JANUARY 1961

RADIO Retailing

SERVICE ENGINEER

Radio, Television and Audio Servicing

SERVICE ENGINEER

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Edited by W. Norman Stevens

Issued as a special supplement with "Radio Retailing"

In this issue:

SERVICE DATA SHEETS

TV169: G.E.C. BT306 and BT308 television receivers.

TV170: Ultra 71/73 and Pilot 51 Series TV receivers.

TV171: Ferguson 506 Series television receivers.

BERNSTEIN TOOL CASE

Comprehensive Contents

Direct TV Replacements have been appointed the sole agency for the Bernstein TV service engineers case. The wooden case is covered with a washable grey plastic and measures 17×13×8 in. A high-grade mirror is fitted to the lid, which is detachable for use in alignment of TV sets and is supported by an adjustable drop stand.

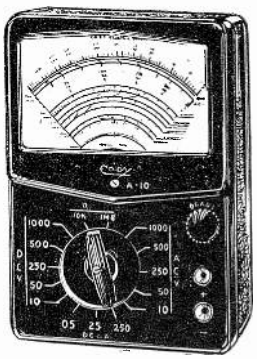
The bottom of the case can hold approximately 62 valves, a testmeter and accessories. The case contains two trays which are fitted with clips to accommodate 50 tools and the prop stand, the layout being such that tools can be selected with ease. The case is fitted with two strong locks with keys and a strong handle.

The large number of tools provided include soldering iron, brush, various pliers, nippers, valve tapping hammer, inspection mirror, tweezers, more than twelve different screwdrivers and trimming tools, testing rods, wrenches, cable splitting knife, files, valve pin straighteners, tinner's snips, double ended spanner, etc. The complete case and contents sells at £26.

ADDA-SHAFT SPINDLES

In their range of *Adda-Shaft* components, Radiospares have released several new spindles. To supplement the existing ¼ in. and 6 mm. types, three new ones make their appearance. The deep flat type has a flat of 0·195 in. as used in Murphy and other sets with a free length beyond mounting bush of 3 in. The key type is specially shaped so that the spindle does not lock in the control and enables adjustment to be made and key withdrawn to prevent subsequent unauthorised adjustment. The preset type has a short spindle of a size to suit the Radiospares spindle locks and slotted for screwdriver adjustment; it converts normal *Adda-Shaft* controls to preset type. All the *Adda-Shaft* types are available in boxes of 6 at 1s. 6d.

Two New Caby Test Meters

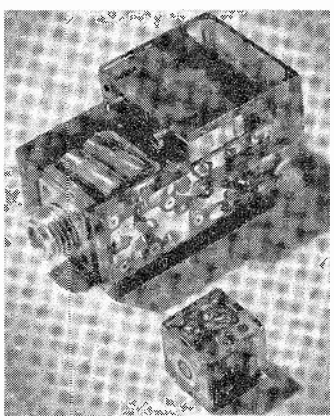


Household Electrix Ltd., of 47 High Street, Kingston-on-Thames, Surrey, send details of the imported *Caby* test meters which they handle. Model A10 is a 2,000Ω/V instrument covering 10, 50, 250, 500, and 1,000V d.c., 10, 50, 250, 500, and 1,000V a.c., 0·5, 25, and 250mA d.c. and resistance ranges of 10kΩ and 1MΩ. Accuracy is ±2 per cent on d.c. ranges and ±3 per cent on a.c. ranges. Measuring 5½×3⅜×1¾ in., and weighing 17 oz., the A10 sells at £4 17s. 6d., including test prods, instruction book and batteries.

The B20 is a larger instrument covering 0·5 and 2·5V d.c. (at 10,000Ω/V), 10, 50, 250, 500, and 1,000V d.c. (at 4,000Ω/V), 10, 50, 250, and 1,000V a.c. (at 4,000Ω/V), 100μA, 2·5, 25, and 250mA d.c., and resistance ranges of 2kΩ, 200kΩ, 2MΩ, and 20MΩ. Accuracy is ±2 per cent of d.c. ranges and ±3 per cent on a.c. ranges. Measuring 5¾×3⅜×2¼ in. and weighing 24 oz., the B20 sells at £6 10s., including test prods, instruction book and batteries.

Dymo Tool and Tapes

Hellermann Ltd., Crawley, Sussex, announce a new version of their standard *Dymo-mite* hand embossing tool, the Type M3, which has the additional facilities for punching holes in the ends of the embossed labels as well as for rounding the corners of labels. *Dymo-mite* vinyl embossing tapes can now be supplied with a matt finish and *Dymo* tapes are available in twin-colour schemes.



This is a microminiature preamplifier unit, no larger than a 0·5 inch cube, shown with its predecessor, produced by McMichael Radio Ltd for use in telemetry equipment. It is encapsulated in *Araldite* epoxy resin, which permits the use of very fragile components in a much smaller assembly.

Appointment

Frank J. Healey, pictured right, has been appointed Service Manager of the radio and television division of Dynatron Radio Ltd.

Mr. Healey has for the past four years been senior outside service engineer for the same company.

NASHTON ADDITIONS

Nashton announce their Type T11 transistorised r.c. oscillator with the facility of a quadrature output. Frequency range is 0·2 c/s to 20 kc/s in ten switched ranges with six-position multiplier. Accuracy is ±2 per cent down to 20 c/s, ±3·5 per cent down to 0·2 c/s. Two outputs (90-deg. phase difference) each give a continously variable voltage up to 0·3V r.m.s. with a stability of ±2dB and distortion of less than 1·5 per cent or 3 per cent. Price is £68.

The T12 is a portable r.c. oscillator with a frequency range of 20 c/s to 200 kc/s in ten steps and four range multipliers. Accuracy is to within ±2·5 per cent of indicated frequency. Output is 1V p-p, level being +2dB (reference level 20 kc/s on 10^4 multiplier). Distortion is less than 1·5 per cent. Price is £46 10s.

Service Viewpoint

Sunk without Trace

MENTION the word "trace" to the average service engineer and he will start thinking of those strange (and sometimes incomprehensible) squiggles he gets on the screen of the 'scope. But if events progress on anticipated lines the word concerned may have a deeper significance providing that it is spelt with capital letters.

For *TRACE* is yet another example of artfully contrived initials, arranged to make a complicated series of initials (generally unnecessary in the first place!) pronouncable, such as ERNIE, VERA and the rest of the gang.

This time *TRACE* stands for Transistor Radio Automatic Circuit Evaluator, which could mean practically anything and must have been the result of many tortured hours of perspiration and inspiration. It is an American innovation, dreamed up by the Philco company to aid service engineers in their battles with printed circuit transistor radios.

The *TRACE* outfit consists of a set of plastic-coated boards, one for each model in the range, contained in a folder. The *TRACE* board fits over the printed panel of the receiver (wiring side) and has a block diagram of the circuit in black, with r.f. signal paths shown in blue, i.f. paths in red and audio signal paths in green.

At test meter and signal generator injection points (transistor connections, i.f. transformers, etc.) holes are provided so that with the board in place the engineer applies the probe at the appropriate hole.

Servicing becomes simply a matter of signal tracing to isolate the fault, injecting audio, i.f. and r.f. signals, working from speaker to aerial, in the conventional way but without having to work out where to apply the signal. Having arrived at a point of no output, the valve voltmeter is applied to check transistor voltages at the isolated stage, using the holes provided for the purpose.

In other words, for straightforward faults, trouble-shooting by this system is a job the apprentice can handle comfortably. And it is obviously quicker than working out the relationship between the physical and electrical aspects of a receiver, unless one is very familiar with a particular model.

Although Philco are to date the only company producing these *TRACE* boards on a comprehensive scale, General-Electric have followed with a similar aid for one of their transistor portables, preferring the more romantic name of *Silent Partner*, and we understand that other American manufacturers are working on the idea.

If the idea catches on, it can be adapted to suit more elaborate equipment—audio amplifiers, TV—and may well lead to a revolutionary approach to printed circuit servicing techniques. And it could well be a means to overcome the seemingly insoluble problem of the shortage of trained technicians. With such devices, the number of skilled engineers per workshop, could be lower than the present desirable minimum.

In addition to the block plan on the working side of the board, the Philco *TRACE* has the circuit diagram on the reverse side. In this way, all relevant servicing information is available in a convenient form, thus eliminating the need for separate service manuals. And in the future, a service engineer without his service boards would find himself in the condition suggested in the title of this article.

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.

Service Reform

WHAT opportunity has the keen apprentice in what seems today to be an environment of rank-conscious old hands and precipitated servicing? The 330 candidates who were referred in the RTEB practical radio test of 1959 could well be due to lack of adequate practice in fault finding, etc.

The eager apprentice, many of whom are more ambitious and intelligent than were their predecessors, is frustrated at an early stage of his studies, simply because his valuable time is wasted by the habitual repair of electric fires, toasters, irons, and suchlike.

This was the general routine ten years ago, but with the advancement of electronic novelties and the possibility of colour TV in the not-so-distant future, this silly argument of "five years radio before TV trouble shooting" must stop and more consideration given to service reform.

Unfortunate is the case of the bookworm enthusiast who regularly keeps in touch with his theory but whose daily task is delivering the repairs he never does. What are his prospects of study and training if he is seeking immediate reward?

He deserts the radio and television field to better his prospects in the more fascinating and glamorous field of electronics. Can you blame him?—**V. L. C. Young,** *Ipswich.*

Insult

THE editorial *Add a Little Method* (November) was an insult to a hardworking body of men. It is simply not true that the radio repair trade is full of "haphazard hamhandedness". The myth of the bungling serviceman seems to be the result of the modern do-it-yourself craze.

It is worth noting that recruits to our ranks from the do-it-yourselfers are often extremely able chaps. More often it is the older engineer, stuck in his rut, unwilling to learn new methods, who gets the trade a bad name.

But on the whole, those engineers who come to the trade and manage to stay the pace do not need the kind of criticism handed out in your editorial—**J. Mortimer,** *Swansea.*

Things to Come

IT must have been due to reading the recent correspondence on apprentice difficulties and pondering over your party game of *Mergers* in the December issue. The cheese may have helped, too. Anyway, the result was a very disturbing dream . . .

I was one of the brave new engineers. Owing to poor intake the service workshop was manned entirely by doddering old has-beens with grey beards and gout, supplemented by half-witted apprentices with buck teeth and the I.Q. of a Bluebottle.

It seems that company mergers had been proceeding with such rapidity that the logical conclusion had been reached and we now had one all-encompassing monolithic conglomeration of companies. They produced one range of radio, TV and audio equipment, marketed under sixty-five different trade marks.

This was helpful to those compiling service data sheets ("this chassis is common to the following 65 models") and was ideal for the limited mentality of the engineers who by then had been reduced to the level of babbling imbeciles not only incapable of passing the RTEB but incapable even of spelling it.

Just before I woke up I discovered that a government of a certain political persuasion had nationalised the whole cumbersome giant and *the* national newspaper (they had all been merged) announced the end of capitalism by a process of self-detruction. The date on the newspaper was 1984—**D. Cameron,** *London.*

No. 14

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.

IT is a regrettable fact that most radio and television engineers "work blind" for the greater part of their time. Using the minimum of test equipment, they apply the yard-stick of experience to the job in hand, and are more often successful than not—whatever the customer may tell you!

The apprentice, however, lacking that experience that provides the short-cuts, has to proceed with his tests "according to the book". The more of this he does, the better for his future. The sounder his groundwork of basic theory, the more firmly can he build his reputation with later experience.

Reluctance

Yet we continually hear from service managers and others concerned with apprentice training that lads fight shy of instruments. This applies mainly to the more complicated, more specialised instruments, such as pattern generators, comprehensive bridges and wobbulators, and most particularly to the oscilloscope.

Even the old hands are reluctant to use the 'scope for routine work, it seems. Its especial virtues are not always realised, its complete functions only hazily understood.

The scope is much more than an instrument for alignment. It can speed service considerably if it is intelligently used. Waveforms in all parts of the set can be studied and rapid diagnosis made, especially in the complex circuits of timebases and a.g.c. networks, and these tests can be made with the minimum of disturbance to the receiver.

Characteristics

There are many oscilloscopes on the market, with a wide variety of characteristics. Generally, however, the instrument for service department use will need a linear timebase from 10 cycles up to 100 kc/s or more. The vertical amplifier must have variable gain and wide response, the response characteristic being the important factor, usually required to be high-gain at low frequency, say 200 times or more at up to 500 kc/s bandwidth, and a gain of much less than this, say 30 or 40, at the greater bandwidths required for studying complex waveforms with high-frequency components (up to 5 or 6 Mc/s).

X Timebase

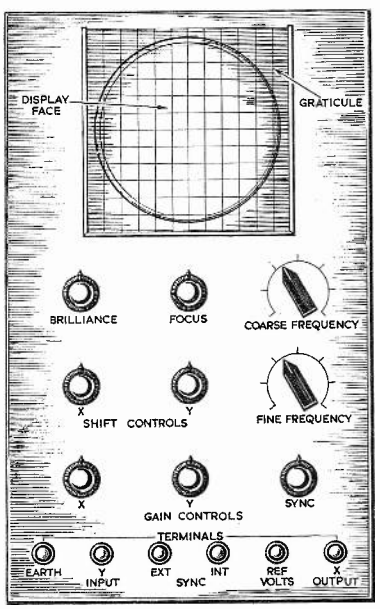
The X timebase (which moves the spot horizontally across the display face of the c.r.t.) will be fed through an amplifier, altering the gain of which will alter the width of the display. Altering the frequency of the X timebase will allow the internal frequency to be brought into step with the frequency of the voltage under inspection.

When both are the same, one complete cycle appears on the screen of the scope. When the internal timebase is a sub-multiple of the external frequency, the appropriate number of cycles appears.

From this we have a means of checking frequency, for the X timebase can thus be synchronised to the known mains frequency of 50 cycles. Usually there is further refinement, the X timebase voltage being brought out to a terminal on the front panel of the scope to provide a "sweep" voltage.

This should not be confused with the "Sync" input. The purpose of this latter is to provide a signal to the X timebase from the input voltage (which is fed to the Y or vertical input). The provision of an external sync input is for synchronising the X timebase to an external source of frequency, which has special applications, as we shall see later.

Using the 'scope



Typical oscilloscope control panel.

Internal Sync

When using the internal sync, it is usual for these two terminals "Internal and External Sync" to be strapped together. This depends on the particular design of the 'scope.

The "Shift" controls move the whole trace bodily across (X), or up and down (Y) the screen. Focus and Brilliance controls will be self-explanatory to anyone accustomed to handling television receivers.

A further refinement is the provision of an input for a reference voltage. This is used for calibrating the gain of the Y amplifier, a note of the height of the trace being made for a known voltage. This can be derived from an internal mains transformer and the readings taken and marked either on a transparent graticule or calibration chart.

Thus the "Y-Gain" and "Y-Shift" controls can both be calibrated directly in voltage measurements. This voltage will, of course, be r.m.s., and must be multiplied by 1·414 to obtain a peak reading, or, as is more usually needed, by $2 \times 1{\cdot}414$ for peak-to-peak measurement.

Laying the Ground

This rather skimped introduction to the scope is simply to lay the ground. Old hands will, I hope, bear with me when I go on to say that the scope has an input impedance which will load the circuit to which it is connected.

Allowance must be made for this, and the maker's specifications should be checked. Moreover, there may be different types of connecting probe in use, each of which will have its own impedance, for which allowance must be made.

The input to the scope is normally taken directly between the earth terminal and the appropriate input, and is a voltage input. But the scope can be used for current measurement just as easily by connecting the appropriate input across a suitable resistor. The resistor is inserted in the circuit in such a way as to provide a voltage for the scope to measure.

We shall later go on to some practical hook-ups in which the scope can be used, and discuss the waveforms that we can expect to be displayed. Before closing this short introduction, however, let me sound a note of warning.

Much work with the scope will be done on a.c.–d.c. equipment; always check the polarity before connecting the scope, or indeed any instrument, to the equipment under test. Make sure the chassis of the receiver is not live.

New Books

Practical Electrician's Pocket Book, edited by Roy C. Norris. Published by Odhams Press Ltd., 6 Catherine Street, London, W.C.2. Size 4×5 in. 530 pages, illus. Price, 7s. 6d.

HERE is the latest edition, the 63rd, of a well-known old friend, in its familiar size and red binding. Little needs to be said about it, except to draw readers' attention to the new revised sections. The 1961 edition has a useful 14 page introduction to automation and new chapters on automatic oil-burning units, maintenance of motors, transformers (principles and practical designs with hints on installation and maintenance), wireman's tools and accessories, and staff location systems.

The chapter on domestic appliance repairs has been revised and extended, Lighting is re-shaped to provide greater practical guidance, Power Factor Correction has been revised, Instruments and their Use has been enlarged to cover the latest products and Space Heating has been revised.

Anyone whose work touches on the practical aspects of matters electrical cannot go wrong on the modest price asked for this valuable reference book. —*S.W.*

Practical TV Troubleshooting compiled by the staff of Gernsback Library Inc. Published by Gernsback Library Inc., 154 West 14th Street, New York 11. Size 5½×8½ in., 128 pages. Price 18s. 6d.

THIS is a collection of outstanding servicing articles from recent issues of the well-known *Radio-Electronics* magazine. In thirteen chapters are contained the observations of a group of top technician-writers on the "really tough troubles", the emphasis being on cutting time and making more profits.

Books on TV troubleshooting from across the Atlantic are seldom more than curious to the British serviceman. With the barrier of different standards, mains voltage and frequency and design techniques, there seems little common ground on which we may meet our American cousins.

Reading this 102nd addition to the excellent Gernsback Library made me feel less distant. It caught my interest, held my attention and finally earned my approval. The Yanks, it seems, are as human as we.

They too hate intermittents, revel in the more obscure "dogs" and chew for hours over the ones that "nearly got away". And in this collection they do it with sufficient humour to make the lecture entertaining. We chuckle, and learn a lot.

Some of the chapters, such as No. 7, on the Synchro-Guide, 11 on Foldover and Halos, and 13 on Gated-beam discriminators contain much that is not applicable to British systems. But others, with titles such as "Intermittents", "Ghosts" "Common Faults", "Horizontal timebases" "Oscillator Squegging", have the kind of universal information that will benefit any technical reader.

Well written, with plenty of explicit diagrams and some photographs illustrating Chapter 12, on Common TV Faults, this inexpensive book should prove of interest. It does not purport to be a textbook, nor a reference manual, yet within its limits it succeeds in imparting a great deal of useful information.

If there is one criticism that could be levelled, it is that nowhere in the book is credit given to individual authors of the chapters—a bonus they well deserve.—*H.W.H.*

★ *With regard to the note in the November issue concerning Gernsback Library publications, while these are in fact available from the Atlas Publishing and Distributing Co., we understand that the British Agents for this series of publications is Modern Book Company, 19 Praed Street, London, W.2.*

TECHNICAL GEN for SERVICING MEN

RADIO, TELEVISION and AUDIO FAULT FINDING

PRESENTING DETAILS OF FAULTS ENCOUNTERED, DIAGNOSED AND CURED BY SERVICE ENGINEERS ON RADIO, TELEVISION AND AUDIO EQUIPMENT, TOGETHER WITH HINTS AND TIPS OF USE TO OTHER SERVICEMEN IN DEALING WITH DAY-TO-DAY SERVICE WORK.

Cossor 950

Vision I.F. Trouble

This receiver came in with very weak, poorly defined, picture. The 6BX6 vision i.f. valve was found to have low emission, so it was replaced. Signal strength was now very much improved, in that when the contrast control was turned up the picture would overload and go negative, but the picture was still very grey with no real black and white, very much as if the tube emission were failing. However, as raster brightness was normal, this was ruled out.

On checking the video stage, the 100kΩ resistor, which is connected from pin 6 (anode) of the PCF80 video amplifier to chassis, was measured and found to be more than 1MΩ. This resistor was replaced, with no noticeable improvement.

As all other components in the video amplifier circuit were O.K, the preceding stage was checked and the video detector diode and the overload diode (both OA79's) were found to have identical forward and reverse resistance of only a few ohms. Both were replaced, and the picture was restored to normal.

If the 6BX6 valve had suffered from a grid-screen short circuit before losing emission, the overload diode (which is in the grid to chassis circuit of the 6BX6) would be damaged. And if the 6BX6 conducted very heavily with the internal s/c, the voltage produced across the secondary of the i.f. transformer may have been enough to damage the detector diode.—G.C., Boroughbridge (866).

Pye P160BQ

No Sound Output

The customer complained that with this fairly new transistor portable radio he could get no sound. On test, a fairly loud tunable oscillation was noted on longwave but nothing at all on medium wave except for a very soft "valve" hiss, only discernible with the speaker very close to the ear.

Attention was directed to the front end and after aerial and various components were eliminated, probing of the 0·0068μF polystyrene capacitor C2 brought on sound on both medium and long wavebands. The trouble seemed to be a dry joint and both ends of the capacitor were resoldered and the set appeared to be satisfactory.

When the customer came to collect the set we switched it on to demonstrate, as normal, and—the set showed exactly the same symptoms as before the "repair"! Further testing showed that C2 was going intermittently o/c. A replacement gave permanent cure.—F.E.R., St. Ives (850).

Bush DAC90A

Valve Base Error

One of these radio sets was brought in suffering from severe mains hum and the fault was eventually traced to an internal leakage from the output valve heater to pin 4, which is used on the valve base as an intermediate connection for the grid input coupling circuit. A new output valve cured the fault.

However, several weeks later the set was returned to us with exactly the same fault, due to exactly the same cause. On checking with the valve manual it was found that pin 4 of the UL41 is labelled "IC" and so should be left unconnected.

Accordingly, the grid input circuit wiring was simply and conveniently altered to avoid the intermediate connection to pin 4. The set then functioned perfectly without the need for a new valve.

Recently, another of these sets came in with the symptoms of weak output. This was traced to a positive d.c. voltage on the output valve grid. Again an internal leakage in the valve on to pin 4 was the cause and the same modification cleared the fault.

The original wiring of the grid circuit in both cases was the same and it would appear that an oversight occurred during manufacture. These faults emphasise the importance of following the valve makers' instructions and leaving pins marked "IC" unconnected.—E.L., Blackburn (895).

H.M.V. 1893

Low Frame Scan

Low vertical scan in this model served to show how a circuit remote from the one showing the fault can be the source of the trouble. In this case the frame scan was only about half of the raster size expected. It did, however, appear quite linear, although it was noticed that the two linearity controls (one for top, one for overall) did operate but the top one had a far greater response.

Knowing that the frame height was obtained from the boost h.t. line, a glance at the line scan, which gave full sweep, seemed to indicate that all was well here. However, this was misleading, as tracing back from the height control to the voltage take-off from the boost line at R78 gave only the standing h.t. line voltage.

The other side of R78, however, was at boost voltage, around 600V. The culprit was shown to be C63. The resistor could have gone high, but this was unlikely. A replacement C63 cured the fault.—A.B.C., Billericay (839).

Ferguson 506T Series

Two Makers' Mods

Quite a number of these receivers sooner or later develop frame linearity trouble, namely cramped at the bottom and stretched at the top. From experience we find that in many cases replacement of the 0·1μF capacitor C98 by one of 0·05μF cured the trouble. But if the fault persists, a more extensive modification is necessary, as follows:

Change R127 from 270kΩ to 120kΩ.

(Continued on page 135)

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

TECHNICAL GEN *continued*

Change C95 from 0·05μF to 0·02μF. Fit a 1MΩ, ½W, resistor between the anode of V13A and chassis. Replace C63 and C97 (both 0·01μF) orange coloured and plastic covered capacitors, which are known to collect moisture condensation under the cover and cause leakage.

Also on this range, for cogging on BBC Test Card C, replace the 0·001μF capacitor C53 with one of 0·03μF. This, and the previously described modification for frame non-linearity, have been introduced by the manufacturers in their later Model 646T.—E.L., Long Eaton (891).

Philips 1768U

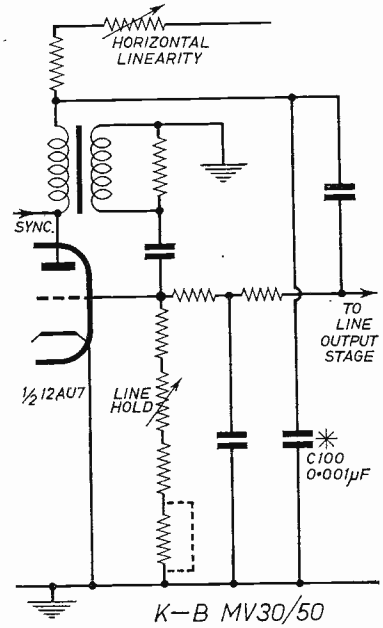
Tuner Unit Fault The customer complained of loss of sound and vision on Band III. On Band I sound was good, but vision signal was very weak—adjustment of the contrast control had very little effect. As a first check the tuner valves were tried, but with no improvement and the gain of the vision i.f. strip was checked and found to be satisfactory.

Voltage tests on the tuner revealed that R311 (6·8kΩ), the oscillator anode h.t. feed, had gone high. This component was a spiral type carbon resistor with plastic sleeving tightly fitted over it. No doubt this would reduce its heat dissipation and I suspect may have accelerated its failure.—L.T., Ashtead (879).

K-B MV30/50

Line Circuit Fault This was an intermittent fault which did not occur until the receiver had been on soak test for several hours. The symptoms when the fault did develop were line tearing and a peculiar smearing of the picture with a very touchy line lock.

Luckily the fault stayed on long enough for a clue to be obtained, and this was when the horizontal linearity control was adjusted. A definite change of line oscillator frequency was noted and a check of the most likely culprit, the 0·001μF decoupling capacitor C100, solved the problem. It had been breaking down intermittently.—J.P.J., Burnley (840).



Brainless Bertie

Bertie assisted the storeman—
Soon there was several quid lacking—
Sub-caps and silicon diodes
He had tossed out with the packing.

Feste

Pye V510

No Line Drive In a case of no e.h.t., having checked most of the likely components with little success, we decided to bring the oscilloscope to our aid. On switching on the set from cold, a check was made to see if, in fact, there was any line drive.

As the set began to warm up and the line oscillator started to operate, drive at the PL81 grid was normal. However, after the set had been running a little longer, drive suddenly stopped. A check on the oscillator revealed it had also stopped operating.

A routine check failed to bring anything to light and so attention was turned to the discriminator circuit. This receiver uses a twin selenium diode D3–2–1Y and our testing revealed that one half had gone o/c. In the type of circuit used, pulses are fed back from the line output stage to the centre tap of the diodes for the purpose of comparing its frequency with that of the sync pulses.

It was now clear that only one diode had been conducting, so that instead of the discriminator being balanced, a heavy negative bias was being applied to the line oscillator control circuit, so biasing it off as soon as the line output stage started to work. A replacement restored normal operation.—C.S., Cambridge (896).

Bush TV75, TV85

Two Recent Faults A Model TV75 came in with the fault of no e.h.t.; in fact no oscillation. Valves were checked and so were all components in the oscillator circuit. Further tests proved the line output transformer and scan coils to be satisfactory. All components in the line output circuit proved good, too, except for C119, the efficiency diode

(Continued on page 137)

RECEIVER SPOT CHECKS

No. 64: FERGUSON 506T and 508T

Low Gain: Check R6 for h.r. and C8 for leakage.

No Sound or Vision: Check R146 for o/c and C10 or C21 for s/c; R31 for o/c and C31 for s/c; R8 for o/c and C11 for s/c; R11 for o/c and C13 for s/c; C14 for leakage and C33 for leakage or s/c.

No Vision: Check R47, R48, R56 for o/c and C45, C46, C53, C54 or C56 for s/c. Check for faulty W3 diode. Check L38, L39 or L40 for o/c.

No Sound: Check R92 or R94 for o/c and C95 or C79 for s/c. Check for faulty W4 diode or T2 for o/c. Check R105 for o/c, C88 for o/c or s/c.

Low, Distorted Sound: Check R101 for h.r. or o/c.

Low Brilliance: (Or no brilliance without signal). Check C112 for leakage or s/c.

Inoperative Line Timebase: Check T4 primary for o/c, C66 or C64 for o/c or s/c, C65 or C61 for leakage. Check R84 for o/c and C68 for s/c.

Wrong Line Frequency: Check R73 for h.r.; if necessary to replace, use high stability type. Check C66 for leakage.

Poor Line Sync: Check C59 for o/c.

Inoperative Frame Timebase: Check C91, C92 or C93 for fault. Check C94, T3 or R119 for o/c.

Insufficient Height: Check C63 for s/c or leakage, causing loss of h.t. potential on V13A anode and diminishing brightness. Check C98 for leakage.

Poor Frame Linearity: Check C96 for o/c or low capacitance. Check C94, C97 or C98 for leakage.—E.L., Long Eaton (741).

Heathkit
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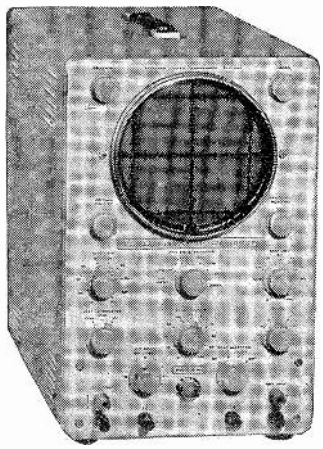

Heathkit 'Scope

PORTABLE 2¾" SERVICE 'SCOPE, Model OS-1

The OS-1 uses a 2¾" cathode ray tube and is a compact portable oscilloscope ideal for servicing and general laboratory work. Y amplifier sensitivity 10mV/cm; response ±3dB 10 c/s–2·5 Mc/s. Time base 15 c/s–150 Kc/s. Features include Int. Ext. and 50 c/s sync; Sine sweep; time base output for wobbulator; X amplifier socket; 1. 10 and 50 volt calibrator. Uses printed circuit board for consistency and ease of assembly. Case 7⅜" × 4 11/16" × 12½" long. Weight only 10½ lbs. ..... **£18. 19. 6.**

5" FLAT-SCREEN OSCILLOSCOPE, Model O-12U

Laboratory instrument at utility 'scope price. Exceptionally wide-range time-base (10 c/s to 500 Kc/s) "Y" frequency range 3 c/s to over 5 Mc/s, sensitivity 10mV RMS/cm. Electronically stabilised. Output for Wobbulator. Voltage Calibrator (1 volt pk. to pk. source). Instantaneous shift, drift free. Automatic lock-in synch. Rise time 0·08μ secs or less. "Z" modn. facilities, 2-gold-plated printed-circuit boards and pre-cut cable wiring harness greatly facilitate assembly. ..... **£34. 15. 0.**

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VALVE VOLTMETER, Model V-7A

Because of the accuracy, reliability and sheer value of the Model V-7A it is outselling all other VVM's. The precision and quality of its first-class components cannot be duplicated elsewhere at this price. Indication is by a large 4½" 200μA meter clearly calibrated for all ranges. The voltage divider networks use 1% precision resistors. A gold-plated printed-circuit board simplifies the assembly, saves time and eliminates the possibility of wiring errors. It also ensures duplication of laboratory performance.

This multi-function VVM measures A.C. Volts (RMS and pk. to pk.), D.C. Volts and Resistance. The 7, A.C. (RMS) and D.C. ranges are 1·5, 5, 15, 50. 150, 500 and 1500. The 7, A.C. pk. to pk. Voltage ranges are 4, 14, 40, 140, 400, 1400 and 4000. D.C. input impedance is 11MΩ. Seven Ohm-meter ranges have multiplying factors of X1, X10, X100, X1000, X10K, X100K and X1MΩ. Centre-scale resistance readings are 10, 100, 1000, 10K Ohms, 1MΩ and 10MΩ. A centre-zero dB scale is provided also for measuring audio amplifier performance. Test leads, prods and battery are included in the kit..... **£13. 0. 0.**

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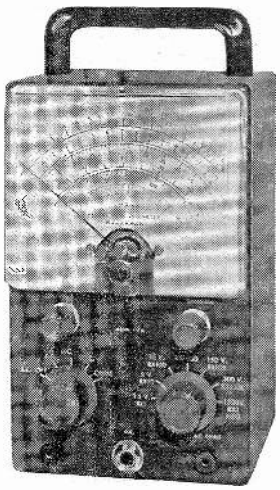

V-7A

Other Models Include :

OSCILLOSCOPE TRACE DOUBLER, Model S-3U. Will extend application of single beam oscilloscope by enabling it to give simultaneous traces of two separate and independent signals... **£9. 18. 6.**

RESISTANCE/CAPACITANCE BRIDGE. Model C-3U. Measures Capacitance 10pf (0·00001μF) to 1000μF; Power Factor; Resistance, 100 Ohms to 5 Megohms, and indicates leakage. ..... **£7. 19. 6.**

AUDIO SIGNAL GENERATOR. Model AG-9U. 10 c/s to 100 Kc/s Sine-wave output, 10 volts down to 3 mV f.s.d. Less than 0·1% distn. Decade frequency selection. dB ranges, −60+22. ..... **£19. 3. 0.**

Multimeter, MM-1U. Measures wide range of voltage, current, resistance and dB in over 20 ranges. Sensitivity 20,000 ohms/volt D.C. and 5000 ohms/volt A.C. 0-1·5, 1500 volts A.C. and D.C. O-150 μA, 15 A D.C. Resistance 0.2 ohms to 20 megohms. 4·5 in. meter, 50 μA f.s.d..... **£11. 8 6.**

WIDE-BAND AUDIO WATTMETER. Model AW-1U. Ideal for audio power measurements. 10 c/s to 250 Kc/s; 25W. continuous 50W intermittent. Switch-selected non-inductive int. or ext. load. 1% multipliers. 200μA meter calibrated in Watts and Decibels. ..... **£13. 18. 6.**

WIDE BAND AUDIO VALVE-MILLIVOLTMETER. Model AV-3U. This sensitive and highly stable VVM quickly measures A.C. mains, ripple and heater voltages, audio input/output, gain in volts and dB's. Range 10mV to 300V full scale deflection ..... **£13. 18. 6.**

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POWER SUPPLY UNIT. Model MPG-1. Provides 3 D.C. outlets 250–300 volts up to 90 mA., 170–220v. up to 30 mA, 150–200v. up to 10mA and 6·3v at 2·5 A A.C. ..... **£4 9. 0.**

DECADE CAPACITANCE BOX. Model DC-1. Precision 1 per cent silver mica capacitors are used and switches are of the ceramic wafer type to ensure minimum loss. Three decade switches are used and cover a range of 100 pF to 0·111 μF in increments of 100 pF..... **£5 18. 6.**

R.F. SIGNAL GENERATOR. Model RF-1U. Provides extended frequency coverage in six bands from 100 Kc/s to 100 Mc/s on fundamentals and up to 200 Mc/s on calibrated harmonics. Up to 100mV output on all bands. Ideal for alignment..... **£11 11. 0.**

GRIP DIP METER. Model GD-1U. A Grip Dip Meter giving continuous coverage between 1·8 and 250 Mc/s. Self contained, including mains power supply for 200–250 volts A.C. operation. Box of 5 plug-in coils supplied. The instrument can be used to measure resonant frequency, inductance, capacitance and Q factor together with locating the source of parasitic oscillation, etc. ..... **£9. 19. 6.**

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TECHNICAL GEN continued

boost capacitor, which was s/c. The peculiarity of this fault was that h.t. was present in the circuit due to the failure of this component.

We have had a recurring fault on the the TV85 and TV85C. This is frame jitter, the first case leading us quite a dance. After testing frame valves and components, we eventually found the cause to be a poor connection between the plugs and sockets from the frame scan coils to the frame output transformer. Tightening these effected a cure. This same fault had been experienced with four sets.—N.B., Tadcaster (876).

Pam 550, 551

Two in One

One of the sets came in with low gain and noisy vision. A suspected tuner fault was eliminated, by using a replacement tuner. Further testing pointed to a fault in the a.p.c. system and this was proved to be the case for the gain came up and the noise level dropped when the a.p.c. line was shorted to chassis.

In these sets the system is of the mean level type, the control voltage being derived from the sync separator, the diodes to provide delay, etc. Investigation of these circuits revealed no clue, however; in fact every component was checked in vain.

Wondering where to try next, a closer look at the screen revealed a faint hum bar across the middle of the picture, pointing to poor smoothing, and this led us to consider the possibility that both faults could be caused by the same component. It was decided to check the decoupling and h.t. smoothing, the aim being to discover the cause of the hum bar.

We were soon rewarded. It was found that by shunting the main smoothing capacitor with a good 100μF both faults cleared. This being rather baffling, we checked up on the circuit diagram and it was noted that practically all the main decoupling and smoothing was provided by a 60+100+200μF electrolytic. It was assumed that the various stages were being coupled together via the h.t. lines, thus giving a rather bewildering fault. Needless to say, a replacement capacitor restored normal operation.—C.S., Cambridge (897).

SERVICE BRIEFS

Philips 1756U: The frame timebase would only lock in such a way as to give a double image. A great deal of time was spent investigating the frame oscillator circuitry, the sync and clipper circuits, all in vain. As a last resort the frame output stage was checked and C85 (in the frame feedback network) was found to be s/c and a replacement cleared the trouble.—D.McL, Lochgilphead (785).

R.G.D. 300FM: Fault was motor-boating at high volume levels, with a bad hum, apparent on a.m. bands but not on f.m. or gram. It was found that the trouble was due to a short circuit between the primary and secondary of the first i.f. transformer, the short being between the capacitor across one winding, and the other winding.—G.R., Barnsley (759).

Ultra WT9-17: At very low contrast level all was satisfactory, but on increasing contrast sound and vision went unstable, the picture being lost under a mass of patterning and the sound being very noisy and distorted. Valves and voltages checked O.K and the trouble was eventually traced to the 0·001μF capacitor C29 which decouples the anode of the first vision i.f. amplifier and had gone o/c. The curious thing was why the sound channel was affected to such an extent.—G.R., Barnsley (761).

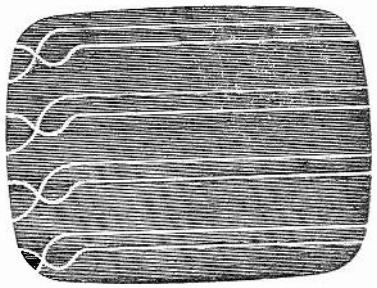
Ferranti T1001/T1002: One of these sets came in with the complaint of no frame sync. At first a common fault was suspected, viz.: failure of the selenium diode MR1, but replacement failed to provide a cure. Further checking revealed that the integrating capacitor C112 had developed a 12kΩ leakage to chassis, which prevented frame pulses from building up sufficient potential to be conducted by MR1. Consequently there was complete lack of frame pulses at the frame oscillatr anode.—E.L., Long Eaton (778).

G.E.C. BT1252

Wavy Left Side

The customer complained that the left hand side of the picture was "wavy" for about two inches. Adjustment of the line balance trimmer did not improve the condition and it was then noticed that, in fact, the lines of the picture were crossing thus producing a "wavy" effect, shown in exaggerated form in the sketch.

After checking the line oscillator and output valve and their associated circuits, without any clues, attention was given to the scan coils. The resistance of the



windings proved to be normal but checking the insulation between the line and frame sections revealed the trouble. This was a leak of about 100kΩ. Replacement of the scan coils cured the trouble.—J.A.B., Malton (841).

Ultra V17-80

Failure of Picture

The complaint with this receiver was failure of picture; i.e., no raster. Sound was normal. On switching on, it was found that the boost and e.h.t. voltages were absent, but there was quite a respectable line whistle. Pickup of spark, by screwdriver, on the e.h.t. rectifier anode was somewhat below that expected.

The boost and e.h.t. valves were checked by substitution and the components in these circuits were checked without revealing a fault. It was then discovered that rotation of the line hold control had no effect on the pitch

(Continued on page 139)

Queer Customers

MOHAMED ALI was a very good customer. But he had never been happy with the radiogram he bought from us a few months ago. It did not pick up "distant stations" as well as expected. He had had better results at sea with his little 110V portable.

We rigged up better aerials, we fitted a perfect earth, we tuned the set to the peak of perfection; but still Mohamed Ali complained. At last, in desperation, the service manager promised to call himself and "tickle up the tuning" on the particular programme that the customer wanted to hear.

And that was how the boss found himself in a dockside dosshouse at four-thirty a.m., listening for Radio Pakistan. I hope his wife reads this!—M.A.Q., Gilfach (890).

The dealer who has G.E.C. as partner can lean back, confident in the playing of these quality-controlled and tested hearts of radio receivers and TV sets. Service is excellent from his accredited wholesaler or G.E.C. Radio Group Centre. And to make things easier still, modern G.E.C. valves are now supplied with Continental titles.

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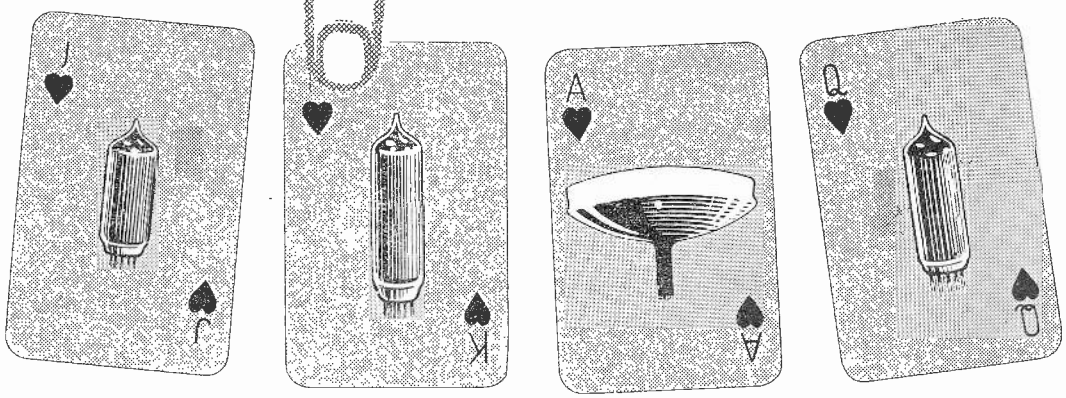

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REPAIRING TV CABINETS

Some useful advice on treating polyester finishes

A SYSTEM of surface treatment and repair for Polyester finished television cabinets is now given to dealers by the service personnel of the G.E.C. Radio Group. Capable of being applied by people with no special polishing skill, the methods restore surface gloss to its original standard and make scratches and indentations entirely disappear.

The materials and tools which the G.E.C. recommend their service departments to use are:

A small quantity of Polyester wood finish.
A small quantity of Polyester catalyst.
1 Polyester burnishing stick.
1 Polyester polishing stick.
3 sheets No. 500 waterproof abrasive paper.
1 tin Belco special polish K564/10.
3 camel hair quill brushes.
A heavy duty portable drill with a chuck speed of approximately 1000 r.p.m.
2 G.S. 6 in. mops.

Some Examples of Treatment:

Slight surface scratches and packing abrasions: The polishing wax stick should be applied to the mop as it is revolving on the portable drill. The pressure on the mop must be sufficient to allow a quick and efficient cut but must not be too excessive as to slow the motor.

Smears and general dullness of finish: Belco special polish No. 564/10 should be applied sparingly to the cabinet surface with a soft cloth and rubbed vigorously along the grain of the wood until it has dried off. This should be followed by brisk polishing with a clean soft cloth until all traces of the special polish have been removed.

Surface scratches which may be deep but which have not penetrated to the wood: The Polyester wood finish film is considerably thicker than that of French polish and cellulose finishes and, therefore, quite deep scratches may not penetrate to the wood. These can be burnished out by using the burnishing wax stick and the burnishing mop to cut down the area on and around the scratch until it disappears.

A deep damage will require considerable thickness of Polyester finish to be removed. It may be advisable to emery paper the area of damage with 500 abrasive paper using soap and water as a lubricant until the damage has almost disappeared, and to follow with burnishing.

Burnishing must be followed by polishing, using the polishing mop with the appropriate wax.

Deep indentations, and scratches which have penetrated to the wood: Where there has been a deep indentation of the wood with the polish left intact and yet the damage cannot be burnished out, the depression can be built up with Polyester wood finish. The area of the damage should be roughened with "500" grade abrasive paper to provide a key for the finish.

The Polyester and catalyst must be mixed and immediately applied to the parts that need building up. A fine quill brush should be used, taking care to confine the application of the Polyester to the area being treated. No allowance need be made for shrinkage as Polyester wood finish does not contract when hardening.

When the repair has been built up slightly higher than the surrounding polish it should be left for six hours to harden fully, after which it should be cut down to the level of the original polish. "500" grade waterproof abrasive paper may be used with soap and water as a lubricant.

A better method of cutting is to use a razor blade inclined at 70 degrees to the cabinet surface, with the blade top leaning in the direction of movement. This is followed by burnishing and polishing.

Deep damage which has penetrated to the wood is treated in the same way after colouring the exposed wood with French polish.

TECHNICAL GEN *continued*

of the line whistle, so it was decided to check the line oscillator circuit.

The hold control in this blocking oscillator circuit is part of a potential divider network from the h.t. rail to chassis and it was found that the 100kΩ feed resistor R62 was o/c. This was yet another lesson in not taking things for granted.—J.R.A., Peterhead (883).

Philips 1458U Series

Bright Random Noise The set worked at normal gain and good sound, but gave the symptoms of bad corona trouble. First checks were on the c.r.t. cap, e.h.t. rectifier, output transformer, etc., failed to show any cause. The fault then cleared for two days, "hot runs" failing to produce the fault.

On reappearing, the symptoms were bright random pinpricks over the modulated raster only. At this stage the oscilloscope was brought into use and by tracing the signal through with a diode probe and high gain amplifier it was discovered that noise was present at the last i.f. grid but not at the previous i.f. anode h.t. feed point.

This narrowed the search down to i.f. intervalve coupling components. Since valves had been eliminated earlier, all localised components were checked and found to be normal, both for value and insulation at working voltages.

This left substitution as the only remaining hope and during this process it was found that changing C36, the 12pF tubular ceramic in series with the 38·15 Mc/s acceptor S17, cleared the fault. Replacing the original capacitor brought the trouble back.

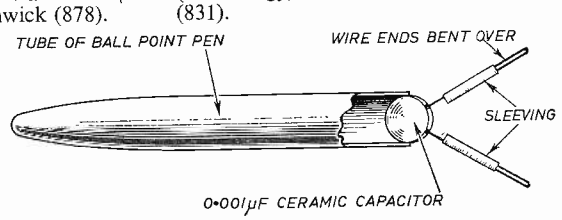
After final removal C36 was again checked for leakage and found to be apparently OK. But it was found to produce noise when tested as follows: It was placed across a 90V battery in series with a 100kΩ resistor. Battery negative was taken to negative input of high gain amplifier. Junction of test capacitor and 100kΩ resistor taken to "live" amplifier input via a 0·1μF capacitor.—G.M., Smethwick (878).

Capacitor Checker

Useful Simple Tester The usual way to check for o/c decoupling capacitors in sound and vision i.f. stages of TV receivers is to temporarily solder in a known good one across the original because holding the capacitor in the hand naturally produces misleading results. This procedure wastes a lot of time and it was felt that something easier could be devised.

The result of these deliberations was a simple tool made up from a discarded plastic tube from a BIC ballpoint pen, as shown in the accompanying sketch. Into one end is inserted a 0·001μF ceramic disc capacitor; it will just fit tightly. The wire ends are bent back double. Two short pieces of sleeving complete the job.

The use of this simple tool needs no explanation. Made in a few minutes it will amply repay the effort in time (and energy) saved.—S.W., Buckingham (831).



Sketch of the simple capacitor tool described in the text.

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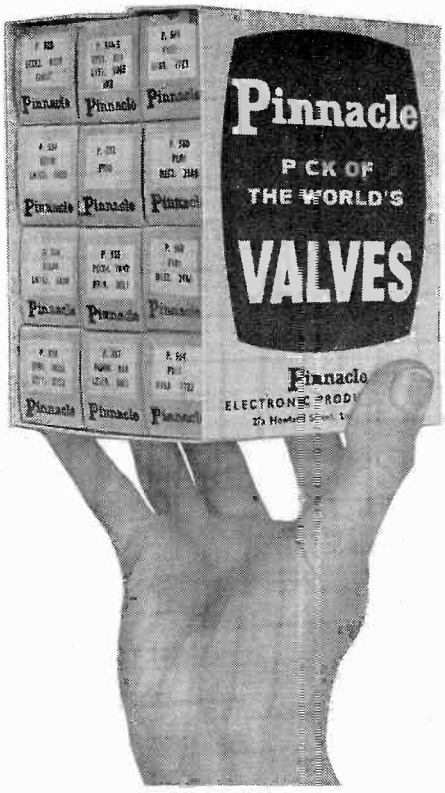
P538	EF80	Z719 Z152	6BX6	6BW7	30F5
P551/S	EY51	U43	SU61	R12	6X2
P552	EY86	—	6S2	—	—
P555	PCC84	B319	7AN7	PCC84	30b1
P557	PCF80	LZ319 LZ239	8A8 9A8	—	30C1
P560	PL81	N152	21A6	PL81	—
P564	PY81	U153	17Z3	—	PY81



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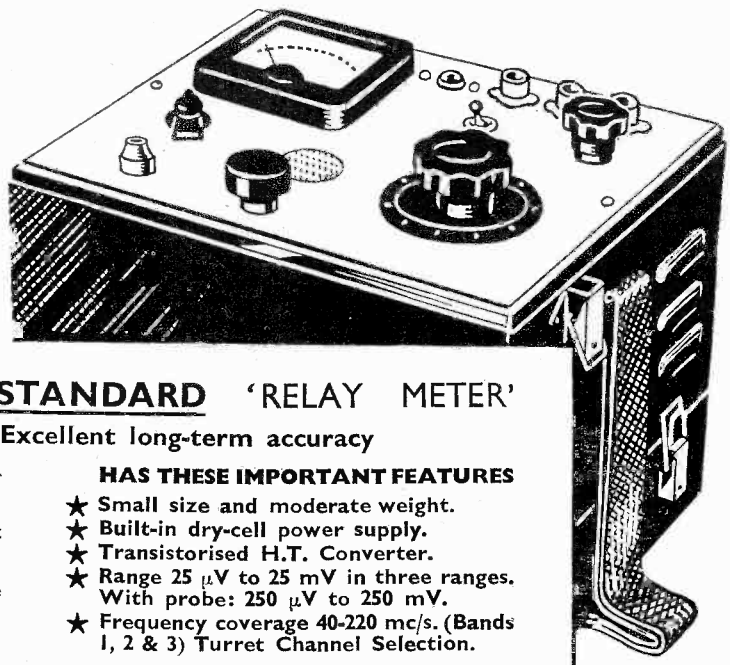

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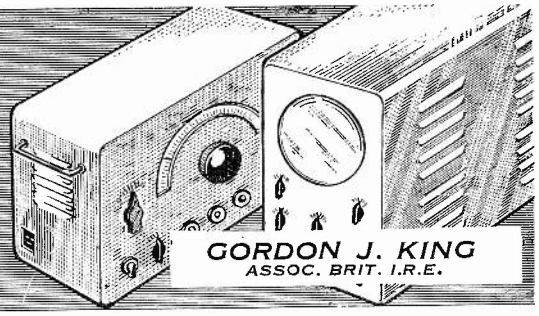


GORDON J. KING
ASSOC. BRIT. I.R.E.

THIS final article in this series of Modern Test Instruments details a few more of the miscellaneous items of recent introduction. We start first with valve testers.

PART EIGHT

Miscellaneous Test Instruments

Taylor 45C Valve Tester

This is a popularly-priced instrument which measures in terms of mutual conductance. It measures the mutual conductance of valves by indicating the ratio of change in anode current with change in grid volts, and is capable of testing over 5,000 types of valves.

The instrument incorporates twenty-one valve holders, including the latest British, American and Continental types in addition to the more vintage types. A picture tube adaptor (Model 445) is also available. This provides for tests of emission, filament continuity and cathode leakage, and can be used with the tube in the receiver. A further adaptor is available for the testing of 110 degree tubes.

The instrument has two test ranges, 0-3mA/V and 0-15mA/V, the lowest reading being 0·1mA/V, and checks diodes and rectifiers under actual operating conditions. Each section of frequency changers and other multiple valves can be checked separately for either mutual conductance or emission.

The actual checking process can be carried out speedily and efficiently by unskilled operators. The instrument is supplied with a detailed instruction manual and a comprehensive valve chart giving full test data for over 5,000 different types. It also includes test facilities for the recently introduced 12-volt car radio valves.

Avo Valve Characteristic Meter, Mk. IV

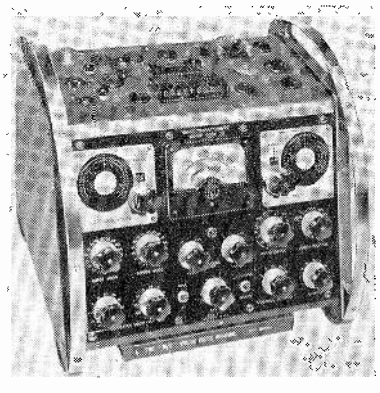
This latest version of an established instrument features increased facility for correct setting of negative grid potentials, particularly at low values; more accurate and concise methods for determining grid current, in particular when the valve under test suffers from reverse or primary emission; additional anode voltages for testing the recently introduced low anode voltage valves; improved regulation of anode and screen voltage supply to reduce reflected impedance problems; overload protection for the movements.

Specification: Anode V between 12·6–400 in steps; Screen V 12·6–300 in steps; Grid V 0–100 continuously variable. Anode and screen currents from 2·5–100mA f.s.d.; grid current 0–100μA. Heater voltages between 0·625–117V. Mutual conductance from 0·1–60mA/V. Diodes and rectifiers can be tested under reservoir load conditions between 1–180mA.

A comprehensive instruction and data manual is supplied with the valve tester.

Mullard High-Speed Valve Tester

This instrument measures such things as emission, electrode insulation, heater-to-cathode insulation heater continuity, etc., and valves are tested under factory approved conditions and to factory service limits. A means of checking cathode-ray tubes is also provided.



The latest version of the Avo Valve Characteristic Meter, Mk. IV.

The condition of a valve under all tests is indicated by a spot movement on the screen of a small cathode-ray tube on the instrument's front panel. The state of the valve is revealed by a simple colour graded scale, and a separate scale indicates the results when testing r.f. diodes.

The instrument is automatically set-up for any type of valve by the insertion of an appropriate perforated paxoline control card. In conjunction with a gate-switch consisting of 130 pairs of silvered contacts, the control card arranges the test circuits to make all the necessary connections to the valve socket and to select the correct voltages for the various electrodes.

A test selection switch arranges the circuits for the various tests in correct sequence, and four press-buttons apply insulation and continuity tests to the electrodes. Fourteen sockets accommodate all types of valves normally encountered in the service department, and provision is made for the addition of new types as required.

The tester can also be used for picture tubes, which can be checked for emission, etc., without removing them from the receivers. This is effected by means of extended fly leads.

The instrument is attractively housed in a substantial metal case of dimensions $16\frac{7}{8} \times 16\frac{1}{4} \times 11\frac{3}{8}$ in., and is mains operated 180–260V, 50 c/s, 100 watts average.

The purchase price is inclusive of a "test card" library to meet user's requirements, housed in a specially designed metal container.

Taylor Circuit Analyser 20B

This kind of instrument can prove invaluable in tracing faults in almost any section of a radio or TV set with the minimum of ease. It can also be used very effectively in tracing disconcerting intermittent faults and those faults which give rise to an intermittent high background noise, such as occurs in older style sets due to trouble in i.f. transformers, oscillator coils, etc.

The Taylor 20B comprises a high-frequency detector coupled to an audio amplifier, loudspeaker and magic-eye indicator, via suitable switching and

terminals. A probe contains a highly efficient pentode detector and is built into a metal case and connected to the main instrument through 3 ft. of lead.

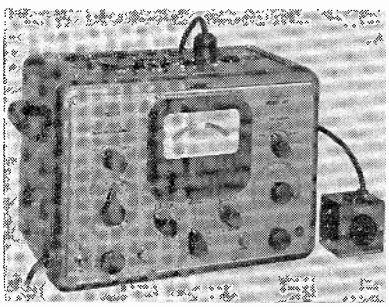
The a.f. amplifier has variable gain with a high maximum and can be coupled either to the loudspeaker or the magic eye. Terminals are also available to allow the direct use of the internal speaker at either high or low impedance. Headphone sockets are included to permit a very weak signal to be traced through a circuit with the minimum of ease.

The instrument is mains operated, 110–120V and 200–250V, 40–100 c/s, 25 watts, and is built into an attractive case of typical Taylor design of dimensions $12\frac{1}{2} \times 8\frac{1}{2} \times 6$ in. The weight is $10\frac{1}{2}$ lbs. and an unobtrusive handle at the top of the case allows for ease of transportation.

Taylor Insulation Tester 130B

This handy little instrument is in essence a mains operated ohmmeter. It embraces insulation tests and medium values of resistance. Indication is given on a 4 in. scale Taylor centre pole moving coil meter with knife-edge pointer, and has a sensitivity of 37·5μA.

The two test ranges are 20 ohms to 100,000 ohms at test pressure of 50mV



The 45C valve tester, one of the range of servicing test instruments marketed by Taylor Electrical.

and 200,000 ohms to 1000 megohms at test pressure of 500 volts, at infinity.

A press switch is available for disconnecting the meter movement when it is required rapidly to charge a capacitor for test. The instrument is mains powered 115V or 200–250V, 40–100 c/s, is housed in a case measuring $8 \times 5\frac{1}{4} \times 4\frac{1}{2}$ in. and weighs 6 lbs.

Pye "Scalamp" Electrostatic Voltmeter

This is a highly useful device for solving those e.h.t. problems, and really cuts out the guess-work. There are three basic models: Cat. No. 11308 1–5kV on d.c. or r.m.s. a.c.; Cat. No. 11309 3–10kV on d.c. or r.m.s. a.c.; Cat. No. 11310 5–18kV or 5–20kV on d.c. and 5–12kV r.m.s. on low-frequency a.c.

The instrument employs the electrostatic principle in which a specially designed vane is held in the proximity of a well-insulated electrode by a taut-suspension of the galvanometer type. The movement is suitably damped by a magnetic damping arrangement.

Indication of voltage is given on a large, curved scale by means of a brilliant spot of light and hairline indicator. The light is provided by a 4-volt bulb within a lamphouse, and this is usually energised from the mains supply, via an inbuilt transformer. However, in cases where mains is not to hand, a shorting bar allows the instrument to be lit from a 4V battery.

Accuracy is of the order of ±2 per cent of f.s.d., but may be a little less on a.c. due to form factor effects, etc. Change of polarity does not affect the accuracy under normal conditions.

Radar Kilovolter

A less accurate, though nevertheless effective way of checking TV e.h.t. is by means of the Radar "*Kilovolter*". This is a neat probe-type instrument in which the applied e.h.t. voltage produces a spark across a voltage-calibrated spark-gap.

The instrument is suitable for measurements from 3 to 30kV, is perfectly safe to use, but is designed exclusively for use with line-flyback, r.f. and pulse e.h.t. systems. The "brute-force", mains type e.h.t. systems should not be metered with any device unless designed specifically for this purpose in view of the lethal nature of the power supply.

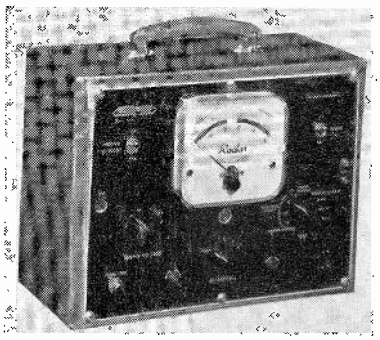
The instrument is of convenient shape and size to enable the e.h.t. to be measured at the tube anode *in situ* in the set and the correct reading may be noted after withdrawal as with a clinical thermometer. An advantage is that no load is taken due to the test when the instrument is correctly adjusted.

A flexible flying lead is connected to the chassis of the receiver or power pack and the end prod is applied to the e.h.t. point. The spherical electrodes forming the gap are then screwed together until flash-over occurs. A slight turn of the gap adjusting knob will cause the flash-over to cease and the voltage may be read directly from the calibrated, linear scale.

It is recommended that a.c.-type e.h.t. can be measured without undue danger by the inclusion of a series current-limiting resistor of approximately 1 megohm per kilovolt. The instrument has dimensions $6\frac{1}{2} \times 1\frac{1}{4}$ in., exclusive of prod.

Radar C.R.T. Tester Reactivator 202

This instrument has a large following throughout the country since it performs not only to clear certain faults from picture tubes but it also provides the following tests: Filament continuity or partial short-circuit by measurement of heater current (on two ranges, 0–0·5A and 0–2·5A a.c., linear scale); inter-electrode insulation up to 200 megohms at 200V; final anode beam current which is indicated on the embodied meter movement on a two-



The *Radar* c.r.t. tester-reactivator Model 202 manufactured by Waveforms.

colour (low/normal) scale; the maximum beam current being limited to 250μA which is considered a safe value for all tubes; current measurement from 0 to 250μA d.c., test leads and clips are provided; e.h.t. measurement up to 25kV by means of a special high-voltage probe; resistance measurement up to 100 megohms at 200V.

In addition, the instrument provides reactivation which is controlled by a four-position switch, giving varying degrees of processing by a combination of pulsed cathode emission and, in the case of very weak tubes, heater boosting. Indicator lamps are provided as a reminder that reactivation is being applied and also to indicate when the process is complete.

Another facility is the clearing of inter-electrode leaks and shorts by a "clear leak" device. Connection to the picture tube is made by a universal socket unit which fits all tubes, and in most cases avoids having to remove the tube from the set.

The instrument also serves as a voltmeter, and measures heater volts from 0 to 25V a.c. (1,000 ohms/volt) and gun potentials to 500V d.c. (4,000 ohms/volt) and, as previously mentioned, final anode potentials with the e.h.t. adaptor.

The instrument is housed in a portable steel case finished in durable grey hammer enamel with strong carrying handle. Thermal cut-outs which can be re-set are incorporated to protect both the instrument and tube against overload. The dimensions are $13 \times 10 \times 6$ in. and the weight approximately 14 lbs. Operation is from a.c. mains 200–250V, 50 c/s.

Grayshaw CR Bridge CR50

This inexpensive instrument is designed for measuring resistance from

1 ohm to 10 megohms and capacitance from 10 pF to 100μF. This is accomplished in fourteen ranges, having a total scale length of over 120 inches. The calibrated scale is printed on the front panel of the instrument in a very clear manner, and is linear over the entire range.

The internal elements are of an accuracy of 1 per cent and balance is indicated on a magic-eye. Facilities are available for testing the leakage of all types of capacitors and for conductance measurements in the range of 50,000 ohms upwards. For such measurements below this value a modified CR50 is available having a 1,000 c/s source in place of the 50 c/s normally used.

The instrument is completely self-contained in a steel case, finished in black crackle. The overall measurements are $5\frac{1}{2}\times 8\times 5\frac{1}{2}$ in. high, and the front panel is designed to slope forward, thereby facilitating the reading of the scale when the instrument is used on the test bench. Operation is on 200–250V, 50 c/s mains.

Taylor Capacity Resistance Bridge 110C

This is an a.c. operated bridge, designed to provide rapid and accurate measurements of capacitance and resistance at mains supply frequencies.

There are eight capacitance ranges from 0–120 pF to 1,200 μF, and also the same number of resistance ranges from 0–12 ohms to 120 megohms. The calibration scales are approximately 9 in., one divided evenly over 120 divisions for direct measurement, and a second—a comparator scale—for component tests against an external standard.

Balance is indicated on a magic-eye, which itself is coupled to an internal amplifier. Power factor measurements up to 50 per cent can be made on all capacitance ranges. A test voltage of approximately 40V is applied to the component under examination.

Provision is made for a polarising voltage to be connected in series with an electrolytic or other capacitor under test. The instrument is powered from 40–100 c/s 220–250V (or 115V) mains, weighs 7 lbs. and housed in a metal case of dimensions $8\times 5\frac{1}{2}\times 5$ in.

Beulah R-C Bridge C-3U-F

This bridge measures over the range of 10 pF to 1,000μF and 100 ohms to 5 megohms. In addition, the power factor of capacitors can also be measured as can leakage. The instrument provides polarising voltages from 5V to 450V. All readings are taken from large calibrated scales direct. Bridge balance and leakage are indicated by a dual-sensitive magic-eye electron beam.

A facility is available which immediately discharges a capacitor after a test for leakage has been performed. Positive indication is given in the case of both open-circuit and short-circuit capacitors.

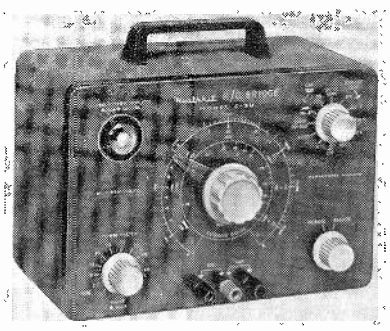
Manufacturer	Instrument	List Price
Taylor	Valve Tester Model 45C	£32 10s. 0d.
Mullard	Valve Tester	£98 0s. 0d.
Avo	Valve Characteristic Meter, Mk. IV	£80 0s. 0d.
Taylor	Circuit Analyser, Model 20B	£19 0s. 0d.
Taylor	C-R Bridge, Model 110C	£17 10s. 0d.
Taylor	Insulation Tester, Model 130B	£16 0s. 0d.
Pye	*Scalamp*, Electrostatic Voltmeter	£28 0s. 0d.
Waveforms	Radar *Kilovolter*	£3 17s. 6d.
Waveforms	Radar 202 C.R.T. Tester	£40 19s. 0d.
Grayshawe	C-R Bridge, Model CR50	£8 2s. 6d.
Beulah	C-R Bridge C3UF	£13 2s. 6d.
Heathkit	C-R Bridge, Model C3U	£7 19s. 6d. (kit)
Beulah	Wattmeter, Model AW1UF	£19 19s. 0d.
Heathkit	Wattmeter, Model AW1U	£13 18s. 6d. (kit)
Beulah	Capacitance Meter, Model CM1UF	£19 19s. 0d.
Heathkit	Capacitance Meter, Model CM1U	£14 10s. 0d. (kit)

SUMMARY TABLE OF INSTRUMENTS DESCRIBED IN THIS ARTICLE

Beulah Capacitance Meter CM-1U-F

This is an inexpensive direct-reading meter, test capacitors being measured on a $4\frac{1}{2}$ in. 50μA movement with full scale ranges of 100pF, 0·001μF, 0·01μF and 0·1μF. The scales are calibrated linearly.

The measurement of capacitance is accomplished by rectifying a square



Appearance of the Beulah CM1UF and the Heathkit CM1U direct-reading capacitance meter.

sided pulse (two valves being used in a cathode-coupled non-symmetrical multivibrator) and reading its average on the meter. The impedance of the meter circuit in conjunction with the unknown capacitance determines the shape, and consequently the average value, of the rectified voltage. The range switch selects the value of the feedback capacitance and the preset calibrating potentiometer.

Dimensions are $7\frac{3}{8}\times 4\frac{11}{16}\times 4\frac{1}{8}$ in. Power requirements are 200–250V a.c., 25 watts.

Beulah Audio Wattmeter AW-1U-F

This instrument is highly suitable for the service department which undertakes the repair of audio equipment and hi-fi amplifiers.

Measurement in both decibels and watts is given on a $4\frac{1}{2}$ in. 200μA meter movement. The power range is 0–5mW, 50mW, 500mW, 5 watts and 50 watts full scale, and the frequency response is ±1dB from 10 c/s to 250 kc/s. The instrument load is selected by a switch over 3, 8, and 15 ohms.

Heathkit Models

Kit versions of the C3UF, AW1UF and CM1UF, from which the assembled instruments were derived, are available from Heathkit. The specifications are exactly similar and full assembly instructions are provided (see summary table).

So ends this present series on Modern Test Instruments. Although it has been my aim to present as many as possible of those instruments most likely to be required in the up-to-date service department, there have, of course, been omissions, but the instruments not covered are in essence those of a more specialised nature used outside the service department.

Conclusion of Series.

SERVICE WITH A GRIN

by H. W. HELLYER

Welcome . . . warily

HERE we are again, lads, perched on the edge of another "milestone in history", waiting for some button-happy goon to flick us into the dust of the Road to the Fringes. But wait, don't turn over, this is not a political grouse.

After last month's rap over the knuckles in *Service Viewpoint*, I have downed my bludgeon and taken up again my bladder, my cap and bells. I promise not to plug uni, bi, or multi-lateralism, nor to mention Cape Canaveral, Holy Loch, or the long, wet road to Harwell.

Incidentally, it is my private opinion that all the wet weather we've been having lately is responsible for the H-bombs. (Good fission weather?)

Having said which, allow me to welcome 1961 with characteristic bonhomie. Indeed, now that the pedants will concede us the point, let us welcome the new decade.

The only trouble with this welcoming act, as regards radio, is that history is apt to confound us. Those of us foolish enough to indulge in the Old Moore act find future events make our jokes bounce back in our faces. The old lady who said "*You can do anything with electronics nowadays*" was not far wrong. The fact that she was hopefully passing last year's corroded torch across the counter at the time only serves to add savour to the joke.

Many of the "impossibilities" that we laughed about have become actuality. The materials and circuits of industrial electronics are the pointers to our future, Joe.

We are accustomed to our little niche in society, and it comes hard to realise that the radio and television engineer is now a much more civilised animal. You and I are on the fringe, dabblers in domestic entertainment equipment. Our petty problems hardly signify. Already we are several steps on the way to the "module" technique, what with packaged service and replacement printed panels. It will soon be reactionary to think of tracing a fault and replacing a component. We shall just watch for the blinking light and swop modules.

On the edge of another milestone in history.

No kidding, did you see the report on the latest valve techniques? Development engineers at General Electric, U.S.A. have succeeded in squeezing a five-valve assembly, from frequency changer to output of the normal radio receiver, into two multi-electrode envelopes. Moreover, they hint that other circuit elements can be included, giving eventual plug-in packages.

"You can do anything with electronics these days".

How some of our customers will face replacement costs of a complete stage-plus-bottle when a tuppenny capacitor has shorted does not bear thinking about.

Another prospective development is the domestic "picture on tape". The British Amateur Television Club met in September and showed that it could be done, with a slow-scan system using 125-line definition. As ways are found to reduce the bandwidth still further, no doubt an electronic rival to the cine-camera will land upon our benches for repair.

Imagine Mrs. Grouser demanding that Dad's bald head be over-scanned, or Junior's bare knees straightened. Complicated by shots taken from the telly, reproduced in the parlour, dubbed by that clever cousin and edited by arty sister, the tape recorder problems of tomorrow should be quite a likely field for us, Joe.

We thought the customer understood.

I had great fun only last week with a simple, conventional machine. It came in with bad "wow" and the fault was quite obviously a distorted rubber tyre on the pinch wheel. Replacing this cured the fault (as they say in the Tech Gen pages); a test tape played through as sweetly as you could wish. But when we returned the machine, the customer was furious. "*Listen*," he howled, "*It's no better than before*".

Of course, he was right. The material on the tape had been previously recorded with the faulty pinch wheel and was as full of tremolo as an ageing baritone. As it was a recording of a private party, we had thought it better not to erase it, despite the "wow".

This we explained patiently, and thought the customer understood. But he must have been reading too many amateur tape magazines for he instantly rejoined: "*Well, couldn't you have taken it off my tape onto another machine, then put it back on the tape when mine was repaired?*"

Perhaps the clever gents in the research labs can come forward with a "wow eraser" to help us out with such problems? I dare not make too great a joke of it for they have probably done something like this already.

While systems from TV to telegraphy clamour for more and more ether space, the Information Theory boys are reducing the communication basics of speech to a few tens of cycles, retaining only what is necessary for intelligibility, and dispensing with all extraneous matter. Bandwidth compression with a vengeance.

Which brings one salutory point, if this contributor's wafflings were thus treated, I fear the *Service Engineer* section of *Radio Retailing* would occasionally be graced with a blank back page.

After which obvious hint, I can do no more than to wish those whom *Service Viewpoint* called our "faithful followers" the very best wishes for 1961.

Published by the Proprietors, Fountain Press Ltd., 46–47 Chancery Lane, London, W.C.2, and printed by Bournehall Press Ltd., Bushey, Watford, Herts

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ESSENTIAL SERVICING DATA

VOL. 1

Television Receivers

saves time with

E. S. D.

the radio and television engineer's first reference

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 EF39; 1 FB34; 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 EF1 may be replaced by a 6C9.

—osc. high.
Channels: All fiv
Band III Tuner TT2258.
Controls: Bright Volume 25k w./w.
Electrolytics: 12 common negat
Aerial: 70–80 ol
Mains: AC only d.c.).
Fuses: Two 1.5
E.H.T.: 8kV (
SPECIAL REMA a sound i.f. of 19 16 Mc/s.
SERVICING NO adjustment occur check the 2.7-m between the cent blocking oscillat in value.

T217 (17*in. ta. also late ver and T21*
Valves: 6 10F1 2 1 13; 1 2C 1 282; 1 U Boot-wobble
C.R.T.: Mazda
Inter. Freq.: So 16 Mc/s.
Channels: All fi
Band III Tuner:
Controls: Volur

Extract from Vol. I 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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