NOVEMBER 1961

RADIO AND ELECTRICAL Retailing

SERVICE ENGINEER

Radio, Television and Audio Servicing

SERVICE ENGINEER

Vol 4. No. 7 NOV., 1961

Edited by W. Norman Stevens

Issued as a special supplement with "Radio and Electrical Retailing"

In this issue:

SERVICE DATA SHEETS

TV187: Ekco TP373/T394, Ferranti TP1051/T1072 television receivers.

TV188: Ferguson 606T, H.M.V. 1913, Marconiphone VT165 series television receivers.

R157: Philco Model 202 transistor portable.

Aveley Electric to handle Simpson Meters

AVELEY Electric Ltd., have obtained the exclusive U.K. Agency for the Canadian made Bach-Simpson test meters. The first two models are now released.

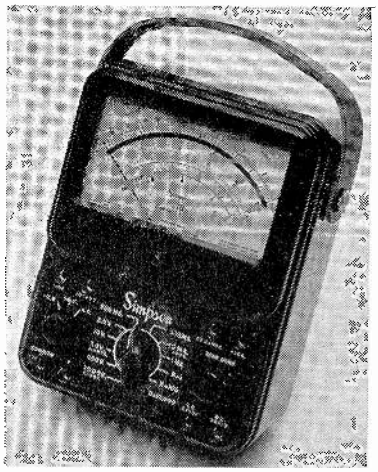
The Simpson 260 is a 30-range a.c.-d.c. volt-ohm-milliameter with sensitivities of 20,000Ω/V on d.c. and 5,000Ω/V on a.c. The ranges are: D.C. voltage—250mV, 2·5V, 10V, 50V, 250V, 1kV, 5kV. D.C. current—50μA, 1mA, 10mA, 100mA, 500mA, 10A. Accuracy on d.c. ranges is 3 per cent of full scale deflection.

A.C. Voltage—2·5V, 10V, 50V, 250V, 1kV, 5kV. Accuracy on a.c. ranges is 5 per cent of full scale deflection. A.F. voltage—2·5V, 10V, 50V, 250V. Decibel ranges (1mV at 600Ω)— −20 to +10dB, −8 to +22 dB, +6 to +36 dB, +20 to +50 dB.

Resistance ranges are 2kΩ (12Ω centre scale), 200kΩ (1·2kΩ centre), 20MΩ (120kΩ centre). Accuracy is 3 per cent of scale length.

Price of the 260 is £17 15s. 0d. Optional extras include leads (15s. 0d., probe type or 13s. 0d. clip type), case (pouch type) £2 17s. 3d., case (ever-ready type) £5 9s. 8d.

A more advanced instrument is the Model 270, which features an anti-parallax mirror scale and knife-edge pointer, and protection in the form of

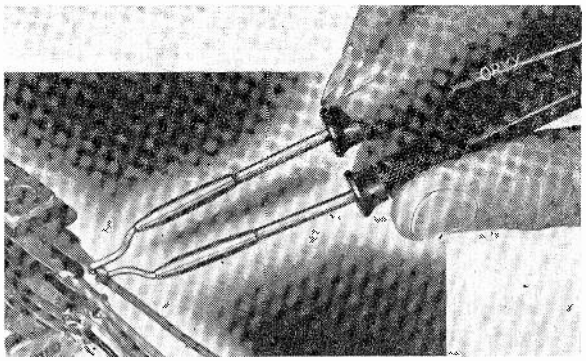


circuit fuse, meter current limiting diode and spring-loaded jewels.

The 270 provides the same 30 ranges as the 260 to the following accuracies—d.c. to 10A and to 250V, ±1·25 per cent; d.c. to 1kV, ±1·75 per cent; d.c. to 5kV, 2·5 per cent; a.c. to 1kV, ±2·25 per cent; a.c. to 5kV, ±3 per cent. Ohms, ±5 per cent of reading, centre scale; limits of effective range (10 to 90 per cent of full scale angular deflection), ±10 per cent of reading. The Model 270 is priced at £19 17s. 6d.

Further details may be obtained from Aveley Electric Ltd., Ayron Road, Aveley Industrial Estate, South Ockendon, Essex. (*Telephone:* South Ockendon 3444).

A New Soldering Tool for Printed Circuits



A NEW soldering tool, designed specifically for use in modern printed circuit applications and for miniaturised equipment in confined spaces, has been introduced by Oryx Electrical Laboratories Ltd., Industrial Estate, Meadow Road, Worthing, Sussex (*Telephone:* Worthing 30066).

The instrument is a soldering iron in the form of a pair of tweezers, enabling both sides of a joint to be heated simultaneously so that the solder runs all around the joint. Printed circuit boards can be straddled by the tweezers and the joint heated from both sides, reducing the danger of any pad "lift off" and preventing the destruction of a joint on one side when the other side is heated.

Conversely, the instrument will be found extremely useful in removing defective components from printed circuit assemblies because two ends can be de-soldered simultaneously. The intimate tip contact localises the heat and reduces the risk of damage to adjacent components.

The instrument weighs only one ounce, similar in weight to a fountain pen, and the placing of the elements near the actual working tips ensures that the handle is always cool. The tip temperature is selected to melt modern low temperature solders yet protect bi-metals and semi-conductors.

Three models are available. The TW5 (5 watts each limb) has a tip temperature of 464-deg. F and features concave stainless steel tips. The TW6 (7 watts each limb) has a tip temperature of 482-deg. F. The TW9 (9 watts each limb) has a tip temperature of 554-deg. F. All models operate from a supply of 6V a.c. or d.c. and retail at 3 gns., subject to a standard trade discount of 25 per cent. The TW6 is recommended for general miniature soldering applications — relays, tag panels, printed circuits.

MULLARD EQUIPMENT

The telephone number of Mullard Equipment Ltd., Crawley New Town, Sussex, has been changed from Crawley 3421 to Crawley 28787.

More Trade Notes on page 110

Service Viewpoint

DO WE NEED 625? asks K. CHAUNCY

A service man's view of the 405-625 controversy

NOTHING since television began has caused such a split in the trade as the "great 625 controversy".

The first question is—"*Do we really want or need 625 lines?*" The answer depends upon so many factors that it is impossible to give a direct "yes" or "no".

Sales Boost

Do we *need* it? The answer is, I am afraid definitely in the negative. The trade badly needs a lift at the moment, and most dealers would welcome the extra business derived from colour TV or new line standards. We all remember the Coronation TV boom and the ITA conversion boom. Therefore, one is led to the conclusion that the 625 "conversion" campaign has been launched merely to give a sales boost to manufacturers and to one manufacturer in particular.

So to the question "do we want 625?" the answer is plainly "*some* of us do".

As a service manager, I welcome extra business, but to even start to sell convertible sets to the public before the Pilkington Committee has issued its report, is sheer folly.

What System?

What system will be used if it is decided to transmit on 625 lines? The system used in most Continental countries has negative modulation with inter-carrier f.m. sound. The i.f. bandwidth must be at least 5 Mc/s., and, for good horizontal definition, a 6 Mc/s. bandwidth is to be preferred.

Conversion of normal 405 line receivers means a complete new i.f. strip, a u.h.f. convertor, a new or modified line stage, and a very extensive switching system. Only the sound output stage, frame output stage, and h.t. rectifier circuits would remain unaltered.

With positive-going sync pulses, most manufacturers consider flywheel line sync a "must", because the sync pulses are much more prone to disturbance.

Not Very Slimming

This means that unless a set is manufactured specifically as a "convertible" set, any sort of economical conversion is definitely *out*. This automatically produces a problem for the average dealer and his service staff. What of all those shining new 19 in. and 21 in. slim-line sets he has sold over the past three years?

The British TV owner, unlike his American counterpart, likes to keep his set for years, and no amount of high-pressure salesmanship will move him. So, if a new system were to be introduced within, say, the next three years, how would these nice new slim-line models look? Very sorry indeed, I am afraid.

As it is, there is only just enough room in these cabinets for the "works". As for a u.h.f. convertor, a complete new i.f. strip, plus all the switches involved—well, I will leave it to any serviceman's imagination!

Weaker Signals

Furthermore, most of us living within the primary service areas of the British TV transmitters are used to leaving our customers with rock-steady crisp pictures. On u.h.f. it will be another story.

(*All things considered equal, the service area is reckoned to be about two-thirds of the v.h.f. area.—Editor*).

What then is the answer to "625 conversion"? The only sensible answer is to tell our customers that sets not designed for conversion must stay as they are, and, if new programmes are transmitted on u.h.f. with 625 lines, then a new set must be purchased to receive them, keeping the 405 set as a spare set.

Customers who buy the so-called "switchable" sets must be told quite frankly upon purchasing them that a further expense will be involved later on, but, until the standards and methods of transmission are decided upon, the exact cost cannot be here and now stated.

Over-enthusiasm

Before ITA started transmission many over-enthusiastic salesmen sold sets on the definite assurance that they could be "very easily converted". The problems and headaches for the poor service engineer that followed are too well known to be stated here.

Problems involving u.h.f. and a change of standards would be infinitely worse. So, unless a manufacturer categorically states that a set can be converted, then it is unwise to proceed with the sale. In any event, the responsibility of conversion must rest upon the manufacturer and his ability to produce and sell such conversion kits as may be necessary.

Definition

Assuming that 625 line transmissions on u.h.f. will take place, what sort of pictures must we expect our customers to receive?

To the credit of 625 lines there will be better vertical definition and a lack of "line-ness". However, the horizontal definition will be poorer, and it is the horizontal definition which gives most detail in the picture and produces the sharp outlines and general crispness of the pictures that we are used to seeing. Those who saw 625 receivers at the Radio Show noted that they appeared rather "smudgy", and that the 405 line sets were crisper.

British is Best

I am not, fundamentally against what is, obviously, an excellent transmission system adopted and used in many countries, but the lay press reports and advertising may well have led the public to expect such a vast improvement in picture quality that disappointment will be certain when it is discovered that the improvement (if any) is very small.

A radio trade acquaintance of mine has seen television in the U.S.A. and in several Continental countries, and he considers that in contrast, definition and general clarity the "old fashioned" British pictures are undoubtedly superior.

Are we then to go to an enormous amount of trouble and expense to produce something which is very little better than that which we have already?

Furthermore, if 625 line transmissions are adopted, they will have to be in u.h.f. bands IV and V, as bands I and III are unable to accommodate any more transmitters. This means that many new transmitters will be needed to produce adequate coverage of Britain.

Local Stations

In the U.S.A. local TV broadcasting is the chief method of coverage with coast-to-coast co-axial and beamed u.h.f. links for National events. It is fairly easy to cover medium-sized towns with one u.h.f. transmitter "beamed" over the town's rooftops. The range is strictly limited to about 10 miles around the centre of the town.

In Britain, however, we are used to covering large areas with one BBC and one ITA transmitter fairly nearly

(*Continued on page 100*)

No. 17

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.

MANY lads I know are scared stiff of the transistorised radio receiver. They are uncomfortably aware of the high price and vulnerability of transistors, and are afraid to apply routine tests.

This fear stems from a lack of knowledge – and experience. We cannot supply the latter, but the former is simply a matter of intelligent study. Unfortunately, articles on transistors tend to delve too deeply. In an effort to be explicit, the writer puts all his cards on the table at once, and the result is confusion.

Taming the Transistor

What and Why?

Perhaps the best way of getting acquainted with transistors is to take a closer look at particular circuits and find out what they do, and why. In other words, just to look at a few of the cards and get to know them. Then it is easier to fit the rest of the pack into place.

Having said that let's refer to Fig. 1. This is a typical i.f. circuit of a commercial set, with nothing omitted. The transistor is a p-n-p type, used as a common emitter amplifier. This can be recognised by the arrow, which is the symbol for the emitter, pointing inward to the base, the straight line. The other terminal is the collector.

Note that the configuration of the circuit is very like that of a conventional valve amplifier. In this case, the input is fed to the base, that is between base and emitter, effectively, and the output taken from the collector – effectively between collector and emitter.

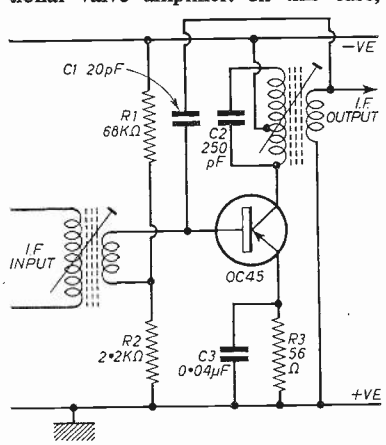


Fig. 1: Typical transistor i.f. stage.

Voltages

What is conventionally the h.t. rail is seen, in this instance, to be negative. The negative voltage is only 9V, and a look at the values of R1 and R2 will show that the voltage at the base will be very nearly the positive voltage, as will also the voltage at the emitter terminal.

In fact, with no signal coming in, these voltages will be 0·18V and 0·04V respectively, measured between the positive line and the appropriate terminal. From the same point to the collector would give a reading of some 7½ volts. *First point to remember: when checking voltages of p-n-p transistors, the positive probe of the meter goes to chassis.*

If you look again at R1 and R2 you will see that they are a potential divider across the supply. This should remind you of the similar circuit used to regulate the screen grid of a valve amplifier.

Indeed, their purpose is simply to hold the base bias within the required limits. R3 does the same thing for the emitter, decoupled by C3.

All this is quite straightforward. But now look a little more closely at the circuit. Note that the i.f. transformers are shown with a large primary and small secondary, and the output of the transistor is taken to a tapping on the primary winding.

Impedance

This is because the input impedance of the transistor is low, when used in this fashion, and the output impedance is high. Which brings us to another interesting difference from valve techniques: *we are concerned with current rather than voltage amplification.*

Of course, the two factors are tied up, but whereas in valve practice we think of a variation in grid bias causing a change in anode current and thus a change of voltage across an external load, in transistor technique we find it easier to consider a change in base current producing a greater change in collector current.

The odd man out, C1, is a small capacitor used to neutralise the inherent feedback in the transistor. If this little chap goes open circuit; the result will be distortion.

Remember that the junction transistor is, to put it crudely, a pair of back-to-back diodes, and the resistance paths between electrodes will vary according to the polarity of the applied voltage. This is one basic difference between the transistor and the valve (which is a one-way device) see Fig. 2.

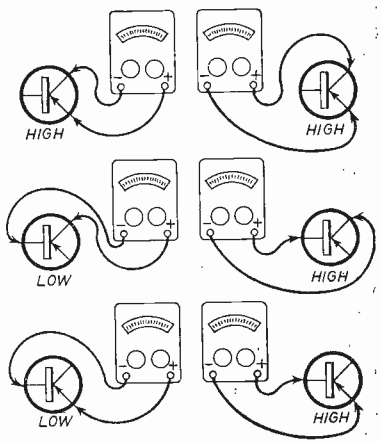


Fig. 2: Typical measurement of transistor with 20,000Ω/V meter. Note that the positive terminal refers to *polarity* at meter (ohm-meter battery may apply positive voltage to negative terminal of meter). Do not take these readings with transistor in circuit. Use Ohms X100 range of meter.

Ohm-meter Testing

Which brings us to the touchy question of testing transistors with an ohm-meter. Should we do it – and if so, what readings would we expect to get?

First point I would make here is that transistors are basically long-life devices. They can be damaged by careless handling, excess heat or light and application of incorrect voltages. But when a set comes to you for repair *the transistor is the last thing to suspect.*

Whereas replacement of valves was a simple, two-minute test, to change a transistor can be a fiddling

The Apprentice Engineer

AT THE BENCH

—continued

business. Check the other possibilities first.

Those other possibilities reduce to two or three favourite faults. You will notice that there are high capacity, low-working-voltage electrolytic capacitors decoupling the battery supply line and various stages, and also used for coupling certain stages. Leakage here can give rise to weak signals, distortion, or erratic reception.

Supply Voltage

Next, the supply voltage, which should be within reasonable tolerance. If the voltage drops more than 25 per cent when the set is switched on, it is advisable to try new batteries. Remember, that battery voltage alone is not all that matters: there is the question of internal impedance.

A battery can be only a little low on load yet have developed sufficient internal leak to give unwanted coupling between stages. Replacement is simple, and well worth a try if distortion or motor-boating is the complaint.

Finally, these small sets are invariably built around a printed circuit, with the possible faults this implies. Always check for mechanical faults, dry joints, cracks in the conductor foil, loose components, etc. Check, too, the ferrite rod aerial, which is a vulnerable part of the circuit. A crack in this will drastically reduce signals.

Probing

Remember, when carrying out the "judicious probing" for mechanical faults, not to short-circuit conductor paths. The danger here is that by shorting the emitter to chassis (or base) a dangerous increase in collector current can ensue. Also, do not disconnect or re-connect transistors or other components with the battery in circuit. This can cause surges, with disastrous results.

These small points are no more than one has to remember when testing valve sets. For example, one instinctively avoids short-circuiting h.t. to chassis, heaters to other pins, etc. *There is no need to fear transistor testing, provided common sense is employed.*

It should hardly need repeating here that a heat shunt (a pair of pliers on the component side of the lead wire) should be used when soldering.

SERVICE VIEWPOINT

—continued

co-sited. Even so, there are many areas of fringe reception and so many other "pockets" and valleys where band III reception is almost impossible. South Wales is a notable example, and even in the London area there are bad reception areas for ITV.

To achieve adequate u.h.f. coverage we shall need many more transmitters than at present. Is this a case for more "piped" TV? It could well be the answer, because to get us the microvolts we are used to having at our aerial sockets, we shall need about four u.h.f. transmitters for the London area alone. And what about the coasts and fringe areas?

"Snowy" pictures are the order of the day in many areas of America. The British public is used to something very much better and will demand it!

I have no doubt that excellent pictures are possible on 625 line u.h.f. transmissions, but have the protagonists thought of the enormous cost involved to achieve a satisfactory coverage?

Colour TV

So far, I have said nothing about colour TV. The chief factor against this is, of course, the expense of the receiver, particularly the tube.

However, assuming that cheaper colour sets will be shortly produced, I think that colour TV transmission on 405 lines on bands I and III is a much better proposition than a mass switch-over to 625 lines on u.h.f.

The BBC are able to start fully compatible colour TV broadcasts on 405 lines using the same band I transmitters. All viewers would be able to continue viewing in black and white on their old sets until such time as they are able to afford to buy a colour set.

Colour TV broadcasts have been broadcast for some time in the U.S.A., but the chief snags have been:—

(1) The high cost of the receiver and the replacements, particularly tubes.
(2) The unreliability of the earlier sets. (There has been an improvement recently).
(3) The lack of skilled personnel to maintain the receivers.
(4) The very complex controls and adjustments required to keep the pictures up to a reasonable standard. (Here again, there has been much improvement recently).

Problem

Certainly from the service engineer's angle, colour TV will be a real problem. From the manufacturer's point of view the chief problem is one of expense. If a cheap, and reliable, tube can be produced, then colour TV for the mass market may be with us within five years or so.

Compatible TV has its problems, as service engineers in the London area know. When colour is received on a black and white set there is a very noticeable dot pattern. This problem may well be overcome by the transmission engineers before long.

Public Confused

Unfortunately, the public have been very bewildered and confused by the advertising of certain TV companies, by the national newspapers, and—what is worse, by the Radio Show.

To some people 625 lines means colour. To others, colour TV is "just round the corner". One man even had the impression that I could convert his 14 in. four-year-old receiver to colour for £35! (*This obviously arose from a report we saw in a National newspaper, about 625 lines, which bore the completely irrelevant heading "Colour for £35"!*—Editor).

Such is the state of affairs at the moment, and I think most service engineers will agree with me when I say that to anticipate the Pilkington Report is courting disaster.

Expense

Whatever happens, it will mean a good deal of expense for the viewing public, and enormous expenditure for the broadcasting authorities.

The BBC's standards convertor seems to work so well that to change to 625 lines in order to receive more Continental programmes seems a complete waste of time and money, but this was actually one argument in favour of the "switch-over".

To sum up then, it seems that a change to 625 lines on u.h.f. using the CCIR system would mean new sets for nearly all viewers in order to receive the alternative programmes.—(*And new aerials, too.*—Editor). Colour TV on 405 lines using a compatible system seems a reasonable idea, if only the cost and complexity of the receivers can be reduced.

As a last word, I would say that in view of the expense involved, I rather feel that the Chancellor of the Exchequer will have the final say on the subject of 405 versus 625 lines.

In view of the controversial nature of the above article, we have taken the unusual step of publishing it under the Service Viewpoint heading. This does not necessarily imply that we agree with all the opinions expressed by the author.

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Kolster-Brandes OV30

Cramp at Bottom

One of these receivers was admitted to the service department with the complaint of excessive cramping at the bottom of the frame. The PCL82 frame output valve was changed, to no avail. The next step was to check electrode voltages but these appeared to be satisfactory and the cathode bypass capacitor was also checked and this found to be quite normal.

The search was then concentrated on the linearity feedback correction circuit. Eventually the trouble was traced to a combination of C90 and C91, which function as a split charging capacitor for the correction voltage fed back from the pentode anode. The faulty components were checked on a bridge; they had not gone open circuit but had lost overall power factor.—D.F., Canterbury (1098)

Cossor 940

Collapse of Frame

Frame would collapse to a thin line and then open out with the picture upside down. The inverted picture was not very linear and was about 1½ inches short of top and bottom of the mask. The fault would persist until the set was switched off and cooled down. If the aerial plug was removed, the frame collapsed to a line.

A routine check was made of the frame oscillator and output valves, although it was difficult to see how these could cause such a curious fault. The bottom was removed and it was found that moving C87 (0·01μF/ corrected the picture. This capacitor, which was going o/c, is the coupling capacitor across the top halves of the multivibrator.

When the fault occurred, the multivibrator ceased to function and V11 triod section amplified the integrated sync pulse present on its grid. This was further amplified by V10 triode section and passed on to the frame output valve grid.

The whole thing worked as a three-stage sync amplifier feeding a negative-going waveform on the grid of the frame output valve during frame scan, resulting in an inverted vertical scan. The frame hold control affected linearity and the height control made the picture behave as though made of indiarubber!—F.C., Crewe (1062)

Ekco T344

No Contrast Control

The set was placed on test and, after about one hour, the picture went negative and the contrast control had no effect on it. The chassis was removed from the cabinet and the a.g.c. line voltage was measured at pin 6 on the 6/30L2 a.g.c. gating triode; this was found to be 150V d.c. positive.

This voltage was less on the other side of the 100kΩ resistor R48 so the fault was assumed to be in the other section of the a.g.c. line. The 30pF capacitor C81 was immediately suspected of being leaky, but a quick check proved this component to be OK.

The lead from C81 to the a.g.c. line was followed back and the insulation was found to be burnt through where the lead passes over the boost diode base. This was touching the anode pin. The lead was replaced and re-routed and the contrast control worked normally.

This fault is worth noting because this is the third time it has appeared in the workshop, on the same model and for the same cause.—T.P., Crewe (1078)

G.E.C. BT318

Lack of Punch

One of these sets came in for service with the complaint of an apparent lack of "punch" and the gain was certainly not comparable with other sets of this type. The tuner was first suspected but was proved free from trouble by substitution, this being easy since another one can be quickly plugged in.

Attention was then directed towards the common sound and vision i.f. amplifier, a Z729. Luckily, however, before more complicated testing was embarked upon, it was noticed that the heater of this valve was not quite so bright as that of the other valves. The valve was replaced and immediately gain returned to normal. The Z729 was later proved to have a partial short circuited heater.—W.D.G., Prestwick (1085)

Wright & Weaire 4AN

Capstan Motor Trouble

The following troubles were experienced with one of these decks fitted to Vortexion WVA, Ferrograph 4AN, etc. The client complained that the capstan motor refused to drive the tape on certain mains sockets at his home, even though the amplifier and spool motors functioned normally.

On test in the workship, the machine worked correctly on record and playback, speeds being normal. Eventually,

(Continued on page 103)

Items for publication

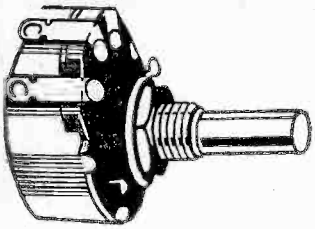
in this feature are welcome, particularly in regard to the more unusual type of faults. All contributions used will be paid for at our usual rates.

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 — RER Service Engineer, 46 Chancery Lane, London, W.C.2.

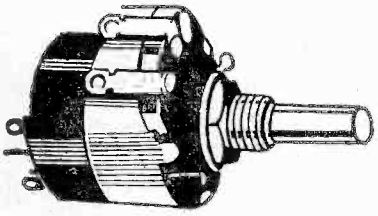
The Editor does not necessarily endorse the views expressed by contributors to this feature

Volume Controls for Radio & TV

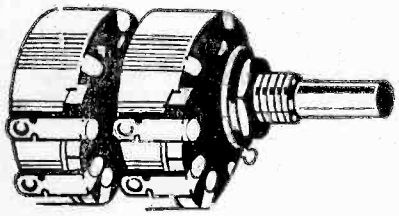
by return



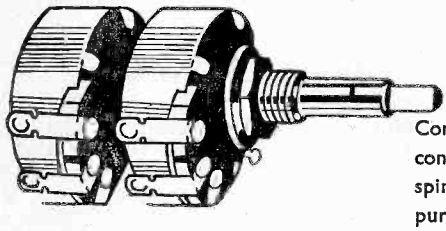
Type 'A' Controls
A standard Switch Control in all standard values.
Price 3/4d. Trade



Type 'ADP' Controls
A standard Double Pole Control in all standard values.
Price 5/4d. Trade



Type 'AG' Controls
(Ganged) control designed for stereo work, two controls on one spindle.
Price 7/0d. Trade



Type 'AM' Controls
Complete range of multi-controls with special dual spindles for replacement purposes on specific TV sets.
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TECHNICAL GEN *continued*

after much checking for o/c links, etc., and switching faults, the capstan motor was found to have a leak from windings to earth. Here was the clue.

Our bench points are not earthed, this explaining why the machine appeared to be OK in the workshop. However, when used on an earthed 3-pin socket, the motor winding leak effectively bridged sections of the multiple pole split-phase capacity-fed stator winding, thus nullifying the rotating electrical field pattern necessary for correct operation of this type of synchronous capstan motor.

Replacement of motor cured the trouble and the customer was advised to have all mains sockets checked and earth leads fitted to prevent a possible fatal accident.—G.M., Smethwick (1068)

Philips 17TG200U

Line Hold Trouble

The trouble here was that the line hold was beyond the range of the manual control. Adjustment of the sine wave oscillator coil S602/603 caused the picture to lock at the extreme end of the cose setting, so proving that a frequency-determining component was at fault.

Various components were tried before it was noticed that R605, the h.t. feed resistor, was slightly discoloured. When removed and tested it measured 1kΩ instead of 2·7kΩ. A new one restored the oscillator to its correct frequency after the coil had been readjusted.

But the story does not end here. Further probing revealed the cause of the failure of R605. This was C620, h.t. decoupling, which had gone s/c but had blown out, so disconnecting itself before the resistor suffered more than just overheating. At first glance, neither capacitor nor resistor looked as though they were damaged. Incidentally, an open circuit C620 has no obvious effect on picture or on line hold.—W.D.C., Prestwick (1084)

● RECEIVER SPOT CHECKS ●

No. 74: KOLSTER-BRANDES RV10

No A.G.C.: Symptoms, noisy picture—check R93, R94, for o/c and C82, C83 for s/c. Symptoms, noisy picture and reduced brightness—check R92 for s/c. Symptoms, slight hum bar across picture—check C80 and C83 for o/c.

Weak Sync: Line only, check R95 for h.r.; frame only, check R99 for o/c; line and frame, check R96 for s/c. Weak frame sync and jitter, check R110 and C88 for s/c.

Line Speed Incorrect: Check C56, C59 and C57 for high resistance leakage, check R67 for s/c, R63 for h.r. and R62 (hold control) for s/c.

Frame Speed Incorrect: Check C93 for o/c. If accompanied by cramping at top and extension at bottom, check C96 for o/c.

Increased Brightness: Check R126 for o/c or h.r. If accompanied by cogging on line, check R61 for h.r. If accompanied by smeary picture, check C61 for s/c or h.r. leak.

Reduced Brightness: For slight reduction of brightness, check R61 and R126 for s/c and R124 for o/c or h.r. If brightness level varies, and brightness control is inoperative, check R125 for o/c.

Reduced Width: Check C62, C63, C64 for o/c on h.r. leak. Check C60 for s/c. If accompanied by reduced brightness, check R68 for h.r.

Collapse of Frame: Check R109 for s/c (collapse to 6 in.), R111 for o/c (2 in.), C91 for o/c (2 in.), C87 for o/c (1 in.), C84 for s/c (½ in.)

Partial Frame Collapse: Check R103 for s/c, C89, C95 for o/c, C93 for h.r. leak, R108, R110, R102 for h.r. If accompanied by top foldover, check R117, R118, R119 for s/c and C94 for o/c (weak sync also). If accompanied by reduced brightness, check R73 for h.r. and C65 for h.r. leak. If accompanied by bottom cramping and top extension, check R121, R122 for o/c or h.r.

Frame Linearity Faults: *Extension at bottom:* check R117, R118, R119 and R116 for o/c, and C94 for s/c or h.r. leak. *Overall extension:* check R102, R108 for s/c, R104 for h.r. If confined to the centre, check R119 for h.r. If accompanied by increased brightness check R73 for s/c. *Cramping at Bottom:* check C90 for o/c and, if accompanied by slight top extension, check C96 for s/c. *Bottom foldover:* check C92 for s/c or h.r. leak. *Cramping at top, extension at bottom:* check R104 for o/c, R122 and R121 for s/c.

No Control of Brightness: If left side of picture goes black and brightness control inoperative, check R123 for o/c. For insufficient control of brightness, check R130 for h.r. If brightness is excessive with no modulation for a few seconds, then disappears, check R124 for s/c.

Line Foldover: If accompanied by increased height and reduced brightness, check C63 for o/c.

No Frame or Line Sync: Check R61, R95, R96 for o/c, R101, C85 and C55 (with overload on picture) for s/c.—D.C., London (1108).

Brainless Bertie

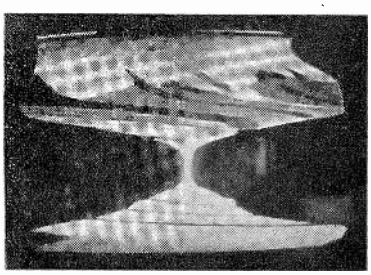
Dig that crazy,
Mixed-up kit!
Bertie grew lazy,
'Modified' it.

Feste

Bush TV66

Wine Glass Effect

The trouble with this receiver was a "wine glass" effect, which turned out to be a vessel of wrath so far as the customer was concerned as the picture resolved into this unusual shape, in the middle of *Emergency Ward* 10. The curious effect of this fault is shown in the accompanying photograph from the screen.



The trouble, however, in spite of its formidable symptoms, turned out to be nothing more involved than a heater-to-grid leak (of 500kΩ) on the PL81 line output valve.—F.C., Crewe (1076).

Pye V510

Two Frame Faults

On one of these receivers, the trouble was frame creeping up at the bottom of the picture and stretched at the top. This fault has, in fact, been experienced four or five times with sets of this comparatively new type and in every case has been traced to a very high resistance leak in the 0·1μF capacitor C73 which is in parallel with the frame output valve grid resistor R76, reducing the value of the grid resistance to about 8MΩ.

A fairly common fault on this model appears to be weak frame hold.

(Continued on page 105)

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.

Price 1s. each

Ace "Astra" Mk. II Model 553 (TV52, May, 54).
Alba T655 TV (TV130. Dec., 58).
B.S.R. UA8 autochanger (S7, March, 57).
Bush T36 series TV receivers (TV83, Apr., 56).
Bush TV22 series TV receivers (TV67, Jun., 55).
Bush TV53 series TV receivers (TV101, Feb., 57).
Bush TV94, TV95, TV96, (TV185, Sept., 61)
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).
Invicta 940, 941. (TV181, July, 61).
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).
Pam 119A, 120A, 123A, 1000A (TV181, July, 61).
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).
Philips 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 CTL58V.S series (TV150, Feb., 60).
Pye CTM17S series (TV131, Feb., 59).
Pye V200/V400 series (TV163, Sept., 60).
Pye V210 series (TV168, Dec., 60).
Pye V700A, V830A (TV181, July, 60).
Regentone "Big 15/5," T and C (TV48. Feb., 54).
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).
Ultra 1781/83 series. (TV183, August, 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).
Bush TV92 and TV93. (TV182, August, 61).
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 Stereograms (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).
Ekco TC369, T370, T372. (TV180, July, 61).
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 serjes (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).
Ferranti TC1047, T1048, T1050. (TV180, July, 61).
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).
Kolster-Brandes QV30FM series (TV184, Sept., 61)
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).
Ever Ready *Sky Baronet, Sky Countess* (R152, July, 61).
Ferguson 348BT 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 U1003/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 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)
Philips 493VT car radio (R154, Sept., 61)
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).
Pye TCR2000 car radio. (R153. August, 61).
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).

TECHNICAL GEN continued

After adjustment, and running the set for some time, the picture will start to slip vertically but can be locked again by adjustment of the vertical hold control. Further adjustment may be necessary after a few more hours and has often been necessary on switching on.

An improvement has been made by altering the value of the vertical sync separator grid resistor R89 from 150kΩ to 100kΩ.—R.R. Mansfield (1083)

Ferguson 536T

No Frame Scan The complaint was complete frame collapse. The chassis was removed from the cabinet and voltage checks carried out on the frame scan amplifier, a PCL82. All voltages appeared to be normal.

At this point it was noticed that the 330kΩ anode load resistor R121 was running slightly hot. This led to the checking of the 3000pF V13A-V7B coupling capacitor C91, which was found to be short circuit. Replacement of C91 restored the frame scan but with insufficient height and poor frame linearity.

Once again, checks were made on the frame amplifier and the 0·01μF capacitor C97 in the frame linearity feedback circuit was found to be open circuit. Replacement corrected lack of scan and poor linearity.—W.J.P., Colchester (1091).

G.E.C. BT318-319

Frame Circuit Fault One of these receivers came in with the complaint of distorted picture. On test, it was seen that the top half of the picture was stretched out and the bottom half tightly cramped. Both vertical form controls were operative but could not remedy the fault. There was also insufficient height and the screen could not be filled.

Frame timebase valves V15 and V16 were tested but found OK. Bearing in mind that similar symptoms may be caused by an o/c cathode bypass capacitor C122 or a leaky feedback capacitor C121, both components were checked and substituted, to no avail.

Further wiring investigation brought us to the junction of C124, 125 and R113, which looked perfect, neatly covered with a large blob of solder, but a hard pull or rocking of C125 would clear the fault.

When the solder joint was removed, It was seen that the wire end of C125 was covered with resin and dry. Thorough scraping, cleaning and resoldering top end of C125 restored normal picture.—E.L., Long Eaton (1074)

SERVICE BRIEFS

Sobell T279: Trouble was lack of width after set had been installed for a month. Replacement of the PL81 restored set to normal for about a month, when the fault recurred. This time we investigated further and found that the 2·2kΩ screen feed resistor was completely s/c. On this model, line frequency drift is quite common and the manufacturers recommend changing the 10pF capacitor C109 from suflex to silver mica.—A.C.L., Norwich (995).

Bush SRG91: The complaint on this receiver was that there was unbalanced stereo sound on radio (balance controls in gram only). After a while the fault was traced to the V6 grid stopper R27 which had been moved by chance on a previous repair. Varying its position relative to IFT5 varied the pickup from this transformer. It was found necessary to fit a screen between R27 and the i.f. transformer to reduce the offending radiation.—A.A.S., Mansfield (978).

Philips 1756U/1768U: On the 1756U the trouble was initially over-contrasting and the raster, after a few moments, disappeared, although the line stage was oscillating. It was found that V11 and V12 voltages were low but the V12 grid was positive. This was due to C45 which had developed a low resistance short. On the 1768U the fault was uncontrollable frame slip. This was due to R87 which had gone high.—A.A.S., Mansfield (977).

Ultra 60 Series: The complaint was no raster. Sound was normal, but there was no line whistle and the 30F5 line oscillator was glowing brighter than usual. On test it showed low emission but no inter-electrode s/c or leakage. It was then seen that the 1·8kΩ cathode resistor R97 was charred and o/c and that the trimmer TC1 was s/c. Therefore a full h.t. was applied to the V13 grid, resulting in the damage to R97. Replacement of the three components restored normal operation.—E.L., Long Eaton (919).

● odd spot

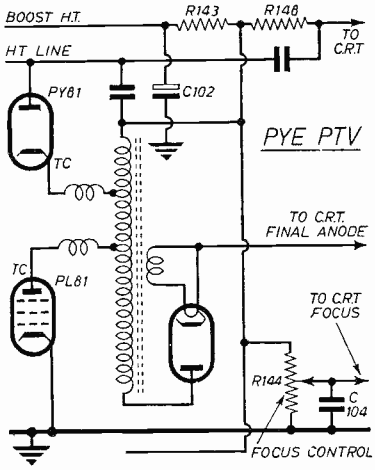
IT was a great temptation when we opened up a television receiver on the bench and found a pound note inside the baseplate. But honesty prevailed and after the repair my mate returned both receiver and money, remarking: "Here's a pleasant surprise for you, Madam".

"Oh, no", said the customer, "We knew it was there. That's the way we save for our licence, by putting the money safe—in the bottom of the set".—B.R.G., Glamorgan (1107).

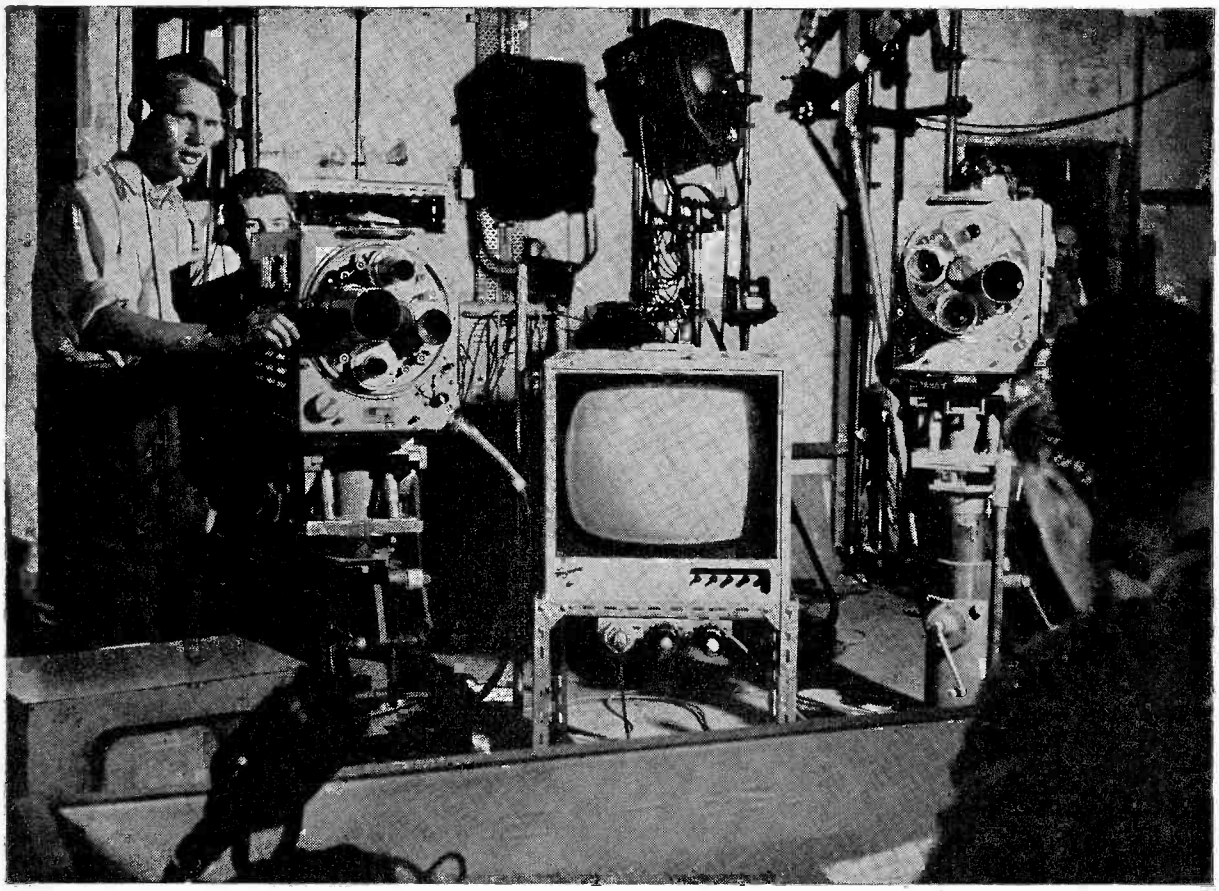
Pye PTV

Unusual Focus Fault This portable set arrived at the bench with no raster and the note from the customer that when the focus control was turned fully one way the picture appeared but was difficult to lock horizontally. On test it was found that turning the focus control fully one way restored e.h.t. and by adjusting the preset line hold control a picture could be obtained.

On voltage checking with the raster off, it was soon found that there was no h.t. to the top cap of the PL81 or PY81. With the set cold, the junction of R143 and R148 was checked and found to be a direct short to chassis. It was soon established that C104 from the focus control tap was short circuit.



From the circuit diagram it will be seen that the short from the junction of R143/R148 was in effect cleared when the focus control centre tap was turned to the earthy end of the track. Replacing the 0·1μF capacitor restored the circuit to its proper working conditions.—D.Mc.L., Lochgilphead (1050)



Photograph of television studio by kind permission of the B.B.C.

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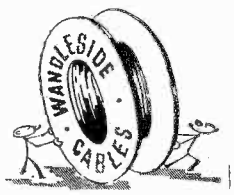

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adding sound to COAXIAL TELEVISION RELAY

by GORDON J. KING
Assoc. Brit. I.R.E.

RELAY or "wired radio" was born as a sound-only system which required a pair of conductors to carry the sound signals from house to house. Large audio amplifiers fed high-level signals into the beginning of the cable network at a relatively high impedance and voltage.

Each subscriber was fed with a signal of the required level to work a loudspeaker terminal unit at adequate volume. The loudspeaker was housed in a conventional cabinet complete with a matching transformer and volume control.

This arrangement developed over the years into a multi-programme system, whereby multiwires replaced the simple pair and several audio signals were fed into the network to give subscribers a choice of programme.

Subscribers' units then featured, in addition to the volume control and transformer, a programme switch which simply connected the loudspeaker to the wires carrying the required programme. This is an excellent arrangement and, indeed, is in use still in many areas.

Later, the demand was for television, so television was added to that kind of sound system. Special multiwire cables were developed and in some cases a set of wires handled a sound programme in addition to one or two television programmes, while additional wires were erected for additional programmes.

Coaxial Relay

Since those days television has been growing and the demand for sound-only relay has been diminishing, and a different type of relay system has evolved dealing essentially with television on coaxial cable.

Coaxial cable for relay has several advantages among which is that its wide bandwidth allows the distribution of signals from d.c. up to 200 Mc/s in Band III at least.

Thus, there is available a very wide spectrum on which can be launched a host of programmes, both sound and vision, including data transmission channels for business purposes and music channels – all on a single cable.

The first published account of Soundline, a new system of adding sound to TV relay, developed by the author.

Another advantage is that the "free programmes", such as BBC and ITA, can be distributed at their original frequencies and that an ordinary set, or an inexpensive version on an ordinary set, can pick out the signals just the same as they can from domestic aerials.

The coaxial system, therefore, works in full favour of radio and television dealers. In fact, many dealers are installing systems of this kind themselves.

Programme Expansion

The coaxial relay system is all set for programme expansion, for with coaxial the channels can be fixed once and for all in terms of frequency and the future possibility of mutual interference and co-channel effects are killed right from the start.

We have heard a lot lately about future programmes and new standards and of colour television. All these things can be handled on a coaxial system.

Once the coaxial is up there is never any need to add to it. There is sufficient spectrum space within it to handle all future programmes, including "toll" programmes, coin-box control and all the other things that the future demands.

VHF-FM Sound

Since coaxial relay has been practised, ways and means of adding sound-only programmes to a television coaxial relay system have been investigated. A method which is in use extensively at the present time is the distribution of the v.h.f.-f.m. signals at their natural frequencies in Band II.

To receive these signals a subscriber requires, of course, an ordinary v.h.f.-f.m. receiver. In fact, the relay, as with "free television", simply replaces the domestic aerial system.

This is a good idea and one which can be extended to other programmes. For example, it is now mode to pick up Radio Luxembourg at the main receiving point of the system and re-modulate it f.m.-wise on a new Band II carrier. This signal is then applied to the cable network along with the television and ordinary v.h.f.-f.m. signals and can be received by subscribers by tuning their ordinary v.h.f.-f.m. receivers to the appropriate frequency.

There are several disadvantages in this arrangement, however, and one is that the signal attenuation in the cable network at Band II frequencies is rather high for reasonable size cable.

This means that repeaters need to be installed every few hundred yards to make good this loss, and there is a limit to the number of repeaters that can be connected in line. Moreover, it is now the current practice to employ ultra-wide-band repeaters from about 38 Mc/s or below to 100 Mc/s or even 200-odd Mc/s.

TV and FM

Such repeaters handle both television and v.h.f.-f.m. sound, but as more carriers are introduced into this wide spectrum so the maximum signal level per carrier is decreased.

This is because an amplifier can only handle a signal of a certain maximum level depending on its design, whether the signal comprises just one carrier or a dozen or so carriers, before it goes towards non-linearity, and if there is more than the slightest trace of non-linearity in a relay amplifier intermodulation of

all the signals results. That is, sound-on-vision, vision-on-sound, vision-on-vision and so on.

Distributed amplifiers which provide the ultra-wide bandwidth are less prone to intermodulation than are their narrower-band counterparts, and as a consequence they are adequately able to handle all the existing carriers, including v.h.f.-f.m. at a reasonable signal level without trouble.

L.F. Distribution

A system new to this country, and developed by the author, uses for sound distributuion relatively low frequencies falling in the octave 2-4 Mc/s. It is possible in this band to distribute, at least, 20 separate sound signals on a coaxial network. Thus, sound can be added to an existing television and v.h.f. system without affecting the performance in any way.

This method of distributing sound has several advantages, including the fact that the loss in one mile of cable at 2-4 Mc/s is less than the loss in 500 yards of the same cable at Band I frequencies.

Where *reasonable* frequency channel space is likely to be at a premium, even on a coaxial system, when there are, say, three "free programmes" and a number of "toll" and other programmes, being able to ship all the sound programmes and sound accompaniment of television programmes into a narrow lower frequency spectrum may well solve many problems.

This, of course, provides more room for vision-only carriers and, with certain reservations, there is no fundamental reason why Band II should not also be used for extra vision channels, if required.

High-level Distribution

The sound carriers are applied to the beginning of any coaxial network at approximately 6 volts r.m.s. The reason for this is essentially to minimise the complexity of subscribers' receivers. In addition to television and v.h.f.-f.m. signals, each subscriber is provided with a signal of between 5 and 10 mV on each sound carrier.

Generally speaking, however, when the low-frequency sound system is installed there is little need for v.h.f.-f.m. distribution as well – the foregoing purely illustrates that the two sound systems can be run side-by-side from the technical point of view.

The low-frequency system which is at present available, is designed for a maximum of 10 carriers with 200 kc/s spacing. The carriers are produced by a crystal-controlled oscillator, and are fed to the network

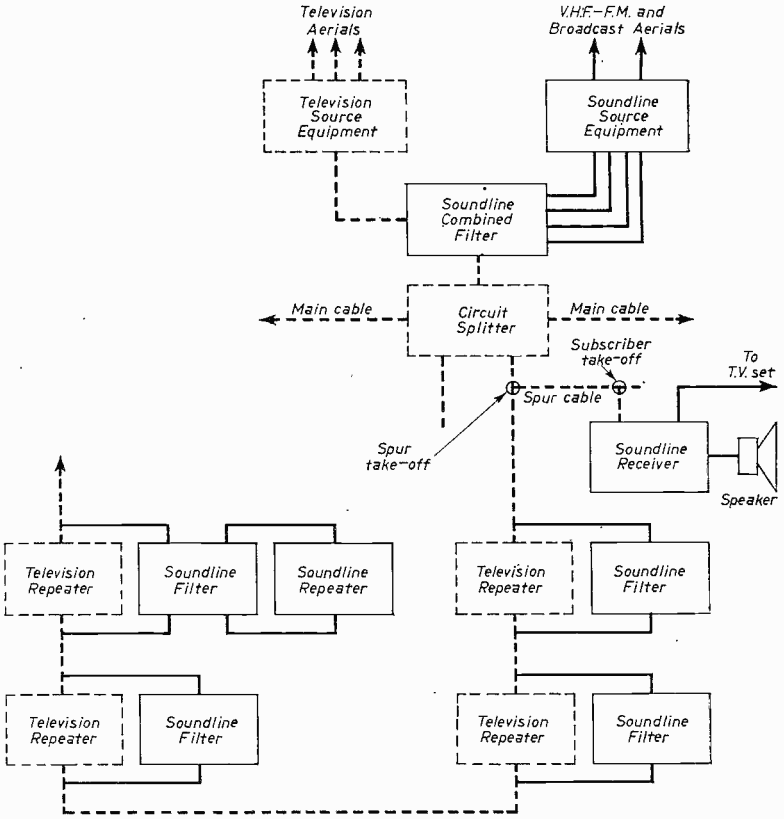


Fig. 1: Showing how *Soundline* may be added to an existing co-axial system. The broken line items are those which may already be in use on television, while the full line items are the sound additions. Owing to the smaller cable loss at the lower frequencies, a *Soundline* repeater is required after three or four television repeaters.

through filters and decade attenuators for individual adjustment of carrier level.

Each carrier is amplitude-modulated with the required programme material, which can either be a radio programme or locally derived material from a tape recorder, record player or microphone, but it should be noted that there are various laws governing the distribution of locally derived programmes at the present time.

Four-channel Multipliers

As the demand initially will be for four-channel systems (e.g., Light, Home, Third and Radio Luxembourg), the system as a whole is designed on the basis of multiples of four channels. Thus, there will be available four channel systems, eight channel systems, twelve channel systems and so on. This applies essentially to subscribers' receivers and repeaters.

Modulators

For each programme distributed is required a separate modulator. This is a fairly conventional three-valve rack-mounted device which is usually set up with the television equipment at the aerial station, but could be installed elsewhere if required. This contains the crystal oscillator and modulator, and on some models an f.m. tuner unit is also incorporated to facilitate distribution of the BBC programmes.

The front panel features a modulation depth meter and control, a jack for applying the programme material should this be something other than a radio programme and the decade attenuator.

There are also a main signal outlet and a test point for monitoring, and also an inbuilt loudspeaker, switch-controlled, for monitoring the a.f. applied to the oscillator.

The signals from the modulators are combined to a common outlet in a resonant low-loss combining filter. There are also filters and a socket to introduce the television and v.h.f. signals so that they are also combined to the common outlet.

The common outlet, of course, feeds the main distribution cables, and to avoid disturbing any existing line-powering arrangements, the combining device carries a line power filter.

Repeaters

The repeaters are also in multiples of four channels, and each channel uses but a single frame-grid valve giving a maximum gain of 30dB. Each channel has its own manual gain control, but there is also a.g.c. which, in effect, prevents the output on each channel rising above the level set by the manual control.

The design is such that a maximum output approaching 6 volts r.m.s. is available on each channel and since each valve is concerned with only one signal intermodulation problems are considerably minimised in spite of the high signal output (maximum of 24 volts r.m.s. on a four-channel system).

The repeaters are mains powered and contain their own power units and splitting and combining filters.

Subscribers' Receivers

Like the repeaters, the subscribers' receivers are also in multiples of four channels. A four-channel version has a four-position programme switch, an eight-channel version has an eight-position switch and so on.

The receiver presented the biggest design problem since it had to be inexpensive and yet provide good domestic quality at about 500 mW. A single triode-pentode valve forms the heart of the unit, and it is arranged in such a way that there are four separate stages, which are: r.f. amplifier, detector, a.f. amplifier and output.

This was done by reflexing the triode as r.f. amplifier and a.f. amplifier. There are thus three tuned circuits which, in addition to a Q-multiplier arrangement, provide adequate adjacent channel selectivity at 200 kc/s spacing.

The receiver is built with its power unit, programme switch and volume control on a small chassis which can easily be installed in a small control box or in a speaker cabinet or even inside the cabinet of a television set or record player.

There are two coaxial sockets connected by filters, one which accepts the normal downlead of the relay and the other which takes a fly-lead for connection to the television set. The filters thus direct the low-frequency sound signals to the sound receiver and the v.h.f. signals to the television set.

Television Filters

It is fairly obvious, of course, that the low-frequency sound signals would not get very far in a television system because the television repeaters would not pass them. Moreover, the fairly high sound signal level could well disturb the television repeaters and cause intermodulation and other effects.

This was overcome by simple filters for inclusion at each television repeater point. The filters have a low-pass characteristic and bypass the sound signals round the television repeaters.

They also have a stop band characteristic to prevent the sound signals from either getting to the television repeater input or output socket. They also include filters for passing line power on systems where this kind of powering is adopted.

Conclusions

In Fig. 1 is shown how this low-frequency system may be connected to an existing television coaxial relay system. The items in broken-line are those which may already exist for television, while those in full-line are the sound additions.

This system has been given the name "Soundline" and the main distributor is Viewline (Sales) Limited of Hyde Road, Paignton. It is understood that other area distributors are being appointed. It is also understood that this equipment will not be sold to the public direct, but will be channelled through relay operators, relay-operating dealers and ordinary radio and television dealers.

In conclusion I should like to record my thanks to Mr. J. A. A. Pullen, Director of Viewline (Sales) Limited, for his kind permission for me to publish 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.

Solid and Mellow

CAN other readers direct me to a really "boxey" radiogram without those spindly crutches that pass for legs on contemporary furniture?

I still get requests from customers for a "solid-looking, mellow-sounding instrument". No use telling me to educate them in high fidelity and modern design. They *know* what they want and if they can't get it from me they will go elsewhere.

The question is, what modern manufacturer in the "average" price range turns out the style of furniture, and with the sort of reproduction, my customers want to see and hear? —**Dealer,** *Swansea.*

(*Editorial Note: And what* **we** *want to know is, to* **where** *do these disgruntled customers go? Do they scour the country wandering from dealer to dealer in their hopeless quest until they go mad or settle for a reconditioned second-hand gram?*)

Bosom Colleagues

ALTHOUGH we have many ladies active among radio retailers, the number who engage in service work can be counted on a thumbless hand. I wonder why? It is not unusual for the ladies to take up a "man's job" and often do it better than the mere male. Women in professions are commonplace nowadays.

Radio service should appeal to the innate desire for tidying things up that is supposed to lurk in the female bosom. It would also brighten things up a bit!—**J. Brown,** *Manchester.*

(*Editorial Note: Take heart, Mr. Brown. It was lately reported from Nottingham that the Fifth Form of the Player Secondary School had constructed a do-it-yourself oscilloscope from second-hand store oddments. Buying a kit would have been "too easy", said science master D. Shorthouse. The point is that Player Secondary is a school for girls. So there's hope yet.*)

As She is Spoke

I HAVE sometimes been accused of owning a perfervid imagination, when I retail the incidents of a serviceman's life in *Service with a Grin.* Just to prove this accusation a calumnious defamation, I enclose a missive that came in this morning's post. I think you may agree that nothing is more ridiculous than the unvarnished truth. If you use this letter, you will, of course, respect my legal rights by not publishing our customer's name and address.—**H. W. Hellyer.**

The letter reads: *Dear Sir or Madam. Please forgive me but I hope I'm not a nuisance but a few week ago I had a little trouble with set and afterwards I had to recall telly adjustment man out. I would like one day when he is out here to call, the last one who was here:—just that little bit too much width* sometimes *a man's head will appear like so* (....*....) *sort of flat on top its not a lot. but my* 3 *yrs pays of repair insurance ends in Nov. Trusting you can understand. thank you.*

(....*....) Here appeared an inspired doodle, impossible to describe but which could be taken as a bald-headed cat with a beard.

TRADE NOTES

New Tuning Device by Brush

A new device designed to take the place of conventional trimmers and even gang capacitors has been introduced by Brush Crystal Co. Ltd., of Hythe, Southampton (*Tel.:* Hythe 3031).

It is a silicon variable capacitance diode, an extremely small, lightweight, device for use in radio and TV receivers for v.h.f. tuning, automatic frequency control circuits, frequency modulators, band-pass filters and remote control tuning. The capacitance depends on the reverse bias voltage applied to the diode. The diodes are being marketed at prices which make them competitive with conventional methods of tuning.

Also introduced by Brush is a new range of silicon p-n-p junction transistors, claimed to be the cheapest in Britain. The OC700 series consists of five transistors designed to meet the needs of most low frequency applications. The company is also producing a new range of zener diodes, re-grouped into preferred voltages and considerably reduced in price.

RADIO HOBBIES EXHIBITION — November 22-25

The 1961 International Radio Hobbies Exhibition will be opened by Henry Loomis, Director of the Voice of America radio network, at noon on Wednesday, 22nd November. Sponsored by the Radio Society of Great Britain, it will be held at the Royal Horticultural Society's Old Hall, London, S.W.1 daily from 22nd to 29th November inclusive (11 a.m. to 9 p.m.). Admission price is 2s.

Apart from commercial companies, showing a wide range of components, test gear, equipment and literature, the 29 stands will include displays by the Army, Navy and R.A.F., in addition to the G.P.O. Research Branch, exhibiting for the first time. The British Amateur Television Club will exhibit a colour TV display built by members. The RSGB transmitter GB3RS will be operating throughout the period of the exhibition.

Everyone visiting the exhibition can obtain a free entry card for an opportunity of winning a £185 Hammerlund communications receiver.

MULLARD FILMSTRIPS
ON MODERN PHYSICS

The Mullard Educational Service has commenced production of a number of colour filmstrips dealing with some of the sub-divisions of modern physics, some being aimed at school level and others at graduate level. The eight filmstrips now available are as follows:

E100: *Classification of Electronic Valves and Tubes* (39 frames)—suitable for A level students and keen O level pupils. E102: *The Triode* (29 frames)—A level and above. E103: *The Tetrode and Pentode* (30 frames)—A level and above. E104: *The Cathode Ray Tube* (24 frames)—A level and above. E105: *Television Picture Tube* (28 frames)—mainly for A level, also VI form science teaching. E109: *Luminescence in Gases and Solids* (30 frames)—beyond S level. E110: *Photoelectric Emission* (31 frames)—S level and above. E120: *Introduction to Nuclear Physics* (26 frames)—A level and above.

These filmstrips may be purchased at £1 5s. 0d. each including comprehensive notes, from Unicorn Head Visual Aids, Ltd., 42 Westminster Palace Gardens, Artillery Row, London, S.W.1. Further details on the filmstrips may be obtained from Mullard Educational Service, Mullard House, Torrington Place, London, W.C.1.

New Books

★ *SERVICE ENGINEER REVIEWS OF THE LATEST TECHNICAL LITERATURE*

Colour Television: **The N.T.S.C. System Principles and Practice. By P.S. Carnt, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E. and G. B. Townsend, B.Sc., F.Inst.P. M.I.E.E., A.K.C. Published by Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1. 487 pages. Size 8¾×5½ in. Price 85s. net.**

THE radio retailer and his engineer are constantly challenged by the customer's question, "When is Colour TV coming?"

Until lately, the answer has been a tentative , "*Not this year, nor next; maybe sometime. maybe . . .*" But since the T.A.C. recommendations on line standards and the many representations to the Pilkington Committee we have been uneasily aware that the corner around which Colour TV lurks is drawing ever closer.

The Radio Show (and the splinter group "Little Show") will have made us even more apprehensive. We are confronted with our ignorance. When Colour comes, are we to be caught clod-footed, baffled by new equipment, bemused by new techniques?

We certainly shall, unless we prepare ourselves. This book comes just at the right time, when a revival of interest in the subject is combined with a sense of impending change.

Terms of Reference

But first a word about the authors' terms of reference. Messrs. Carnt and Townsend are well-known members of the G.E.C. research team of scientists who have been directly concerned with the development of colour television techniques for a number of years. They have lectured extensively up and down the country and recently completed a hectic stint of explaining to dealers the methods that could be expected, at the New Horticultural Hall, Westminster.

The main basis of their theme is that Colour TV can as well be broadcast on the 405-line system, N.T.S.C. standards, as on any other. Indeed, this volume is a powerfully detailed argument for this point of view.

Beautifully produced, with 14 full colour photographs, 8 monochrome plates and 233 line illustrations, *Colour Television* describes the adaptation of the American N.T.S.C. system to the British 405-line, positive modulation, a.m. sound, standards. Assuming a working knowledge of monochrome television, the sixteen chapters are essentially practical, although the authors do not make the common mistake of "writing down" to their readers, and, in fact, a more detailed mathematical treatment of some aspects of colour television is given in the eight short appendices.

After a chapter of basic introduction to the principles of colour transmission and reception, the true introduction to the subject occupies a valuable 32 pages of Chapter 2, which includes a lucid explanation of such terms (new to the engineering staffs of the retail trade) as Colorimetry, Tristimulus, Chrominance, Luminance and Alychne, with adequate diagrams.

Compulsory Reading

This should be compulsory reading for the technician who hopes to stay in the trade when colour "rounds the corner". Although he may find the first few pages hard going, the solid groundwork will stand him in good stead. Despite the contention of the authors, that "*colour television is less drastic a step from monochrome than was vision from sound broadcasting*" it is obvious that the "cowboy", the "valve-swopper" or the "ham-fist" will be too expensive a luxury for the retailer to maintain. A more thorough theoretical grounding is vital for the servicing of colour sets.

This book can provide the theory —and more. Practical servicing has not been ignored. After six meaty chapters of description of signal standards, colour specifications, transmitter coding and receiver decoding, Chapter 7 ushers in the practical viewpoint with an "Introduction to Colour Receiver Design".

Subsequent chapters cover various features of receiver design, shadow mask tube operation, test equipment and receiver installation. There is a chapter on fault-finding, necessarily general and indicative rather than particular and explanatory, for as yet there are no "guinea-pigs" available in Britain save the highly specialised closed-circuit systems, as used by the medical profession.

Encouragement

But technicians will be encouraged by the introductory words of Ch. 14: "*Colour Television receivers contain more components and circuits than monochrome receivers but are no more difficult to service.*" Nevertheless it is stressed that designs will vary widely—something we are already accustomed to! The engineer is advised to work strictly according to the maker's manual until enough experience is gained. The complex adjustments alone will gainsay hit-or-miss service.

There is little doubt that browsers will flick to page 391, to study "Shortcomings of N.T.S.C. systems." They are likely to get a shock, for it seems that these shortcomings are relative. According to the authors' arguments, other systems have equal or worse drawbacks. They are staunchly in favour of 405-line N.T.S.C. with a.m. sound. Let us hope that their parent company will not disown them if developments prove other roads are easier to follow.

Certainly, developments will not outdate this volume, for the fundamentals of colour television are the theme and motif of a comprehensive work. Whatever changes there may be in propagation, in display devices, in standard specifications, the principles will remain. It will only be necessary to modify the exposition in the light of future progress—and when the balloon goes up, the authors will, we hope, give us renewed pleasure with another edition. If it incorporates some practical circuits of "commercial domestic" receivers, and a rundown of adjustments, so much the better for technicians and others of practical bent.

Messrs. Carnt and Townsend are to be congratulated on what bids fair to become a basic textbook on the subject. The service department without this volume on its shelf will not be adequately equipped for the market breakthrough when Colour TV finally comes around that corner. —*M.A.Q.*

GEC Device Guide

A new and revised edition of the GEC semiconductor division's *Device Guide*, a 10-page booklet giving brief information on the range of GEC semiconductors.

The new edition contains information on many newly introduced devices, including the new subminiature high speed switching diode GEX71, the widened range of medium power zener diodes SZA/C series and new high power silicon controlled rectifiers. In addition to concise electrical and mechanical specifications, the publication includes a list of CV types supplied by the Division, with their nearest commercial equivalents and a commercial comparative table. Copies are available, free, from General Electric Co. Ltd., Semiconductor Division, School Street, Hazel Grove, Stockport, Cheshire.

SERVICE WITH A GRIN

by H. W. HELLYER

Representationalism, like

TAKING second place to that perennial favourite, the danger of imminent atomic annihilation, is the odd report of a stolen Old Master or a revolutionary way of painting sans pigment, sans canvas, sans all. Art is news.

At the time of writing, some genius has managed to back the favourite headline each way by offering to return a spirited portrait on payment of a ransom to the Nuclear Disarmament Fund.

And what, says Joe, has this to do with us, whose nearest acquaintance with "brushing" is a badly soldered e.h.t. joint; who thought "tempera" the outburst of an Italian service manager?

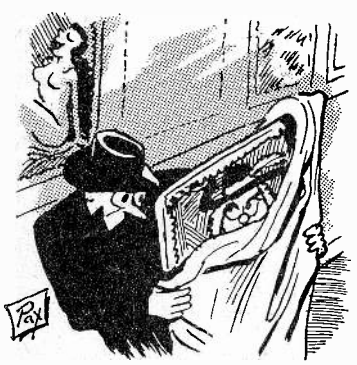
★

Two recent experiences combined to twist my agile brain into these artistic channels. First was a report of the Radar Branch, Technical Group, REME, entitled *Speeding the Production of Circuit Diagrams.*

The second experience was a flying visit to colleague Gordon J. King, to catch him in the midst of preparing a new book. Around him on the table were piles of pencilled roughs, the sort of scribbled diagrams that you and I employ to illustrate our arguments.

It was comforting to know that we are not alone. Those labyrinthine squiggles on the backs of old envelopes, those cross-hatched sub-circuits around the margins of the manuals, the blotched, part-erased, wholly erratic hieroglyphs are characteristic of our trade.

The exhibitors of Cork and Suffolk Streets might do worse than come to our radio benches for contemporary inspiration. There's a patch of wall by the telephone which could be included in the New London Situation, even upside-down.



The odd report of a stolen Old Master.

The wonder of it is, that with all this apparent chaos, we manage to make ourselves intelligible – at least, to each other. Attempts to "standardise" the style and symbols of circuit diagrams have been as notable for their lack of success as for their good intentions.

Antipathy on the part of the drawing office staff.

★

The REME scheme is a fine piece of logical planning, the result of time and motion study of the whole process of producing a circuit diagram, from the designer's doodle to the finished schematic.

Using sheet p.v.c. and an appliqué technique, the symbols are prepared according to BS 530, and scaled to suit a ¼-inch grid. The designer then makes his freehand doodle on graph paper, keeping his connecting lines on the grid, which is no great hardship. The drawing office need only produce a kind of "Underground Railway" tracing of the various sub-circuits, moving them about until a balanced circuit is formed. All the draughtsmen actually draws is a series of connecting lines.

Symbols are rapidly stuck on, adhering to the p.v.c. by air pressure alone, rather like a licence holder on a windscreen, and reference numbers, etc., are clipped from typed, gummed paper and also stuck to the sheet. The whole thing can then be photographed, the original dis-assembled for use over again, and the master photostat kept for reproduction.

An attack of Wimbledon Neck.

In a sample run-through with a typical superhet circuit, a total time-saving of 37 per cent over conventional drawing office procedure was made. And material saving was significant, for no expensive tracing linen is needed, and the appliquéd symbols can be used again and again.

It was amusing to be told that the main disadvantage of the REME method was "antipathy on the part of drawing office staff to give the process a fair trial." Natural conservatives among us will recognise the service engineer's reaction to printed circuits.

As there are already manufacturing and publications contractors sitting up and taking notice, it seems that we are finally on our way to some degree of standardisation.

That will be one thing less for your scribe to carp about. But I hope the technique of marking component values on the diagram will be retained. There is nothing more soul-destroying than getting an attack of "Wimbledon neck" by glancing from circuit to component list on separate sheets as the circuit's mysteries are unravelled.

★

None of this, of course, will prevent Joe from doodling in the margins. Say what you like about accuracy, but you have to admit that his symbols have character. His valves, with their long, elliptical envelopes, look morose and his transistors beam in their circular "boxes". You can almost tell the capacitance of his electrolytics by the weight of his pencil as he thickens the bar.

And if standardisation gets us in its grip, I am going to save a few of these doodles for a future exhibition. After all, if Lucio Fontana can get 850 guineas for a white canvas with four razor slashes under the label of "spacialism", there must be hope for a few of my Tech Gen contributions.

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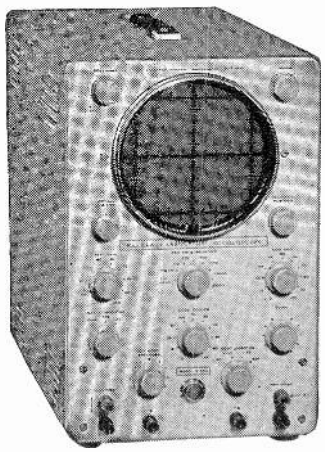

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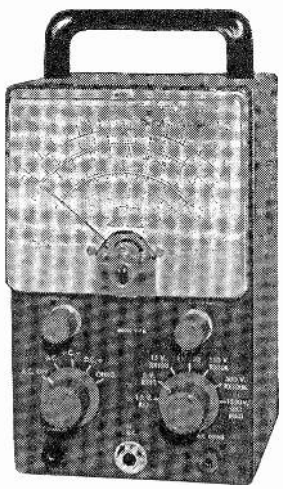

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Mains: 200–250V a.c. only live chassis.
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—osc. high.
Channels: All fiv
Band III Tuner TTD258.
Controls: Bright Volume 25k w./w.
Electrolytics: 12 common negat
Aerial: 70–80 ol
Mains: AC only d.c.).
Fuses: Two 1.5
E.H.T.: 8kV (1n
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 (17*in. ta also late ver. and T20*
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C.R.T.: Mazda
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Extract from Vol. I showing typical entry.

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