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SERVICE ENGINEER

Vol 2. No. 11. April, 1960
Edited by W. Norman Stevens
Issued as a special supplement with "Radio Retailing"

In this issue:

briefs

● The BBC Sheffield TV booster near Lydgate reservoir will open in May or June. This should cure ghosting and interference for many Sheffield viewers.

● The 1960 Electrical Engineers' ASEE Exhibition opens on 5th April at Earls Court, London. It closes on 8th Apr.

● The 1959/60 edition of the *Mullard Pocket Data Booklet* contains 70 pages of useful information, including a comprehensive valve, semi-conductor and c.r.t. equivalent lists, data on all types of Mullard domestic valves and semi-conductors, notes on ion trap magnet adjustment and details of thermistors. Copies may be obtained from Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.

● The M.O. Valve Co. Ltd., Brook Green, Hammersmith, London, W.6, is offering a service on GEC reclaimed TV tubes. Thirteen types are covered, from 9–21 in., prices ranging from £5 to £14 13s. 4d.

● Large initial enthusiasm for pay-as-you-view TV is reported by Leech & Hainge Ltd., who have installed a service in some parts of Oxford and North Berkshire. Sets are installed free (with aerials) and the viewer gets an hour's viewing for a shilling in the slot. No deposit is charged and insurance and maintenance are free.

Service Viewpoint

EVERY year, Hugo Gernsback (editor of *Radio-Electronics*) sends to fellow journalists a booklet called *Forecast*. This contains startling prophesies, many of which have an uncomfortable habit of materialising as the years roll by. We thought you would be interested in one of this year's efforts.

Skipping the simple stuff like negative-gravity spaceliners landing on lunar hotels, and methods of embalming by electro-plating, we come to an intriguing device called the *Odorchestra*. After digesting preliminary appetisers such as "*humanity has always been very much immersed in all sorts of scents, odours and smells*" (as all servicemen will agree), that not only practically all the lower but also even higher animals " *make their sexual selection via the odour of their mates*," we come to the "odoriferous cinema". He means, of course, the "smellies", an old gag which now looks like rebounding on the wags with sickening violence.

The Odorchestra

Sooner or later, it seems, we'll have an *Odorchestra*. Briefly, apart from conventional long-haired musicians disseminating old fashioned crotchets and quavers, we have an *Odorconsole* played like an organ by an "odour-musician". Before him is an *Odor-score* which accompanies the orchestra. Every time this smell-merchant depresses a key or pulls out a stop, a given odour permeates the audience. When he plays chords, a number of odours waft into the auditorium, probably suffocating the more sensitive enthusiasts.

Accompanying this symphony of scents, we have a display of colour patterns on a large screen. Colour-music is not new, but in the illustration shown, the display looks something like a blown up surrealist impression of a migraine headache. These patterns are used to blend colour symphony and odour symphony to music. Although for our money we'd rather have Jayne Mansfield, Gernsback calls it a "new sophisticated-esthetic triumph of the senses". Every man to his choice.

But dwell a moment on the implications. After the spoken woid on stage and gramophone record, we had sound radio. After the cinema, TV. Then colour cinema, colour TV. Soon we are to have smelly-cinema. You see . . .!

We are not trying to cause alarm and despondency in the ranks of service engineers but f.m., stereo, colour TV are only the beginning. The smells are on the march.

Thnk of the fun. When a customer drops in and complains "my set stinks", is the trouble (a) the mains dropper overheating, (b) an inquisitive mouse that got cremated, (c) the "whiff-sync" circuit out of alignment, or (d) is it just one of *those* sets?

Imagine, also, the outside engineer calling to examine a faulty Smell-TV with the complaint of intermittent smell accompanied by scent-shift and odour of eggs and bacon with frying on sound, only to discover that the lady next door was cooking the breakfast and had left the window open.

Or again, after spending hours 'scoping the a.o.c. (automatic odour control) and examining the smell emitter, to find that the smell of molten wax *was* a smell of molten wax and C879 has gone s/c again. And what would *you* do with a Smell-TV suffering from hay fever?

Friend Gernsback places no date by which we can expect the *Odorchestra*, so we cannot estimate when it will be part of every good TV set. But it probably won't be just yet awhile. In fact we feel prompted to make a prophesy of our own. By the time the last of this generation has put away his testmeter for the last time, a certain authority in this country will announce that colour television (on 405 lines) is just around the corner.

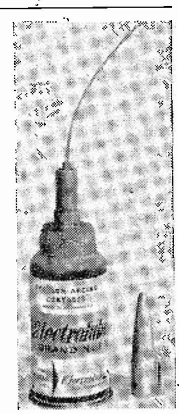
New Dispenser for Electrolube

— *and two grades*

The makers of *Electrolube*, the well known lubricant, announce that it is now available in two forms: No. 1 for light current applications and No. 2 for treatment of sparking contacts and heavier current duties.

Coincident with this is the news that the fluid is now available in a new type nylon "snorkel" dispenser which overcomes the problem of evaporation experienced with the old polythene type. The flexible tube gives a 4 in. "reach", permitting direct application drop by drop at the required point without scratching or pressure. It eliminates waste and allows instant control of the feed by pressing on the bottle as required.

The lubricant can be applied from the end of the tube or by squeezing a few drops on to the foam washer under the stopper when valve pins, connecting plugs and other small parts can be lubricated. There are 5,000 drops in each bottle. The price range emains unchanged.



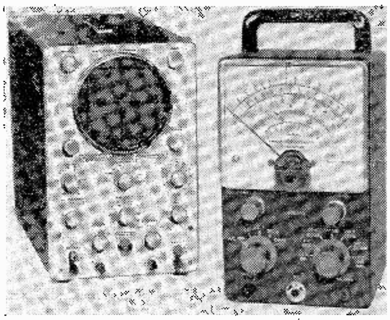
BEULAH A NEW RANGE OF INSTRUMENTS

Direct TV Replacements announce the introduction of a range of test equipment under the trade mark of *Beulah Electronic*. These will be basically constructed from the well-known *Heathkit* range (only available in this country in kit form) and the saving of development and tooling costs is reflected in the competitive prices of the *Beulah* range.

The first release under this arrangement consists of nine instruments and accessories. Model 0–12U–F is a general purpose oscilloscope with wide-band amplifiers, a 5 in. c.r.t. and gold-plated printed circuitry. A feature is a patented sweep circuit covering 10 c/s to 500 kc/s in 5 steps. A peak-to-peak voltage calibrating source is provided. The price, including a 48-page instruction manual is £44.

Model S–3U–F is an electronic switch to be used as an oscilloscope trace doubler. In addition to its normal function of extending a single beam oscilloscope for two simultaneous traces, it is useful for determining the phase shift between two voltages, one (or both) of which may be derived from currents. Many phenomena related to time may be studied by means of this double trace feature. Price is £15 15s.

The V–7A–F is a low priced valve voltmeter for general use. It has 7 a.c. voltage ranges (r.m.s.) up to 1·5kV, 7 a.c. voltage ranges (peak-to-peak) up to 4kV, 7 d.c. voltage ranges up to 1·5kV, 7 ohms ranges (full measurable range being 0·1 ohms to 1,000 megohms) Input resistance is 11 Megohms. It has a 4½ in. 200μA meter and the d.c. sensitivity is more than 7 megohms per volt. Accuracy is ±3 per cent full scale. Price is £19.



Two models from the *Beulah* range, the O-12U-F and V-7A-F.

Also available is an r.f. probe (Model 309–CU–F) designed to extend the frequency range of the valve voltmeter to 100 Mc/s and to enable useful voltage indication to be obtained up to 300 Mc/s. Price is £1 13s.

Model AG–9U–F is an a.f. generator with wide frequency range (10 c/s to 100 kc/s) and a distortion between 20 c/s and 20 kc/s of less than 0·1-per cent. Output may be varied at will from 10V f.s.d. down to 3mV f.s.d., output being monitored by a 4½ in. 200μA meter. There are eight different switch selected ranges covering 0–0·003V to 0–10V f.s.d. The meter is also calibrated in dB. Price, including 24-page instruction booklet, is £26 3s.

A resistance-capacitance bridge, model C–3U–F, measures from 0·0001 to 1,000μF, power factor and leakage (polarising voltages of from 5 to 450V are available), and 100 ohms to 5 megohms. All readings are taken from the large calibrated scales direct, no calculations being required. Bridge balance and leakage are indicated on a magic-eye indicator. When testing for leakage, a control automatically discharges the capacitor under test. Price, with comprehensive instruction manual, is £13 2s. 6d.

The three other instruments are Models AW–1U–F audio wattmeter calibrated in dB and watts (five ranges from 5mW to 50W full scale) on a 4½ in. meter with switch selected load resistors (£19 19s.), Model CM–1U–F direct-reading capacitance meter with full scale ranges of 100pF, 1,000pF, 0·01μF and 0·1μF (£20 10s.), Model AV–3U–F audio valve millivoltmeter using a new circuit featuring a cascade amplifier with cathode-follower isolation between the input and the amplifier, and between output and preceding stages (£19 19s.).

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.

Those Mains Plugs

THE other evening we took out on demonstration four television sets of different makes. All four sets had a different mains socket fitted on the back panel. One of the manufacturers concerned has used the same socket for as many years as we can remember; we like this one because it is a standard 5 amp. fitting. The other makes are not predictable and are likely to introduce a new plug next year if the fancy takes them.

Is it not about time that the manufacturers made some sensible agreement to fit the same type of plug? Any special arrangements regarding polarity reversal could be overcome easily by the way the back of the cabinet was cut. Service engineers could use a soldering iron with a standard plug and time spent fiddling with mains connections would be saved.—R. **Johnson**, *Carnforth.*

[As a result of the comments made by Mr. Johnson, we understand that the question of standardising these plugs and sockets will be raised with BREMA—Ed.]

Silicon Rectifiers

IT would be interesting to know how many servicemen have had trouble with the latest type of silicon power rectifier. I have had to replace three sets (two rectifiers in series) in brand new receivers within a week.

The annoying thing is that the dinky little fellows are used in place of a PY32, yet there is plenty of room in the cabinet for the valve and the price reduction does not seem to be significant.

Is there any real need for makers to jump on the bandwagon of every new device, regardless of whether it is better than the technique it replaced? Another point: in two of the cases mentioned, the mains dropper had also suffered before the a.c. fuses blew. An h.t. fuse would have been an added protection—or would that have cost too much?—W. **Henry**, *Glamorgan.*

New Books

Practical Electrician's Pocket Book, **edited by Roy C. Norris. Published by Electrical and Radio Trading, 180 High Holborn, London, W.C.1. Size 4×5 in. 535 pages, illus. Price 7s. 6d.**

THIS well established pocket book (now in its 62nd year) will need little introduction to most readers. It is packed tightly with a wide range of information of interest to the practising electrician.

The 1960 edition, however, contains many new features. Making its debut is a chapter on public address, covering amplifiers, microphones, loudspeakers, and up-to-date methods of solving sound reinforcement problems. Also new are sections on semi-conductors, storage batteries (giving details of nickel-iron and nickel-cadmium, as well as lead-acide types), principles and fault-finding hints on refrigerators, education in the electrical contracting industry and Electricity Board tariffs.

Several sections are revised, including those on protective multiple earthing, electric floor warming, power factor correction, wiring and instruments. All-in-all this reference book is excellent value for anyone whose work touches on the subjects covered.—*D.C.*

GOLTOP DATA

Newmarket Transistors Ltd., (Exning Road, Newmarket, Suffolk), has produced a series of application notes, giving circuit information and other data on *Goltop* transistors. A wide range is covered, including audio amplifiers, regulated power supplies, converters and inverters, blocking oscillator, r.f. oscillator, electronic photo flash, crystal marker oscillator and tape recorder bias oscillator. Readers may obtain copies of application notes covering particular interests from the address given above.

SERVICING THE MODERN SET

A new series dealing with the practical servicing aspects of modern radio and television receiver design techniques.

PART 1: PRINTED CIRCUITS

BY B. R. GOOD

THE shape of service is changing. Electronic innovations are reaching the production lines with ever-increasing speed. Not so quickly, but just as inevitably, they land upon our benches.

If a "Rip Van Winkle" serviceman of pre-war days could come into the modern workshop and see a normal day's repairs, he would be more than a little perplexed.

Some of the changes in the past few years have included: printed circuits, transistors, ferrites, f.m. and stereo. New valves have brought with them drastically different circuitry. Loudspeaker techniques have changed. The immense growth of sales in electro-mechanical equipment has brought with it the need for a wider understanding of "the ironmongery". Tape recorders alone require a specialised approach.

Our "Rip" would find his test gear totally inadequate. He would no longer be able to rely on his multi-purpose meter, his hit-or-miss signal generator and his valve-tester. Nowadays, the well-equipped service department needs more. We have reached the stage where even the apprentice takes a c.r.o. for granted.

In this series it is my purpose to discuss some of the aspects of modern domestic receivers—with the accent on "modern". I shall make no apology for occasionally dipping into theory, for it is my firm contention that to service a set efficiently, the workman must first *understand* it. Makeshift methods won't do!

I can do no worse than begin with the printed circuit.

EARLY SYSTEMS

The technique is not so new as may be supposed. As long ago as 1937, J. A. Sargrove was working on a receiver using deposited conductors. His idea was to make a set that could be reproduced by purely automatic processes. The capacitors, inductances and resistors, too, he envisaged as printed components. His ideas were not so far-fetched as some cynics then supposed.

At the same time, independently, experiments were going on in Britain and Germany with a vacuum deposition process. A patent was registered in 1941.

In the same year, Dr. Paul Eisler was working on the etched foil technique. This presented great production possibilities. A company was formed, Technograph Printed Circuits Ltd., to exploit Dr. Eisler's ideas.

For the next few years little was heard of the development of printed circuits. This was perhaps due to a security blanket, for the American Defence department was busily adopting the process in a ballistics programme. In 1947, details of a proximity fuse, using what was fundamentally the original technique, but with greatly improved materials, were made public.

This was the year of the breakthrough. Major publications by Brunetti and Curtis aroused interest. Simultaneously it appeared that several firms were developing processes along quite different lines.

As well as the better-known etching process, some success was reported by P. P. Hopf and the chemical firm of Ward Blenkinsop, working on a hot die-stamping process. This was similar to the Bondac process, later used by Hunts Capacitors very successfully.

THE ECME

In 1947, also, J. A. Sargrove succeeded in producing his dreamchild, the fully automated receiver. Automated, that is, as regards production. Using printed circuits throughout for wiring and most of the components, he evolved an almost complete a.c.–d.c. radio set. He entitled his process, ECME, Electronic Circuit Making Equipment, and although it had only limited potentiality, many of his ideas led directly to modern developments in producing planning.

The ECME principle, though not exactly the kind of printed circuit we shall be concerned with, is nevertheless worthy of note. The pattern of the "wiring" is etched on the high grade laminated sheet directly, resulting in a series of grooves and depressions which are then filled in by spraying metal over the whole surface. Face-milling removes the surplus, leaving the grooves filled with conducting metal.

Components are formed in various ways. Inductances comprise a series of spiral grooves, sprayed and filled with conductor, dimensions closely controlled. The original radio design achieved an accuracy of $\pm\frac{1}{2}$ per cent of inductance.

Capacitance presents a different problem. Some values are simply made by spraying predetermined areas of the panel on both sides. The metal deposited forms the plates, and the panel the dielectric. Naturally, there is soon reached a limit to the practical thinness of the dielectric. This is overcome by corrugating it, and by altering its dielectric properties by adding "high constant" pellets during moulding.

Resistors present less of a problem. They are formed by spraying graphite, or similar resistive compounds, through stencils. Dissipations of about a watt per square inch are one limiting factor. But, on the whole, the technique has interesting possibilities for mass production of simple panels. Later developments have superseded ECME for high grade electronic circuitry.

The principle of milling off surplus conductor is intrinsically wasteful, and various methods of overcoming this waste by depositing only metal required for conductors have been devised.

PHOTO-ETCHED

Better known, perhaps, and most widely used in the domestic radio and associated equipment, is the photographic etched copper printed plate. This takes many forms, but can be resolved into two main processes.

First, the pattern of the printed circuit is meticulously designed, mocked-up much larger than actual size and photographed. By using a transparent matrix, the exact position of each component entry hole and wire bridge connection is registered, for later drilling of the plate.

In production, it is vitally necessary that the components used shall be standardised. Indeed, some effort has been made for overall standardisation of components, controls and mountings for use with printed circuits. (A Preferred Components Catalogue has been drawn up).

Switches, too, can be devised that are actually part of the printed pattern, with a rotor, or slide commutator, making contact with the minimum of mechanical variation. Extremely small yet complex switches are used in some electronic applications.

The second part of the process is the actual preparation of the plate, usually of laminated phenolic board, or epoxy resin bonded glass fibre material. To

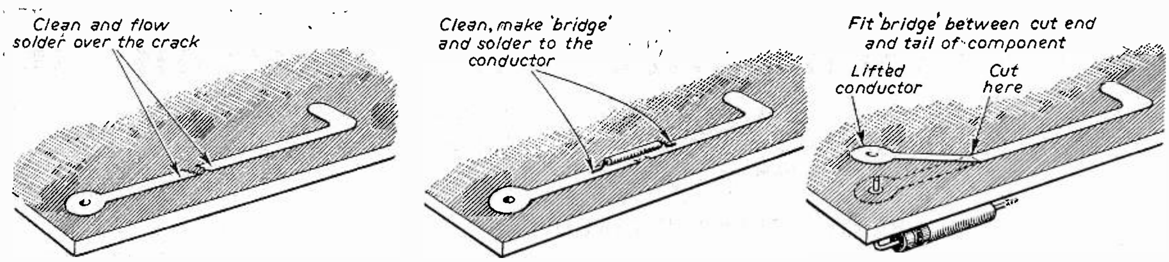


Fig. 1: Details of bridging breaks in conductors.

this is bonded rolled copper foil, usually about one and a half thousandths of an inch thick. The copper foil is coated with a resist—a chemical that is impervious to the etching solution to be used. This coating is then overlaid with a light-sensitive emulsion which is exposed to a light source through a negative of the printed pattern.

FORMING CONDUCTORS

Thus, the areas of the board which are to be left metal-clad, i.e., the conductors, are activated by the light through the negative. The board is then washed and rinsed and the surfaces not activated are cleared, leaving the copper unprotected. The plate is then dipped in the etching solution, washed, dried, and coated with a protective varnish.

Holes are drilled in the predetermined positions, often by ingenious automatic machines that work from the information fed them from the master matrix. Components are fitted and soldered into place.

This is all very sketchy, and each stage of the operations has its variants. There are different methods of photographing, printing and etching; holes may be punched from a master plate; a solder bath may be used, or a flow-soldering method, whereby the plate is carried over a flux roller, the flux heated and dried as the carriage moves on, then over a wave of molten solder, so that only the conducting surface has solder applied to it.

SPECIAL CARE

However, despite the inadequacy of description, enough will have been said to demonstrate that the printed plate and its associated components need special care when repair treatment is necessary. For example, flexing of the panel is likely to cause a strain of the bond between the copper and the laminate, especially at a point of narrow width of conductor.

This may seem obvious, but it is often forgotten when servicing. Too much pressure may be put on a valve as it is inserted in the centre of an unsupported area of printed panel: a component may be prised, not too gently, in a test for a suspected dry joint.*

Another fault that can be caused in this way is the elusive "hairline crack". Guarded by its resin coating, it may be exceedingly difficult to detect, giving rise to a number of intermittent faults.

It is advisable to check by normal service methods, i.e., metering for a break in continuity or a rise in resistance, rather than aimlessly stressing the panel in the hope that the break will become visible. In doing this latter—too popular—test, it is far too easy to make fresh breaks in other conductors!

When such breaks are found, they are best mended by bridging. A portion of the conductor is cleaned at each side of the gap, to remove the protective resin. Then, if the break is small enough, say less than $\frac{1}{32}$ in., it can be soldered over. Use the minimum of heat and a good quality resin-cord solder.

To elaborate this latter point before proceeding: an instrument-type soldering iron is most suitable. In most radio and television work, a 25-watt, $\frac{3}{16}$ in. bit, soldering iron can be used efficiently. Solder should be small-gauge, resin cored, 60/40, and should be used sparingly.

BRIDGING GAPS

Where a conductor has lifted from the board, or the break is too wide for efficient soldering over, the bridge can be made from a piece of wire. First, cut away the raised portion and clean off ends to be joined. Make the bridge of exact length, so that a short piece of wire lies along the axis of the conductor, and solder quickly, holding the bridge firmly in place. Do not use long, flexible bridges, which may add to the stresses at the severed end of the conductor, causing a later fault.

If there is any possibility of a short-circuit to an adjacent conductor where the above operation is carried out in a confined space, make the bridge from convenient points on the conductor, more widely spaced. Take care to use insulated wire if this is done, and do not depart from the general layout of printed conductors.

When faulty components have to be replaced, special care is needed. The board should first be inspected, to see which method has been used for mounting the component. Some manufacturers favour a semi-permanent mechanical joint, with solder effecting the electrical bond. Where this has been done, the lead wires of the component will be bent after passing through the board and before soldering.

REMOVING PARTS

To remove a component so fixed, a good deal of heat would be necessary, while the solder melted and the wire was straightened. The effect of overheating would be to char the protective varnish, possibly provide a leakage path between conductors of high and low potential, and certainly risk loosening the adhesion between the conductor and the board.

The technique of component changing is thus wasteful, unless one is certain it is necessary, for the best method is to cut the lead wires as close to the component as possible, leaving a tail protruding from the soldered joint on the board.

This tail then provides anchorage for the replacement item. Leads from the new component are cut to the appropriate length, twisted into small loops and soldered to the tails. Tin the component leads first, to ensure a quick operation.

When doing this, use long-nosed pliers as a heat shunt on the board side of the new joint, apply the resin-cored solder and make the joint as quickly as possible.

In some cases it is necessary to have a heat shunt also for the component—as in the case of crystal diodes, small "puff" capacitors, etc.—and this is best done by fixing a small crocodile clip to the upper section of the lead. A clip, prepared by affixing a short length of heavy gauge wire, can be kept specifically for this purpose.

Some components will be found to be inserted in the board with straight leads. In these cases, a gentle pull when the joint is heated should free them. The operative word is "gentle". Do not apply such force as may strain either the board or its conductors.

If a blob of solder is large, tending to spread when heated, with consequent danger of short-circuits, it should be reduced before making the new joint. This can be done by removing the solder

*Complaints about "dry joints" on printed panels are continually reaching us. It is possible that some of these are not so much "dry" as "forced" by careless servicing. With the better automatic processes, dry solder joints are virtually eradicated. Further, one manufacturer quotes a bond strength of 20 lbs. between conductor and laminate (twice this for glass fibre), which is surely sufficient!

a bit at a time on the clean bit of the soldering iron. Remember to wipe the bit between each application, or the last stage may be worse than the first!

USE OF BRUSH

Alternatively, a brush with firm, close bristles can be used, to brush away the molten solder before it can re-adhere. This is the method favoured by the author, who carries several paint brushes filched from his small daughter's toy-box. Care must be taken that the solder thus removed is not allowed to scatter indiscriminately.

The brush is useful, too, for removing tagged components, such as preset controls, switches and valvebases. Here, again, the method of mounting will determine the method of removal. Lugs are often inserted in their fixing holes, twisted to give mechancal support, then soldered.

In these cases it will be necessary to straighten the lugs before the component can be withdrawn. Therefore, most of the solder will have to be removed, and brushing is the best way of doing it. Gentle pressure after removal of surplus solder and straightening of lugs should free the mounting sufficiently for withdrawal.

In stubborn cases, or where the control is a definite write-off, it is often easier to clip off the lugs where they enter the board. The stubs thus left can then be withdrawn from the reverse side of the board when the solder is heated, with no need for clearing and straightening.

A novel method of repair that may be resorted to when a multi-tag component such as a switch has to be changed consists of making a mock soldering iron the shape of the contact points—usually a circle.

If a solder gun is used, this is easily done by bending a piece of heavy-gauge copper wire into the shape required and fixing it in place of the nozzle loop. A similar ruse can be worked with a heavy-duty soldering iron by running the wire round the bit in the form of a spring. It is unlikely that enough heat could be transferred with a smaller iron, using this method. And, in any case, great care must be taken that heat is not applied where it is not wanted.

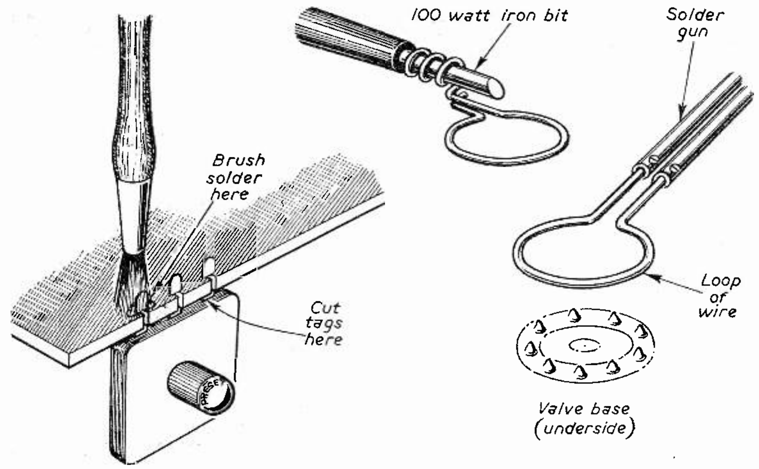


Fig. 3: Methods of removing tagged controls and valve bases.

CIRCUIT TRACING

Circuit tracing on printed boards can be difficult, because of the practice of mounting components on the side remote from the conductors. A great help in this respect is the use of a bright light on the side of the board away from the observer. The board is usually sufficiently translucent for the "wiring" to be seen.

An aid to tracing is the present method, adopted by many manufacturers, of printing a good deal of information on the component side of the board. This, used in conjunction with a circuit diagram, should make tracing much easier; simpler than on many of the older sets.

Printed circuits have earned a few grumbles from harassed engineers—so would any new technique. Intelligently approached and treated with due care, they should make life a lot easier for us. The problems they pose are special ones, but certainly not worse ones than before. And the latest developments, plated circuits, make component changing easier still, whilst eliminating several of the smaller causes of trouble, such as raised conductors, solid-looking dry joints and so on.

MODULES

Modules have become widely used in the modern television receiver. Separate sections of the circuit have their individual boards, sometimes interconnected by wired harnesses, sometimes by leaf-socket and sprung slide connectors.

Repair techniques on sets using these modules depend on the philosophy of the service department. Obviously, it is easier, once a fault has been roughly located in a particular section, to replace the module completely.

This can secure a quicker turn-around of jobs, but is likely to prove expensive in the long run—despite the favourable "return schemes" operated by some manufacturers. If a wide variety of receivers is to be handled by the department, it is impractical for the outside serviceman to carry a great stock of replacement modules.

It is even less practical to lift a set for workshop repair and then merely replace the module on the bench. But for emergency repairs, or "last-ditch" efforts with time-wasting intermittents, the module is what one correspondent called "a gift".

Points to remember when replacing modules are: fit all screws correctly, ensure clean connections, and treat soldered tags gently, especially when disconnecting. If the mounting involves a rubber grommet for shockproof security, don't forget to put it back. Do not use extra washers which may overlap the edge of a conductor (a production fault on one model). Take care with the thin edge of multi-point slide connectors, and keep surfaces clean.

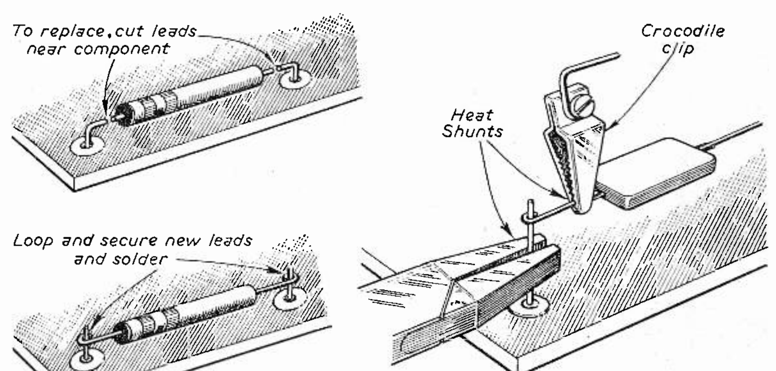
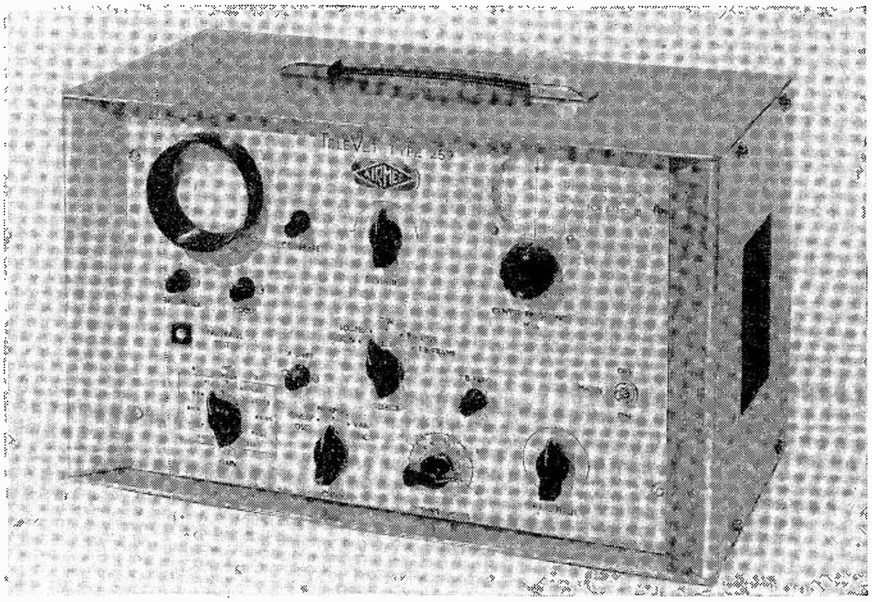


Fig. 2: Details of removing and reconnecting components, as described in the text.

GOOD NEWS FOR SERVICE ENGINEERS

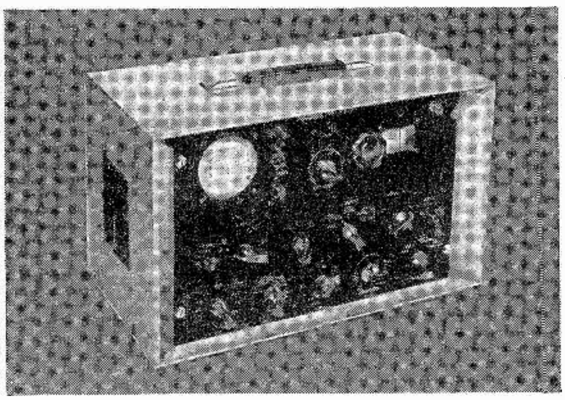
here's the NEW TELEVET 259



The new Airmec Televet incorporates all the facilities provided by the well-known Televet type 877, PLUS these greatly improved features.

Send for leaflet No. 202

- **Improved pattern—locks on all types of set.**
- **Wider band width oscilloscope—D.C. to 700 kc/s.**
- **New spiral tuning scale over 4 ft. in length—calibrated every 100 kc/s.**
- **Line transformer test incorporated.**



The AIRMEC RADIVET

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Pye V310F

Frame Not Linear

The fault of poor frame linearity occurred on a brand new receiver while out on trial. A valve fault was naturally expected but this was not the case. Voltages in the frame output circuit were normal, as were components in the feedback network, and indeed all other components in the output circuit including the output transformer.

The fault came to light while examining the frame oscillator. A voltage check on this (cathode coupled multivibrator) revealed a very low voltage at the anode of the first triode (30V). This anode is fed via a 2·7MΩ resistor R77 from the boost h.t. line and although the resistor checked normal, the boost h.t. was found to be some 150V low.

In testing for a leak on the boost line, a partial short was found in the 0·05μF filter capacitor C92 connected between the boost and h.t. lines. We were rather puzzled that the drop in boost voltage did not have much effect on picture brightness, as the accelerator anode on the c.r.t. is fed from the boost line. Had it have done so, the fault may not have proved to be so misleading.—C.S., Bicester (651).

(This fault has also been reported by other readers—Ed.)

Cossor 946

Shift of Picture

The trouble here was intermittent horizontal shift of picture to the right of the screen. This would happen after several hours viewing, would last for a few seconds then flick back to normal and jump to the right and back again for the rest of the evening.

The set was soak tested until the fault appeared. Valves were changed without success. Voltage and oscilloscope waveforms on the flywheel sync, line oscillator and line output stages revealed no clues; no differences could be found with the fault on or off.

In an attempt to find a cure, capacitors were clipped in one at a time across original ones in the line timebase. When one was connected across the 12AU7 line multivibrator cathode bypass capacitor C47 (0·002μF) the picture stopped flicking to the right and remained steady. The original C47 was clipped to the bridge and placed near an electric fire. When it became warm it started varying in capacitance from about 0·0006μF to 0·002μF.—S.W., Buckingham (717).

Alba T655

Cloud of Smoke

There was a cloud of smoke and the sound disappeared. Visual inspection showed that R31, the 470Ω h.t. feed to the screen of the sound i.f. valve V6 had burned badly, taking with it the adjacent jumper leads and a section of the printed circuit. Normal procedure with this kind of fault is to replace both resistor and its decoupling capacitor, which usually causes the breakdown.

However, in this case an extensive wiring job had to be done to repair the damaged part of the panel on site. No spare was immediately available, though the makers have an excellent replacement service.

After rewiring and cutting away damaged printed conductors to avoid further short circuits, we took the precaution of metering the circuit—and the short was still there. Removing V6 cleared it.

The valve had developed a G1/G2 short. I dread to think what the customer would have said if we had switched on again without making that final test.—B.R.G., Gilfach (707).

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.

Grundig TK20

Unstable on Playback

While on playback, one of these tape recorders produced motor-boating and hum when the volume control was advanced from about half-way to maximum. The fault, sounding suspiciously like an h.t. decoupling fault, turned our attention on the various h.t. decoupling capacitors, but they all tested OK.

It was then found that very light tapping anywhere on the chassis would cause the motor-boating to vary, though only slightly. By further tapping experiments the relay W was pinned down as being most sensitive to the disturbance. This relay has several switching operations in different parts of the circuit and one of the switches (W1) was found to be making contact, not a dead short but about 2–3 ohms between the contacts.

As the chief function of this switch is to earth one side of the record/replay head (and also to earth the lead from the record a.f. output to the record/playback head on playback), the 2–3 ohms from true earth was sufficient to cause the motorboating. Cleaning the contacts and adjusting them was the cure.—G. H., Harrogate (701).

Stella 8514

Very Severe Distortion

This set had been converted by the local relay company for piped TV. The complaint was distortion on sound when the set warmed up, which eventually grew so bad that the customer was forced to switch the set off and let it cool down. As the fault was so obviously in the audio output stage, the relay boys disclaimed responsibility and we were called in.

The ECL80 sound output valve and its associated components were in order, however, and it was not until the distortion occurred that we thought of checking the input from the "slave feed" unit.

Here, the audio is fed to the grid of the pentode section in order to retain the use of the volume control and associated circuitry. But the mechanic who had done the conversion had taken the input lead to a "convenient" point on a tag strip and had omitted to

(Continued on page 161)

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Roberts P5A portable radio (R73, May, 55).
Roberts R66 portable radio (R88, Aug., 56).
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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).
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TECHNICAL GEN
continued

disconnect the anode load of the triode section.

Thus, there was a 330kΩ resistor feeding h.t. to the secondary of the input matching transformer of the relay unit. One snip with a pair of sidecutters cured the fault.—B.R.G., Gilfach (705).

Invicta 537

No Contrast Control

One of these receivers came into the workshop with the complaint that the contrast control was ineffective. The set was put on test and it was found that the a.p.c. circuit was not operating. At first, the crystal diode in the a.p.c. system was suspected but after checking on this it proved to be working satisfactorily.

After checking the circuit diagram, it was seen that the a.p.c. is taken back to the sync separator and decoupled with a 0·1μF capacitor C71. This proved to be o/c and a replacement restored normal operation.

Although this one was on an Invicta chassis, the same fault has often been experienced since on associated models.—V.W., Broxbourne (716).

RECEIVER SPOT CHECKS

No. 53: VIDOR CN4213 and CN4215

Line Inoperative: Check V11B anode feed resistor R55 (1·5MΩ) for o/c, feedback capacitor C57 (80pF) for o/c or leakage, C58 (0·5μF) for o/c or s/c causing lack of boost voltage, and C55 (0·01μF).

Line Hold One End: Check R56 (180kΩ) for h.r.

Critical Line Hold: Increase value of C47 from 5pF to 15pF.

Frame Inoperative: Check wirewound potentiometer R51 (30kΩ) for o/c, C52 (0·1μF) for o/c, s/c in blocking oscillator transformer.

Poor Sync: Check R41 (270kΩ) for o/c, C46 (0·1μF) for s/c and V6 (EB91) for low emission. If poor sync is accompanied by a pale picture, check for faulty vision detector crystal diode.

Instability: Check C6, C9, C14 and C38 for o/c.

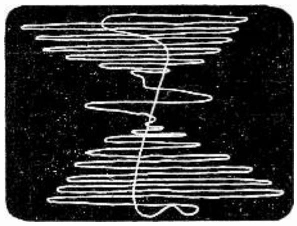
Low, Distorted Sound: Check R28 (10MΩ) for o/c or h.r., C37 (100μF) for o/c or low capacitance, R31 (220kΩ) for h.r., and C36 (0·005μF) for leakage.—E.L., Long Eaton (711B).

Ekco T162

Unusual Raster Effect

Original fault was complete breakdown due to lack of h.t. The two 50-ohm limiting resistors on the mains rectifier were o/c and the emission of the valve was low. Resistance to chassis from h.t. line was normal. Replacement of faulty components restored h.t. to line.

However, on warm-up it was noted that the line timebase did not give the usual high pitched whistle, although the e.h.t. rectifier was glowing and e.h.t. was present. A most unusual raster appeared on the screen and this can best be described as vertically swept oscilloscope trace of a squegging oscillator running at an X sweep equal to that of the frame timebase.



The trace started at the centre of the oscillatory period, damped down towards the centre of the screen with a single bright sinusoidal trace before starting to oscillate again. The trace ended at the point of maximum oscillator amplitude, followed by a very bright S-shaped flyback from bottom to top of screen (see diagram).

The use of an oscilloscope was unnecessary in this case since the raster revealed all the information required. The line timebase was squegging due to intrusion of a.c. into its h.t. supply. Mechanical checking revealed rotted insulation on wiring to the base of the U801 rectifier. A short circuit existed across the wiring connected to the two cathodes. Since half of this valve is used as the efficiency diode, raw a.c. was being fed to both line and frame timebases.—J.E.R., Nottingham (704).

Cossor 945

Buzz on Band I

The picture was normal on both Bands I and III, but sound was normal only on Band III. The Band I sound was accompanied by what sounded like vision-on-sound buzz but which was not affected by the Band I oscillator tuning.

As the Band I signal is far stronger here, overloading due to an a.g.c. fault was suspected and not (as was possible) tuning misalignment. Voltage checks showed negative a.g.c. voltage present on the a.g.c. lines. The a.g.c. line decoupling capacitors were then checked and here the fault was found.

The a.g.c. voltage, derived from the sync separator grid circuit, fed with video waveform, has as its first decoupling capacitor C54 (0·1μF) and this had gone o/c. Replacement cured the trouble.—G.H., Harrogate (695).

Brainless Bertie

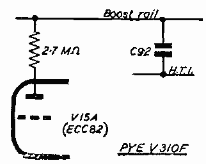
Chasing a "no-mains" fault
Till his head was throbbin',
Bertie found the customer
Hadn't put a bob in!

Feste

Pye V310F

Low Frame Amp.

This receiver had a picture of normal width, but the raster was only about three inches high. By adjusting the height control, the screen could could be filled, but the picture was non-linear and the linearity control would not correct this. On testing h.t. voltages, it was found that the boost rail was only 200V, the same potential as the main h.t. rail.



Investigation found that the capacitor C92 (0·05μF) was short circuit. Replacing C92 restored the boost rail to 500V and with it normal frame amplitude. This fault has occurred on several receivers of this type. C92 is easily replaced on removing the panel underneath the receiver.—G.B., Oxford (647).

Alba T721

Common I.F. Fault

A rather baffling one on this model had the symptoms of overloading on vision when the *sound* was turned up. The last third of the movement of the volume control slider produced an effect of over-contrasted picture, although the contrast potentiometer did have some control over it.

After some thought and circuit study, we came to the conclusion that it must be instability in a stage that handles both sound and vision. The h.t. to the i.f. strip is separately decoupled, the audio output rail being taken from the "hot" side of R82, which has the 32μF electrolytic C62 decoupling it on this model. The sound output stage was normal, the cathode of the PCL83 V9 was in order,

(Continued on page 163)

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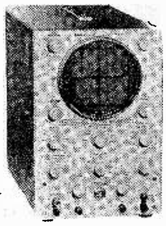

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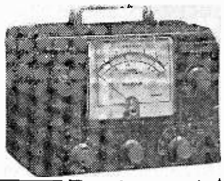

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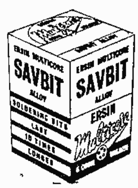

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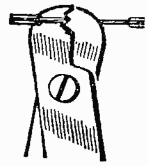

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TECHNICAL GEN *continued*

and the volume control itself appeared to be working correctly.

Rather baffled, we were prodding round the common i.f. stage when we came on the fault. C3, the 0·001µF capacitor which decouples the a.g.c. line to the V8 grid, had a dry joint to the printed circuit at the earthy end. Resoldering cured the fault, but we still have not worked out exactly why *those* symptoms occurred.—B.R.G., Gilfach (706).

Cossor 948

Fade and Hum

After about ten minutes the sound faded and a hum developed. This hum was controllable by the volume control and tapping at the screened lead which connects the i.f. panel to the sound output panel showed that the final audio stages were healthy.

A secondary symptom was that the sound i.f. valve V6 appeared microphonic when the fault was present, although it actually tested OK by substitution with the common i.f. amplifier.

All valve voltages seemed normal but it was as we took readings that the clue came. Putting the meter on pin 8 brought the sound back and reduced the hum. The culprit was obviously the decoupling capacitor C4. Replacing this 0·001µF ceramic capacitor cured the fault.

The misleading factor had been its failure only when the adjacent valve V6 became warm.—B.R.G., Gilfach (708).

Pye C17

An A.G.C. Fault

One of these consoles was brought in for servicing with the complaint of no vision and sound, with a suggestion that the fault might be in the tuner. Valves and h.t. readings to the tuner were found to be satisfactory. The set was lively from the vision i.f. valve V3 and the sound i.f. valve V15; the voltages on these were normal.

On checking for voltages on the remainder of the vision and sound valves, however, while anode and screen potentials were present, no cathode voltages could be read. This led us to check the grids of these valves and it was found that a heavy negative bias was present which was biasing them to cut-off.

On this set, the a.p.c. and a.g.c. is combined and fed to the controlled valves and the excessive negative voltage was coming from the sound a.g.c. Checking at the source of this voltage showed that C53, decoupling the V15 screen feed, was o/c and causing instability and that the excessive signal from this oscillation was being applied to the sound detector and developing a large negative voltage on the load R73. Replacement of C53 restored normal operation.—H.W.G., Folkestone (700).

SERVICE BRIEFS

Pye PV110: After being out for only a short while the set was returned to us with the complaint of distorting sound and bad mains hum. On the preliminary tests, this fault gave all the symptoms of faulty electrolytics but they tested OK. After studying the circuit and testing one or two voltages, which were found to be low (valves had been checked early on), the capacitor C56 (47pF) between the two anodes of V13 was found to be s/c. Replacement cured the fault which, in symptoms, was rather unusual.—W.H.B., Tadcaster (589).

Philips 1468U: Complaint was dark picture and lack of width. There was ½ in. missing each side and when brightness was increased the effect was that of the e.h.t. rectifier going soft. The h.t. and boost lines were low, but no shorts could be traced. On disconnecting the line circuit from the h.t. line, however, the h.t. returned to normal. Tests eliminated everything except the scan coils. The trouble was the resistor and capacitor across half the frame coils—the resistor was slightly burnt and the capacitor s/c.—C.J., Fowey (578).

English Electric 1650: Trouble was flyback lines on picture when locked. Frame sync seemed normal and frame circuit was checked and found normal. The trouble was traced to the video amplifier where the screen grid decoupling capacitor C38B, 16µF, was o/c. This had decreased the gain of the amplifier and with it the amplitude of the sync pulses. It also introduced a certain amount of hum, producing a false frame lock.—J.Y., Bacup (574).

Vidor CN4213: The set worked perfectly for a considerable time, after which low sound and vision and reduced picture size would occur. As the h.t. line was normal it was assumed the trouble was in the heater chain circuit, and just as the meter was about to be connected to measure the c.r.t. heater voltage the fault cleared. The c.r.t. heater read 6·3V, but when later the fault reappeared it dropped to 4V, as it did on other valves. The trouble was traced to an intermittent CZ1 thermistor.—D.R.E., Ashford (565).

Murphy V340D: The trouble was distortion on sound with self oscillation, which appeared if the volume control was advanced very slowly at certain settings. After valve and voltages tests revealed nothing, probing around the sound output valve revealed that the fault disappeared when the blue lead from the tone control to the output transformer was moved. The trouble was due to this lead running close to the grid pin of V10A and repositioning cured the fault.—C.P., Barnet (543).

● odd spot

Excessive crackling was the trouble with this Pye battery portable. After fitting new valves, shorting grids to chassis, decoupling anodes via an 0·5µF capacitor, removing the DK96 and DF96 valves, the crackle was found to be present at the anode of the DAF96 with its control grid shorted to chassis.

The coupling capacitor between the DAF96 and DL96 was disconnected and monitored with an oscilloscope. The crackle was present at this point with only the DAF96 in circuit; what is more, it was also present with the h.t. battery disconnected.

Checking the l.t. battery plug, it showed a resistance of 1·5kΩ and a tongue test showed that it had been resoldered by the customer using Baker's Fluid. — W.H.S., London (579).

Queer Customers

THIS one really happened, believe it or not. One day an old gentleman arrived at our workshop with a mains radio and complained of crackling and background noise.

We checked the set and found it was a little noisy but on connecting an earth lead it worked very much better. On questioning our customer as to whether he had an efficient aerial and earth, he assured us that he had a proper outside aerial and a connection to earth.

A few days later we arrived at his home to hear the set in its usual conditions and found he certainly did have an earth connection—to a jam jar filled with earth under the table.—D.McL., Lochgilphead (639).

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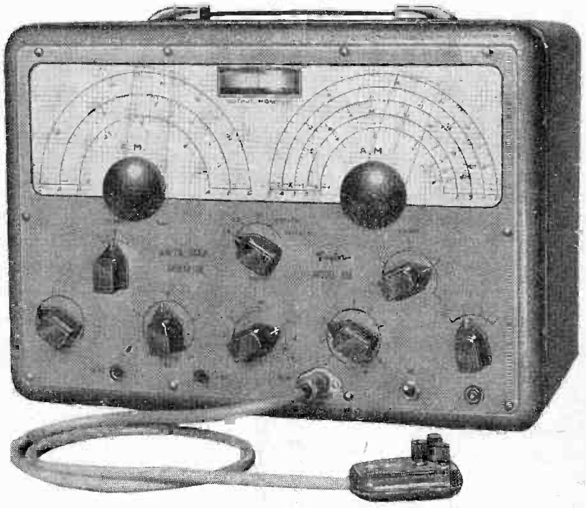

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No. 11

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.

ONE of the jobs that the beginner is reluctant to tackle is servicing the turret. The general impression gained, from talking to and hearing from apprentices, is that the front end of the set is a forbidden area, wherein it is unsafe to venture.

But if a little logic is applied, and the usual care taken, turrets and incremental tuners can be tackled with confidence.

The first thing to remember is that the tuner is handling a band of the highest frequencies in the set. Therefore, the effect of capacitance and inductance is of more importance than elsewhere. At 40 to 100 Mc/s the positioning of components and wires plays a vital part in the tuning process. Alter them, and the tuning will be upset.

Do Not Disturb

When replacing any component in the tuner unit, always restore the wiring to its original layout. Better still, disturb it as little as possible.

The majority of faults experienced in tuner units are, oddly enough, very simple ones. They can have some misleading and disturbing symptoms, however, so extra care is needed with diagnosis.

For example, in a case of "No Sound or Vision", check that an intermediate frequency signal is actually reaching the input to the common i.f. amplifier.

A quick disturbance test with the blade of a screwdriver at the take-off point will usually verify the i.f. strips. Some indication of "life" should be obtained, such as an interference pulse on both vision and sound. The raster may show little sign with some video circuits, but a healthy click via the sound circuits is usually a pretty broad hint that the fault lies previous to this stage, i.e., in the turret.

Valve Changing

Valve replacement will be the first step in turret trouble-shooting. This is obvious, but a few words may be necessary before we dismiss the subject.

When replacing the frequency changer, do not always assume that sound and vision will be obtained immediately. The previous valve may have been deteriorating for some time. To compensate for this lack, the oscillator may have been retuned by a previous serviceman. When the valve is replaced, the changed conditions will throw the tuning point beyond the range of the fine tuning control.

If the turret contains a number of coils—as it normally does—a clue can be obtained by switching to adjacent channels. The vision carrier should be heard as a buzz at some tuning point, and there will probably be some hint of modulation if all is in order. *Then—and only then—go ahead and retune the preset oscillator inductance.*

When replacing the double-triode cascode r.f. amplifier, always check the type and replace with an exactly similar valve, or direct equivalent. More and more modern sets are using the frame-grid valves in this position, and the new type, such as the PCC89, is not a direct replacement for the old, such as PCC84.

If the sound and vision are still absent, check the next suspect, the oscillator h.t. feed resistor. This component is usually 6·8–10kΩ and will be at least 1 watt, usually non-inductive. If the frequency-changer goes unstable, for any reason, it is often this resistor that suffers.

Oscillator

It is worth remembering that the oscillator, when operating correctly, draws from 10 to 15mA. Measuring the grid voltage with a valve-voltmeter would show a negative bias due to the self-biassing action of the oscillator.

If this bias is removed, and the valve ceases to oscillate, there is possibility of sudden heavy current which could damage the load resistor.

The voltage at the anode under normal conditions should be between 70–100V. Oscillation will cease when this reading is taken—do not prolong it unduly.

When in doubt about its efficiency, switch off and measure the resistance of the load component. Any tendency to "highness" should make it suspect. When replacing, use an exact replacement if possible.

A much more troublesome tuner symptom is intermittent loss of gain. This may take the form of fading or flashing, and can often be aggravated by vibration. There are several possible causes. Dirty valve pins are the first possibility. After cleaning the pins, insert the valves several times, using the pins to clean the socket contacts. Inspect the sockets for a splayed inlet. Wipe surplus dirt from the top of the socket insulator.

Coil Biscuit

Next, and probably most frequent cause of losses, is the coil biscuit itself. The contacts are silver plated studs that make against springs. They gather dirt and soon get "coked-up". Clean the biscuits with a soft, dry cloth. Do not use any switch-cleaner.

Remember to clean not only the coil biscuits that are in use, but also the others in unused positions on the rotor. These, too, may have their film of dirt, which can transfer to the active coils via the spring contacts.

The same cleaning procedure applies to the springs. Avoid undue pressure here; if necessary, gently aligning them with the thin blade of a knitting needle inserted between the rear of each spring and the gap in which it seats.

Check the mechanical action. The centre flange of the rotor of many turrets will be seen to have a perimeter consisting of a number of arcs. Into these a roller should seat, firmly, under spring pressure, at each switch position.

Occasionally, the fixing screw works loose, or the pin holding the roller works out of the fork. This causes a slight extra tolerance for the channel switch, leading to erratic tuning.

Fine Tuner Rotor

Another mechanical point is the fine tuner eccentric rotor. This is often made of paxolin, or similar composition, and rotates between the stud of the oscillator tuning point and the earthed plate which forms its other pole.

Clean the paxolin and the plate, ensure that the fixing bolts are tight, that the main body of the tuner unit is also adequately earthed, and that the rotor cam is not loose on its shaft—another common "tricky one".

The cam is sometimes loosened by ham-fisted rotation, being brought up against its stops too hard. If this has happened, dismantle the shaft and cam complete, hold the shaft in a vice with the cam resting on the top of the jaws, and lightly lock it to the shaft by means of a centre-punch and hammer at about three points, turning the brass of the shaft slightly to grip the paxolin.

Occasionally it may be found that the lead-off wire to the stud of the fine tuner has worked loose. It is worth trying to resolder, but because of the large mass a good deal of heat may be needed. This repair is seldom successful. *The complete tuner should be returned to the manufacturer.*

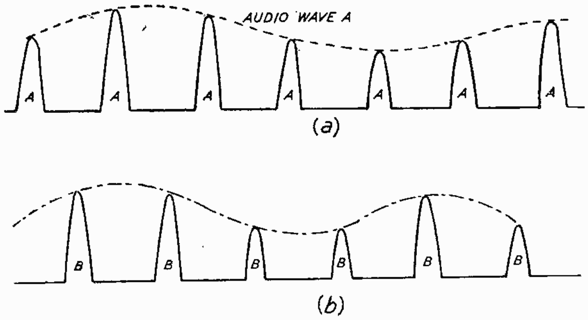
Finally, check the spring that bears on the fine tuner cam, see that it is

(Continued on page 167)

MULLARD STEREO

Engineers and authorities in several countries have for some time been investigating the practicability of providing stereophonic radio transmissions and various methods are at present under review by different bodies. The European Broadcasting Union, meeting in Cannes recently, considered a number of proposals.

This is a description of a new system using the time multiplexing technique similar to that used in some point-to-point communications systems. It is a compatible system and was developed by G. D. Browne of Mullard Research Laboratories.



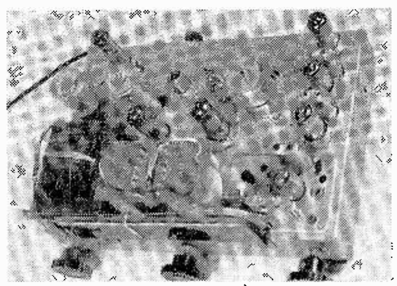
THE Mullard system stereophonic broadcasting is a twin-channel application of the principles of pulse amplitude time multiplexing under conditions in which the bandwidth, after multiplexing but before modulation of the transmitter, is restricted to a logical minimum.

The system is essentially symmetrical in character as regards its treatment of the A and B stereo signals, and permits simplicity and economy in receiver design and construction. It would require only minor modifications to normal f.m. transmitting equipment. The r.f. channel bandwidth may be identical with that used for normal f.m. broadcasting.

The Transmitter

The A and B stereo signals are fed to an encoder whose output (the complex signal) passes, in place of the normal mono signal, to the transmitter frequency-modulation equipment. The remainder of the transmitter is conventional.

A sampling generator operating at the multiplexing frequency produces two sinusoids in anti-phase. These are fed into two mixing or multiplying devices to which are also applied the two stereo signals suitably pre-emphasised. The sampling sinusoids are half-wave rectified by the circuits to produce two-time interlaced pulse trains, one amplitude modulated by A, the other by B. The resultant output waveforms from the encoding mixers are shown in Fig. 2a and b. Although for clarity, pulses with an angle of flow of about 90 degrees are shown,



An experimental receiver, on which designs for domestic sets could be based, as used in the recent practical demonstration of the new Mullard stereo broadcasting system.

half-wave rectified pulses (i.e., an angle of flow of 180 degrees) produce the best results for optimum system performance.

Adding these outputs gives the complex signal of Fig 2c, which alone does not contain any information to resolve the A, B ambiguity in a subsequent receiver. To provide correct synchronisation a small amplitude component at the sampling or multiplexing frequency in phase quadrature with both sampling pulse trains is introduced to give the asymmetry shown in Fig. 4d.

The rounded shape of the pulses is due to the bandwidth limitation effect, produced by passing the complex signal through a low pass filter, just before entry into the frequency modulator of the transmitter. Thereafter a normal transmitter is used.

The Receiver

The receiver is conventional up to the output circuit of the frequency discriminator, which is maintained at adequate bandwidth to recover the complex signal. The negative sync pulses are separated and are used to phase lock an oscillator at the multiplexing frequency. The oscillator output is rephased by ± 90 degrees to obtain the correct in-phase, anti-phase relationship for operating the decoding mixers.

These are thereby synchronised with the encoding mixers in the transmitter and thus reproduce the A and B signal respectively. After de-emphasis these signals are directed into the output amplifiers.

When the stereo receiver is receiving a mono transmission, no sync pulses are available and the mono signal appears in both audio output circuits, irrespective of whether the sync oscillator free runs or stops under these conditions.

Frequency Spectrum

Owing to bandwidth limitations due to radio frequency channel allocations and to presently adopted techniques in typical standard receivers, it has been necessary to confirm that the proposed system can be operated within these restrictions.

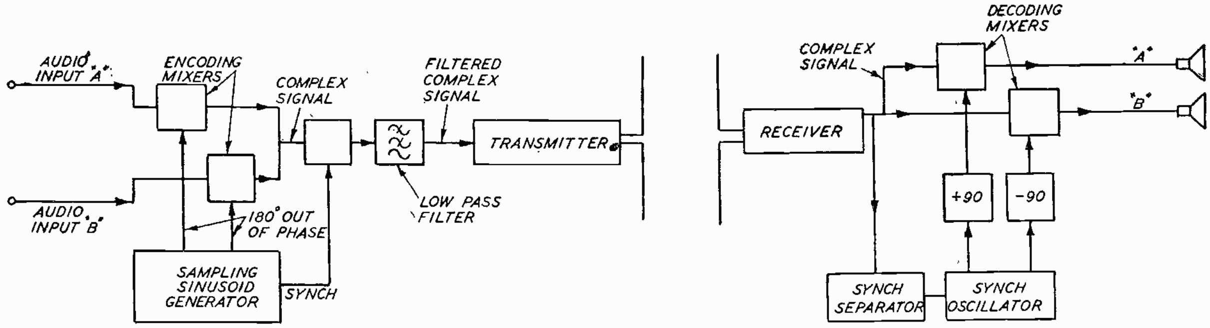


Fig. 1: Block schematic diagrams of the time multiplex system. On the left, the transmitter arrangement. On the right, the receiver arrangement.

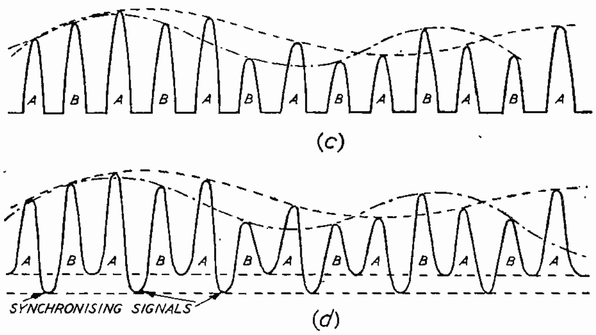


Fig. 2: Basic waveforms of the system. (a) Sampled audio wave A, (b) sampled audio wave B, (c) complex signal waveform obtained as a result of adding the two sampled audio waves A and B, (d) filtered complex signal waveform with synchronisation pulses.

The filtered complex wave fed to the frequency modulator has a frequency spectrum consisting of A+B at audio frequency, A–B DSB a.m. on a suppressed subcarrier at the sampling frequency, and A+B DSB a.m. on a subcarrier at the second harmonic of the sampling frequency (see Fig. 3). Audio bandwidth is usually 15 kc/s and the sampling frequency 32·5 kc/s. The bandwidth of the spectrum shown therefore is 80 kc/s.

This is acceptable in f.m. transmitters without exceeding the r.f. bandwidths normally used in, say, Band II. By retaining a complex signal bandwidth of 80 kc/s, ease of receiver synchronisation is achieved without either radiating a special high power sync signal or complicating the receiver by the inclusion of high quality sync filters.

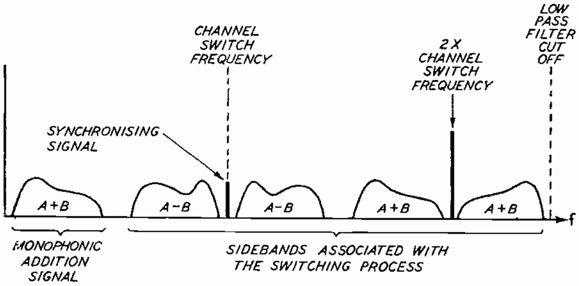


Fig. 3 (left): Spectral content in the complex signal.

Fig. 4 (below): The sync separator and decoder circuit as used in the receiver. Conventional parts of the circuit are shown in dotted line.

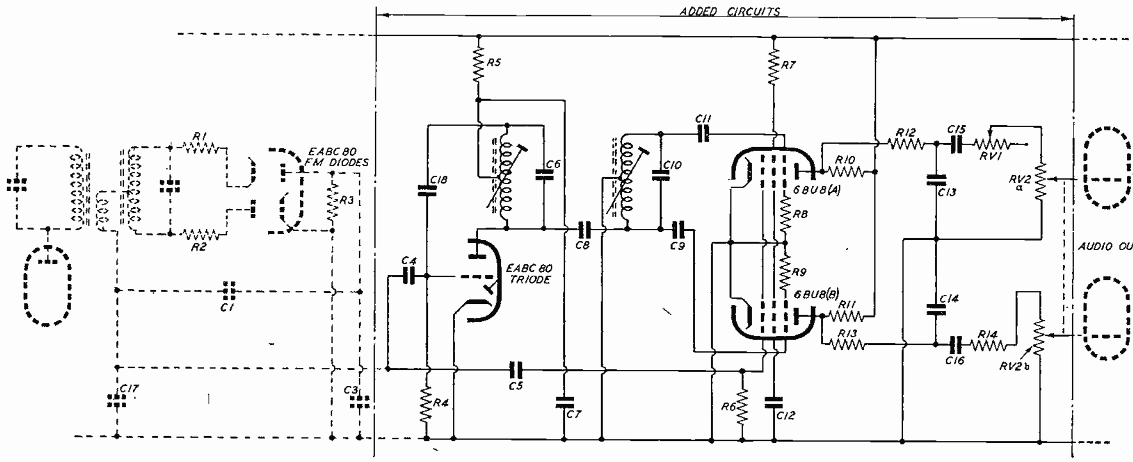
Performance

This may be summarised as follows:

Since the system basically provides two equal, linear, symmetrical and independent signal paths it is capable of transmitting two-signal stereophony or bilingual or other two-signal broadcasts. Most modern f.m. sets would provide adequate bandwidths for all the necessary components of the transmitted signal to be collected and recovered for decoding without distortion.

The listener with a mono receiver would continue to hear an acceptable mono signal when receiving a stereo transmission. The sound level may change a few dB when the transmitter is switched from mono to stereo but this may be obviated if desired by restricting the transmitter deviation on mono. When a mono signal is being transmitted, the listener with a stereo receiver would hear a mono signal from both audio outputs.

The theoretical limit of crosstalk of the A input into the B output, and vice versa, for halfwave rectified encoding and decoding pulses, is —45dB. This is well below the maximum permissible for stereo broadcasting and will also be acceptable for many bilingual and other two-signal transmissions, as was effectively shown at the recent demonstration of the system to the press.



AT THE BENCH—*continued*

neither binding tightly nor so slack that the cam rubs the plate. It is assumed that the two springs that bear on the main rotor shaft will have been visually inspected at an earlier stage.

They are worth mentioning for on some tuners they are the means of indirectly earthing the main rotor assembly. Although this has no electrical contact, dirt at these moving surfaces can cause sporadic flashes when the chassis is vibrated.

A drop of switch-cleaner at these points, followed by light oil lubrication, will not come amiss. But beware of cleaning fluids or oil on either contacts or fine tuner cam.

There are various designs of tuner unit that have constructional differences. In the main, however, the above points apply to all switched turret types. Those with such features as radial coils, peripheral tuning and so on are basically similar, and require the same treatment.

Incremental tuners are a different problem, but the mechanical points are much the same. Check and clean switch contacts; do not disturb wiring or coil settings. And, if it is necessary to tune, always tune the highest frequency coils first.

Other settings will usually fall into place from this tuning point. If in any doubt, check with the maker's instructions.

SERVICE WITH A GRIN by H. W. HELLYER

Lightly Turning

"IN the spring a Young Man's fancy . . ." but you know the rest. It is one of those universal quotations that means everything or nothing, according to your situation. And, for our purpose, it could be aptly paraphrased " . . . a serviceman's fancy . . ."

"Get your skates on"!

There is something about April that does things to us all. It makes the apprentices skip like lambs and the outside engineers like little sheep.

The hint of green makes Young Men of us all—even your scribe, whom recent correspondents (see *Letters to the Editor*, January and February) have designated a has-been.

I hasten to assure them that I am still active, still tootling around from house to house, enjoying the ever-fresh experience of meeting people, and managing to repair a few of the sets between times. Yes, even those with more complexities than in the "good old cycle-shop days."

Generally, radio service is a young man's trade. Somewhere between the Scylla of the 11-plus and the Charybdis of the School-leaving Certificate, the radio reef looms up. The young mariner founders: from the shallows of experiments with bells and batteries he is plunged into the colder depths of electron theory.

It is at this stage that the imagination is caught, I think. Either one must *see* a thing working and be satisfied, or one must delve further.

If the youngster is fortunate enough to gain a trade apprenticeship he can be sure of an interesting future. Life as a serviceman—in or out—is never dull.

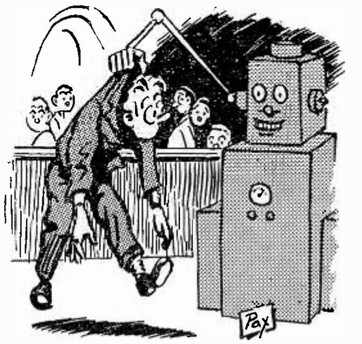
Of the older men among us, some graduated from the armed forces. Bitten by the radio bug, sometimes merely because to take a radio course was an easy way of escaping spud-bashing, they donned their bowlers and plunged into the whirlpools of commercial service.

A few weeks of this and it was soon apparent which entrants were with us to stay. The "easy job" can be deuced difficult when one is required to be diplomat, demonstrator and do-it-yourself exponent as well as a technical genius.

It makes the apprentices skip like lambs.

And then there is the hardened core of elderly faithfuls; the Mr. Chips' who have followed radio from its crystal set days to the present—er—crystal set days. Do not be misled, Messrs. Williams and Weatherhead, by the outward and visible signs—the wrinkles on our foreheads that make us look as if we'd slept in our worries all night. Inwardly and spiritually we have had a lot of fun.

And we are not in the least dismayed by the prospect of growing complexity.



The auto-sec selects the most suitable man.

Let me illustrate why by a little leap forward (after all, it is the right year).

It would be about the turn of the century, had the Augustan calendar been retained. In the chrome and porcelain emporium of Bodgit's Radio Co., the automatic secretary has recorded a complaint. Indelibly filed on tape-film is the information, (extracted from the welter of Mrs. Whatsit's words by an ingenious device called a "Summariser") that the *Superama*, stereoscopic, stereophonic, home-kine, colour smellafeelavision refuses to function.

Silently, invisibly, the service machinery comes into play. From the index of available engineers the auto-sec selects the most suitable man. He has just returned from an intensive manufacturer's course on the *Superama*. He has even passed the "conditioning test" and believes the maker's advertisements about it. He is signalled.

Up from the subterranean vaults of the workshop comes our old friend, Joe Van Winkle. The service manager gives him a copy of the complaint card, allots him three apprentices to carry the appropriate test gear, tells him: "*Get your skates on*."*

Arriving at Mrs. Whatsit's address, they are whisked up the forty-five floors in the external elevator.

At the entrance Joe presents his credentials to the selector-eye, the psuedo-bronze door vaporises and they slip off their skates and enter.

The *Superama* screen covers the greater arc of the elliptical walls. The boys deploy and commence to assemble their equipment.

Boy One: "*Power input radiation indicated.*"

Boy Two: "*Source A, B, C and C-plus in order.*"

Boy Three: "*Back-radiation nil—no, wait a micro-sec, I've got a reading!*"

Boy One, disgustedly: "*Of course you have. That's decremental residue.*"

Joe: "*Good lad. Yes, that indicates that the set was functioning up to last night, when the solar batteries reversed. Right, son, switch on.*"

Boy Two seeks, finds and twists one of the knobs on the firescreen and reports: "*No joy. That means the trouble must lie between the input source and the split feeds to chassis, doesn't it?*"

Boy Three: "*I'll hook up the spot-check analyser—*".

Joe: "*Whoa, let's have a look first.*" He inspects the control knob, finds it is, as he suspected, one of the old-fashioned type, withdraws his trusty grub-screw driver and tightens the knob on its spindle. "*Now try again.*"

As they whisk to street level in the elevator, he catches a whispered remark from Boy One: "*. . . these old-timers . . . hit-or-miss. We could have found that by diagnosis and analysis.*"

Have I made my point, or are you going to stamp on my grey hairs again? Ah well, April is the cruellest month.

* *This is not an anachronism. In 1965, when the plans for the motorway network were scrapped because of defence committments, the situation on the roads became such that cars larger than ten horse-power had to be banned by law.*

The process was cumulative, and now transport had become divided between the fast freight on segregated routes and the perpetual Pink Zone of pedestrian traffic within all city confines. Movement between blocks was effected by the use of motorised skates, but skaters were forbidden on the slow-moving belts of the sidewalks.

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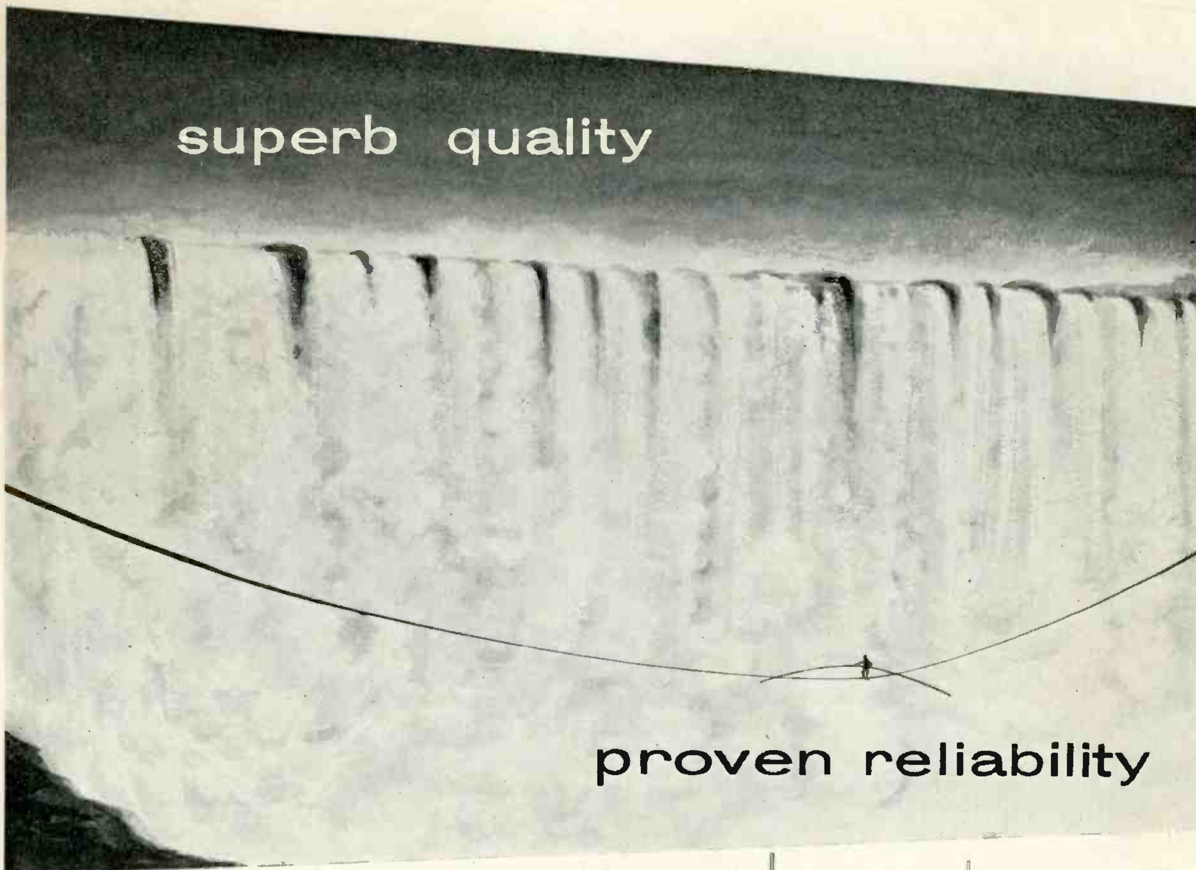

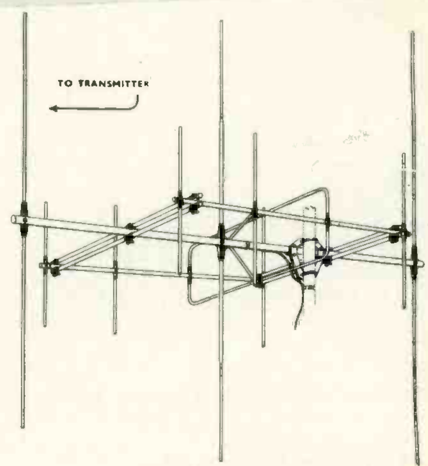

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