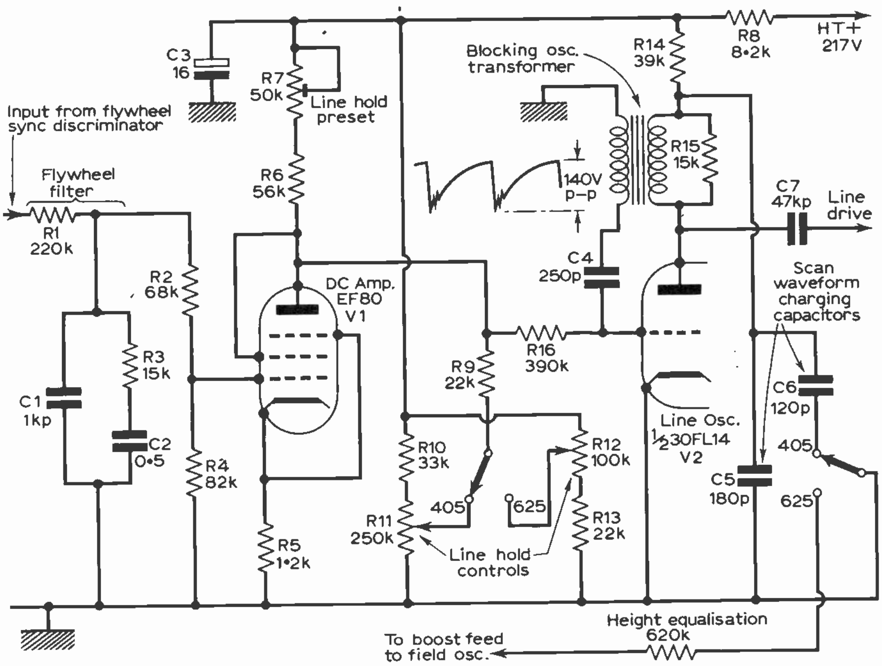
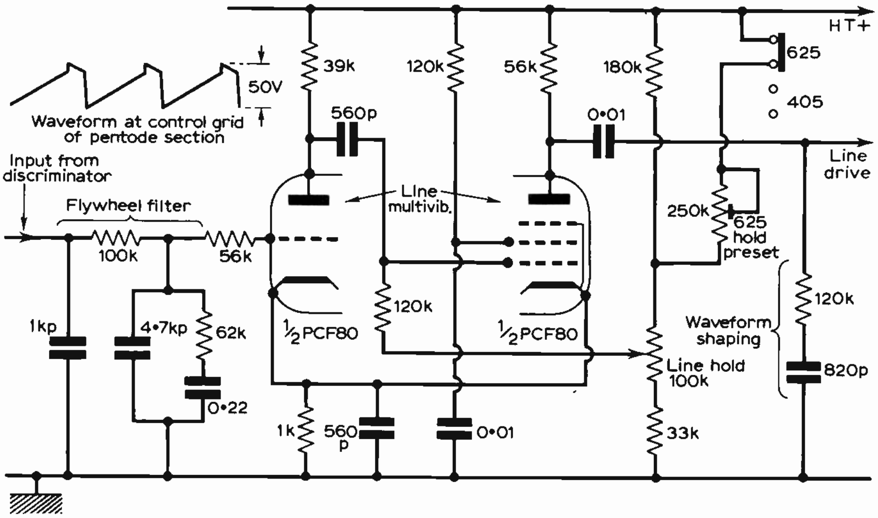


Fig. 1: A modern example of the blocking oscillator circuit, as used on many recent Thorn/BRC models. The basic action is as follows: C4 holds V2 cut off until the charge on it leaks away sufficiently for V2 to start to conduct. When V2 conducts positive feedback to its grid via the blocking oscillator transformer and C4 drives it rapidly into saturation. The field in the transformer then rapidly collapses, charging C4 negative to V2 grid so that V2 is cut off again. The cycle of operations is then repeated. C5 and, on 405, C6 charge via R14 when V2 is cut off to give the forward scanning stroke, and discharge rapidly when V2 is driven hard on to give the flyback stroke of the scanning waveform.

Fig. 2: The cathode-coupled multivibrator circuit used in recent Bush-Murphy models. In this type of circuit the two valves switch on and off alternately, producing a modified squarewave output at the anode of the pentode shown here. To obtain the correct squarewave ratio the circuit is arranged so that the triode conducts for approximately 90% of each cycle and the pentode for 10%. The output is coupled to the line output pentode after further correction to the required shape by the waveform shaping network. Cathode coupling is achieved through the shared 1kΩ cathode resistor.



found in recent Bush-Murphy hybrid models. A PCF80 is used with the triode anode capacitively coupled to the pentode grid, and with the shared common cathode resistor the combination oscillates at a frequency determined by circuit constants monitored by the line hold control setting and the a.f.c. control potential. On system change to 625 a rheostat-connected potentiometer is parallelled across the top resistor in the network biasing the pentode, thus increasing the positive voltage tapped off to increase oscillator frequency. The circuit is completely conventional and again controlled by a twin-diode discriminator. The inset oscillogram taken from the pentode grid shows a sawtooth waveform of about 50V peak-to-peak on 405.

Philips Circuit

Other manufacturers, such as Philips and Decca, use a twin-triode multivibrator circuit with the anode of each valve capacitively cross-coupled to the grid of the other to provide the essential positive feedback. In both makes a valve is used to provide the a.f.c. control voltage and this is monitored by the line hold control setting.

Figure 3 shows the Philips circuit which is used in many of their models including the Style 70 series and the more recent hybrid G19T210A/G19T211A series. Four triodes in all (two ECC82s) are used in the line-up. V1A acts as a line sync pulse clipper, V1B is the discriminator and V2A and V2B the actual multivibrator pair.

V1A is driven from the anode of the PFL200 sync separator, functioning as a pulse clipper with its output applied via a 150pF capacitor to the anode of V1B. The grid of this latter valve is supplied with a pulse from the line output transformer, and by normal grid capacitor-grid leak action develops the comparatively high negative potential of 43V on v.h.f. and 38V on u.h.f. at its grid. The anode voltage of this valve is only 48V on v.h.f. and 42V on u.h.f., so that its anode current is purely

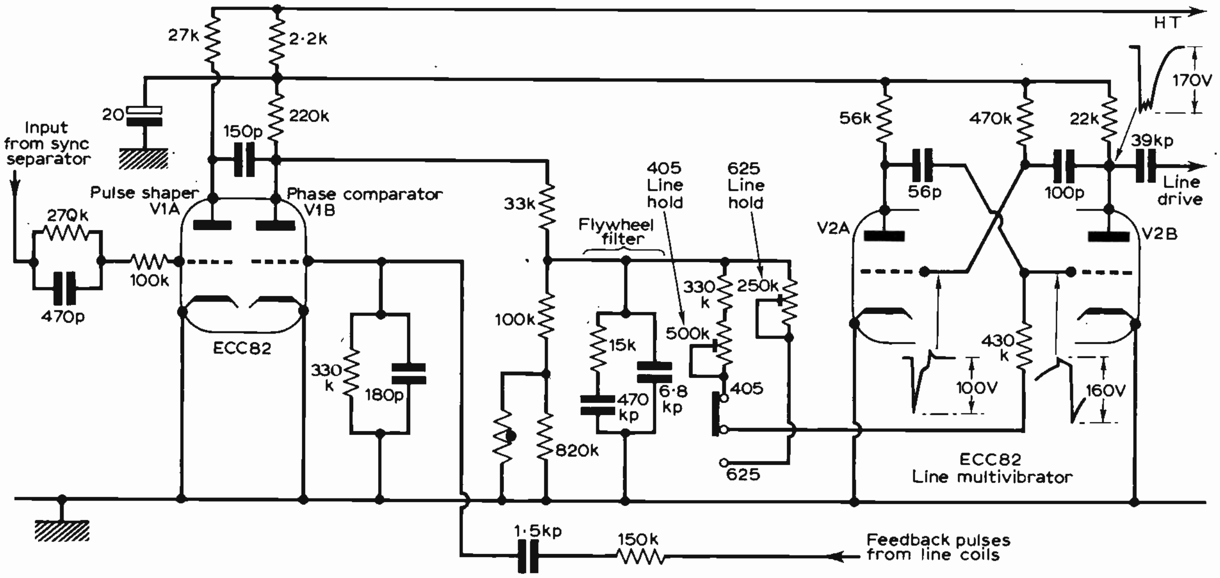


Fig. 3: Complete line generator circuit as found in current Philips models, using an anode-to-grid cross-coupled multivibrator, V2. This is controlled by a flywheel circuit using a simple triode phase comparator.

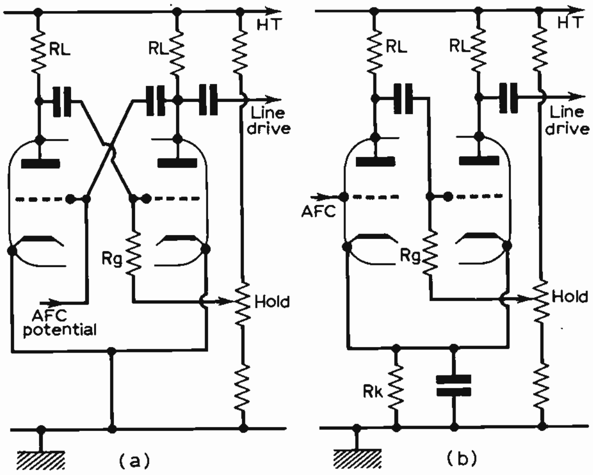


Fig. 4: The two basic forms of multivibrator, (a) anode-to-grid cross-coupled and (b) cathode-coupled with a single RC anode-grid coupling. It was general practice at one time for one valve to control the charge and discharge of a charging capacitor as in the blocking oscillator circuit.

dependent on the coincident phasing of the two pulses applied to its grid and anode.

The grid of V2B, half the multivibrator pair, is directly coupled by the 405/625 line hold controls to V1B anode so that the line oscillator frequency is determined both by the setting of these controls and V1B anode voltage. Once either control is set for correct line lock any variation in generator frequency will result in a change in the coincident phasing of the two pulse trains fed to V1B causing a change in V1B anode voltage and thereby a change in V2B grid voltage to restore the original line frequency. V1B anode voltage, being the multivibrator control source, is stabilised by a n.t.c. resistor to avoid frequency drift due to thermal changes in component values. The multivibrator output is capacitively coupled to a PL500 line output pentode.

Sinewave Oscillator

The STC group use a sinewave oscillator in their line generator circuits, this type of circuit having the advantage that even without control there is a natural tendency to maintain the correct frequency (for the same reason a tuned circuit is sometimes found in multivibrator stages). Waveform shaping is then used to produce an output suitable to drive the line output pentode in a linear manner.

In this STC circuit (Fig. 5) the pentode section of a PCF802 is employed as the oscillator with the two windings of the oscillator transformer connected between its screen and control grids to obtain the necessary positive feedback. An iron dust core in the transformer permits frequency adjustment on 625 while additional capacitance is switched in on 405 to lower the resonant frequency. The self-bias of 20V and the values of the components in the anode circuit shape the output waveform which is capacitively fed to the line output pentode.

Frequency control of the oscillator is effected by the triode section of the PCF802. This is arranged as a reactance valve across the transformer. Bias for this valve is derived from a twin-diode discriminator and should the oscillator tend to drift

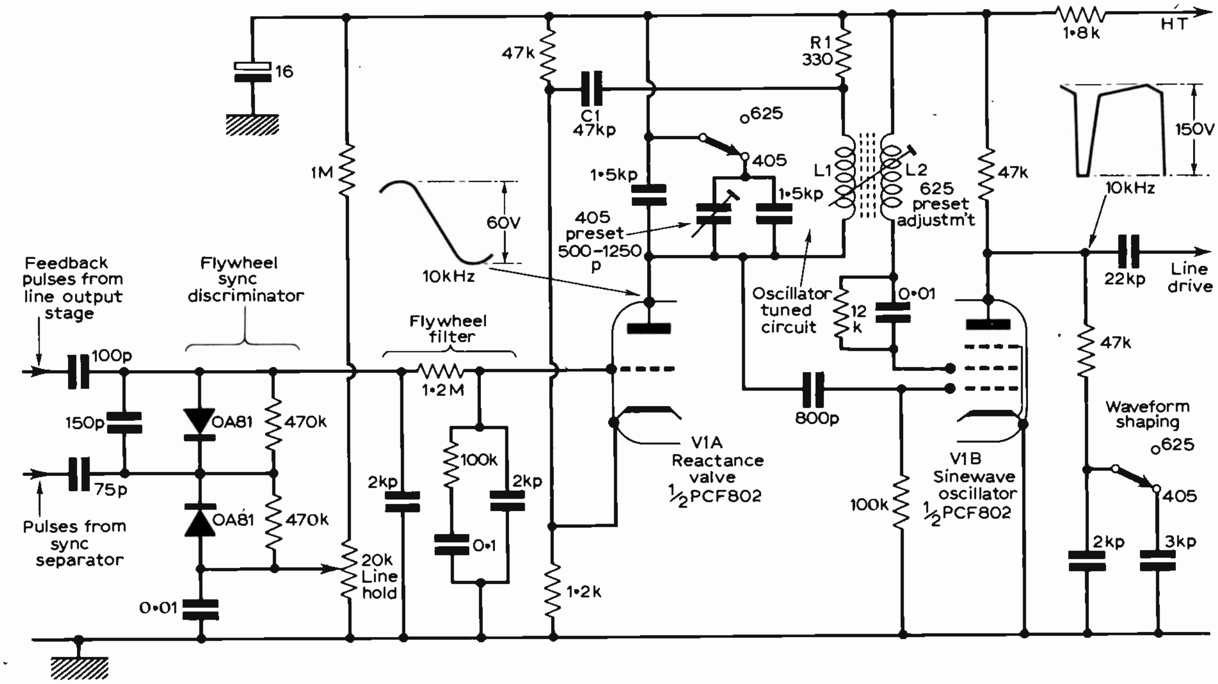


Fig. 5: The complete line generator circuit used in recent RGD-KB models. The pentode is a sinewave oscillator with the tuned feedback circuit connected between its screen and control grids. The output at its anode is shaped by the waveform shaping network shown. The frequency of oscillation is controlled by the reactance valve V1A, whose anode voltage is controlled by the signal fed to its cathode via C1 and the output of the flywheel discriminator circuit applied to its grid. This type of circuit is widely used in colour receivers.

off frequency the resulting discriminator output change will alter the triode's conductance and thereby its apparent capacitance.

Such reactance valves basically function by being driven by a grid signal which is 90° at variance with the anode-cathode signal so that the anode current is in quadrature with the anode voltage and thus has a reactive component. The grid input signal lags or leads the anode signal according to the input phase splitting network, i.e. it may be inductive or capacitive, but in general as in this STC example the valve is arranged to operate as a variable capacitive reactance and simulates the effect of a voltage-controlled variable capacitor. Should the discriminator output voltage change the resulting bias change to the valve will alter its capacitive loading across the oscillator transformer.

With the circuit are two oscillograms showing the near perfect sinewave present at the reactance valve anode and the shaped switching waveform fed to the grid of the line output pentode via the 0·022μF coupling capacitor.

So much then for overall operation. Now what about fault diagnosis?

Failure to Oscillate

The great snag with this fault is that it results in the line output pentode running red hot due to absence of self-bias, while the boost diode, screen feed resistor, power rectifier and surge limiters will all be over-run. Quite frequently on servicing a set with no h.t. we have found the cause to be a burnt-out section of the surge limiter due to breakdown of the heater-cathode insulation of the boost diode, this in turn being produced by excessive temperature rise in the valve caused primarily by failure of the line generator to provide drive for the line output valve.

It therefore pays to substitute an old, low-emission pentode while testing or if the fault proves stubborn temporarily to remove the screen grid voltage or to replace the valve altogether with a plug-in base adaptor having a suitable value resistor wired across the heater pins. With line output valve heater voltages averaging 25V a 75Ω resistor should prove adequate.

The onset of oscillation can then be checked with a low-range a.c. meter connected from the line output pentode grid to chassis or in many instances by checking with a high-resistance d.c. meter connected from the generator grid to chassis to check for the reappearance of negative self-bias. If a self-biased valve fails to oscillate absence of bias will result in higher than normal anode current which in turn will lower the anode voltage; it is easy to assume wrongly that this symptom is the cause of the trouble. If a line generator stage fails to operate you can generally expect the anode voltage to be markedly lower as a coincident symptom in this way.

Most instances of complete failure to operate are due to a defective valve or defective a.f.c diodes, the latter particularly in Bush/Murphy receivers, with dry-joints or shorting solder blobs in printed circuits being runners-up. Certain Bush/Murphy models are particularly prone to defective a.f.c. diodes. The most common defects in components are shorting turns or poor winding-to-core insulation in blocking transformers, open-circuit coupling capacitors in cross-connected multivibrators or a short-circuit in the small capacitor shunted across the cathode resistor in multivibrators employing common cathode coupling.

Inability to Obtain Correct Frequency

This is a fairly common fault and usually develops gradually over a lengthy period of time, the correct line hold position moving nearer and nearer to one end of its travel until ultimately it becomes impossible to obtain satisfactory lock. In most cases the cause is value change in a resistor associated with the generator time-constant circuit, high-value small-wattage current carriers being the likeliest possibilities.

Remember, however, that in many makes of receiver there is a preset line hold control, usually mounted on the timebase panel, which enables the locking point of the main user control to be shifted towards centre. It may be a miniature potentiometer or compression trimmer and in 405-only models it is only necessary to place the main control in the centre of its travel and adjust the preset for correct lock.

In many dual-standard models there is a definite drill stipulated by the manufacturers. For instance in the STC sinewave oscillator models previously mentioned it is necessary to adjust the transformer dust core on 625 after short-circuiting the a.f.c. circuit and setting the line hold control to obtain +3V between the grid of the reactance valve and chassis. Adjustment is made on 405 by means of the preset trimmer associated with the oscillator transformer.

Preset Line Hold Setting

In the BRC 970 series the preset line hold is factory set and normally should not require further adjustment. However, should component replacement make it necessary the drill is to short-circuit the sync separator grid to chassis and adjust the 405 line hold control for an almost stationary picture. Remove the short-circuit and check that the picture breaks up when the control is rotated in either direction from the original position. If necessary adjust the preset line hold control to achieve this requirement. Reapply the sync separator grid short-circuit and adjust the 625 line hold control in the same way but do not alter the preset line hold setting. Finally remove the short-circuit.

No or Weak Sync Lock

Almost without exception this is caused by a sync separator or a.f.c. circuit defect and as such has been covered in other instalments. However, occasions do arise when sync feed components or d.c. amplifiers—where employed to magnify the a.f.c. discriminator voltage—prove defective. As it is directly coupled to the line generator a fault in the d.c. amplifier stage will cause a marked change in the line-lock position so when this symptom plus impaired sync lock simultaneously develop first replace the valve and then check operating voltages. In a d.c. amplifier no capacitors are directly involved and fault diagnosis is simply a matter of checking voltages.

TO BE CONTINUED

A NEW CENTRE FOR THE EDUCATION OF SCIENTISTS AND ENGINEERS

Not even a full year old in its new expanded site near Uxbridge, the Brunel University has already acquired a unique image in the eyes of industry, science (including social scientists) and engineering. The creation of such a technological university under the name of Brunel seemed a logical foundation. It is steadily moving from being a top college of advanced technology (which received its Royal Charter in 1966 and was then based at Acton) to an expanding centre of higher education. But it will be of that particular kind of knowledge that is directly and immediately related to the technological society of today.

Isambard Kingdom Brunel

But first what does the name "Brunel" convey? The famous Victorian Railway Engineer, of course. Every engineer of today, including readers of PRACTICAL TELEVISION, has a sneaking regard for the steam locomotive, its efficiency, its inbred expansion, its masterful noises and its contented purr as it comes to a halt. These were the sounds which were music to Brunel.

It was over a hundred years ago that Isambard Kingdom Brunel, Chief Engineer of the Great Western Railway, designer of the Clifton and Saltash bridges, the R.M.S. Great Britain, R.M.S. Great Eastern, the Maidenhead railway bridge and dozens of other marvels of engineering, passed close to Uxbridge in planning the great 7ft. 0½in. railway tracks to Bristol and to the West for the Great Western Railway. Carefully wending a *level* route between Staines and Uxbridge (which were awarded branch lines) it drove on through Slough (with a branch for Windsor) and aimed (more or less) for Bath and Bristol—then premier port for American shipping.

The name Brunel continued to have technical associations, latterly through Adrian Brunel (his great grandson) who wrote, produced and edited films at Bushey Film Studios in 1920 and later became a top film director with Gainsborough Pictures. I. K. Brunel's great great grandson, Christopher Brunel, continues the family's administrative and technical expertise with National Screen Service in evolving magical optical effects and apparatus for film montages, illusions and kinematographic hocus pocus.

The fact that the Brunel University is geographically situated between several film and television studios within the greater London area may have growing significance, advantageous to Brunel engineering logic and to film and TV professional know-how. Only a few minutes away by car are situated ATV, MGM (British) and ABPC studios at Borehamwood, Pinewood at Iver Heath, Intertel and London Weekend at Wembley, BBC (Ealing and Shepherds Bush), Shepperton Studios and Bushey Studios, which is where Adrian Brunel came in with the "British Actors" Film Company in 1920. That was in the great days of "glasshouse" studios, using daylight reinforced with a few arcs.

Brunel—Where & What it is

Brunel University's new premises are actually in Hillingdon, one mile south of the centre of the busy town of Uxbridge, a tiny little market town in the days of I. K. Brunel but latterly, 100 years later, a busy centre for commuters and light industries. The new university buildings were commenced in 1964 on a flattish site of about 170 acres and were opened in 1968 by Lord Beeching. The laboratories, lecture rooms and communal buildings, together with residential halls and playing fields, are planned as a single campus. However for the time being some sections of the university (including the departments of biology, chemistry, physics, polymer science and technology) will have to remain at the original home of the university at Acton until about 1971. There will then probably be a community of 2,500 or 3,000 students at the Uxbridge complex.

White Boards

Already the university is involving itself closely with technical industries, which are many and varied, particularly those in the area in which it is situated. At undergraduate level this involvement expresses itself in the organisation of courses that are based on the "sandwich" principle, with alternating periods of academic study and supervised training in industry. At the graduate level the advanced study courses are all directly relevant to local and national needs. Original research work is carried out and in many cases is based upon contracts between the university and research councils, government departments or private industry. A recent seminar was held at Brunel University under the heading of Scientific Photography, chaired by C. R. Cooper, the Head of the Central Unit for Scientific Photography, Farnborough. Both lecturers and students of Brunel played an active part at this first-class event, which featured slides, films, epidiascope and white boards (as distinct from blackboards—see photo). These were not just gimmicks; they were in fact the simplest possible improvement in presentation, easier to read than most blackboards I have peered at in the distant past.

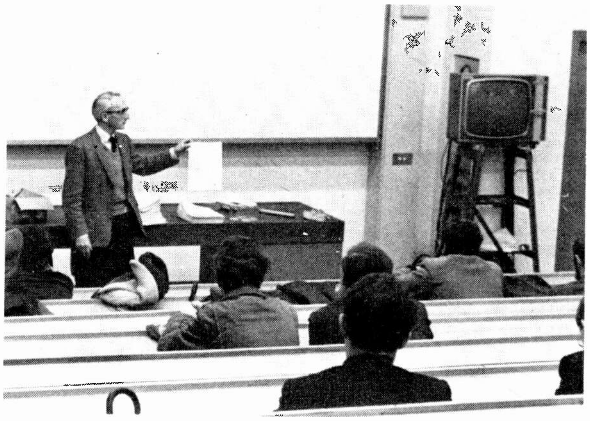
Industrial Training

It is a condition for the award of a first degree that a student has had a satisfactory industrial training, and the form of industrial training undertaken by each student depends upon the course taken. There are radical differences between the training given in the fields of applied sciences, engineering and the social sciences. The university intends to ensure that students are engaged in their industrial and practical periods at their level of ability and attainment. Naturally the demand on ability increases as the course progresses.

Television & Audio Visual Division

Readers of this journal will be interested to hear a little about the activities of the Audio Visual Division of the university. This occupies a studio about 25ft. square, with vidicon TV cameras, 16mm. film cameras and telecine, synchronised magnetic tape sound recorders, monitors, waveform monitors—and a variety of lighting equipment. They are at present preoccupied in helping, by film, tape or photographic means, the work carried out in other divisions. It exists primarily to provide service for teaching (especially through TV) and is also, with the Department of Education, investigating the use of visual aids in teaching. Students in the Audio Visual Division of Brunel are not under the delusion that they are all potential D. W. Griffiths or Mack Sennetts, nor that they only need to phone Bert Easey, Head of Pinewood's camera department, to become lighting cameramen earning huge salaries. First they must learn how to avoid causing negative scratches when (as "clapper loaders") they join a film camera unit.

I was particularly impressed with the layout of this very first audio-visual department. It was pleasing to note that compatibility between the 1in. gauge videotape (helical scan) recorders was good, and that the recorded lectures (or other material) could be played off at some of the other educational organisations—such as the Inner London Educational Authority. This standardisation of gauges and modes of ½in. and 1in. videotape is now being investigated by the British Standards Institution, Committee TLE/22/2. There are 23 different helical scan videotape standards now being used in British educational establishments, and a technical committee for making compatibility decisions was not constituted until March 1968—five years too late and with millions of pounds poured down the drain. It would be advantageous in this age of technology for the positions of Minister of Education and Science and his Civil Service and Arts advisers to be occupied by properly trained engineers. Grants to amateurish do-gooders usually cost four times as much as the job would if carried out by professional engineers.



A Brunel lecture in progress. Note the white "blackboard" and television monitor.

Undergraduate Courses

In giving my report to readers of PRACTICAL TELEVISION I may have given an impression that Brunel is a super-crash "sandwich" course organisation, a kind of extended night school. If so I must put down the main and important undergraduate courses available and their principles: (1) they extend over four years; (2) they can be of the "sandwich" type, students spending approximately 6 months in each of the first three years in appropriate industrial training; (3) they lead to the degree of Bachelor of Technology (B. Tech.).

The Brunel University Television Service has produced several series of technical courses on helical-scan videotape. These cover metallurgy, mechanical engineering, first aid, polymer technology and physics for engineers. The last-named course is in 20 lectures as follows and was presented by Dr. B. R. Orton: (1) The nature of the atom. (2) The nucleus. (3) Measuring the nuclear mass. (4) The interaction of alpha particles with matter. (5) Models of the atomic nucleus. (6) Radioactivity—alpha, beta and gamma rays. (7) Radioactivity—laws of radioactive decay. (8) Radioactive decay and nuclear fission. (9) Nuclear fission and nuclear reactors. (10) The dangers and uses of radioactivity Part I. (11) The dangers and uses of radioactivity Part II. (12) Quantum physics and photoelectric effects. (13) The Bohr atom. (14) Electron spin and space quantization. (15) The laser. (16) The ruby and semiconductor laser. (17) Holography. (18) The wave mechanical view of the atom Part I. (19) The wave mechanical view of the atom Part II. (20) The electron microscope.

With such a set of titles it is a national calamity that the circulation of these kinds of educational productions are restricted by non-compatibility in videotape gauges and modes of operation. The civilised attitude of the governing body, executive and administration of Brunel University, headed by the Rt. Hon. Earl of Halsbury, have already accomplished much in a very short time. They are now likely to keep Brunel on a broad gauge to the future. ■

TRANSISTORS IN TIMEBASES

PART 1

H. W. HELLYER

COMPLETELY transistorised television receivers are still rather a rarity. It is as long ago as 1960 that we saw the then revolutionary fully-transistorised (save for the e.h.t. rectifier) design by Perdio, about which more later. There followed one or two tentative designs with sections of the circuitry transistorised, and then Thorn made their usual exciting contribution to progress with a receiver that appeared to go all the way towards solid-state production. There was some niggling argument within the trade as to whether one could really call an e.h.t. rectifier a valve, and this seemed to be the last hurdle to be cleared. Yet though the completely transistorised TV set is a tenable proposition, there are remarkably few on the market.

One reason for the slowness of development is difficulty in the design of the timebases. This really is the tricky part of the circuit for semiconductor technology to overcome and, in an effort to discover why, this series of articles will take a look at some past and present fashions in transistorised timebases, and a glimpse or two into the future.

PULSED OPERATION

Timebase applications require that transistors operate as switching devices, that is as non-linear rather than linear amplifiers. Whereas the usual aim is to preserve fidelity of waveform shape when amplifying—and designers go to a great deal of trouble to this end—the timebase amplifier handles a pulse and may offer at its output a waveform of quite a different shape. Quite often the important factor is not so much the shape as a whole but the time taken for changes of the edges of the pulse waveforms to occur.

These switching transistors have different operating conditions from normal amplifiers. Inductive loading is more often the case and despite large voltages and currents the total power dissipation is fairly low. Whereas a Class A amplifier operates continuously at maximum dissipation, the switching transistor is either held non-conducting (the "off" condition) by a reverse bias applied to its base-emitter junction, or is held fully conducting (the "on" condition) by forward base emitter junction bias, and since in this latter condition the collector-emitter resistance is very low so that there is only a very small voltage drop across it there is very little dissipation. With no base-emitter junction bias applied collector-emitter leakage current flows; but with reverse base-emitter junction bias applied only the very small collector-base leakage current flows.

In the simplest case as shown in Fig. 1(a) if the emitter is held at zero potential and a negative-going pulse is fed to the base-emitter junction then the transistor will switch on and the collector voltage will fall almost to chassis potential so that a similar but larger amplitude pulse is produced across the load resistor. If the input pulse is sufficiently large this fall in collector voltage *Vc* will approach chassis potential as the transistor conducts more and more heavily until the transistor is said to "bottom". In this condition collector current is maximum and *Vc* minimum.

SWITCHING SPEED

Switching transistors spend most time either "off" or "bottomed", seldom dissipating power, so they run well within their power limits providing the drive is maintained and the collector current limited by repetitive switching. Therefore switching speed becomes an important factor.

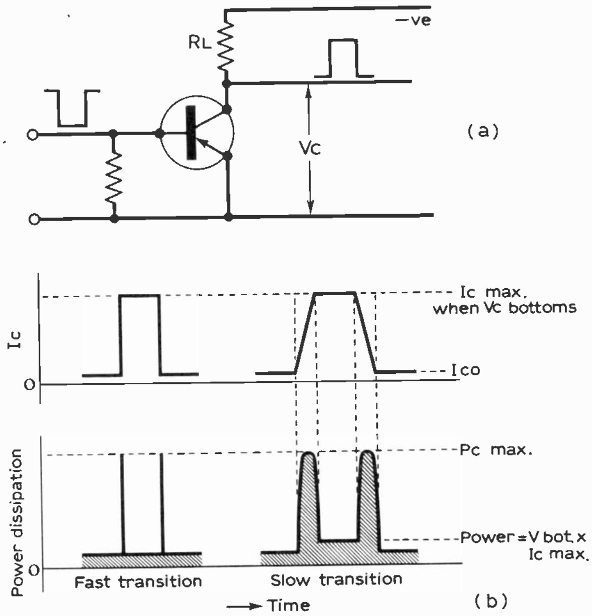


Fig. 1: (a) A simple common-emitter stage. Biasing is imposed by the input load and the operating conditions are such that the transistor is held cut off until an input pulse arrives. This drives the transistor hard into conduction so that it "bottoms," i.e. collector current is maximum and collector voltage minimum. (b) Poor high-frequency response, caused by input circuit design or a faulty transistor, results in loss of steepness of the pulse edge, i.e. slower transition. This results in greater power dissipation, as shown at bottom right.

By switching speed we mean the rate of transition from one state to another—from " off " to " on " in effect—rather than the rate of repetition of the incoming pulses. To demonstrate the importance of transition time Fig. 1 (b) shows two different graphs of collector current plotted against time with, below, the resultant power dissipation. The first is for a near-perfect transistor with only a small leakage current thus giving rise to a very small total power dissipation when a pulse with sharp edges is applied to it. But the same transistor faced with pulses whose verticals slope appreciably as shown on the right will dissipate much more power per pulse; the dissipation rises as shown to a peak about half-way through the transition periods—from off to on and similarly again from on to off. In both cases the peak power is actually the same, and so is the collector current in this example, but it is the *mean power* that is the damaging factor.

This is a cumulative thing: greater dissipation causes heating, this impairs the transistor's efficiency and reduces its switching ability. The high-frequency response of the transistor, as indeed of the associated circuitry, must be adequate to preserve these fast transitions, and the waveform presented to the transistor must be as near perfect as we can get it.

IMPROVING SWITCHING SPEED

Which makes it seem a little like cheating when we see tricks like " sharpening-up " or " speed-up " capacitors employed in timebase circuits. These are intended to compensate for the inevitable slowing-down effect which the transistor has on the pulse as it passes through. These capacitors and certain kinds of tuned circuit have the effect of distorting the waveform and must be carefully chosen so that the amount of distortion they provide balances the anticipated loss. Other methods of ensuring sharp transitions include driving the transistor hard and from a low-impedance source. The hard driving makes sure of bottoming, and the low-impedance input reduces any effect the input capacitance of the transistor may have on the drive waveform. Transformers with step-down ratios will be found. especially in line output and videotape recorder pulse circuits, or a preceding emitter-follower stage may be seen.

The use of the sharpening capacitor is shown in Fig. 2. To understand this fully we need to delve a little into the physics of the transistor and consider the storage effect. Different conditions exist when switching " on " and when switching " off ". In the first case the starting base input current has to charge the base-emitter capacitance and to overcome the Miller effect the magnitude of which will depend on the collector voltage swing. This charging current is in addition to that needed for bottoming, but the transistor will not conduct fully until this charging process has occurred. Short though the time may be, it slows down the switching time available, so the speed-up capacitor C helps by providing a surge of base current when switching " on ".

STORAGE EFFECT: TURN-OFF DELAY

When the transistor is switched " off ", however. the storage effect is of importance. Two factors need to be considered here. First there is a delay after the cessation of the input to the base representing

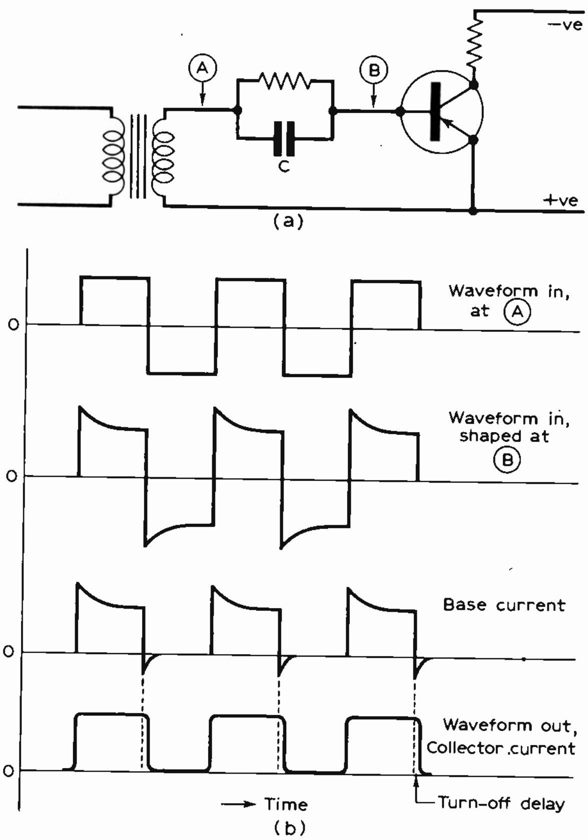


Fig. 2: (a) The input pulse can be sharpened by the use of low-impedance input loading and by a speed-up capacitor C at the base input. (b) The waveforms at A and B above, showing the pulse sharpening effect of the speed-up capacitor. The resultant base and collector current waveforms are also shown.

the time taken for the carriers in the base region to reach the collector region and recombine, i.e., for the charge in the base region to be dissipated. Secondly there is the fact that a transistor when bottomed has, unlike a linear amplifier, its collector junction forward biased. This means that there is considerable injection of carriers across the base-collector junction so that the transistor must consequently be driven hard " off " if the collector current is to be quickly reduced to the small amount of leakage current flowing when the transistor is switched off. The term storage effect is used to describe this fact that carriers are still moving in the base and collector regions, forming a flow of collector current, for a period after the base input to the transistor has ceased. The speed-up capacitor helps at switch off by providing a reverse spike on the base current waveform.

PRACTICAL WAVEFORMS

Figure 2(b) shows waveforms at the marked points of the circuit and demonstrates the way the output waveform is produced by the change in collector current. In the best of all possible worlds it is not a feasible proposition to obtain a true squarewave, some rounding of corners being inevitable. Fortunately we can ignore some of their effects by choosing our zero line carefully and by concentrating on the vertical part—the transition rather than the flat-tops—of the waveform.

SYNC SEPARATOR STAGES

Often these fast-switching circuits are deceptively simple, and it is in exact operating conditions and close tolerance of components that the operation is maintained within the required limits. Take as an example the almost rudimentary-seeming sync separator circuit shown in Fig. 3. This is the Pye Model TT1, a fully-transistorised TV receiver

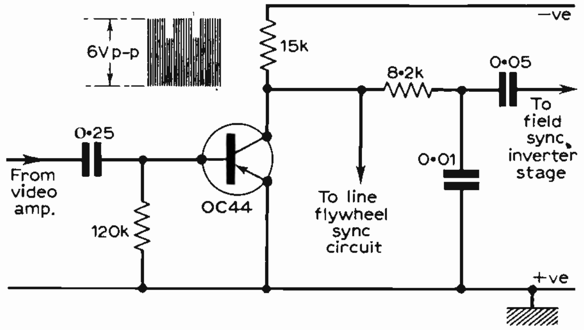


Fig. 3: An early transistor sync separator stage, used in the Pye all-transistor Model TT1 released in 1961. This is a deceptively simple circuit. The transistor acts as a clipper, removing the video content of the input waveform to allow through only the sync pulses.

released in 1961. Here we have an OC44 with the composite video signal derived from a tapping on the video output stage collector load. During the sync period the negative-going signal drives the transistor hard into conduction and a sharp positive-going sync pulse appears across the collector resistor. At the same time the flow of base current charges the base capacitor, which leaves the base in a biased-off condition when the signal returns to sync base level on the positive-going trailing edge of the sync pulse. The timebase circuits are thus effectively buffered from the video signal. The secret is in the exact choice of components to suit a particular transistor.

PHILIPS T-VETTE CIRCUIT

In the Philips circuit used in the T-Vette portable receiver, which is fully transistorised, an OC44 is again used as a sync separator, but a very different approach can be seen as shown in Fig. 4. Here the video drive also feeds the a.g.c. system, an emitter-follower being employed to supply control voltage and video drive current. Therefore a.c. coupling is necessary to take off the signal for the sync separator without affecting the driver stage. Under these conditions noise could upset the sync badly on weak signals so current limiting is used to clip the noise on sync peaks. The a.g.c. preset control is set to give the amplitude of signal needed for efficient clipping.

PYE V710A

A circuit that merits a mention even if only because of its peculiarity is the lonely transistor sync separator of the Pye Model V710A which came out in 1962. This is shown in Fig. 5. Nestling amid a fairly conventional valved circuit we find an OC45 connected as a common-emitter stage but biased-off

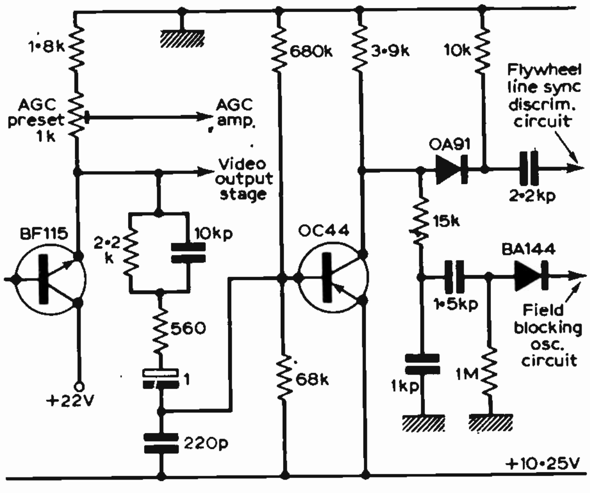


Fig. 4: In the Philips T-Vette portable television model the OC44 sync separator stage is driven by the video emitter-follower stage, a.c. coupling being used. The emitter-follower also drives the a.g.c. amplifier stage and provides peak signal clipping to reduce the effects of noise on the sync separator under weak signal conditions.

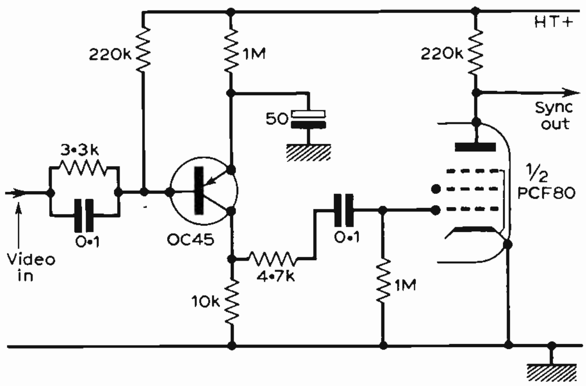


Fig. 5: The only transistor in an otherwise conventional chassis used in the Pye Model V710A was this OC45 sync separator stage. It was followed by a pentode sync pulse amplifier stage.

by the combination of the base tapping and the presence of the 0·1μF capacitor in the base input circuit which is fed from the cathode of the video amplifier. The sync pulse output is applied to a sync amplifier, which is the pentode section of a PCF80, and one cannot help thinking this was used simply because it happened to be available in the valve line-up. For various reasons the V710A was not a favourite among field engineer's jobs, and it is feared that many an OC45 was cursed and changed when the faults causing poor sync conditions probably originated elsewhere in the circuit. It is a general rule, even among the timebase transistors, that the semiconductor itself is not the first suspect if faults occur.

PERDIO PORTARAMA

Simplicity is again the keynote of the sync separator circuit of another early fully-transistorised set, the Perdio Portarama. This portable model was way

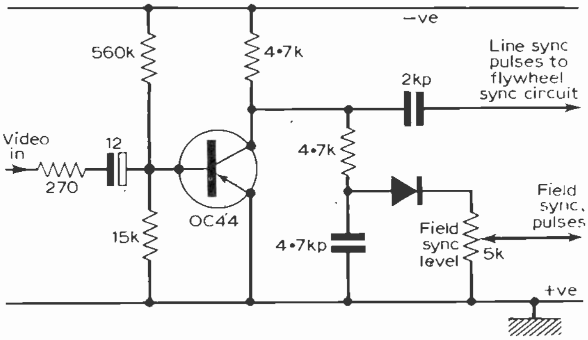


Fig. 6: The Perdio Portarama all-transistor portable model used an OC44 in another of the simple input-charge type of circuit. For all these circuits regulation of the rail voltage is essential as the circuit operating conditions are as important as the component values.

ahead of its time and contains a number of features to which we shall refer in later articles. The sync separator stage, again using an OC44, is shown in Fig. 6. The base is biased by the tapped, fixed potentiometer (560kΩ and 15kΩ) but the operation relies upon the presence of the signal for the additional bias for correct conditions. This is achieved by the diode action of the base-emitter junction, giving d.c. restoration of the sync tips. Positive-going sync pulses appear across the collector load and are fed to the line flywheel sync discriminator circuit and via a sync-level control to the field oscillator.

SONY TV306UB

Finally another deceptively simple circuit from a more exotic source, the Sony Model TV306UB, where the circuit configuration (Fig. 7) may look unfamiliar but can be analysed in much the same way as before. A 2SC402 npn transistor is used as a form of clipper, taking off the composite video signal

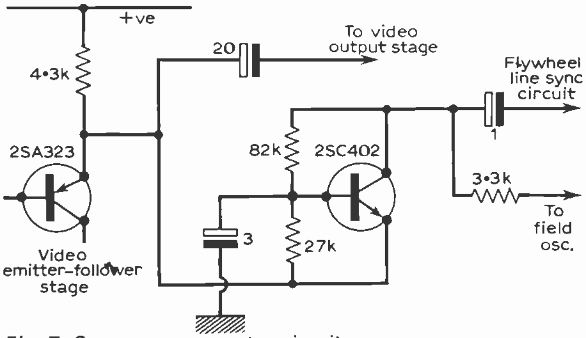


Fig. 7: Sony sync separator circuit.

from the emitter load of the second video amplifier and relying upon the self-biasing action of the shunt resistors and the 3μF electrolytic base return capacitor for the correct cut-off point. This particular circuit is also used with the equipment employed to monitor the videotape recorder with which Sony have had such a resounding success, and which has been the subject of earlier articles in these pages. As an example of transistor techniques it should justify a close look from us in succeeding articles and, if space allows, we shall study both the camera and videotape recorder timebase circuits in some detail.

TO BE CONTINUED

PRACTICAL AERIAL DESIGN PART 4

A. J. WHITTAKER

FOR the reception of Bands IV or V in fringe areas or areas of difficult reception an improvement can often be made by fitting a mast-head amplifier. These amplifiers are fully transistorised and fitted in a weatherproof box or container. They employ a high-gain, low-noise transistor and have a magnification of between 10 and 14dB (i.e. 10dB=1:3 and 14dB=1:5). Power is fed to the mast-head amplifier via the coaxial feeder, the requirements being typically 16-18V at 3-4mA. The input and output impedance is 75Ω.

DIPLEXERS

Diplexers are high- or low-pass filter circuits designed to allow two or sometimes three aerial systems to be connected to a common downlead feeding the television set. Fig. 1 shows the arrangement with two aerials, Bands I and III, connected to a common feeder. The filter takes the forms shown in Figs. 2 and 3, Fig. 2 being the low-pass section and Fig. 3 the high-pass section.

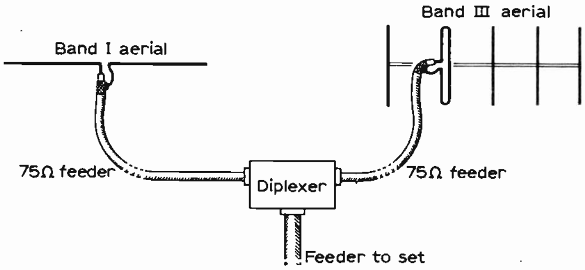


Fig. 1: Use of a diplexer with separate Band I and III aerials so that a common downlead can be employed.

The low-pass section is so called because it is designed to pass the lower frequency television signal in Band I and to reject the Band III frequencies. It is thus connected to the Band I aerial. The filter is desgined so that at Band III frequencies the inductive reactance of L1 and L2 is high and the capacitive reactance of C1 low. In this way the filter impedes any Band III signal currents that may try to get through to the feeder. The filter is actually a transmission line in itself, having "lumped" inductive and capacitive components. When the filter is correctly terminated by a resistive load of 75Ω the circuit resonates and forms an effective short-circuit to the unwanted signal. This occurs at the crossover frequency of the filter section.

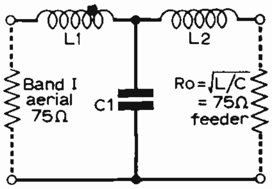


Fig. 2: Low-pass filter.

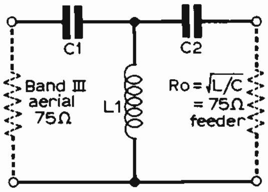


Fig. 3: High-pass filter

The high-pass section shown in Fig. 3 is designed to pass frequencies in the higher television Band III. The capacitive reactance of C1 and C2 is low to frequencies in Band III and the inductive reactance of L1 is high. Thus the filter forms an easy path to these frequencies. For television frequencies in Band I the filter forms a high impedance. When the section is correctly terminated by a resistive load of 75Ω it again resonates at the crossover frequency, effectively shorting the unwanted signal.

For the low-pass filter the values of *C* and *L* can be found from the formulae:

$$C=1/(\pi f_c R_0) \text{ and } L=R_0/(\pi f_c)$$

where *C* is in farads, *L* in henrys, f_c is the crossover frequency (Hz) and R_0 the termination load in ohms. π is 3·14 approximately.

For the high-pass section the formulae are as follows:

$$C=1/(4\pi R_0 f_c) \text{ and } L=R_0/(4\pi f_c).$$

The working of these devices is complex and this is made more so because of the change in aerial reactance at the end of the channel over which it is designed to work. At the high-frequency end the aerial will be inductive whilst at the low-frequency end it is capacitive. In these regions of the transmission bands there will be a partial mismatch between aerial and diplexer with a consequent rise in v.s.w.r. (voltage standing wave ratio). However the aerial will remain sensibly resistive over most of its passband and will present a 75Ω load to the filter. The diplexer unit will in turn remain sensibly flat over the desired channel passband but will, theoretically, short-circuit the unwanted signal at the filter crossover point where it resonates. Fig. 4 shows a typical bandpass characteristic for a diplexer for Band I and III working. The loss is 1dB maximum and the attenuation 20dB/octave.

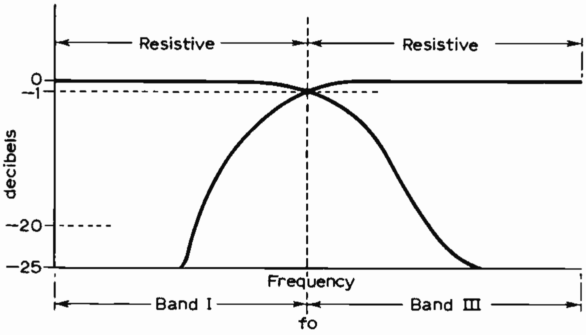


Fig. 4: Typical diplexer bandpass characteristics.

Diplexers are also available for u.h.f./v.h.f. working. The high-pass filter is the u.h.f. section and the low-pass the v.h.f. section. Triplexers are filter units designed to accept Bands I, II, III signals, or a combination of u.h.f. and v.h.f. signals. In practice printed circuit techniques are employed, with the coils printed into the circuit configuration.

TV SIGNAL DISTRIBUTION SYSTEMS

Television signal distribution systems are many and varied and only a typical system can be discussed here. Where it is necessary for example to feed a block of flats or a housing estate from one common aerial system a distribution system capable of receiving Band I, II, III, IV, V signals and transmitting these over feeder lines to blocks of flats or individual houses as applicable must be provided. Figure 5 is a block schematic diagram showing the general arrangement of units in a typical v.h.f. distribution system (some relay systems convert all incoming signals and feed them at h.f. over twin-pair feeders to subscribers).

The translator unit is a frequency changer device which converts the u.h.f. carrier frequency to a lower one suitable for transmission over long feeder lines (necessary because u.h.f. signals cannot be sent along long line lengths). The u.h.f. picture intelligence and line structure are of course retained. Any single channel in Bands IV or V is converted by the translator to any single channel in Band I or III. It does this by changing the carrier frequency and producing a v.h.f. "intermediate frequency" signal in Band I or III. This is further amplified by the main line amplifier and transmitted down the feeder to the distribution outlets. The circuit employed is typically all-transistor, employing low-noise, high-gain devices with two stages of r.f. amplification followed by a mixer with a crystal-controlled oscillator.

The main line amplifier is usually designed to accept two Band I, three Band III and one wideband Band II f.m. radio input. In Bands I and III narrowband amplifiers comprising a single-channel two-stage amplifier which can be adjusted to accept a converted 625-line signal are used. The v.h.f./f.m. radio channel has a bandwidth wide enough to cover all BBC transmissions on Band II. The output of the six separate amplifiers is combined in a four-stage wideband amplifier and thence fed to the output terminals. The low-level output is typically −20dB down on the high-level output (i.e. 10 : 1). The overall gain of the wideband amplifier is nominally 40dB on the television channels and 34dB on the f.m. radio channel. The bandwidth of the input amplifiers is typically 3·5MHz on Band I and 6MHz on Band III while the f.m. channel is typically 7MHz. The bandwidth of the wideband output amplifiers is typically 40MHz to 220MHz. The output impedance is 75Ω and noise less than 8dB.

Repeater amplifiers are required to amplify signals at a point in the distribution system where the strength of the signal has fallen to too low a level for practical distribution. A typical repeater amplifier employs four stages of solid-state, wideband amplification. The power supply is via the low-level signal input line obviating the need for separate cables. A nominal specification for a line repeater amplifier may be gain 30dB (1:31), bandwidth 40MHz to 220MHz, maximum output 250mV r.m.s., cross-modulation better than −46dB (i.e. 200 : 1), input and output impedance 75Ω, noise better than 7dB and power supply 4 to 5W.

The power supply usually has a double-wound transformer for mains isolation and power consumption of 65VA at 2·5A loading. All circuits should be amply fused and a warning lamp included to indicate a fault on the output line.

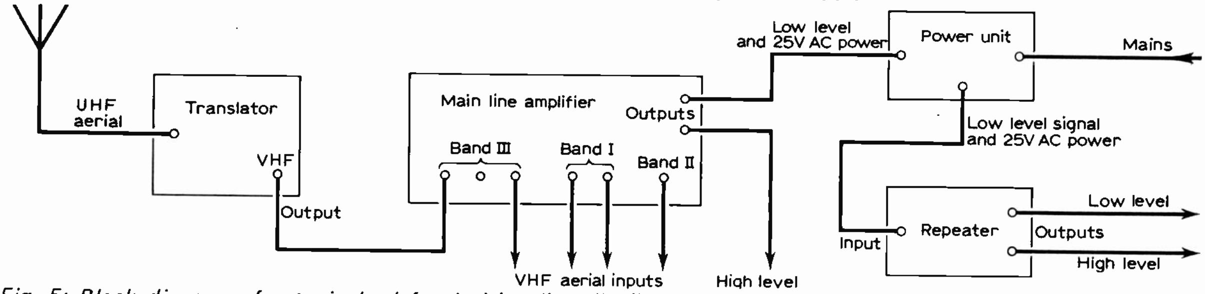


Fig. 5: Block diagram of a typical v.h.f. television line distribution system.

Correction: The example of a Band IV/V Yagi aerial given in Part 3 was worked out for channels 44 to 51. This should have been channels 41 to 51, i.e. a bandwidth of 88MHz. The mid-band frequency is thus 674MHz and the calculations should be amended accordingly.

TO BE CONTINUED

SERVICE NOTEBOOK

G. R. WILDING

Excessive Height

Excessive height was the complaint with a modern Style 70 dual-standard Philips receiver and on inspection it was found that even with the height control at minimum the raster was excessive. We also noticed that vertical linearity was bad and that intermittently there appeared a series of small white spots which formed sloping lines across the raster towards the base.

The field output valve in this model is a PCL85, and as these types have been giving some trouble recently we first tried a new replacement. Results were exactly as before so we next tried altering the two linearity presets to see what effect they produced.

The main linearity control is in series with a 120kΩ resistor connected across the input to the valve's pentode section and operated normally, but we found when adjusting the "top" linearity preset that it had no real effect till about one third from maximum when it suddenly reduced height to normal proportions and also completely removed the intermittently appearing spots. There was obviously a break across the miniature carbon track and on replacing this component the height could again be normally adjusted by the vertical amplitude control.

As this "top" linearity control feeds a negative feedback voltage from the field output transformer to the output pentode control grid it would appear that the spots were caused by slight arcing across the break in the track during the flyback period.

When investigating almost any kind of field trouble—varying height, poor interlace or even weak locking—it always pays to check the operation of the presets for even if not faulty they can frequently indicate where the defect lies. Most instances of spasmodically varying picture height are due to a badly contacting preset slider, but if the track is carefully cleaned and a spot of contact lubricant grease applied this will usually restore perfect rotary contact.

Distorted Sound

WE CAME across a GEC Model 2000 the other day which had distorted sound at all volume levels with the distortion level increasing after the set got really warm. The volume was below normal. The set uses an EH90 heptode acting as locked-oscillator detector on 625 and as audio amplifier on 405. The circuit is shown in Fig. 1. On 625 anode current variations depend on the phase relationship between the input signal which is applied to the first control grid and the locally generated 6MHz signal which is developed across the tuned circuit L3, C7 connected to the second control grid. Thus the f.m. input is demodulated. On 405 the "local oscillator" section is made inoperative and the u.h.f. sound feed is virtually shorted out.

The PFL200, from the screen grid circuit of which the EH90 derives its anode supply, the output

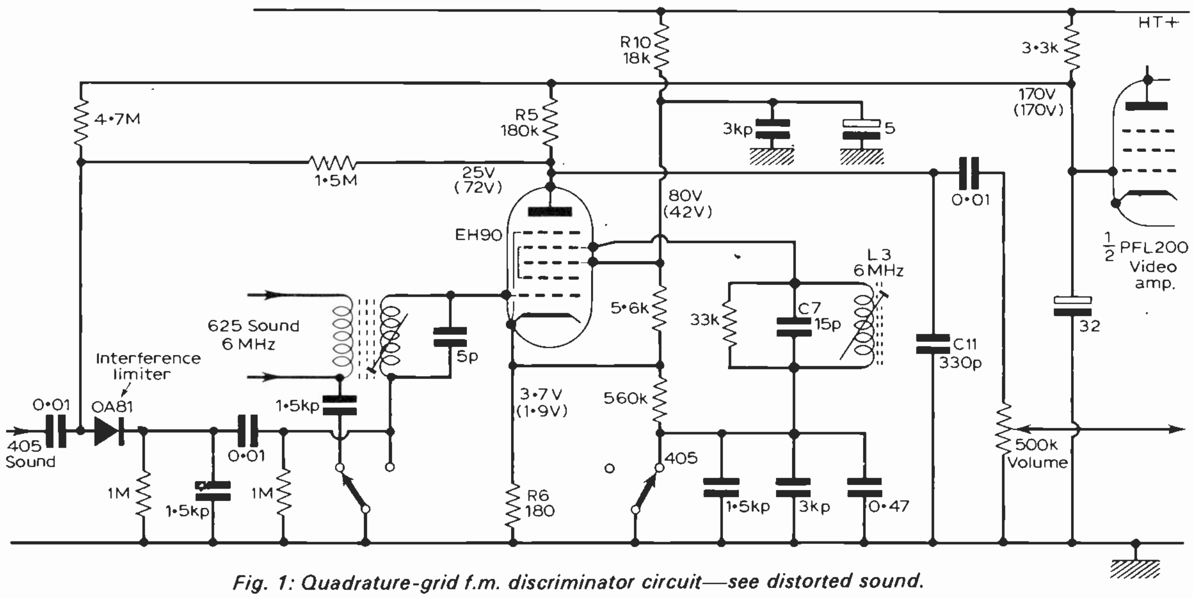


Fig. 1: Quadrature-grid f.m. discriminator circuit—see distorted sound.

pentode and the EH90 were found to be in order. Voltage readings were then taken and those obtained, with the correct readings in brackets, are shown in Fig. 1. All voltages were incorrect and the greatly reduced anode voltage was felt to be the main cause of the distortion and reduced volume. As the PFL200 screen voltage was correct the low EH90 anode voltage could be due to R5 being high, C11 leaky or excessive EH90 anode current. However, if R5 or C11 had been faulty in this way the screen current would have increased since it would have comprised a greater proportion of the cathode emission and the screen voltage would have fallen due to the increased current through R10. As it was the screen voltage was almost doubled.

The increased cathode voltage confirmed that the valve was passing excessive current. If this increase in cathode voltage had been caused by an increase in the value of the cathode bias resistor R6 both the anode and screen voltages would have increased. On the other hand an increase in screen voltage caused by R10 falling in value would account for all the voltage changes. Pentode and heptode anode currents are largely determined by screen voltage—note the effect on the line output stage when the screen voltage is increased. Excessive current through the EH90 would also account for the increased distortion as the valve overheated. R10 was removed and found to have decreased in value from 18kΩ to about 4·5kΩ Its replacement restored correct voltages and normal sound.

Erratic Height

A PARTICULARLY annoying fault for the viewer and often very difficult to localise quickly is a picture that spasmodically varies in height by a fraction of an inch or so at top or bottom of the raster—or both. Obviously caused by a minor variation in voltage or component value or an intermittent slight capacitor leakage, the small and irregular nature of the fault generally involves considerable bench time.

Once valves have been eliminated it is good policy to check the miniature linearity presets, especially if they are of the open type, for bad contact between slider and track due to dirt and grease makes stable height impossible. If the amplitude variation occurs towards the base of the raster the first suspect however must be the cathode electrolytic decoupler, and the best practice is to replace it automatically.

When presets and electrolytics have been eliminated the next move is to prod around the field circuit putting light pressure on any resistors that show discoloration and replacing all capacitors that seem affected by heat or whose wax coating seems particularly tacky. If you have all the values of components to hand, follow manufacturer's standard practice and replace every possible. I mention having the values to hand because in field timebase circuits component values must be strictly adhered to or you will have difficulty in getting good linearity, adequate height and good sync locking. Nothing is more frustrating than removing a suspect capacitor, possibly damaging it in the process, and finding on reading its value that you haven't got an exact substitute. So consult the service sheet and stock up first.

We had an example of this type of fault recently in a Ferranti 19in. model which had had most

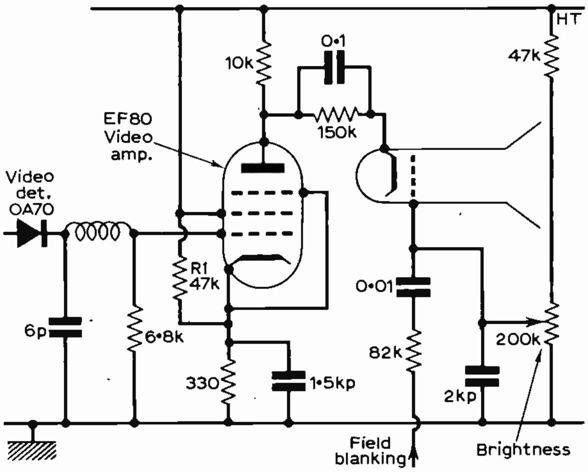


Fig. 2: See video bias stabiliser resistor.

possibles replaced by the outside engineer. The fault still persisted spasmodically however so it had been brought in for a bench test.

The first thing we noticed was that although the tube was only some months old it lacked the expected sparkle and that when height variations occurred brilliance level varied slightly. This immediately raised suspicions that the tube had a slight intermittent leak from the first or the focus anode to an earthed point, since the resulting increased boost h.t. current would slightly reduce the boost h.t. voltage and thereby the field generator anode voltage. Coincident brilliance and height variations could on the other hand be caused by an intermittent defect in any component associated with the boost h.t. supply.

However the reduced sparkle from the tube was the deciding factor and in this particular model it did not take a great deal of work to "hook-up" to another tube. On test with the other tube height remained rock steady proving the existence of an intermittent leak in the original tube.

Video Bias Stabiliser Resistor

A NUMBER of 405-line only receivers employed the type of video amplifier arrangement shown in Fig. 2, with direct coupling between the video detector and video amplifier grid and between the video amplifier anode and c.r.t. cathode, the video amplifier bias being stabilised by a resistor. R1 in the diagram, connected between h.t. and the video amplifier cathode. This resistor can change value and in a recently encountered Alba model had reduced in value from 47kΩ to 33kΩ. This increased the video amplifier cathode voltage so that it was biased close to cut-off. The resulting fall in anode current and increase in anode voltage reduced the set's brilliance level and resulted in both the sync pulses and low-amplitude (dark) picture signals being amplified on the curved, flatter part of the valve's characteristic curve. Timebase locking was thus impaired and it was difficult to separate the darker Test Card squares. The reduced sync pulse amplitude could also have impaired a.g.c. action because of the reduced sync separator grid bias. Change in value of this component can therefore cause a number of faults.

TO BE CONTINUED

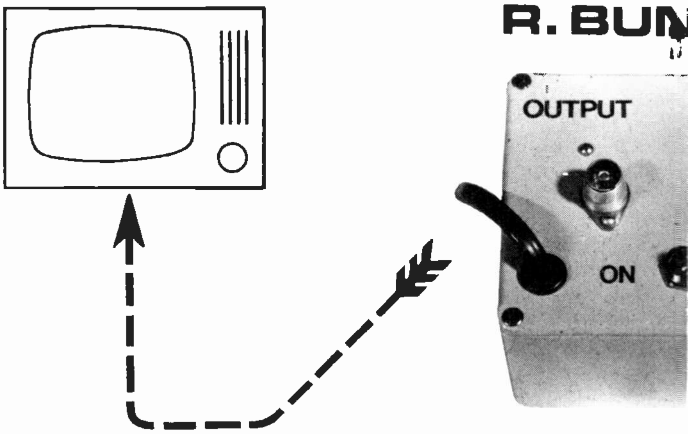
AERIAL

for DX re

R. BUN

RECENTLY featured in these pages was an aerial having omnidirectional reception characteristics and suitable for use as a simple array for DX work. Because of the design of such an array it does not provide much gain and consequently the preamplifier described here will be of great interest to enthusiasts using this type of aerial or indeed to any DXer who needs a Band I preamplifier for use with his normal directional array.

The amplifier covers the main channels in Band I for Sporadic E reception, from about 48MHz to 64MHz. The gain over this band is maintained at around 26dB and the noise figure is around 5dB. These figures were obtained from comparison with a commercial two-transistor preamplifier with known performance figures. Below 48MHz the gain drops but there is reasonable performance down to 41·25MHz (ch. F2 sound). Similarly above 64MHz the preamplifier has a measure of gain up to 67·75MHz (ch. E4 sound).



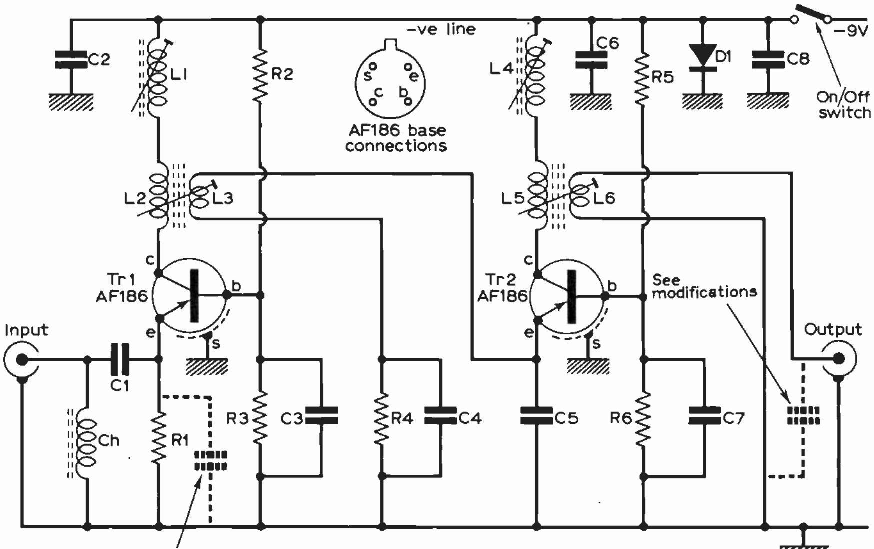
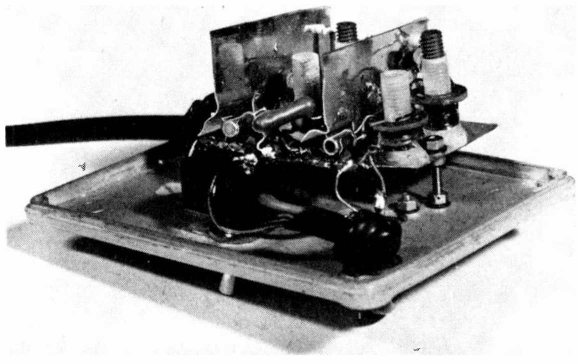


Fig. 1 (left): Circuit diagram of the Band I DX preamplifier.

Circuit Description

The circuit is shown in Fig. 1 and as will be seen the AF186 biasing is the conventional Mullard recommendation for this type of circuit. The collector of each transistor has two separately tuned coils, the one nearest the collector being tuned to the h.f. end of the band and the coil farthest from the collector to the l.f. end of the band. Inductive coupling is used between the first and second stage and similarly to the output socket. With this type of transistor it is important that the emitter/base is screened from the collector and this is accomplished by using a transistor clip soldered to the chassis, adjacent to a metal screen, the AF186 connections being soldered to the appropriate points either side of this screen. Reference to previous issues of PRACTICAL TELEVISION in which this type of circuitry is used (August/September 1968 and October 1965) will explain the full mechanical construction. Fig. 2 shows the physical arrangement.

A v.h.f. choke is fitted across the input to prevent any breakthrough from strong radio transmissions, which can occur with an untuned input. If a locally sited transmitter still produces radio breakthrough

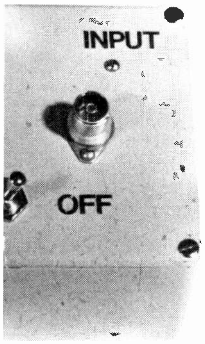


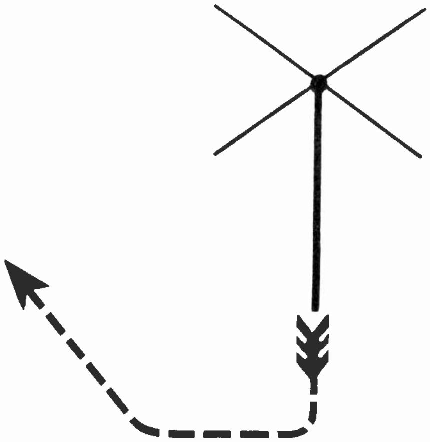
The interior of the prototype. Note the aluminium screening between the input and output circuits in each stage. The collector and shield connections are taken to one side of the screen, the base and emitter connections being taken to the other side.

REAMP

ception..

INEY





this can be completely eliminated by using a high-pass filter such as the GPO type FS38A.

The silicon diode fitted across the switch (D1, Fig. 1) is optional. It merely shorts the voltage supply should the connections be inadvertently reversed, thus protecting the transistors.

The prototype preamplifier is fitted in an Eddystone diecast box—it is essential that the amplifier is mounted in a tin or metal case in order to obtain good screening. The preamplifier is very stable and during the winter months gave a good account of itself despite the mainly poor DX conditions.

★ components list

Resistors:

R1	1kΩ
R2	12kΩ
R3	4·7kΩ
R4	1kΩ
R5	12kΩ
R6	4·7kΩ

All 10% ¼W

Capacitors:

C1	200pF
C2	1000pF
C3	1000pF
C4	1000pF
C5	10pF
C6	1000pF
C7	1000pF
C8	10,000pF

All ceramic 500V d.c. working

Micellaneous:

C V.H.F. choke
2 coaxial sockets,
metal case,
s.p.s.t. toggle switch

Semiconductors:

D1	BY100, BY101 etc.
Tr1	AF186
Tr2	AF186

Coil details:

4 ¼in. coil formers with dust cores and coil connecting tag strip

L1, L4	12 turns close-spaced
L2, L5	8 turns close-spaced
L3, L6	3 turns close-spaced wound over L2 and L5

All coils wound with 24 s.w.g. enamelled wire

Noise generator circuit components:

C1	470pF ceramic
C2	1000pF ceramic
R1	10kΩ ¼W 10%
R2	120Ω ¼W 10%
D1	1N21

Coaxial socket and s.p.s.t. toggle switch

Alignment

To align the preamplifier the h.f. coil in each stage is tuned first and the l.f. coil second. The use of a noise generator will considerably assist in the alignment and the circuit of a simple noise source is shown in Fig. 3. The output of the noise generator is fed into the preamplifier and the output of the preamplifier fed into the receiver, the amplifier being aligned to give an equal noise signal on the screen over the range required, in this case channels E2-4, the response falling off at the h.f. and l.f. ends of the band as mentioned earlier. It is advisable to turn the gain of the receiver up to maximum with the a.g.c. preset on the "distant" setting in order to minimise the compensating effects of the a.g.c. circuitry.

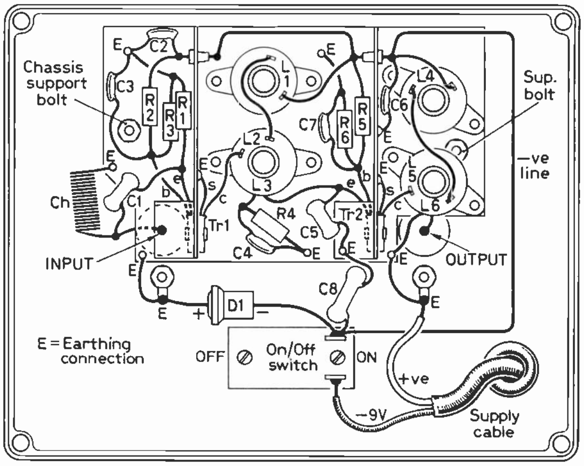


Fig. 2: Layout of the preamplifier.

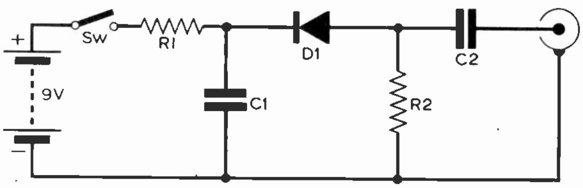


Fig. 3: Simple noise generator circuit.

Overload Protection

Possibly some DX enthusiasts will consider that the gain of this preamplifier is excessive so that

—continued on page 521

BBC MOBILE COLOUR TV DEMONSTRATION UNIT

In 1967 the BBC equipped a vehicle for public demonstrations of high-quality television reception of BBC-2. A very successful series of such demonstrations has been carried out at many places throughout the country, including the *Colour Comes to Town* exhibitions planned in co-operation with the British Radio Equipment Manufacturers Association (BREMA). The number of people who have been given the opportunity to see high-quality reception through the use of this vehicle is now approaching one million.

In preparation for the BBC-1 u.h.f. colour service the vehicle has been re-equipped with the latest and more comprehensive apparatus for receiving and distributing colour signals off the air simultaneously from BBC-1, BBC-2 and ITV, or alternatively the outputs from mobile telecine or videotape machines when the off-air signals are not available.

A full programme for a further series of public demonstrations at exhibitions, agricultural shows, holiday camps, etc., has been arranged. The vehicle will also be used at the travelling three-programme Colour Television Show being planned for the autumn in collaboration with BREMA and the ITA.

Programme and Test Signal Sources

The receiving aerial is carried on a 50-ft. pneumatically-operated telescopic mast and can be rotated through 180° by means of servo motors. The aerial signal, via a head amplifier if required, is fed to a distribution amplifier and thence to three u.h.f. receivers which can be tuned to any channels in Bands IV and V. The video outputs of the receivers feed video distribution amplifiers via subcarrier equalizers providing 0, 3 or 7dB lift at 4·43MHz.

Alternative video sources are mobile videotape and telecine machines, fed similarly through equalizers to distribution amplifiers.

The following test signals are available from the generators in the vehicle: colour bars; step wedge; grille; picture line-up signal (PLUGE) and black level and burst. A sync pulse generator and PAL coder are incorporated and the vehicle can accept RGB inputs from a colour camera.

Systems Control Panel, UHF Modulators, Monitoring

The outputs from the source distribution amplifiers and the test signal generators as well as the demodulated sound outputs from the receivers are switched in the Systems Control Panel. In this the output from any video and sound source can be switched by relays to the input of any of four u.h.f. modulators. Sound levels are controlled by faders. The outputs of the four modulators will be on one of the standard u.h.f. channel groups: 39, 42, 45, 49, with a reserve group of 40, 43, 46, 50. The u.h.f. outputs from the modulators are combined in a passive matrix and fed via distribution amplifiers to the exhibition site and to domestic colour receivers in the vehicle, which can thus operate as a self-contained demonstration unit.

Comprehensive monitoring facilities are provided, with selector switches on the Systems Control Panel. Four 5in. picture monitors can preview sources before these are switched to the u.h.f. modulators or can monitor the outgoing signals. A high-quality loudspeaker and peak programme meter are used for sound monitoring.

Talkback between the vehicle and three remote points is provided and there is a separate circuit for communication with the aeral rigger. Public address from microphone and tape recorder sources is handled by a mixer panel feeding a 50W amplifier and two line-source loudspeakers.

Power Supplies

The vehicle can be powered from a standard mains supply but also carries a 5kVA petrol-engined alternator so that it can operate independently.

General view of the BBC's mobile colour demonstration unit with aerial mast extended and side awning out.

waveforms in COLOUR receivers PART 2

GORDON J. KING

IN PART 1 it was explained how the red and blue colour-difference signals (R—Y and B—Y) are "weighted" at the transmitter to form the V and U signals respectively. This weighting action effectively reduces the amplitude of the signals making V equal to R—Y/1·14 and U equal to B—Y/2·03. The idea is partly to avoid the composite Y and chroma signals from overloading the transmitter in terms of modulation and partly to introduce the recognised PAL parameters to the composite signal. The weighting is usually handled between the colour-difference matrices and the V and U chroma modulators at the transmitter, as indicated in Fig. 5 of Part 1.

Colour Signal Recap

It must be understood that all the signal applied to the colour transmitter as vision modulation is of a *video-frequency nature*. We fully understand the Y signal in this connection, of course, as it is the same as the signal we deal with in our monochrome sets from the vision detector right up to the cathode (or grid) of the picture tube, via the video amplifier. Prior to the vision detector the picture signal is often referred to simply as a "vision signal", to distinguish it from the video signal which appears only *after* detection—that is after the carrier signal at i.f. has been eliminated. In the sound channel we often refer to the "sound signal" in the i.f. channel up to the sound detector, and the audio signal from the detector onwards through the a.f. stages to the speaker.

In colour sets we still have all these signals as well as the signals which add the colour to the basic monochrome images. These are sometimes called colouring signals, which is a term common to all signals actually dealing with the colour action. However, there are other, individual colouring signals, each one with different characteristics. We have already come up against the colour-difference signals, of which there are three: R—Y, G—Y and B—Y; and now we have just been introduced to the V and U signals. If we look back to Fig. 5 in Part 1 we shall recall the primary-colour signals; those signals produced when the colour camera analyses the scene in terms of the three additive primary colours, which are, of course, red, green and blue. In addition to all these signals we have the *chroma* signal. The very first lesson in colour television, therefore, is to understand exactly how all the colouring signals differ—and why. And also, most important, to appreciate how the chroma signal differs from the other colouring signals.

The Chroma Signal

Since we have already considered all the signals in a basic manner with the exception of the chroma signal, let us now get to grips with this. Referring again to Fig 5. in Part 1 it is shown that the weighted red and blue colour-difference signals (called V and U) are fed to the corresponding modulators along with a subcarrier (so-called to distinguish it from the transmitter's main carrier). The V and U signals (which at this time are still at video frequency) are thus made to modulate the subcarrier by varying its amplitude in accordance with the colour features of the scene. This is ordinary amplitude modulation; but since it is necessary to combine the modulated V and U signals to allow them to be passed through a single transmitting circuit in such a manner that each signal can be reclaimed at the receiver for separate processing without interaction, a special system of modulation must be used because the subcarrier frequency is the same for each modulator. In practice there is just one subcarrier generator at the transmitter, the signal from this being fed simultaneously to the V and U modulators. However, to keep the V and U signals in isolation, so to speak, the phase of the subcarrier signal fed to one modulator with respect to the other is shifted by 90°. If the subcarrier delivered signals of the same phase to both modulators it would be absolutely impossible to separate the modulated V and U signals once they had been combined in a single transmitting circuit.

Stereo Analogy

This has a fair analogy in stereo gramophone records. With these the common groove carries information corresponding both to the left and right channels, and this is applied to the groove via the stereo cutting head and a *single stylus* from left and right channel signals in isolation. The phasing of the left and right signals applied to the cutting head produces a complex cut in the groove, and on replay the left and right channels can only be reproduced in correct isolation via the *single replay stylus* when this is effectively "phased" to match the phasing at the cutting head. The single stylus thus sorts out the left and right channel signals in the complex groove for separate processing —through the left and right replay channels in this case.

Signal Phasing

With colour television the initial phasing of the complex signal is achieved by the V and U modulators in conjunction with the subcarrier signals, while the "unscrambling" action at the receiver, leading to the isolated regeneration of the V and U signals, is performed by the V and U (sometimes called R—Y and B—Y) detectors or demodulators.

We shall be dealing with the signals in the receiver later.

Now, when the V and U signals come by way of the R−Y and B−Y signals from the transmitter matrices they are of ordinary video makeup. However, when they are modulated on to the subcarrier they change from ordinary video to chroma signals, giving V chroma and U chroma to the point where the two are added, thereafter being referred to merely as the *chroma signal*.

V and U Modulators

We shall be returning to the submodulating action later, but for the time being let us keep with the basic signals which the modulators yield. Normally when we consider the action of amplitude modulation we visualise the carrier wave taking on a shape corresponding to the modulation signal, giving the so-called modulation envelope. This sort of thing happens when the V and U signals are modulated on to the subcarrier, but here the modulator is of such a design that it fails to pass the subcarrier proper, instead just letting through the sidebands of the V and U signals, the two sets of sidebands being combined to produce the chroma signal. A basic modulator performing this function is shown in Fig. 1. This could be for either the V or U signal—there are two, one for each. V2 and V3 are driven by the phase-splitter V1, and when there is no input V2 and V3 conduct equally. Subcarrier is applied via T1 to the third grids, and because T1 secondary is centre-tapped the signal on the grid

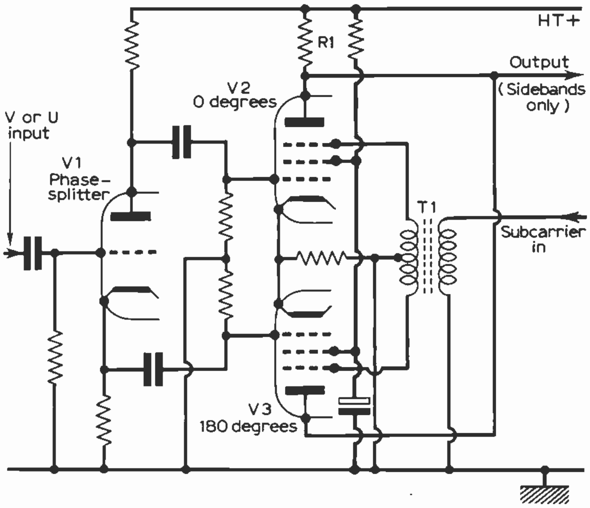
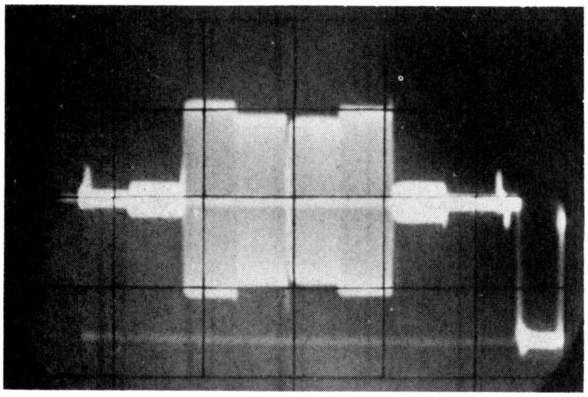
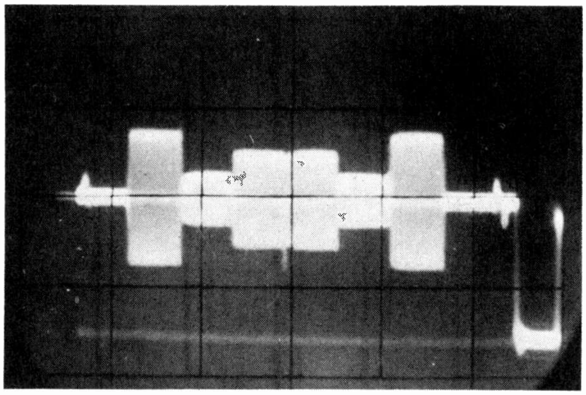


Fig. 1: Simple form of V or U modulator in which the subcarrier is suppressed, an output being obtained only when an input signal is applied via the phase splitter.

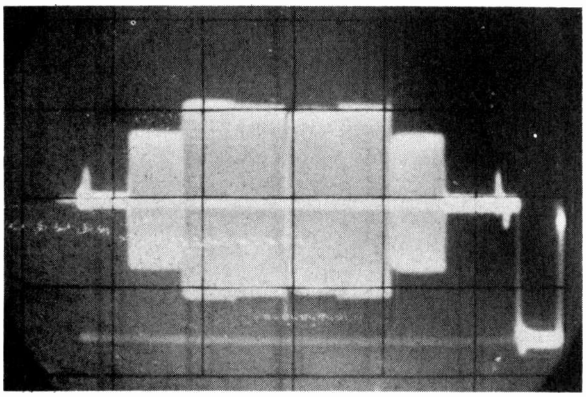
of one valve is 180deg. displaced from that on the same grid of the other valve. Subcarrier signals in the common load R1 thus add in phase-opposition, giving zero output. However when colouring signal is applied to V1 the phase-splitting action causes V2 and V3 conduction to unbalance—because the control grid of one goes towards positive while that of the other goes towards negative—and signal appears across R1. The effect is that the sum of



(a)



(b)



(c)

Fig. 2: Off-screen chroma signals. (a) V signal, (b) U signal and (c) chroma signal, i.e. added V and U signals.

the upper and lower sidebands of the input signal—V or U—appears across the load R1, meaning that the *amplitude* of the modulated signal varies in direct sympathy with the amplitude of the colouring information; but note clearly that output occurs only when there is a V or U input—there is no output from the subcarrier alone owing to the cancellation effect of the modulator.

Colour Signal Traces

At this juncture it would be as well to have a look at some actual chroma signals present in the transmitting system, whether it be a real transmitting station or a signal generator. Fig. 2 shows at (a)

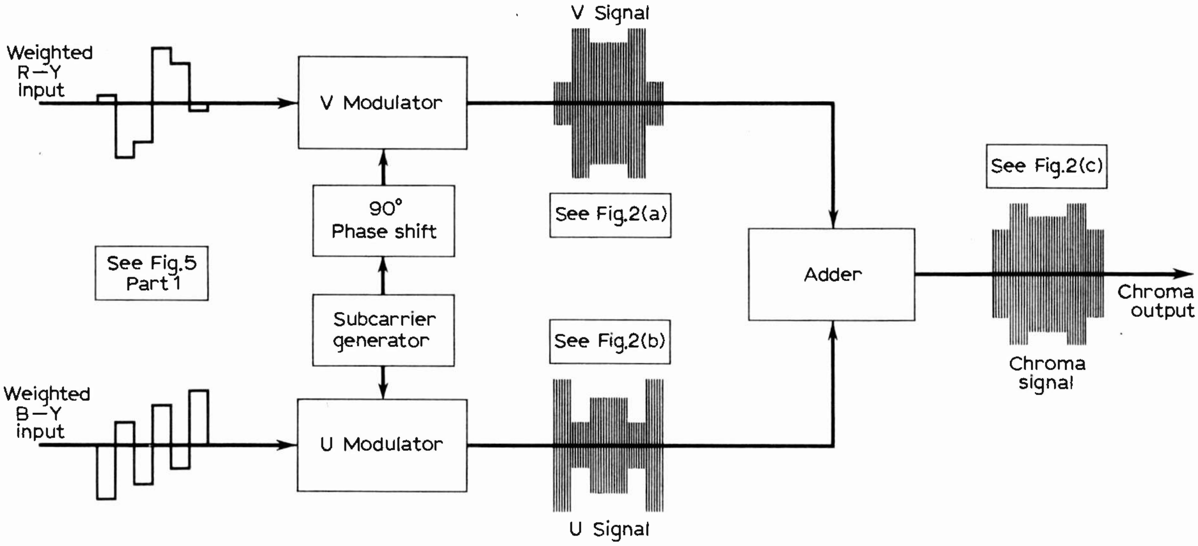


Fig. 3: Detailed block diagram of the chroma modulator section of a colour transmitter.

V signal and at (b) U signal *after* modulation on the subcarrier, while (c) shows the chroma signal which results from the addition of the V and U signals after they pass out of the modulators. These signals were obtained from the standard colour bars, the traces being photographed directly from the screen of an oscilloscope.

Transmitter Block Diagram

Figure 3 shows how the weighted R—Y and B—Y signals—giving the V and U signals—are translated to modulated V and U signals and thence to chroma signal via the adder. In the PAL system the V signal is caused to alternate in phase from line to line of picture. This is the PAL trick which holds the colours in the reproduced picture fairly constant—matching those of the scene—in spite of changes in phase of the chroma signal which could take place in the transmitter or receiver or, indeed, anywhere in the propagation medium (e.g.. land lines, coax links and the ether itself) between the transmitter and receiver. For the moment, however, there is no great need for us to dwell on this particular aspect of the PAL system (it will be investigated in some detail later), but it is important for us to understand why a colour system is intrinsically phase-sensitive.

Quadrature Modulation

To get to grips with this we shall have to return to the V and U system of modulation, where the subcarrier frequency is the same for both modulators with a phase displacement of 90deg. This sort of modulation—called *quadrature modulation*—is not new. It was in use for communications before the advent of colour TV, being an artifice allowing two separate sets of information to be transmitted via a common circuit without interference: a sort of "duplexing" arrangement. Fig. 4 shows two signals of the same frequency but with a 90deg. phase difference between them. These can, in fact, represent the V and U signals, and are labelled as such in Fig. 4.

Now an important aspect of a pair of common-frequency signals is that when they are displaced in time or phase by 90deg. (time and phase are virtually the same in this connection) the peak of one wave occurs exactly when the other wave is passing through the zero or datum line. In Fig. 4, for example, the peak of the U signal is at 90deg. while the V signal is passing through zero, and this effect occurs consistently all along the time or phase scale.

Let us suppose that we have two signals like the V and U signals in Fig. 4 and add them together in an "adder" like that shown in Fig. 3. What happens? Well, the two signals simply form one, composite signal as shown in Fig. 5, where the V and U signals are in thin line and the composite

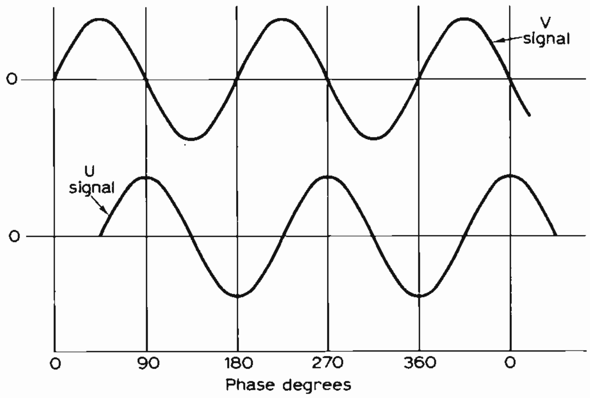


Fig. 4: Two sinewave signals, marked V and U, with the same frequency but a phase difference of 90°.

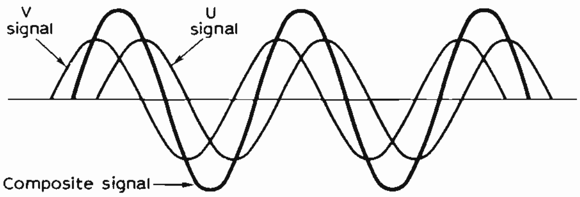


Fig. 5: The addition of the V and U signals, shown in thin line, results in the signal shown in heavy line.

signal in heavy line. Actually, since the V and U signals appear only when there is colour information in the circuit (refer to Fig. 1, and accompanying text), the composite signal in Fig. 5 can be considered as the chroma signal.

Reclaiming the V and U Signals

So far so good, but why all the fuss about the 90° phase displacement, for surely a composite signal would occur no matter how the two signals are phased? This is perfectly true, but in order to reclaim the V and U signals separately without interference at the receiver the carrier phase relationships have to be restored *very* accurately. It is thus essential to start off with a chroma signal of known and accurate parameters, for if the phase displacement shifts or is of a random nature it would be impossible to match this accurately at the receiver and it would not be possible to get the original V and U signals for working the "colouring" sections of the set.

Simple Vectors

Now, when two signals go to compose a composite signal, the three signals concerned can be very easily represented by a vector diagram, as shown in Fig. 6. Here the vertical line corresponds *in length* to the amplitude of the V signal, while the amplitude of the U signal is likewise repre-

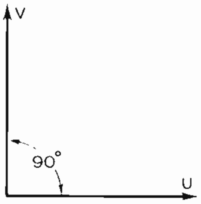


Fig. 6: Because of the 90° phase difference between the V and U signals they can be represented by this sort of vector diagram, where the lengths of the lines correspond to the amplitudes of the two signals.

sented by the horizontal line displaced by an angle of 90° from the V signal. This angle signifies the phase difference between the V and U signals.

The amplitude of the chroma (C) signal, therefore, can be found simply by completing the vector diagram, as shown in Fig. 7 for various values

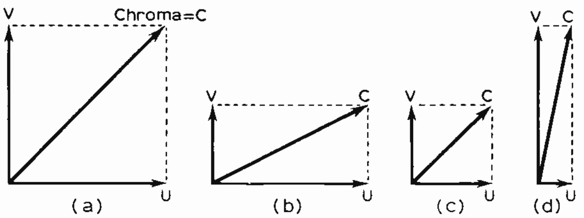


Fig. 7: The composite signal shown in Fig. 5 (i.e. the chroma signal) has amplitude and phase characteristics governed by the lengths (amplitudes) of the V and U signals, the C signal being obtained by completing the vector diagram shown in Fig. 6. Notice that both the amplitude and phase of the C signal are related to the V and U signals.

of V and U. Since the angle between the two signals remains at 90°—given by the phase shifter in Fig. 3—the amplitude of the C signal is equal to

$$C=\sqrt{(V^2+U^2)}$$

which is nothing more involved than very simple geometry. Figure 7(a) shows the C signal when V and U are equal in amplitude, (b) when V is smaller than U, (c) when both V and U are reduced in amplitude and (d) when V is significantly greater than U. A very important aspect of this consideration is that not only does the amplitude of the C signal fluctuate with changes of amplitude of V and U signal, *but also its relative phase changes.* And just as noteworthy the phase of the C signal remains the same, although its amplitude alters, when the amplitude of the V and U signals is adjusted in step. This is brought out at (a) and (c) in Fig. 7, where the phase of C is the same in both.

Negative and Positive V and U Signals

Figure 7 deals with V and U signals which go vertically upwards and to the right. It is possible for these signals to have negative or positive phases themselves, which could cause the V signal to go downwards and the U signal to the left, as shown in Fig. 8. This means, therefore, that

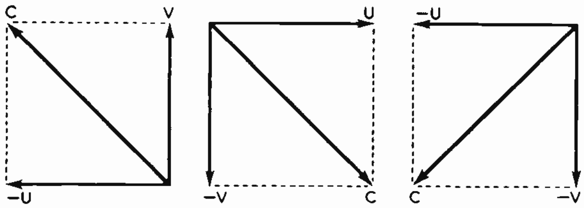


Fig. 8: The C signal can have any position within the full 360° since the V and U signals can have negative as well as positive values, as these diagrams show.

the chroma signal could rotate the full 360° of a circle as governed by the phasing of the V and U signals themselves and by their relative amplitudes, and for this reason the C signal is often related to the vertical and horizontal axes having both positive and negative scales, as shown in Fig. 9. Here the amplitude and phase of C at any instant depends on the instantaneous amplitude values of V and U, one example being given in Fig. 9.

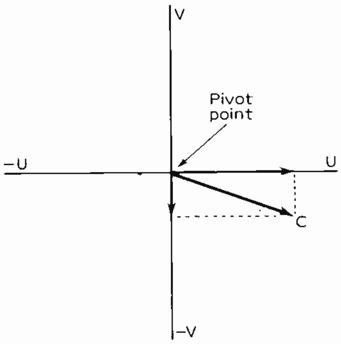


Fig. 9: The C signal can be considered as being pivoted at the centre of this diagram. The C signal swings about the pivot as the values of the U and V signals change.

Thus the chroma signal can be considered as being "pivoted" at the intersection of the two axes, and both rotating and altering in amplitude under the control of the colouring signals. This, then, is why the chroma signal is sensitive to phase. We shall see in subsequent articles that the phase of the chroma signal determines the colour that is displayed on the screen of the colour picture tube.

TO BE CONTINUED

CHARLES RAFAREL

DX TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

NO GRUMBLING this month! The SpE conditions for May have left little to be desired and at long last we have had some excellent openings. In fact compared to the corresponding period last year this anticipated May opening has been a lot better in both the strength and duration of the signals. Already quite a crop of "mysteries" has occurred and a few interesting new things are appearing on our screens to arouse our curiosity.

These May openings started at the beginning of the month (as reported in our last issue) and continued to build up throughout the period. There were only two days, the 13th and 26th, when conditions were so poor that only unidentified "bursts" of signals were received, showing that there was still at least some activity. The predominant directions of reception were North East to Scandinavia, East to USSR, Poland etc. and more rarely to the South for Spain, Italy etc. The skip distances too were comparatively long, that is to say West Germany was not often received.

Another feature this time, and it has happened before in previous years, is that the openings to the East were in the mornings with a frequent drop-off around midday and early afternoon and with reception from the South starting in the early evenings for 2-3 hours.

Just how good conditions have been can be assessed from the fact that Band I was open to USSR and Poland on the 24th and 31st: I feel that this is quite unusual so early in the season. Two "new" ones for me here were Poland Zielona Gora Ch. R3 and USSR Kiev II Ch. R3. New ones are always quite an event particularly in Band I where conditions have to be just right.

Now here is the log for the period 4/5/69 to 31/5/69:

4/5/69 USSR R1, Czechoslovakia R1, Austria E2a and W. Germany E4.
5/5/69 Czechoslovakia R1 and W. Germany E4.
6/5/69 USSR R1 and R2, Czechoslovakia R1.
7/5/69 Czechoslovakia R1 and Sweden E3.
8/5/69 Czechoslovakia R1, Austria E2a and Sweden E3.
9/5/69 USSR R1, Czechoslovakia R1, Norway E4 and W. Germany E4.
10/5/69 USSR R1 and Czechoslovakia R1.
11/5/69 USSR R1 and Poland R1.
12/5/69 Czechoslovakia R1 and "mystery" pattern R1 (see later).
13/5/69 Only unidentified bursts.
14/5/69 USSR R1. Czechoslovakia R1 and Poland R1.
15/5/69 Czechoslovakia R1 and Poland R1.
16/5/69 USSR R1. Norway E2 and E4, Sweden E2, E3 and E4.
17/5/69 USSR R1 and Austria E2a.
18/5/69 USSR R1 and R2, Czechoslovakia R1, Poland R1. Austria E2a and Sweden E2 and E4.
19/5/69 Spain E2, W. Germany E4 and E. Germany E4.
20/5/69 Czechoslovakia R1, W. Germany E4, Yugoslavia E3 and E4, Austria E2a, Italy IB and "mystery" caption E4/IB (see later).
21/5/69 Spain E3.
22/5/69 Czechoslovakia R1, Sweden E2, E3 and E4, Norway E3 and W. Germany E4.
23/5/69 USSR R1 and Czechoslovakia R1.
24/5/69 USSR R1, R2 and R3, Poland R1, R2 and R3 and "mystery" Retma test card R1 (see later). Spain E2 and E4, Norway E2, E3 and E4 and Sweden E2, E3 and E4.
25/5/69 USSR R1, Poland R1 and R2, Norway E2, E3 and E4, Sweden E2, E3 and E4.
26/5/69 Only unidentified bursts.
27/5/69 Norway E3.
28/5/69 USSR R1, Czechoslovakia R1, Hungary R1, Poland R1 and Spain E2.
29/5/69 Czechoslovakia R1 and Italy IB.
30/5/69 USSR R1, Norway E2, Sweden E2, E3 and E4. W. Germany E2 and Spain E2, E3 and E4.
31/5/69 USSR R1, R2 and R3, Sweden E2 and E4, Norway E2, E3 and E4, Poland R1, Spain E2, E3 and E4.

"MYSTERIES"

On 12th Ch. R1 there was a curious black-and-white checkerboard pattern of small squares. Many years ago the Czech TV service used one like this but it has not been seen recently. As the Czech test card was about on the 12th I suppose the pattern could have been from another Czech station, but I am wondering if perhaps there is another and more interesting explanation.

On 20th Ch. E4/IB at 17·26 there was a caption "RIB-BRT" in white on a black background, followed by a clock marked RTB at 17·29. This must have been a relay of Belgian TV by some unknown station but what the RIB stands for is a complete mystery to me.

The most interesting "mystery" however was on 24th when following a phone call from Maurice Opie about a Retma card on Ch. R1 carrying some black lettering at the bottom I checked and located it too, but the signal by then was too weak to decipher the wording. Maurice hopes however that a photo he took will reveal something. Let us hope so, we think that at long last this might be Bulgaria.

—continued on page 521

MODIFIED VIDEO INPUT FOR CCTV SIGNALS

H. K. HILLS

TELEVISION receivers designed especially for schools and hospitals are free of purchase tax provided they can also accept a local video signal. The BRC group therefore modified a standard production model to provide this extra facility and as many interesting technical points are involved an account of this modification gives considerable insight into the practicalities of receiver design in seeing how this requirement was met. First although neither BREMA nor the Customs and Excise stipulate technical data it was considered safe to assume that normal studio

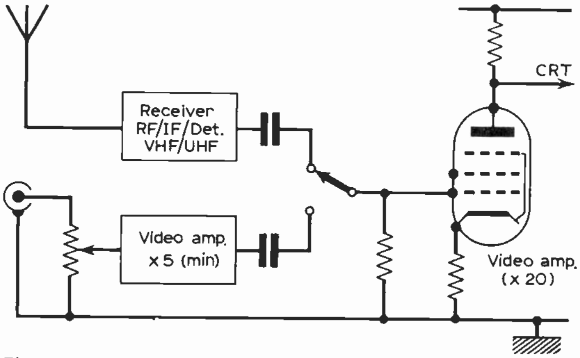


Fig. 1: The requirements of a "Schools" receiver able to accept a 1V peak-to-peak local video input.

requirements should be met and therefore to design the receiver to operate on a video input having a value of 1V peak-to-peak sync and signal across 75Ω. This immediately raises problems for with a conventional valve video pentode having a stage gain of 20 a grid input of 5V is required to deliver 100V peak-to-peak to the tube cathode. Clearly therefore extra amplification must be given to the local video input before applying it to the video pentode. The overall scheme must therefore be as shown in Fig. 1, but to maintain picture definition at peak white without risk of video instability the changeover switch must have a low capacitance to chassis and short connecting leads.

Signal Switching

There are three possible ways of achieving this requirement: (a) Mechanical; a switch could be mounted on the detector/video panel and operated via a Bowden cable or similar means. (b) Electrical: a relay could be used to operate the switch energised by an exterior user control. (c) Electronic: by switching power to a diode, valve or transistor. Method (c) was adopted and although it entailed a further printed panel and power supplies this objection was a minor one since these facilities were also required for the additional local video amplifier.

A diode was chosen to provide the switching action and its basic operation as a means of providing on/off a.c. coupling between two points is shown in Fig. 2. If a d.c. potential is applied across

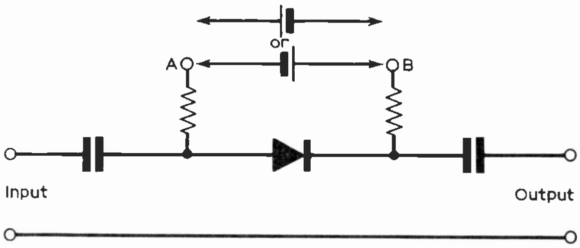


Fig. 2: Biased diode used as a switch between a.c. input and output.

A and B so that the diode is forward biased (top) an a.c. input signal will be transmitted to the output terminals. On reversing this d.c. potential (lower battery) to reverse bias the diode the input and output live terminals will be effectively isolated.

To ensure correct operation however the following conditions must be met. (1) The diode bias must be significantly larger than maximum signal values otherwise the diode could be cut-off by peak reverse signal voltages when switched on and vice versa. (2) The d.c. supply resistors must be much higher in value than the circuit impedance to prevent damping it. (3) The bias potential must not exceed the reverse breakdown potential of the diode. (4) The forward current must not exceed the maximum value for the diode. (5) The load impedance must be virtually free from capacitive reactance at the highest frequency handled. And (6) the feed capacitors must have low reactance to the lowest frequency handled to avoid signal loss.

A practical example of such a diode switch connected in series with the video signal path in a modified BRC 950 receiver is shown in Fig. 3. When switched on the diode is forward biased by 20V, its anode being at +40V and its cathode at +20V. When switched off although its cathode is still maintained at +20V its anode is at chassis (zero) potential leaving the diode reverse biased to that figure.

Capacitor *Cs* represents the sum of the stray circuit capacitance plus that of the video input circuit and as such is in conflict with the need for low capacitive loading. When the circuit is handling waveforms of

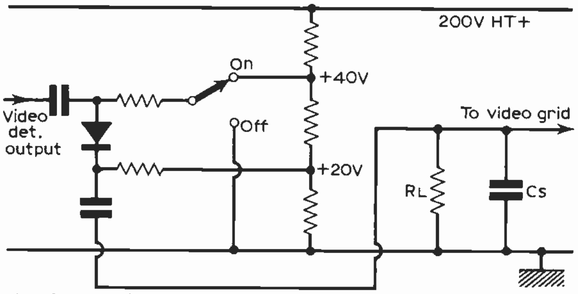


Fig. 3: Practical biased diode switch connected in series with the video signal path.

large amplitude and transient nature the presence of this capacitance can cause serious distortion since the maximum rate at which an output waveform can decay, irrespective of input, is determined by the time constant of C_SR_L. This effect is identical to that produced by the *CR* combination in diode sound interference limiters when their joint time constant prevents the a.f. stage responding to short-term car ignition pulses.

In this video application and with average values of stray capacitance the resistor R_L which forms the discharge path for C_S must not exceed about 1.5kΩ if the diode circuit is to follow frequencies up to 6MHz. Such a low-value resistor however heavily loads the detector and makes it necessary to use very high-value coupling capacitors to maintain l.f. gain and for complete a.g.c. stability. In fact the capacitors would need to be of several hundred microfarads and tests showed that compromise values impaired the very high standard of performance required for schools receivers. However by using an emitter-follower with its high input impedance and low output impedance to couple the signal to the diode switch circuit conventional sized components can be used.

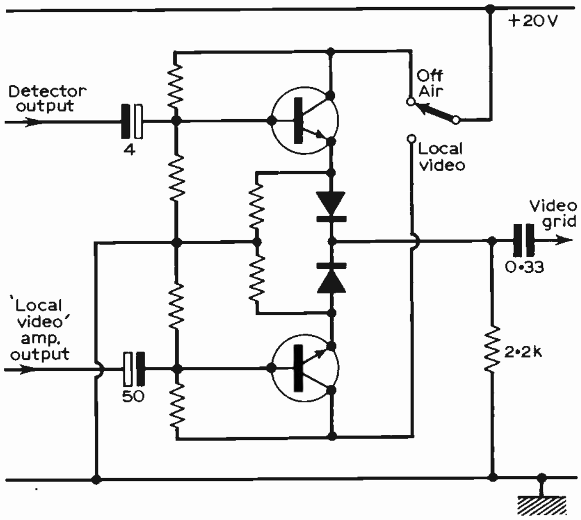


Fig. 4: Dual emitter-follower and switching diode arrangement used to link the video output stage to the detector or local video input.

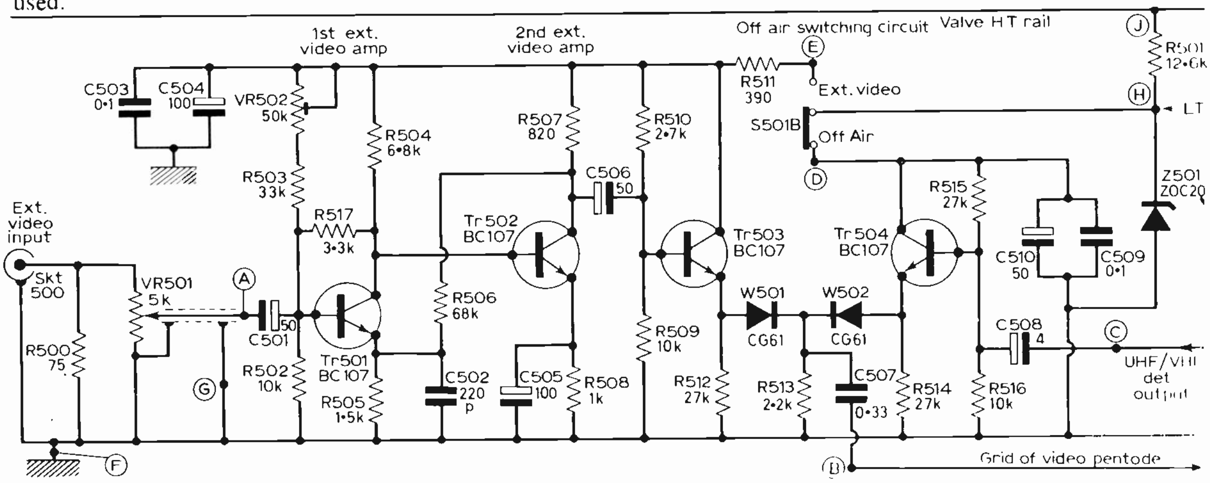


Fig. 5: The two-stage video amplifier for external inputs (Tr 501 and Tr 502) plus the electronic switching circuit for changing over from broadcast to local video as used in the BRC schools model.

An emitter-follower is of course the transistor equivalent of a valve cathode-follower having its load resistor in the emitter lead and its collector returned directly to l.t. The phase of the output signal is in phase with the input signal applied to the base —hence the term—but the amplitude of the output will not quite equal input amplitude. Emitter-followers make excellent impedance matching stages between a high-impedance signal source and a low-impedance following stage and are now widely used in standard TV design.

By using two such emitter-followers arranged as in Fig. 4 the receiver detector or local video amplifier output can be switched directly to the video pentode grid without impairing performance and merely by transferring the l.t. supply to the relevant stage.

Practical Circuit Details

The actual video amplifier used to boost the IV local input to sufficient value to fully drive the PFL200 is a two-stage BC107 line-up. Direct coupling is maintained between the two stages with capacitive feed to the emitter-follower. The complete unit, amplifier and electronic switching arrangement to enable a standard production model to cater additionally for local video input, is shown in Fig. 5.

As power consumption is low it is taken from the valve h.t. rail via a dropper resistor (R501) and shunt zener diode. A 5kΩ potentiometer shunting the 75Ω resistor across the video input socket permits control of input amplitude while forward bias to the first video amplifier Tr501 is adjustable by a 50kΩ preset.

In conclusion it may be wondered why the switching diodes are incorporated into the complete design since the base-emitter junctions of the two emitter-followers function in a similar manner. The reason is to protect these transistors since the high level of signal plus the substantial d.c. potential could equal their reverse breakdown voltage. ■

(Technical information was kindly supplied by D. R. Topping, Chief Engineer, BRC Ultra Division.)

UNDERNEATH THE DIPOLE

THE DERBY IN COLOUR

As EXPECTED the BBC-2 coverage of the 1969 Derby in colour was first class, with magnificent panoramic shots following the race throughout, cameras being located on high towers covering the whole course. I am sure that the full treatment of live transmission for 1 hour 20 minutes must have been highly entertaining, relaying all the sights, sounds and special characteristics of this world-famous race course, and of course the race itself. The Epsom trimmings I did not see, for the evening repeat I watched was restricted to ten minutes only. The edited version for this short period gave little more than the race itself, a thrill that might have also been achieved by the dogs at the White City or the trotters on a Kentucky course.

It was in my opinion a mistake to omit the wide range of scenes which are a characteristic of only this great race course on Epsom Downs. I refer to the early morning parade of police, the gypsies, the tipsters, the fortune tellers, the two fairgrounds (and their roundabouts) the bookies, the arrival of the coaches-and-four and of the Queen, the Royal Enclosure, the Silver Ring, the three-card-tricks men and the police chasing them and so on. All profoundly interesting, all vividly English, mostly so visual that commentary is rarely required. For viewers who haven't betted or secured a sweepstake ticket the race is often of secondary interest in the unique atmosphere centred on one day, Derby Day. The Grand National, the Gold Cup at Ascot, the St. Leger at Doncaster and the November Handicap at Manchester all have special characteristics worth seeing supplementary to the actual race.

BFI's NATIONAL FILM ARCHIVES

Film recordings of big national sporting events have been preserved for years. The Derby of 1896, won by Persimmon, owned by Edward Prince of Wales, was filmed passing the winning post and the animated pictures shown on the same evening at the Alhambra Music Hall by Robert W. Paul, film pioneer and scientific engineer. Even though it was photographed and printed on the somewhat unstable nitrate film base of that time, duplicate negatives have been made and preserved in the BFI's National Film Archives. The techniques used at The British Film Institute—a specially designed series of film vault archives—are ahead of any other film preservation storage in the world.

PRESERVING VIDEOTAPE

These days however equal or better visual recordings are also made on colour videotape, of which the ageing characteristics have not yet been fully explored, nor has a reliable preservation technique been evolved. I feel that under the jurisdiction of the Curator of the BFI Archives a preservation technique should be investigated. The main problem seems to be a tendency for the iron oxide emulsion to detach itself from the plastic base, of which there are several types. At the moment transfers from the original tape to another, newer tape, is a favoured method. Another way is to transfer to 16mm. or 35mm. film. But these are expedients. There are many historic events that are videotaped only and *must* be preserved.

PERFORMERS' PLUG

Thomas Edison's recitation of the nursery rhyme *Mary had a little lamb* into the horn of the first phonograph back in 1877 gave the first impetus to preserving a live performance. From these humble beginnings were to grow the entire complex of electronic entertainment—the music hall song *Daisy Bell* of circa 1892 has even been recorded by a computer voice! We live in the age of "living sound", colour TV, pictures from beyond the moon and background music in the office lift, and one doesn't ever need to see a live performer in the flesh—they do tend to clutter up the canteen!

The performer is in a dilemma—where once he had to be there "Direct From The West End In Person", now after putting it bit by bit on tape he can sit at home waiting for the repeat fees. From the days of the comedian Dan Leno and the great actor Sir Henry Irving to as late as the 1950s one had to be there for the show, and the successful actor or variety artist could always avoid the theatre where he'd "died" or "got the bird". Now the successful cavalier in the Civil War TV series tends to always play cavaliers of various stations—and when 1914 Tommies are in vogue at the Television Centre or at Elstree he's back on the dole.

EQUITY ANNUAL REPORT

British Actors Equity Annual Report this year tells us a lot about the protection that the working actor has had built up for him. Perhaps the most important for the actors has been the agreement by the film producers that cinema films shown on TV at home and abroad will bring additional repeat fees for the casts. But this agreement's date of implementation has yet to be agreed and will not be retrospective to cover films already made. Equity's long drawn out series of negotiations with the ITV companies looks like giving the actors and the companies a fairer crack of the whip. A notable advance refers to the setting up of a joint "watch-dog" committee which in relation to the quality of programmes "will have power to intervene if agreed norms in relation to a preliminary read through for the entire speaking cast, and a specified minimum amount of rehearsal in advance of any recording, are not provided".

PICK-UP SHOTS

In advance of the signing of the new agreement Equity and the Companies have agreed variations of the existing Agreement, in particular with the *Tom Jones* series. Equity's Report states "these experimental arrangements have been helpful not only to the Companies but also to us in trying out various aspects of the new flexibility in production methods which our new Agreement is likely to permit." In relation to the BBC too the Report tells of fruitful agreement covering the position of artists whose engagements involve a gap between prefilming and the beginning of rehearsals. Prefilming covers "pick-up shots"—for example establishing shots, such as getting in and out of cars, usually shot on location and often made before the actor has any idea how his role is to develop!

THE COPYRIGHT ACT

Like most Reports this one has its fair share of statistics and the ones about "Foreign Artist Permits Supported" shows that whilst the BBC favoured 311 variety artists to ITV's 207, the BBC's figure for straight actors and singers was only nine compared with ITV's 68. But with the possibility soon of being able to take in world-wide channels by the twist of a knob, the protection of the performer today is a never ending task. Because, to adapt the last line of Edison's nursery rhyme: *And everywhere the actor went, the mike was sure to go.* No copyright in this—or is there?

Performing rights, copyrights, licences, tolls, patents, permits, passports! You don't have to pass by many bars (in music) before you infringe some composer's copyright and become liable to a royalty. Indeed in certain circumstances one note only with a recognisable accompanying chord will be detected by the legal eagles of the Performing Rights Society. There are schedules of charges, together with (under separate agreements) unscheduled charges.

The question which has so far remained untested is whether the use of videotape, EVR and other recordings comes under the definition of "cinematograph film" under the Copyright Act of 1956, which states the following:

> "(10) In this Act 'cinematograph film' means any sequence of visual images recorded on material of any description (whether translucent or not) so as to be capable by the use of that material (a) of being shown as a moving picture or (b) of being recorded on other material (whether translucent or not) by the use of which it can be shown;"

Clause 10(b) is pregnant with legal portents, briefs, fees, high-court cases (with lyrics by Gilbert set to the now non-copyright music by Sullivan). The legal implications of the words: "being recorded on other material (whether translucent or not) by the use of which it can be shown" deserve consideration in this journal, which is now recognised as the journalistic catalyst of the technical show business: television, films, films for television, closed-circuit, educational and what-have-you. Therefore J. Bathbun-Spryke of the firm of Ullage, Mullage, Mangin and Spryke (of Lower Stationers Hall) states: "This Act clearly covers a wide range of electronic legerdemain[1], absente reo[2], which (de facto[3] and de jure[4]) is obviously persona grata[5]. Whatever media are used modus vivendi[6] can be status quo[7]." All television and film legal advisers should study this sage advice before going on their weekend cycling tours to "Stratters" and back. What's "Stratters" you ask? That's Stratford-on-Avon, cradle of drama and focal point of the Gold Clips Tricycle Championship, referred to thus, nem. con.[8], by British Actors Equity and the Arts Council.

For the benefit of any reader who feels compelled to take the above legal prescription to his local chemist, I append ipso facto[9] a legal glossary.

[1] Legerdemain: sleight of hand.
[2] Absente reo: in the absence of the accused.
[3] De facto: In fact, whether by right (de jure) or not.
[4] De jure: by right.
[5] Persona grata: anyone capable of having and becoming subject to rights.
[6] Modus vivendi: a temporary working agreement.
[7] Status quo: the existing state of things at any given date.
[8] Nem. con.: without opposition.
[9] Ipso facto: by the very act itself.

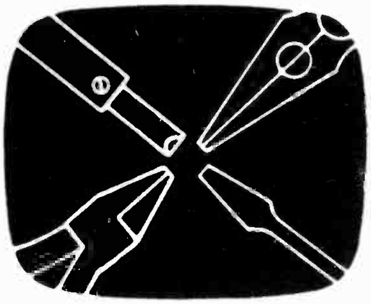
BRUNEL UNIVERSITY

The foundation of Brunel University near Uxbridge, opened last year by Lord Beeching, started a new era in technical and scientific learning worthy of its name. It has developed into an advanced field of electrical, mechanical, physics and electronics learning which in my personal view may lead the world.

I have visited Brunel and my reaction was highly favourable. The place had all the most desirable characteristics of a well-run *engineering* university, not a rest campus for arty-crafty kinkies. Satisfactory and rewarding careers lie ahead for graduates here, I felt, compared with some other universities whose names have become a stigma whenever their graduates apply for a job. As distinct from engineering colleges the arts colleges are crowded with students who are self-opinionated daubers of abstract rubbish. The outlook is indeed doleful: employment exchanges will be crowded with would-be artists while on the other hand there will be vacancies for postmen, plumbers and bricklayers.

Of interest to readers of this journal is the fact that the Brunel lecture rooms have been supplemented by a studio for closed-circuit television or motion pictures (using 35mm. as well as 16mm. film).

Iconos



SERVICING television receivers

L. LAWRY-JOHNS

THORN 850 CHASSIS

IT HAS recently been pointed out to us that although we have covered the 900 and 950 series in these servicing articles we have not dealt with the earlier and very widely used 850 chassis. We shall rectify the omission with this article which although it will concern basically the Ferguson 3618 series should help in the servicing of a very extensive range stretching as far back as the 705T. There are dozens of associated models, too numerous to list, in the HMV, Marconiphone and Ultra brand names of the Thorn group, not to mention other makers who have employed the chassis such as Decca in their DR61.

The basic dual-standard chassis is quite comfortable to work on, the tube being fixed to the front of the cabinet with the leads long enough to enable the chassis to be unlatched and moved back far enough, with the bonding strips removed, to allow access to most parts. The tuners are mounted separately.

Common Faults

Probably the most common fault on this series is failure of one or more sections of the mains dropper. On most models this large wire-wound resistor, with its several tappings, is mounted vertically on the left side of the chassis. On some models however it is mounted horizontally at the rear centre. When the symptoms are no mains supply to the valve heaters or to the h.t. rectifier although the supply is at both sides of the fuseholder it is a matter of moments to check along the tags of the dropper with a neon tester or a.c. voltmeter to find where the supply is present and where it is not.

Having located the faulty section the repairer must then decide whether to replace the whole dropper or wire a replacement section across the faulty one. The faulty section should never be shorted out as this will reduce the reliability of the receiver and shorten its working life. The life and reliability of any receiver are largely determined by the setting of the mains voltage adjustment when the set is first installed, and the tappings should always be set as high as the set will satisfactorily operate. An underrun receiver is always more reliable than one which is overrun by the voltage setting being too low (which is the same as a section of the dropper being linked across).

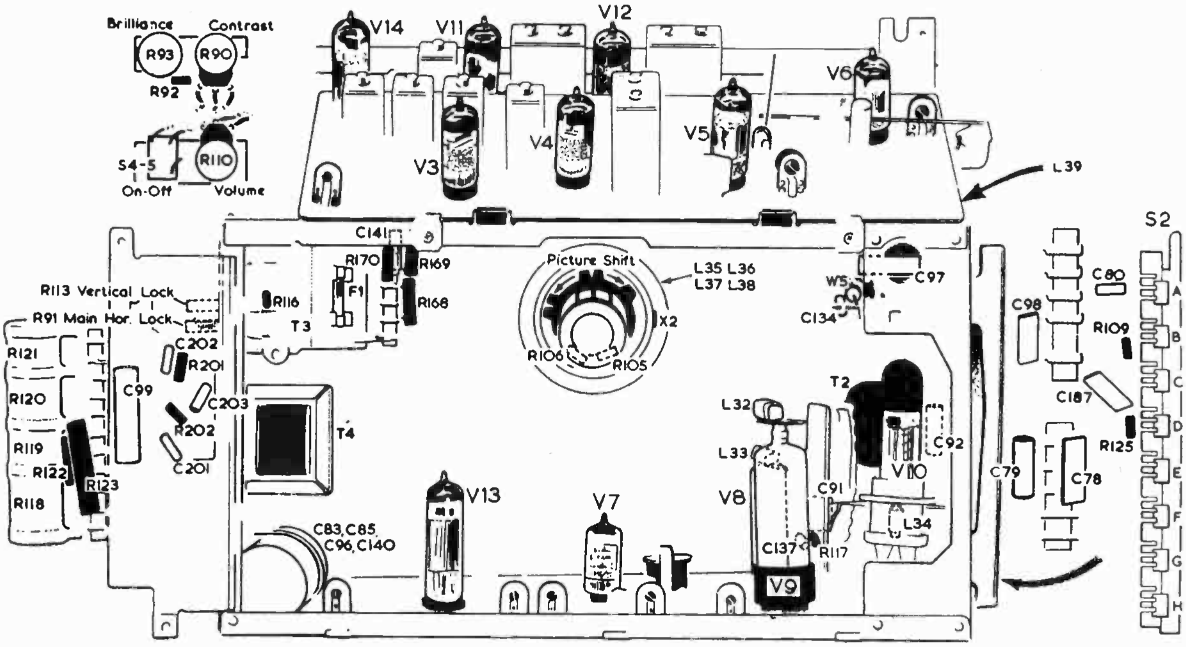
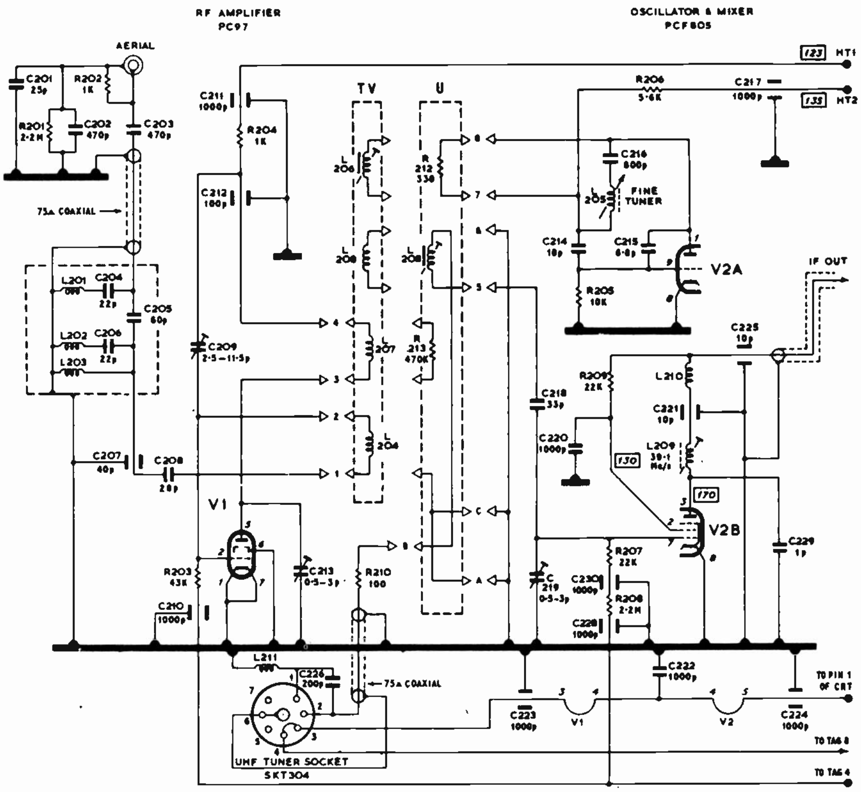


Fig. 1: Rear chassis view. In some versions the mains dropper R118-R121 is mounted horizontally at the rear centre.

Fig. 2 (right): Circuit diagram of v.h.f. tuner type MT6 used on most receivers in this series. L211 and C226 not fitted on all tuners. Early models were fitted with tuner type MT4. This is similar, the main difference being the use of a PCF86 in position V2.



The upper sections of the dropper concern the h.t. supply and a failure here will leave the valve heaters glowing. There are two other separate resistors associated with the dropper. The larger is R123 (107Ω) in the d.c. smoothing circuit and the smaller R122 (10Ω) in the voltage adjustment (a.c.) side. Both are 10W 5% types.

We would stress that these resistor figures and remarks apply to the actual receivers under discussion and not to earlier models which used a different dropper and smoothing arrangement.

VHF Tuner

This tuner suffers from the usual contact trouble but there is no difficulty in cleaning the turret studs as the cover is easily sprung off and there is room to do this In isolated cases where cleaning is not effective the spring carrier can be levered in slightly to effect more positive contact with the studs. This can be done with a screwdriver blade without using undue force.

Other than this the most common trouble is associated with the fine-tuner sprocket disc at the rear. The disc becomes loose on its spindle which prevents the sprockets exerting the correct pressure on the fine-tuning plate. The fine-tuner knob at the rear therefore becomes ineffective. The disc is

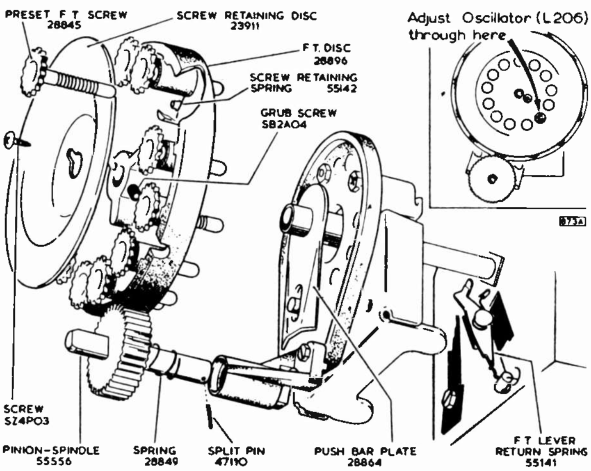


Fig. 3: Preset fine tuning mechanism. On some models manual fine tuning is used.

secured on the shaft by a grub screw. This can only be tightened effectively with an Allen key ($\frac{1}{8}$ in.). Using a small screwdriver will spoil the screw and will not effect a positive grip.

We have also known the wire which operates the fine-tuner core to come adrift from the nylon bush on the end of the lever and this is a possibility which should not be overlooked.

Apart from valve failure the other troubles seem to be confined to resistors changing value—check R206 and R209—and shorted lead-through capacitors. This latter condition causes the h.t. feed resistors (R169 or R170) to cook up—these resistors are mounted to the right of the fuse F1 as shown on the rear view diagram.

UHF Tuner

Very little trouble should be experienced with this unit. Loss of gain calls attention to the PC88 and PC86 valves (tuning drift to the latter). Apart from this we have known resistors to change value and wires to spring off the valve base tags, in particular from pin 2 of the PC88 causing complete loss of u.h.f. signal.

Video Faults

The video amplifier is a PCL84 (V5). This valve sometimes gives trouble leading to loss of vision signals. Probably the most serious effect is when the valve develops a screen-to-grid short. When this happens not only do the associated resistors cook up but the vision detector diode is usually ruined by the excessive current flow. This of course is W1 (OA70) inside the oblong can to the left of the PCL84.

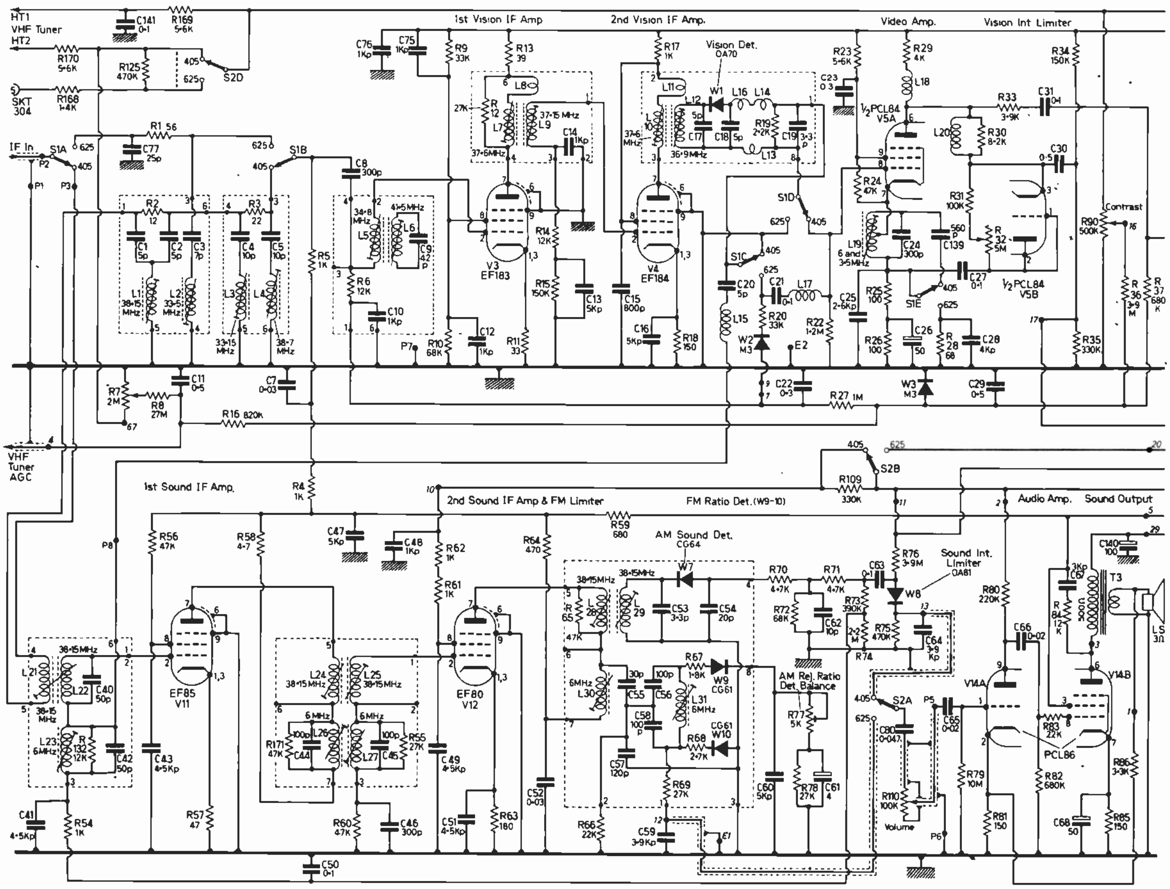


Fig. 4: Circuit diagram of the

Quite often however the valve is blameless and resistors change value on their own account, particularly R24 (47kΩ).

Weak sync may be caused by C26 losing capacitance (50μF) or R24 changing value, whilst on 625 the field sync can often by improved by changing C23 from 0·03μF to 200pF.

Field Timebase

Whatever field faults may be experienced, one item must always be checked. This is R138. If V7 is removed, R138 will be found immediately behind it. It is 22kΩ and frequently changes value causing loss of height and field roll. Replace with a 1W resistor of the same value. Other causes of field roll may be a faulty valve—check the PCL85 and the ECC804 (6-30L2)—R144 (2·2MΩ) changing value or a leaky capacitor (check C113 and C114).

Bottom compression is another extremely common trouble. Check the PCL85, try another 100μF capacitor cross C117 and check the value of R150 (possibly damaged by excessive current through a faulty PCL85). It should be remembered that a decrease in value of the cathode bias resistor will not only cause poor linearity but also shorten the life of the valve. An increase in value will cause top compression (a fact that is not always realised). C119 (0·01μF) sometimes leaks causing bottom compression and this is another item which should not be overlooked.

Total loss of field scan, resulting in a single white line across the centre of the screen, can be caused by a faulty valve (V7 or V13) and quite often by a faulty field output transformer. In this case there will be no h.t. at the PCL85 anode pin 6 (there will be h.t. at point 28 on the panel but not at point 30). Check the primary and secondary connections on a replacement transformer as these may not be the same as the original.

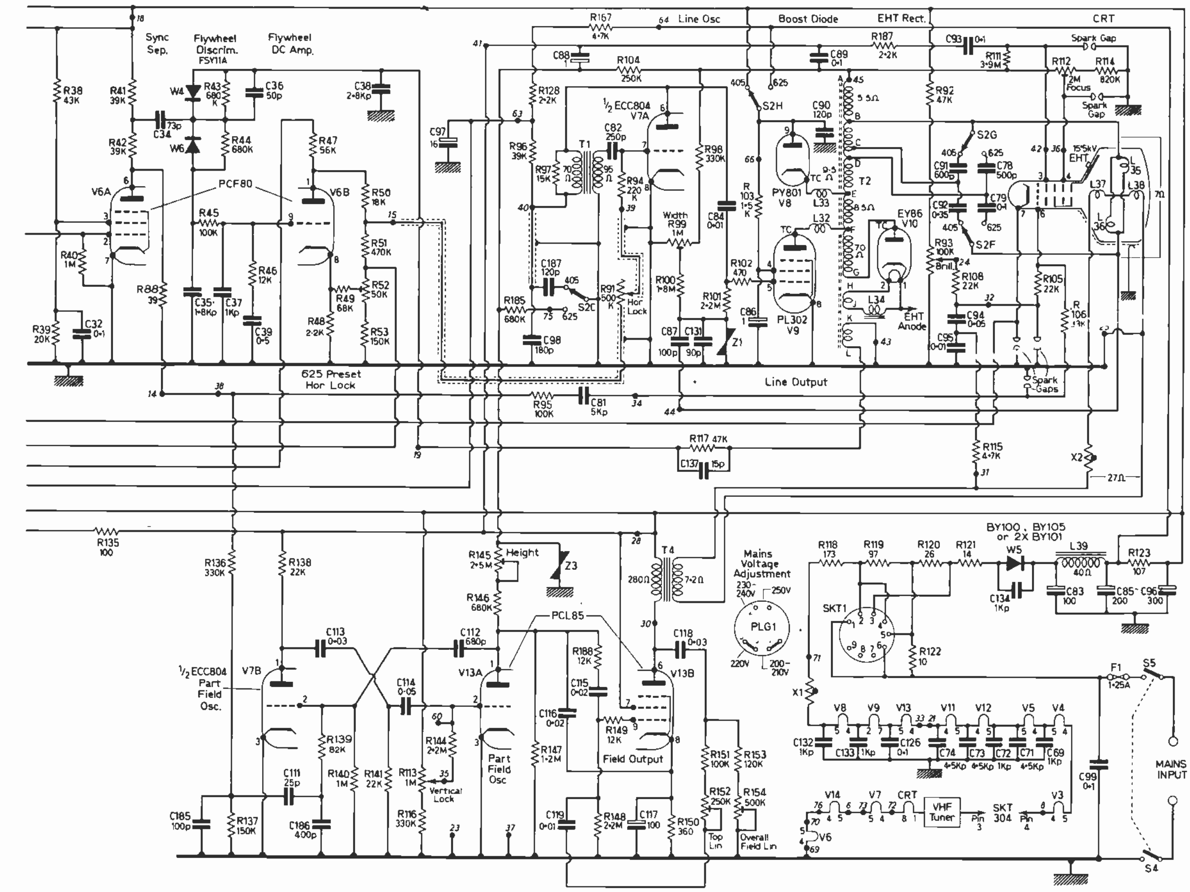
Electrolytics

The main smoothing block on the lower left side can give rise to several different fault symptoms including poor sync, hum bars on the picture, wavy verticals etc. The leads to the several tags are wrapped, not soldered. When a replacement block is fitted the leads should be soldered as any attempt to wrap will cause the wires to fracture.

Receivers with Radio

Models such as the HMV 2614 incorporate facilities for f.m. radio reception. An extra switch is mounted on the v.h.f. tuner shaft and this switches the timebase h.t. out and a compensating resistor in (to adjust the h.t. voltage) when the turret is rotated to select the Radio 2, 3 or 4 coil biscuits. The i.f. output is then 6MHz and this is passed to the sound i.f. and 625 f.m. detector stages.

TO BE CONTINUED



Thorn 850 dual-standard chassis

Models fitted with the Thorn 850 dual-standard chassis include the following: Decca DR61 and DR71; Ferguson 3617, 3618, 3619, 3620, 3621 and 3622; HMV 2609, 2614*, 2616 and 2618; Marconiphone 4609 and 4610; Ultra 6619, 6621*, 6622 and 6623*. Models with an asterisk following incorporate f.m. radio circuitry.

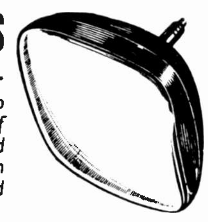
VOLTAGE DATA

Taken with 208V mains input and no signal. Contrast and local/distant controls at maximum, all other controls set for normal operation. Total h.t. current 300mA (405), 330mA (625). Boost voltage (junction T2/C89) 508V (405), 650V (625).

H.T. at C83 243V, at junction L39/C85 230V, on both systems.

Valve		Anode volts 405	Anode volts 625	Screen volts 405	Screen volts 625	Cathode volts 405	Cathode volts 625
V3	EF183	204	206	48	48	—	—
V4	EF184	190	193	190	195	2	2
V5A	PCL84	126	148	160	167	8	1
V5B	PCL84	68	80	—	—	125	148
V6A	30C1/PCF80	135	146	41	44	—	—
V6B	30C1/PCF80	74	112	—	—	—	—
V7A	6-30L2/ECC804	139	118	—	—	—	—
V7B	6-30L2/ECC804	73	73	—	—	—	—
V9	PL36 or 30P19/PL302	—	—	170	190	—	—
V11	EF85	174	92	130	35	—	—
V12	EF80	166	92	177	22	2	0·5
V13A	PCL85	33	33	—	—	—	—
V13B	PCL85	190	197	205	208	19	19
V14A	PCL86	97	97	—	—	—	—
V14B	PCL86	196	202	205	208	4·5	4·5

LAWSON BRAND NEW TELEVISION TUBES



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A47-13W (T)	MW53/80	C19/10A	CME1902	21DKP4
A47-14W	AW-47-97	C19/10AP (T)	CME1903	23SP4
A47-17W (P)	AW-53-80	C19/AK	CME1905	171K
A47-18W (P)	AW53-88	C21/1A	CME1906 (T)	172K
A59-11W (P)	AW53-89	C21/7A	CME1908	173K
A59-12W (P)	AW59-90	C21/AA	CME2101	212K
A59-13W (T)	AW59-91	C21/AF	CME2104	7205A
A59-14W (T)	C17/1A	C21/KM	CME2301	7405A
A59-15W	C17/4A	C21/SM	CME2302	7406A
A59-16W (T)	C17/5A	C21/TM	CME2303	7502A
AW36-80	C17/7A	C23/7A	CME2305 (P)	7503A
AW43-80	C17/AA	C23/10A	CME2306 (T)	7504A
AW43-88	C17/AF	C23/AK	CME2308	7601A
AW43-89	C17/FM	C23/AKT (T)	CRM173	7701A
AW47-90	C17/HM	CME1402	CRM212	CRM121
AW47-91	C17/SM	CME1702	CRM211	MW31-74
MW43-69	MW/53-80	CME1703	17ARP4	
MW43-64	T908	CME1705	17ASP4	
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30FL1	13/6	EF85	5/9	PL84	6/3
30FL12	14/3	EF86	6/3	PL500	12/9
30FL14	11/9	EF89	4/9	PL504	13/3
30P4	11/6	EF183	5/9	PY32	10/-
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DAC32	6/9	EL84	4/9	PY88	6/6
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DAF96	6/3	EY86	5/9	PY801	6/6
DF33	7/6	EZ80	3/9	R19	6/3
DF91	2/9	EZ81	4/6	U25	12/9
DF96	6/3	KT61	8/3	U26	11/6
DK32	6/9	KT66	15/9	U191	12/3
DK91	5/6	N78	14/6	UABC80	6/6
DK96	6/6	PABC80	6/9	UBC41	8/3
DL35	4/9	PC86	10/3	UBF89	6/3
DL92	5/9	PC88	10/3	UCC84	7/9
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ECC83	4/9	PCF808	11/9	UY41	7/9
ECC85	5/6	PCL82	6/9	UY85	5/3

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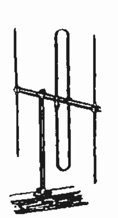

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MONTREUX 1969

—continued from page 489

tion on these developments which could have far reaching consequences for our urban landscapes.

COLOUR BROADCASTING

Generally, one found European broadcast engineers still a little envious of the 20-million colour receivers in the USA and the 1·4-million in Japan. But West Germany now has more than 500,000 colour sets, costing from about £200 upwards, although the total hours of colour programming have always been fewer than in the UK.

The prospects and preparations for British three-channel colour starting this November were outlined in a survey paper by Charles Marshall, honorary secretary of the Royal Television Society. He underlined the tremendous efforts of the Independent Television programme companies, the ITA and the BBC to set up colour facilities which will be unparalleled in Europe even though, at the moment, this country is lagging well behind West Germany in the number of colour receivers.

Some of the problems involved in colour reception on the Continent can be seen in the multi-standard colour sets designed to allow reception of either PAL or SECAM colour transmissions. Such receivers are appreciably more expensive than single-system sets but are almost essential to viewers such as those around Lake Geneva where both French SECAM and the Swiss PAL transmissions are regularly viewed. That at least is a complication which has been avoided in the UK!

MONTREUX 1971

The next Montreux international television symposium—a quite separate event from the annual Montreux "Golden Rose" programme event—is to be held in 1971, from May 21 to 28. ■

DX-TV

—continued from page 511

Not exactly a mystery, but how it fooled me at the time!—on 24th at 12·26 on Ch. E2 there was a very queer "test card", a large white circle with some irregular black patterns on it, and I duly noted in my log "no corner circles". As the signal increased it was followed a few moments later by a captain "Ha vista Apolo 10" and was TVE relaying space shots of the Earth!!! That will teach me, I hope, not to jump to conclusions in the future!

NEWS

We reported last month that the Swedish test card was now carrying a dark band across the centre and have now been able to study this card in more detail. It is the new Swedish colour test card and in some ways is similar in the centre circle to the BBC-2 test card F. There is a young girl's head on it, at the top the letters TV1 and Sveriges Radio, with the word Stockholm at the bottom as before. Presumably for those lucky DXers who can get u.h.f. from Sweden the card is marked TV2.

The most important news however is from R. Bunney: he has done it again! This time it is his convincing claim of reception of Iceland TV on 30/5/69. At 13.00 to 13.30 on Ch. E4 he received an electronic test card similar to the one we published as Data Panel 23, but without any written caption on it. Previously to this there were openings to Norway and this reception was during a "lull". The new signal was at a maximum with the aerial to the North West: all told it is an "odds-on" bet that this was Iceland on E4, the 300kW station, and our heartiest congratulations to him! Alas I missed this one, but my aerial will point to the North West in the coming weeks!

DX AERIAL PREAMP

—continued from page 505

during the Sporadic E season it will drive the receiver into overload. Indeed it may be that these signals can drive the receiver into overload without any amplifier. If this is so it is most likely that a modified 405-line positive-modulation receiver is being used. If overload is experienced with negative-going vision an overload diode should be fitted as shown in Fig. 4. This will completely solve the

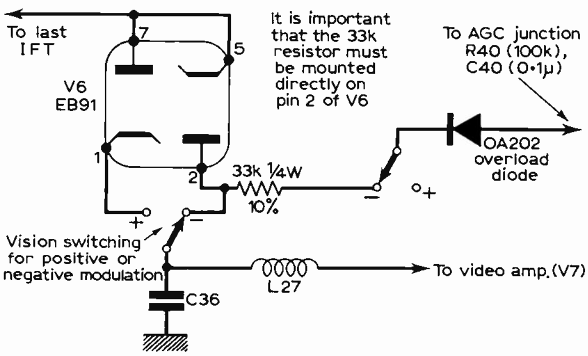

Fig. 4: Overload modification suitable for the Bush TV53-TV66 range of receivers.

problem. I actually use an amplifier with 30dB gain during the season and have experienced no trouble at all with strong signals. The circuit as shown is for fitting to a Bush TV53-66 range receiver (these are popular for DX reception). It is important to keep all connections to the detector short and the overload diode must be switched out on positive-going vision to avoid loss of gain.

Modifications

If instability is produced when the input socket is touched with your finger, fit a 5pF capacitor as shown in Fig. 1 between the emitter of Tr1 and chassis. This will overcome the effect and the preamp should then be stable over the complete range.

An improvement can be obtained in some preamplifiers of this type by adding a capacitor of 10-25pF across L6 as shown in Fig. 1. This improves the h.f. performance somewhat. It is well worthwhile experimenting with different values while on a weak station at the h.f. end of Band I. In the two prototypes the optimum values were found to be 15pF and 25pF. ■

YOUR PROBLEMS SOLVED

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply service data or provide instructions for modifying 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 525 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

INVICTA 338

There is a good 3in. of blank screen to the right. I have changed several valves and components but this has had no effect on the fault. I also replaced R35 (470Ω 1W) which had the appearance of being burned out.—L. Dyson (South Wales).

Centre the picture by means of the ring magnets behind the deflection coils. Ensure the width-linearity sleeve has not been pushed too far into the deflection coils on the tube neck. Check the h.t. output of the rectifier and change it if there is too much drop (a.c. input to d.c. output).

PAM T750

A spark ¼in. long can be drawn from the anode of the EY86. There is no e.h.t. at the final anode of the tube due to the heater not lighting. The timebase whistle seems to vary in pitch and the sound is weak on all channels.—J. Redland (Somerset).

There would seem to be two faults in your set: one in the line output stage and the other in the sound channel. The lack of e.h.t. voltage could mean that the line output transformer has poor insulation or a short-circuit between the turns of a winding. This might not kill the pulse potential altogether—still allowing a spark to be drawn from the EY86 anode—but it may attenuate it sufficiently to prevent the rectifier heater lighting properly.

Weak sound could, of course, be caused by almost any fault in the sound channel, including misalignment and a faulty aerial system. First check the appropriate valves.

MARCONIPHONE 4617

On BBC-2 only I get a loud buzz whenever a title (or in the case of a foreign film subtitle) is superimposed on the picture. The fault cannot be improved by tuning the u.h.f. fine tuner.—E. Bishop (Surrey).

This is the symptom of intercarrier buzz. It can result from various causes including drift in the alignment of the intercarrier sound channel, unbalance in the f.m. ratio detector circuit (check the two diodes and associated resistors and adjust any preset here for minimum buzz) and misalignment of the vision i.f. channel, causing the sound i.f. carrier to rise up the side of the overall response curve.

RGD 605

The picture is cramped at the bottom and extended at the top with a blank space about 1 in. deep at the bottom of the screen. Also the picture sometimes assumes a "concertina" type of effect, starting like a wave at the bottom and moving up the screen to the top.—D. Pryor (Wales).

There are two faults in your receiver. One is in the h.t. supply smoothing, responsible for the picture ripple effect, and the other in the field output stage.

Actually a low-value smoothing electrolytic, which would certainly cause the first fault, might well be aggravating the second. In the first instance therefore check the main electrolytic smoothing capacitors.

If the field fault persists check the field output valve and the electrolytic capacitor connected to its cathode.

INVICTA 237SP

This set is working well on BBC only. There are two broken lines at the top of the screen. I have replaced the PCL82 but this has not cured the fault.—J. Rollins (Berkshire).

A blocking oscillator transformer is used in the triode section of the PCL82. It is the design of this which determines the trace period.

You may find that a slight adjustment of R105 (top linearity) will "hide" the pulse and bar lines which are inserted into the BBC signal.

STELLA ST1017U/46

There is hum on sound and the field sync is intermittently weak with slight line pulling. I have replaced the sync separator valve and checked that the voltages are correct. I have also checked the field sync coupling capacitor and found that to be OK.

I replaced the h.t. smoothing capacitor and this reduced hum in the sound stage to normal, also checked the h.t. feed and decoupling components in the video stage and found them to be in order.—K. Warr (Essex).

The 180Ω resistor to pin 6 of the left side ECL80 (next PCL82) is suspect. Check this and the video amplifier cathode electrolytic (100μF 12V). We presume that the 10μF decoupler has already been checked.

EKCO T231F

Adjustment of the contrast control has no effect whatsoever on the picture—A. Maw (Yorkshire).

We advise you to suspect a faulty c.r.t., faulty contrast control or faulty servo control which affects the contrast and is in the screen grid circuit of the first vision i.f. stage. The component itself is a variable resistor located below the chassis adjacent to the tuner.

PYE V310S

The fuse blows immediately the set is switched on. Prior to the fault the picture and sound were of very good quality. I have checked for burnt or charred resistors and capacitors but could not find any. I renewed the thermistor and the 0·02μF capacitor across the mains.—H. Berridge (Cambridge).

You possibly have a short-circuit 1800pF capacitor C52 between the anode of the rectifier and chassis. The fault could alternatively be in the rectifier itself or due to chafing leads shorting to chassis on a corner. The only short way of finding your fault is a progressive disconnection of the supply leads, monitoring the results on an ohm-meter.

MURPHY V280A

This set has good sound and raster and at times a very faint negative picture. I have replaced all valves and checked the e.h.t.—R. Shenton (Wiltshire).

The symptoms you describe suggest a faulty c.r.t. or trouble somewhere in the video amplifier stage. The best method of checking this is by using a signal generator progressively moving grid by grid from the c.r.t. to the tuner.

PETO SCOTT 738

There is no raster and no sound. All the valves were found to be in order but the EY86 was not lighting up. Upon checking it was found that there was no voltage at the pins of the valve and no voltage at the cap. The PL81 and PY81 similarly had no voltage at the caps but they lit up as normal.—J. Blakeley (Northumberland).

You will probably find that the 27Ω section of the mains dropper is open-circuit. This feeds a.c. voltage to the PY82 rectifier (via the 47Ω resistor to pin 9 of each base). Check the a.c. mains from the live section (the heater end must be live) to the point where the supply is open.

KB ROYAL STAR

On recently fitting a new tube to this set I found that I could not get the picture centralised. It is condensed on the right-hand side and stretched on the left. I also find the hold is constantly losing lock.—R. Whyte (Ross).

The picture shift control is immediately behind the deflection coils. Check the PL36 line output valve and adjust the linearity sleeve under the deflection coils. This must not be inserted too far in and in fact adjustment of this sleeve may possibly be the answer to your problem.

Check also the PCF80 video amplifier and the line oscillator.

PYE 40F

When switched on the picture is compressed at the top and bottom, only filling one third of the screen. It is slightly more compressed at the bottom. After two to three minutes the picture becomes unstable and then slightly overfills the screen. It then settles down to a normal picture.

I have had all the valves tested and they all appear to be serviceable although they are probably now a little "down" on performance.—H. Hancock (Wiltshire).

We would say that the PCL85 field output valve is slow heating. This of course is a fault that would not show on test.

MARCONIPHONE VT69

The picture was present but there was a 2in. gap down the left side of the screen. The following day the picture lost definition and now there is only a snow effect and the sound has disappeared. I have replaced valves PCC84, PCF80 and PL83 and there is no improvement in the picture. The sound comes back when the set is first switched on now, but fades after about 5 minutes.—G. Devine (Derbyshire).

Check the h.t. voltages and rectifier. If necessary check the main electrolytics. With the h.t. line normal, check for proper working of the line time-base. Check valves and components associated with this and the line output transformer (which could be at fault). If the sound still fades, check valves and decoupling capacitors.

EKCO T221

The screen is completely blank. I have replaced the e.h.t. rectifier (U26) and the line output valve (20P4). As far as I can tell everything is normal except for the complete lack of picture. The e.h.t. rectifier is glowing blue.—M. Male (Essex).

If the sound is OK and the e.h.t. rectifier is glowing blue we feel that you may have a short-circuit somewhere on the e.h.t. feed to the final ancde of the picture tube. This could be caused by a leaky e.h.t. reservoir capacitor, by electrical leakage on the heater winding of the line output transformer, or by trouble in the picture tube itself.

The essential effect of course would be lack of e.h.t. voltage.

FERRANTI T1027

The fault is flickering pictures. There is no loss of line or field hold and the sound is normal. This flickering can be stopped by advancing the contrast control to unviewable limits. Thinking the fault may be i.f. instability I have systematically made slight adjustments to the video i.f. coils but to no avail.

The signal strength apparently affects the flickering (I use an indoor aerial which provides excellent signals on both channels).

Also could you state the purpose of the metrosil R74 as there was no effect on e.h.t. or e.h.t. regulation when I removed it from the circuit in an effort to stop the flickering.—P. Rowley (Northants).

It would appear that the e.h.t. rectifier is defective. This is the U26.

The purpose of the metrosil is to present a constant load to the U26 to prevent variation of picture size and focus as the brilliance varies.

FERGUSON 406T

The sound on this receiver fades to about one-third volume after it has been in operation for about ten minutes. There are no other faults and the sound never disappears completely—F. Wakefield (Gloucestershire).

We would advise you to examine the lower of the two PCL82 valves on the right side. Check the valve, its connections and associated components. Then check the sound i.f. EF80 and circuit, detector and noise limiter circuits.

BUSH TV56

I receive good sound but a raster is unobtainable. I have changed all the valves in the heater circuit but without any success. There appears to be no high voltage at the metal cap at the top of the e.h.t. rectifier.—M. Wilson (Staffordshire).

Check valves ECC82, PY81 and PL81. Check line drive to the PL81 control grid. If this is present check the screen feed resistor to pin 8 and also the boost line capacitor and continuity of the deflection coils. If all these points are in order check the line output transformer.

PHILIPS 19TG153A

A new aerial for BBC-2 was installed and tuned in on the u.h.f. tuner but the tuning screw in the tuner locked. In trying to free this screw the plastic bush broke. I now wish to repair this but cannot see how to remove the u.h.f. tuner.—R. Shackleton (Lancashire).

It is a comparatively simple matter to remove the complete control panel, having pulled off the three knobs and removed the 4BA fixing nuts on the inside of the panel and rear centre bushed screw. The whole unit can then be withdrawn.

BUSH TV95

There is sound but no raster or picture. All the valves and tube light up except the EY86 which remains cold. I tried a new EY86 but with the same result and when I tried to obtain a spark from its anode it remained dead.—H. Dixon (London, W.12).

The EY86 will not operate if there is a fault in the line timebase. Check the PL81 and PY81 and associated components including the boost line capacitor.

ULTRA V1760B

There are three poor images, one on the left of the screen, one in the centre and the third at the right-hand side of the screen with a vertical bar of widely spaced lines between each. I have changed V6, V8 and V13 but the fault remains.

The horizontal controls are working but that I have described is the best possible picture I can obtain. Although the U25 works perfectly in another receiver the picture goes dark and blows up when the brightness is turned up.

This fault is present on all channels. — T. Humphreys (Manchester).

The fault is associated with the horizontal hold circuit. Check the components associated with the hold control and others in the oscillator circuit and change the line oscillator valve itself.

PHILIPS T-VETTE

This receiver is OK for an evening's viewing but when next switched on there is no sound or vision on u.h.f. or v.h.f. There is however a perfect raster. Each time I take it to the dealer he reports that there is no fault and that the set only needs "adjustment".—J. Shearing (Hull).

The transistor T3002 (AF178) may well be at fault. This is the mixer transistor on the v.h.f. tuner unit (common to u.h.f.). Whilst we suggest this particular point we must point out that the fault could well be on the i.f. panel and the AF181 stages should also be checked.

BUSH TV53

I have two of these receivers both with faults. On set 1 the horizontal hold is very sensitive. Any slight knock on the side of the set breaks up the picture only momentarily. The line output transformer and valves are OK.

Linked with this is severe sound-on-vision on BBC-1 although this can be tuned out slightly on ITV. The adjustment of Channel 3 coil produces no remedy. The stronger the aerial signal input (both BBC and ITV) the more pronounced the picture break-up.

On set 2 there is a lack of e.h.t. to the line output transformer. All the valves in this section are OK. Occasionally the EY86 does light up and is accompanied by flashes from the PY82 valve bases.—R. Wilson (Wiltshire).

On set 1 we would recommend that you replace the hold control (1MΩ). Check the setting of the local/distant plug on the left side (set to local) and tune the sound rejectors if necessary.

Regarding the faults on set 2 we suggest you check the boost line capacitor (0·1μF) and ensure that all connections are good.

PHILIPS 1768U

There are two pictures on the screen with a horizontal black band dividing them.—W. Eaton (Cheshire).

The trouble here lies in the line timebase. It is possible that the resistor at the top of the line hold control has changed in value. Also if necessary change the line oscillator valve.

CCIR TV CONVERSION

I brought back from abroad with me a 12 in. transistorised 12/240V 625 v.h.f./u.h.f. CCIR TV. Can this be adapted for use in England.—J. Thompson (Birmingham).

The simplest way to convert this receiver is to retune the 5·5MHz sound intercarrier strip to 6MHz and use on 625-line BBC-2.

EKCO T444

This receiver has suddenly lost overall gain. The picture is grainy and there is "mush" on sound as though the aerial is disconnected.—E. Dawson (Lincolnshire).

You appear to have a defective r.f. transistor in the tuner. Normally it is better to have these replaced by the manufacturers but if you are skilled in these matters you may be able to replace it yourself without disturbing BBC-2 unduly.

PILOT PT450

The screen suddenly went blank except for a narrow horizontal line across the middle. This can be eliminated or increased by the brightness control. The sound meantime remains perfect.—L. Coote (Middlesex).

You should check the 30PL13 field oscillator/output valve (upper right) and associated components if necessary.

BUSH TV85

There is a loud hum on the sound and dark lines appear across the screen looking similar to sound-on-vision. There are also horizontal white lines flashing down one side of the picture, about 1 in. wide.—E. Wilding (Lancashire).

If the alignment is not at fault (has not been disturbed) we would suggest you replace the electrolytic capacitors in the h.t. smoothing circuit.

Check the line output stage and deflection coils for signs of discharge.

SOBELL TPS710

A dark shadow measuring about 4 in. in diameter has appeared in the centre of the screen. This can only be seen when the set is switched on—whether or not a transmission is being received.—T. Millington (Lancashire).

If the picture size varies with the brilliance, replace the e.h.t. rectifier. If the patch, however, is still obvious when the set is switched off, clean the front of the tube face and mask.

We cannot rule out the possibility that the tube itself may be at fault.

PHILIPS 17TG306U

When the set is switched on there is only a thin horizontal white line across the screen, although the sound can be heard. I have had all the valves tested and they were found to be in good order.—D. MacLeod (Scotland).

Check the h.t. voltages to the field timebase valve bases. If these are in order it is highly likely that the deflection coils are open-circuit.

In these models it is prudent to check the continuity of the field deflection coils as these are often responsible for field collapse. Check the connections to the tag strip from the coils as a lead may be disconnected or connected improperly.

ALBA T324

The top of the picture is pulling and when there is a test card displayed the picture shrinks and swells slightly. I have changed all field timebase valves and the capacitor with the vertical form preset.—N. Covell (Lancashire).

Change the main electrolytic smoothing capacitors. Check the field output bias resistor and decoupling capacitor if necessary.

QUERIES COUPON

This coupon is available until August 22, 1969, and must accompany all Queries sent in accordance with the notice on page 522.

PRACTICAL TELEVISION, AUGUST 1969

TEST CASE 81

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.

? *THE symptom on an HMV Model 1871 was a very bad hum bar on the picture; in fact the effect was so severe that almost two-thirds of the picture was blacked out. Thinking that the tube had developed a heater-cathode leak the enthusiast tried a reconditioned one which he had in hand, but the same trouble was displayed on this.*

Because the sound channel was essentially free from background hum it was concluded that all must be well with the main smoothing electrolytics, and with this in mind the vision channel was investigated without the cause of the hum being revealed. Rather bewildered, the enthusiast next decoupled the tube to chassis at grid and then cathode with an 0·25µF capacitor, and on decoupling the cathode the symptom disappeared (but no picture, of course). With the cathode undecoupled, decoupling the grid had no effect at all.

What could have been the cause of this symptom? See next month's PRACTICAL TELEVISION *for the answer and a further item in the Test Case series.*

SOLUTION TO TEST CASE 80

Page 476 (last month)

Because the sound channel was inoperative on the Rediffusion system the symptom as discovered by running the set on an ordinary aerial was not initially revealed. The enthusiast soon discovered however that the sound i.f. channel was in a state of oscillation and that the high-amplitude signals from this were being reflected into the vision channel, causing the patterns.

A few tests soon brought to light an open-circuit ceramic i.f. bypass capacitor on the screen grid of the i.f. valve (it was actually fractured) and replacement of this solved the trouble. On returning to the Rediffusion system the tuner had to be retuned to secure the best picture on the available channels. On this system channel changing is handled not at the set but at the "inverter" box.

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