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JULY 1961

SERVICE ENGINEER

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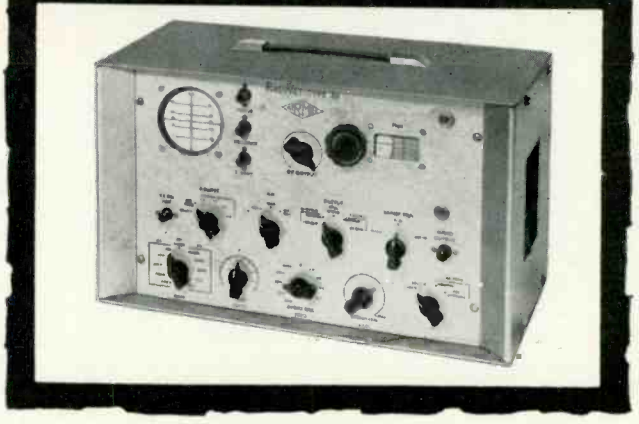

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SERVICE ENGINEER

Vol 4. No. 3 JULY, 1961

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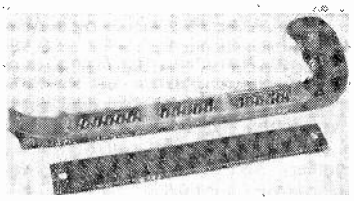
SERVICE DATA SHEETS

R152: Ever Ready *Sky Baronet, Sky Countess* portable radio receivers.

TV180: Ekco T370 and Ferranti T1048 series TV receivers.

TV181: Pye V700A and Pam 119A series TV receivers.



STANLEY CUTTING BLADE

A new special wood cutting blade designed to give fast stock removal on softwoods and man-made timbers has been introduced by Stanley. The new blade retails at 3s. 0d. and is interchangeable with the existing blade (designed as a general purpose cutter for a wide range of materials, including mild steel) on both the Stanley shaper-file and shaper-plane.

Shaper-planes will in future be available with both blades at 18s. 6d. The shaper-file will have only the general purpose blade, selling at 12s. 6d. Only one screw has to be loosened to change the blades, and this can be turned with a coin.

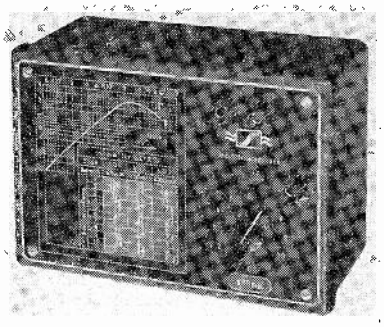
NEW GRUNDIG INDUCTANCE DECADES

Types LD1, LD2 and LD3

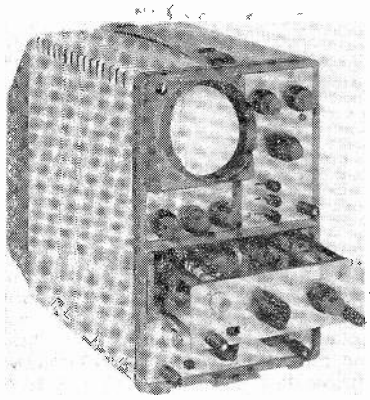
Wolsey Electronics Ltd., Cray Avenue, St. Mary Cray, Kent, sole distributor for Grundig instruments in the British Isles, announce the addition of a new instrument, an inductance decade available in three versions.

Type LD1 covers from 1–11mH, Type LD2 from 10–110mH and Type LD3 from 100mH–1·1H. Accuracy is to within ±2 per cent. The decades are intended for quickly constructing filter circuits, electro-acoustic equivalent circuits, equalisers, experimental networks and similar applications in the a.f. range.

By using large ferrite shell-type cores, Q is maintained above 100 for medium audio frequencies with good level stability and temperature independence. The Q is shown as a function of frequency on the front plate of each unit, the frequency coverage being from 50 c/s to 10 kc/s.



An additional facility is the provision of plug and socket terminals fitted within the thumb terminal. The case is of sheet steel and measures 190 × 130 × 90 mm. and weight is 0·8kG. The decades cost £23 10s. 0d. each.



New Serviscopes D33 and S32

Telequipment Ltd., 313 Chase Road, Southgate, London, N.14, announce two new *Serviscope* oscilloscopes, Models D33 and S32, the former featuring interchangeable amplifier units. Any of the basic range of amplifiers (which slide quickly into position from the front of the instrument) can be supplied, or special units can be built to requirements.

Of the basic range of amplifiers, the A3 is a general purpose unit with a wide frequency response and the additional facility, when needed, of a X10 sensitivity over a limited bandwidth. It has many applications in servo computer, TV and radar development and maintenance.

The A4 is a differential amplifier giving high gain. Maximum sensitivity is 1mV/cm. d.c. and the frequency response 200 kc/s. It is intended to adapt the oscilloscope for work in the electro-mechanical, medical and biological fields. The A5 is an ultra high gain amplifier with maximum sensitivity as high as 100μV/cm. a.c., frequency response 5 c/s to 150 kc/s and is intended primarily for applications in the electro-acoustical and magnetic recording fields.

The D33 oscilloscope is a double-beam instrument incorporating a new p.d.a. tube (3·5kV); accessories include a high impedance divider probe, camera attachment and extendable light hood.

A similar p.d.a. tube is fitted in the new S32 *Serviscope* which although only weighing 16 lbs. gives a high performance and is capable of fast pulse work. Fast rise time and an efficient triggering device are allied to a bandwidth increase to 7·5 Mc/s at 100mV/cm. and a high gain position providing 200 kc/s at 10mV/cm. a.c. to 200 kc/s.

EKCO-PYE SERVICE

More Pooling

Following the recent pooling of service facilities in Scotland, Ekco and Pye have now extended this arrangement to Birmingham and Manchester. The two Companies' service depots are combining under the control of Radio and Television Services Ltd., at the following addresses:

230-232 Highgate Road, Birmingham, 12 (the former Ekco service depot).

Stock Street, Cheetham, Manchester, 8 (the former RTS depot).

Mr. A. C. Hopkins, the Ekco depot manager, will be manager of the Birmingham depot with Mr. Taylor of RTS as chief engineer, Mr. R. Toulman, of RTS, will be manager of the Manchester depot with Mr. J. W. Moorhouse, formerly with Ekco, as chief engineer.

Service Viewpoint

THIS month we reach a milestone—on page 41 of this issue we publish *Technical Gen* No. 1000. The policy of giving *Technical Gen* contributions reference numbers was started in August 1957, so a little simple arithmetic will reveal the fact that some 250 items are published every year.

Ten Years On

Technical Gen 1000 was not specially hand-picked for the occasion, it was just allocated in strict sequence on acceptance, yet as luck would have it, it is a good one for prospective contributors to study.

It gives the facts clearly, is sufficiently off-beat to make it interesting and it embodies a touch of dry humour which adds to the enjoyment of even the most ardent reader.

But *Technical Gen* goes back much further than 1957. Thanks to the foresight (inspiration?) of the, then, editor the March 1950 issue of *British Radio and Television* (our title up to two years ago) started a new feature which would "*carry a monthly selection of unusual radio and television faults, together with their solution. They will be compiled from the log books of a team of servicing experts.*"

The new feature, *Technical Gen for Servicing Men* continued in that form for a year, being compiled by a special team of contributors in the form of a chatty article broken down into sections. It is interesting to flip through that issue.

Announcement of the first stage of the B.B.C. Regional TV plan, only two stations (London and Birmingham) then being operative. In *Brand New* a display of cumbersome-looking TV sets consisting mostly of cabinet and available in two versions – one for Alexander Palace, one for Birmingham. Service sheets numbers R2 and TV2. And record reviews!

In the February 1951 issue came the first of the *Technical Gen* features to take the present form of short items submitted by readers themselves, so that although a few months late we can take the opportunity to celebrate the 10th anniversary of *Technical Gen* as well. Rumblings of things to come in this issue in the summary of the Beveridge Report which gave the go-ahead for commercial TV and the development of v.h.f. radio. As the editorial said: ". . . (*these recommendations*) *if acted on will affect the majority of our readers in far-reaching ways*". How true!

From then on, *Technical Gen* has gone from strength to strength, gaining for itself a reputation and popularity extremely gratifying to those involved in producing the magazine. In fact it is by far the most successful venture of this type in trade journalism. It stands alone.

While not wishing to detract any credit from the man who "thought of the idea" it is obvious that the real secret of the lasting success of *Technical Gen* lies in the wonderful support given to the feature by readers.

Here, perhaps, we might add a note of encouragement to those who have been unsuccessful in getting their contributions published. Obviously we cannot accept all items submitted. Some are too brief, too vague, too commonplace, but largely we get more than can be used. This may be discouraging to some, but healthy competition is not a bad thing. Keep trying!

Though high on the Hit Parade, there *are* readers who consider some of the offerings rather elementary. Apart from the fact that one cannot always please everybody, an editor must always try, and many of the simpler reports are included deliberately for the benefit of the younger readers. Thus we hope to reach the tastes of most readers at least some of the time.

Since *Technical Gen* has run continuously for over ten years we see no reason why it should not continue for many more years to come. Until, perhaps, we get those predicted receivers which will be so "reliable" and incorporate such "robust and indestructible" components that the only thing they will need in the way of service is a quick flip over with a duster.

New Books

★ *SERVICE ENGINEER REVIEWS OF THE LATEST TECHNICAL LITERATURE*

Radio Valve Data. **compiled by the staff of** *Wireless World,* **published by Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1. Size 11 × 8¼ in. 156 pages. Price 6s. 0d. (6s. 10d. post-paid).**

THIS is the seventh edition of a book which first appeared in 1949 and has become established as a very valuable reference book for the amateur and professional alike. It seems superfluous to explain that the book gives comprehansive data on valves, c.r.t.'s, transistors, etc., mainly in the form of characteristics tables.

The latest edition is again enlarged and now contains operating data on 4,800 British and American valves and semiconductor devices including Zener diodes, rectifiers and cathode ray tubes.

In this edition the valve base connection codes are included in the index, as well as retained in the main tables. This allows the user to find the base connections of a valve easily and quickly without having to turn to the main tables. The book has been completely re-indexed and includes a list of equivalents.

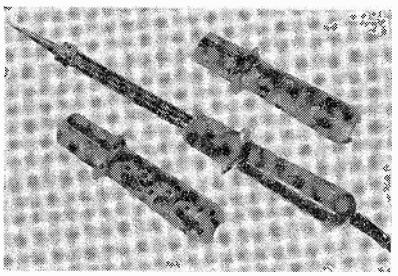
The main tables firstly classify valves by function—such as frequency changers, recovery diodes, output valves, etc.—then by manufacturers' names and finally into current, replacement or obsolete types. Within each section the valves are listed in order of their heater voltages.

A useful feature of the layout is that it enables comparison to be made between the electrical characteristics of valves from different manufacturers. Six shillings is a small price for service engineers to pay for the compact information contained therein.—*D.C.*

RDMC Handles for Wolf Soldering Irons

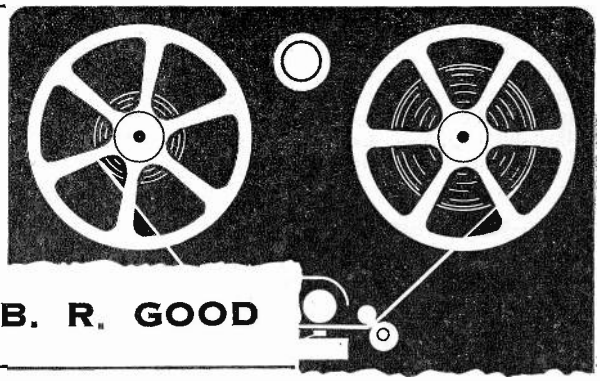
Dropped from a height on to concrete . . . thrown down stone steps . . . these were some of the tests carried out by G.P.O. engineers on Wolf soldering irons fitted with new handles moulded from Rockite Dough Moulding Compound. No handles broke.

The handles are hollow, moulded in two halves by Minerva Mouldings Ltd., and a raised flange provides a guard for the engineer's hand, the rim of the flange being octagonal instead of round to prevent the iron rolling if placed on a



sloping surface. Connections between the electrical lead and the element are made inside and Tappex inserts are introduced during the moulding process.

Servicing the MODERN TAPE RECORDER



PART FOUR OF A NEW SERIES BY **B. R. GOOD**

THE EL3542 is similar to the Philips machines described in the latter part of the previous article, but has the added complication for the service mechanic of being a three-speed machine. The speeds are $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i/s and are engaged by three separate buttons on the top-plate.

Separate intermediate wheels are used for each speed. These are applied to a stepped motor pulley and the flywheel when the appropriate button is depressed. Fig. 1 shows the general arrangement of this action, and some of the points that may need attention after a machine has been in use for some time.

Speed Control Keys

The speed control keys, A, B, and C (lowest speed to the left), are pivoted at the front on rod D. When a key is depressed, the shaped bracket E pushes operating lever G forward, compressing spring F. This forces guide bracket H forward, the inner end running through a slot in bracket K.

On the guide bracket for each speed position is mounted the appropriate intermediate wheel. Although the drawing does not show this exactly, the wheels are mounted directly above one another, the shapes of the guide brackets correcting the angle of thrust.

Flywheel Clearance

Clearance between the flywheel and intermediate wheel should be a half-millimetre in the neutral position, with a similar clearance to the pulley. The upper intermediate wheel runs near the upper edge of the flywheel, L.

An important adjustment here is the height of the flywheel, which can be regulated by a thrust screw, M, at the bottom. This has a locknut which should be firm after adjustment.

Also important is the free running of the flywheel, which can be checked by running up at $7\frac{1}{2}$ i/s, then switching the machine off *at power input*, when the flywheel should take $3\frac{1}{2}$ to 4 minutes to come to a halt. An adjustment for running time is provided, by loosening screws OO of bearing plate N and moving this latter for free running.

Attention should also be given to the pulley bearing support, where two screws allow some variation of alignment. *These should be adjusted so that the motor runs immediately on switching and the intermediate wheels, when engaged, set centrally on the steps.*

Operated by the speed buttons is a frequency correction arrangement, altering the circuit of the ECC83 stage by a switch slider actuated by the speed change lever movement. The setting can be varied by bending the fork arms on the end of this lever.

The electrical features of this range of machines include a straightforward circuit but a number of switches and two relays, whose maladjustment can give rise to fault symptoms.

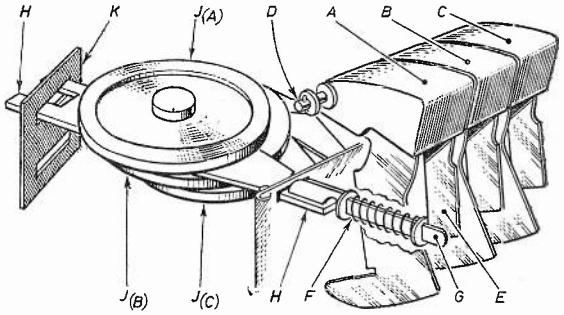
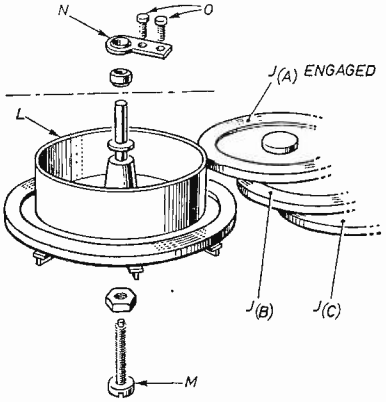


Fig. 1: Sketch of speed control key mechanism in the Philips EL3542 tape recorder. The drawing below shows the three idler wheels and their position with regard to the flywheel assembly.



Output Stage

An example of the techniques used can be gained from a study of the output stage and auto-stop device, where several of these switches apply. The skeleton diagram, Fig. 2, shows that h.t. from the EZ80 rectifier is applied through a sectional winding of the output transformer for smoothing, being decoupled by two 32 μF sections of C18, the triple electrolytic. The other, 50μF section of this component decouples h.t. for the first stages, EF86 and half-ECC83, of the amplifier.

When the pentode section of the ECL82 is used as a normal output stage, i.e., during "Playback", switch A, A1 is open. but on "Record", this slider switch performs a number of functions, among which is closing the two contacts shown in Fig. 2.

It can now be seen that section C of the output transformer is short-circuited, effectively muting the output by a reflected zero impedance to the primary.

At the same time the anode is taken through switch contact A1 to the oscillator coil L, with feedback via Co

to the grid circuit. Audio input has been cut off by the open-circuiting of D, on the same switchbank.

In the "Playback" position, switch A1 short circuits oscillator coil L to chassis. Bias for the record head is fed via adjustable capacitors Cc and a section of the stereo switch slider.

Auto-stop Relay

Also in this section of the machine is the auto-stop relay, activated by the metallised "leader" of the tape. There are alternative ways of obtaining the earthing action: in this instance, the left hand tape guide post is in two sections, one bonded to chassis, the other in series with Relay 1 and the cathode of the ECL82, as shown, post contacts B.

Short-circuiting B energises Relay 1, closing switch Re. 1., and energising Relay 2 from the h.t. line of 220 volts. This relay moves a locking bracket, releasing the depressed record or playback buttons.

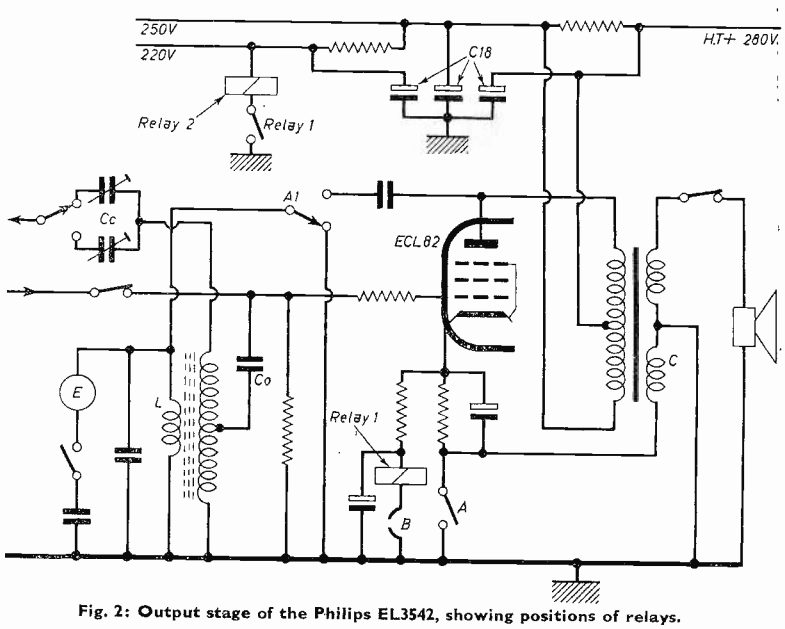


Fig. 2: Output stage of the Philips EL3542, showing positions of relays.

Stereo Playback

As mentioned above, facilities for playing back pre-recorded stereo tapes are incorporated in this model. Stereo recording is of necessity a much more complicated business, as we shall see when studying a later Philips machine, the EL3536.

This machine, the EL3536, employs 7 valves plus a magic eye, two crystal diodes and a contact-cooled rectifier, has a 6×4 inch loudspeaker built-in and another, 6½ inch in the lid. Inputs are provided for monaural or stereo microphones, radio and pickup; outputs are Radio diode, Extension loudspeaker, Monitoring headphones and 2-volt line.

To achieve the impressive specifications with an economy of equipment, the manufacturers have evolved an interesting circuit, which depends upon some complicated switching. Details of this would take up more space than even our benevolent editor can spare. However, a useful idea of function may be gained by studying the skeleton "amplified block" diagram of Fig. 3.

Circuitry

Input from the stereo microphone SM is applied to the grid circuits of left and right-hand channels, V2L and V2R (EF86). Signals pass via modulation controls ML and MR to V3 and V3¹, left and right. These are double triode, ECC83 valves. V1 is also an ECC83, each half being used to amplify pick-up inputs, which are then passed, via modulation control, to the inputs of V3L and R. Thus, at the input of V3, mixing of external signals takes place.

From the anode of V3¹, a feedback circuit to the cathode of V3 allows frequency correction at the three available speeds of operation. Simplified switching is shown as Sc.

A sample of V3¹ output is taken to V5, the magic eye, via the OA85 diodes, V5 being an EM84.

From V3¹ outputs, signals are also available for headphone monitoring and external line. Loudspeaker monitoring is obtained by taking the same signal of the left-hand channel through the output stage V4L, an EL84.

The other EL84 is used, on "Record" as the erase and bias oscillator, voltages being fed to the erase heads E and record heads PR. Record signals are also taken from the output of V3¹.

Protection Circuit

The same valves, except for V1, are used for playback. Signals from the heads are fed to the inputs of V2L and R and amplified through the chain, this time using both EL84 valves as output stages. Tone, balance and volume controls are incorporated.

A protection circuit for the right-hand channel output stage when the appropriate speaker is disconnected uses a ganged switching circuit, operated by the internal loudspeaker switch and the external loudspeaker sockets.

It is thus possible to operate the machine with balanced external loudspeakers if required. When testing, this output circuit should be properly connected in order to check the output of the left-hand channel under normal conditions.

The left-hand amplifier is used for monaural record and playback, but a "Monaural Output" switch puts left and right hand output stages in parallel during playback.

Head Positions

Another difference that has been noted on later machines is the repositioning of heads and the use of a contact spring for the automatic stop device. *The changes are small, but important: the combined erase head is now set obliquely, favouring a more intimate tape contact.*

This latter point is aided by the addition of a pressure pin on the left-hand end of the pressure roller arm assembly. The R/P head is mounted slightly more toward the rear. Adjustment of the height of the head is again by the three spring-loaded mounting screws and final adjustment of azimuth setting is made with the screw at the right rear of the head mounting.

Relay Sequence

The auto-stop has a spring leaf which clips on the black moulded tape guide on the right-hand guide post. The post is now a fully earthed, spring-loaded unit, providing the second pole of the relay switch. The relay sequence is more positive, with Relay 1 between a point on an h.t. potentiometer and the upper pole (spring leaf).

When the metallised strip of leader tape shorts the stop switch Relay 1 is energised and contacts close, completing the circuit between Relay 2 in series with h.t. and chassis. Relay 2 releases the locking bar and neutralises the push-buttons, as before.

There are a couple of points toward better running mentioned by Messrs. Philips' Service Department. One is the fitting of a smaller diameter felt ring under the right-hand turntable (spool carrier). A 38 mm. ring as used under the left-hand turntable can be fitted, and spares are available from the manufacturers.

The second point is a recommendation to ensure that the PVC bearing under the RH friction disc is adequately greased. Excessive wear and change in the height adjustment can result from allowing this bearing to run dry.

A word of warning that the manufacturers do *not* give may be appropriate here. Many adjustments on these Philips machines consist of bending levers, etc. While this is perfectly legitimate, the utmost discretion should be used.

Slider Switches

Always be sure that the fault being sought is quite definite: this especially applies to the slider switches as used in all later models. These printed switch sliders are operated via cables, the nipples seating in fork brackets. *Bending the forks gives a wide range of adjustment, causing the switch sliders to "edge"—and can be so easily overdone!*

Care should be taken in servicing that the upper decks of these models are spotlessly clean and the minimum of lubrication applied. Properly adjusted, this range of equipment is capable of remarkably good performance; a little patience in mastering what may seem at first a complex set of mechanics is rewarded by very pleasing results.

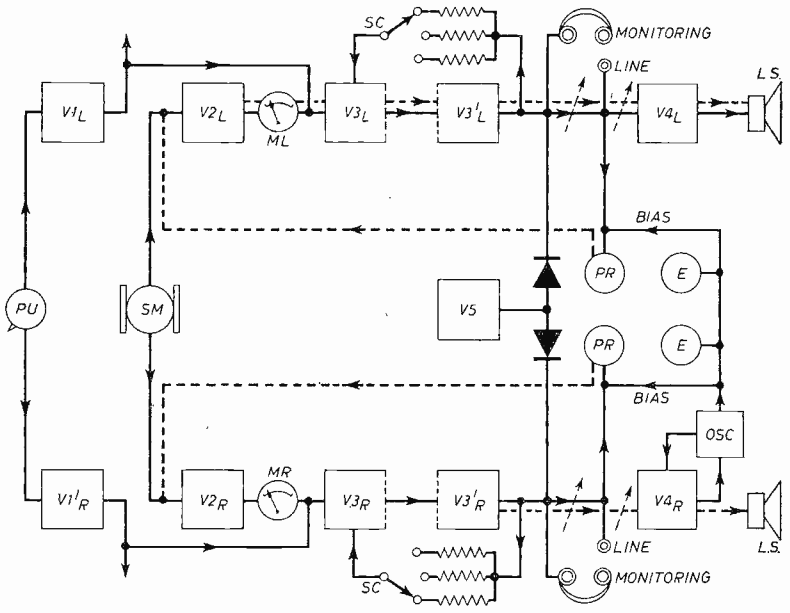


Fig. 3: Block diagram of the Philips EL3536, showing switching.

WALTER TAPE RECORDERS

Very different in conception is the popular Walter design. Here, the single lever operation takes precedence, and the whole mechanical assembly is dependent upon the movement of the "joystick".

Although this firm ceased production earlier this year, a very large number of machines is in use. These will be supplying the service engineer with repair work for some time to come, and a few words of advice are called for.

Mechanical

Fig. 4 shows the main mechanical assembly of the underside of a typical model (202, 303, Playtime).

Later models retain most of the features shown here, with additional functions, such as speed change, and varying electrical circuits. It is not necessary to outline the sequence of operations: merely to point out some adjustments required during service.

There are two drive belts, A, the clutch belt, from the groove in the motor pulley C nearest the motor to the clutch drum of the right-hand spool D; B, the capstan drive to the flywheel F.

These are of rubber, subject to wear, occasionally to hardening—which can sometimes be cured by the application of a little heat—and can be difficult to replace if the correct sequence of operations is not followed.

To replace clutch belt, A, first put the joystick control lever into "fast reverse". This draws lever R downwards, removing the clutch pressure spring, shown dotted at E, from the clutch spindle, allowing the new belt to be eased between them. Then switch to "Playback", enabling the belt to be passed between brake pad G and the drum and passed over the pulley. *The lower segment, remember.*

Drive Belts

More likely is replacement of the other belt, B. To do this, it is first necessary to unscrew the knob of the joystick, remove the four screws of the capstan/flywheel plate H and lift the assembly so that the joystick is clear of the deckplate. Then the clutch

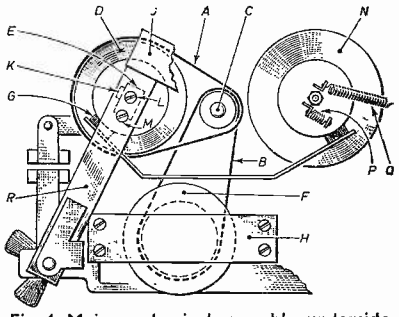


Fig. 4: Main mechanical assembly, underside, of a typical Walter tape deck.

lever R can be maneouvred from the motor bracket, J, and the flywheel is free to be lifted so that the new belt can be looped around grooved segment.

Lay the belt in an approximate position to the motor pulley, reassemble the parts in reverse and feed the belt over the motor pulley by using a hook from the top of the deckplate, through the convenient hole. It sounds fiddly, but can de done very rapidly after a couple of practice shots.

Pressure Spring

Mention was made above of the clutch pressure spring. This is a most important part of the mechanism. Complaints of erratic spooling or no "fast" action in the forward direction may be caused by maladjustment here. (*In later models, this device is used on both turntables, and it is worth remembering that sluggish take-up in either direction usually necessitates adjustment of the clutch spring on the*

(Continued on page 40)

SERVICE DATA SHEETS

THE DATA SHEETS LISTED BELOW ARE STILL AVAILABLE FROM STOCK TO SUBSCRIBERS, POST FREE, AT THE PRICES QUOTED. A COMPLETE INDEX TO ALL DATA SHEETS PUBLISHED UP TO DECEMBER 1960 IS AVAILABLE AT 9d.

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Bush T36 series TV receivers (TV83, Apr., 56).
Bush TV22 series TV receivers (TV67, Jun., 55).
Bush TV53 series TV receivers (TV101, Feb., 57).
Cossor 930 series TV receivers (TV62, Feb., 55).
Cossor 937, 938 and 939 (TV90, July, 56).
Cossor 943 TV (TV127, Oct., 58).
Cossor 945 (TV112, Nov., 57).
Cossor 946 TV (TV104, May, 57).
Cossor 947 TV receiver (TV114, Jan., 58).
Decca DM35/45/55 (TV155, May, 60).
Ekco T330/331 series (TV154, April, 60).
Ekco T342/344/348 (TV157, June, 60).
Ekco T345 series (TV165, Oct., 60).
Ekco T368/T371 series (TV176, April, 61).
Ferranti T1002 series (TV154), April, 60).
Ferranti T1021, 1023, 1027 (TV157, June, 60).
Ferranti T1024 series (TV165, Oct., 60).
Ferranti T1046/T1049 series (TV176, April, 61).
Ferguson 204T series TV receivers (TV87, June, 56).
Ferguson 306T/308T TV receivers (TV97, Nov., 56).
Ferguson 506T, 508T, 546T (TV171, Jan., 61)
Ferguson 516T series (TV173, Feb., 61).
G.E.C. BT1252 series TV receivers (TV96, Oct., 56).
G.E.C. BT1746 series TV (TV81, Mar., 56).
Grundig 500L and 700L/C (S3, Dec., 53).
H.M.V. 1840 series TV receivers (TV109, Sept., 57).
H.M.V 1890 and 1893 (TV171, Jan., 61).
H.M.V. 1892, 1896 (TV173, Feb., 61).
Invicta 538 series (TV168, Dec., 60).
Kolster-Brandes HF40 series TV (TV70, Aug., 55).
Kolster-Brandes MV30 and MV50 (TV91, Aug., 56).
Kolster-Brandes NV40 series (TV115, Feb., 58).
Kolster-Brandes OV30 series (TV148, Jan., 60).
Marconiphone VC/VT59DA (TV100, Jan., 57).
Marconiphone VC60DA (TV61, Jan., 55).
Marconiphone VT68DA/VT69DA. (TV84,May,56).
Marconiphone VT163 (TV173, Feb., 61).
Marconiphone VT164 (TV171, Jan., 61).
McMichael 55 series TV receivers (TV79, Feb., 56).
Murphy V214/V216 TV receivers (TV78, Jan., 56).
Murphy V230 portable TV (TV103, April, 57).
Murphy V270/V270C TV (TV120, May, 58).
Murphy V270A TV receiver (TV140, July, 59).
Murphy V280/V300C TV (TV124, Aug., 58).
Murphy V280A series (TV134, March, 59).
Murphy V310 TV receiver (TV145, Dec., 59).
Murphy, V320 series (TV159, July, 60).
Murphy V330 series (TV167, Nov., 60).
Murphy V350 series (TV175, March, 61).
Pam 500 TV receiver (TV108, Aug., 57).
Pam 600S, 606S, 690 (TV144, Nov., 59).
Pam 800 series (TV168, Dec., 60).
Peto Scott TV 1411 series (TV65, Apr., 55).
Philco BT1412 and BT1551 (TV71, Sept., 55).
Philco 1000 *Slender Sevenieener* (TV139, June, 59).
Philco A1960/1, A2060/1 (TV137, May, 59).
Philco A1962M/A1967M (TV142, Oct., 59).
Philips 1458U series (TV129, Nov., 58).
Philips 1756U series TV (TV111, Oct., 57).
Philips 1768U/2168U (TV117, March, 58).
Philips 1796U/2196U (TV152, Mar., 60).
Phillips 100U/200U series (TV179, June, 61).
Pilot PT450 series (TV161, Aug., 60).
Pilot TV84/87 television series (TV59, Nov., 54).
Pye PTV portable TV (TV113, Dec., 57).
Pye CW17 series TV (TV122, June, 58).
Pye CTL58VS series (TV150, Feb., 60).
Pye CTM17S series (TV131, Feb., 59).
Pye V200/V400 series (TV163, Sept., 60).
Pye V210 series (TV168, Dec., 60).
Regentone "Big 15/5," T and C (TV48, Feb., 54).
R.G.D. 1455 and 1456 TV receivers (TV99 Dec.,56).
Ultra V84 and Y84 TV receivers (TV47, Jan., 54).
Ultra 81 series TV receivers (TV74, Nov., 55).
Ultra 915 and 917 TV receivers (TV93, Sept., 56).
Ultra 50 series TV (TV123, July, 58).
Ultra 52 series TV (TV135, April, 59).
Ultra 60 series TV (TV126, Sept., 58).
Ultra 62 series TV receivers (TV141, Sept., 59).
Ultra V1770 series (TV161, Aug., 60).
Ultra 1780/82 series (TV177, May, 61).
Vidor CN4217/8 TV receivers (TV57, Oct. 54).

Price 9d. each

Alba T717 and T721 (TV143, Nov., 59).
Alba T744FM TV series (TV121, June, 58).
Alba T766 TV receiver (TV166, Nov., 60).
Ambassador-Baird TV 19-20 (TV119, May, 58).
Argosy Model T2 TV receiver (TV53, June, 54).
Beethoven B94, 95, 98 and 99 (TV92, Aug., 56).
Bush BE15 battery radio (R51, Mar., 54).
Bush RC94 AC radiogram (R34, Nov., 52).
Bush VHF54/VHF55 receivers (R94, Jan., 57).
Bush VHF61 a.m.-f.m. radio (R134, Oct., 59).
Bush VHF64/RG66 radios (R116, July, 58).
Collaro RC54 record changer (S6, Oct., 55).
Cossor 500 series radios (R95, Feb., 57).
Cossor 522/523 a.m.-f.m. radio (R72, May, 55).
Cossor 524 *Melody Maker* (R85, Mar., 56).
Decca SG177/SG188 Stercograms (S12, Oct., 58).
Decca *Double Decca* Model 51 (R65 Dec., 54).
Deccalian radiograms 91 and 92 (R23, Dec., 51).
Deccalian Model 90, radiogram (R21, Nov., 51).
Dynatron TV38 series (TV151, Mar., 60).
Etronic ECS2231 projection TV (TV46, Dec., 53).
Etronic ETA632 radio receiver (R43, Aug., 53).
Ever Ready *Sky Monarch* (R104, July, 57).
Ever Ready *Sky King, Queen, Prince* (R106, Sept., 57)
Ever Ready, *Sky Personal, Sky Leader* and *Sky Baron* (T150, April, 61).
Ferguson TV tuner units (TV85, May,56).
Ferguson 300RG autogram (R78, Aug., 55).
Ferguson 382U series (R124, Jan., 59).
Ferguson 341BU portable radio (R67, Jan., 55).
Ferranti 005, 105 and 405 (R36, Jan., 53).
Ferranti 147 series radio receivers (R81, Nov., 55).
Ferranti 255, 355, 455, radios (R107, Oct., 57).
Ferranti 1325/1825 TV receivers (TV95, Oct., 56).
G.E.C. BT302-5 (TV160, Aug., 60).
G.C.E. BT1449/BT2448 (TV102, March, 57).
G.C.E. BT2155/8149 (TV156, June, 60).
Kolster-Brandes HG30 radiogram (R53, April, 54).
Kolster-Brandes QV20/1 series (TV162, Sept., 60).
Marconiphone T/C10A radio (R41, June, 53).
Marconiphone VT64/65DA (TV76, Dec., 55).
Masteradio D154 "Ripon" series (R84, Feb., 56).
Masteradio TD4T and TD7T/C (TV58, Nov., 54).
Masteradio TE series (TV128, Nov., 58).
McMichael *Clubman* Model 535 (R62, Oct., 54).
McMichael FM55 a.m.-f.m. radio (R82, Dec., 55).
McMichael MP20 (TV 174, March, 61).
McMichael MP27 series (TV178, June, 61).
Murphy A146CM baffle radio (R75, June, 55).
Murphy V200 TV receiver (TV72, Sept., 55).
Pam 701, 702, 714, radios (R100, May, 57).
Peto Scott 16 series TV receivers (TV86, June, 56).
Peto Scott 19 series TV (TV116, March, 58).
Peto Scott 1722/1723 (TV149, Feb., 60).
Peto Scott 1730 and 2128 (TV158, July, 60).
Peto Scott 1731/2131 (TV164, Oct., 60).
Peto Scott 732 series (TV172, Feb., 61).
Philips 141U portable radio (R56, June, 54).
Philips 643 series a.m.-f.m. radio (R87, July, 56).
Philips G62A series (R131, July, 59).
Pilot TV94 series TV receivers (TV107, Aug., 57).
Pilot VS9 console TV receiver (TV34, Nov., 52).
Pilot PT451, PT651 (TV170, Jan., 61).
Pye P23CR and P24CR (R48, Jan., 54).
Pye P29UBQ (R37, Feb., 53).
Pye *Fen Man* I and IRG (R109, Nov., 57).
Pye *Fen Man* II and IIRG (R112, Jan., 58).
Raymond F46 radio receiver (R69, Feb., 55).
Regentone ARG81 series (R127, March, 59).
Regentone RT50 tape recorder (S14, Sept., 59).
R.G.D. T14 transportable VT (TV138, June, 59).
Sobell TS17 and T346 TV (TV94, Sept., 56).
Sobell 626 Series a.m.-f.m. radios (R102, June, 57).
Sobell TPS710, T192, T293 (TV174, March, 61).
Sobell TPS781 series (TV178, June, 61).
Sound A20 tape recorder (S9, Feb., 58).
Stella ST151A radio (R66, Jan., 55).
Stella ST8314U TV receiver (TV55, Aug., 54).
StradModel 510 table receiver (R35, Dec., 52).
Taylor testmeter Type 171A (T16, Aug., 54).
Ultra ARG891 "Ultragram" (R83, Jan., 56).
Ultra "Troubadour" U696 (R44, Aug., 53).
Ultra "Twin" portable radio (R55, June, 54).
Ultra U930/U940 *Minstrels* (R119, Aug., 58).
Ultra V1763 TV receiver (TV 147, Jan., 60).
Ultra VP14/1753 series (TV153, April, 60).
Ultra 1771 series (TV170, Jan., 61).
Vidor CN4228/9 TV receivers (TV136, May, 59).
Vidor CN4230/1 TV receivers (TV125, Sept., 58).
Waveforms *Radar* 405D (T.I.7, Apr., 56).

Price 6d. each

Alba 69 series radiograms (R120, Sept., 58).
Alba 3211 series (R126, Feb., 59).
Bush TC184 television tuner (TV75, Nov., 55).
Cossor Model 466 car radio (R71, Apr., 55).
Cossor radio Model 494U (R38, Mar., 53).
Cossor *Melody Portable* 543 (R92, Dec., 56).
Cossor 546 transistor portable (R115, May, 58).
Cossor 551/552 portables (R117, July, 58).
Cossor 575/579 (R142, June, 60).
Cossor 580 stereo player (S13, April, 59).
Cossor 581 and 569 portables (R137, Nov., 59).
Cossor CR1500A stereo radiogram (R147, Nov.,60)
Decca *Deccalian* 88 player (S10, March, 58).
Decca RG200 radiogram (R125, Jan., 59).
Deccalian Model 81 (R29, Apr., 52).
Defiant MSH953 AC radio (R40, May, 53).
Defiant RSGH89AC radio (R70, Mar., 55).
Dynatron TP11/TP12 (R141, May, 60).
Ekco BPT333 transistor portable (R143, July, 60).
Ekco BPT351 transistor portable (R145, Sept., 60).
Ekco RT366 tape recorder (S17, June, 61).
English Electric *Rotamatic* TV tuner (TV82,Mar.,56).
Etronic EPZ4213 portable radio (R52, Mar., 54).
Etronic radio Model ETU5329 (R39, Apr., 53).
Ever Ready Model "C" radio (R50, Feb., 54).
Ever Ready *Sky Baby, Sky Princess* (R99, May, 57).
Ferguson 348BT transistor portable (R151, April, 61).
Ferranti 13-channel TV tuner (TV73, Oct., 55).
Ferranti 525 radio receiver (R58, Aug., 54).
Ferranti Model 546 radio (R45, Sept., 53).
Ferranti UJ1003/RP1008 (R123, Dec., 58).
Ferranti PT1010 transistor portable (R143, July,60).
Ferranti PT1030 transistor portable (R145, Sept.,60).
Ferranti TR1044 tape recorder (S17, June, 61).
G.E.C. BC501/BC502 portables (R146, Oct., 60).
G.E.C. BT306, BT308 (TV169, Jan., 61).
H.M.V. radio Model 1122 (R54, May, 54).
H.M.V. radio Model 1356 (R42, July, 53).
H.M.V. 1252 f.m. adaptor (R111, Jan., 58).
H.M.V. 1417 transistor portable (R151, April, 61).
Invicta 26 "Vicki" portable (R93, Jan., 57).
Invicta 33 series radio receivers (R89, Sept., 56).
Invicta Models 37 and 59RG (R86, May, 56).
Invicta Model 55 portable (R46, Oct., 53).
Kolster-Brandes TV converter (TV77, Jan., 56).
Kolster-Brandes FB10 portable (R32, Sept., 52).
Kolster-Brandes MP151/2, PP251 (R135 Oct., 59).
Kolster-Brandes NG20/NR30 (R113, Feb., 58).
Kolster-Brandes OP21 (R122, Nov., 58).
Kolster-Brandes PP11, PP21, PP31 (R130, June, 59).
K-B RT20 tape recorder (S16, May, 61).
Marconiphone P17B portable (R49, Jan., 54).
Marconiphone T24DAB (R77, Aug., 55).
Marconiphone T82B transistor portable (R151, April, 61).
McMichael 153 table radio (R75, July, 55).
McMichael 493 portable radio (R47, Nov., 53).
McMichael 554 radiogram (R96, Feb., 57).
McMichael 855 table radio (R91, Nov., 56).
McMichael MT102 portable (R149, Feb., 61).
Masteradio D155 series (R108, Nov., 57).
Murphy V310 modifications (TV146, Jan., 60).
Pam 111 transistor portable (R140, April, 60).
Pam 706 *Pixie* portable (R97, March, 57).
Pam 710 portable (R90, Oct., 56).
Pam 955 series radios (R103, July, 57).
Pam TB59 (R138, Feb., 60).
Peto Scott MR60 *Fanfare* tape recorder (S15, March, 61).
Portogram "Junior 8" reproducer (S5, July, 54).
Portogram "Preil 20" amplifier (S4, May, 54).
Philco A 536 W/M radio receivers (R68, Feb., 55).
Philips television tuners (TV88, June, 56).
Philips G77B, G81U, G83B (R137, Dec., 59).
Philips 301T and 395T (R148, Dec., 60)
Pilot television tuners (TV89, July, 56).
Pilot PR251 transistor portable (R144, Aug., 60).
Pye HF25/25A hi-fi amplifiers (S11, June, 58).
Pye P131MBQ portable (R121, Oct., 58).
Pye P43 radio receiver (R63, Nov., 54).
Pye 13-channel tuner unit (TV66, May, 55).
Pye *Pipers* P115U/P116U (R110, Dec., 57).
Pye *Black Box* record reproducers (S8, Sept., 57).
Pye 841130 series TV tuners (TV110, Oct., 57).
Raymond F55 table radio (R74, June, 55).
Regentone PRG1 and Five-18 (R139, Mar., 60).
R.G.D. B56 portable radio (R132, July, 59).
Roberts CR portable radio (R80, Oct., 55).
Roberts "Junior" portable (R26, Reb., 52).
Roberts P5A portable radio (R73, May, 55).
Roberts R66 portable radio (R88, Aug., 56).
Roberts R77 portable (R105, Aug., 57).
Roberts RT1 transistor portable (R118, Aug., 58).
Sobell FMG57/FMG708 radios (R114, April, 58).
Sobell ST301 portable (R149, Feb., 61).
Taylor Model 20B (T.I.5, Sept., 52).
Ultra 101 transistor portable (R144, Aug., 60).
Ultra FM950 f.m. radio (R129, May, 59).
Ultra TR100 portable (R128, March, 59).
Ultra U960 portable radio (R133, Sept., 59).
Vidor Model CN414 portable (R28, Apr., 52).
Vidor CN420A portable radio (R64, Dec., 54).
Vidor CN421 portable radio (R79, Sept., 55).

SERVICE DOWN UNDER

BY P. E. CLEMENT

WITH Australian television now 4½ years old, the pattern of service has crystalised. There can be few places where the growth of TV has been so rapid, and the service organisations were (and still are) hard pressed to keep pace.

So far transmissions are limited to the six State capitals, while Canberra, the Federal capital is still without TV. 1961 however will witness another leap forward with country stations springing up in many of the inland towns.

DIFFERENCES

Here in Melbourne, and no doubt in other cities too, TV service is very different to that in England. The organisation is different. The sets are different, the system is different, and even the customer handling problems are different!

Most service work is carried out by huge nationwide service organisations and retailers tend to contract with one or other of these rather than run their own service set ups. The Melbourne branch of one such firm may handle up to 700 calls a day.

I work for this firm and any facts and figures quoted here relate to it, although they are more or less general.

The first time a "Pommie" technician (if you call yourself an "engineer" here you'll be thought a snob) tries to pick up an Aussie set he gets the impression that some joker has nailed it to the bench. Back home you may have carried a 21 in. set down three flights of stairs to the van. Forget it. Here it is as much as many of us can do to lift some chassis out of the cabinet on to the floor.

BULK

Most common size is the 21 in. The 24 in. and the new 23 in. sizes are quite popular, while 17 in. are not generally made any more. Apart from one or two portables there are no 14 in. sets. Hefty wooden cabinets, thick hardboard backs weighing 7 or 8 pounds, solid steel chassis and parallel fed heaters necessitating enormous mains transformers all contribute to the gross tonnage.

Naturally this sheer bulk is reflected in the pattern of service work. Almost all repairs are carried out in the field, only the more obscure faults or persistent intermittents are pulled into the workshop.

Then usually only the chassis is taken and rigged up on the bench with a test CRT. One sighs for the clean design and "getatability" of the average British set.

Many earlier Australian models were nightmares of inaccessability. In hardly any is there access to the under chassis. If tests are to be carried out while the picture is observed the chassis must be removed and the tube reconnected with extension leads.

Further complications are added by control panels and turrets on separate sub chassis at the end of trailing leads. Fuses can be hidden away under the chassis or in other fantastic places. In one case the entire works have to be removed to adjust a line oscillator slug, in another it is a two-hour job to change a height control.

405-625

In all fairness it should be mentioned that *some* manufacturers are taking steps to correct this trouble. Notable in this field are Australian H.M.V. whose later sets have a hinged vertical chassis that swings out giving perfect access. This is not a universal trend unfortunately. Some of the latest 23s are still horrors.

Strange to relate the change from 405 lines to 625 with f.m. sound has little effect on service techniques, but the transformer fed parallel heater system has. By far the greater number of faults are in the line oscillator stage and its associated circuits.

This is surprising in view of the reliability of U.K. oscillators. Whether this is due to the type of oscillator used (more often the American pattern) or is someting inherent in the 625 line system with its faster line speed is difficult to say.

Contributor Peter Clement who recently emigrated to Australia gives here an interesting picture of service "down under" and the differences he is finding.

A combination of negative going picture modulation and horizontally polarised signal result in a marked reduction in car ignition and other impulsive interference; so much so that State governments have no need to order ignition suppression as in the U.K. Aircraft flutter is also reduced. Ghosting on the other hand is much more of a problem than back home, and the choice of 300 ohm ribbon feeder instead of co-ax does little to help.

F.M. SOUND

The use of f.m. means that the intercarrier sound system can be used, and all Australian sets I have encountered do so. In this the wide band i.f. stages amplify both sound and vision signals.

At the video detector the sound and vision carriers beat together to produce a 5·5 Mc/s sound i.f. (5·5 Mc/s is of course the difference between the two carriers). This is picked off from either after the video detector or from the video anode, amplified by one i.f. stage and applied to a ratio detector.

It is strange to think that sound troubles can arise in the video stage. Almost the first Australian set I handled had sound distortion which was traced after much difficulty to a dry joint on the video anode load. Picture was perfect.

L.S.D.

Technicians pay is quite generous, At my firm a field technician draws £23 for a basic 5 day, 40 hour week, plus £5 per month bonus for keeping his van clean. Overtime at the rate of £3 for a four hour shift (more for Saturdays) can be worked almost any evening he wishes. A man who works 12 hours on a Saturday can pick up an extra £11 (less tax).

It should be remembered that these are Australian pounds. At the current rate of exchange £1 Australian = 16s. Sterling. Even so these rates are good by most standards. Some firms pay more than this, but I have heard it said, "The pay is good if you live to enjoy it." Income tax is lighter than in the U.K. and a married man can easily *take home* £30 if he is prepared to work a night or so's overtime or a couple of shifts on Saturday.

With overheads like this it is no wonder

(Continued on page 40)

MODERN TAPE RECORDERS
—continued

opposite *spool to that which is receiving tape incorrectly.*

The spring is now shown fully on the diagram, but is a U-bend of sprung copper with a cutout portion, so shaped as to engage the lower portion of the spindle at one pressure for record or playback, to be released entirely on rewind and to be engaged fully on fast forward.

Before adjusting, ensure that the brakes are clear on all functions except neutral, and that the brake drum has no vertical play on its spindle. This can be adjusted by screw K until the drum is just free vertically when the joystick is moved to rewind.

These points being checked, screw L can be tightened, after releasing its locknut, until the spring pressure is such that the spool is slightly under tension on record and playback, but free in rewind.

Care should be taken with this adjustment, first applying small pressure and testing by turning spools with the finger, then applying power to check that belt drive does not alter the situation.

Screw M adjusts the pressure for fast forward. When making this adjustment, ensure that the turntable is stiff to turn by hand and that this action transmits rotary movement to the capstan via the flywheel.

On fast reverse, on these earlier models, the large drum N moves over to engage the belt and drum D is free to unspool its tape. Engagement is assisted by spring P and return to neutral by the longer spring Q.

Speed Change

On later models an additional trouble spot is the speed change. (This range employs 3¾ i/s). To change to 7½ i/s, the capstan drive belt is forked to a larger segment on the motor pulley, and this must only be done while the motor is running. *Despite the manufacturer labelling the deck and emphasising this point in his operational instruction book, there will inevitably be a few "repairs" that merely consist of replacing this belt because of mishandling.*

Another mishandling fault is wow as a result of the pressure wheel having been left engaged. When replacing this rubber wheel, make certain that the larger amount of brass bush is upwards, or the wheel will rub in the head casing and give more trouble.

Further adjustment may be necessary to the capstan bearing, and this can be done by slackening the four screws of H and gently moving the whole plate until the capstan rides freely.

SERVICE DOWN UNDER
—continued

that charges to the customer are stiff. A 15 minute Service call costs £2 2s. 6d. (plus parts of course). Extra time is charged at the rate of 7s. 6d. per quarter hour.

Most firms insist on (and get) cash on the nail. Costs of office staff to send out reminders, etc., would quickly eat away the profits. The public on the whole accept this, whereas the average English housewife would go through the roof.

In the same way a farmer's wife living 20 or so miles from town knows she will get charged travelling time and accepts it. A full maintenance contract costs 18 gns. for the first year rising to 26 gns. for the fourth. This includes a State Government tax of 1s. in the £1. Few if any, firms will insure a set after the fourth year.

NO SPIKKA

High on the list of our technicians' worries is the language problem. There are so many New Australians in Northcote (a North Melbourne suburb) that one chemist displays a sign "English Spoken Here". A prospective emigrant might find a short course in Greek or Italian useful when he lands.

TECHNICAL GEN for SERVICING MEN

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Philips 2192U

TECH GEN 1000

Another imtermittent! This time, the vision faded after some hours of operation. When the fault occurred, we made a quick test, discovered the h.t. was very low, chuckled, changed both PY82 rectifiers, and made ready to go.

Although the picture and sound came up nicely, we took precautionary readings and were astonished to find that the h.t. was still only 165V. This led us to investigate the a.c. input to each rectifier—sure enough one of them was receiving no input.

The feed to this one is via a section of a slider switch (TV–f.m. radio) on the front of the lower chassis. Purpose of the switch section was to cut out one rectifier on radio only and restore operation for TV. This it was not doing, and one lonely PY82 had been battling away gamely all the time. No wonder it faded away. Moral—always check after repairing. — M.A.Q., Bargoed (1000).

Kolster-Brandes PVP20

Shakes and Crackles

Over the phone the customer described the symptoms as picture shaking and sound crackling when anyone walks near the set. Mentally diagnosing a loose aerial coaxial plug or socket I arrived at the customer's home but found it went deeper than that, although tapping the cabinet verified the complaint.

The cabinet shell was removed and the chassis tapped. This narrowed the fault down to a microphonic 9D7 common i.f. amplifier but with the shell removed the fault was less pronounced. The 9D7 was replaced and the cabinet shell fitted back on. The fault appeared to have been cured.

Two days later the customer complained that the fault had reappeared, so the receiver was brought in to the workshop. Here it was found that the 9D7 was microphonic again, so another one was fitted. The cabinet was put back on and the fault seemed to have gone, but a sharp tap on the cabinet brought the condition back again.

The cabinet shell was again removed and I was just going to remove the i.f. panel to see if it had any fault when it was noticed that three of the screws securing the panel to the main chassis were loose. Tightening these securely really fixed the trouble and there have been no more complaints.

The moral here, of course, is never to neglect those loose fitting screws. And, by the way, when we were called in the customer had remarked that he thought there might be a screw loose! —S.W., Buckingham (1006).

Spencer West 174

Wrong Frame Speed

This receiver came in with incorrect frame speed and on test it was found that the speed was well outside the range of the hold control. No circuit was available so the chassis was examined to determine the type of circuit and its frequency controlling components.

It was found that there were two ECL80's in the frame timebase, one being the output valve and the two triodes being employed as a multivibrator. The valves themselves were, of course, changed, but this made no difference to the frame speed.

The multivibrator coupling capacitors and grid resistors were checked but found to be within their tolerances. The hold control itself and its associated components were also fruitlessly checked.

It was then realised that the cathode resistor of the output stage, which was bypassed by 50μF capacitor, was also common to one section of the multivibrator. The bypass capacitor was checked and found to be open-circuit. A replacement restored correct speed.

After the receiver had been on for a short while, the frame started to bounce. This seemed to be a new fault and the usual tests were made. Eventually it was found that the capacitor just fitted had become s/c. A further replacement, followed by a soak test, and we passed the set as OK.—V.D.C., Bristol (1010).

Pye V310F

Video, Sound Faults

The symptoms on this receiver were that the video amplifier was overheating and there was no sync or contrast. On checking the voltages on V6, the video amplifier, it was found that the anode was low and this led to the checking of the grid of the sync separator V16. This voltage was highly positive. The coupling capacitor C67 was checked and found to have a low resistance short. Replacing it cured the trouble.

A sound section fault has occurred on a number of these receivers and has been due to the fact that heat from the sound output valve V13 has caused the ceramic capacitor C56 to crack, resulting in an open circuit. The remedy is to fit the replacement ceramic capacitor as far from the valve as possible.—A.A.S. Mansfield (1009).

Pilot 452

C40 and C49

The fault of no line and of no frame, due to C49 and C40 respectively, identical types of component, going short-circuit, seems to be a common fault on this TV receiver.

The capacitor C49 is the boost capacitor and when it goes short-circuit the symptoms are that the line timebase can be heard to oscillate

(Continued on page 43)

Items for publication

in this feature are welcome, particulary in regard to the more unusual type of faults. All contributions used will be paid for at our usual rates.

When sending in items for Technical Gen, please write (or type) on one side of paper only, adding rough sketches (where considered necessary) on a separate sheet of paper. Correspondence should be addressed to — RR Service Engineer, 46 Chancery Lane, London, W.C.2.

The Editor does not necessarily endorse the views expressed by contributors to this feature.

Tests over

5,000

DIFFERENT TYPES OF VALVES!

MODEL

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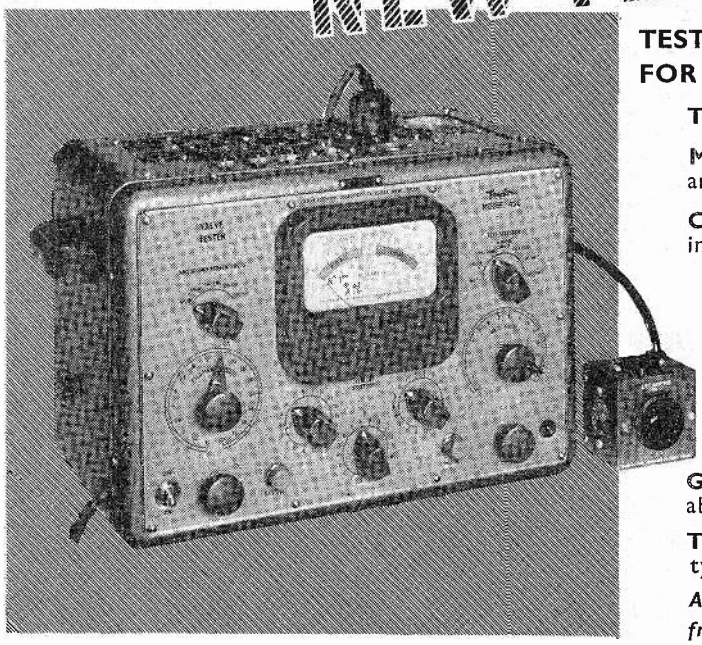

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normally for the first few seconds and then cut itself off with a negative voltage (about −80V) appearing at the grid of the 30P4.

C40 decouples the boosted h.t. feed to the frame timebase and the first anode of the c.r.t. (pin 3). A quick check on this component is to try the voltage appearing at the c.r.t. first anode.—A.C.L., Norwich (994).

Pye V310

Jagged White Line

Severe brushing was evident on this receiver, a jagged white line appearing down the left-hand side of the raster. An attempt was made to localise the source by carefully listening for the familiar sounds, but in this case the brushing was inaudible.

The line output transformer was examined but revealed no sign of a possible fault. Attention was next turned to the scan coils and it was found that when the scan coil assembly was rotated on the tube neck the brushing could be made to come on and off. They were removed but there was no sign of an interwinding leak or breakdown.

It was then noticed that the line scan corrector loop on the neck of the tube had its insulation burnt away in two places, allowing the exposed metal foil to short across part of the scan coils. Insulating with polythene sheeting effected a cure.—V.D.C., Bristol (1011).

● odd spot

FOR unusual symptoms, this one will take some beating as a genuine case. Recently I was asked to attend to an elderly Philips set and this was done with no trouble at all, it being just a common valve fault. But then the fun started.

While I was waiting for a signal in order to set it up, I heard a distinct ticking sound in the speaker, accompanied by sound-on-vision corresponding with each "tick". As I moved back to scratch my head in amazement, the owner of the receiver remarked that he had been experiencing the "ticking" ever since he had had the set.

As I moved towards a clock on the wall, a large old-fashioned pendulum type, I noticed that each time the pendulum swung, so the TV set clicked. Now, although the clock was not, of course, connected to the mains supply in any way, stopping the pendulum stopped the ticking in the set.

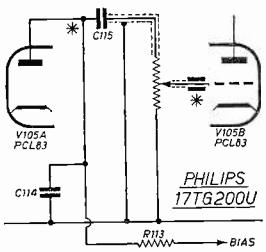
The receiver is near the Mendlesham transmitter and the people concerned were using an indoor aerial which nearly runs above the clock. The only reasonable explanation I can offer is that the pendulum is at a resonant length as the effect is only noticed on channel 11.—R.E.B., Bedford (1005).

Philips 17TG200U

Three Recent Faults

The receiver came into the workshop with distorted sound and it was found that the anode and cathode voltages of the sound output valve were low, as was the voltage on the anode of the a.f. amplifier.

The grid of the output valve was positive and the fault was found while checking this. The ferrox cube bead on the grid lead of the output valve was shorting to the deck on which R113 is soldered, thus bypassing the coupling capacitor (see diagram).



Another fault on the same model was that the line was running slow at about 2 kc/s. Voltages on the reactance and line oscillator valves were 10–15V low and the grid of the PL81 was reading only —15V. Resistance checks revealed that C622 was leaking (500 ohms).

On another 17TG200U the complaint was that sound disappeared after heavy interference was experienced. After the preliminary checks, resistance tests showed that the secondary of S102 was open circuit, thus causing loss of bias and cutting the valve off on the interference pulses. The cures in all three cases are obvious.—A.A.S., Mansfield (976).

Bush TV56, TV96, TV82R

Three Recent Faults

On a TV56, the fault was reduced height, which resulted in the anode voltages of the frame output valve being low. Further checks showed that R51 in the frame linearity circuit had become low resistance thus causing the height to collapse.

Brainless Bertie

Bertie doesn't often use
A genuine replacement fuse,
A piece of cable serves instead,
And when that blows the set is dead.

Feste

On a TV96 the fault was no line sync and R145 was seen to be overheating, this component being part of the line feedback circuit to the sync discriminator. On checking C128, which is in parallel with the resistor, it was found to be leaking. Replacement cured the fault.

On a TV82R the trouble was insufficient height and by moving the frame hold control to the bottom end of its track the picture momentarily went into frame collapse and then to distorted frame. This effect could also be produced by varying the contrast control.

While checking the voltages in the frame circuits the interlace—such as it was – collapsed. This led to checks in the interlace circuits and it was found that the 560pF C104 was leaking. On replacing this component, height and interlace were restored to normal.—A.A.S., Mansfield (1002).

Grundig TK20

Tape Recorder Faults

The customer's complaint was "low volume on playback—not recording". A rough look showed that the machine had been tampered with and the first obvious fault was the record/playback relay, the contacts of which were badly upset. On repairing this, it still would not record.

This was found to be due to a worn and dirty record/playback head. On repairing this the machine worked perfectly except for the fact that the volume level indicator did not work. The trouble here was traced to a short-circuit capacitor C22 which was imposing a positive voltage on the grid of the EM84 through the metal rectifier MR2. On replacing C22 and MR2 the machine worked perfectly.—N.O'R., Fermoy (1007).

Cossor 948

Sets up Howl

The complaint with this receiver was intermittent vision and any attempt that was made to take voltage readings around the i.f. panel (this set has six printed circuit panels) would either bring on or remove the fault condition.

Valves were replaced but to no avail.

(Continued on page 45)

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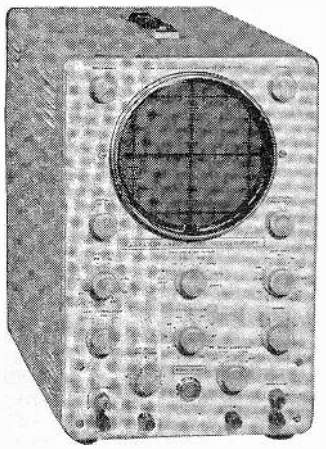

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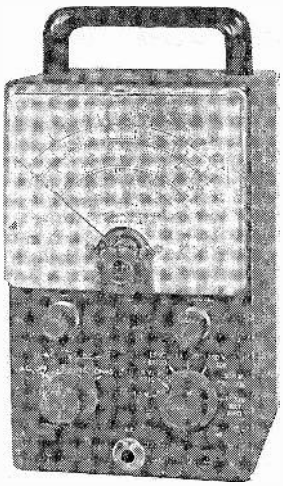

V-7A

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TECHNICAL GEN continued

Then, while taking voltage checks, a howl was set up in an adjoining set when the fault was on. This gave us the clue that the i.f. amplifier was oscillating and further checking revealed that the 0·002μF capacitor decoupling the anode and screen h.t. feed to the vision i.f. amplifier was going intermittently open circuit. Replacement restored normal operation.—F.H., Brighton (1004).

Murphy V510 and V310A

Two Recent Faults

On a V510 the frame just about locked approximately one-third down and the line had considerable pulling to the left-hand side, with very weak locking. The fault was only apparent when the set was first switched on.

Reversal of mains polarity gave exactly the opposite effect: i.e., frame just locking about one-third up with considerable line pulling to the right. The fault proved to be nothing more than a heater-cathode s/c in the 30FL1 common sync valve.

A very poor picture on a Model V310A was thought at first to be due to a low emission tube, but this was quickly disproved. The actual fault was the 6·8kΩ common video amplifier grid and vision detector cathode resistor which had gone down to about 2kΩ. —F.E.R., St. Ives (996).

Stella 8314

Verticals are Bent

This rather misleading fault is more interesting because it could occur with other receivers. The complaint was that all the verticals were bent at the top, indicating a displacement of the lines at the start of the frame scan. The line generator valve was replaced but with no improvement. The sync separator was likewise substituted and the amplitude of the sync waveform examined on the 'scope, but again with no success.

It was found that the fault disappeared when the brilliance was reduced to a very low level. This suggested that an excessive beam current was affecting the line output stage and producing the fault. The tube itself seemed to be normal, with none of the defocusing usually experienced with a soft tube.

The only other thing which would appear to give rise to the fault was a mis-set ion trap magnet. This was duly adjusted in the normal manner and the fault immediately cleared. The brilliance was also increased although it had not appeared to be low before.—V.D.C., Bristol (1012).

Philips 2157U

Frame Fold Over

After running for a few minutes, the frame would fold over at the top of the picture and the whole thing would jitter violently. The ECL80 frame valve immediately came under suspicion, but in this case did not appear to be the culprit. On checking the operation of the preset controls it was found that the frame linearity control was not operative with the fault on.

The control and its associated series resistors were measured but found to be in order. Next, attention was turned to the feedback capacitor shunting the control and resistors (C85, 0·001μF). It measured 500-ohms on the meter.

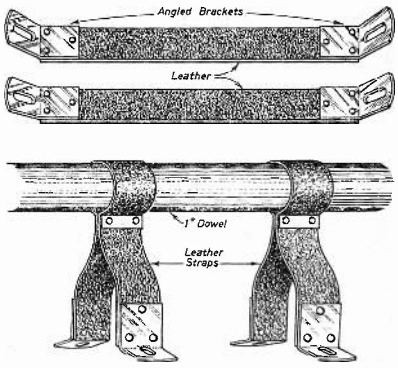
A replacement C85 restored linearity and also cured the jitter. The effect of the leaky capacitor on the linearity is obvious but I am not too clear why it should produce the jitter.—V.D.C., Bristol (1013).

Tape Recorder Remover

Reader's Service Accessory

Skinned knuckles and blue air often result from attempting to remove certain types of tape recorders from their containers. A device has been made in this service department to avoid this disastrous state of affairs.

Two lengths of leather strap are needed, to each end of which are clamped angle brackets, the holes being slotted to allow for adjustment. Also required is a length of ¾ in. dowelling. The centre of each strap is semi-permanently clamped around the rod, with a



reasonable allowance for movement of the straps along the rod to facilitate the gadget's use on various types of machines.

The brackets are clamped on to the supports which normally carry the top plate of the tape recorder. The body of the machine can then be removed with reasonable ease.

The straps should not be made too long as there is a tendency for a reduction in control. The rod is also not essential as if desired the straps can be carried along the forearm and the tape recorder lifted out that way.—A.A.S., Mansfield (979).

SERVICE BRIEFS

Philips Jupiter: This was a case of "double trouble". Symptoms were lack of gain, traced to the second i.f. valve screen decoupling capacitor which had gone s/c. However, I was not satisfied with the results and on further investigation it was found that the screen feed decoupling capacitor on the ECH81 frequency changer had also gone s/c. In future I shall check all voltages. —W.S., Warminster (937).

Ultra V815: Picture was cramped at bottom half of screen and folded over when the height was increased. All components in the oscillator and output circuits were checked and cleared, leaving only the scan coils. These are connected to the frame output valve anode through the electrolytic capacitor C82 which was found to have lost capacitance.—A.H., Barnsley (885).

Pye V510: On first switching on, sound was normal but as line oscillation built up sound faded away. By turning sensitivity control to maximum, sound could just be heard. This rather pointed to either a tuner or a.g.c. fault. After extensive meter work it was found that the grid of the video amplifier was reading zero volts. Inspection of the printed circuit revealed a dry joint to the grid of the video amplifier.—P.M., St. Andrews (887).

Philips 1796U: In a case of reduced frame amplitude, all electrode voltages of the frame output valve were normal and the boost h.t. supply to the triode section of the PCL82 was suspected. The potential difference measured between boost and normal h.t. lines was only 20V. The fault was then quickly traced to the 0·027μF ceramic capacitor C83 which had developed a leak causing the considerable reduction in boost voltage.—N.C., Seaford (944).

Murphy U502: We had several calls to this mains f.m. radio for drifting. This occurred at different intervals of time and would never seem to show up when we had the receiver out of its cabinet. The first valve was changed without improvement and eventually the trouble was traced to the 180pF capacitor C20. We felt this worth reporting, being not only another intermittent fault, but because the same trouble has since been experienced on two more receivers.—T.G., Seaford (946).

No. 16

The Apprentice Engineer

AT THE BENCH

by G. L. A. MORGAN

A page of practical advice, hints and tips, short-cuts and workshop notes for the apprentice.

Using the 'scope—3

MOVING on to TV service with the aid of an oscilloscope we find there are a number of applications where a waveform display can tell us a great deal more than a mass of meter readings.

Recognising this, many set makers quote waveforms rather than figures in their service manuals. The engineer who is familiar with the 'scope will find many short cuts around the synchronising and timebase circuits.

Line Output Stage

Let me start with a word of warning: *beware of the very high pulse voltages around the line output stage. The unguarded prod of the 'scope should not be used when testing near e.h.t.*

Instead, it is possible to employ a small capacitor of high insulation at the tip of the prod. The simplest form is a 'gimmick' capacitor, made from a piece of polythene-insulated wire wrapped around the end of the prod and protruding beyond it. See Fig. 1.

This method will reduce the applied voltage, but there should be ample input from modern timebase circuits to give an adequate display. In fact, the danger is that the 'scope input will be overloaded.

This leads to clipping and resultant errors in diagnosis. Always check that the gain is turned down, or the signal attenuated before application. Most instruments allow for this attenuation.

When testing around the sync separator and oscillator circuits of the timebases, it should only be necessary to clip the prod of the 'scope to the insulation of the wire adjacent to the test point. Alternatively, a small capacitor of about 500 pF can be inserted in the "live" lead. (A series capacitor should normally be used as a protection against high d.c. voltages).

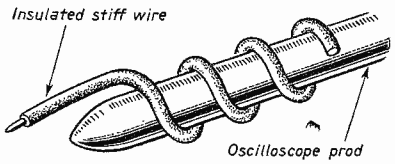


Fig. 1: Method of loose coupling to oscilloscope for testing e.h.t.

Sync Traces

As an example of what might be expected, Fig. 2 shows the traces that may be obtained at input (A) and output (B) points of a simple sync separator stage. The things to note are the appearance of the modulation at the input (the full video signal as applied to the c.r.t.) and the steepness of the leading edge of the sync pulse at the line sync output.

Any "fuzziness" of the upper trace of these pulses indicates that video modulation is getting through to the output, leading the engineer to suspect the operating conditions of the valve—especially the screen grid voltage.

It is worth observing that the upper part of this trace need not be the clean, "ideal" curve but could be something like the shape of the dotted line. Different circuits give widely different waveforms; but the important factor is the squareness of the leading edge and the near-vertical trace of the firing stroke.

Line and Frame Pulses

The line sync pulse will go via the coupling capacitor to fire the line oscillator. There are variations, line sync clippers, shapers and flywheel circuits, but in general the line synchronising will be direct, whereas the frame pulses will be integrated. This is not the place to go into details of line differentiating and frame integrating circuits; in any case, they differ widely from model to model.

The point to note is that the integrated frame pulses give a quite distinctive trace at the input to the frame oscillator. A common test for which the 'scope is indispensable is the vetting of frame sync input for line pulses breaking through—frequent cause of faulty interlace.

This is done by muting the oscillator and looking for the presence of line pulses. With a low sweep frequency, about 25 c/s, a trace similar to that shown at (C) should appear, the line pulses forming a thick line at the bottom (or top, if the trace is inverted).

A further test can be made by increasing the 'scope timebase frequency up to 5 kc/s and viewing the line pulses throughout the circuit.

Logical tracing can reveal the circuit point at which the interfering pulse is entering, much more rapidly than by any other method.

Similarly, quick tests can be made throughout the video, synchronising, shaping, oscillator and output stages for the presence of the correct waveforms.

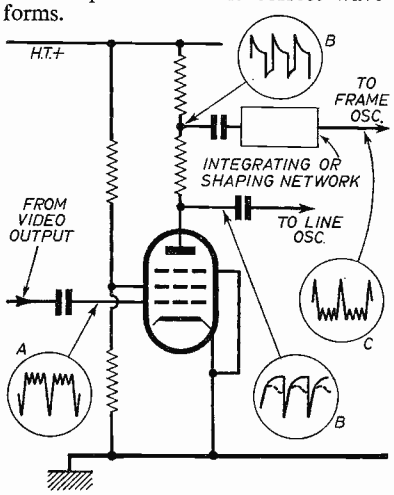


Fig. 2: (Right) Basic sync separator stage showing typical input and output waveforms.

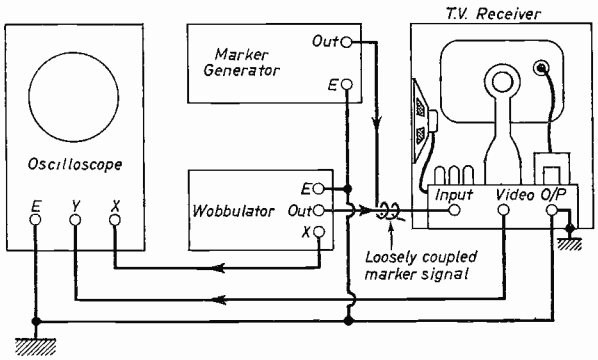


Fig. 3: (Left) Block diagram showing complete hook-up for visual alignment.

Alignment

But the oscilloscope comes into its own when it is employed as an aid to receiver tuned circuit alignment. By viewing the complete response curves of the i.f. stages, as a frequency varying through the pass-band is fed into the receiver, a much more exact idea of signal-handling capabilities of the set is gained than by the numerous fixed-frequency inputs that would be necessary when the signal-generator plus output meter method was used. *In addition, response faults caused by faulty components, etc., are more readily revealed.*

Fig. 3 shows the hook-up for complete visual alignment. It will be noted that a wobbulator, giving a frequency-modulated signal at the basic frequency of the required input, is modulated by an input from the timebase of the 'scope.

Marker Pip

A desirable feature is the provision of a "marker pip". This may be provided by the wobbulator, but if such a facility is not available at the instrument, it is easily obtained by taking the spot-frequency from a normal

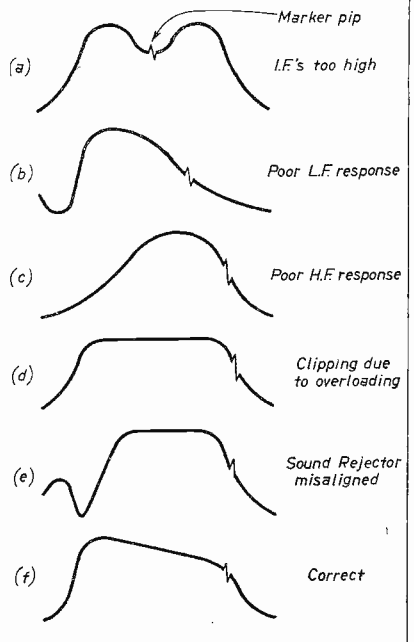


Fig. 4: Typical alignment traces obtained on oscilloscope as described in the text.

signal generator. The marker produces a "pip" on the response curve, as seen in Fig. 4, denoting the exact frequency of a spot on the curve.

This signal should be kept as small as possible, and it is a wise precaution to switch it off occasionally during alignment, as a check against the marker input causing distortion of the curve.

The "Y" terminal of the 'scope is taken to the load resistor of the video detector, and full advantage of the 'scope amplifier may be taken. A larger signal could, of course, be obtained at the video output or cathode ray tube, giving greater vertical deflection, but to ensure correct response it is better to use the former method.

Locking

The 'scope timebase frequency should be within reasonable locking distance of the mains frequency. A setting of 25 or 50 c/s is usual, the fine frequency adjustment being made until the hum voltages due to spurious pickup cancel out and a trace free from vertical jitter can be obtained. This is largely a matter of experience.

When making these alignment tests, beware of overloading! Too large an input to the set end and to the 'scope Y input can cause a curve that looks (like a film star's) too good to be true. See Fig. 4(d).

Instructions

Two or three points to watch: tune rejector circuits before checking response, following maker's instructions; render a.g.c. inoperative – connect a battery between chassis and a.g.c. line, positive to chassis, giving about three volts negative on the line; for sound alignment use sweep of about 1 Mc/s and marker at sound i.f., for vision, 8-10 Mc/s and marker at vision carrier frequency.

Wherever possible, follow the instructions in the maker's manual. If there are no 'scope alignment instructions, practise on a "good" model of receiver, drawing the curves obtained for future reference.

TRADE TOPICS *Letters to the Editor*

The Editor welcomes letters on subjects of technical or trade interest, but does not necessarily endorse the views or opinions expressed by correspondents.

High Speed Record?

I WAS most interested to note that on Service Data Sheet S16, the speed of the K-B RT20 tape recorder is given as 33 i/s.

Is this the breakthrough we have all been waiting for? At this speed it should be possible to accommodate the necessary bandwidth to capture TV signals with fidelity. When the trend is towards slower and slower speed with the corresponding lowering of quality, the manufacturers are to be congratulated on making such a bold innovation.

Unfortunately there appears to be a misprint in your statement, for you say this gives a playing time of 1½ hours on normal tape. According to my slide rule this would need 14,850 feet or 2·812 miles of tape, which would I fear be rather difficult to get under the lid.

However, with a suitable modification to the hinges or the use of stacked spools . . . .—**H. W. Hellyer,** *Gilfach.*

(14,850 feet? Don't forget it is double-track. As a matter of fact the significance escaped us at the time, but we are now investigating the world-shattering possibilities. At the same time we have another team of experts working on the theory that 33 i/s was, in fact, possibly a misprint for 3¾ i/s—Editor).

Personal Toolboxes

IN reply to Mr. Featherstone's comments (May issue), he would be wise to include in his tool box a pair of glasses (optical type) because the description of my personal toolbox definitely includes a "reel of solder and soldering iron" (which is, incidentally a Pifco type with light in handle for getting to grips with components in dark corners).

The 3 in. side cutters are a miniature pair and with the long handles, transistor set component removal is much easier, but perhaps Mr. Featherstone uses his fingers?

I also carry a "shops box", which is an old acoustic gramophone case with the internals removed. This is divided by hardboard partitions of varying width to suit all usual sizes, small compartments into which a small meter fits and a compartment into which is fitted a 5-in. speaker with leads and crocodile clips for use where cabinets are removed leaving no speaker on the chassis.

While writing, I would like to comment on H. W. Hellyer's excellent sense of humour. I often wonder if he is a service engineer himself as certain remarks he makes at times indicate that he has a store of knowledge about the public at large.—**W. Smith,** *Warminster.*

(Mr. Hellyer admits to more than a passing knowledge of the practical side of servicing and usually wears a haunted look on his face due to years of battling with intermittents and testy customers. He wears well considering his venerable age—87 next birthday. As for his sense of humour, we feel that at times this becomes offensive and in the worst possible taste—see previous letter — Editor.)

SERVICE WITH A GRIN

by H. W. HELLYER

Read any Good Books?

FROM time to time our esteemed Technical Editor trundles across to my desk with a bundle of literature. "Review these," he grunts, then oozes away in a cloud of pipesmoke before I have time to protest.

He couldn't be more furtive if he was peddling pornography. Indeed, as I plough through the stodgy text of some of his offerings, I sometimes wish that he was. It is an occupational disease of the writer of text-books to be staid to the point of stultefaction.

The duty of the reviewer is to devour, digest, then disgorge—rather like a literary cow, or one of those disgusting Roman Emperors. And sometimes the aforesaid stodgy text gives a severe attack of mental indigestion. The review comes out wind-laden—and unprintable. Which may be why my initials do not appear as often as my devoted followers would like to see them under the heading "New Books".

Unless it is because I cannot equal the experience of G.L.M., argue with B.R.G. or meet M.A.Q. on common ground; and I lack the caustic wit that D.C. sometimes displays. Or can it be that I am always saddled with those awkward volumes that purport to be *'suitable for the amateur and the practising radio serviceman*".

In his garret above the busy workshop, there may lurk some technical writer who can inform without patronising, discuss without disdain, guide us, goad us, occasionally surprise us with wit, break new electronic ground and leave us avid for more at the end, as if we had closed a thriller.

Such a volume would, of course be rather thick. It would have to contain all the circuits that have ever been. Especially those that do not quite appear in our files. You know the sort of thing . . . we have model BBQ9 and BBQ11, but this unidentifiable chassis must be the one between.

Oozes away in a cloud of pipesmoke.

Although it has several features of each it is common to neither. In some respects it is totally dissimilar.

This fact can sometimes be explained after hours of "going back to basic" in an effort to unravel the set's mysteries, when some blundering know-all leans casually over our shoulder and tells us it was made by a different firm altogether.

In the matter of "going back to basic" this imaginary *vade mecum* will have to be carefully compiled. The serviceman who lightly thumbs the first few pages and is greeted with columns of fundamental formulae or old-fashioned line drawings of section-

Rather like a literary cow.

alised electrolytics is not likely to reach the highly practical sections on "*Getting a little extra gain*" or "*Frigging the printed circuit*" that form the main course.

On the other hand, when he looks up the chapter on "*The Frame Oscillator*" he is more likely to be investigating a cure for cramps than wanting to know the ideal waveforms that can be obtained with a perfect laboratory set-up. Although it is nice to be able to read the underlying mathematics of the fault after a half-hour's tentative probing has revealed a dry joint on the valvebase.

All too often the book is written the wrong way round. Bogged down with theory, the reader misses those practical gems that might have helped him. (Though from bitter experience I find that the umpteen causes of a fault listed in one of those 'Trouble-shooting" volumes never include the fault that is on the set I am testing.)

My agent will handle enquiries.

A few authors acknowledge our yen for practicality and try to cater for it. Among them people like Cocking and Spreadbury, Scroggie and Briggs, who contrive to be entertaining as well as instructive. It's a rare gift. Very down-to-earth are the "Handbook" volumes of our friend Gordon King. Here, a direct personal experience is reflected; reading them, we are quite aware that he has burned his fingers on the same "hot ones" that we have met.

But even these stalwarts have a duty to their publishers. They must write for novice and veteran alike. The servicing fraternity could hardly guarantee sufficient circulation – after all, Joe, when did you last *buy* a radio servicing book? To widen the appeal, the writer has to instruct the kindergarten and sixth form within one set of covers. He must explain to the do-it-himselfer which end of a soldering iron gets hot, and analyse for the service manager the physics of a tunnel diode.

In between these extremes, we plodding servicemen must ferret for information. We need an elbow-level reference book of likely causes and cures, popular and infrequent. Preferably cross-indexed per set and per type of fault. There can be a chapter of basic formulae if you like, and another chapter of pre-digested theory that even we can understand.

A bumper bundle of Tech Gen contributions would fill this bill admirably, don't you think? The idea is modestly offered to our publishers (my agent will handle the rush of enquiries) and I am even ready to assist with the editing. It would make a change from reading and reviewing some of the technical fairy stories that land on my desk.

At least, we could be sure that the faults described really happened. Sometimes they happen too soon! Especially when I take the trouble to write up a snorter after working hours, only to find that what I have polished off for posterity was published by E.L. of Long Eaton, V.D.C. of Bristol, or that ubiquitous Boroughbridge bloke six weeks ago.

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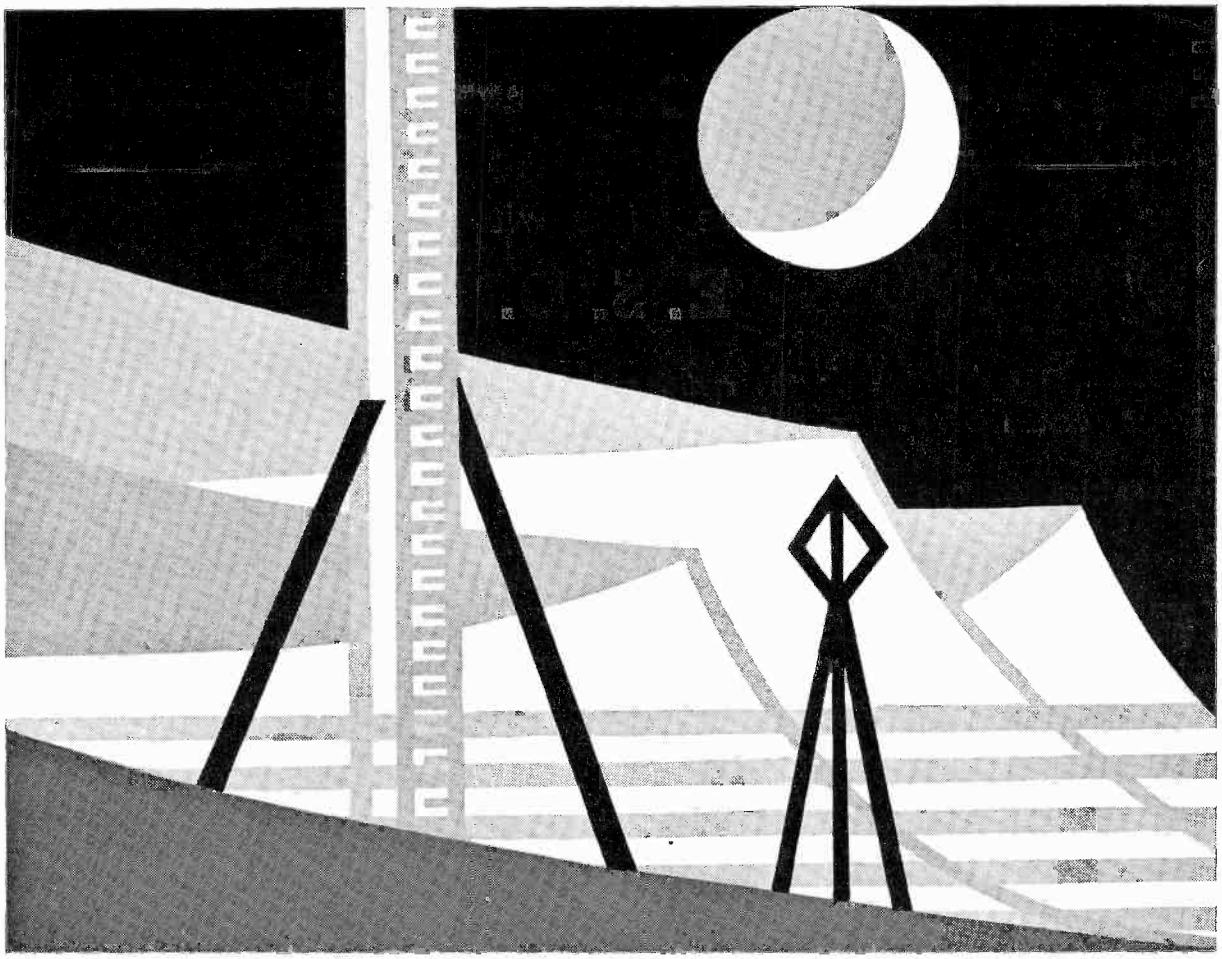

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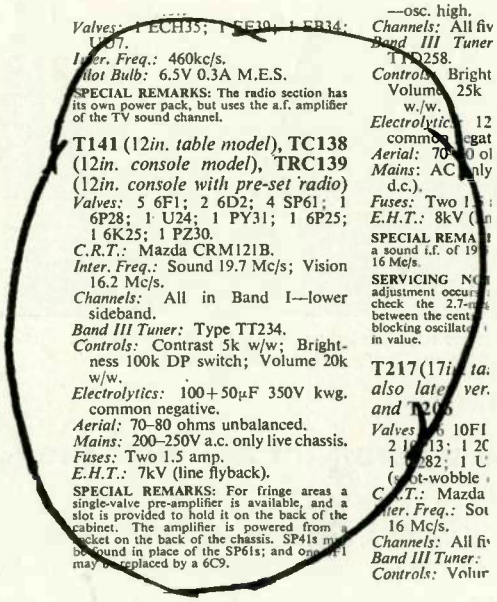
Compiled by GORDON J. KING

ESSENTIAL SERVICING DATA

VOL. 2

Radio Receivers and Radiograms

Volume One has 142 pages of information on TV receivers, of immediate practical value to the television service engineer, both in the workshop and in the field. Details are given of valve complement, c.r.t., i.f.'s, controls, electrolytics, metal rectifiers and diodes, thermistors, surge limiters and mains droppers, mains input, fuses, e.h.t., aerial inputs, together with servicing notes or special remarks. A special section deals in detail with Band III converters and conversion.



Valves: 1 ECH35; 1 EF91; 1 EB34; 1 U37.
Inter. Freq.: 460kc/s.
Pilot Bulb: 6.5V 0.3A M.E.S.
SPECIAL REMARKS: The radio section has its own power pack, but uses the a.f. amplifier of the TV sound channel.

T141 (12*in. table model*), **TC138** (12*in. console model*), **TRC139** (12*in. console with pre-set radio*)
Valves: 5 6F1; 2 6D2; 4 SP61; 1 6P28; 1 U24; 1 PY31; 1 6P25; 1 6K25; 1 PZ30.
C.R.T.: Mazda CRM121B.
Inter. Freq.: Sound 19.7 Mc/s; Vision 16.2 Mc/s.
Channels: All in Band I—lower sideband.
Band III Tuner: Type TT234.
Controls: Contrast 5k w/w; Brightness 100k DP switch; Volume 20k w/w.
Electrolytics: 100+50μF 350V kwg. common negative.
Aerial: 70–80 ohms unbalanced.
Mains: 200–250V a.c. only live chassis.
Fuses: Two 1.5 amp.
E.H.T.: 7kV (line flyback).
SPECIAL REMARKS: For fringe areas a single-valve pre-amplifier is available, and a slot is provided to hold it on the back of the cabinet. The amplifier is powered from a socket on the back of the chassis. SP41s may be found in place of the SP61s; and one EF91 may be replaced by a 6C9.

—osc. high.
Channels: All fiv
Band III Tuner TTD258.
Controls: Bright Volume 25k w./w.
Electrolytics: 12 common negat
Aerial: 70 0 ol
Mains: AC only d.c.).
Fuses: Two 1
E.H.T.: 8kV (
SPECIAL REMA a sound i.f. of 19 16 Mc/s.
SERVICING NO adjustment occurs check the 2.7-m between the cent blocking oscillato in value.

T217 (17i ta
also late ver. and T205
Valves: 10F1 2 1 13; 1 2C 1 282; 1 U (s t-wobble
C.R.T.: Mazda
Inter. Freq.: Sou 16 Mc/s.
Channels: All fi
Band III Tuner:
Controls: Volur

Extract from Vol. 1 showing typical entry.

Volume Two has 190 pages of information on radio receivers and radiograms of equal value to the field engineer and the man at the bench. Details are given of valve complement, mains input, i.f.'s, electrolytics, pilot lamps, controls, mains droppers, waveband coverage, speaker, fuses, and in the case of radiograms or record player unit, pick-up. Notes on aerial inputs, and provision of extension speaker and pick-up sockets are also given. There are also sections on tuners and notes on transistors and printed circuits.

Volume I covers the basic circuit specifications of the vast majority of post-war TV receivers and includes a section on Band III converters. Volume 2 deals similarly with radio receivers and radiograms and includes a section on tuners. Both volumes are packed with data, invaluable in the service workshop, essential to the outside engineer.

Vol. 1—(Television Receivers) **10/6** post paid

Vol. 2—(Radio Receivers and Radiograms) **13/6** post paid

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