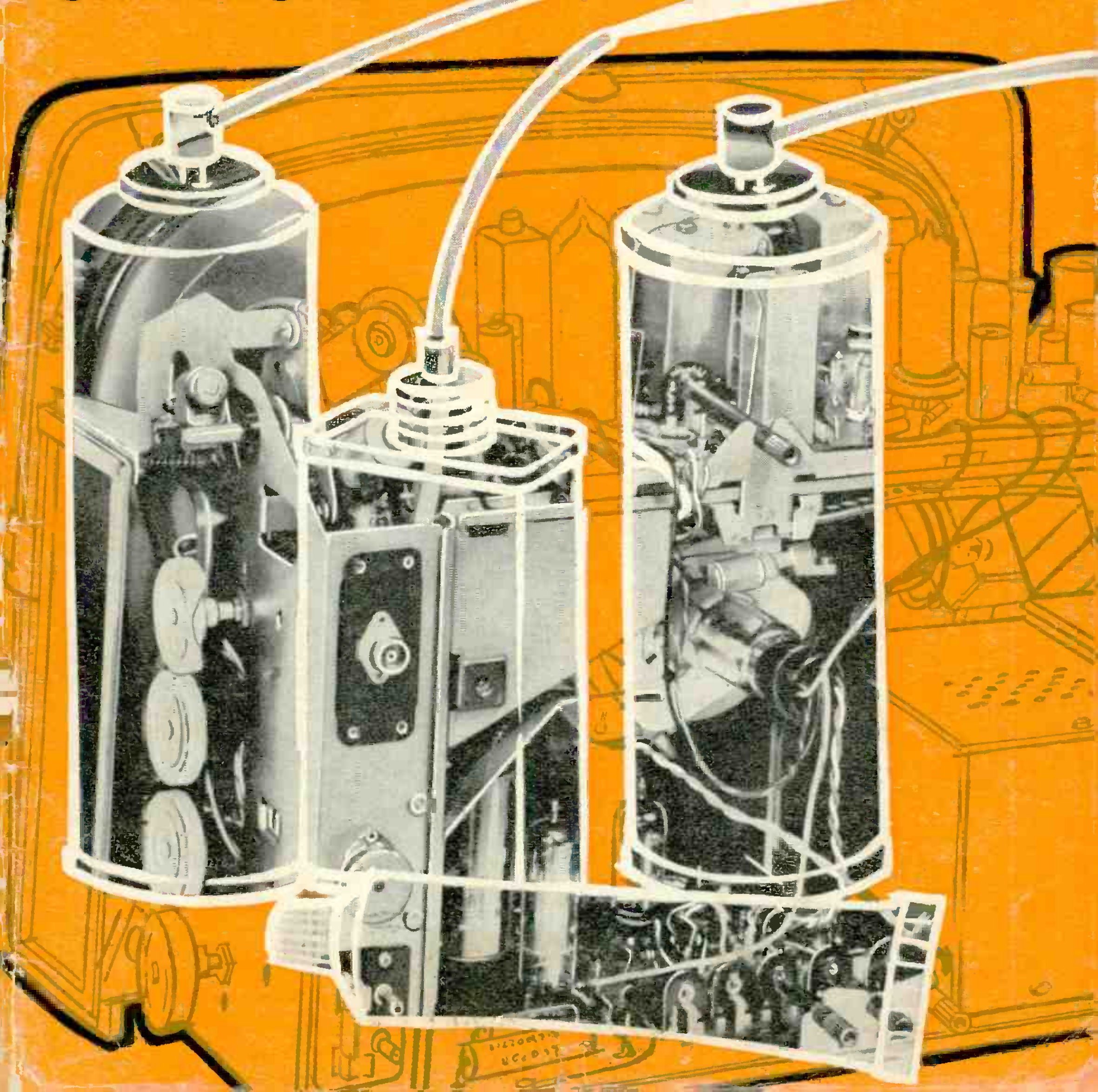
Practical TELEVISION

FEBRUARY 1968

2/6

CHEMICAL AIDS TO SERVICING



Practical Television

RECENT visits to setmakers have brought home the increasing specialisation on the engineering side today. One team concentrates on tuners, another on i.f. sections, and yet others on the field and line timebases, power supplies, sync separators and a.g.c. systems. Now with colour added we have decoder and convergence specialists and, presumably, those teams working away to get the whole thing in operation using a handful of integrated circuits. Pity the service engineer who meets the set at the other end when its gone wrong: he can't call in his line timebase lab when faced with an awkward e.h.t. fault.

One wonders whether this is the best way of doing things, however, especially when recalling how far Baird went largely on his own and the achievements of that team of engineers, including Schoeberg and Blumlein, who engineered the entire 405-line system which we still use, with its line and field sync intervals, front and back porches and so on in a matter of months, providing at the same time fully-electronic cameras and a whole host of then new circuit techniques. Blumlein, a list of whose patents—132 of them—would fill several pages of this magazine, started on telephones, developed an important technique of making three-terminal measurements, a stereo system that is basically the one used today but had to wait for the modern plastics microgroove disc to become a commercial proposition, and numerous pulse techniques including the monostable circuit in addition to his work on television and later radar before his untimely death in an aircrash—in 1941. Would engineers today prefer a diet as varied as that —or, perhaps more to the point, would they ever be given the opportunity to indulge it?

Could this division of labour be the result of modern management techniques rather than a decision by engineers on how best to tackle the problems at hand? And could it contribute to the notorious brain drain that is nowhere more pronounced than in the field of electronics? The manager likes to sit down and split the task before him into a number of separate compartments—indeed he is taught to do so today. But engineering is a largely creative enterprise: the true engineer is the man who knows instinctively that with patience, applied science and a certain insight he can find the answer to a tricky problem—and on top of this has the desire to get on with it. This is difficult for management to appreciate; and still more for them to take it into account when planning ahead. But without understanding between the two sides no undertaking will yield satisfactory results all round.

W. N. STEVENS—*Editor.*

FEBRUARY 1968
VOL. 18 No. 5
issue 209

THIS MONTH

THE NEXT ISSUE DATED MARCH WILL BE PUBLISHED ON FEBRUARY 23

TELETOPICS

Kodak and BBC collaborate

FROM December 6th to 22nd, Kodak and BBC presented a new photographic exhibition—"Colour Comes to Television"—at Kodak House, Kingsway, London, W.C.2.

By the use of colour transparencies, prints and diagrams, the exhibition outlined how we see colour, the history of colour television, how the system works, and a large section was devoted to telling the story of one of the BBC's first colour drama productions.

Miss Susan Hampshire, star of the colour TV series "Vanity Fair", opened the exhibition. Picture shows: Left to right, Mr. David Attenborough, Miss Susan Hampshire and Mr. A. E. Amor, Kodak chairman, at the opening of the current Kodak exhibition "Colour Comes to Television".

Ammanford TV relay station

THE BBC has placed contract with Messrs. T. Richard Jones of Ammanford, Carmarthenshire for the construction of the building for the Ammanford television relay station at Mynydd Betws, Carmarthenshire.

The Ammanford station will transmit BBC-Wales on Channel 12, and is expected to be brought into service during 1968.

This new relay station is expected to provide an improved service to some 8,000 people in Ammanford and its immediate surroundings.

Aerials for Britain and France

BELLING - LEE Aerials Limited recently welcomed to their Liverpool plant, directors and executives of M. Portenseigne s.a. one of the major French television aerial manufacturers.

The two companies are to exchange manufacturing, marketing and technical information, with the expanding horizons of European television in view.

Glasgow schools in TV lesson hook-up

WHEN Glasgow school children returned from their summer holidays, some of their lessons were transmitted from the Corporation's Educational TV Service studio. A total of 320 City schools are linked by closed-circuit television.

At present, the service screens three Maths and three French programmes every week. The new channel covers 4th and 6th form science and health lectures and hygiene for infants.

The programmes are telerecorded on Scotch video tape by a team of teachers after normal school hours. Each week 60 lessons are relayed to pupils.

Since the revolutionary system started—the first of its kind in Europe—under two years ago, over 30 miles of television recording tape, running at 7½ inches per second, has been used.

Last year, the Queen visited the studio in Bath Street and spoke "live" to the children. The Royal occasion was recorded on the 3M Company's video tape for posterity.

BBC-2 TRADE TESTS

BBC-2 Trade Tests are now radiated daily (except Sundays) as follows, subject to programme commitments and essential engineering work.

Mondays to Saturdays inclusive: 09.00-10.00 Black and white test card: 10.00-10.05 Service Information: 10.05-10.15 Test Card "F": 10.15-10.20 Colour Bars: 10.20-10.30 Test Card "F": 10.30-10.43 Colour Receiver Installation Film: 10.43-10.55 Colour Film: 10.55-11.00 Test Card "F": 11.00-11.25 "Play School" or Colour Film: 11.25-11.30 Test Card "F": 11.30-11.35 Service Information: 11.35-11.55 Colour Film: 11.55-12.00 Colour Bars: 12.00-12.10 Test Card "F": 12.10-12.23 Colour Receiver Installation Film: 12.23-12.30 Test Card "F".

14.00-14.10 Test Card "F": 14.10-14.15 Colour Bars: 14.15-14.30 Test Card "F": 14.30-14.35 Service Information: 14.35-15.00 Colour Film: 15.00-15.10 Test Card "F": 15.10-15.23 Colour Receiver Installation Film: 15.23-15.30 Test Card "F": 15.30-15.55 Colour Film: 15.55-16.10 Test Card "F": 16.10-16.15 Colour Bars: 16.15-16.30 Test Card "F": 16.30-16.55 Colour Film: 16.55-17.10 Test Card "F": 17.10-17.15 Colour Bars: 17.15-17.30 Test Card "F": 7.30-17.55 Colour Film: 17.55-18.10 Test Card "F": 18.10-18.15 Colour Bars: 18.15-18.30 Test Card "F": 18.30-18.55 Colour Film: 18.55-19.00 Test Card "F": 19.00-19.05 Colour Information and 19.05- Colour Film, except Saturdays.

Sound during the test card and colour bars transmissions follows this sequence as far as is practicable: 4 minutes 440c/s tone, 1 minute no sound, 15 minutes recorded music.

Recorded music only is transmitted when five minutes or less are available for the above sequence.

Service Information transmissions at 10.00, 11.30 and 14.30, and Colour Information at 19.00 are preceded by two minutes of caption.

On Saturdays, the start of scheduled programmes at 19.00 necessitates the termination of trade test transmission at 18.58.

Infra-red TV used in glass manufacture

AT the St. Helens factory of Fibreglass Limited, Mullard Limited has demonstrated the ability of an infra-red television system to provide information about the temperature distribution on the outer wall of a furnace. From this information, it may be possible to draw certain inferences about the condition of the inner wall, which could lead to the early detection of a weakness in the structure more conveniently than by the conventional methods using pyrometers and contact thermometers.

The infra-red television system comprises a thermal-imaging camera, and an oscilloscope. In the camera, the radiation from the furnace wall is focused on to the plane of a Nipkow disc which, when rotated, scans the field of view. The radiation is then focused on to a lead sulphide infra-red detector. The camera can be used with a heat source ranging from 130 deg. C. to several thousand degrees C., and with a heat source at 200 deg. C. it has a resolution of 5 deg. C.

A raster, generated electronically and synchronised to the disc, is applied to the X and Y amplifiers of the oscilloscope. The output from the infra-red detector is amplified and used to intensity-modulate the electron beam in the c.r.t. of the oscilloscope. Consequently, the oscilloscope presents an image corresponding to the infra-red radiation received by the camera, hot areas appearing brighter than cold areas.

New aerial catalogue

A NEW 1968 catalogue featuring aerials for u.h.f. and colour transmissions has been produced by Belling-Lee Aerials Ltd.

The catalogue, of new format, and supplied with separate quick-reference wall chart, aerial component booklet, and price list, covers the comprehensive range of television and f.m. radio aerials, aerial components and accessories.

Copies of the new catalogue may be obtained from Belling-Lee Aerials, Heysham Rd., Netherton, Bootle 10, Lancashire.

TV and BIG BUSINESS

CONFRAVISION, is the new name given to a possible future service, which would be available to businessmen, who, simply by booking studio time, would be able to hold meetings and conferences with business colleagues in distant places over inter-city closed-circuit television links.

The Post Office will test the likely demand for a future Confravision service by inviting representatives of commercial and industrial undertakings at top management level to two experimental working Confravision studios in London. This experimental demonstration link accommodates up to five people at each end. One studio is situated at the GPO Engineering Department's Headquarters in Gresham Street, E.C.2; the other is at the GPO Research Station at Dollis Hill. The Studios will offer Confravision and other allied facilities such as facsimile transmission and photocopying of documents, and sound recordings of the proceedings.

Studios in a future Confravision service would be strategically sited, initially in the principal cities of the United Kingdom. There are no technical reasons why the service should not be extended to smaller towns where there is sufficient demand or development for calls to Europe and the USA.

The studios would be self-operated and, by the inclusion of privacy equipment, proceedings would be kept confidential to parties in the studios. A translucent "blackboard" would enable *ad hoc* material to be written or drawn by felt-tipped pen and displayed at the distant studio. A second camera situated behind the "blackboard" ensures that the writer does not obstruct viewing.

Simple switches enable the chairman, or anyone delegated to do so, to control cameras and microphones. If the chairman preferred not to be tied or otherwise inhibited by operating the control switches, the control box could be moved to a desk in the studio but out of range of the camera. From that position a secretary could control cameras and microphones and, also, gain access to facsimile transmission and photocopying equipment in a room adjoining the studio.

Until the precise range of facilities required by potential users is confirmed, Confravision call charges can only be speculative. Time and distance between studios would be important factors to be taken into account, and, of course, call charges would need to be economical both to the Post Office and business users. Speculative charges are in the range of £120 per hour for calls between studios 100 miles apart to £200 per hour at 200 miles.

Whatever the cost of Confravision calls may be, the savings on travel and accommodation as well as executive wear and tear need to be equated with them. In addition, Confravision would considerably increase management flexibility and, more important, productivity, by keeping executives in close touch with a more diverse and geographically scattered number of projects.

Brimar industrial tube brochure

BRIMAR have published a 1967-68 edition of their abridged data brochure on Industrial Cathode Ray Tubes. Since last year's edition, the number of available tube types shown has doubled to 80, covering the applications of radar, oscilloscopes, picture monitors and data display.

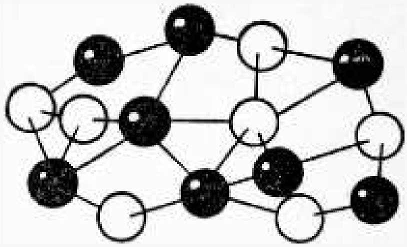
Free copies of the Brimar Industrial CRT Brochure are available from Brimar Valve Representatives, Brimar Industrial Wholesalers or direct from Publicity Department, Thorn-AEI Radio Valves & Tubes Ltd., 7 Soho Square, London W.1.

ANNUAL FILM SHOW AND MEETING

This will be held at Caxton Hall, London, on Friday, March 29th and will include a special feature on Colour TV.

Tickets available shortly. Write now to 'Film Show', Practical Television Editorial, George Newnes Limited, Tower House, Southampton Street, London W.C.2.

CHEMICAL AIDS TO SERVICING



G.R. WILDING

CHEMICAL aids to servicing now cover a wide variety of uses. There are anti-static compounds specially made to clean plastic surfaces such as protective TV screens and to minimise dust attraction. Silicone greases to protect and lubricate switches, to assist heat conduction from high power transistor heatsinks, and for coating e.h.t. components to prevent corona discharge. Then there are the fairly recently introduced freezing agents in aerosol containers. These, when sprayed on small components, instantly reduce their temperature to about —50°C and often show up intermittent internal defects or dry soldered joints which might otherwise take a long soak test to reveal, while, when applied to transistors, diodes or p.u. cartridges prior to close soldering, they completely prevent any possibility of resulting thermal damage.

However, undoubtedly the greatest contribution to the radio and TV trade generally is made by those contact cleaning and protecting fluids or greases which can so effectively reduce service calls to clean tuner contacts of all types, v.h.f./u.h.f. system switches, rotary or slide controls, valveholders, printed-circuit panel connectors and all types of internal plug-in connectors. Simultaneously the use of such material lengthens the life of all moving contacts.

SWITCH CONTACTS

At one time it was thought that for maximum electrical contact switch surfaces should be left as clean as possible and dry. However, the great enemy of low resistance electrical contact is tarnish, and without some protective cover metals can oxidise very quickly resulting in a considerable ohmic contact, very markedly shown up in high gain amplifiers and receivers of any type. Further, when switch contacts carrying a sizeable current open the circuit voltage develops across the gap to produce a small spark of high momentary temperature which can pit the contact surfaces. If the switch is carrying a highly inductive current, the potential developed on contact break can be very high thus greatly increasing spark size and resulting pitting. As a by-product of this sparking, which is really a miniature arc, air electrolysis produces minute deposits of nitric acid which condenses on the contacts to further increase corrosion. The greater the corrosion, the more sparking takes place and a vicious circle develops resulting in a highly inefficient switch action.

While TV tuner contacts pass only quite small currents, variations in contact resistance in this first stage produce major effects in reception and near perfect action is vital. U.H.F./V.H.F. system switches on the other hand pass sizeable currents, especially those sections involved with the line output stage, and sparking can soon damage the necessarily limited surface area of the contacts. In many receivers the screen supply to the line output pentode is removed before anode circuit changes are made to reduce the risk of voltage surges damaging the switch and other components in the receiver.

Switch cleaning fluids therefore are designed first to remove tarnish, dirt and grease from contacts, and then leave a thin film to prevent or at least greatly inhibit further tarnish formation. Additionally, these chemicals also serve as a mechanical lubricant to ease switch operation.

However, some switch cleaners attack rubber and polystyrene-based plastics, so must be used with care when applied to the clip-in coil sections of certain turret tuners. Those in aerosol cans however and greases based on the same formula are generally completely inert.

CLEANERS AVAILABLE

Servisol is one of the widest known switch cleaning lubricants, and is now available in two varieties, (a) the original liquid but with a 4in. nylon reversible applicator so that it can be applied "spot-on" to switches and valveholders, and (b) Super Servisol in an aerosol can which has the advantages of not attacking any plastic, paint or rubber, etc.

These products, together with "Freeze-It" and the anti-static cleaning compound previously referred to are distributed through electrical and radio wholesalers, but in case of local difficulty can be obtained directly from the manufacturers.

Radiospares Ltd. distribute six different types of switch cleaner and lubricant, including a silicone grease which is also very effective as a coating on e.h.t. transformers and leads to eliminate corona discharge and inhibit moisture condensation. The other five products are a general purpose switch cleaner based on trichlorethylene, an electrical cleaning fluid, a contact fluid, a contact lubricant in grease form, and an aerosol contact lubricant also based on the contact fluid. These products, however, are only available to members of the trade by post, and though some larger retailers may supply amateurs direct, there are no fixed retail prices for Radiospares products.

Since its introduction in 1954 by H. E. R. Kingsbury, Electrolube has won wide acceptance and highly favourable comment from both light and heavy sections of the electrical engineering industry. While Electrolube is obtainable in various forms it is most suited to TV servicing and maintenance either as type 2A-X in an aerosol can or as 2G-X, a grease version of the former in a small tube. Both remove tarnish and oxydisation from switches and controls, and leave a protective film to eliminate or inhibit sparking and further corrosion. These types have no harmful effect on rubber or plastics. As well as being a switch cleaning and protecting material, the 2G-X grease version will also stop corona discharge when applied to e.h.t. transformers and leads, and is particularly suitable for large contacts using a wiping action, as in many turret tuners.

Also available from Electrolube is a freezer with high-pressure jet to give rapid cooling. The freezer leaves a protective lubricating film to protect against moisture.

TV SERVICING

The great benefit conferred by all the switch cleaning preparations mentioned is that the outside service engineer can often rectify bad contact in a tuner, volume control or other potentiometer with just a few drops of liquid or a quick spray from an aerosol can without having to do any dismantling and with the knowledge that the control will stay in good operational order for some time.

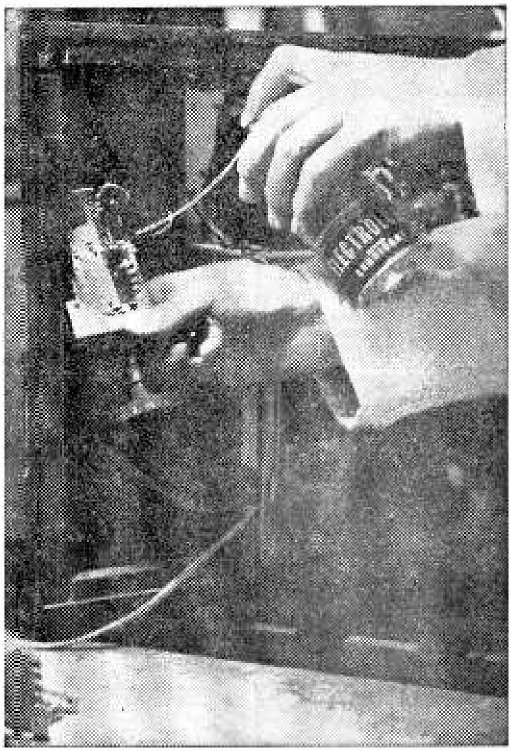
A high percentage of TV complaints are attributable to poor contact in one form or another—even one intermittently contacting valve in its holder can completely ruin reception—and the economics of television maintenance are such that all instances of poor electrical contact must be able to be rectified quickly with the minimum of servicing action. Take for instance that most common of TV defects, a noisy volume control section of a combined on/off/volume/brightness control. Either to replace the unit, with the need to unsolder and re-solder many leads, or to dismantle the component, clean the track and wiper and reassemble, is going to take a lot of time. With chemical switch cleaners, the drill is simply to get a little of the liquid or spray inside the volume control casing, rotate the knob several times from end to end to distribute the preparation over the track, and in most cases this action will completely remove the noisy operation. If there doesn't appear to be any opening through which the chemical can be applied, often removing the knobs and letting a small amount trickle down the spindle will suffice. In extremely bad cases I have nipped a very small hole in the outer cover with sharp side cutters to permit the ingress of the cleaner, but usually there is a small gap under the control's soldering tags.

RECEIVER OVERHAUL

If using preparations that can attack plastics, be extremely careful not to get any on control knobs, for even a few drops can soften the various materials used for them today.

In most instances, therefore, brushing away the surface dust and dirt from switches, controls and valveholders and then applying a light amount of liquid or aerosol cleaner will suffice, but when a receiver is to be completely overhauled, the following is the full treatment to be followed.

Tuners: Completely dust out the unit and remove all dirt, grease and contamination from switch contacts with a fluff-free cloth. Apply cleaner sparingly to all contacts and reclean to remove hardened tarnish and grime. Finally, after checking that all contacts make with adequate pressure, apply a light protective film.



Electrolube 2A-X being sprayed on a television receiver turret switch. In a large number of emergency calls from users it has been found that no basic technical fault in fact exists, a set often becoming inoperative because of a build-up of tanish or dirt on the turret switch contacts, valve pins or other load-carrying surfaces. A rapid application of Electrolube 2A-X, followed by a few movements of the switches or valve pins, will clear the fault and allow the set to operate. Up to eight months protection is claimed by following this procedure. The aerosol container, to which is attached an extension tube device, allows the Electrolube electrical and mechanical lubricant to be applied to inaccessible places, and in the correct quantity (which should be very small).

System switches: Remove all surface dust and grease with a small, soft brush. Apply cleaner sparingly and operate the switch several times with the set switched off. In those receivers, for example Ferguson, H.M.V. and Marconiphone models, which must be switched on before the power-actuated system switch will operate, wait till the volatile ingredients have evaporated.

Valveholders: Clean surface thoroughly, apply a few drops of cleaner into each pin socket and repeatedly insert and remove cleaned valve, wiping pins each time. Give a further light re-application before finally replacing valve.

"Open" miniature presets: Clean track with fluff-free cloth to remove accumulated dirt and grease, lightly apply cleaner and operate slider from end to end. ■

A Rhombic for Band III

D.J. SUMNER

THE writer lives in an area where two ITA stations are received at worthwhile strength (Horsham, Sussex). The aerial normally used is a proprietary eight-element yagi mounted on the rooftop and this gives a fairly good signal from the Croydon transmitter. However, it only produces a trace of signal from Chillerton Down as it is off the back of the aerial. Attempts were made therefore to provide a home-made aerial to receive the alternative station.

Most textbooks recommend for the amateur a stack of yagi aerials having few elements apiece rather than a single long yagi, due to the problem of getting everything correct with the latter. Accordingly, two three-element arrays were made from wood and wire and stacked side by side with half-wave spacing. Result? A poor picture which was well below entertainment value. It was also found to be very difficult to find a means of supporting an aerial as flimsy as this above about 20 feet.

As the mast used for this project was available, some long wire aerials were tried next. An inverted "V" was the obvious choice to start with as such an aerial needs only one mast. The difficulty is in making good earth connections for the terminating resistor and feeder at 200Mc/s. Results were poor, although the signal was there. Attempts at using quarter-wave rods as an "artificial earth" did not make much improvement.

To ease these problems, a vertical rhombic was tried as shown in Fig. 1. This had sides of length 20 feet corresponding to about four wavelengths, and a semi-apex angle of 72 degrees. Its lowest point was seven feet off the ground. The required bearing was obtained from a map using a protractor, this being accurate enough for the type of aerial. The rhombic was placed in the correct direction using a compass, remembering that the "line of shoot" is along the aerial with the terminating resistor nearest the transmitter. The terminated end was tied back to a point at its own level on a convenient tree using a non-conducting cord. For termination a 620-ohm carbon resistor was used, the physical arrangement being illustrated in Fig. 2.

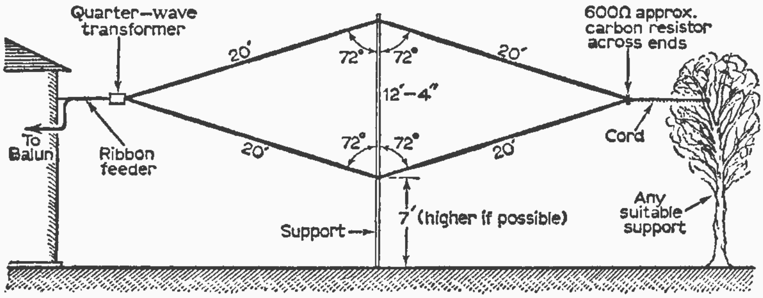


Fig. 1: General arrangement of the Band III rhombic aerial. All sides must be exactly the same length, though the length itself is not very critical The angle of 72° shown is critical.

Matching

At the feeder end the aerial presents an impedance of about 600 ohms balanced with respect to earth. This was easily matched to a 300-ohm ribbon feeder by a quarter-wave transformer having a characteristic impedance of 424 ohms. Such a device consists of two quarter-wave lengths of wire side by side spaced seventeen wire diameters apart and connected directly between the aerial and the 300-ohm feeder. If insulated wire is used for the transformer, wooden spacers are satisfactory (Fig. 3).

The 300-ohm ribbon feeder was about 15 feet long but any length up to about 30 feet should be all right. This takes the weight at the feeder end and was tied back to the house. The ribbon must not be tied itself or a choke will be formed, reducing the signal. The feeder was led indoors by the most direct route.

—continued on page 206

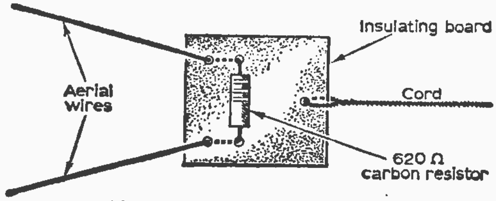


Fig. 2: Mounting for the terminating resistor.

Servicing TELEVISION Receivers

No. 142 - ALBA T990 SERIES

by L. Lawry-Johns

THERE are four models in the series, two 19in., the T990 and T995, and two 23in., the T230 and T235. Models T995 and T235 were supplied complete with u.h.f. tuner but the other two were supplied without and were intended for areas without u.h.f. coverage or in sites where a communal aerial system pipes the u.h.f. signals in at v.h.f. Before anyone says "yes, but!" we would mention that provision is made for maintaining the supply to the v.h.f. tuner when the receiver is switched to 625.

Layout and access

Figure 1 shows the appearance of the chassis in its swung-down position for servicing. This permits access to most of the valves etc. The line output stage valves are screened however and the v.h.f. tuner valves cannot easily be replaced without unhitching the tuner assembly. The chassis can be swung down once the two 4BA nuts which secure the top to the cabinet side members have been released. There are two printed panels, timebase and amplifier, which have plug and socket connections and are each secured by two screws. Note that if both panels are removed, the system-switch bar will drop. This necessitates it being held in its operating position when one of the panels is replaced. The spring-loaded switch rod will retain the bar in position once the panel is in place.

Removal of tuner unit assembly

Pull off the front knobs, u.h.f. tuning, 405/625 switch, v.h.f. channel selector and fine tuner. The assembly is secured inside by three 4BA nuts, two at the top and one at the bottom. When these are removed the assembly can be removed to the extent of the connecting leads.

Notes on setting-up

First ensure that the mains leads are properly connected so that the chassis is at neutral (black lead to top centre dropper) when the red lead should be live. For 240V mains red goes to tag 1, black to tag 6. If 625 is to be received, switch to this first and allow set to warm up. Set the main

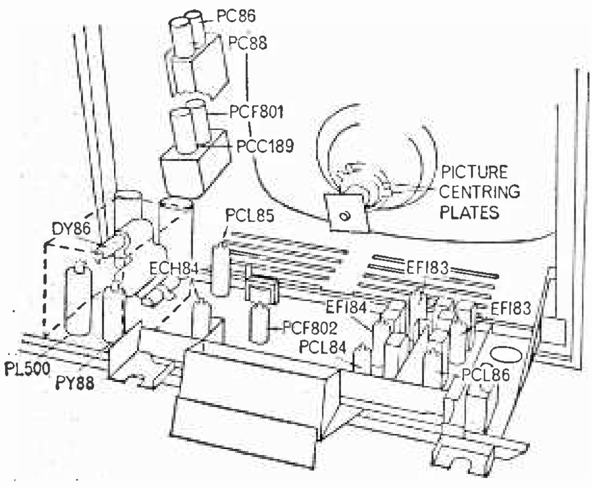


Fig. 1: Rear view of chassis in swung-down position.

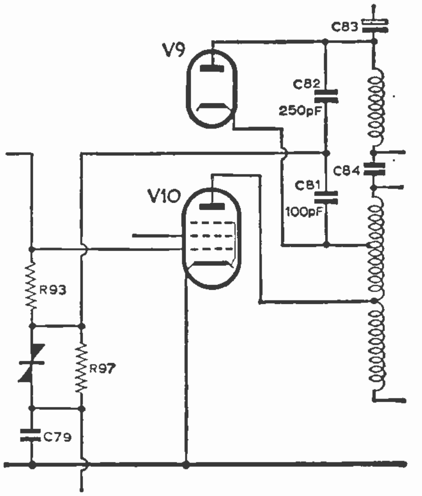


Fig. 2: Line output stage variations in early receivers (serial nos. 237001–238000 and 241001–242500).

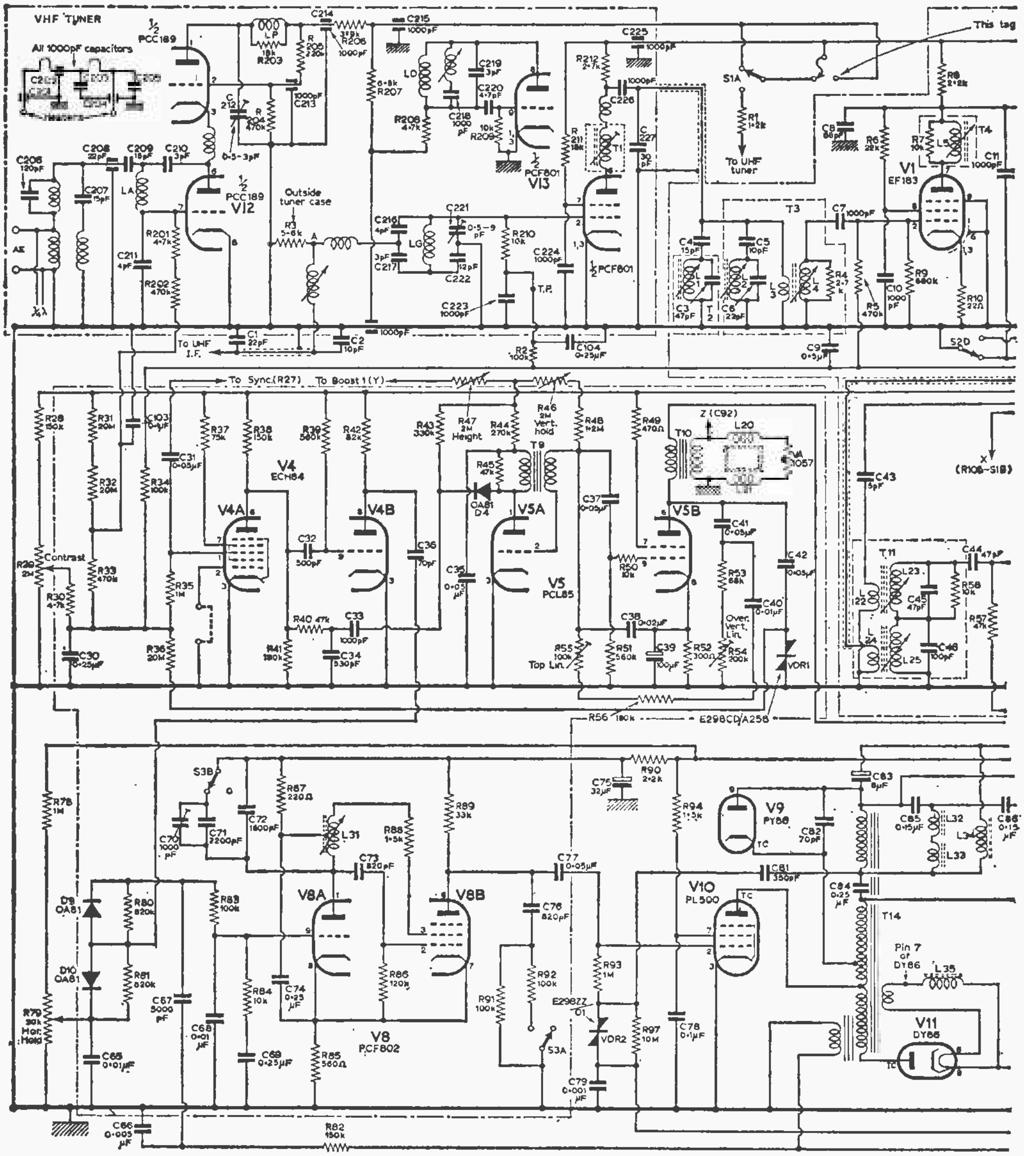


Fig. 3: Circuit diagram of the main chassis and

line hold to approximately mid-position. Adjust the line oscillator coil core (near the PCF802) to lock the picture. Switch to 405 and set C70 trimmer for a locked picture. If not quite within range reset the coil core slightly and compensate with the line hold but bear in mind that the core is the 625 preset and C70 the 405 preset.

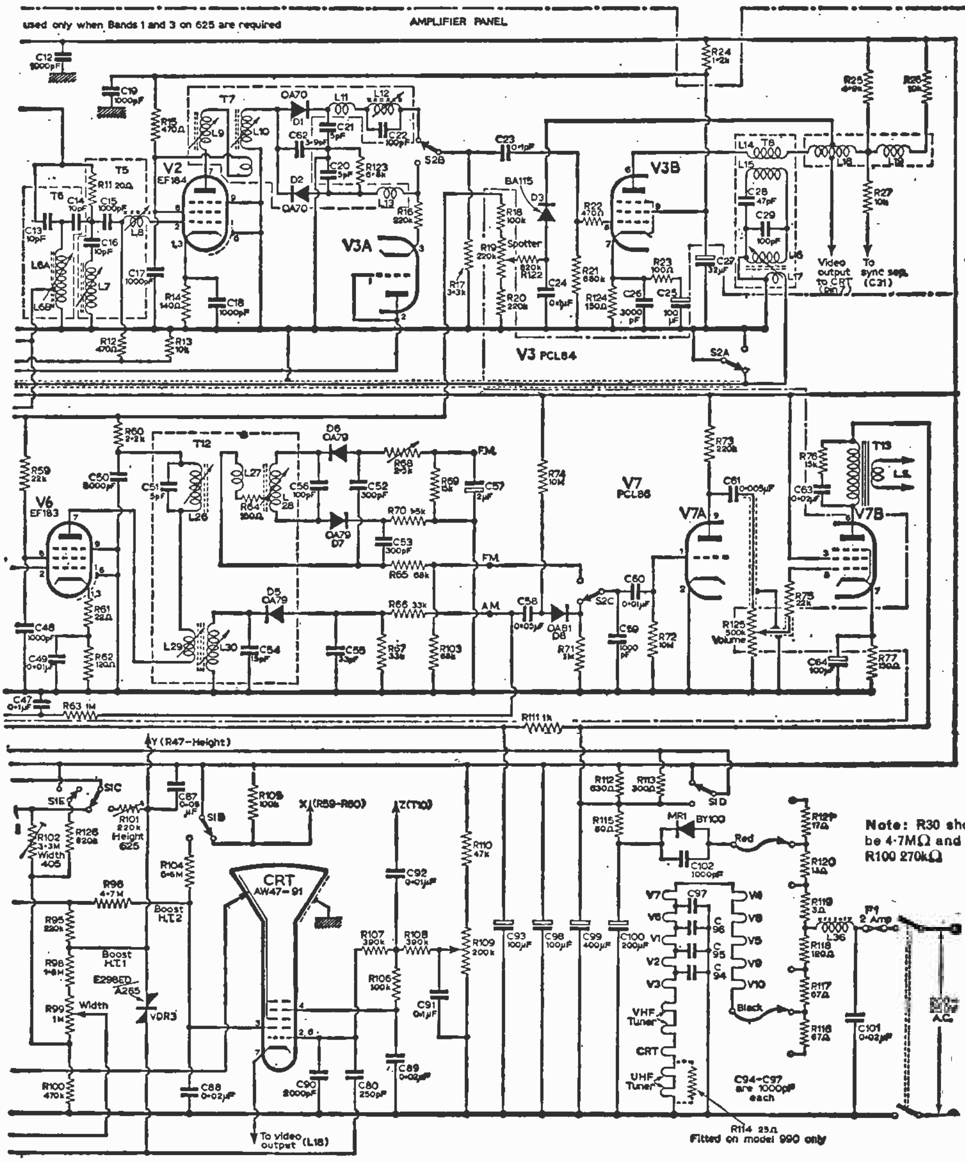
A degree of buzz may be experienced on 625. If so, tune for optimum picture and sound, ignoring the buzz, and set R68 on the amplifier panel to reduce buzz to minimum.

For correct height first switch to 405 and adjust the normal height control. Then switch to 625 and set R101, which is the top slider control on the line output chassis, for correct height.

For correct width first switch to 625 and adjust the main width control. Then switch to 405 and adjust R102, bottom slider, for correct width.

Communal aerial systems

When 625 transmissions are piped in at v.h.f. the v.h.f. tuner must be kept operating. To carry out this small modification swing down the chassis



v.h.f. tuner unit, Alba Models T230, T235, T990 and T995.

and note the long tag strip which runs alongside the line output box. Counting from the top the lead linking tags 3 and 5 must be moved to link tags 2 and 5. When this is done the u.h.f. tuner is not supplied at all but the v.h.f. tuner is operative in all switch positions.

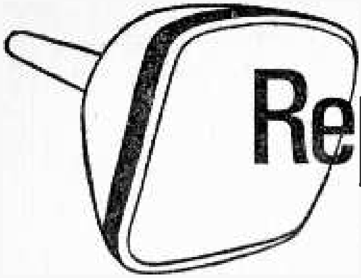
Modifications

In earlier models the line timebase was as shown in Fig. 2. The field blocking oscillator circuit was modified in some later models: the revised circuit will be shown next month. On early models R51 was 680kΩ, R52 400Ω, R111 470Ω, C85 0·12μF and C86 0·25μF.

Voltage checks

H.T.1 240V; H.T.2 187V; output at rectifier 270V; Boost 1 312V; Boost 2 425V. E.H.T. 17·25kV with normal width and picture. C.R.T. cathode (pin 7) 143V, grid (pins 2, 6) 0-120V according to brilliance control setting.

To be continued



Replacing your Tube

S. GEORGE

TUBE replacement is one of the regular features of professional TV service work, and at current low prices re-gunned tubes represent excellent value indeed and can transform any receiver in good working order to almost new standard. However, when contemplating tube replacement there are several important factors to check to prove that the suspect c.r.t. is indeed faulty. Tubes can develop various faults, which can broadly be divided into three groups, (1) low brilliance, (2) interelectrode leaks, and (3) intermittent or zero results.

LOW BRILLIANCE

To take group (1) first, since they represent by far the greatest number. First of all check the mains voltage tapping. In many instances it will be found to have been reduced previously to improve failing brilliance, but if it has been excessively reduced, say to 220V, or if sections of the mains dropper resistor have been replaced with incorrect values or even shorted out, be prepared to replace several valves at least when the voltage tapping is again reverted to its correct setting after tube replacement. If the set has been worked on the 230V tapping and only for a limited period, reversion to the correct tapping may only warrant the replacement of one or two valves.

Valves should normally run with a distinctive cherry-red cathode, and with experience one can soon tell if they are being over-run without checking on the voltage tapping or wondering if mains dropper resistor replacement sections are correct. In practice they seldom are. However, when in doubt, measure the a.c. voltage developed across the tube heater or any convenient valve and compare this with its rated figure.

In those recent models that employ a silicon rectifier in series with the heater chain the voltage developed across the valve and c.r.t. heaters will differ from the a.c. rating. For instance in the Thorn 980 series service manual the manufacturers emphasise that to obtain correct heater circuit readings a moving-iron or hot-wire meter should be employed. If an Avometer is employed it will indicate approximately 4V d.c. across a nominal 6·3V heater and show a heater current reading of approximately 0·2A. However, you would be very unfortunate to require a replacement tube for such recent models.

When making a.c. voltage checks across valve and c.r.t. heaters, remember that they vary widely and that only Mullard and equivalent types with an E prefix have 6·3V heaters. The heater voltage for a PL81 is 21·5V, for a PY81 17V, while a PL36 requires 25V. Possibly even more surprising is that a PCC84 requires 7V, a PCC89 7·5V, a PCF80 9V, while the tuner triodes PC95 and PC97 require only 3·6V and 4·5V respectively.

It is usually best therefore to relate heater current to c.r.t. heater voltage, bearing in mind that while a slight increase above rating indicates a proportionately excessive heater current, a greatly *reduced* heater voltage, with all valve heaters glowing normally, is an almost sure indication of a partial short-circuit across the c.r.t. heater.

The only exception to this generalisation is when there is a heater-cathode short-circuit in a valve higher in the heater chain, partially by-passing heater current to chassis. However, this always results in attendant symptoms plus excessive glowing of the valve heaters positioned between the faulty valve and the series thermistor.

A complete absence of c.r.t. heater voltage, with unheated cathode but with all valves normally glowing, is a sure sign of a complete c.r.t. heater short-circuit. In older tubes this was not an uncommon defect after some years of service.

However, especially in some older models, you may be agreeably surprised to find the set operating on the 250V tapping, and that when set to the now almost universal 240V tapping results are very much better all round. Similarly, now and again you may come across the receiver where the thermistor does not sufficiently reduce in value when hot so that heater current remains slightly less than normal. The obvious remedy is a replacement thermistor.

The next move is to check the ion trap setting in older receivers and to make sure that the vision interference limiter is fully off in all types.

LOW EMISSION

The main symptoms of low tube emission are (a) generally impaired brilliance, lacking any degree of sparkle and especially poor when viewed in daylight, (b) inability of the tube to reproduce highlights above a certain peak value so that all white and light picture areas are reproduced as a monotone, (c) tendency to produce negative pictures when brilliance or contrast is advanced too far, and (d) impaired focusing.

However, never overlook the fact that a low emission video output valve can produce symptoms strongly suggesting a faulty tube, while inadequate signal strength will always make even the best of tubes seem poor due to the necessity of advancing brilliance beyond optimum thereby producing "milky" blacks and curtailing the luminance output range. When video valves have low emission they produce a low contrast picture which just seems to fade into the background raster as gain is increased instead of increasing the black—white disparity.

TUBE REPLACEMENT

So far so good. Having checked voltage tappings, ion trap setting where applicable, limiter setting, and after confirming low tube emission by careful observation—what are the practical snags, if any, to tube replacement? Very few in practice, but the following points should be borne in mind and will certainly make the job easier and prevent any need to remove and refit the replacement c.r.t.

(a) While the more recent maskless and Panorama tubes are almost self-positioning, in older receivers where the tube is mounted by a rim band to the chassis or cabinet it is vital to maintain the original distance between this band and the faceplate of the reconditioned tube (see Fig. 1). Failure to maintain this distance will either result in an inability to replace the chassis fully forward or leave a gap between mask and tube permitting dust to settle on the faceplate.

(b) Carefully handle and replace any neck width and linearity sleeves to approximately their original position, and always replace all polythene insulating washers.

(c) If scan coils are stuck to the tube envelope, a few drops of switch cleaning fluid to the baked wax will usually free them.

(d) When replacing scan coils, mount them hard up against the tube flare to avoid risk of raster corner cutting. A typical scan coil assembly is illustrated in Fig. 2.

(e) Make sure all chassis contacts to the c.r.t. aquadag coating and all earthed leads are reconnected.

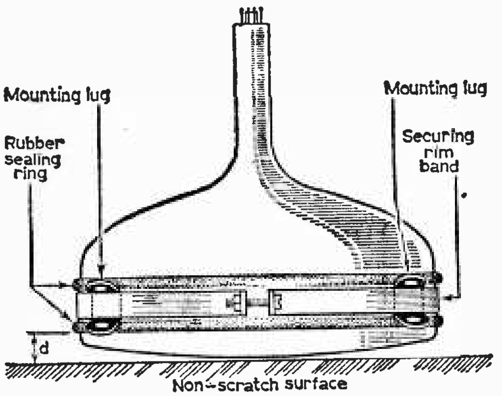


Fig. 1: When fitting replacement tubes secured by rim bands always check distance "d" as well as the location of the mounting lugs.

(f) Always handle reconditioned and new tubes carefully, carrying them by their sides and always supporting the faceplate when holding the neck. Never lift tubes by the neck alone. Reconditioned tubes are inherently strong and completely safe, but there is no point in applying unnecessary strain.

One final note: when replacing tubes, be meticulous about cleaning both the inside and outside of the mask and the cabinet interior otherwise, on replacing the chassis, a few specks of dust are sure to find their way from somewhere right on to the new faceplate.

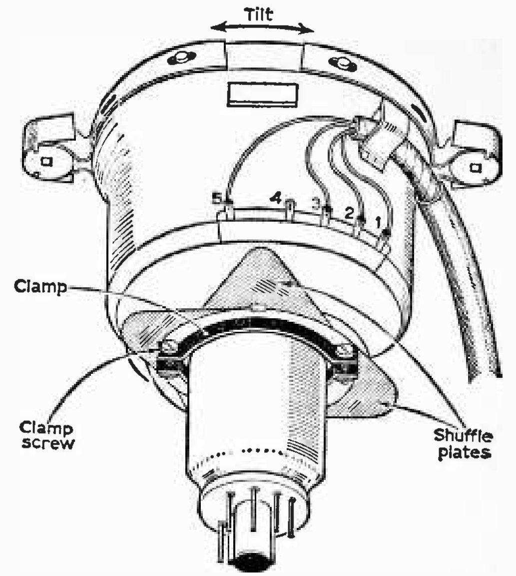


Fig. 2: Typical scan coil assembly (Philips). Slackening the clamp screw enables the assembly to be removed from the tube neck. The shuffle plates centre the picture while scan coil rotation levels the picture.

When handling the masks of some earlier models be extremely careful to avoid touching the front as thumbprints are almost impossible to remove without damaging the surface.

INTERELECTRODE LEAKS

Interélectrode leaks in tubes invariably produce an inability to completely "black-out" the raster, and little, if anything, can be done to alleviate the condition. "Flashing" the leaky electrodes with an e.h.t. spark is sometimes claimed to cure at least partially the defect—though not without attendant risks—but as leaks only develop in old tubes anyway the reduced brilliance level usually also present is sufficient reason to merit tube replacement.

Another type of c.r.t. leak which can often provide puzzling symptoms is that from the e.h.t. connector and final anode to an earthed electrode inside the tube. This always results in lack of raster due to negligible e.h.t. brought about by the heavy load thus imposed on the e.h.t. system. This fault is best shown up by removing the e.h.t. connector to about half an inch from the tube anode cavity, and noting if the resulting stream of sparks across the gap is controllable by varying the brilliance control setting. Normally, of course, by reducing the brilliance setting and thus biasing back the tube conductivity should cease, but if there is an internal short to the final anode e.h.t. current will be massive and unaffected by the control setting. Naturally unless this test is made it is easy to assume that lack of e.h.t. is a receiver defect and not due to a fault in the tube. As before, the only cure is a replacement tube, although doubtless the e.h.t. rectifier will also merit replacement.

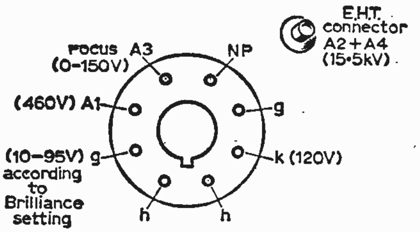
ABSENCE OF RASTER

Complete absence of raster, unless intermittent and able to be restored momentarily by a tap on the tube neck to thus positively indicate a tube defect, will often raise doubt as to whether the tube is at fault or whether there is a defective electrode supply.

The main points to remember are that absence of voltage to the focusing electrodes will not kill the raster, and that assuming e.h.t. is present a blank screen can only be caused by (a) absence of first anode voltage or (b) a cathode voltage grossly in excess of the grid voltage. Precise figures cannot be given since they vary so much from one tube to another.

First anode voltage can easily be checked. It is not critical but, being fed via a high value resistor, any voltage measured will be much less than its normal operating value, due to the loading imposed by the meter resistance. If first anode voltage is absent, and it is generally either present or completely absent, the almost certain cause will be a short-circuited first anode decoupling capacitor. However, assuming a good first-anode voltage reading the only cause of screen black-out can be insufficient or excessive grid voltage.

With older receivers using direct coupling from the video pentode anode to the cathode of the c.r.t., excessive cathode voltage can be caused by the failure of the video valve to pass anode current thus maintaining its anode voltage at that of the h.t. rail. The most likely causes of such an event are, apart from failure of the valve itself, absence of screen grid voltage or an open-circuit cathode bias resistor.



AW47–90 base details

Fig. 3: Base connections and typical operating voltages for the Mullard AW47–90 tube as fitted on the G.E.C./Sobell T25 range of models. If e.h.t. and first anode voltages are present failure of a raster to appear when the grid and cathode are momentarily shorted positively indicates a faulty tube. Focus voltage is not essential for producing a raster.

But to check on the working capability of the tube, merely temporarily short-circuit the grid and cathode base connections (see Fig. 3). If e.h.t. is present, failure of the raster to appear with this simple test, providing the ion trap has not been displaced, undoubtedly means that the tube is unusable, probably because of an internal electrode disconnection.

Because of the multiplicity of potentials at the tube base, often increased by the use of a blank pin connection as a soldering tag, it is usually necessary to refer to a tube base diagram to ensure shorting out the correct electrodes.

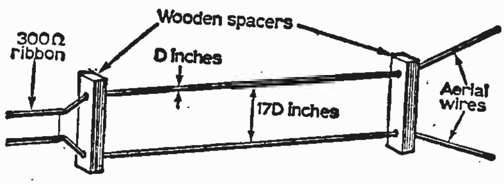
We have made no mention in this short article of the Fenbridge p.v.c. skin implosion guards used with some recent tubes, but as they have only as yet been used in small numbers and in modern receivers there should be little call for their replacement. However, we propose to cover the replacement drill in a future issue.

In conclusion, tube replacement is generally a straightforward mainly mechanical job which should present no real difficulties—just be careful not to snap off any leads to the scan coils or base connector and always place the tube faceplate on a piece of soft material to avoid producing scratches. One point that needs emphasising since overlooking it often results in the reconditioned tube having to be taken out and re-fitted is to be sure to mount the tube with its anode connector to the same side as that of the original—or the e.h.t. lead just won't reach. ■

A RHOMBIC FOR BAND III

—continued from page 200

At this point a 300/75-ohm balun transformer was used in order to match the feeder to coaxial cable. The suggested arrangement (Fig. 4) uses two small coils and two trimmers. The coaxial cable is connected to the receiver and the balun adjusted for best picture. The adjustment is not critical as the tuned circuits are heavily damped by the aerial. An improvement may be obtained if the 300-ohm feeder connections are reversed as the aerial tends to be slightly unbalanced because one half of it is nearer the ground.



Channel	Length of line	Channel	Length of line
6	16½"	10	15"
7	16"	11	14½"
8	15¾"	12	14"
9	15¼"	13	14"

Fig. 3: Details of the quarter-wave transformer used to match the aerial to the 300-ohm ribbon.

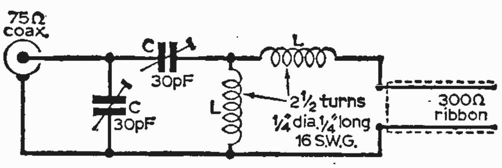
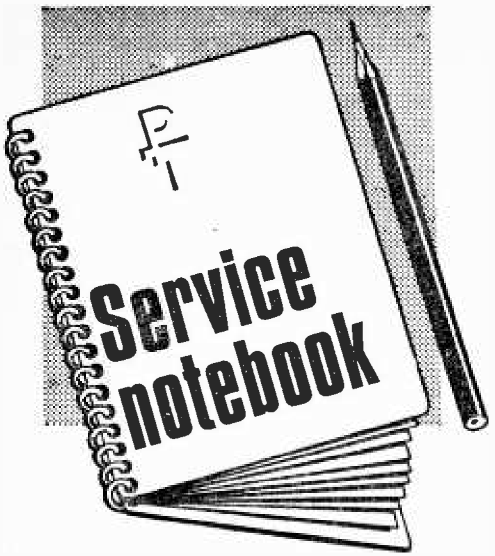


Fig. 4: Balun for matching 300-ohm ribbon to coax.

The results were really quite good, and the aerial is not as conspicuous as the home-made yagi. The overall impression is that a rhombic is "sure fire" for band III and seems to give its theoretical gain of about 11dB. ■



by G. R. WILDING

A SERVICE apprentice told me the other day that while working on a television set that he had checked by a neon tester to have a "neutral" chassis he received a strong shock from it after switching the set *off* from the adjacent wall socket. The explanation of this, to him, most surprising occurrence was that the switch had been wired in the neutral lead and although the neutral feed was chassis connected, as indicated by the neon tester, when switched off the apprentice had received his shock mainly via the heater chain from the "live" supply terminating at the chassis. Which shows how important it is never to simply short-circuit an o/c half of the two-pole on/off switches fitted as standard to all receivers. Furthermore, never stand on a tiled or concrete floor when working on a.c./d.c. receivers.

The outside service engineer's main shock hazard is when called to repair a TV set standing on this type of floor in farmhouse or cottage-type houses, and when his shoes are wet. Even if the chassis is neutral, it is possible to touch a live a.c. point when centring the picture or making adjustments, so he should always stand on a small slip-mat to make any internal tests. Furthermore it is essential

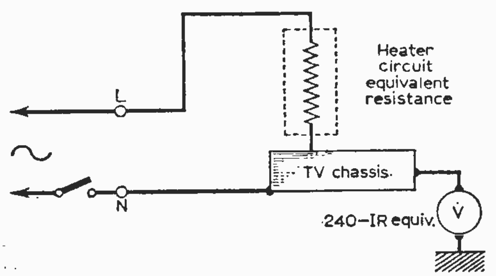


Fig. 1: With a television receiver chassis properly connected to the neutral mains supply lead it becomes live if switched off by breaking the neutral lead only.

to have only one hand inside the cabinet so that if a high voltage point is accidentally touched the resulting current flow will only be across the hand or wrist, and not across the chest and heart.

Every TV workshop should have a dry, wooden floor, covered with lino or carpeting to eliminate the main danger from electric shock, that is from the hand through the body to earth. If the mains supply can be fed via a high wattage 1 : 1 isolating transformer, so much the better. I remember once getting hold of a radio transformer terminal block and being unable to relinquish my grip due to the paralysing current. The only way I could free myself from the current was to literally tear my arm away, resulting in one shoulder being permanently lower than the other! So always have a mains master switch within reach to cut off all power outlets, but never have an earth connection or radio "earth" lead to hand. You might just touch it while contacting a high-voltage point.

No E.H.T.

Called to service an elderly Bush 17in. receiver the other day, we found sound OK but no picture —the latter due to absence of e.h.t. or indeed any sign of a spark at the EY86 anode. There was no noticeable line whistle, but on removing the EY86 it immediately developed, while a good stream of sparks could then be drawn from the loose anode connector.

On fitting a new EY86 line whistle again disappeared, but on replacing the original PL81 line output valve, back it came again. We then replaced the original EY86 and found that the e.h.t. continued. Obviously the original PL81 could not function when loaded with the e.h.t. rectifier. We have known many instances of faulty e.h.t. rectifiers preventing the line output stage working correctly, but this was the first instance when a perfectly normal rectifier just loaded the output pentode sufficiently to prevent it operating.

Incidentally when servicing some of these Bush receivers remember that the surge limiters are in the cathode lead of the mains rectifier and not in the anode lead—in other words, between rectifier and reservoir capacitor and not between rectifier and a.c. input. The effect is the same of course, but the arrangement can be confusing if a service manual is not to hand.

Faulty E.H.T. lead

A customer recently complained about a slight buzzing noise coupled with interference to the picture in a nearly new 19in. receiver. On investigation it was obvious that we had a slight spark-over or incipient breakdown in a voltage carrying component—probably in the e.h.t. section. On removing the set back the buzzing sound became more audible but no actual sparking was evident.

However on moving the e.h.t. lead to obtain a better view inside the e.h.t. can the fault ceased. Further tests showed that when this lead was close to the glass envelope of the PL500 line output pentode the symptoms reappeared, to vanish again when the lead was moved away.

This model employs a voltage tripling e.h.t. rectifier unit and on unplugging this, complete with the e.h.t. lead from the line output trans-

—continued on page 213

INSIDE tv TODAY

PART 5 M. D. BENEDICT

FILM is used in television in two ways, either as part of a programme or as a complete programme entirely on film. When used as part of a programme the film camera is used to pre-record part of the programme which cannot be recorded in the television studio. The reasons for using film as part of a programme are many but, in general, it is easier to take out a film unit than to re-create the scene in the studio. Thus outdoor sequences, both staged and real events, are usually filmed when part of a programme. Other uses of film include dangerous stunts and special effects. Slow-motion effects are usually done by filming although, as you will see in the next article, it is possible to produce a slow-motion video tape replay. Filming techniques are more precise than television, as any amount of time can be spent over the filming of each shot whilst television requires decisions to be made while the action is occurring.

Film has one tremendous advantage over television techniques: the resulting programme can be shown in any country, on any line standard, or even in the cinema. For this reason many of the most popular exported programmes are filmed. For instance *The Avengers*, *Thunderbirds*, *The Saint* as well as many more are produced in this way. It is, however, also possible to telerecord a programme produced in the studio by using a film camera viewing a high-quality monitor, and many of the BBC's programmes are recorded in this way for export.

Film comes in four basic sizes, 8, 16, 35 and 70mm. 8 and 70mm. film is largely avoided for television use. 8mm. quality is usually too poor, the narrow width of the film making handling difficult and the effects of dirt and fluff on the film even more objectionable. 70mm. film on the other hand has the unsuitable aspect ratio of around 2·5:1. 35mm. film is used for optimum quality, most of the exported productions being on 35mm. film. High-quality telerecording also uses 35mm. film but 35mm. film stock costs about six times as much as 16mm. film stock, so that most film is shot on 16mm. stock unless optimum quality is required, or where complex processing and great accuracy is required as in advertisements or titling.

Sound Systems

As well as the various film standards, there are several sound systems now available. Since about 1930 film sound has been recorded on an optical track where the modulation is recorded in the varying density or the varying width of a continuous track laid down one side of the film. During recent years, however, magnetic systems have been developed so that at present there are three main systems.

The COMOPT system—*com*bined *opt*ical track—is still in use for release prints.

The COMMAG system—*com*bined *mag*netic track—is used for news as it allows the camera, with a record head assembly built into the mechanism, to record sound simultaneously with the picture directly on to a strip of magnetic material laid down one edge of the film. Editing can be done simply and quickly but with considerable limitation on the cutting. This is because, with COMMAG, the sound is recorded earlier on the film than the corresponding pictures, as it is not physically possible to mount the record head and its assembly next to the film gate, so that for both camera and projector a sound and picture separation is standardised at 26 frames for optical tracks and 28 for magnetic tracks, allowing projectors to reproduce both optical and magnetic tracks. As there are 40 frames per foot for 16mm. film this is a distance of 7½in. from the film gate. For television working 25 frames are exposed per second, corresponding to the field rate of the television system. Thus the sound/picture delay is about one second. Editing film or the sound then means that the picture changes about a second before the sound. Such limitations on where to cut film are very constricting and so it is convenient to separate the sound track during editing. Film coated with iron oxide, like recording tape, is used for this purpose.

SEPMAG—*sep*arate *mag*netic track as it is called—is the third system in use. In order to maintain the synchronisation of sound and picture the sound reproducer and the film machine are locked together either electronically or mechanically so that once laced up in synchronisation it should remain in sync when running. SEPMAG is often used in television studios for transmission but for general release a COMOPT print is usually made as this is simpler to print and easier to handle. Each telecine channel, then, should be able to handle COMOPT, COMMAG and SEPMAG facilities, although it is not necessary to provide SEPMAG facilities permanently tied to one projector.

Telecine Equipment

Two types of telecine are found in use today—the flying spot and the vidicon telecine. Vidicon telecines are simply a standard film projector showing into a standard television camera. Vidicon tubes have many characteristics suitable for telecine use, in particular the fact that the vidicon stores pictures flashed on to it until the next picture is flashed on to it. Thus there is no flicker or any fluctuation in picture level as occurs with some types of tube used with an ordinary projector.

Vidicon telecines tend to be cheaper than other types as these projectors, and the sound equipment, are completely standard equipment developed for the cinema and built in competitively large quantities. Vidicon camera channels are both simple and cheap to build, requiring very little additional circuitry for inverting the signal to allow negative film to be transmitted as positive, thus saving time and processing costs.

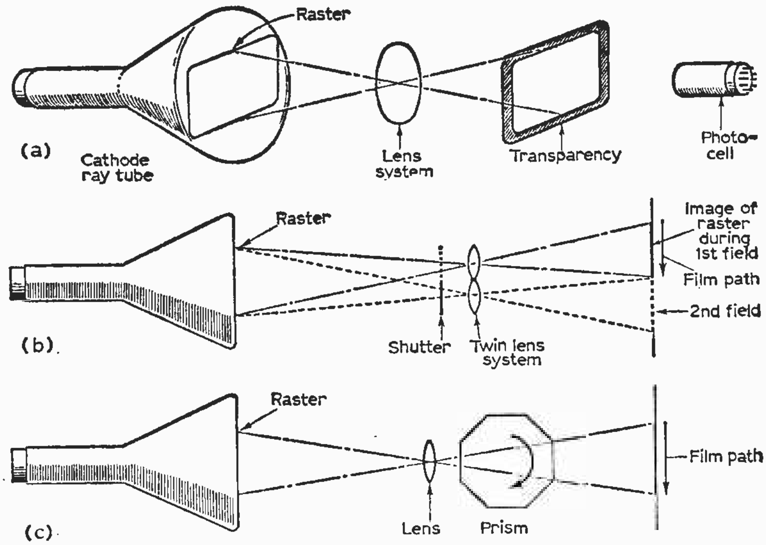


Fig. 6: Flying-spot telecine systems.

Until a few years ago, the vidicon tube was rightly considered inferior to other pick-up tubes and scanning systems, but recent improvements based on better electron optics have allowed first-class results to be obtained from these tubes. As mentioned when discussing cameras, the vidicon does require a high level of illumination to get good results so that it is not really ideal as a studio camera, but there is no problem in providing such levels into a film projector, so that the improved definition now available with the vidicon is matched by improved lag characteristics.

Flying-spot Scanning

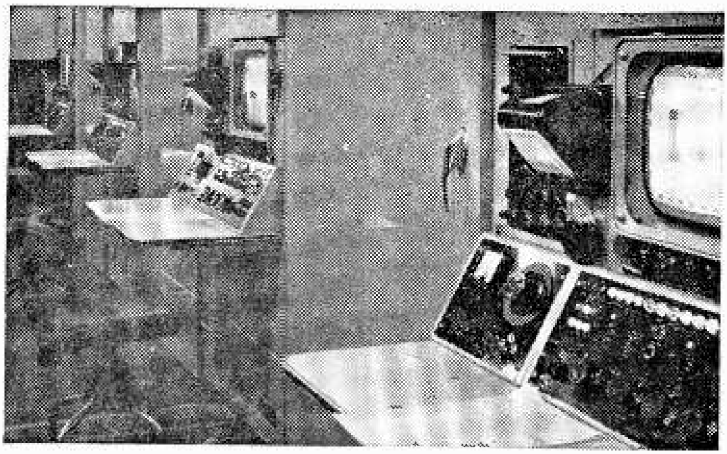
More complex are systems using the flying-spot system of scanning. To understand this, imagine a cathode-ray tube displaying a raster the image of which is focused on a slide (Fig. 6a). Behind this slide is placed a photocell and this will pick up the light passing through the slide from the image of the spot which effectively scans the slide. Thus at any time the output of the photocell is proportional to the density of the slide at the point scanned. Flying-spot scanners similar to the above description are used to generate test card or station identification signals, and produce pictures of the highest quality.

When it comes to film, however, trouble occurs as it is not quite possible to make a mechanism which will complete the pulldown from one frame to the next within the 1·5mS allowed for the vertical flyback to occur on the cathode-ray tube, so that if a simple projector mechanism was to be used part of the picture would not be scanned as the shutter would not have opened in time.

Other techniques have therefore been adopted. Moving the film in a continuous manner can be used to provide some of the vertical scanning movements of the spot, but only one field would be scanned by this means and no interlaced field could scan the same picture frame. A second image of the raster, however, may be projected (Fig. 6b) on to the film by a second lens system, this being spaced exactly the same distance apart from the first image of the raster as the film moves in one field period. Shutters select one or the other image, so that as the particular frame to be scanned moves past the film gate it is scanned by the image of the raster only half its normal height. However, the film continues to move and this movement of the film, combined with the vertical scanning, provides the complete coverage of the whole frame of film. Following behind the spot is the mechanical shutter so that the original raster image is blacked out at the end of one field. Another shutter then reveals the second image of the raster; this scans the frame, which has moved down, so that the second image scans exactly the same area in exactly the same manner as the first image to give the interlaced field. Called the twin-lens system, it gives excellent results.

If a ray of light enters a block of glass at an angle it is bent or refracted; as it leaves the block it is bent back by the same angle but is shifted over to one side. This shift increases as the block is rotated, and this principle can be used (Fig. 6c) to shift the image of the raster as the film moves so that relative to the film it is stationary. Instead of a block of glass, a glass prism with many faces is used and, as the film moves, each set of opposite faces of the prism moves the image of the raster along with the film. This is the polygonal-prism system and produces extremely good results.

Unfortunately both types of flying-spot telecine are rather complex mechanically and there is no call for the special mechanisms in the cinema world. An exception to this is found with some simple film editing viewers using a polygonal prism to allow a continuous motion system without a shutter. However, generally speaking the flying-spot telecine mechanism has to be specially developed for tele-



Left: Flying-spot telecine control panels at the rear of the film transport mechanism. The operator has operational controls, intercom with the studio and hears talkback from the control room and also has a monitor and 'scope to help him control picture quality. *Southern ITV photo.*

vision, making costs much higher than for the standard cinema projector used with a vidicon telecine.

A disadvantage of the twin lens is that the picture rate has to be the same as the frame rate, preventing its use with the 525-lines, 60c/s standard used principally in the USA. As half the vertical movement is provided by the motion of the film, the scanning raster is 4 x 1½, so that when the film is stationary only half the film is scanned. This gives a vertically stretched image which is recognisable but not transmittable. The polygonal-prism telecine in no way locks film to the scanning raster, however, can be run at any speed or from a still frame and will cope with the American standard. Both flying-spot telecines suffer from the disadvantage of being specialised equipment, their costs being very high compared with vidicon channels which are approximately one-third of the cost of a telecine system.

Sound Reproduction

Sound for all telecine channels is reproduced by passing the film around a drum to smooth the movement, which is intermittent at the film gate of a vidicon telecine, of the film. At this drum a ray of light is passed through the sound track of the film and the variations in transmission are read out by a photocell. Alternatively, a standard magnetic replay head is mounted against the drum and is used to reproduce COMMAG film. SEPMAG sound is reproduced on a special bay of equipment rather like a large audio tape recorder. SEPMAG stock is film base complete with sprocket holes, but instead of being coated with light-sensitive emulsion it is coated with the usual magnetic material found on ¼in. audio tape. It is pulled past the record and replay heads by sprockets coupled electrically or mechanically to the sprockets on the projector which drives the film. Both the pictures and the sound track are laced up in the respective telecine channels and SEPMAG reproducer so that a fixed mark is in the film gate and a corresponding mark is against the magnetic head. Pictures and sound are thus in synchronisation and will remain so when the telecine and SEPMAG reproducer are run up to speed. Electrical coupling is achieved by using a three-phase transmitter and receiver system. These components are called selsyns. Where several telecine channels and synchronising reproducers are provided in the same area, electrical locking is much more flexible, allowing any telecine to be coupled to any SEPMAG reproducer.

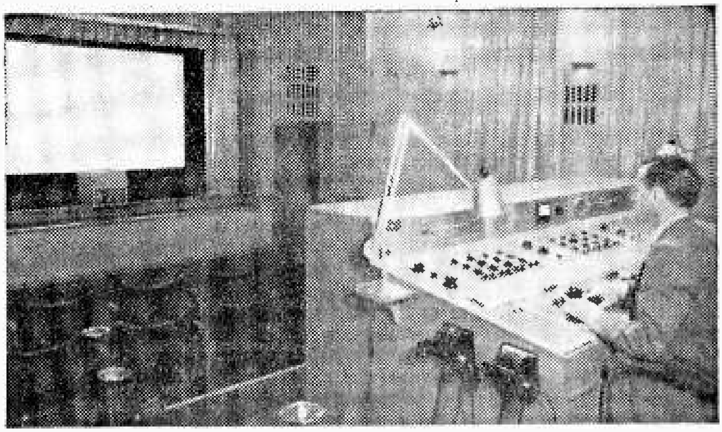
Cameras

All film originates at the film camera, usually producing a negative which is edited, then printed and the sound dubbed on to give the complete positive version for distribution or transmission. This is not quite as simple as it sounds and there are several variations.

Many types of film cameras are in use, but the heavier, complex type of film cameras are not necessary and lighter, more portable cameras are often used. Arriflex 35mm. and 16mm. cameras are very popular but one finds many other sound cameras, such as the Eclair and the Auricon (used a lot for news in its COMMAG form). Many types of silent cameras are to be found, the Bell and Howell and the Bolex being very popular. Cameras suitable for sound use are often fitted with a soundproofed case, called a "Blimp", in order to reduce pick up of noise from the camera by the microphone. COMMAG film cameras usually have a special recording amplifier which plugs into the camera and drives the recording head, providing bias and allowing monitoring through a replay head placed just after the record head. Thus an instantaneous check on quality is available to the sound recordist.

COMMAG does have its disadvantages, particularly when editing, and when speed and ease of handling are not the prior considerations a portable tape recorder using standard ¼in. tape is used. In order to keep the tape in synchronisation with the film camera a "pilot tone" is recorded on the tape on a second track. The pilot tone is a 50c/s signal derived from the camera output. 2c/s represents a frame of film. A pilot tone output from the film camera is coupled to the recorder and recorded at the same time as dialogue and effects. When the recording is complete, the sound on the tape is transferred to SEPMAG stock on a special recorder which amplifies the pilot tone and uses it to control the recorder's speed so that 2c/s of pilot tone represents a frame of SEPMAG. Hence the SEPMAG is in synchronism with the pictures recorded in the camera.

SEPMAG recorders are very big and heavy compared with the highly sophisticated transistor tape



Right: Dubbing theatre and mixer with controls for each channel. Channel levels are controlled by the quadrant faders under the Dubbing Mixer's hands.
ABC TV photo.

recorders found in the £100-£200 range, so that this system is often preferred. Several manufacturers have developed a crystal-controlled camera in which the output of two highly accurate crystal oscillators is divided down to 50c/s. One 50c/s unit is mounted in the camera and drives the camera motor via a power amplifier: the other is mounted in the tape recorder and is recorded as a pilot tone track. Owing to the high stability of the crystals the two signals are at the same frequency so that the camera and pilot tone are in sync without a direct connection between the camera and tape recorder, thus allowing the cameraman and sound recordist maximum flexibility of movement with lightweight equipment.

Personnel

What other personnel besides the cameraman and sound recordist are to be found with a film unit depends entirely on the production, varying from just one electrician to set the lights to four or five electricians, with a lighting cameraman, operating hundreds of lights powered by a mobile generator, a boom operator to assist the sound recordist, scene hands to move props and scenery as well as to move the camera or its dolly. Sitting next to the cameraman on the dolly is the focus operator—a special operator for the zoom lens may also be required—a director, assistant director, producer, several assistants and a secretary, all having a particular job to do. A large production will have all the personnel required for a feature film, but the costs rise astronomically with such productions, so that they are rare.

Filming Techniques

Although ideas are changing under the influence of television the classical method of filming is with one camera. Each shot is filmed by itself, after which the camera is stopped and moved to a new position if required and another shot taken. As new positions for the camera are fixed, adjustments to the lighting are made, sets altered and actors' positions varied to improve the individual shot. It is commonplace for much of a love scene to be shot without one of the parties being present on the set, if a series of close-ups are required. Naturally, though, continuity must be very closely observed or the whole thing becomes farcical. In this shot-by-shot progress, with each shot being taken several times to get a perfect "take", lies the flexibility and strength of film as a medium, but it does require much valuable time. Some directors now use simultaneous shooting on several cameras, a technique usually preserved for expensive battle and spectacular scenes where costs prohibit a repeat. Each cameraman is briefed on what is required by the director before shooting commences, but after that it is up to him to follow the action without guidance from the director. However the film is shot on the studio set, it is always assembled in the desired order to make a complete sequence by the film editor.

After the film has been shot and the sound recorded the film is sent to the laboratories to be processed. News and current affairs programmes save time by editing the film while it is negative and reversing it electronically in the telecine. The usual system, however, is for the laboratory to return prints of the day's shooting, allowing the director to check each shot before the scenery is derigged or the unit moves on to another location. Rushes, as these prints are called, are then handed to a film editor who edits and splices each shot into the required sequence, working in conjuntion with the sound editor who edits the sound, transferred to SEPMAG, into the correct sequences. Sound is usually divided into two distinct types, dialogue and effects.

Sound Editing

Dialogue is usually recorded during filming, synchronisation being achieved by filming a clapper-board at the start of each scene. A hinged strip of wood on top of the board is slammed shut so that the editor can use the clap on the sound track and the picture of the strip of wool shuttering as reference points for synchronisation. Identification of scene and shot numbers are also written on the board. In some cases, it is not possible for a microphone to pick up dialogue and post-dubbing is resorted to. Actors viewing the rushes of the sequence speak their lines again in a dubbing theatre. Exact synchronisation of the sound and the movements of the performer's lips is the aim but where this is not achieved by post-dubbing or the original is not satisfactory the editor may have to dub each word so that the movement of the lips coincides with the sound. Editing machines consist of a table with a simple projector system and magnetic replay system as well as two sets of transport, feed and take-up spools, to allow the editor to move the sound relative to the picture and adjust the synchronisation by viewing the sequence. When he is satisfied he will splice the particular phrase or sentence to the previous one.

Sound effects divide into continuous background noises (car engine running, traffic in street, birds singing, etc.) and spot effects occurring at a particular point (car door slamming or gunshots). Background effects are recorded usually from a library of sound effects and simply dubbed on to SEPMAG. Whenever a change in background noise is required by changes in scene the dubbing mixer, who works with the sound editor, feeds all the effects required to a sound mixer and cross fades from one background noise to the next to give the complete background noises for a complete sequence. This is recorded on a SEPMAG recorder. For rehearsal of each sequence the timings are indicated by a large display indicating the number of feet from the start of the scene to allow the mixer to change smoothly exactly when the pictures change. Spot effects are recorded on to SEPMAG stock and the exact position, adjusted on the editing machine. Blank film stock is spliced in between the actual spot effects so that the effect occurs at the correct point from the stock.

Both kinds of effects are combined by running both sets of tracks together, feeding in the sound mixer and recording a balance between the two tracks so that all effects occur at the correct sound level. Music is similarly combined and the sound is built up a bit at a time until finally it is all combined. Dialogue is usually last so that when a foreign language version is required a simple dialogue track in the required language can be mixed with the combined effects and music sound tracks.

Film Production

In the meantime the final edited pictures are returned to the laboratory, where the negatives have been retained. These are then cut, using the edited rushes as a guide. Variations in exposure of the negative can be corrected during the printing stage when the negative is run through an optical printer. Exposure of the printing lamp is varied at each shot to achieve the required correction. In television, sound can be transmitted using a SEPMAG reproducer locked to the telecine channel, but often a married print is required when an optical track is recorded from the complete SEPMAG track and combined at the printing stage. Mixes and fades, called opticals, are produced using a special type of printer and cutting the negative into two reels of film; for a mix, the exposure of one reel is reduced as the other is increased from zero. In the same way, pictures and the optical track are printed together, the final result being a positive copy with optical COMOPT sound track.

Use of Film

Titles for many programmes are on film as more complex ideas and gimmicks can be used and be repeated exactly when required. Special rostrum cameras mounted above movable tables are used, often with the use of stop-motion photography. Techniques such as this allow complex animations and movements of objects, letters, etc., by exposing one frame, making a small adjustment to the position of the object photographed, exposing the next frame, making another adjustment and so on, until the complete movement of the lettering has been achieved. Run at ordinary speed, the letters seem to move of their own volition.

Advertisements are shot in the manner described but with greater care and precision. Complex special effects allow the director to inject the maximum impact to draw the viewer's attention and put over the advertiser's message.

Filmed items are found in most television productions, varying from those using filmed titles only to those programmes about the cinema with one camera shot of the presenter to introduce each film. Other programmes use film inserts to cover action which is complex or too dangerous to reproduce in the studio. For such items, the performers and a camera crew go out to the selected location and film such sequences some weeks before the sequence is used in the programme.

Other programmes use film to illustrate a point with film from a library. Most broadcast organisations maintain a library of interesting and informative film, and there are several commercial organisations offering such a service. Film is provided by many sources, for example by organisations who film the highlights of their own activities, such films often finding their way on to documentary programmes and school programmes. Examples of these are the American space authorities whose public relations department ensures that films of space flights reach the widest possible audiences.

News and current affairs use film cameras to capture action from all over the world by a complex network of distribution agencies so that film from any part of the world can be obtained almost always within twenty-four hours. Interviews can be filmed by a reporter and camera team.

All these techniques may be used on the all-film documentary type of programme where so much of the material is on film, so there is no point in using a studio to combine them into a programme. As such documentaries often deal with subjects of wide interest they are often sold abroad where the fact that they are on film is an advantage as no standards conversion is needed to cater for different line standards.

Filming TV

Television pictures can be recorded on film simply by pointing a cine camera at a high-quality picture monitor. Unfortunately a horizontal black band will appear on the resulting film. This is caused by the difference in synchronisation between the film camera and the television picture. If, however, field sync pulses are fed to a power amplifier which drives the film camera motor, the bars will be held steady and, by adjusting the relative phasing of the film and the television picture, the shutter can be synchronised to close during the period when the flyback occurs so that no bar appears on the film. With 16mm. film it is not quite possible to complete the pulldown and operate the shutter in the required time so that a small amount of the picture is lost at the top and bottom of the frame.

Although this technique is just satisfactory for 16mm. film recording, the larger size 35mm. film precludes such a system. Instead the display cathode-ray tube has a longer persistence phosphor and the top of the picture is stored by this long persistence until pulldown of the film is complete and the shutter opens. Parts of the picture which are stored in this way have a reduced contrast and brightness and a graded filter is fixed to the face of the cathode-ray tube so that all parts of the picture have equal exposure. As with the 16mm. film system the motor must be in exact synchronism with the incoming signal. In both cases special servo signals ensure that this is so.

To correct for the film characteristics a special nonlinear amplifier is used to give the correct transfer characteristics. Similarly, the amplifier can be set to display a negative picture allowing a positive film to be made. Unfortunately although this reduces costs the soft nature of the film leads to handling difficulties as scratching occurs very easily, so this facility is rarely used.

In order to reduce interference between the line structure on the film and the line structure of a telecine channel scanning the film, spot wobble is often used for the film recorder. In some cases, this is applied to the telecine channel as well.

Film recordings are widely used by the BBC and its Television Enterprises Department, who sell series to overseas countries. Many series have been seen abroad, including *Z Cars* and *Steptoe and Son.*

Duplexing

Old feature films made for the cinema form a considerable proportion of the films seen on television. As with the cinema, each film is too long to be shown continuously on one projector so that several reels are used and can be projected alternately on two machines. Similarly, two telecines are used and both are fed through to a "duplexer" unit which switches between the output of the two machines. Special marks, called cue dots, are printed about 12ft. and again at about 9in. from the end of each reel. At the beginning of each film a "leader" is spliced, consisting of a special piece of film with marks and numbers from 12 to 3. These numbers correspond to the number of feet of 35mm. film before the start. Each machine sets up on a particular number and as the first cue dot appears the operator runs his machine so that his reel starts as the second cue dot appears, and the duplexer is operated to switch sound and vision from the second machine to the outgoing line. As the second machine continues on transmission, the first machine reloads with the next reel and prepares for the next changeover.

Film vs TV

Television techniques are usually preferred to film techniques in this country at least. In many parts of the world the majority of programmes seen on television are, in fact, filmed. America in particular produces television programmes on film. But television has the advantage of immediacy and atmosphere, and the fact that one can see the final result as the recording proceeds. Film techniques are usually more flexible but tend to be more expensive.

Other reasons for using film are concerned with economics: when production costs can be covered by the home markets sales abroad are favoured by the use of film with its independence of line standards. Hence American cowboy, crime and comedy series are almost always filmed and sold abroad, having covered the production costs by home sales. Similarly old cinema feature films are seen on television as they can be cheaply sold after their costs are covered when first released in the cinema circuits. Modern films are not shown, due to restrictions by the film distributors who fear loss of audience to television if all the best films were seen on television.

It is interesting to note that film and television are coming closer together in an effort to improve efficiency. Each film studio may expect to produce about two to three minutes of film per day compared with television's thirty minutes. Film cameras attached to television cameras (Gemini system) and simple television cameras attached to film cameras (Mitchell system 35) allow the television technique of simultaneous shooting from several camera angles and vision mixing (editing) whilst the action actually takes place. On the other hand, television techniques, in particular video tape recording, can use many of the film world's editing techniques, as next month's article on video tape recording will show.

to be continued

SERVICE NOTEBOOK

—continued from page 207

former, it was found that the insulation had actually melted where it had come into contact with the extremely hot PL500. The inner conductor was not completely bared and the slight discharge only took place when the lead almost touched the glass envelope. It would appear that the inner conductor of the e.h.t. lead and the valve anode formed the plates of a capacitor. Of course the only remedy with a faulty e.h.t. lead is to renew it or cut off the damaged section if length permits. In this particular receiver we were able to cut off the damaged section and on resoldering the lead into the voltage tripler unit results were perfect.

Some receivers have very long e.h.t. leads so that service work can be carried out with the chassis removed from the cabinet and with the tube operational. In such cases care must always be taken to dress the lead away from high temperature areas and from high voltage pulse points, such as boost rectifier cathodes or e.h.t. rectifier and line output valve anodes, or the cumulative effect could prove too much for the already highly stressed lead insulation.

to be continued

UNDERNEATH THE DIPOLE

THE years 1922 to 1968 form nearly a half-century which started with crystal detectors (and headphones) and has now arrived at techniques in which crystals control the frequencies of the largest radio transmitters and power stations. Fifty years ago loops of strands of iron wire were steadily and continuously magnetised and played-off by Marconi's wireless magnetic detector, used then for receiving spark signals on many ships. Today magnetic tape achieves a thousand purposes in industry, apart from recording television pictures.

1922 and all that

1922 was a year of great importance historically. It was notable for the inauguration of the British Broadcasting Company Ltd. whose Managing Director, Mr. J. C. W. Reith (now Lord Reith), was interviewed for television by Malcolm Muggeridge a few weeks ago. This extraordinary series of filmed interviews, totalling ten hours in all, was superbly edited into three parts of about fifty minutes each. Entitled *Lord Reith Looks Back*, it turned out to be a fine character study of the architect of Britain's broadcasting. Naturally it was of special interest to members of the BBC staff who worked at 2 Savoy Hill, where the BBC had its London, 2LO studios and administrative offices until Broadcasting House in Langham Place was opened in 1932.

Technical varieties at Savoy Hill

Your columnist was not at Savoy Hill at the commencement but started a little later as a youthful transmitter engineer at 5NO, Newcastle, transferring later to Savoy Hill. Not many members of the junior engineering staff came into contact with the Chief: however amongst my duties was to make regular visits to the homes of Mr. Reith and Lord Clarendon (the Chairman) to maintain their elaborate wireless receivers. Naturally I occasionally met these awe-inspiring individuals, who, in such surroundings, permitted themselves to unwind a little.

On other days of the week your columnist might be involved in OBs of the cello and nightingale from Surrey Woods; from Lillian Baylis's opera productions at the Old Vic (via Daventry to the left headphone and 2LO to the right!). Exciting days, those! The Savoy Orpheans with a mini-piano were received and relayed from an Imperial Airways aeroplane when over Croydon Airport, and the first direct reception of American broadcasting (KDKA) was received in a shed at Biggin Hill on a Beveridge aerial about half a mile long!

Royal Variety Performance

If he saw it, I wonder what Lord Reith thought of this year's Royal Variety Performance, video taped from the Palladium on a Monday and broadcast on the ITV network the following Sunday? I feel sure he would have enjoyed it. Many of my friends thought it was one of the best for years, unanimously agreeing that the cheerful performance of Tanya, the "adorable elephant", scored the biggest hit. Dicky Henderson did a good double-act with Tanya and compèred the whole show in his usual immaculate manner.

The combination of Harry Secombe, Bruce Forsyth, Lionel Blair and Dicky Henderson in a simultaneous soft-shoe dancing act was variety at its best, as were Ken Dodd, Bob Hope and Tommy Cooper. Val Doonican was as relaxed as ever, with a polished vocal act which had plenty of warmth and charm.

Nothing, so far, I think that would have upset Lord Reith in any of these items, but he might have rejected the untrained voices of pop-singing wrigglers who seem incapable of performing more than four inches from a microphone, though it must be admitted that some of the "fff" orchestral accompaniments took command at times. The pop-disc fashion today it seems is for over-amplification tinctured with various types of reverberation and contrived distortion. The disc recording style should not be necessary for the Palladium, of all places. Still, it was a fine show and the organisers, Leslie Macdonnell, Bernard Delfont and Arthur Scott are to be congratulated on raising a large sum of money for the Variety Artistes' Benevolent Fund, which amongst other splendid objectives maintains Brinsworth, the home of many of the older members of that profession.

The profile of a gentleman

Lord Reith might well have shuddered at one of the BBC's Wednesday night plays *The Profile of a Gentleman*, not because of the story line so much as the information furnished by the author, Jimmy O'Connor, who had spent ten years in prison and was thus able to give a real professional touch to the crime story he had written. And a very good story it was, too, skilfully directed at a terrific pace, not without its comedy interludes and X-type supplementary scenes. The planning and execution of a bank robbery is not a new subject, and the complex preliminary preparations have often been used for building up the tempo to the climax, even when it is a vintage Ealing film comedy-thriller such as *The Lady Killers* (with Sir Alec Guinness as gang leader and Peter Sellers as one of his lieutenants) which ITV transmitted recently. This technique was admirably used in *The Profile of a Gentleman*.

Colour films for TV

At one time not so long ago the leading film cameramen in this country were inclined to look down upon television lighting engineers and even on film cameramen who worked on films made specially for television series. This situation has now completely changed and there are progressive film studio lighting men who are not only keen to work on TV films but are prepared to talk about this type of work in public, or at any rate in the form of a paper read before the British Kinematograph, Sound and Television Society.

This is precisely what Alan Hume, B.Sc. did when he spoke on *Lighting Techniques for Colour Television Series*. He spoke of the need for soft lighting, with a low contrast ratio between highlights and shadows, and stressed the pitfalls of separation of different colours—shades of pale blue and pinks, for instance—which are often so similar in density on a grey scale that on some black-and-white TV receivers they have no separation at all.

Of course this is something he is familiar with from experience. When all motion picture cameras have TV camera attachments, a waveform monitor and a mean-level light meter will give a lot (if not all) the information required. Experience is, however, the main guide. This applies to the ultimate use of the print of the colour film whether it is reproduced on one of the colour sets beginning to be available, on a modern black-and-white television set with "black-level clamp" circuit, or on the average TV set with a.g.c. circuitry.

Earl Mountbatten speaks

In a speech on this same subject at the Dinner of the Guild of Television Producers and Directors in November Earl Mountbatten commented as follows:

"You, the producers and directors, and your very able technicians take an enormous amount of trouble to feed the transmitters with the best possible pictures. We all know that if the picture is well lit and there is an even balance between black and white the television receiver in the home reproduces it extremely well. But when the picture is predominantly black, with just a few highlights, such as a street scene at night, or an intimate bedroom scene with just a bedside lamp lighting a face—or perhaps two faces, and nowadays possibly backsides—the picture reproduced in the one receiver is quite different from what you see on your closed-circuit monitor.

"Most existing TV sets are incapable of reproducing faithfully black and white when the balance between the two is predominantly black. In fact we all know that the screen goes an insipid grey. The same thing happens when you use captions with white letters on black. They reproduce as white on grey with an unpleasant streaking effect.

"In a nutshell, your efforts in dimly lit scenes—creative and technical—are being frustrated. The viewer in the home is deprived of seeing the picture that you want him to see. This has been going on for so many years that the public is oblivious of the fact that they could have far better reproduction under these conditions of lighting.

"Eight years ago details of a new circuit were released which would enable the viewer to see the exact picture which the producer sees on his television monitor. Because of the enormous competition in the sale of domestic television receivers manufacturers have had to keep the cost to a minimum.

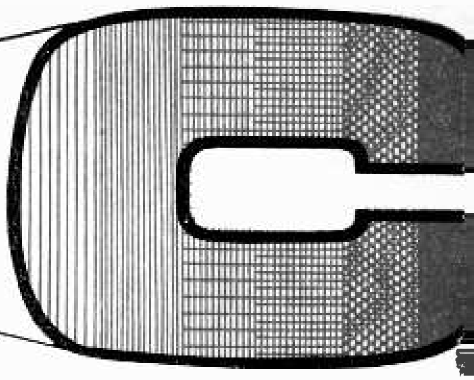
"But now cheaper circuits have been developed to control this black-and-white problem and which make it easier for the viewer to control receiver brilliance. The components for these circuits are small and inexpensive—and the piece of apparatus has now got a name—it is called *black-level clamp*. If this were to be incorporated into the receiver circuitry during manufacture, it would ensure the faithful reproduction of the same pictures that you create in the studio, and which at present are virtually confined to what you see in your monitors. White would be white, and black would be black—and remain black.

"I am glad to say that television sets are now coming on to the market which incorporate this new technical facility, and I am sure we will all want to wish this venture the success it deserves."

This is what we have been saying in PRACTICAL TV for years. Earl Mountbatten was speaking to the converted at that dinner, to the Television Producers and Directors. Fortunately a full copy of the speech has been passed on to the British Radio Equipment Manufacturers' Association, who, as it happens, seem to be seeing the light at last. Some of their colour TV sets give excellent results on colour. More surprisingly, the same colour sets often give much better black-and-white reproduction than their last year's black-and-white model!

Iconos

An enthusiast LOOKS AT



TIME was, when television spread its wings to the Provinces in the early post-war years, that PRACTICAL TELEVISION was born as an offspring of *Practical Wireless*. Its format in those days was different from the magazine you know today. Television was a rich man's luxury, due to the price and scarcity of receivers, and many of the articles which appeared dealt with the conversion of surplus war equipment. Anything, in fact, which contained a cathode-ray tube could, apparently, be converted to produce pictures, and the enthusiasm and ingenuity of the home constructor became the admiration of the Editorial Staff.

Late last year, a whole generation later, television took the biggest stride since then, with colour TV coming to the United Kingdom at last, and the circumstances of the early days of the TV enthusiast look like repeating themselves with colour sets being in limited production and as expensive as a good used car. About now many of you will be saying "Is there any way I can get myself some sort of colour picture?" And with the odds so heavily stacked against the amateur it is so easy to say "Not really". This, of course, will not satisfy those of you who have retained or inherited the enthusiasm and ingenuity of the early years of television. This article will not open wide the door to colour TV for you, but the peep it provides will possibly encourage some of you to try and break the door down!

THE BLACK & WHITE VIEWER

If you operate a monochrome 625-line receiver you will have been receiving colour transmissions already. This is something that you shouldn't be able to detect simply by observing the picture, since the PAL system is extremely compatible, and if all is well within your receiver the worst you should be able to detect is a slight cross-hatch or bead patterning in some coloured areas (such as the flesh tones in the middle of Test Card "F").

As far as the receiver is concerned the colour information it receives is of two types—the red and blue difference signals which are mixed in with the picture itself, and the all-important reference burst. This latter is radiated immediately after the line sync pulses on every picture line but not during the field equalising or sync periods. It takes the form of 10 cycles of pure unmodulated colour subcarrier transmitted on average in antiphase to the blue difference signal but swinging 45deg. either side of mean every other line to provide an identification signal to enable the PAL receiver to sort out which is the set of red lines transmitted "upside down" (a feature of the PAL system to avoid the reproduction of wrong colours due to phase changes in the signal).

As far as the monochrome viewer is concerned it means that to monitor the reference burst so as to determine if a colour programme is on the air it is necessary to move the picture over to the right by means of the shift control until the left-hand edge of the raster just appears. In the dark area between the raster edge and the beginning of the picture there will be seen a vertical grey band about $\frac{1}{4}$in. wide whilst the reference burst is present (see Fig. 1). If you are fortunate enough to be

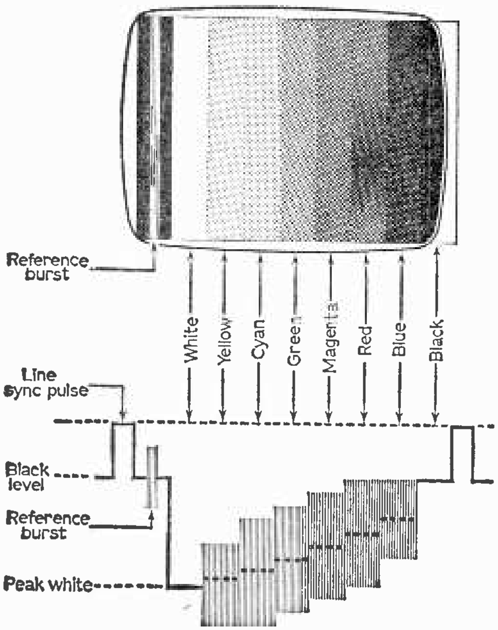


Fig. 1 (left): The burst spotter's guide. Above is shown the colour bar test pattern as received on monochrome, displaced to the right to enable the burst signal to be observed on the left. Below is the same waveform as monitored on a good quality 'scope.

COLOUR

BY H. PETERS

PART 1

The third form of interference is a series of ghostly vertical bars at the left-hand side of the screen. This is called "burst on flyback" and as its name implies it is caused by a slow line retrace on the set allowing the reference burst to brighten up parts of the picture area. The cure for this should be found around the line output transformer stage unless the receiver has flywheel sync where a pair of unbalanced discriminator diodes could cause a phase shift of the line trigger point with respect to the picture. Once again a notch filter would help, but readers ought to be encouraged to find the basic fault rather than to sidestep it. This is easier said than done, however, particularly if the trouble is due to design limitations imposed by the dual-standard requirements of our present systems.

able to monitor the line waveform on an oscilloscope capable of resolving 4·43Mc/s, this will give you a far more positive means of identifying whether the reference burst is present or not.

So far as checking with a set is concerned, by the way, unless the set has a good response at 4·43Mc/s, you will not see the burst at all, and you may need to detune your set towards "sound-on-vision" when a 1·57Mc/s beat pattern between sound and the colour subcarrier will be resolved to denote the presence of colour. You may indeed find that this will be the easiest way to "see" colour information particularly on DX reception.

The monitoring of the colour subcarrier is an interesting feature that DX fans may care to try since both the Germans and the Italians are well advanced with the PAL system. These two countries already use 625 lines on their v.h.f. as well as on their u.h.f. stations so there is no technical reason why the colour subcarrier should not be added to their v.h.f. transmissions (at the time of writing no definite information on this subject is available).

INTERFERENCE

Three forms of interference can be experienced by black-and-white viewers during a colour transmission. The first is the appearance of a dot pattern in the saturated parts of the picture, that is to say on the parts of the picture where the colours are very vivid. At the same time the average brightness of these parts of the picture may increase due to the vision detector adding the d.c. component of the detected colour signal to the monochrome (luminance) signal. The cure for this is to fit a notch filter to remove the 4·43Mc/s component of the video waveform in the video amplifier stages. This notch filter will be a rejector coil similar to the 3·5Mc/s filter found in many 405-line receivers (see Fig. 2), in fact such a coil could be adapted for the purpose by the removal of a few turns of wire.

The second form of interference is a beat pattern of vertical or "wicker work" at 1·57Mc/s. This again can be produced at the detector if the colour subcarrier beats with the 6Mc/s intercarrier sound. The notch filter would eliminate most of this as well, but its existence suggests that the i.f. alignment is in need of attention, particularly if there is a tendency to sound buzz on 625 lines.

AERIALS

No doubt many readers will have glanced at advertisements which tend to create alarm and despondency on the theme "You may be satisfied with your BBC-2 aerial but will it be all right for colour?" Usually these advertisements do not elaborate on what the difference ought to be, or what colour requirements are. They merely say "Try one of ours and you will be all right". Not a satisfactory answer for the enquiring mind. Accordingly let us set your mind at rest immediately by saying that there is nothing special about aerials for colour TV. They are not gold plated, anodised, or cocooned in fibre glass. If you have a properly erected, well designed BBC-2 aerial bringing in a good clean signal, and matched in nicely to the down-lead and the receiver, you are well away.

Why all the fuss then? The coded colour signal comprises a short sharp reference burst on the back porch of the line sync pulse together with the colour difference signals which appear on the picture when the coloured scene is different from the monochrome one. When there is no difference, there is no difference signal. Thus

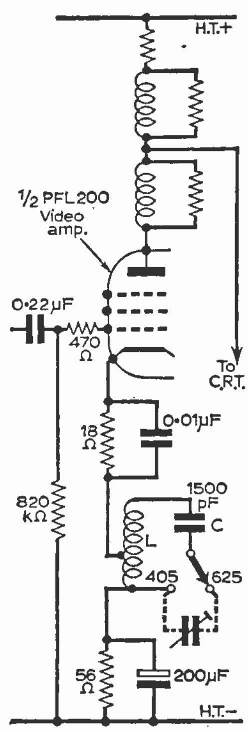


Fig. 2 (right): Notch filtering as used in recent Pye/Ekco models. L and C are switched to form a high-Q parallel-tuned rejector on 405, resonant at 3·5Mc/s. To remove subcarrier patterns on 625 a similar filter resonant at 4·43Mc/s is needed. In this case a capacitor connected across the switch as shown and of value determined by experiment would be all that is required.

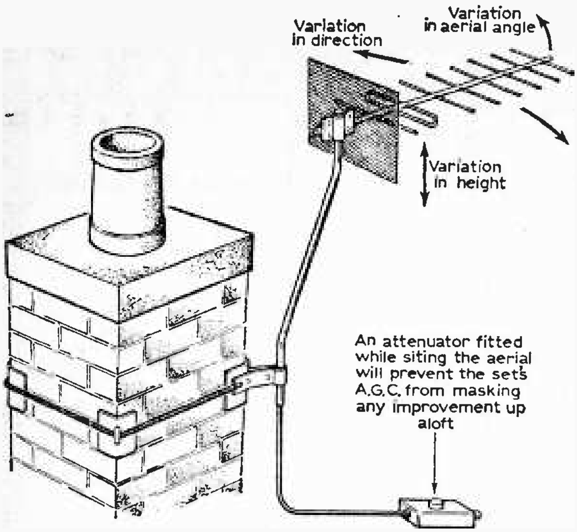


Fig. 3: The last μV of signal can be obtained at any location by varying aerial height, position and angle. This is most important when receiving colour since the chroma signal is much weaker than the monochrome luminance signal. The aerial may also need to be twisted on its axis for optimum results.

happens during white, grey, and black parts of the scene. On pastel shades where there is a good white content the difference signal is small. Only on strong bright colours does it assume sizeable proportions. It is, in fact, lucky if at any instant it takes up anything like ten per cent of the total radiated power. So, to take the 500kW Belmont station as an example, even on the gaudiest scene only 50kW of the effective radiated power will be consumed by the colour signal. The remaining 450kW is still given over to the luminance signal, much to the relief of the fringe monochrome viewer. What all this means is that the aerial needed by the colour viewer has to be capable of resolving a good clean signal from what effectively is a 50kW station, instead of a 500kW station. Usually a Yagi array with three or four more director elements than is general in your district will, however, be adequate for the job. A balun or similar matching device at the head is desirable, and the downlead should be of the best quality low-loss coaxial cable that you can afford.

Careful sighting to reduce "ghosts" and other forms of signal cancellation will also pay dividends, and when choosing an aerial it should be remembered that it will in the future have to cope with three other programmes occupying a 12-channel spacing. The specification is thus that the gain variation should be less than 3dB over the group of channels and no greater than 1dB over any one channel. All the well-known branded aerials conform to this specification as do the arrays suggested in the article on the centre pages of the March 1967 issue of PRACTICAL TELEVISION. The only aerials which may run into trouble are those specially cut high-gain arrays erected in the pioneer days of 625 lines before BBC-2 became operational.

There will of course be reports of excellent results from set-top aerials, but an element of luck creeps in if the correct proportions of sound, vision and colour subcarrier are to be accurately maintained into the receiver. At present-day prices the cost of a good aerial is small even by comparison with the rental deposit required on a colour set, so why spoil the ship for a ha'porth of aluminium!

DO'S AND DON'TS

If you are going to do the aerial work yourself here are a few precautions that even monochrome viewers may like to note.

Do erect the aerial where it can be pointed, tilted, twisted, moved up and down, and moved around laterally (see Fig. 3).

Do remember that on the edge of the reception area every foot of height counts, but nearer to the station reception may improve by *lowering* the aerial. This is because a strong u.h.f. signal produces a strong "ground reflection"; at certain heights the two will add but at other heights they will subtract, giving layers of weak and strong signal.

Don't be fooled by the a.g.c. system on the set. You will never get your array in the best position if every gain improvement that you make is cancelled out by the a.g.c. action of the receiver. Dig out that old plug-in attenuator from the early BBC-only days and fit it between the downlead and the aerial socket whilst you are squeezing the last drop from the aerial.

Don't make sharp bends in the u.h.f. downlead. Using the best low-loss cable you can get, curve it gracefully, standing it off the gutter where possible at the point where it passes over the roof.

Don't fit an aerial from the wrong group. Directors on group A aerials are as long as reflectors on group C aerials, so expect funny directional effects if you have not got your groupings right.

Finally, do check that you are not in a poor reception area for which a booster station is planned. Booster stations are usually vertically polarised, as well as being in a different aerial group. It is no joke to pay £12 for an aerial installation to find that in a few months' time it will have to be changed to suit the booster station.

TO BE CONTINUED

LETTERS TO THE EDITOR

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

SERVICE NOTEBOOK

SIR,—I am writing to offer my comments on your feature "Service Notebook" which I consider excellent. Also the series "Timebase Traces" filled a gap in the kind of literature on oscilloscope work not usually found in many textbooks.

Could we not have the "Test Case" answers in the same issue, perhaps on a different page?

Altogether an excellent, up-to-date magazine which to me has one very good point in that it never ceases to be *practical* as well as theoretical and always assumes that the reader is one who has "average" TV knowledge and is not a fully fledged professional who would delight in pages of maths and formulae. These are not always "easy meat" to many people.

I can repair successfully both radio and TV as a spare time hobby with knowledge gleaned from both your magazines PRACTICAL TELEVISION and *Practical Wireless* which I have taken many years, so I will conclude and wish you every success.—G. Cox (Glossop, Derbyshire).

625 LINES IN "405" CHANNELS

SIR,—In my letter, printed on page 31 for October, may I point out the omission of the following words between "they push the pupil smaller" and "by dilation": "(by contraction) and pull it open". As you will see, "pupil smaller" and "dilation" contradict each other, as some readers may notice and criticise.—A. O. HOPKINS (Worthing, Sussex).

WHO INVENTED TELEVISION?

SIR,—The credit for the invention of the scanning disc is usually given to Paul Nipkow, in the latter part of the last century.

Nipkow's eight-hole disc was developed by J. L. Baird to 30 lines; culminating in the three-colour system on a single disc.

About the same time, Dr. Vladimer Zworykin in the USA was perfecting the c.r.t. The groundwork of this had been done by Sir William Crookes, in England, much earlier (the well-known Crookes' Tube).

Full credit should be given to Baird for the equipment for the first public television service; which gave some of us a lot of interesting fun on the London Regional frequency with the sound on the Midland Regional; detail was lacking but male or female artists could be identified and whether they were singing or talking.—A. DEVERILL (Rickmansworth, Hertfordshire).

wide range pulse generator

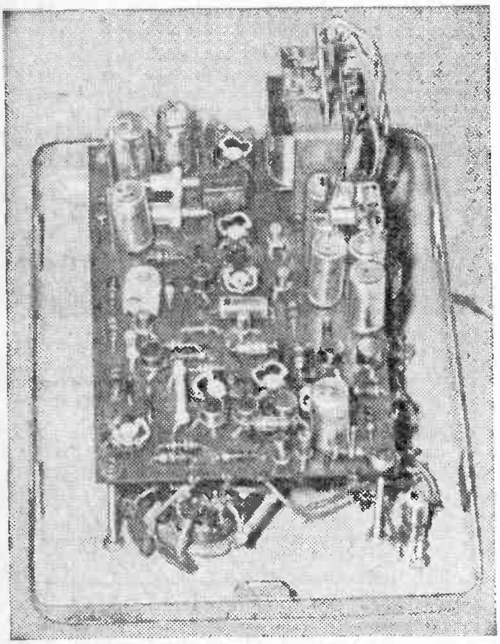
PART 2

BY MARTIN L. MICHAELIS, M.A.

IT is convenient to power small transistorised circuits such as the present design from a standard miniature bell transformer with an 8V secondary winding. A wide range of different d.c. output voltages can be obtained from this transformer by adopting appropriate rectifier circuits.

D1, C2 and D4, C3 are the two halves of a conventional full-wave voltage doubler. C1, D2, D3, C6 is a negative conventional half-wave voltage doubler, and C4, D5, D6, C5 is the corresponding positive conventional half-wave voltage doubler circuit. Driving these three conventional circuits *simultaneously* from the *same* transformer winding provides us with a composite voltage quadrupler circuit with available outputs at 1, 2, 3 and 4 times the peak a.c. input voltage. Any one of these four points may be grounded. In the present example, the grounding is such as to produce the required supplies of +11V, −22V and −33V with respect to chassis.

The positive voltage is required for the collectors of the positive pulse output stage and for the polarity inverter stage. The −22V supply is the input to the zener diode D7 which produces the stabilised collector supply of −15V for the remaining stages, and the highest voltage of −33V is the input to the zener diode D8 which provides the −22V stabilised supply for the sawtooth oscillator input circuit. The sawtooth oscillator is a modified Miller-transitron circuit which operates as an analogue converter from voltage to frequency, with a conversion slope of approximately 1kc/s/V. The −22V supply is thus necessary to cover the range up to 20kc/s with the track of VR1. Stabilisation with D8 is obviously necessary since this voltage directly determines the oscillation frequency.



Inside view of prototype with rear cover removed.

Any miniature silicon l.t. rectifier with a p.i.v. rating of about 100V and at least 250mA peak current rating may be used for the power rectifiers D1 to D6. Almost any type of zener diode with the correct zener voltage ratings may be used for D7 and D8. The power dissipation ratings should be about 300mW.

SAWTOOTH OSCILLATOR

Tr2 is the Miller amplifier, or operational amplifier, as it is variously called. C11 is the Miller capacitor, which reflects by virtue of the Miller effect as a virtual capacitance between the base of Tr2 and chassis and has a value approximately equal to the value of C11 multiplied by the voltage gain of Tr2. This virtual capacitance commences to charge via VR5 to the voltage at the slider of VR1. Since the voltage across the virtual capacitance is the base bias for Tr2, the collector current of Tr2 gradually rises during the charging process. This collector current flows via the emitter-base path of Tr3 and through R4 until it has increased to the trip threshold value for the current-sensitive combination Tr3, Tr4 which thereupon suddenly act as a switch short-circuiting R4 and thus switching on Tr1 hard due to the resulting increase of negative bias voltage developed across VR6. This starts the flyback. C11 charges very rapidly to virtually the full collector supply voltage, via Tr1, Tr3, Tr4 and D9. This amounts to complete discharge of the virtual capacitance at the base of Tr2, so that Tr2 immediately cuts off. When C11 has charged to the extent where the charging current has dropped below the trip threshold of Tr3, Tr4 current ceases altogether and the entire sequence of events can commence all over again.

This circuit simultaneously produces a sawtooth waveform at Tr2 collector and a negative pulse flyback waveform at the collector of Tr4. The negative flyback pulses are exploited as output of the oscillator stage. They are about 25 microseconds wide, *irrespective* of the frequency, since they are determined by the rate at which C11 can charge through Tr1, Tr3, Tr4, i.e. by fixed circuit parameters. In addition to its wide frequency range, this is a second outstanding advantage of this oscillator circuit. The constant output pulse irrespective of the frequency permits the use of a simple trigger amplifier and stable triggering of the subsequent univibrator at all frequencies, without needing a trigger stability control on the front panel.

TRIGGER AMPLIFIER

Tr5 limits and inverts the pulses, producing positive-going pulses of about 2 volts amplitude at its collector. C12 and R10 differentiate these pulses, producing alternate positive and negative voltage spikes from the pulse flanks. D10 shorts out the negative spikes, leaving only the positive spikes at the base of Tr6, which steps down the impedance to provide the necessary current drive for triggering the univibrator stage Tr7, Tr8.

UNIVIBRATOR STAGE

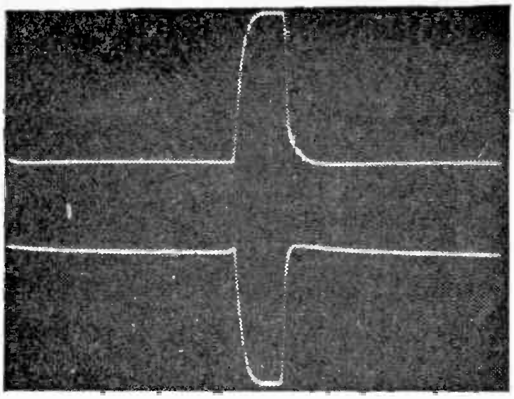
Tr8 normally rests conducting heavily, because VR8 is returned to chassis. The resulting voltage across R14 is sufficient to hold Tr7 cut off. When a negative trigger spike arrives via C13 at the base of Tr7, however, the latter is lifted above cut on. The resulting negative voltage step at Tr7 collector is fed via the selector capacitors on S2 to the base of Tr8, thus reducing Tr8 conduction. This in turn reduces the voltage across R14 and thus further augments the conduction of Tr7. The process is thus cumulative, resulting in rapid cut off of Tr8 and heavy conduction in Tr7. This state of the circuit persists until the capacitance switched into circuit with S2 has charged through VR8 to a point enabling Tr8 to begin to conduct again. A cumulative process similar to the first one then takes place in the opposite direction, returning the circuit to the resting state with Tr7 cut off and Tr8 conducting heavily. This state persists until the next trigger spike arrives at Tr7 base.

Thus the pulse repetition frequency is determined by the drive oscillator frequency but the pulse width is determined by the capacitance value selected by S2 and the setting of VR8. VR8 is preset to give the nominal pulse widths with the specified capacitors on S2. The series arrangement of C18 to C28, instead of a separate capacitor for each setting, has been adopted for convenience. It leads to a more compact construction, since the capacitors are wired between successive tags of the switch.

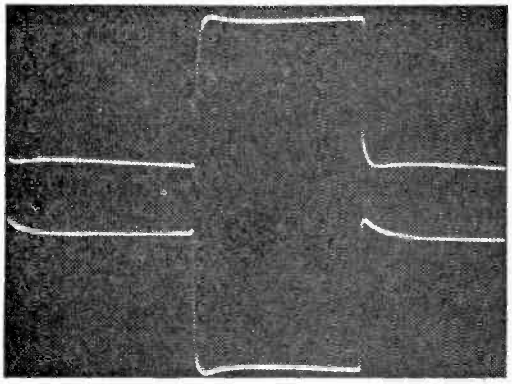
Following each trigger spike a negative pulse appears across R15 at the collector of Tr7, and a positive pulse appears across VR9 at the collector of Tr8. The negative pulse has a poor waveform because Tr7 is conducting for its duration and thus passes on transients resulting from the differentiation of the input pulse. On the other hand, Tr8 is cut off during the pulse so that negligible transient input is passed through to VR9. The negative output pulses must therefore be produced by inversion of the positive pulses appearing across VR9.

POSITIVE PULSE AMPLIFIER

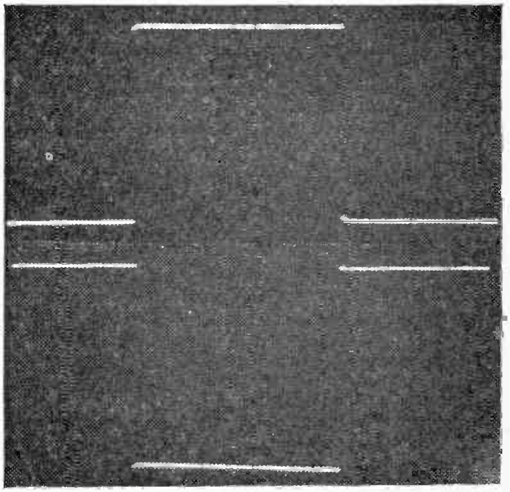
The positive pulses from the slider of VR9 are fed via C16 to the base of Tr9, which together with Tr10 constitutes a two-stage emitter follower feed-



Pulse output at shortest pulse width—10µS. Rise time 2µS, fall time 600nS. Positive pulse at top, negative pulse below



Pulse output with pulse width equal to one line—100µS approximately (405-line system). Positive pulse at top, negative pulse at bottom.



Pulse output at field pulse width—20mS. Positive pulse at top, negative pulse at bottom.

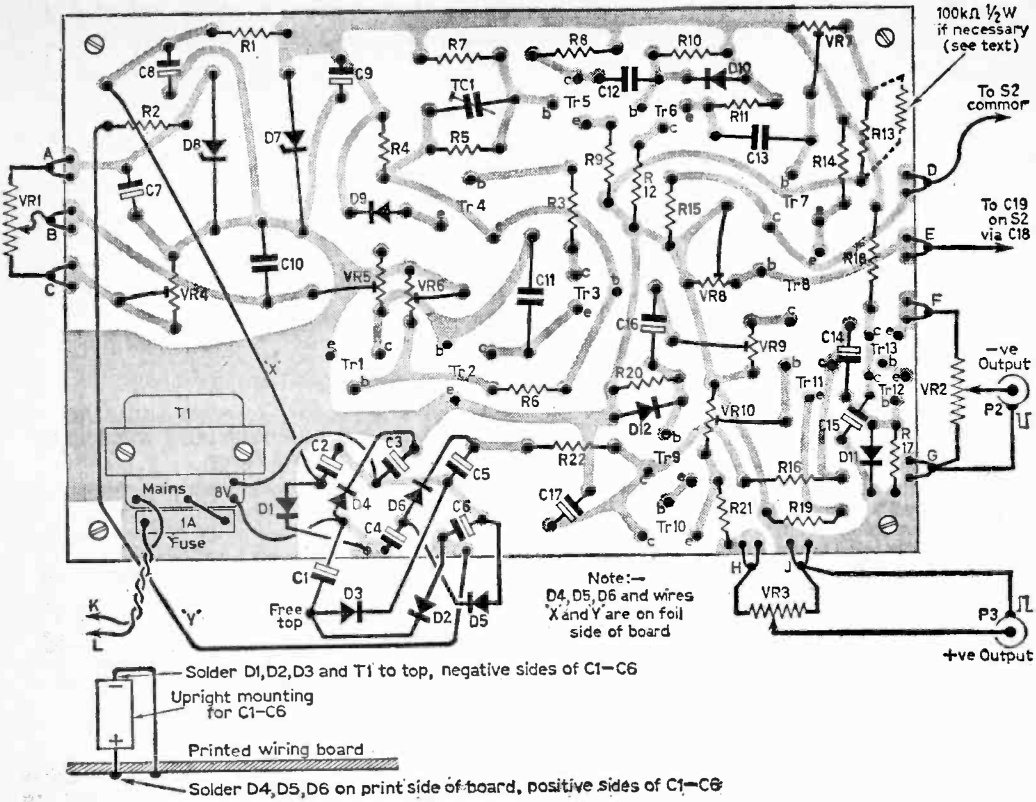


Fig. 2: Printed wiring board, shown from print side. Components on other side.

ing the output P3 via the amplitude control VR3. R20 and D12 at the base of Tr9 constitute a d.c. restorer (clamp circuit) making the pulses rise positively from chassis potential irrespective of the pulse width to pulse interval ratio. VR9 is adjusted so that the pulse amplitude across the track of VR3 is exactly 5 volts.

PULSE INVERTER

VR10 is in parallel with the low-impedance positive pulse output. A fraction of the latter is thus fed from the slider of VR10 to the base of Tr11. R21 prevents reduction of the drive to Tr11 due to loading of P3, i.e. it makes the positive and negative output amplitude settings mutually independent. The positive pulses applied to the base of Tr11 appear inverted as amplified negative pulses at its collector. The amplification factor is approximately equal to the ratio of R16 to R19.

NEGATIVE PULSE AMPLIFIER

C14 blocks the d.c. potential present at the collector of Tr11. R17 and D20 function as d.c. restorer (clamp circuit) to produce a new reference level such that the pulses applied to Tr12 base always drop negatively with respect to chassis potential, irrespective of the pulse width to pulse interval ratio. Tr12 and Tr13 function as two-stage emitter follower to achieve the required very low output impedance. VR2 is the amplitude control and P2 the output socket for the negative pulses. *After* correctly adjusting VR9 for the positive pulses, adjust VR10 so that the negative pulse amplitude across the track of VR2 is exactly 5 volts.

OSCILLATOR ADJUSTMENTS

After completing the construction, carefully check all components on the printed circuit board (in particular the polarity of the electrolytics, the polarities and connections of the power rectifiers, and correct transistor electrode connections). Then connect an oscilloscope to Tr5 emitter (top of R9), set VR5 and VR4 midway and VR1 to maximum frequency (slider to C7) and then switch on.

Commencing with VR6 at zero resistance, increase VR6 and note that oscillation commences at some point, then slowly rises in frequency, reaching a maximum frequency at some setting and thereafter decreasing again in frequency quite sharply and ceasing abruptly with slight further movement of VR6. Leave VR6 set at an angle before the maximum frequency setting, approximately equal to the angle on the other side of the maximum frequency setting at which oscillation ceases again.

Now adjust VR5 to make the frequency exactly 20kc/s. Then turn VR1 to the minimum frequency

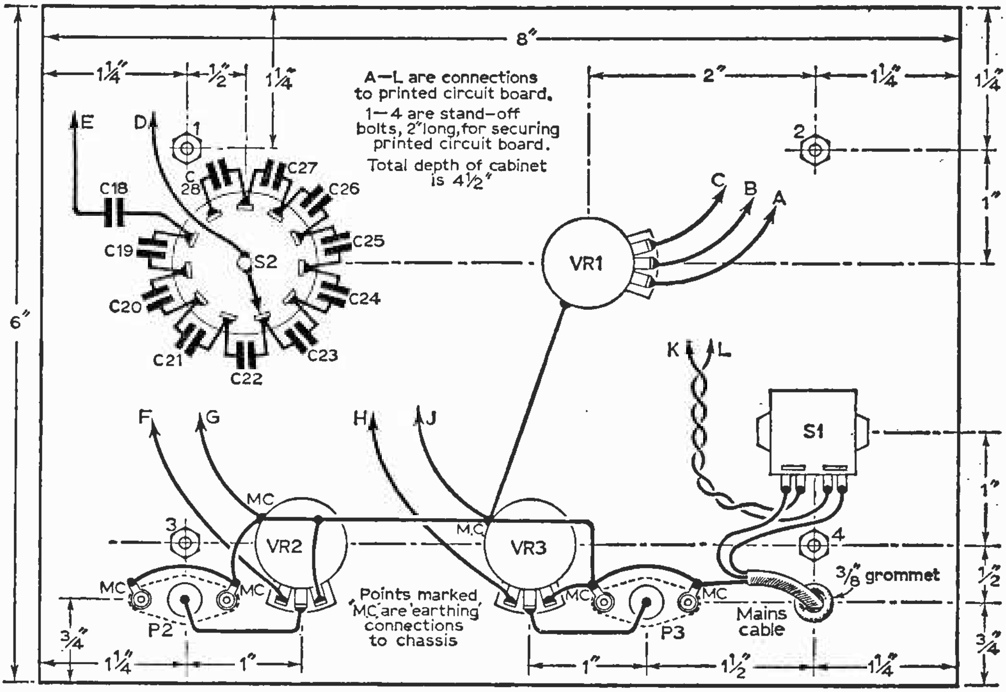


Fig. 3: Rear view of front panel layout.

setting and adjust VR4 to make the frequency exactly 20c/s. Alternately repeat these adjustments of VR5 and VR4 until mutually correct settings are obtained. If the final setting of VR5 is less than half the track, substitute a smaller value for C11 (e.g. 0·005μF). On the other hand, if the maximum setting of VR5 still produces a frequency greater than 20kc/s, or if the frequency cannot be reduced to 20c/s with VR4 at the other end before oscillation ceases altogether, substitute a slightly larger value for C11 (about 0·01μF). Such modifications to C11 value may be necessary with substitute transistor types, although the circuit is otherwise not critical regarding the actual transistor types used.

The frequency measurements are conveniently made by using an oscilloscope with horizontal deflection calibrated in time/centimetre, or by first using known frequencies from an audio signal generator to calibrate an oscilloscope in this manner. The oscillator stage is now correctly adjusted.

FREQUENCY DRIFT

There is negligible frequency drift with temperature except very close to the bottom end of the tuning range at the lowest frequencies. The temperature coefficient is here negative, i.e. the frequency falls with rising temperature and oscillation may cease altogether at the bottom setting of VR1 for high ambient temperatures. This is not serious, because oscillation commences and all specified frequencies are then obtainable at a slightly advanced setting of VR1. Frequencies higher than about 500c/s are hardly affected, so that the effect is merely one of slight cramping of the bottom end of the tuning scale, with the appearance of a small dead region right at the end. Judiciously selected high-value negative-temperature coefficient resistors (100kΩ or more at 20 deg. C) shunted across the track of VR1 and positioned close to Tr1 and Tr2 to sense the same temperature will remove the drift entirely.

TRIGGER ADJUSTMENTS

With the oscilloscope still connected to the top of R9 (using a properly compensated probe and an oscilloscope with at least 1Mc/s Y-amplifier bandwidth), adjust TC1 for steepest slope of the positive flanks of the pulses from the oscillator. Now transfer the oscilloscope to the top end of R12 and make a fine adjustment to TC1 for maximum amplitude of the observed negative spikes. If the maximum obtainable amplitude is less than 1·5 volts, substitute a resistor of greater value for R7 (up to 1MΩ may be required). Such modifications may be necessary if substitute types of transsistors are employed.

Now connect the oscilloscope to the top of VR9 and set VR7 slider to the −15V end of the track. Then slowly turn VR7 slider towards R13 until the univibrator triggers and pulses appear on the oscilloscope. For this adjustment, S2 should be set to the 10 microsecond pulse width position. Move VR7 slider about 30 deg. towards R13 beyond the point at which triggering commences. Then check that triggering is secure for all frequency and pulse width settings.

If the onset of triggering is less than 30 deg. from the bottom end of the track of VR7, solder a 100kΩ 0·5W carbon resistor in parallel with R13 (as indicated on Fig. 2) and repeat the adjustment of VR7. If triggering cannot be obtained at all at any setting of VR7, even with the 100kΩ resistor added across R13, yet the trigger pulses are observed correctly at R12 and there are no circuit mistakes or faulty components, then try increasing R14 to 8·2kΩ or even 10kΩ, and placing a 47kΩ resistor instead of a 100kΩ resistor in parallel with R13. This more drastic modification may be necessary if inferior transistors with low current gain (less than 30 at 1mA collector current) are substituted for Tr7 and Tr8. Such transistors will also impair the pulse waveform, so that as far as possible avoid using transistors with current gains less than 30 for Tr7 and Tr8.

PULSE AMPLITUDE ADJUSTMENTS

It is important to make the following adjustments *in the order given.* Connect the oscilloscope to P3, set VR3 to maximum and then adjust VR9 to make the pulse amplitude exactly 5 volts. Then connect the oscilloscope to P2, set VR2 to maximum and adjust VR10 to make the pulse amplitude exactly 5 volts. Check that the pulse amplitudes do not change by more than ±10% with frequency and pulse width to pulse interval ratio alterations. If greater changes are found, C14 or C16 may be leaking or connected the wrong way round; or D11, D12 may be defective, reversed or of unsuitable type. All four pulse diodes D9 to D12 must be silicon types with low self capacitance (at most 5pF, preferably less) and p.i.v. ratings of about 50 to 100V.

If the negative pulses at P2 show severe extension of part or all the lagging flanks, unsuitable transistors are being used for Tr12 and Tr13. The lagging flanks of the pulses will then trail out in a long exponential which may have a duration many times as great as the actual pulse width. This fault arises if the current gain and/or the cut-off frequency of the transistors employed is too low for this circuit, which is unfortunately the case with all readily available silicon pnp transistors and many germanium pnp audio transistors. Suitable types are germanium pnp transistors intended for the 10·7Mc/s i.f. stages of v.h.f. f.m. receivers. The current gain at 1mA collector current should be about 60 to 90. With suitable transistors there should be no significant difference between the pulse waveforms at P2 and P3, except for the opposite polarities.

PULSE WIDTH CALIBRATION

Adjust VR8 to make the actual pulse width correspond as closely as possible to the nominal values specified against the switch S2. If desired, individual fine adjustments may then be made by trimming the values of C18 to C28. For this purpose, commence with the 20mS setting and modify the value of C18, then modify the value of C19 in the 10mS setting, etc.

PULSE WAVEFORM IMPROVEMENTS

The only significant distortion of the output pulses is the finite duration of the flanks. The leading flank of each pulse is produced by sudden cut off of Tr8. The collector potential of Tr8 cannot thereby return to chassis potential instantaneously, but only at an exponential rate determined by the discharge time constant of the stray capacitances through the track of VR9, which is somewhat under 1 microsecond. The flank thus takes about 2 microseconds to run between 10% and 90% of the full amplitude, irrespective of the pulse width or repetition frequency.

This is quite negligible for the longer pulse widths, but becomes appreciable at the 10 microsecond pulse width setting. Little can be undertaken to reduce the stray capacitance, but we can reduce the value of VR9 to obtain steeper leading flanks. R15 and R14 must then be decreased too, in proportion. On the other hand, the ratio of VR8 to VR9 must not be greater than the current gain of Tr8, otherwise pulse distortion results due to inadequate base drive for collector saturation. The production of steeper leading flanks by reducing the value of VR9 thus calls for transistors of higher current gain for Tr7 and Tr8.

The lagging flanks are already steeper because they are determined by the charging time constant of the stray capacitances at the collector of Tr8 through the smaller resistance R14 and the negligible internal resistance of Tr8 emitter-collector path. Since R14 must be decreased in the same ratio as any decrease of VR9, the lagging flanks will be improved to the same extent.

PRECISION PULSE GENERATOR

The circuitry from Tr5 to Tr13 may be duplicated as a precision pulse generator. The base of Tr5 is fed directly from the positive pulse output from P3 of the first version of the circuit in the basic unit, whose negative output pulses are used to trigger the oscilloscope in the negative trigger setting. The output pulses of the precision pulse generator section can then be applied to the circuitry on test, whose output waveforms can be observed in the strobe-trigger mode of the oscilloscope in the manner previously described.

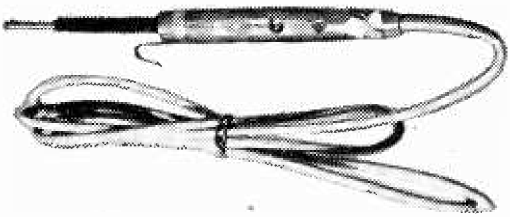
Tr7 and Tr8 in the precision pulse generator section must be chosen with current gains of at least 100, VR9 should be 2kΩ, R15 2·2kΩ, R14 560Ω, VR10 1kΩ, R16 1kΩ, R19 220Ω and R22 270Ω. It is also advisable to use a transistor with a current gain of at least 100 for Tr9.

A precision pulse generator section of this kind may be constructed as an additional module incorporated in the same cabinet, or as a separate unit with its own power supply. Its output pulses will be sufficiently accurate for testing the response of most video circuits. On the other hand, the output pulses with the component values of the prototype and correspondingly cheaper transistors are sufficiently accurate for testing the response of audio equipment. The leading flank duration of about 2 microseconds corresponds to a cut-off frequency of over 100kc/s in an amplifier able to pass this pulse flank without further visible distortion. ■

TRADE NEWS • TRADE NEWS • TRADE NEWS

TRADE NEWS • TRADE NEWS • TRADE NEWS

IRONS WITH NEONS

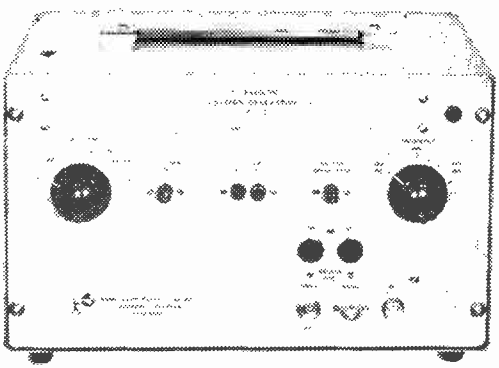


LIGHT Soldering Developments Ltd., 28 Sydenham Road, Croydon, are now supplying, to special order, four models from their Litesold range of soldering instruments fitted with neon indicators to show when the supply is switched on. There has been considerable demand for this feature to reduce the risk of accidental burns to operators and equipment. These indicators are available on the 10, 18, 20 and 25 watt models.

The neon indicators are mounted entirelv within the moulded nylon handles and are visible over a very wide angle through domed, clear-Perspex lenses let into the handles. It is planned to use handles moulded in natural nylon for this application as soon as possible, to allow the lenses to be dispensed with and to permit the indication to be visible from any angle.

Instruments with neon indicators are available for all voltages from 100 to 250 volts, a.c. or d.c. Prices are from 35s. 6d. to 37s. 6d. each.

CROSSHATCH/DOT PATTERN GENERATOR



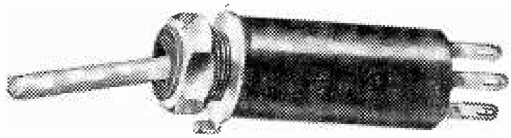
A NEW crosshatch and dot pattern generator, designed and developed by Bush-Murphy Electronics is now in full scale production at the Welwyn Garden City factory of the Bush-Murphy Division of the Rank Organisation.

Designated the TPG55, the new generator is primarily designed for testing the geometry of colour receivers. It is equally useful for conventional linearity and interlacing checks on monochrome receivers and provides the following facilities: a dot pattern for static convergence tests; a grid pattern for dynamic convergence tests; a grey scale for tracking checks; a raster for purity adjustments.

The performance of the TPG55 is based on professional TV standards. It provides either an r.f. output of several millivolts tunable over the full range of Bands III, IV and V or a video signal of approximately 1 volt (—ve sync) into 75Ω. The signal characteristics are as specified by the BBC except that in the case of the 625 line system there are no equalising pulses before and after the field sync pulse group as these are unnecessary in the TPG55's application.

The TPG55 is available for either battery or mains operation. Its size is 12 x $7\frac{3}{4}$ x $8\frac{1}{2}$in and its weight, with battery, is under 9lb. Price, less battery, is £88 10s. and the mains power unit, which is an optional extra, is £4 5s.

MINIATURE TOGGLE SWITCH



THE new TS/1 toggle switch manufactured by Rendar Instruments Ltd., is designed as a medium price, single-pole changeover switch which combines high performance with small physical size and excellent reliability.

Tested to an operational life of over 30,000 cycles at 24V d.c. on 3 amps, it has an initial contact resistance of 5 milliohms. Insulation resistance between each contact, and between contact/panel and contact/button is greater than 10,000MΩ.

The TS/1 is also suitable for use at 250V a.c. mains voltage with a maximum current of 1·5A. The test voltage between contacts/panel, and contacts/button is 2,000V d.c. Between contacts it is 1,500V d.c.

The neat appearance and compact dimensions of this switch make it suitable for control panels on audio, automotive and other electrical equipment. The $\frac{7}{8}$in. diameter body requires only 1in. depth behind the panel. The button is available in a variety of colours.

For further information concerning the TS/1 toggle switch, contact Rendar Instruments Ltd., Victoria Road, Burgess Hill, Sussex.

LASKY'S 35th BIRTHDAY

LASKY'S Radio are celebrating their 35th birthday and in conjunction with this have published a 12-page colour pictorial catalogue.

Their business which started some 35 years ago in Harrow Road, Paddington, supplying mainly valves and electronics components to the few radio hobbyists of that period, has now largely expanded and, after 35 years, they now have five branches throughout the West End, two being exclusively devoted to Hi Fi equipment and the remainder dealing in the whole range of goods shown in the catalogue, plus thousands of other items impossible to show.

In addition to this they have a 12,000 sq. ft. mail order department which caters for the customers who write from all corners of the world. It is especially for these customers that the pictorial catalogue has been produced and it offers them the facilities and benefits of shopping at Lasky's from their own home.

VIDEO TAPE RECORDING

PART 5

H.W.HELLYER

HAVING last month looked at the general arrangement of the Sony 405-line system of helical scan tape recording for video signals we may proceed to study some of the circuit details. Many of these are quite unusual and will be of particular interest to readers who have not previously met transistorised video circuits. To put the system in perspective Fig. 14 shows the complete arrangement in semi-practical form, i.e. as it may be wired up. The Sony CV2000B kit, consisting of camera, recorder and monitor, can be unpacked, assembled and in working order in eight minutes flat, including the usual fiddling with a tripod that can be as recalcitrant as a deckchair on a windy day!

The heart of the system is the video recorder, and other parts couple into this. On the rear panel there are two a.c. outlets, one switched by the main power switch, the other straight through. The purpose of this arrangement is to allow the small monitor TV to be powered for normal reception even when the system is not in use. It also ensures that the camera is off when the video recorder power switch is off, providing the connections are properly made.

In Fig. 14 a second power supply is used to feed the large monitor receiver, an extra to the basic system, employed only for playback. In practice it is possible to convert a standard 405-line receiver quite simply for this purpose as the video output signal is a normal 1·4V peak-to-peak positive-going signal (i.e., negative sync). It can thus be applied to the input of the normal video stage so long as precautions to avoid damping by its low impedance (nominal 75Ω) are taken.

In response to requests for an even simpler method Sony issued suggested circuits for r.f. modulators which convert the video and audio signals to a standard television signal in the Band I region and thus provide a signal suitable for plugging directly into the aerial socket of a standard receiver. But it must be remembered that this is for replay only. To record television signals it is still necessary to employ the small video monitor receiver to which the receiving aerial is shown connected in Fig. 14. Camera signals are coupled to the monitor sets via the video recorder, but it is also possible to bypass this and link up a closed-circuit television system with only minor modifications to external connections.

Recording circuits are a small part of the whole, and should afford a good introduction. The video signal extends from d.c. to 3Mc/s or so and for reasons we have already noted it is not feasible to use the conventional recording methods. To begin with it is by no means easy to equalise the replay signal to compensate for the recording characteristic if we use constant-current recording techniques. In addition it is vital that we preserve the signal-to-noise ratio at least as good as the received signal. This is combined to some extent with the need to retain very low frequencies, d.c. in fact. Without digging too much into theory, it is sufficient to explain that movement of the tape past the recording and playback heads cannot always be constant. Small variations in thickness of tape coating or base pliancy cause amplitude variations which drastically affect the signal. Not only is contrast affected, as users of previous kit systems of linear recording found to their cost, but also the waveform of the signal, with the inevitable effect on synchronism as well as resolution.

Therefore the signal is imposed on a constant-amplitude envelope and saturated-recording rather than constant-current recording is used. The obvious way to modulate a constant-amplitude envelope (though not the only way) is to frequency modulate a carrier with the video signal. We thus find that the recording channel consists

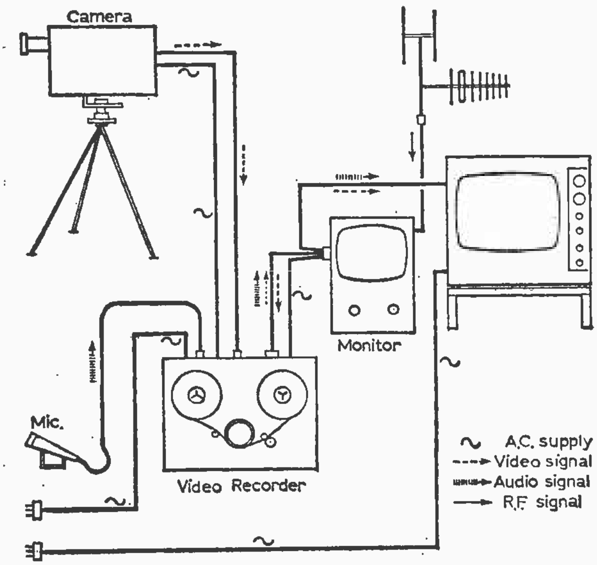


Fig. 14: Practical wiring layout of the Sony 2000 system, showing interconnection between the camera, recorder, monitor/off-air receiver and large-screen monitor, with microphone input in a conventional mode.

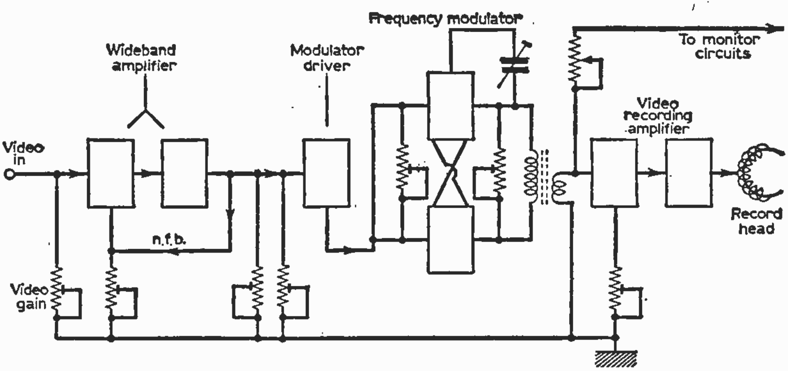


Fig. 15: Block diagram of the record section of the Sony 2000. The video signal is applied to a two-stage wideband video amplifier and thence to a modulator driver which controls the 1·7Mc/s oscillator. The frequency modulated output is fed to a two-transistor amplifier for application to the recording head. An output is taken prior to this stage to feed the monitoring circuits and meter indication is from the latter section, not directly from the recording circuits.

of a small transmitter as shown in block form in Fig 15.

The incoming video signal is first applied to a two-stage wideband video amplifier, across the video-level control, which is brought out to the main deck. This is a 500kΩ variable resistor, and to match the input to the 75-ohms unbalanced line a 100-ohm resistor is fitted across this control. Pre-emphasis is necessary and to maintain the wideband characteristic negative feedback is applied across these two stages. To ensure correct conditions a network consisting of a small capacitor, a fixed and a variable resistor in series is placed across the emitter load of the first stage. It is simple to set this preset control by monitoring an incoming test card off-air and, starting anti-clockwise, turning up the control until ringing or overshoot are just observed, then turning back slightly. But this is only done after the carrier setting and white-clipping adjustments are carried out.

Driver and modulator

The third stage is a modulator driver using an npn (2SC318) transistor in the emitter-follower

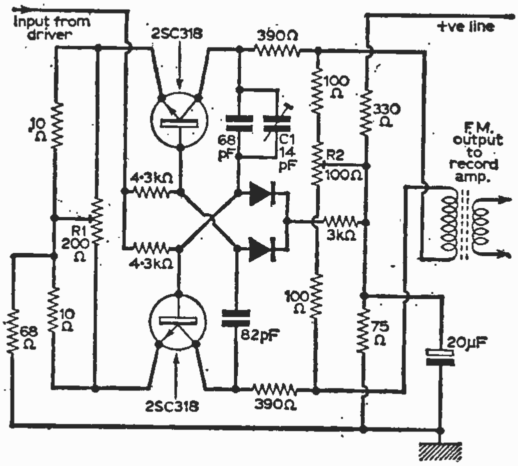


Fig. 16: The f.m. modulator stage consists of an astable multivibrator.

mode to provide the necessary low-impedance output for the modulator. A clamp circuit is fitted at the input to the driver stage. Using the sync tip as reference this maintains constant-carrier frequency by setting the d.c. conditions. The clamp circuit consists of a diode connected to a preset which is part of a potential divider across the supply, the signal being applied to the cathode of the diode via a 1μF electrolytic from the collector of the wideband video amplifier. This sets the black level, in effect, using the 1·6Mc/s pedestal, conducting only on sync tips. The voltage at the output of the emitter-follower is then between 3 and 4 volts, setting the d.c. reference conditions and thus the basic frequency of the modulator.

This reference plus signal input is applied to the bases of the modulator transistors, which comprise an astable multivibrator circuit, as in Fig. 16. The above explanation has been given to demonstrate that the two preset variable resistors R1 and R2 shown in this circuit are not frequency setting controls but are used to control the waveform and its symmetry.

A third control, the 14pF preset capacitor C1, is provided and the combination of these three is vital to the overall quality of the recording. It is thus necessary to set the basic 1·7Mc/s frequency by means of the modulator driver control, using a tuned tank circuit for the purpose, and measuring the output across the secondary of the output transformer of the modulator. As the control is altered two peaks will be found (see Fig. 17a) and, as can be seen from the output curve, the second of these is the appropriate one.

The modulator driver applies a varying d.c. to the bases of the astable multivibrator. The base voltages are thus changed by the video signal and this variation alters the rate of oscillation so that the frequency of the output is directly proportional to the base input. As base input increases, frequency increases, and vice versa. The diodes shown stabilise the circuit and the primary of the output transformer "floats", giving a push-pull output.

Modulator adjustments

And so to that tantalising waveform and symmetry business. If we put an oscilloscope across the output transformer secondary (and we need a

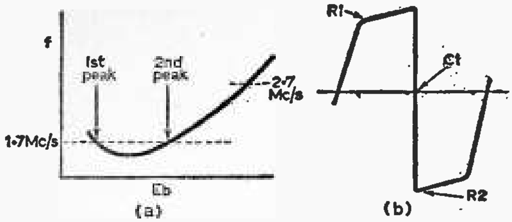


Fig. 17: (a) Output/frequency curve taken at base of video record amplifier, showing need to lock the oscillator to the second peak to avoid the bend at the bottom of the curve. (b) Symmetry waveform. Exact symmetry of the oscillator waveform is essential and three presets are provided for this purpose. After symmetry adjustment check basic frequency to ensure no offset has occurred.

good one for this purpose with a 1·6Mc/s timebase and fast rise time) we get a waveform far removed from the sine wave of theory. More, in fact, like that shown in Fig. 17b. The important factor is not, in this case, its nearness to a sine wave, but the symmetry of the two halves, including the slope at top and bottom. Why a good 'scope is needed becomes evident if we consider the point at which the positive waveform cuts the baseline, and which is a vital factor in assessing performance. The setting of the "cutting point" of this line is determined mainly by the small preset capacitor C1, the two resistors R1 and R2 adjusting the slope of the top and bottom of the waveforms respectively. In practice it should not be necessary to alter these factory adjustments, but as their offsetting can produce poor resolution, picture noise, and at worst bad linearity, a slight touch may occasionally help.

As with so many setting-up procedures—one of the new techniques we are all going to have to learn in tackling colour television—the trick is to assess the picture intelligently, altering only what must be altered, and being ready to return to the initial setting if no change is observed. The old-hand's dodge of making a small diagram first, showing the relative angles of preset knobs or slots, is coming back into fashion. I once saw Bernard Rogers, Chief Development Engineer of Rank-Bush-Murphy Ltd., set up a Bush colour television receiver on Test Card "F" in three minutes flat, and he confesses that he can do it only by knowing exactly where the presets should be for ideal conditions. Very much of an anti-twiddling man, his advice is to be noted.

However, we must be practical and if one does not have 'scope and frequency meter handy some other method of setting up the f.m. modulator of the video tape recorder is needed. After some experiments I find that it is necessary first to make sure of the playback side of things, just as with a conventional tape recorder. Then play back a known good tape and check the limiting and demodulation until all is as well as can be. Then, and only then, lace up again with fresh tape and turn to record. Luckily with the system we are considering we do not actually need to record and replay for every adjustment. The monitor does a lot to help us. We can feed in a video signal, again preferably the test card from the monitor receiver, and cut the motor switch, leaving the recording head still.

Now if we adjust the basic frequency control we would expect to get a *moiré* pattern, a shot-silk effect, on the displayed picture. Quite a fine balance of adjustment can be made to reduce this to nil, but the vital factor is assessment of the picture to determine just what is causing the various tricks of spot or line or haziness. A little practice is needed; training in temporarily ignoring the unwanted distortion until you are ready to eliminate it. Having set the frequency to its optimum point a slight adjustment of the symmetry controls will sharpen up the resolution and reduce the spotting of peak noise to give a clean off-air picture. Record this and examine the playback: if there is still some haziness in the recorded highlights, or evidence of over-modulation, despite an undersetting of the video control as indicated by the meter, we can adjust the white-clipping control slightly and check again.

This control is virtually across the base circuit of the modulator driver and after any adjustment to it the frequency setting should be checked again. A diode with its anode connected to the base is incorporated in the third stage, the cathode being preset from a variable control. Its function is merely to clip the white peaks and prevent overmodulation.

Record output stage

So much for the modulated signal. This is then fed to the recording head, but the process is not all that easy. We must apply some equalising to compensate for the magnetic characteristic, which is of course nonlinear. To obtain the correct level, overall characteristic, and necessary matching impedance a two-transistor circuit is used, as shown in Fig. 18. Readers will probably recognise the near-bootstrap arrangement which is used to accept the high-impedance input and preserve high gain with

—*continued on page 231*

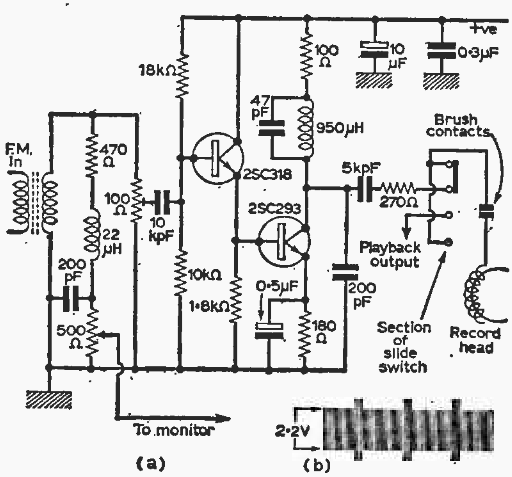


Fig. 18: (a) Circuit of the video record output stage. (b) Sample waveform at head feed.

PART 2

ON TURNING PRO

BY VIVIAN CAPEL

IF professional service is to be offered to the public there are certain essential requirements which must be met, whether it is done from a private home or from business premises. In most areas the majority of service calls are received over the telephone so that it will be necessary to have a telephone installed on the working premises. It may be possible to manage without one for a short while if there is a waiting list in the area but it will mean a slower start and work will be lost. If people are unable to call because of distance or time they must either write or phone, and very few will take the trouble to write.

Most work will originate as a call to visit the customer's home. The repair will be carried out on the spot but if it is of a major nature then the receiver will have to be removed to the workshop.

Transport

Obviously then, the next requirement is a means of transport. An estate car is the ideal thing for the small business as it can be used both for business purposes as well as private use. A private saloon car can be used but some difficulty may be experienced in transporting some of the larger receivers, the problem being increased if more than one set must be transported on the same journey.

Whatever vehicle is used care must be taken to see that it is properly taxed and insured for the commercial use to which it will be put. Otherwise the beginner may find what others have discovered to their cost: that modern slim-line television receivers are difficult and dangerous things to transport. A sharp corner or emergency stop can send them tumbling over if they are stood on their base. They cannot be transported on their backs because of the fibre c.r.t. dome and if carried on their fronts the bevelled implosion shield gives a small area of contact with the floor and so makes them liable to slide around. And there is the real danger of scratching the front of the shield.

The answer to this problem is provided by a large sheet of foam plastic not less than 2in. thick. Slim-line sets can then be laid face downward on this sheet where the bevelled front will make an indentation in the foam that will hold the set quite firmly even on sharp corners. The problem does not arise of course with older sets having larger base areas.

Outside service calls

Also required for these outside service calls will be a portable tool kit including the essentials for on-the-spot repairs but omitting the larger and lesser used items. A good multirange meter is a must, but perhaps the most important is a comprehensive stock of valves. The majority of outside service work consists of changing valves; in fact many professional outside engineers will take their kit of valves first into the house while leaving their tools and meter in the van. A range of resistors should be carried, some low-value, high-wattage wirewound types for replacing surge limiters etc., and also a selection of 1W carbon resistors. Some of the more common capacitor values should likewise be included.

One item which will be found invaluable on outside service work is a small mirror with some form of stand so that when placed on a nearby piece of furniture the screen of the receiver can be readily observed while adjustments and repairs are being performed at the back of the set.

Workshop

Now we come to the workshop itself. These vary tremendously in size and layout depending upon the volume of work carried out and the accommodation available. It is almost impossible to suggest an ideal layout as circumstances in each case will be very different. There are various essentials which must however be provided and also several pitfalls to avoid when planning a new workshop. The non-professional who has perhaps been used to building and repairing equipment on the dining room table may feel that a large workshop is unnecessary. As a result he often makes the mistake of choosing a smallish room which later proves to be totally inadequate. If then there is a choice of accommodation, always choose the largest room which may be available.

The first essential in a workshop is, of course, the work benches. Although you may be the only one working at present, provision should be made for at least two working positions. Often it will be found necessary to drop a job in order to attend to a more urgent one. This can be done if there are two positions without clearing the first job off the bench. It may also be that a long or difficult job is being done in between the regular repair work in which case it can be left on the bench and worked on as time permits. The possibility of future expansion and the employing of another engineer should also not be overlooked.

Intermittent faults

Another essential for which space must be found in the workshop is a bench, table or rack on which intermittent sets may be given a soak test. These are always a headache to the engineer and unfortunately are all too common. Sometimes it seems as if they come in batches and there will be several sets with intermittent faults in the workshop at the same time. These have to be run until the fault shows up and after the repair a further run is necessary to make sure that the fault has been definitely cured. It can be appreciated, then, that a special place for the testing of these sets is essential rather than to let them run on the work bench and thereby hinder other more straightforward jobs. Really a rack is the most practical thing for this purpose as two or three sets can then be left running, one above the other, thus taking the minimum of room.

Next, room must be found for an incoming and also outgoing section, that is where sets that are awaiting service and those that have been completed can be stored. If at all possible these should not be adjacent to each other, as it is possible for sets to be found in the wrong section especially during busy periods and even more so if there should be more than one set of a particular model in for repair at the same time. This could mean an unrepaired set being returned to its owner with the expected undesirable consequences. Here again there is a lot to be said for using racks so that two or three times the number of sets can be accommodated on the same floor area.

Inevitably there will be jobs for which no spares are to hand. These must then be put to one side until the necessary parts are available. Thus there will be need of a section for storing sets that are awaiting parts. This need not be in the workshop itself, in fact it would be desirable if it were in a separate room as then there would be less likelihood of damage to cabinets etc. during the waiting period. Sets that are in this section should bear a label with the description of the parts that are awaited so that there will be no confusion or mistakes when the components arrive.

Stores

An important part of any workshop is the stores. Here again there can be considerable variety in size and layout from a single cupboard to a whole room on its own. Whatever form the stores take, however, it is important that they should be neat and tidy. It is essential to know just where the various parts are so that they can be instantly located. Valves can be stored together in the alphabetical and numerical order of their type letters and numbers. Resistors and capacitors are normally supplied on cards or in packets and these can be kept in order in long shallow boxes so that again any particular value can be quickly found. The various service aids manufactured by Radiospares for trade use only will be found particularly useful. They include such items as knob spring clips, nuts and bolts, clips of various sizes, circlips, iron-dust cores and many other items which will almost certainly be needed in the general run of servicing.

Service manuals and technical data on various receivers, such as those published with each issue of Practical Television, will be found to be an invaluable aid to service. In many workshops these are to be found scattered around or dumped in a pile and if reference is required to any particular one it often entails a long and sometimes fruitless search. It should be resolved from the start that service documents should be kept in proper order. As this information comes in many sorts and sizes, as good a method as any is to use a number of large box files. Each one of these can be devoted to a particular manufacturer and the manuals inside can be kept in numerical order. The files themselves can then be stored in alphabetical order on shelves erected at a convenient position for the purpose.

Test equipment

Test equipment will need to be stored when not in use and this is probably best done by the use of cupboards. This will keep them clean and out of danger. Those that are in constant use, however, can be kept on shelves or racks near or behind the work benches. Some larger items such as valve testers will require a small table or stand on their own. This brings us to the question of equipment; that is, which items are essential and which are not.

Test equipment, as the reader will no doubt be aware, is very expensive and so it may not be possible to fully equip the workshop from the very start. As with outside service a good multirange meter is the most important. One should be chosen that has a wide resistance range enabling readings of from one ohm up to at least 20MΩ to be made without difficulty; this will obviate the need for a resistance bridge. Next comes a good signal generator having both coarse and fine attenuation and with a frequency range extending beyond 200Mc/s, and finally an oscilloscope with wide-range Y and X amplifiers and with a calibrated trace. These three are the essentials and the bulk of all service work can be carried out with them; however there are numerous other items which are very useful and which can be added as opportunity affords. These are a signal tracer, transformer tester, transistor tester, and an audio-frequency generator. Last of all comes the wobbulator and the valve tester. These are placed last on the list because first they are expensive items and secondly their function can be performed by other means. Alignment can be carried out with the signal generator and output meter and the best test of a valve is to plug in a substitute. These items, however, do have their place and can be added at a future time.

The main thing to consider with all test equipment is that it should be completely reliable and its accuracy should be above reproach. Home-made gear should only be used if it fulfils this qualification.

Having got the layout of the workshop fixed and the essential items of equipment installed the next thing is to lay on the essential services for the work benches. These consist of mains outlets and aerial sockets. In most areas there will be found a wide variety of mains sockets in general use. The customer's plug can, of course, be removed and refitted after the repair but this is a time-wasting procedure. It is better to have a distribution board for each bench that consists of all the sockets that are likely to be encountered in the area. These boards can be mounted at a position convenient to each bench (not forgetting the test rack) but in general it will be found that a position beneath the bench, perhaps fitted to one of the bench legs, is better than mounting it at the back of the bench. In this way there will be no mains leads trailing over the bench and no likelihood of cabinets being damaged by being pushed forward against the mains sockets.

Some districts have a number of different mains voltages in use. This means that each receiver must be examined to determine to which mains voltage it is set and then this adjustment altered to that supplying the workshop; then after the repair the setting must be altered back again. This is time wasting and there is always the possibility that the set will be sent out without the mains voltage setting being put back to its original position. The answer to this one is to fit an auto-transformer to each bench and connect it so that it supplies the distribution board. The adjustments of the tappings on the transformer can be mounted in an accessible position so that the mains input of each bench can be adjusted to suit the incoming receiver. Thus each set will be operating on the same setting that it is in the client's home, a practice which has much to commend it for numerous reasons other than convenience in the workshop.

The other service which needs to be installed is an aerial distribution system. At least four outlet sockets will be required even in the smallest workshop, one on each bench working position and two on the test rack. These must be capable of providing a good signal over the channels normally received in the area. Furthermore they must be mutually independent so that when a set is plugged in to any one socket it has no effect on any set that may be connected to one of the others, hence the sockets cannot be merely looped together. In order to effectively isolate each socket a large degree of attenuation will be necessary. This means that a distribution amplifier will be necessary even though a good signal may be received from the workshop aerial. A suitable amplifier can be built up and details have appeared in previous issues of PRACTICAL TELEVISION. As with other forms of workshop equipment, reliability and unimpeachable performance are essential.

Keeping records

Finally we will consider what records and paper work are necessary in setting up a new service department. A permanent record needs to be made of each job carried out in the workshop together with some quick means of referring to the information. Record systems can be quite complicated or they can be simple; generally the simpler the method the better, providing sufficient information is retained.

A progress book should be kept in which all sets entering the workshop are entered. Here they are assigned a job number which identifies them while in progress through the workshop and also provides a means of referring to the job subsequently. Usually these numbers are consecutive, each being the next number to the previous one appearing in the book. Another suggestion which can be used is to embody the month and the year in the job number. At the beginning of each month the numbers return to one and then follow consecutively until the end of the month. The number would be written like the date, only the job number taking the place of the day and the intervening hyphens being omitted. This has an advantage of enabling the approximate date of the job to be ascertained at any future time by simple reference to the job number. Furthermore, the number of jobs received in any month can be quickly determined by looking at the last job number for that month.

The progress book should record the date of entry into the workshop and also the date it was returned to the customer. A further column in which could be inscribed a *C* or a *D* would denote whether the receiver was delivered or collected by the owner. A brief description of the owner's complaint would also be useful for future reference. The job number should then be permanently fixed to the set so that it can be identified in the future as well as during its present stay in the workshop. A small strip of p.v.c. tape on the back of the set or on the chassis should suffice for this purpose. A copy of the customer's invoice detailing work carried out, components fitted and of course the charge made could be kept and filed. If carbon paper is used for the copy, further time can be saved. Alternatively, details can be entered briefly in the progress book so that all information required is in the one place. For accounting and taxation purposes a separate record must be kept of all amounts received and expenditure incurred.

It is also necessary to have some record of the movement of spares and components to prevent being out of stock of essential parts and also to provide information for chasing parts ordered from the makers or wholesalers and not received (unfortunately a common occurrence). Such information can be provided quite easily by using a book in which a note is made of parts that are running low in stock. In parallel columns then can be entered the date the parts were ordered, the quantity and the supplier with which the order was placed. In the final column appears the date when the items were received.

It can be seen then that there are many things to consider before taking the step of turning professional. If the advice given in these articles is followed and the step is successfully taken the result will be an interesting and satisfying career in which there is always something new even though it may not always be as financially rewarding as may first appear. ■

VIDEO TAPE RECORDING

—*continued from page 228*

frequency selective feedback. It will be noted that there is yet another control here, to set the video recording current. (The lower control is used to tap off a monitor signal and need not concern us at the moment, although it will be seen to be quite important later.)

Saturation-current recording is employed, as already mentioned, and the setting of the video recording current can be made for best practical conditions, again without the need of elaborate instruments although ideally we require a scope with fast rise time and a timebase set at 3mS/cm to read the maximum feed to the head. With sync at 50c/s we should get a form something like Fig. 18b, reading 2·2V peak-to-peak with an off-air picture. In practice we can record a test card, plugging-in the microphone and noting each stage of progressive adjustment audibly, "one . . . two . . . three . . . etc." and setting the control from fully anticlockwise to fully clockwise in gradual steps. Then, having again made our little diagram of the angular movement of the control, all we have to do is play back the portion of tape and note the quality of the recorded picture. The point at which the recording is at a maximum will be quite evident.

There is more to video recording than this, however; we have yet to consider the monitoring, synchronising, and the vitally important noise-cancellation circuits. But although by describing the record section we are to some extent running before we walk its compact form and fairly simple circuitry make it a good introduction to the playback and servo circuits. Next month we will go on to consider what happens to the replayed signal before it comes out as a video waveform once again.

to be continued

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

QUITE suddenly we have had a very sharp change in the pattern of the past few months. Sporadic E has practically gone for the winter, although there should be some short duration activity from time to time. The real news, however, is that the "Trops." have opened up at last and this month's log will be mostly on this subject.

The openings were much later than usual, and are, of course, those we have been waiting for since September. It was worth the long wait for they were very good openings indeed, and although they could have stayed longer, at least it was encouraging and we can only hope that they will continue despite many days when DX has once again been "sub-normal".

Firstly, the Sporadic E (what there was of it) for the period 18/11/67 to 14/12/67. Just three days only and that was that!

30/11/67: R1 USSR and E2a Austria.
1/12/67: R1 USSR.
14/12/67: R1 USSR.

Tropospheric Openings: The first signs were on 18/11/67, but I missed it on 19/11/67, while away with Roger Bunney in Cheltenham visiting David Maden discussing F2 possibilities. The next four days were excellent, however.

20/11/67: W. Germany: Ch. 22 Wuppertal, Ch. 24 Lingen, Ch. 26 Bonn. Holland: Ch. 27 Lopik, Ch. 31 Roermond, Ch. 32 Goes, and Ch. 39 Wieringemeer. Plus the usual French u.h.f.

21/11/67: W. Germany: Ch. 21 Monschau, Ch. 40 Hamburg, Ch. 42 Bremen. Holland: Ch. 27 Lopik, Ch. 31 Roermond, and Ch. 32 Goes. Plus the usual French.

22/11/67: W. Germany: Ch. 21 Monschau, Ch. 22 Wuppertal, Ch. 23 Dortmund, Ch. 28 Boppard, Ch. 26 Dusseldorf, Ch. 40 Hamburg. Holland: Ch. 27 Lopik, Ch. 31 Roermond, and Ch. 32 Goes, and the usual French, plus Ch. 22 Paris, and Ch. 28 Clermont-Ferrand.

23/11/67: W. Germany: Ch. 21 Monschau, Ch. 22 Wuppertal, Ch. 28 Boppard, Ch. 29 Dusseldorf, Ch. 31 Koblentz, Ch. 32 Bremen. Holland: Ch. 27 Lopik, Ch. 29 Goes, Ch. 31 Roermond, and Ch. 32 Goes.

24/11/67: Holland: Ch. 27 Lopik, the only one apart from France.

I must confess that u.h.f. reception other than ORTF2 is such an "event" in my area, I concentrated almost exclusively on this, but did note Holland E6 Smilde, and E4 Lopik, and Belgium E8 Waver, and E2 Ruiselede at good strength on 21/11/67.

There were further more localised openings on 2, 3, and 4/12/67, then the snow came and that was that!

NEWS

(1) The big news this month must be the report of Colour DX/TV from J Shipway of New Addington, Surrey. He calls his achievement "CDX/TV", we think that it makes nice reading.

During the u.h.f. DX opening he had Ch. 29 Goes, Ch. 27 Lopik with colour slides and films, together with Ch. 22 Aachen, W. Germany with colour tests, films, and even advertisements in colour! The receiver used was a Philips type 21KX102a. Apart from colour he logged an East German on Ch. 34/35; this must be a new one not as yet in the official lists.

We are delighted to read of this first CDX/TV success, and offer our congratulations and good luck with future efforts.

(2) The French second chain u.h.f. are now using a new colour Test Card with general appearance similar to the original one but with flowers in the centre square. They also have a "pin-up" girl in a wide hat for one of the slides!

(3) During the recent u.h.f./DX opening I have had a lot of inquiries for the N.T.S. Holland station on Ch. 29. This is the first programme relay at Goes, the second programme is carried by Goes Ch. 32. (Just for the record Goes is pronounced "Goose"!)

(4) Albania Tirana R2 has increased its power from 20 watts to 50 watts, this will not make much difference but it is moving the right way, and you never know!

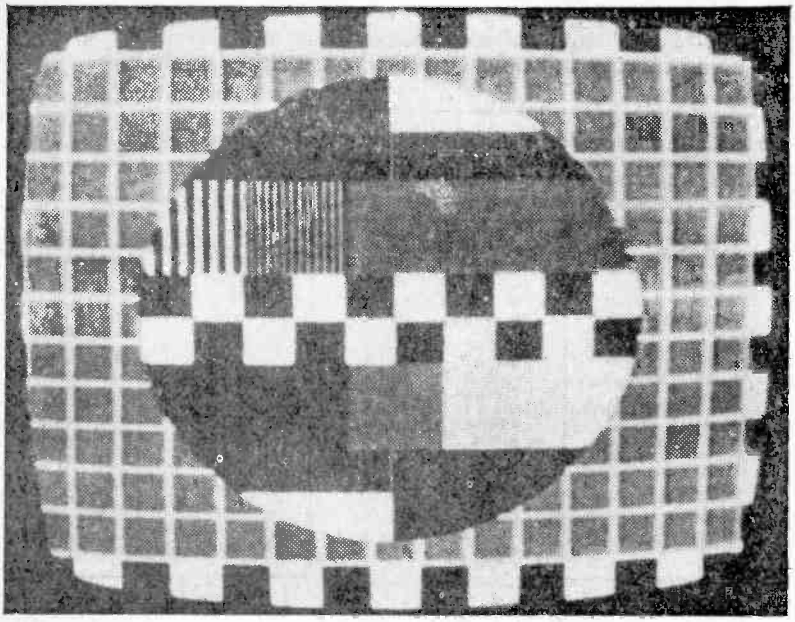
(5) There seems to be a mystery developing in Yugoslavia as I now understand that certain transmitters (the exact ones not specified) are using a "different channel system" (also not specified). So you have been warned if you get J.R.T. stations at curious tuner settings!

READERS' REPORTS

The measure of the recent Trop. opening can be gauged by D. Kelly's report of his reception in Castlewellan, N.I., of F8a Lille on a single dipole cut to 144Mc/s; he is now considering putting up a proper Band III array!

C. R. Dykes of Bexleyheath is back again with Paging stations KRY508 New Orlando 35·2Mc/s,

DATA PANEL-24 N.T.S. HOLLAND U.H.F. SERVICE



Test Card: Electronic type as photograph. As used by Lopik Ch. 27 as an alternative to Test Card as per Data Panel 12.

Photo: C. N. Rafarel, as received in Bournemouth on 22/11/67, this is what u.h.f./DX was like recently.

and KIS 551 E. Lauderdale 35·5Mc/s in the USA, both good omens for F2 DX/TV. The Trops. were open for him with E2 Ruiselede, E4 Lopik, F12 Cherbourg, and F12 Le Mans, so even the h.f. end of Band III was good.

Our old friend G. J. Deaves of Hitchin did very well with France. Chs. 21, 22, 23, 24, 25, 26, 27, 29, 33, 34 and 43. W. Germany, Chs. 21, 22, 24, 26, 29, 32 and 35, plus Holland, Chs. 27, 29, 31 and 32, and Band III APART FROM France and Belgium produced E4 Lopik, and E7 Goes.

These are the first reports of this excellent period, and we now patiently await the next time. Just a final comment on all this: the behaviour of the signals was vaguely reminiscent of Sporadic E in so far as the signals were subject to "selective" fading (rapid at times) during which a station could fade and be replaced by another on the same channel, the direction of reception also frequently varied.

Book Review

THIS IS TELEVISION
By Ralph Steadman. Published by Frederick Muller Ltd. 64 pages. Size 9¾ x 7in. Price 15s.

THIS is the third edition of this book. The introduction claims that the book is written for the youngster, and indeed much of the text is angled in that direction. Yet certain things, such as a section on Writing for Television, are surely intended for an older reader.

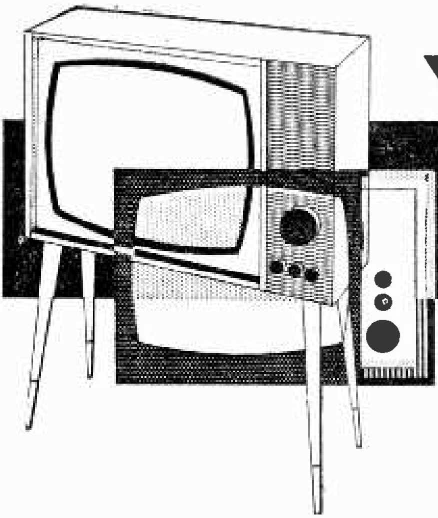
The text takes us through the technicalities of television from the transmitter, the various technical departments and the receiver. It is written in non-technical style and to that extent succeeds in providing a bare outline of what happens—a difficult task.

Main criticisms are that, although this is claimed to have been completely revised, the author mentions only the 405-line system and does not even acknowledge that 625 u.h.f. TV is here. In fact he specifically states that only Bands I and III have been allocated to TV. A lot of the equipment shown (in artist's sketch style) seems to be rather outmoded, too. Also the only mention of colour is that "it is now an accepted fact".

Odd bits of carelessness creep in. For example in the section on The Studio Apparatus Room there is a sketch of an oscilloscope and a blow-up of the waveform being displayed. There is no caption to these sketches, nor any reference to the equipment in the text. And while the waveform is labelled "Black Level" and "Synch. Pulse" correctly, the high spots are notated as "PEAR WHITE"—twice!

There is also a lot of white space, which could profitably have been used for more text. The list of TV terms also has a few odd ones: Kennelly-Heaviside Layer gets a mention (though, naturally, nothing could be found about it in the text) but we were pleased to learn that a Viewer is a person watching television!

A bit hit-and-miss about sums it up, although there is nevertheless a good deal of interesting information and it could well be a useful introduction to the very young reader.—*DC.*



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 237 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

PETO-SCOTT 1726

The picture comes and goes from black-out to normal brilliance, accompanied by columns of white lines. When the picture fully appears, the lines seem to stop momentarily.

I have tested by substitution the line and field oscillator and output valves, efficiency diode, tuner valves and all the valves in the vision strip.

The boost voltage is 600V on a VTVM, although this voltage seems to fluctuate slightly.

This fault seems to have developed over a course of time, because when it first appeared, a slight tap on the side of the cabinet cured it. This type of cure only lasted a short time.—G. Vandrey (Maidenhead, Berkshire).

We would advise you to try the effect of sliding out the sleeve on the tube neck from under the line deflection coils. These line coils are probably shorting to this sleeve.

COSSOR CT1972A

Would you please inform me of the type of metal rectifier and its position in this receiver.—J. Morgan (Chepstow, Monmouthshire).

The h.t. rectifier is a BY100. It is between the mains dropper and the main electrolytic capacitor across it—i.e., it is not on the panels.

PYE SP17LB

The fault is on the sound side only, and is that the volume does not come up to full power until up to half an hour after the set has been switched on. Then the sound does not come up gradually, but appears to click on as though after some certain component has warmed up.—M. Jordan (Great Yarmouth, Norfolk).

The usual cause of your trouble is a defective PCL83 sound output valve. This is normally either just behind the volume control or adjacent to the turret tuner, depending upon which printed circuit is used in your receiver.

HMV 2620

When switching to BBC-2, the picture is very good but after about 10 minutes it starts to deteriorate with the snowstorm effect until after about half an hour the picture is lost completely.—R. Hawkins (Romford, Essex).

The trouble is apparently associated with the u.h.f. tuner unit. Check the PC88 by replacement.

ENGLISH ELECTRIC C42

I get good quality and volume on BBC-1 but the sound on ITV is very low. All the valves seem to be in order and picture quality is excellent.—F. Walton (Blackpool, Lancashire).

We would suggest you check the PCC84 valve on the tuner, trim the top studs (near the PCC84) and realign the i.f. coil cores (left-hand sound coils only).

ULTRA V2171

After about 30 minutes, the left-hand side of the picture reduces by 3in. at the top and 1in. at the right-hand side.

After approximately three hours' viewing the picture turns grey and starts to break up giving the impression of a poor signal but this is not so, as the signal is fed in by Rediffusion to the Channel 2 frequency and the same fault develops if I use my own aerial.

I replaced the U26 valve and the quality of the picture improved but broke up completely after about half an hour and I had to revert to the old valve.—J. Watson (Co. Durham).

It would appear that the h.t. voltage falls and we would suggest that you check this. Change the rectifier if necessary. This is at present a flat contact-cooled type.

Also, if necessary, check the line output and efficiency diode valves.

ULTRA 1984C

When on the correct channel, 10, for ITV, the picture gave the impression that a bad aerial was being used. Knowing that the aerial was a good one, I turned to Channel 9. After tuning, I received a good ITV picture. Two months later, Channel 9 went the same as Channel 10. I then replaced the Fireball tuner with the result that Channel 10 gave good ITV reception. Then, after a month or two, the same thing happened all over again. I am now using Channel 9 for the ITV reception.

All the switch contacts on the tuner are clean.—J. Scott (Glasgow, N.W.).

It is incredible that both tuners should exhibit identical faults. We feel that there may well be something wrong with your ITV aerial system. Make sure this is on direction for the best ITV channel, that the connections are good at both ends of the feeder and that the diplexer (if used) is correctly and efficiently wired.

GEC 2019

The contrast quality of the picture is very poor and the contrast control has no effect whatsoever on BBC-1 and ITV but seems to work on BBC-2. The resistance reading of this control is correct.—J. Smith (South Shields).

The symptom mentioned is caused either by trouble in the v.h.f. aerial system, giving a weak aerial signal, or by a fault in the v.h.f. tuner. There must be a certain minimum level of aerial signal for the contrast control to work correctly. Without this, the picture would be under-contrast with very little change over the full range of the contrast control. We would suggest that first you check the aerial system.

EKCO 344F

I am in the process of renewing a number of resistors and capacitors and would like to renew a diode marked Q3/4 which has a yellow and red band around it.

The picture on this set tends to turn over and I am hoping that this component is the culprit. I have however, not yet found a supply of these Q3/4 diodes.

Also after the set has been on for about 30 minutes, the fuse blows.—A. Astell (Broomhill, Bristol 4).

The Q3/4 is the field sync shaper. An OA79 can be used in this position.

With regard to the fuse failure, note whether an arc occurs in the PY32 rectifier when the fuse fails. Replace the PY32 if necessary.

Check the 0·1μF capacitor across the on/off switch (noting a.c. voltage rating) by disconnecting.

STELLA ST2149A

The fault is that the left-hand side of the screen is more brilliantly lit than the right-hand side.—W. Shanklin (Manchester 11).

Check the 56kpF capacitors (0·05μF 500V wkg) decoupling pin 3 of the cathode ray tube.

FERGUSON 3639

Within minutes of being switched on, on ITV, the picture distorts from left to right. The line hold adjustment clears it, but after about half an hour has elapsed I run out of adjustment movement. BBC lasts much longer—about 2 hours.—G. Phaury (Newcastle upon Tyne).

You should check the 6/30L2 line oscillator valve on the front right centre, by replacement. Check associated components if necessary.

It may also be necessary to replace the discriminator diodes (2 in small black square).

MURPHY V250C

I cannot obtain a picture on BBC-1 or ITV. The sound is very good. Upon looking inside the receiver I found that the PY81 and the valve next to it (no type number is visible) go all blue inside when the set is switched on.—M. Gibson (Congleton, Cheshire).

The valve situated next to the PY81 is a 20P4. It is quite normal for this valve to glow blue during operation and does not appear to have any bearing on your fault. Your trouble could be anywhere in the vision i.f. strip or video amplifier stages, which run in a line from front to back of the set beginning at the inside tuner corner, and ending to the right of the aerial panel.

Normally a signal generator applied to various points should enable you to isolate your faulty stage quickly.

PYE CTM17

When the contrast control is turned up, the picture seems to take on a "varnished" look and goes dull.

Could this be due to the tube losing emission? Also, what purpose does the PL83 valve serve in the line amplifier?—J. Hyde (Lanarkshire, Scotland).

The PL83 at the back of the receiver is the field output valve. On some models there is also another PL83 in mid-chassis and this is the video amplifier.

Your symptoms could be a defective cathode ray tube especially if brightness causes the same trouble. If only contrast effects the picture, however, we advise you to suspect trouble in the video amplifier. This normally is the PCF80 second valve back from the volume control.

PYE VT7CDL

Although this receiver is 13 years old, and still gives a fairly good picture, it has developed shadows across the screen from right to left.—N. McFarlane (Gorebridge, Midlothian).

Your trouble could be due to a failing cathode ray tube or to a fault in the line output stage. In this latter connection, there is a 25μF electrolytic capacitor clipped to the front underside slope of the chassis which decouples the 47kΩ cathode resistor of the PL81. If this electrolytic becomes faulty, it can produce the symptoms you describe.

PYE VT17CDL

The horizontal hold on this receiver became progressively worse until the stage was reached where it was impossible to hold and lock the field.

Through the process of interchanging valves, I inadvertently mixed a PCF80 with an ECC82 white spot supressor—i.e. put the ECC82 in place of the PCF80 sync sep. amplifier valve.

Smoke issued forth from the set and I found that the 4·7kΩ ½W resistor in circuit with the 200μF electrolytic capacitor had turned black. I subsequently changed this with a 4·7kΩ resistor but not of the ½W value. Consequently, the picture now has a three image (side-by-side) condition indicating, I think, too fast synchronisation.

The picture also has a dark band top and bottom, similar to a low input voltage condition. Sound and contrast remain good but the vertical hold is rather sensitive and requires adjustment more frequently than before.—F. Watts (Carmarthen, Wales).

We advise you to double check the PCF80 line oscillator stage and also the three small diodes in the adjacent circuitry. If these appear to be in order, we advise you to suspect low h.t. due to a faulty metal rectifier, or mains smoothing capacitor.

STELLA 8917U

The horizontal line hold has become very critical and there is great difficulty in locking the picture.

The brilliance control and the contrast control, also the picture interference limiter control, upset the picture if they are moved slightly.

I have replaced the ECL80 valve and substituted the PL36 valve and have replaced several resistances which varied slightly from their original value, but I have not cured the fault.—J. Heyes (Stalybridge, Cheshire).

There are two electrolytic capacitors in the video circuit, one is a 100μF (cathode bypass capacitor) the other is a 10μF (h.t. screen decoupler). Check both of these.

If necessary, also check the ECL80 pin 6 and 8 components.

QUERIES COUPON

This coupon is available until FEBRUARY 23rd, 1968 and must accompany all Queries sent in accordance with the notice on page 235.

PRACTICAL TELEVISION, FEBRUARY, 1968

TEST CASE -63

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

A Pye 510 suffered badly from field non-linearity with particularly bad cramping at the bottom of the picture. The height, too, was down a little, although this could be corrected (with the bottom cramping) by turning up the height control almost to full. The poor linearity could not be corrected by adjustment to the vertical linearity presets.

As this is a symptom typical of a low-emission field amplifier valve, the valve was first checked for emission and, although a little down, a replacement failed to have any effect. All voltages were up to the values given in the manual, and tests with an oscilloscope showed that the drive waveform to the amplifier control grid was of correct amplitude even with the height control turned towards the centre of its range.

The trouble was thus proved to lie somewhere in the amplifier, but tests of capacitors, valves, voltages and ordinary resistors gave no clues at all. There was one item, however, that was overlooked. Which was this? See next month's PRACTICAL TELEVISION *for the answer and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 62

Page 188 (last month)

The symptom was aggravated by a weak aerial signal, which was indicated by the slight picture grain. Normally, of course, the picture should lock solid from a signal not any lower than to cause slight picture grain. So there was a fault in the set, masked by the stronger signal at the friend's house.

This was eventually demonstrated by connecting a 12dB attenuator in series with the higher signal (at the friend's house). On the weakened signal various tests were made in the sync separator stage, but to no avail. Attention was then turned to the video amplifier valve, and although the valve itself was well up in emission, it was noticed that the screen grid volts were some 50V down. The screen grid is fed through a resistor from the h.t. line, and the trouble was soon located to an increase in value of this resistor.

Replacement cleared the trouble completely and allowed the set to be operated with adequate timebase locks on signals even weaker than those applied to the set.

Published on or about the 22nd of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2, at the recommended maximum price shown on the cover. Printed in England by WATMOUGHS LIMITED, Idle, Bradford; and London. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia) LTD. Subscription rate including postage for one year: To any part of the World, £1.15.0d.

(continued on next page)

SERVICE SHEETS *(continued)*

TRADER SERVICE SHEETS

4/- each plus postage

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

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

OAKFIELD ENTERPRISES
LIMITED

30 Craven Street
Strand
London WC2

s.a.e. with enquiries please.

Make	*Model*	*Radio/TV*

1968 List available at 2/- plus postage

If list is required indicate with X

From ....

Address ....

....

....

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

MAIL ORDER ONLY (Feb P.T.)

SETS & COMPONENTS

150 NEW ASSORTED Capacitors, Resistors, Silvered Mica, Ceramic, etc. Carbon, Hystab, Vitreous, ½-20 watt, 12/6. Post Free. WHITSAM ELECTRICAL, 18 Woodrow Close, Perivale, Middlesex.

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

RESISTORS: ½ watt carbon film 5%. All preferred values in stock from 10 ohms to 10 megohms 2d. each. Send S.A.E. for free sample. CAPACITORS: Mullard Miniature Metallised Polyester PC Mounting all 250V D.C. working, 0·01mF 0·022mF, 0·047 mF, 0·1mF, 0·22mF, all at 6d. each. Hunts tubular 0·01mF, 200V working at 3d. each. Send 6d. stamp for extensive list of low priced Electronic Components, Instruments and Equipment. Please include 1/- Postage & Packing on all orders under £1. Dept. P.T.1. BRENSAL ELECTRONICS LIMITED Charles Street, Bristol 1.

EX N.E.V. C.C.T.V. Camera and Monitor Circuits. S.A.E. for list. LOWE, 62 Brownswood Road, London, N.4.

OLYMPIC II TV, S.A.E. for itemised price list. AJAX ELECTRONICS, 18a Rumbold Road, Fulham, S.W.6.

STOP

FULLY GUARANTEED L.O.P.T. REWINDING SERVICE

A few of the types are listed below:—
BUSH TV 53-66.
K.B.P.V.P.20, etc.
PHILIPS 1768U, 17TG100U, etc. **All at 50/-**

NEW FROM STOCK

U25 Type EKCO, slate model. PYE 200-400.
FERGUSON 306-308 305-307 **All at 45/-**
FERGUSON 406, 408, 416, 436, 438
S.A.E. Enquiries *P. & P. 4/-, C.O.D. 6/-*

WITWORTH TRANSFORMERS Ltd.

26 All Saints Road, North Kensington W.11 *Telephone:* 01-229-9071

SETS & COMPONENTS *(continued)*

PHILIPS 625 UHF Conversion Kits, two complete IF and timebase panels, Escutcheon Kit and knobs. 22/6 each, post paid. BARTLETT'S, 38 Clifton Road, Greenford, Middx.

THIS MONTH'S SCOOP!

NEW **BRIMAR C17AF** BOXED
17 110°, 0·3A Short neck
Can replace AW43-88, CME1705 etc.
£3-19-6
Carriage & Insurance 12/6
TELEVISION TUBE SHOP
48 BATTERSEA BRIDGE ROAD, SW11

BARGAIN PARCELS

Any 10 Valves 14/-. Any 100, £6.

PCF80, PCC84 PL36, PL81, PY82, PY800, PY81, PY32, PCL82, PCL83, PCL84, ECL80, ECC82, EB91 EY86, EFB80, EF80, EF85, EF184, 30PL13, 30PL14, 30P4, 30F5, 30FL1, 10F1, 20F1, 6-30L2, U191. P & P. 1/-

ALL VALVES SET TESTED.

3-BY100 Type Rectifiers with Surge Resistors, 10/-

VELCO ELECTRONICS

49 Bridge St., Ramsbottom, via Bury, Lancs.

R & R RADIO

51 Burnley Road, Rawtenstall
Rossendale, Lancs.

Telephone Rossendale 3152

Valves Boxed, Tested and Guaranteed

EBF80	3/-	PCC84	3/-	PY82	3/-
EBF89	3/6	PCF80	3/-	U191	4/6
ECC82	3/-	PCF82	3/6	U301	4/6
ECL80	3/-	PCL82	4/-	6F23	5/-
EF80	1/6	PCL83	4/-	10P14	3/-
EF85	3/-	PCL84	5/-	20P5	3/-
EF183	3/6	PL36	5/-	30F5	2/6
EF184	3/6	PL81	4/-	30L15	5/-
EY86	4/-	PL83	4/-	30P12	4/6
EL41	5/-	PY33	5/-	30C15	5/-
EZ40	4/6	PY81	3/6	30PL13	5/6
EBC41	4/6	PY800	3/6	30PL14	5/6

POST: One valve 9d. Two to Six 6d. Over six post paid

BRAND NEW TELEVISION TUBES — 2 YEAR GUARANTEE!

(CATHODEON AND OTHER LEADING MANUFACTURERS)

We hold large stocks of top quality tubes, why buy ordinary rebuilds? Some rebuilds available, 19in. upwards at 21/- off quoted prices, 12 months warranty. Rimbands, etc. available. Lists. Rimband types, 19in. £8.10.0; 23in. £11.0.0.

CRM121, 2, 3 & 4; MW31-16, MW31-74; C12FM; 121K, C12/1, etc	£3	0	0
AW36-80; MW36-24, 36-44; CRM143, 4; CME1402; C14BM; C14FM, MW41/1, etc.	£4	10	0
CRM141, 2; CRM151, 2, 3; 15EP4 etc. C17BM, SE14/70, AW36-20, 36-21	£4	15	0
AW43-80, 43-88, 43-89; MW43-64, 43-69; MW43-80; CRM171, 2, 3, 4; C17FM; CME1703, 5; C17AF; C17SM	£5	15	6
AW47-90; AW47-91; CME1902; CME1903, etc	£6	17	6
C19AH; CME1901; AW53-88, 9; CME2101, 4; AW53-80; MW53-20; MW53-80; CRM211, 2, etc.	£7	10	0

19in. Twin Panels A47-13W; CME1906, £9.17.6 (Carriage 20/-)

23in. Twin Panels A59-13W, CME2306 .... £12 10 0 (Carriage 30/-)

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

SOME OLD TUBES WANTED, 17" UPWARDS

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

CLOSED Thursday & Saturday afternoons

LISTS BRITISH VALVES!

SETS & COMPONENTS
(continued)

TELEVISION TUBE SHOP

THE

NEW TUBE Specialists

A47-13W	£12.10.0
A59-13W	£15.10.0
AW36-20, 21	£5.12.6
AW36-80	£5. 7.6
AW43-80	£6. 7.6
AW43-88, 43-89	£6.12.6
AW47-90, 91	£7.10.0
AW53-80	£7.12.6
AW53-88, 53-89	£7.17.6
AW59-90, 59-91	£9.10.0
C14BM, FM	£5.15.0
C17BM, FM, HM	£6. 7.6
C17LM, PM, SM	£6.12.6
C21HM, SM, TM	£7.17.6
CME1402	£5.17.6
CME1702, 1703	£6.12.6
CME1705	£7. 7.0
CME1901, 1903	£7.10.0
CME2101, 2104	£7.17.0
CME2306	£15.10.0
CRM93	£5.10.0
CRM124	£5.10.0
CRM141, 2, 3, 4	£5.17.6
CRM152	£5.10.0
CRM153	£3.19.6
CRM171, 2, 3 *	£6. 7.6
CRM211, 212	£8.17.6
MW31-16, 74	£5.10.0
MW36-24, 44	£5. 2.6
MW43-64, 69	£6. 7.6
MW43-80	£6. 7.6
MW53-20 *	£8.17.6
MW53-80 *	£8.17.6
14KP4A, 141K	£5.12.6
171K, 172K, 173K	£6. 7.6
7201A, 7203A	£5.12.6
7204A	£5.10.0
7401A	£6. 7.6
7405A	£6.12.6

Manufacturers' Reprocessed Tubes available at £1 each less than the above prices.

All tubes tested before despatch and guaranteed for 12 months.

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

* Reprocessed tubes only of this type at present.

Midland Stockists:—
Amateur Electronics Co.,
240 Lichfield Road, Aston,
Birmingham.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD LONDON S.W.11. BAT 6859
JUST SOUTH OF THE BRIDGE
OPEN SATURDAY UNTIL 4 p.m.

SETS & COMPONENTS
(continued)

VALVE BARGAINS

Any 10 for 12/-; any 20 £1. 30PL13, 30PL14, 30FL1, PCF80, PCC84, PCL82, PL81, PL36, PY81, PY800, EF80, EF85, ECL80, EB91, ECC82. Valves tested. P. & P. 1/-.

S. ASHWORTH, 9 Manderville Terr., Hawksham, Via Bury, Lancs.

BOB'S BETTER BARGAINS. Any 10 valves 14/6 post paid. Refunded in full if not satisfactory. PCF80 PCC84, PL81, PY81 PL36, PCL83, EF80, U191, EY86, U301, 30F5, EF85, PY32, PY82, EB91, 30PL1, 30FL1, 30P4, ECL80. T.V. legs, set of four with plates 5/-, post 3/6. Mail Order only. GREEN, 2 St. James Street, Rawtenstall, Rossendale, Lancs.

TV SPARES, all makes all sets. SAE/ Quote. EKCO/Ferr. Plastic Housing 15/- each. Car/House Alarm Kits 25/- each. Transistor Car Radios with fittings kit £8.10 stnd. Push button £11.10 comp. Band Radar Detectors for car £13.10 comp. 8 x 80 Binoculars in hide case £7.10; 10/50 £10. Please add P.P. 5/-. Open Sats. All new goods. KING'S, 8 Cray Parade, Main Road, St. Paul's Cray, Kent. Tel: ORPINGTON 30566.

TOWERBY LTD.

For Line Outputs and Deflector Coils

WE have the Country's largest stock of Manufacturers' Original (or Authorised Replacement) Line Output Transformers for many "difficult" makes, including **Ambassador, Baird, Cossor, Ekco, G.E.C., H.M.V., KB, Masteradio, Peto-Scott, Philips, Regentone, RGD, Sobell, Ultra,** etc. Also deflector coils output and oscillator transformers, in. **Alba, Bush, Murphy.** Examples, L.O.P.T. **Murphy** 310/350/410/540/659/759 **95/-; Bush** TV53 **79/6**; 80, **95/-; Cossor** 950 **77/6; Ferguson** 306/308 **79/6; KB** RV20 SV30 PV70 **82/6; Philips** 1768U L.O.P.T. assembly **112/6; Ultra** 1984-200c **87/6.**

SPECIAL OFFER

Ekco improved type for Models T221, 231, 310 all at **37/6. Ferranti** 14T4 series inserts **25/-; Philco** 1019/1021 **52/6; Pye VT4 VT7** ex-equipment **42/6.**
Terms: C.W.O. or C.O.D. (3/6) post/packing 5/-. 2 or more L.O.P.T.s post/packing free.
All enquiries answered but regret no lists available. Same day delivery on most types.

TOWERBY LTD.

MAIL ORDER DIVISION OF T.C.S. LTD.
28 BROCKLEY CROSS, LONDON SE4
Tel: TIDeway 5394

FOR SALE

FOR SALE

RADAR VIDEO & SYNC GENERATOR as new by WAVEFORMS of LONDON, cost £48, accept £20, o.n.o.
21" Mullard MW/53/20 CRT new boxed £4 unused.
21" Mazda CRM 212 CRT new boxed £4 unused.
100yds. Aerialite 75 ohm double/screened low loss co-axial cable O/D⅜ £5.
Aerial Mast ex U.S.A. type 45ft. in 5ft. sleeved sections 2¼" dia. Dural with 2 sets 4 guys with dural ground pegs complete in case £5. new.
apply **GORDON 44 Queensway House, Queensway, Hatfield, Herts**

FOR SALE
(continued)

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

RECTIFIERS

SILICON TV 6/- or complete with instr., resistor condenser 7/6.

Rectifiers—Contact Cooled

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

Rectifiers—Fin Types

Equivs. for RM4 9/6; RM5 17/6; 14A97 13/6; 14A86 10/6; EK2 17/6; EK6 17/6; 14A949 19/-; LW15 19/-; LW7 19/-; 14A100 19/-; 14A989 10/-; FW12V-1A 5/-; 2A 7/-; 4A 10/6.

MULTIMETERS from 32/-

Stamped envelope for full latest selection and bargain offers in cheap meters. Radios. Baby Alarms. Inter-coms and Walkie-Talkies.

Line O.P. Trans; all 30/- each

Murphy V350 and V230 Cossor 948. Philips 1446U/45 and 1746U/45 with EY51.
Under £1 P. & P. 6d. Over £1 Post free. NO C.O.D.

DURHAM SUPPLIES

175 DURHAM ROAD, BRADFORD 8, YORKS.

PADGETTS RADIO STORE

OLD TOWN HALL, LIVERSEDGE, YORKS.
Telephone: Cleckheaton 2866

Speakers Removed from TV Sets. All 3 ohm PM and perfect 6 x 4in. and 6in. round 3/-, post 2/9. Six for 22/-, post paid. 7 x 4in. 5/-, post 2/9. Six for 34/-, post paid. 8in. round 6/6, post 3/6.

New 12in. Speakers with Built-in Tweeter, 28/6, post paid. 3 or 15 ohm Coil.

VALVE LIST

Ex Equipment. 3 months' guarantee

10F1, EF80, EB91, ECL80, EF50, PY82, PZ30, 20P3. All at 10/- per doz. Post paid. Single valves post 7d.

ARP12	1/6	PCL82	4/-	10C2	5/-
EB91	9d.	PCL83	5/-	10P13	2/6
EBF80	3/-	PL36	5/-	185BT	8/6
ECC81	3/-	PL81	4/-	20D1	3/-
ECC82	3/-	PY33	5/-	20L1	5/-
ECC83	4/-	PY81	1/6	20P1	5/-
ECL80	1/6	PY82	1/6	20P3	2/6
EF50	1/-	PZ30	5/-	5U4G	4/-
EF80	1/6	U25	5/-	6B8	1/8
EF91	9d.	U191	5/-	6K7	1/9
EL36	5/-	U281	5/-	6K25	5/-
EY51	2/6	U282	5/-	6P25	5/-
EY86	5/-	U301	5/-	6U4	5/-
KT36	5/-	U329	5/-	6V6	1/9
PCC84	2/-	U251	5/-	6P28	5/-
PCF30	2/-	U801	8/6		

EF50, 10/- doz. Post Paid.

Indicator C.R.T. Type 7921. Complete with 5in. Tube Type 2292. Front marked in figures, also many spares, less valves, clean condition. 10/- plus 10/- carriage.

Ex R.A.F. Tube Unit Type 266. Fitted with VCR97 tube mu metal screen, full of EF50 valves. Many spares. Grade 1 27/- plus 10/- carriage. Grade 2 22/- plus 10/- carriage.

Untested T.V. Sets. 17in. 50/- carriage 15/-. 14in. 30/- Carriage 15/-. All sets complete with tube valves and back.

Bush 14in. T.V. Set. Type TV53. £5 carriage 15/-. Ideal for 625 line picture conversion. Complete with good tube. Tested working, all BBC1 and ITV channels. Cabinet fair.

Jap Personal Earpieces. Small or large plug 1/11 post paid. Silicon rectifiers 500MA, 800 P.I.V., no duds, 2/6 post paid.

Top Grade Mylar Tapes. 7in. Standard 11/6. L.P. 14/-. D.P. 19/6. 5in. Standard 7/9. L.P. 10/-. Post on any Tape 1/6 extra.

TV Tubes. New regunned with slight glass fault 12 months guarantee. All types 19 and 17 inch, 50/-. Carriage 10/-.

Reclaimed TV Tubes with six months' guarantee. 17in. types: AW43/88, AW43/80, 40/- each. MW43/69, 30/-. 14in. types: 17/-. 12in. types 10/-. All tubes 10/- carriage.

VALUABLE NEW HANDBOOK

FREE TO AMBITIOUS ENGINEERS

Have you had *your* copy of "Engineering Opportunities"?

The new edition of "ENGINEERING OPPORTUNITIES" is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new "ENGINEERING OPPORTUNITIES" should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

On 'SATISFACTION OR REFUND OF FEE' terms

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

WHICH OF THESE IS YOUR PET SUBJECT?

TELEVISION ENG.
Advanced Television Eng.—Gen. Television Eng.—Television Servicing and Maintenance.

ELECTRONIC ENG.
Advanced Electronic Eng.—Gen. Electronic Eng.—Applied Electronics—Practical Electronics—Radar Tech—Frequency Modulation—Transistors.

MECHANICAL ENG.
Advanced Mechanical Eng.—Gen. Mechanical Eng.—Maintenance Eng.—Diesel Eng.—Press Tool Design—Sheet Metal Work—Welding—Eng. Pattern Making—Inspection—Draughtsmanship—Metallurgy—Production Eng.

RADIO ENG.
Advanced Radio—Gen. Radio—Radio Servicing—Telecommunications—Sound Recording—Automation—Practical Radio—Radio Amateurs' Exam.

ELECTRICAL ENG.
Advanced Electrical Eng.—Gen. Electrical Eng.—Installations—Draughtsmanship—Illuminating Eng.—Refrigeration—Elem. Electrical Science—Electrical Supply—Mining Electrical Eng.

CIVIL ENG.
Advanced Civil Eng.—Municipal Eng.—Structural Eng.—Sanitary Eng.—Road Eng.—Hydraulics—Mining—Water Supply—Petrol Tech.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT INSTRUMENT TECHNOLOGY, WORK STUDY, MATHEMATICS, ETC.

WHICH QUALIFICATION WOULD INCREASE YOUR EARNING POWER?

A.M.I.E.R.E., A.M.I.Mech.E., A.M.S.E., A.M.I.C.E., B.Sc., A.M.I.P.E., A.M.I.M.I., A.R.I.B.A., A.I.O.B., A.M.I.Chem.E., A.R.I.C.S., M.R.S.H., A.M.I.E.D., A.M.I.Mun.E., C.ENG., CITY & GUILDS, GEN. CERT. OF EDUCATION, ETC.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

445A ALDERMASTON COURT, ALDERMASTON, Berks

THIS BOOK TELLS YOU

- ★ HOW to get a better paid, more interesting job.
- ★ HOW to qualify for rapid promotion.
- ★ HOW to put some letters after your name and become a key man . . . quickly and easily.
- ★ HOW to benefit from our free Advisory and Appointments Dept.
- ★ HOW you can take advantage of the chances you are now missing.
- ★ HOW, irrespective of your age, education or experience, YOU can succeed in any branch of Engineering.

132 PAGES OF EXPERT CAREER - GUIDANCE

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in TV. Radio, Electronics, etc., A.M.I.E.R.E. City & Guilds, Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Radio Television & Radio Servicing Practical Electronics Electronics Engineering Automation

INCLUDING TOOLS

The Specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T.

You are bound to benefit from reading "ENGINEERING OPPORTUNITIES", send for your copy *now*—FREE and without obligation.

POST COUPON NOW!

To B.I.E.T., 445A Aldermaston Court Aldermaston, Berkshire *3d. stamp if posted in an unsealed envelope*

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES". I am interested in (state subject, exam., or career).

NAME..

ADDRESS..

....

....

WRITE IF YOU PREFER NOT TO CUT THIS PAGE

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD