FEBRUARY 1960

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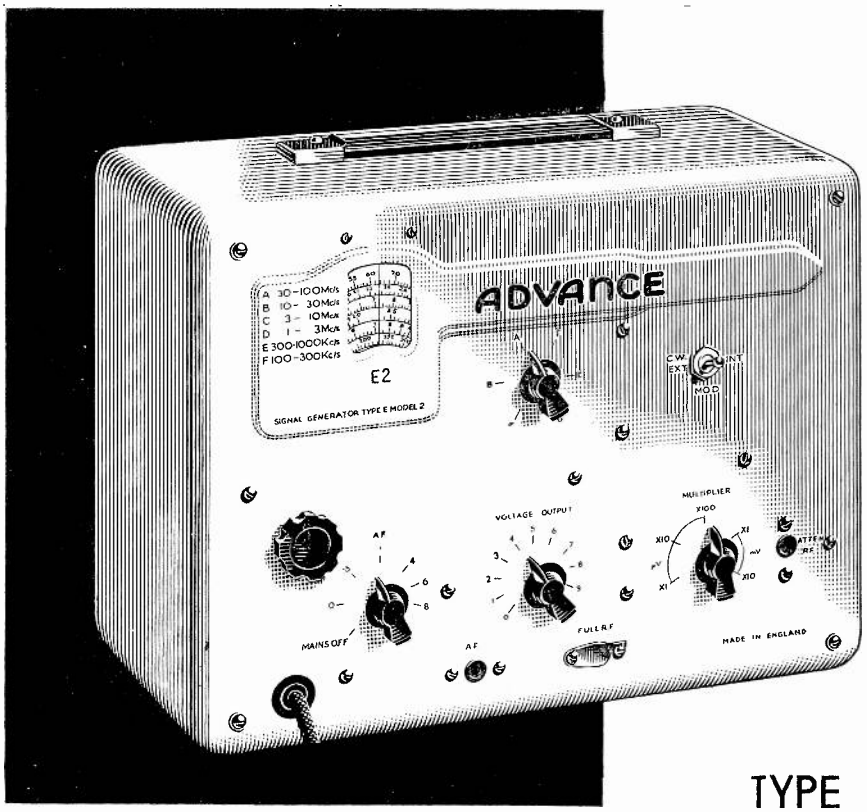

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GD 69

SERVICE ENGINEER

Vol 2. No. 9. February, 1960

Edited by W. Norman Stevens

Issued as a special supplement with "Radio Retailing"

In this issue:

SERVICE DATA SHEETS

RI38: Pam TB59 transistor portable radio.

TV149: Peto Scott 1722 and 1723 TV receivers.

TV150: Pye CTL58VS series TV receivers.

GRUNDIG TO MARKET MEASURING INSTRUMENTS

Grundig are soon to make available a range of instruments of interest to the radio and TV service engineer. The individual items are a beat frequency oscillator, a wobbulator, a valve-voltmeter, a universal valve-voltmeter, an isolating transformer, a grid dip oscillator, two resistance decades, a capacitor decade and a stabilised power supply. Full details of these instruments will be published when available.

NEW VARIABLE TRANSFORMERS

A new type of variable transformer, developed by Philips and marketed by Research and Control Instruments Ltd., overcomes some of the disadvantages of the normal single winding auto-transformer type. It is constructed on the double-wound principle with complete isolation between primary and secondary; a static screen is provided between windings to prevent the propagation of h.f. interference.

There are two versions. The bench mounting transformer is enclosed in a lacquered metal casing and embodies a safety fuse, range switch, output voltmeter, lead and plug. The panel-mounting type is supplied without the casing and other accessories. Further details of these transformers (types B8 709 00/02 and B8 709 50/01) may be obtained from Instrument House, 207 King's Cross Road, London, W.C.1.

Whither the Sixties?

WE are now taking the first tentative steps along the highway of time already named by a national newspaper as the Surprising Sixties. And like the marathon walkers now hitting the headlines with monotonous regularity, some of us are going to end up travel worn and a trifle footsore. But we hope few will have made so much effort to such little purpose.

The service engineer, already beginning his personal assault on the electronic MI stretched out before him, may well ask what surprises the sixties hold in store. One thing is reasonably certain: he will continue to deplore the general quality of many TV sets and to be plagued with certain components and constructions so flimsy and unreliable as to be almost tragi-comic.

He will also continue to note the alarming increase in the number of faulty and inoperative sets arriving from the manufacturers as new. Last year, if you didn't already know, a record crop was harvested.

Those who were repairing sets in the 1930's, and are still comparatively sane, have recognised a similar progression of trends . . . the first "midget" radio, followed by other midgets a little cheaper (and a little nastier) . . . makers competing to produce the Cheapest Superhet, the Cheapest All-wave Set, the cheapest this and that, gimmicks, gimmicks . . .

Theoretically, healthy competition is good and everyone benefits from lower prices. Unfortunately, cutting prices so often means cutting quality. The war mercifully interrupted this chain reaction in which prices and gimmicks were chasing each other in an ever-diminishing (vicious) circle.

Is it happening again? In 1953 the average price for, say, a 17 in. table TV set was around 80 gns. Today it is about 65 gns. During those six years, we concede that purchase tax has been reduced, that improved production methods have been devised and that automation has made strides.

Nevertheless, also in those six years, overheads have soared, workers wages have gone up considerably, the cost of raw materials has risen, and (dare we whisper it?) company profits have gone up, too. Yet despite this, retail prices are much lower. Has the lowering of the selling price been obtained at the expense of quality?

Service Viewpoint

Many service engineers, who after all are in an ideal position to comment on quality and reliability, strongly criticise the trends in design. They have to attend to those faulty so-called "potentiometers", to repair tiny breaks in printed wiring, to repair faults on flimsy circuit boards, and to put right the sets which miraculously escape the eagle eye of a manufacturer's 100-per-cent-foolproof inspection department.

We have been asked where it will end. Old Moore, unfortunately, says nothing about it. Old Joe, however, an observant if morbid serviceman we know, has definite views. He thinks that things are moving with the inevitability of a Greek drama. From replacable panels and unit construction, he feels it is but a step to replaceable TV sets. He sees sets not made for years and years of use, with periodic servicing and rejuvenation, but made cheaply enough to provide entertainment for a limited period, to be replaced when "out-of-date".

Don't laugh at Joe, he's not quite mad. It is common knowledge that Americans trade in their "old" cars and other objects with the regularity of film stars replacing their marital partners. American trends have a habit of breaking into the British Way of Life (which, of course, is being continuously undermined).

And have you tried recently to get, say, an alarm clock or inexpensive watch repaired? The man will shake his head pityingly and tell you it's not worth mending because a new one would not cost much more and "we don't bother with repairs". A sign of the times is that things are not repaired, they are replaced.

In the logical development of this trend, service engineers will become redundant and will join the Do-Do and the dinosaur as interesting but extinct species. Joe spoke enthusiastically about glass cases in museums but we feel he was letting his imagination get out of hand.

But if service engineers should one day find themselves out on a limb, it's worth remembering that an honest copper or two could always be picked up repairing alarm clocks.

Radiospares Cut Prices

With the issue of their January-March catalogue, Radiospares announce substantial price reductions of their ceramic and silvered mica capacitors. The Company claim that over the past four years the overall price structure of products has been reduced by 7½ per cent.

The Radiospares range now includes new values in standard, disc and high voltage ceramic capacitors, new midget mains transformers and miniature jack plugs and sockets. Also new is an audio output transformer specially designed to match push-pull EL84's and equivalents in the ultra-linear mode. Frequency response is 40 c/s to 15 kc/s ±1dB; secondaries to suit 3, 7 or 15-ohms, rated at 15 watts. Dimensions and style of construction is identical to the established heavy duty type. Price is 27s. 6d.

Another addition is a range of small d.c. relays with solid silver contacts which can switch currents up to 2A at 250V a.c. Connections are to a tag panel on top of the relay case, which is of cadmium plated steel, the tags and connections to coil being protected by special varnish-flux against corrosion and for easy tinning. These sell at 29s. 9d. each.

WOLF SERVICE

A new service department has been opened by Wolf Electric Tools Ltd., at 1–3 Dean Street, Bristol 2. (*Telephone:* Bristol 22288). Quotations for repairs can be given on the spot and telephone orders for spares received by 3 p.m. are dealt with on the same day.

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.

IN answer to V. Williams (p. 106, January), it would seem that the reason why some people "hark back to the good old days" is given in his letter – that things were much simpler then. As he says, today the service engineer must be more versatile and must handle more complicated equipment.

What bliss it must have been, in those pre-war days, without printed circuit TV sets, transitor radios, tape recorders, knobs that disintegrate, "pre-sets" which are held together mainly by will-power, combined TV and f.m. tuners which are impossible to align correctly.

And, of course no hi-fi. Or rather, no hi-fi customers! How can you blind a customer with science when he probably knows more than you do about a specialised aspect? I cannot imagine that the old time cycle-dealer-cum-wireless man had trouble with customers giving him lectures on the relative merits of silicon and galena crystals or complaining about peaky frequency response around 5 kc/s.

So, carry on Mr. Hellyer and other (presumably) ancient artificers. Those of us who were denied the privilege of being in the trade in those bygone days can at least dream a little. In the meantime, roll on stereophonic radio and colour TV.—**G. Weatherhead,** *Birmingham.*

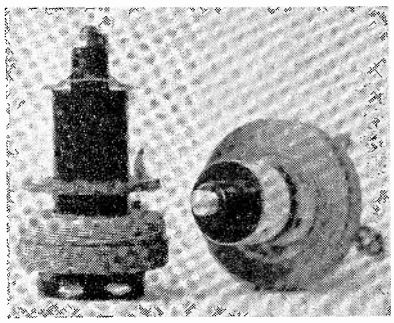
MORGANITE-SIEMENS BREAK

Morganite Resistors Ltd. and Siemens Edison Swan Ltd. have, by mutual consent, terminated existing arrangements regarding the distribution to wholesale and retail trade of Morganite Resistors.

From 1st January, The Radio Resistor Co. Ltd., 50 Abbey Gardens, London, N.W.8., will handle all sales to wholesalers and retailers of Morganite products.

WATCH THOSE PLUGS

Now that import restrictions on electrical appliances have been lifted, the distribution of foreign equipment in this country is increasing considerably. Unfortunately, some of these have mains leads colour coded contrary to British standards, the use of green-covered phase wires being not uncommon. In view of this, all leads should be checked before fitting 3-pin plugs.



Shown above are two examples of the complete range of tape recorder oscillator coils, for both Hartley and Colpitts circuits, now being produced by Direct TV Replacements. The standard types are tunable and cover the range 40-60 kc/s. Net trade price for single coils is 7s 6d, plus 1s 6d postage and packing.

New Books

"From the electron to the superhet", by J. Otte, Ph. F. Salverda, and C. J. v. Willigen. Published by Philips Technical Library, Eindhoven, Holland, and distributed in U.K. and Ireland by Cleaver-Hume Press Ltd., 31 Wright's Lane, Kensington, London W.8., at 55s.

IT is a sad fact that books suitable for the workshop technician in the radio trade are rare. The student, the amateur and the engineer are much better served; for them a wealth of literature exists. But the practising serviceman, seeking guidance, must either thumb wearily through a mass of rudimentary explanation or boggle at forbidding formulae to find the information he wants.

From Philips there comes a volume that falls quite neatly between the two stools. The apprentice and improver (and many an old hand) should find much genuine advice on radio service here – providing he is not first deterred by some of the book's disappointing and off-putting features. But more about them later.

The first edition of this book was in 1954, and this is the third impression. Already it has been published in 8 languages. There are 690 pages and 10 circuit diagrams, plus a quantity of minor illustrations. In manner, the work consists of 42 lessons, each with a resumé and a small test paper following it, specimen answers to the questions being appended. In matter, the subject of radio repair is treated from the bottom up, essentially practical all the way through, with worked examples and illustrations from actual receivers, and just enough academic groundwork to make the explanation easier.

Thus, it can be seen that the book is, in reality, a collection of lessons; a continuous course on radio service. Indeed, Philips tell us that this book was "... *specially written for self-study purposes and also for the radio serviceman who wishes to brush up his knowledge.*"

Drawbacks: Unfortunately there are several aspects of the technical textbook that the authors seem to have overlooked. Firstly, the format. The type is not a familiar one to British eyes, and the paper on which it is printed is rather flimsy. Although this latter point is probably chiding at a necessity, for the volume is already quite bulky, nevertheless, the overall impression the reader gains is of a collection of papers, bound for convenience.

This impression is strengthened by an unhappy omission of continuity in page numbers. The pages are serial for each lesson, but revert to unity at the end of each. The result is that the comprehensive index at the beginning of the book is not very helpful, for one has to leaf laboriously through the heavy tome to reach a particular page. Diagrams also are numbered afresh for each lesson, so that even more thumbing has to be done when some of the latter test papers refer to previous diagrams. In a third impression, six years old, this is an unforgiveable lack.

However, it must be admitted that it will not impede the student or instructor who wishes to work his way steadily through the course. It did not bother me until I had cause to search for the one lone paragraph that mentions the decibel.

These are sins of omission. Yet even these are not so surprising as the lack of any mention of the printed circuit, the transistor, and the ferrite rod aerial. Their absence serves to remind us that this is only a third impression of the 1954 edition. It would seem that a revised edition is called for.

Bouquets: However, to criticise what we have rather than what we would like to have, mention is due of the essentially practical approach. There are excellent chapters dealing with workshop design, tools and their uses, mechanical construction of sets and basic repair methods.

I was favourably impressed, too, by the introduction of certain valve circuits, etc., as they cropped up in the text. An example is the push-pull output stage: although amplifiers are dealt with in earlier chapters, it is not until we reach Lesson 31 and meet them in a logical development of a receiver, that a digression is made into the various principles underlying their use.

Similarly, in Lesson 32, frequency modulation is discussed and it is then that we reach the problem of aerial self-capacity and self-inductance, and touch on the need for matching. Happy the student who thus need not re-learn the "academic" stuff that he formerly cast aside as useless!

The authors divide the book into two main sections. Section "A" is headed *Electricity*, and deals with fundamentals, always with reference to practice. Indeed, they start with that slogan that might well provide a motif for many a workshop calendar . . . "*Theory without practice is lame. Practice without theory is blind.*"

Section "B" gets down to the receiver proper, under the heading *Radio Technique*. A set is built up stage by stage, using circuits that many a serviceman will recognise as commercial models from the excellent Philips stable. Test gear is dealt with, and specimen circuits given, again of actual Philips production equipment.

We work our way through the straight set, the superhet and the f.m. receiver, taking in various test procedures and practical workshop hints as we go. Finally, after a description of a combined a.m. – f.m. receiver, we come on to the oscilloscope, the frequency modulator, and the gramophone.

Mechanical construction, loudspeaker repairs, wavechange switch repairs and basic fault-finding are amply discussed. There is a double lesson on tools, the service workshop is "built up" on paper, and in the last chapter much practical advice on electrical installation is given, plus hints on safety and first aid.

This is a large work, at a not inconsiderable price. As a course of study it should provide a useful balance to those abstract theoretical treatises that lumber the library shelves.—**M.A.Q.**

REPAIRING INTERMITTENTS

PART ONE

FOR WASTE OF TIME AND FRUSTRATION THE INTERMITTENT FAULT REIGNS SUPREME. IN THIS TWO-PART ARTICLE, THE AUTHOR DISCUSSES THE TYPES AND CAUSES OF INTERMITTENTS AND DESCRIBES WAYS OF CUTTING DOWN TIME SPENT IN SEARCHING FOR THESE ELUSIVE FAULTS

by C. R. TAYLOR

UNDOUBTEDLY one of the service engineer's biggest headaches is the intermittent fault. Not only are intermittents a source of frustration to the engineer but they often represent a loss to the firm. Repeated journeys to the customer's house, and the long time usually spent in finding the fault, can seldom be fully charged, especially when the eventual component replaced is no more than a paper capacitor or half-watt resistor.

Intermittents have an annoying habit of occurring quite frequently at the customer's home but never in the presence of an engineer or when brought in to the service department. As a lot of time and travelling expense is involved in making repeated calls on the customer, it is generally unwise to attempt a repair on the spot.

UNCERTAIN CURE

Unless an obvious fault is spotted it will never be certain whether or not the trouble is cured and more than likely a message for a further call will arrive the next day. Every intermittent should be soak tested after repair, however certain the eventual diagnosis appeared, and this can only properly be done in the workshop.

Usually if the customer is told that the set must be taken in because "it may go alright for a time and then go wrong again, so we want to make sure it is completely cured", he will be quite happy to let it go in most cases.

Unless the fault has been actually witnessed by the outside engineer, all relevant details should be obtained from the customer. Customer's descriptions of faults are notoriously unreliable if not downright misleading, so a little shrewd questioning should be employed to extract such information.

If, for example the complaint is that the picture "goes off" questions should be asked to find out if there was any brilliance obtainable or if the screen was completely blank. Also whether it died away gradually or suddenly, whether the picture expanded as it died away, or collapsed into a thin white line. Questions such as these can save valuable time in getting straight to the heart of the matter without wasting time checking the wrong things. While such information is always useful, when dealing with a troublesome intermittent it becomes a necessity.

WHICH WAY UP?

While on that subject, it is well to remember how many people confuse the terms vertical and horizontal. On more than one occasion a fault describes "a horizontal white line" has had us looking for frame troubles when the real fault was line collapse due to a flash over in the line output valve. Make quite sure whether the line went from side to side or from top to bottom. Another valuable item of information is how often the fault comes on, whether it appears soon after the set is switched on and clears later, or it only comes on after a period of running.

PERSUASION

When the receiver arrives in the service department, the object is to try and persuade the fault to appear. Once it has appeared, it must not be accidentally cleared by such means as a surge produced by bridging a capacitor or connecting a testmeter probe, as it may take a great deal of persuading to re-appear.

One way of dealing with them in the workshop is to put them on the soak test rack as soon as they come in and leave them there until the fault occurs. The snag is that the racks will soon be filled and for various reasons some sets may never display their symptoms. Often, the vibration to which a set is subjected while being carried in the van will temporarily clear a fault and any length of soak testing will not show it up. But it has to go back in the van, too. When it reaches the customer's house the fault may be back on.

It is better to give each intermittent a bench examination in which, if the fault is not present, an attempt is made to produce it. This can often be done, rack space is saved and the set repaired quicker. If after a bench test, the receiver still refuses to manifest its symptoms, then recourse must be made to the extended soak test.

STIMULATION

The next problem is how to stimulate an intermittent fault. Many of them are affected by mechanical vibration and so a systematic tapping procedure can be carried out around the particular circuit. Valves especially can be the cause of many an intermittent fault with electrode leaks, etc., and a few gentle taps can often produce the fault.

Care must be exercised in interpreting such results as sometimes the mechanical vibration from a tapped component which is not faulty can be conducted through the chassis to the real offender. In such cases it will be found that tapping any component in the appropriate circuit will produce the symptoms.

If this happens, the culprit can often be discovered by tapping the various components with blows of diminishing strength and it will be found that fewer and fewer respond until the fault can be brought on by tapping one component very gently. Even then the part itself may be alright, the trouble being due to a dry joint on or near it.

Dry joints and wiring are often responsible. Sometimes a PVC-covered lead is strained over a tag which cuts through the insulation and makes intermittent connection with the wire. Earth tags, especially those that are riveted to the chassis, sometimes develop a high resistance to the chassis, or, while measuring a low d.c. path will offer a high impedance to r.f. currents. This class of fault can often be traced by physically moving the leads or tag strips. This should be done gently, using an insulated tool such as a knitting needle.

MOVEMENT OF WIRE

Here again care must be taken not to be misled. The movement of one wire or tag strip may be transmitted to another wire or component and even on to a third member. If it is found that moving a wire brings on the fault and a visual inspection reveals nothing amiss, the wire can be gripped at a convenient point along its length with a pair of long nose pliers and held still, while each half is moved. This should reveal at which end is the bad joint, if such is the cause.

If the fault is produced by flexing a tag strip, the particular joint has still to be located, and this can be done by gripping the strip with a pair of pliers (taking care to insulate the jaws with a couple of pieces of cardboard or other convenient material to prevent the shorting of adjacent tags by the jaws) and then moving the leads connected to

each tag in turn. To check the earthing tags, the strip should be moved until the fault appears, held in that position, and then the earthing tags shorted down to chassis with a screwdriver. Obviously when the fault clears, that tag is the one with a high chassis resistance.

DIRTY CONTACTS

Two prolific causes of intermittent faults are dirty valve pins and tuner switch contacts. These can usually be easily detected by gently rocking the appropriate valves in their holder or the channel selector in the tuner unit. If indeed, such are found responsible, then they can be cleaned.

Recently an excellent preparation, *Electrolube*, has come on to the market for this purpose, and the writer has found it to be the best preparation to date tried in the cleaning of electrical contacts. Although expensive, it is economical, each container incorporating a long thin polythene tube so that a drop can be placed exactly where it is wanted.

Around the neck of the container is a sponge ring which when charged with a few drops of the liquid can be used to rub the valve pins, cleaning them and leaving a film on them. This makes a permanent job.

UNAVAILING SOAK

It often happens that a set never produces its fault in the workshop and a long soak test lasting even for weeks proves unavailing, the set working perfectly during that period. However, on return to the customer it is not long before the symptoms return. We are apt to assign this to the work of mischievous gremlins but often (though not always) there is a perfectly logical reason for such behaviour.

We have already mentioned the effect in the delivery van and how this could either temporarily clear or bring on the fault. But there are a number of factors which may prevail in the customer's home but not in the service department. It may be one of these that is affecting the fault and thereby it would only appear in the customer's house.

Signal strength is one thing. Let us assume that the a.p.c. circuits in the receiver have a fault whereby the a.p.c. control voltage drops intermittently to a lower level. The customer is living in an area where the signal is much higher than it is at the service department. The effect would be that when the gain increases the picture would go peak white. The customer not realising that the fault was due to too much gain would probably quote the fault as being uncontrollable brilliance.

DIFFERENT CONDITIONS

In the service department where the strength is much lower, the same fault may not produce the same symptoms, only a slight increase in contrast which may not be noticed. From the customer's description the engineer will probably be looking for a tube electrode fault or a video output fault. Possibly the a.p.c. voltage developed on the weaker signal may not be high enough to break down the component causing the fault. Therefor not even a change of contrast would be effected. This one has actually happened in practice.

Alternatively, the signal strength may be much weaker at the customer's premises than at the service department. The receiver may have a fault giving fluctuating gain. If the a.p.c. is delayed (as in most receivers) there may be very little a.p.c. volts applied and the variations would be very noticeable. In the workshop, however, there is a good signal and the fluctuations are swamped by the a.p.c., thereby appearing that the fault does not exist.

OVERLOADING

Sound distortion, too, can be caused by overloading due to excessive gain, especially if a.p.c. is not employed or applied to the r.f. stage. Therefore, an intermittent fault affecting the gain of the r.f. stage could give the symptoms of sound distortion when operating in a high signal level area, but not in a lower signal area.

Where the fault may be due to such causes, and where the fault refuses to show up in the workshop, it would be as well to try and approximate the signal conditions existing at the customer's premises. If it is in a weak area, then the receiver should be soak tested with an attenuator in circuit. If on the other hand it is in a stronger area than the service department, a preamplifier could be used and the controls set to give a normal picture.

MAINS VOLTAGE

Another factor which may vary between the service department and the customer's premises is the mains voltage. Some service areas have two or three voltages within a short distance. While it is true that theoretically the voltage tapping adjustment on the receiver itself should take care of this, in practice this is not always the case. If a measurement of the h.t. voltage is made on a low mains voltage and then on a higher mains voltage with the tapping in the appropriate place it will often be found that it will be greater on the higher mains voltage in spite of the compensating effect of the series mains adjustment resistors.

The effect of this can sometimes be seen where a receiver with a doubtful line or frame output valve is brought in from a high mains voltage supply to a lower one. Whereas the scan was just sufficient on the high voltage it may be found to be not enough to fill the mask on the lower.

The time bases are more likely to be effected by this, but it is possible for faults to be brought on elsewhere. For example a decoupling capacitor in any part of the circuit could intermittently break down with the higher h.t. voltage, but function perfectly at a lower one.

It is a good practice, then, when dealing with stubborn intermittents to soak test them on the same voltage as the receiver normally works, feeding it through an auto transformer.

Another thing that should not be overlooked is the mains supply regulation at the customer's house. We may sometimes take for granted that the regulation is within small limits, that is unless we have had some experience of these troubles. This is more likely to happen where the receiver is operating in a country district and the house is connected near the end of a line.

The voltage drop when the load is heavy can be sufficient to cause a marked deterioration of the picture quality and focus, height and width being probably affected. Such an intermittent fault would never be seen in the service department, unless it was also similarly afflicted with poor regulation.

OTHER FACTORS

More unusually, dampness is a possible condition in the customer's viewing room which could introduce a fault, but which would not arise (we hope) in the service department. There was a case where the TV set was placed in a damp corner, and when switched on would manifest signs of brushing and e.h.t. discharge. After about half an hour the fault would clear, that is when the heat had dried out the moisture. No sign of fault would appear in the workshop but on delivery it was noticed that the walls were damp. The cure in this case was to move the set to another corner.

From an unusual factor we go to perhaps one of the commonest causes for intermittents that will not show up in the service room. That is heat. Under viewing conditions, the set is often positioned near to the fireplace, and it is frequently pushed back too near the wall to allow adequate ventilation. When it is brought into the workshop for repair and soak tested, it is run on a rack not usually near any heating and with plenty of air space around.

Furthermore, the back and the bottom panels of the cabinet are removed so that access can be gained to the inside as soon as a fault appears. As a result the temperature of the set on test reaches to nowhere near the value of the temperature when it is running under customer-viewing conditions.

This extra heat can cause p.v.c. insulation to soften and be penetrated by any sharp edge over which it may be strained, and it can cause capacitor electrodes to expand and short circuit through a fault in the insulating medium.

(Continued on page 131)

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.

Stella 8617

Vision on Sound

An unusual fault on this model was vision on sound. It was tuneable and varied with input level, but not with variation of hold controls. We were thus led to investigate the tuner unit and first i.f. stages.

After much fruitless searching we resorted to the 'scope and discovered that the buzz was actually sync. The fact that it did not vary with either oscillator pointed to a fault somewhere between the video and the sync input.

It was not until we had spent much fruitless time scoping and searching that it occurred to us to change the ECL80 sync separator—which any apprentice would have done first! Sure enough—that was the trouble. Yet the valve worked faultlessly in other stages of other sets, and showed no fault on the tester, even when run hot and immediately tested.—G.L.A., Bargoed (661).

Decca DM4/C

Trouble with ECL80

This receiver had a history of frame trouble. ECL80's had been replaced in the field on various occasions but had only alleviated the fault temporarily. The complaint was critical frame hold and, in the customer's words, "a black bar across the picture".

Tests in the workshop were at first carried out with a pattern generator and the set appeared to be quite up to standard, but when later it was connected to the aerial system the frame would not lock correctly and the customer's black bar was the blanking between frames and occurred on a different part of the raster according to whether the set was receiving Band I or Band III transmissions.

The frame timebase was, of course, locking on mains hum, which also explains why we did not experience the fault with the pattern generator. Most careful examination of the frame timebase failed to reveal any faulty component and the h.t. line showed no more hum than normal. In fact the only hum voltage detectable in the whole of the frame circuit was that present on the ECL80 heaters. When these were removed from the chain and fed from a separate a.c. supply, the fault cleared completely. It was therefore decided to place the ECL80 lower down the heater chain and this simple modification was completely effective.

By coincidence, another similar model came into the workshop within a couple of days and this had exactly the same trouble. No other faults could be found and the same "cure" was employed. One is left wondering why these sets worked satisfactorily when new as presumably they did. The answer lies possibly in the cathode-heater insulation of the valves; possibly the insulating properties of the valveholders have deteriorated a little.—I.A.K., Brighton (687).

Sobell TPS180

Bad Mains Hum

This one came in with an unusual amount of mains hum. It was a new receiver and had only been out a few days. Smoothing and reservoir capacitors were checked by substitution but no improvement found and the replacement of the sound output valve had no beneficial effect.

On checking the provisional circuit diagram, a rather unusual means of obtaining the screen voltage for the pentode section of the sound output valve was noted, but here again capacitors had no effect. A voltage check, however, showed that the screen voltage was about 15V higher than specified and R105 (4·7kΩ) screen voltage smoothing and R106 (2·7kΩ) feed resistor were checked.

Here was the trouble. R106 measured only 20Ω yet it was in no way discoloured by overheating. A replacement cured the hum.—H.W.G., Folkestone (691).

Grundig TK820

Stop Button Fault

This machine recorded and played back with no trouble. But the pressure roller did not release when the Stop button was operated. The roller is brought into contact with the tape (the tape in contact with the motor shaft) by a plunger being drawn into a solenoid when on Play or Record.

Obviously, current was still flowing through the solenoid with the Stop button operated, or the plunger movement was not free. But both of these possibilities were eliminated and the fault traced to the solenoid, which had been turned into a permanent magnet.

The plunger was contacting the metal closed end of the solenoid and after the current was cut, still "held on" by the continuous magnetic circuit so formed. This was cured by adjusting the screwed end of the solenoid to avoid contacting the attracted plunger. The plunger then released normally.—G.H., Harrogate (663).

Baird 1712

No Line Scan

We have had a number of similar faults on this chassis (1712, 1812, 1814, 1815). Firstly, lack of line whistle and output. Shorting the line output valve screen grid to chassis (momentarily) restores oscillation but as soon as the set is switched off and allowed to cool down, then switched on again, the fault recurs. In every case the trouble has been due to the 0·001μF capacitor, connected between anode of the efficiency diode through the line hold control network to the output valve grid. It goes o/c.

On the same chassis, we often had fun juggling with the network of resistors in series with the line hold control. This network consists of a series-parallel

(Continued on page 127)

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

arrangement of four 47kΩ resistors and when the line output valve is changed or ages, it is necessary to add or remove one or more of these resistors in order to be able to lock the line hold in the centre of its travel.

To overcome this nuisance we now remove these resistors from the circuit and replace them with a 100kΩ preset control, which can be very conveniently positioned in a hole on the rear of the chassis near the mains input plug. This hole is drilled to take a preset.—G.C., Boroughbridge (678).

Pye CW17

Wrong Line Speed Incorrect line speed was the fault on this one. Correct lock was not only out of the range of the line hold control but also beyond the range of the coarse preset control. As this model uses a multivibrator line generator controlled by a flywheel sync system there were quite a number of possibilities.

The generator valve was first tried hopefully, but to no avail. Then, by reason of past experience, the multivibrator cathode decoupling capacitors were tried, but still with no improvement. Next, the line hold control itself and associated components were checked but they all read within their tolerances.

Attention was then turned to the flywheel control circuit. This is a straightforward circuit with a push-pull winding on the sync transformer coupled via two capacitors to the two discriminator diodes where the phase is compared with a pulse fed back from the line output transformer. The fault was eventually proved to be one of the two sync feed capacitors (C95, C94, 220pF) replacement of which restor d normal line hold.—V.D.C., Bristol (694).

Philco 1010

Crackles and Brushing A production fault on these sets has been quite common in receivers we have sold. After some time in use violent crackling and "brushing" develops. The fault has been found to be caused by a blue or black p.v.c.-covered lead which passes across the rear right-hand terminal of the line output transformer socket, which of course carries considerable r.f. voltage.

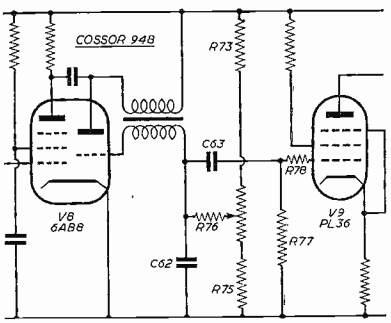
After some time, the insulation of the blue (or black) lead breaks down, allowing the lead to touch the line output transformer terminal. Replacing and re-routing the lead cures the trouble and we now reposition this lead on all models in this range which come into the shop.—G.C., Boroughbridge (683).

Cossor 948

Line Circuit Trouble The fault apparently lay in the line oscillator stage, for the symptoms were that the line would not lock, although frequency was variable when the line hold control was rotated.

We had no replacement panel immediately to hand—and, in any case, deplore the "swop it over" technique, preferring to find the fault. But this one took us longer than we anticipated.

The 6AB8 (V8 line oscillator-cum-sync separator) checked correctly and the obvious causes (R73, 100k and



R75, 220k at each end of the hold control) were in order. C61, the 33pF sync feed capacitor, and C62, 150pF across the secondary circuit of the line oscillator transformer T4, both proved innocent. There was not much left to suspect except the transformer itself.

Then it occurred to us that the fault need not lie in the oscillator stage itself—it could be farther on. Sure enough, on testing the grid leak of the PL36 line output valve we found it read about 100kΩ instead of the correct 470kΩ. This resistor, R77, is situated on the same panel, above and to the right of V8. It won't catch us again.—M.A.Q., Gilfach (657).

Brainless Bertie

Voltage doublers Bertie thinks
Greatly over-rated,
Since he changed a "double-8"
*With can **not** isolated.*

Feste

McMichael MP18

Handle with Care! This set was brought in with the complaint that after 3½ hours running the brightness would completely disappear. The picture was then only obtainable by advancing the contrast control. We placed the set on test but no amount of prodding, tapping, etc., would make the brightness disappear. It was then decided to remove the chassis for further inspection and on lifting the carrying handle the brightness went off.

On a further inspection it was noticed that the green lead from the brightness control to the tag panel immediately behind the aerial socket had somehow during assembly become clamped between the metal panel on which the speaker is fixed and the top of the wooden cabinet. Evidently the rise in temperature caused the sharp edge of the metal to pierce the plastic covering of this lead. Releasing the lead cured the trouble.—H.W.G., Folkestone (692).

H.M.V. 1840

No Frame Hold The main complaint with this receiver was no frame hold, but accompanying symptoms were thinly contrasted picture, weak hold on line and intermittent r.f. patterning on Band I. The customer seemed to be resigned to these by-effects.

A complete check of the sync circuit and frame circuits provided no clues, but during the tests the picture was seen to

(Continued on page 129)

RECEIVER SPOT CHECKS

No. 51: FERRANTI 14T4 SERIES

No Sound or Vision: Check R13, 100Ω, for o/c due to s/c on C18, resulting in lack of h.t. on tuner unit. Check R4, 470Ω, for o/c caused by s/c on C7, resulting in lack of h.t. on V1. Check C17 for s/c or leakage.

Unstable Vision: Check C37, C42 and C55 for o/c.

Unstable Sound: Check C51 for o/c and C52 for leakage.

No Vision: Check for faulty video detector V6. Check for o/c or leaky C38, C43, C56; o/c L131 or amplifier anode load R48; o/c R118.

No Sound: Check for R117 o/c due to s/c on C104A, resulting in lack of h.t. on V10 and V11. Check for o/c C45, L128, faulty diode X1, C83 or C87.

No Frame Scan: Check for faulty T1 or T3. Check for s/c C89 or o/c C91.

No Line Scan: Check C101, C102 and C103 for leakage. Check for o/c on R113.

No Frame or Line Scan: Check C106 (0·5μF) for o/c or s/c, resulting in lack of boost voltage.

Frame Hold One End: Check R93 for h.r. Check for faulty T1.—E.L., Long Eaton (667).

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McMichael *Clubman* Model 535 (R62, Oct., 54).
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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).
Taylor Electrical "Windsor" circuit analyser Model 20B (T.I.5, Sept., 52).
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).

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fade negative and back, still slipping, according to the proximity of the hand to the video amplifier circuit.

Operating conditions of the video amplifier showed 5V positive on the control grid even when no signal was present. On disconnecting the detector diode, the positive voltage disappeared from the video valve grid but were present on the cathode of the diode. No d.c. leak was traced, this standing bias being due to parasitic oscillation in the vision i.f. stages since shorting the grid of the i.f. amplifier to chassis removed the voltage. The actual cause was an o/c screen decoupling capacitor. The standing positive voltage over-biased the video amplifier, clipping sync pulses and causing weak picture.

Hitherto, most i.f. instability I have known has been of the more violent type where the screen goes bright, blotting out everything. In this case, the instability showed itself by the patterning symptom, which disappeared with the slipping frame hold and weak picture when the faulty capacitor was replaced.—L.E.H., Edgware (685).

Philips 3515

Tape Recorder Fault One of these tape recorders was sent to the workshop from the shop stock with the report of no Record and no Playback. On switching on and testing for record, it was found that the recording indicator functioned OK but nothing was recorded on the tape. To test this, the tape was tried on another tape recorder known to be OK and the reverse test was applied; i.e., a tape known to be good was played back but with no result.

A new head was tried with no results so it was decided to check the point on the circuit to which the head is connected and here everything was quite in order, hum being recorded and reproduced. This, of course, led us to suspect the screened cable and here we found the fault.

It was not, as might be expected, a short circuit. The tinned copper single strand wire, through the centre of the piece of low loss coaxial, was severed about 2½ in. down the cable. How this came to be is anyone's guess as there was nothing pressing on this point of the screened cable. It was possibly an original fault, but if so how did the machine pass inspection?—H.W.G., Folkestone (690).

R.G.D. "The 17"

An A.G.C. Fault This receiver came in with the complaint that the contrast control was inoperative and the picture negative. The valves in the a.g.c. circuit had been substituted with no improvement. But when voltages were checked, those in the video amplifier, cathode follower, gating diode and a.g.c. amplifier valves were found to be low, due to the presence of 15V positive on the video amplifier when a signal was applied to the aerial socket.

After some checking of components, the oscilloscope was pressed into service. We found that the line a.g.c. controlling pulse (which is applied via a 100pF capacitor to the junction of R93/C79 in the diode cathode circuit) was not present at this point. Tracing back we found that the 100pF capacitor (C78) was mounted on a tag strip in the line output can and was o/c. This fault proved to our apprentices that the 'scope, which remains on the shelf for weeks on end, does have its moments of glory.—G.C., Boroughbridge (677).

Murphy A272C

Unstable on V.H.F. This radio set came in with complaint that the set was unstable on v.h.f. for 10–15 minutes after switching on. On connecting up, it was found that stability could be restored by redressing the leads in the oscillator compartment of the v.h.f. unit. Unfortunately, however, after cooling down and switching on again, the instability returned for approximately the same time as originally.

It was found that the application of the metallic blade of a screwdriver

(Continued on page 131)

SERVICE BRIEFS

Ferguson 406T: The picture was weak and not locking, sound was normal. Vision valves were checked and found satisfactory. A strong signal was found on the video amplifier grid but only weak modulation on the c.r.t. Voltage tests showed no voltage on the video amplifier anode, none at all, and yet some sort of signal was passing through to the tube. The trouble was due to an o/c h.f. inductor in the video anode circuit.—L.E.H., Edgware (497).

Ferranti T1001/T002: On first switching on all was normal until the efficiency diode began to conduct. During the warming up period of the valve the line output stage was normal and suddenly there was a click and the line output stage ceased functioning. On investigation it was found that the boost capacitor C98 (0·5μF) had broken down. I have had this fault four times and in each case C98 was not completely short circuit but always in the region of k-ohms.—G.J., Bebington (552).

Bush TV77: Sound and picture were normal until the tuner was rotated, then Band I contrast level became excessive, with no picture on Band III, or at times a weak picture with weak frame sync could be obtained. This looked like an a.p.c. fault, but a good deal of testing was necessary before the culprit was traced to an intermittent electrical connection where R27, a 47kΩ resistor in the a.g.c. line, connected to L23 and C38. Flutter on sound and vision is also caused by this type of fault.—G.B., Crawley (533).

Ultra V1750 Range: I have had trouble with several of these sets in the form of very noisy operation of the channel selector switch, accompanied by a tendency for the picture to go negative on Band I if the tuner is touched or sound volume turned up high. In every case the trouble has been caused by dirt and grease on the rod which is operated by the channel selector cam. Cleaning the rod and its earthing contact clears the trouble completely.—G.C., Boroughbridge (506).

Philco A1800: One of these sets came in with the fault that it was impossible to reduce the height, although both linearity, form and height controls had some effect. The trouble was found to be the 0·005μF capacitor which is connected from the anode of the frame output valve to the frame form control. On testing on the bridge is read only 0·001μF.—G.C., Boroughbridge (507).

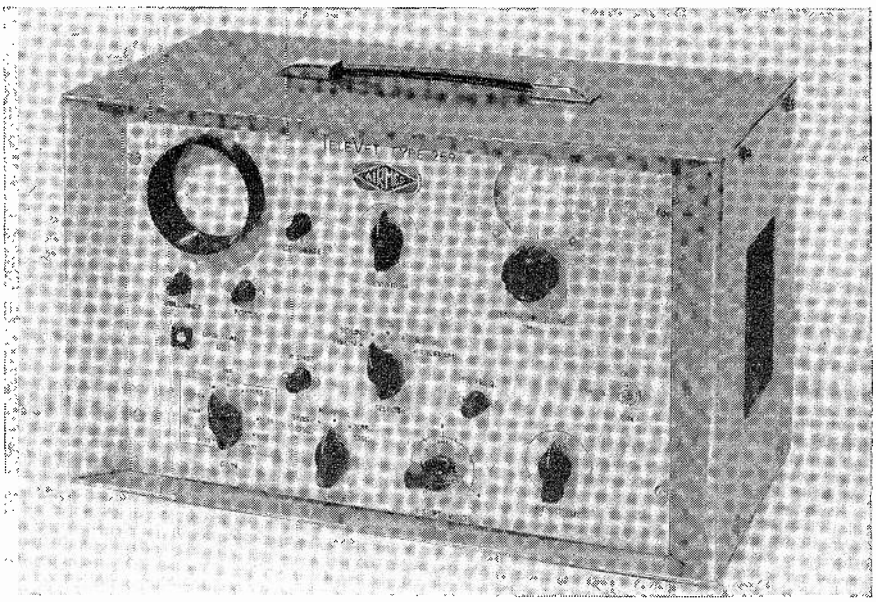
Queer Customers

OUR aerial rigger came into the shop, showed us half-a-crown and said: "Easiest tip I ever earned." Apparently he had just concluded a small roof job in a street of terrace houses and was hefting his ladder back to the van, which was parked round the corner, when a little lady bustled out of one of the houses, pressed two coins on him, said "Lovely job!"—and vanished.

Well, Len, the rigger, doesn't believe in fairy godmothers so it was with some relief, he tells me, that he saw, as he turned the corner, the local window cleaner trundling along in the distance. He caught him up and split the difference.—B.R.G., Gilfach (606).

GOOD NEWS FOR SERVICE ENGINEERS

here's the NEW TELEVET 259



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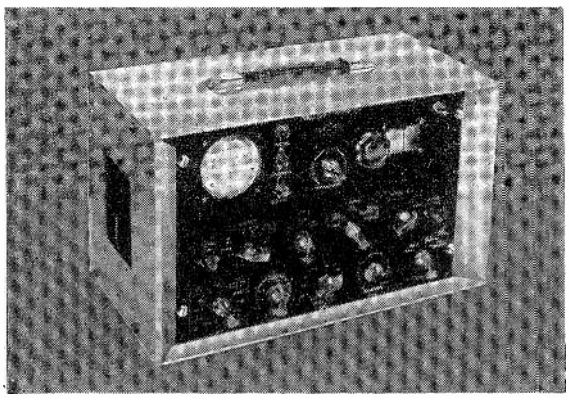

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TECHNICAL GEN *continued*

applied to the earthy end of the r.f. coil completely stabilised the receiver. Not having a service manual to hand, the circuit was examined and at this point of contact a 500pF capacitor decouples the coil to chassis. Not having a 500pF capacitor of the same type in stock, a 0·001μF paper capacitor was fitted. This certainly stabilised the set but the gain was very low.

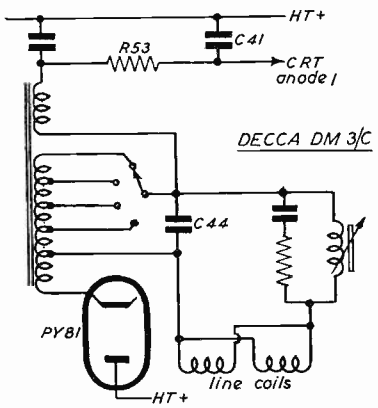
Later, a close tolerance capacitor of original value was fitted and this completely restored the set to its original performance with stability. The faulty original capacitor had lost practically half its capacitance and showed rough edges on the bridge indicator.—H.W.G., Folkestone (675).

Decca DM3/C

Line Output Fault

One of these sets came in for lack of brightness, the picture being unobtainable unless excessive contrast was used, no raster being visible without modulation. On examination it was found that C44 was burnt up and this was replaced, but with no effect on the lack of brightness.

The voltages on the cathode and grid of the c.r.t. were checked and found normal and while at the tube base the gun volts were checked with a high resistance meter and showed 220V. The lead was traced back to source (R53, 220kΩ smoothing for the boost voltage) and the voltage was obviously the same, but at the other (line output transformer) end, full boost voltage was present. The resistor was checked and found OK, but C41 (0·02μF) was down to approximately 10kΩ insulation.



As a matter of interest, when any of the DM series of TV receivers are in for service, we make a point of changing R49, the screen feed to the line output transformer, with a wire-wound 6-watt resistor as we have had so many failures with the 2-watt ceramic resistor originally fitted by the makers.—H.W.G., Folkestone (676).

Ferranti 14T4

Two Recent Faults

The complaint was no reception on Band III. At first the selector switch was suspected but a thorough check ruled it out. Using a signal generator, the fault was traced to C12, 3·3pF, which had developed an o/c. Replacement of this capacitor, which is located across the Band III oscillator coil L110, restored normal operation. Similar symptoms may be produced by s/c on Band III trimmers C2, C25 or C13.

Another of these sets came in with the complaint of picture slightly bent and shimmering at the top. On switching on it was seen that about one inch at the top of the picture was slightly bent and shimmering on the point of tearing. Definition was below standard and line hold was critical.

Symptoms indicated insufficient sync pulse amplitude and possibly a change of line timebase operating characteristics. Consequently, video detector V6, video amplifier V8 and sync separator/line oscillator V9 were tested but found satisfactory. All appropriate voltages were normal. Components in the integrator circuit and picture quality control circuit were checked and passed as satisfactory.

It was then noticed that the vision i.f. transformer cores had been tampered with. Bearing in mind that improper alignment of the i.f. stages can contribute to poor low frequency response and thus decrease sync amplitude, the i.f. stages were realigned—and normal operation was restored. Which again points to the moral: never take anything for granted.—E.L., Long Eaton (666).

REPAIRING INTERMITTENTS

—continued

It can cause cracked carbon resistors to alter value or go open circuit altogether.

Loudspeaker coils can expand and foul the pole pieces if they are not perfectly centred. Latent electrode shorts in valves can come on if the heat is not conducted away. It can be seen, then, that heat can be responsible for any number of intermittent faults.

RAISING TEMPERATURE

Faults which may be due to this cause can be stimulated quickly in the service department by artificially raising the temperature. As it is necessary to have the back and bottom removed, these can be substituted by draping a blanket over the cabinet, leaving the screen clear for viewing. Government surplus blankets can usually be purchased quite cheaply and can also be used for draping sets in transit to protect the cabinets.

It must be remembered, however, that a blanket will not allow even the slight ventilation afforded by a slotted or holed back, therefore the temperature build-up will be much greater and quicker. This will have the advantage of bringing on a fault sooner than normal if it is due to heat, but care must be taken not to allow a receiver to run too long covered in this way or other more serious damage could occur.

HAIR DRYER

Another way of raising the temperature is by the use of an ordinary hair dryer. This can be quite a useful item in the service department. Hot air can be blown directly on to any part of the receiver or on to any component without overheating any other part. Thus a suspected part can be made quite hot by holding the dryer close. Its temperature will be far greater than normal even when operating in warm conditions, and any fault due to heat must certainly show up.

It sometimes happens that a fault has what could be termed a negative temperature coefficient. That is, it is on when cold and clears when the receiver has become well warmed up. It will not recur unless the set is switched off and allowed to cool right down before switching on again. It is surprising how long it takes a set to get right back to cold and much time can be wasted waiting for this when such a fault is encountered.

Here again, the hair dryer can be of service, as switched to the cold position, it can be directed on to the circuitry involved, and will rapidly accelerate the cooling down process.

A further more drastic way still, of bringing on a "heat fault" and one that has been mentioned before in these columns is the dodge of holding a hot soldering iron directly against a suspected component. Normally this could only be done with resistors as wax or plastic covered capacitors would obviously suffer. It is unlikely that any intermittent fault in a resistor would not show up with a hot iron held against it.

This method has been tried many times with success. Even a suspect capacitor can be treated this way, not by holding the iron against the body but on one of the lead out wires. The heat will be conducted sufficiently along the wire into the capacitor to affect any fault which may exist.

One must be careful, of course, not to hold the iron too near the capacitor or for too long so that the lateral soldered connections melt, otherwise a capacitor will be ruined that may have been perfectly alright, or worse still, you may have created an intermittent fault other than the original.

(To be Continued)

Newly designed—by and for practical TV Engineers—the SKANTEST Time Base Component Shorting Turn Tester consists of a PULSED oscillator circuit with two matching test points. Output is fed to a sensitive indicating neon. The pulse technique used has the effect of showing up intermittent faults, i.e., shorting turns due to pin holes in wire insulation. The test points enable both high and low impedance components to be tested. SKANTEST is a fraction of the size—and a fraction of the price—of any similar tester available in this country. SKANTEST saves hours of work, increases goodwill.

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INSIDE or OUT?

asks V. D. CAPEL

FOR SERVICE DEPARTMENT EFFICIENCY IT IS IMPORTANT TO KNOW WHAT WORK TO DO ON THE SPOT AND WHAT TO TAKE INTO THE WORKSHOP

A QUESTION which every new service department has to decide at the very start is where the bulk of the work shall be carried out, on the customer's premises or in the service department? Only after this point is established can other details be planned, such as the number of calls assigned to each outside engineer in a day and the amount of spares and equipment which each one will carry.

If it is decided that most of the work is to be done on the spot, then the outside engineer's van will have to be comprehensively equipped and stocked, and the number of jobs limited. Furthermore, each engineer will need to be fully skilled, whereas if the greater proportion of work is brought into the shop he will not need to be.

Class of Work

A lot will depend on the class of work being handled. If most, or all, the jobs are on sets that are out on rental, it is advisable to do as much of the work as possible on the spot. As the customer will not be presented with a bill for the call there will be no reason why he shouldn't see what has been done to the set, as it is not his property anyway.

Most rental firms stick to just one or two makes and models. This means that the range of spares needed is greatly reduced. Thus a van can be equipped to rectify most faults without an extensive outlay.

Furthermore, when working all the time on the same models, engineers will get to know their way around them, be familiar with the layout and the most likely faults, and will require a lesser degree of skill than when called upon to service a large variety of models.

Again if a rental set should have to be brought away, a loan set will almost certainly have to be left, and this will mean two van journeys instead of the one. Undoubtedly, then, for rental sets everything is in favour of on-the-spot maintenance.

General Calls

For general service calls, conditions are different. Some firms advocate the other extreme in bringing all jobs into the service department. They feel that this saves a lot of disputes over bills. Disputes often arise not over large bills which customers expect when a lot of work has been carried out, but rather the smaller ones accompanied by comments such as "*but he was only in the house five minutes*," implying that they should therefore pay next to nothing for the call, travelling time and van expenses.

If the set is brought in, the feeling is that the customer does not know what time has been spent and will therefore not be in a position to dispute the bill. Unfortunately this principle has been used by some unscrupulous firms to take advantage of the customer and make extortionate charges. These make it bad for reputable firms who, as a result, sometimes find the customer understandably reluctant to allow his set to leave the house.

Another advantage of bringing all jobs in is that far more calls can be made in a specified time, which means that fewer vans are needed. With the high cost and maintenance figures of keeping a van on the road this can mean a decided saving in expenses.

It is true that the set has to be delivered afterwards but if a number of deliveries can be arranged in one area, the combined collection and delivery time would be less than that taken by carrying out the job on the spot.

There would be no need to stock each van with spares and equipment which are more liable to loss and damage than when stored inside (to say nothing of duplicating quite a lot) thereby tying up capital. Skilled engineers would not be needed outside, only van drivers with sufficient knowledge to be able to set up receivers, fix mains plugs, etc., leaving the engineers to work more efficiently in the service department and with no travelling time between each job.

Makeshift Job

Furthermore, very often a job done in the house is a makeshift one, the engineer doing the best he can with the resources at hand, the customer's lounge being far from an ideal place to carry out the more involved repair.

It can be seen that there are advantages in both extremes. It should be noted here, though, that if all repairs are brought in, the service department must be geared up to the large flow of work that will pass through it. Customers will soon complain if they have to wait several days for a repair which another firm may have carried out in the house.

They may not mind being without the set for one day if told that a better and more reliable job can be done in the workshop, but if the delay is longer they will be inclined to try somewhere else on the next breakdown.

Normally, the majority of service departments effect a compromise between these extremes, the simpler jobs being done on the spot, but the more involved brought in. It is generally left to the outside engineer's discretion as to what to do in each case.

This poses the problem for each engineer of what to bring in and when. There are a number of factors which will influence his decision. The firm's policy on this matter will be his first consideration. Do they favour trying to do as much as possible on the premises, or do they prefer all but the very simple jobs to be brought in?

Hazards

The conditions in the customer's home will also have a bearing on the problem. In some cases the set is found on a shelf so narrow that it cannot be turned around and operated sideways with safety. There may be no other working space available, and frequently the mains and aerial leads are pulled tight and disappear to some other part of the room so that there is no slack to enable the set to be pulled out if desired.

A set repaired under such circumstances would take much longer and be more troublesome than usual, to say nothing of the greater risk of accidents. Anything but a straightforward valve change or adjustment, would be "one for the inside boys". Dogs and small children are additional hazards which can have a marked effect on the engineer's decision.

The spares which the engineer has available will also be a deciding factor, as if he only has replacement valves, which he has tried, then further attempt at diagnosis would be futile when he cannot replace the offending part when he has traced it. A further consideration will be the amount of time available. If a large number of jobs have to be done in a given time then only a superficial examination can be carried out and a simple repair effected.

If, on the other hand, there are only a few jobs on his list, then he may be tempted to delve a little deeper if the trouble is not immediately obvious.

Complete Overhaul

Most firms now have a rental side to their business and some have maintenance contracts with their customers.

(Continued on page 135)

Valves Making a Comeback

RECENT DEVELOPMENTS INDICATE THAT THE THERMIONIC VALVE MAY NOT BE ON THE WAY OUT AS PREDICTED BY SOME

By M. A. QUALES

THE great transistor revolution has not yet succeeded in knocking out the thermionic valve. Quite apart from the special applications, where frequency and power limits or temperature ratings preclude the use of transistors, thermionic valves are now being developed which will rival the semi-conductor in size and efficiency.

Latest addition to America's RCA range has been the *Nuvistor*. This miniature valve is now available in sample quantities to equipment makers in Great Britain. At present, types released are triode and tetrode, with 6·3V, 0·14A heaters, suitable for use as r.f. and i.f. amplifiers and oscillators in television receivers.

The novel feature of the *Nuvistor* is its completely automated construction. Spot welding techniques, for long the bugbear of valve makers, are done away with. The electrode assembly consists of cylindrical parts that slip concentrically over each other and are cantilever supported at the base. No mica spacers or support discs are needed.

Each electrode has a flange which sits concentrically with the next, contact with the cylinder and support bars being obtained by a brazing process. The lower lip of the flange is supported by three 120-degree spaced rods, two of them ending in the ceramic base, the third continuing through to form a pin.

This style of "chinese-box" construction serves two purposes. Much greater vibration and shock can be withstood—figures of 2 G's at 5 kc/s vibration have been quoted and shocks up to 850 G's given to the assembled units before failure. Also, the use of metal in place of glass allows higher temperatures to be used for brazing, and incidentally enables wider operating temperature limits.

It is when the *Nuvistor* is compared with the transistor that its special attributes show up. It is only slightly larger and quantity production will bring its cost down to what RCA describe as "an economical figure". The electrode spacings can be many times greater than those of a comparable transistor. This makes manufacturing tolerances much easier to cope with, and the reduced proportion of rejects will also make for happier prices.

Associated circuitry can be much simpler. The special capacitors of some transistor circuits are no longer needed, and as moderate voltages are employed, no high-rated components are necessary. In this respect, the *Nuvistor* compares favourably with both transistor and conventional valve.

More important, perhaps, is its ability to withstand momentary overloads. This has always been the drawback of the semi-conductor, which can be irreparably damaged if its ratings are exceeded. Many special circuits have had to be devised for the protection of the transistor. The *Nuvistor* has the same rating flexibility as the ordinary vacuum valve.

Although research is still going on, present findings indicate that the gain is high, the noise level low, making the *Nuvistor* as good as a frame-grid valve in v.h.f. applications. Impedance is also high and characteristics stable over wide limits.

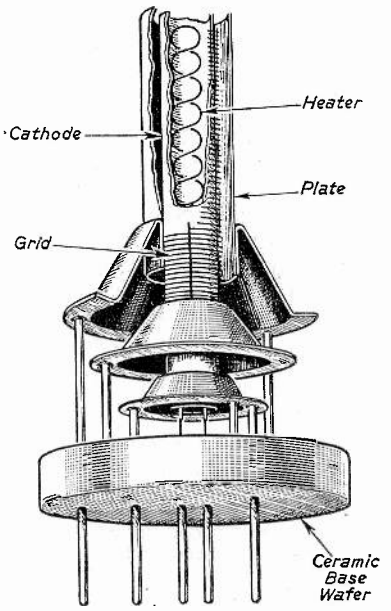
As an oscillator, the *Nuvistor* triode is efficient at television frequencies. The power used can be reduced drastically in comparison with conventional miniature valves. One quoted figure is "5 per cent that of normal amplifiers in conventional circuits", which opens a wide field of possibilities in the portable equipment market.

The tetrode version is rather more complicated and requires special heat-dissipating arrangements. For its small size, a good deal of power is developed and a heat sink, such as the receiver chassis or mounting brackets will be needed, as is normal practice with output transistors.

To elaborate further on the process of construction: the salient point being the brazing process. As stated before, the elements are cylindrical, with concentric support flanges and evenly spaced rods to a ceramic base. This base is first metallised, then the upper and lower metal surfaces ground to leave a conducting layer around the periphery and the interiors of the support and contact pin holes.

The first brazing is carried out at a temperature of about 2,060°F. in a hydrogen-filled oven. The copper coating of the electrode tubes and supports and flanges melts at this temperature, fusing together at contact points and at the interior of the holes in the ceramic base. Then the cathode sleeve and envelope are fitted and a brazing ring dropped into place to bind the whole. After which the unit is re-inserted in the oven at a temperature of about 1,600°F., evacuating the valve without the need for a getter. The important advantage here is that glass envelopes would melt at this temperature before evacuation was complete.

Finally, the temperature is raised to about 1,700°F. to melt the brazing ring, which fuses envelope to the coating around the ceramic base in the evacuated oven, producing a hermetically sealed unit.



Brazed assembly of a *Nuvistor*.

Other types of *Nuvistor* employ the ceramic envelope form of construction. On these, the anode is a thin coating of metal on the inside wall of the ceramic, heat being conducted away through the outer wall.

A beam-power tetrode, rated at 30 watts, yet measuring only 1½ inches in height, with a 1-inch diameter, is being developed for use as a line-output valve for colour television receivers, and for hi-fi amplifiers.

Additional applications are being investigated, and it is no long shot to say that the *Nuvistor* type of valve may eventually oust the glass-envelope type altogether, and prove a considerable threat to transistors into the bargain.

Rivalling the transistor for size and beating it for performance is another "ceramic valve", the General Electric (USA) titanium triode. This is a special purpose valve, developed primarily for defence work, for use in missiles and other applications where size is a deciding factor, but where transistors will not operate successfully because of the high temperatures involved.

Research has been going on at G-E for 15 years, we are told. This little joker, no bigger than a shirt button, is by no means the last word in miniaturisation.

The titanium triode has no heater. Heat is provided by its surroundings.

It operates at about 600°F. The elements are layers of titanium and the envelope of a special ceramic which has been designed to match the expansion characteristics of the elements exactly—

this last development in itself is no mean feat of physics.

It operates at micro-wave frequencies, and the two types at present being laboratory tested have characteristics that are somewhat surprising. One has an amplification factor of 100, a mutual conductance of 6,000 micro-mhos, and passes 5mA anode current at a voltage of 100. The other is designed to work at half this anode voltage, has an anode current of a half-milliamp, a 250 m-m mutual conductance and an amplification factor of 10. Grid voltage is zero.

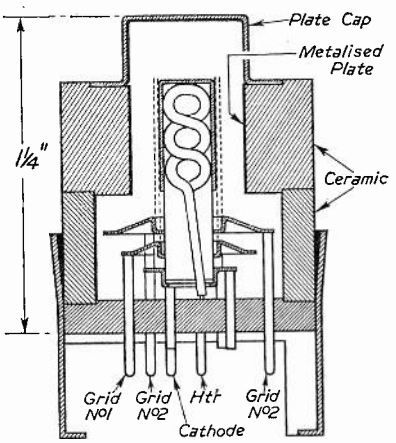
The above could be described as a "hot-cathode valve", with a vengeance. But soon to be making a comeback, some authorities predict, is the cold-cathode valve, already developed experimentally by the American Signal Corps, in collaboration with Tung-Sol Electric Co.

The older generation of servicemen will remember the cold-cathode rectifiers used in some car radios, in vibrator derived h.t. circuits. These were comparatively primitive; the envelope was usually filled with inert gas at low pressure, contained two anodes and a cathode and worked on the ionisation principle, providing current with a one-way path. A "start voltage" was necessary to set up ionisation, and the volts drop across the rectifier was not inconsiderable.

The new cold-cathode valve is a power amplifier. Its inventor, Dr. Dietrich Dobischek of the Signal Corps, began work on the space-charge principle in 1952, bombarding a thin layer of magnesium oxide with an electron beam.

His purpose was to measure secondary emission, and it was when he noted that the emission continued even after the bombarding beam was switched off that the possibilities occurred to him.

All that was necessary, it seemed, was a high potential field to attract the emission once an electronic jolt had been given to the cathode. Various magnesium compounds were experimented with; the present method—



Cross section of *Nuvistor* tetrode.

which has been developed with mass-production in view—consists of spraying on a coating of porous pure magnesium oxide, the surface of which becomes highly positive when bombarded by electrons.

There are several theories attempting to explain this field effect, the nearest being, in our view, a species of "avalanche effect", such as obtains in semi-conductor physics.

To take advantage of the "space-charge" phenomenon, it is necessary to have, first, a "starter", and second, a high attracting voltage. In the experimental valve being developed at the Fort Monmouth, New Jersey, research laboratory, the grid next to the cathode is biased at 200 volts positive and used as an accelerator.

The control grid, at 150 volts positive, is next, and screen at 300 volts, with the anode at the rather high 350 volts. It is anticipated that a reduction to about half this figure will be possible with research along the present lines.

The start charge is the real disadvantage. Here, the application of the valve may determine the means used, for there are several methods of initiating the cathode emission. A pilot heater can be fitted—very little power is required to start the valve working—or the cathode coating could be made radio-active, this making it se-startlfing when h.t. is applied to first grid and anode. Alternatively, the cathode could be made light-sensitive by mixing in a photo-emissive substance, such as caesium.

Only a small stand-by current—down to 10 micro-amps at present—is needed to keep the valve ready for instant operation. In large equipment, such as computers, this presents no problem. For domestic use, it has been suggested that a high resistance bleeder across the on/off switch would suffice to keep valves at "stand-by".

The prospects of the cold-cathode valve—and possibly the cold-c.r.t.—are attractive. Quite apart from the saving in power and heater circuitry, there is the prospect of longer life.

On test, some cathodes have already run for 14,000 hours with no signs of deterioration. Electrode short-circuits that are heat-engendered are less likely, and the troublesome heater-cathode s/c can be forgotten. No warming up time is required: this is an important consideration in some industrial equipment. It would work within much wider limits of temperature than either the conventional valve or the transistor.

Further developments are under way. Valve manufacturers are by no means down and out. The logical line of research seems to be a combination of the advantages of the semi-conductor and the valve, not merely throwing out the old and concentrating on the new. Who knows, some day, somewhere, some-one may re-invent the coherer . . . crystal controlled, of course!

INSIDE OR OUT?

—continued

The set not on rental or maintenance contract is very often in need of a complete overhaul, perhaps not being serviced for a long period, or it may have become the victim of the local handyman.

The result is that once a repair is started the engineer doesn't know what trouble and masked faults he is likely to encounter as well as the original cause of breakdown. Even if he does spend time to repair this, he may find that the set must be brought in to repair the further troubles that show up.

With the rental or maintained set, this is not so likely and in most cases the original fault will be the only one. In addition, there is an obligation toward rental and maintenance customers to supply a loan if the set must be taken in. Clearly, it would be better to spend more time on such receivers (with a view to completing the repair) than with an ordinary job.

Also to be considered is the fact that the engineer's van, the most expensive item of equipment, is only earning its keep when in actual use, and it is not being used when standing for lengthy periods outside of customer's homes. If the time a van is in motion is only a small proportion of its total time out, it is being uneconomically employed.

The experienced engineer will be able to balance out all the various factors described and make a quick decision in each case as to whether or not to bring the job in. Normally about twenty minutes should reveal whether he should. Valve replacements form the majority of outside calls together with general setting up adjustments.

Therefore, such jobs will be routine on-the-spot jobs. Screen cleaning can be attempted in some cases where the job can be completed in about half an hour, but the models that have to be almost completely stripped to clean will, in most cases, have to be taken in.

Noisy tuner switch contacts are a frequent occurrence. In most cases, especially with the birdcage turret type of tuner, the biscuit contacts can be cleaned without too much dismantling. The radial type of turret tuner often buried in an inaccessible position, is another matter, and is best left for the bench.

Often, certain faults crop up regularly with specific models. These become quickly known and recognised. If spares are available, such faults can often be rectified outside as little or no time is taken in preliminary diagnosis.

By thus knowing what to do on the spot and what to take in, the best use will be made of the van and spares available and thus contribute to the overall efficiency of the service department.

by H. W. HELLYER

Over my Shoulder

THE outside serviceman is used to an audience. Like the council navvy, deep in his hole, he takes the onlookers' stares and comments as a normal occupational hazard.

But that does not prevent him from feeling like running up the wall when a well-meaning customer looms up behind him saying, "*Can't do it, can you?*" So it was with some sympathy that I read of an unfortunate fellow who was faced with a charge of assault at Bristol a couple of months ago.

He had been playing snooker, and was shaping up to pot the brown when a bystander asked: "*What's wrong with the blue?*" It was not the first comment this spectator had made—but it was nearly his last. The riled player hit him with the butt end of the billiard cue. The bystander's unwanted advice earned him eight stitches in his head. Can you imagine what *Feste* would say about it? Something thus:

Y'r Honour, the brown sat on its spot,
The frame depended on my pot,
Then someone said, "What's wrong wi' blue?"
I bashed him wi' the billiard cue.

★

We must all have wished at times for a weapon more handy than a soldering iron. Especially when some wise guy persists in pointing out the "valve that doesn't light up". This usually turns out to be the e.h.t. rectifier, and the fault in the line oscillator stage prevents it from being fed with heater current.

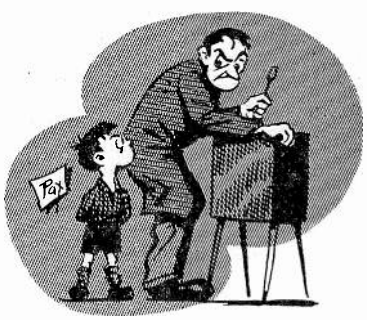
The problem there lies in explaining this to the hovering customer. Even if you cure the basic fault immediately, he is never quite convinced. Then, when you are recalled (maybe six months later!) and the e.h.t. rectifier really has gone he'll smirk triumphantly, "*What did I say?*"

But there is an even more serious victim of the scourge of Scopophelia—the morbid urge to gaze. This is the chap next door. He leans against the mantelshelf and recounts the troubles his second cousin had with a similar fault.

"*It's going to cost you a packet,*" he tells your anxious customer. "*And of course you never know what these chaps are doing. Ten to one they pinch half the bits in the set.*"

★

One accepts these charges with resignation, much as one tolerates the attentions of small dogs and children. They, at least, are more often mischievous than malicious. Except for the occasional small boy who stands beside one, gimlet-eyed. Don't make the mistake of being flattered by his attention. He is not studying to be "a telly-man when he grows up." He is simply following his Dad's instructions to "*Watch that the man doesn't put the old valves back and charge us for new ones.*"



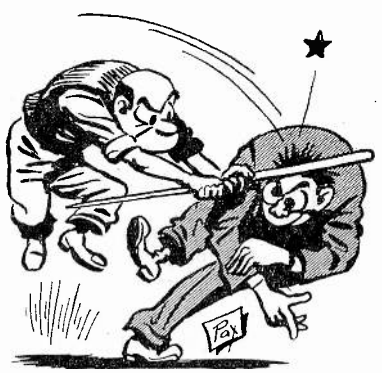
The small boy who stands beside one, gimlet-eyed.

★

It is not only customers and their kin that have this "over-the-shoulder" technique of rattling the poor engineer. Some shop managers and salesmen I have known were particularly addicted to the back of the serviceman's neck.

One in particular used to keep up a running questionnaire. His excuse was that he wanted to remember the technical explanation of these various faults, so that he could expound to customers. Considering that half the faults he called us in to put right consisted of no more than extensive re-adjustment of all the available controls, it would have been an education to hear his sales talk.

The service manager is perhaps excused for this trait of Peeping Tommery. He is, after all, only doing his job. The fact that he thinks he is also doing yours, Joe, has nothing to do with the case.



Hit him with the butt end of the cue.

I discovered it was myopia, not amour.

★

An "embarrassing experience" arose from a peep over my shoulder. I was a small cog in a huge machine of a factory, sitting at my test rack all day. Every so often a progress clerk would come, take readings, jot officiously and disappear into the labyrinth of offices from whence our destiny was controlled.

One particular clerkess was disturbingly pretty. She leaned over my shoulder several times, rather too closely for comfort. It was not until I had my face slapped that I discovered the reason for the proximity was myopia, not amour.

My colleagues tell me that they sometimes meet customers like that. Hmm! Maybe I'm growing a little long in the tooth. Instead of a whiff of "Desire in the Doghouse" wafting over my shoulder, I seem to get the acrid tang of furniture polish as some harridan lays ambush for my fingermarks on her treasured cabinet.

★

I'm always hoping that one of those questing polishers will attempt to dust the inside of the set as I remove the back and switch on. Usually there is a startled shreik and the serviceman finishes his five-minute repair with a half-hour session wiping capacitor toffee from the hot chassis.

One engineer of my acquaintance who advocates the use of a certain "wonder household cleanser" for such stubborn surfaces as implosion guards will perhaps offer me a recipe for removing congealed black wax from an unidentifiable component without damaging it?

In the meantime I must employ my trusty screwdriver, and put up with those remarks from behind my back. Remarks like, "*What'cher doing? Diggin' fer gold?*", that set me wishing I carried a billiard cue in my toolkit.

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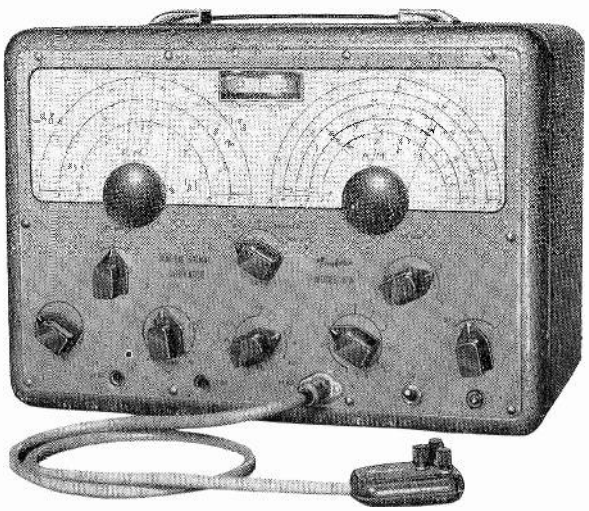

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Calibration Accuracy:	± 1%

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Calibration Accuracy:	± 2%.
Deviation:	Variable to ± 100 Kc/s at 400 c/s.
Attendant A.M.:	Not greater than 1 dB, at 100 Kc/s deviation.
R.F. Out-put:	100 mV. monitored by crystal diode voltmeter.

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