‘Technical Shorts’

by Gerry O’Hara, G8GUH

‘Technical Shorts’ is a series of (fairly) short articles prepared for the Eddystone User Group (EUG) website, each focussing on a technical issue of relevance in repairing, restoring or using Eddystone valve radios. However, much of the content is also applicable to non-Eddystone valve receivers. The articles are the author’s personal opinion, based on his experience and are meant to be of interest or help to the novice or hobbyist – they are not meant to be a definitive or exhaustive treatise on the topic under discussion…. References are provided for those wishing to explore the subjects discussed in more depth. The author encourages feedback and discussion on any topic covered through the EUG forum.

AC/DC Set Lore

Introduction

Why on earth would a company with Eddystone’s philosophy on manufacturing premium-quality sets produce several lines of AC/DC sets for over two decades? - this type of set usually being considered to be the bottom rung of the radio quality ladder. This is a good question – and one asked by many (check out comments on the Gerard’s Radio Corner website http://www.cs.uu.nl/~gerard/RadioCorner/Sets/Eddy670.htm). Well, the answer lies in Eddystone spotting an opening in the market that was theirs to fill back in the late forties and well into the sixties - namely the marine receiver market. To quote Graeme Wormald in the EUG Quick Reference Guide (QRG) *“Stratton’s north-eastern agent, Alf Willings of West Hartlepool had suggested that such a market existed. Most ships’ power supplies were 110v DC and the only sets available for such* [supply] *voltages were American midgets. These had no hash filter nor did they have short-waves or arrangements for a low-interference aerial. There would be a market for a decent general coverage receiver, he said, and there was.”* The first set of this type bearing the Eddystone marque, targeted at ship’s officers and first class passengers as ‘cabin sets’, was the Eddystone S.670 in 1948 sporting 7 miniature B8A valves and a selenium rectifier. This model had a ‘half moon’ dial (photo, right), as fitted to the S.740, and was superseded by the S.670A with a ‘slide rule’ dial in 1954 and then by the S.670C in the ‘MkII style’ case in 1962 through 1964, all with basically the same circuit. Again to quote the QRG *“The whole 670-series was eminent over a twenty-year period and was probably the most*

successful 'universal' AC/DC 110-250v general coverage broadcast receiver", but goes on to say *"It is, however probably responsible for getting the marque a poor name among those who believed these were the only sets the company built!"* but then tempered by noting *"But they were just as well constructed as the professional models costing three or four times the price and looking very similar."* More models were added as the years progressed, including the S.840 series 'economy communications receiver' – its specification reportedly being suggested by Stratton's agent in the British Dependency of Aden on the Persian Gulf as an 'upgrade' to the S.670 series cabin sets (QRG), this time aimed at the short wave listener. The S.840 series was a successful set that ran for some 15 years from 1953 (the S.840 with 'half moon' dial), through the S.840A in 1954 ('slide rule' dial) and the S.840C in 1962 through 1968 in the MkII style case (photo, above right). Again, almost the same circuit was used in each of these models. A special version was also manufactured for the Swedish Merchant Marine, the S.909 series, and also several models were re-badged as MIMCO (Marconi Marine), eg. Model 3873A. Yet another variation was the 'miniature' S.870 AC/DC model series, introduced in 1956, marketed for ocean liner passenger cabins and, apparently, a 'cult' domestic market (QRG) and were manufactured until 1966 (S.870A, photo, left) – these were really 'cute' little receivers and were actually smaller than the first 'miniature' transistorized sets of the 1960's (EC10, EB35 etc).

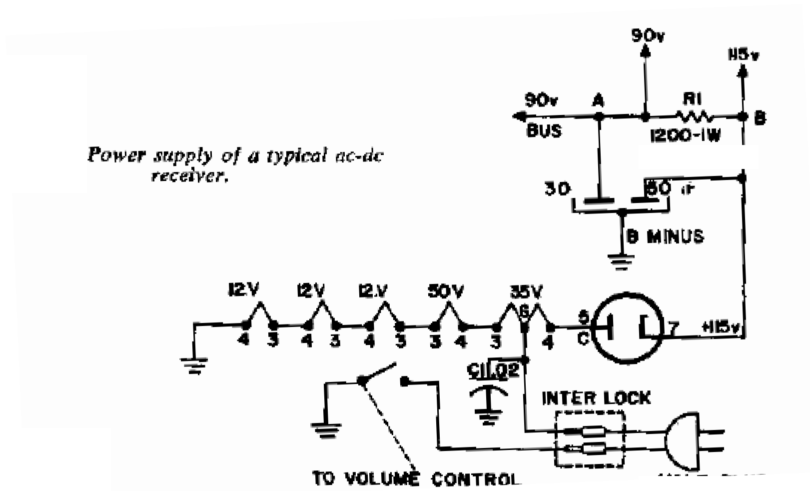
Well, so much for a potted history of the Eddystone AC/DC line, but what made this type of set 'tick' and how come they were able to work on AC or DC over a wide range of voltages and yet were cheaper to produce than AC only sets?

The Condensed History of the AC/DC Set Design

The power supply circuit (or lack of it) is really the 'heart' or 'secret' of the AC/DC set: most of the remaining circuit elements are the same, or very similar, to those found in standard AC-only sets. The other main difference, especially in metal-cased AC/DC sets produced in the UK, such as the Eddystone ranges, were that the chassis was electrically isolated from the metal outer case for safety reasons: unlike my US-made National Model NC-46 (photo, right), dating from the mid-1940's, which was built without this 'luxury' as that set was intended specifically for the US market with the 110v mains supply having the 'neutral' line grounded and connected directly to the metal chassis/case.

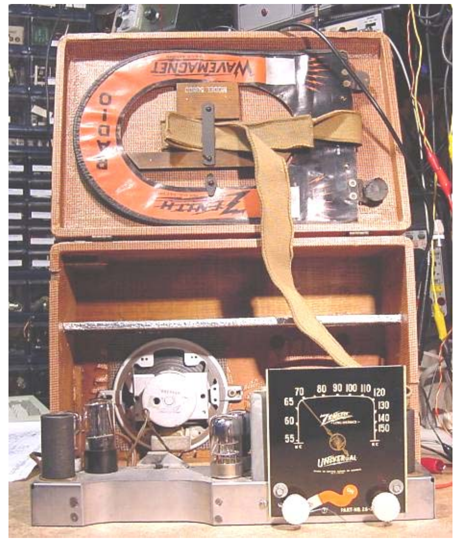
The drivers for the development of AC/DC set were:

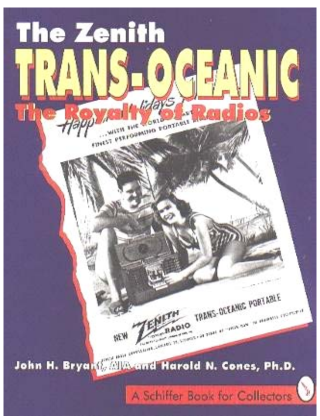
- Cost: the mains transformer was probably the most expensive single component in a radio set;
- Weight: the quest for portability (around the house or between houses) meant that the weight of the mains transformer was undesirable – two to four pounds of 'excess baggage';
- Size: the mains transformer is a bulky item; and
- Availability (or not) of AC mains: many US cities had DC power supplies. Also, many ships had DC supplies.



Power supply of a typical ac-dc receiver.

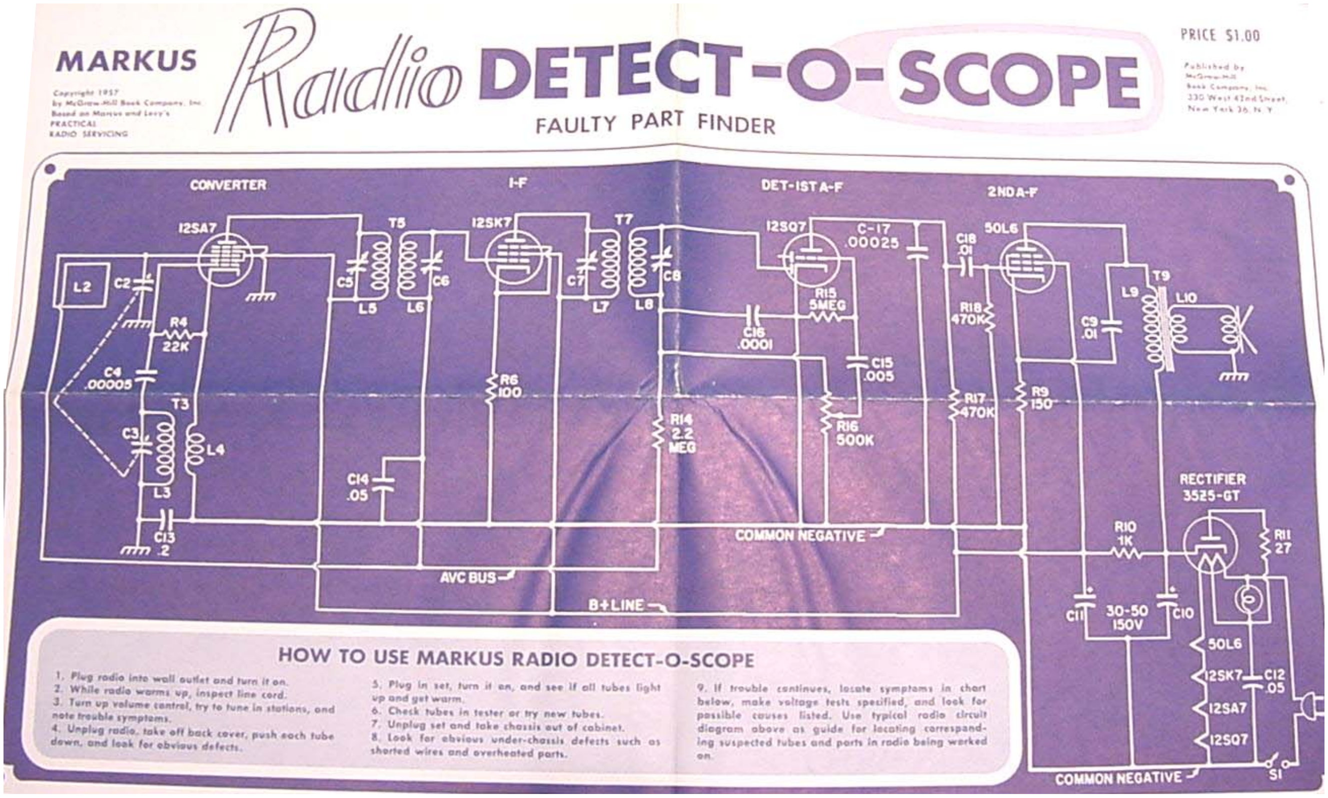
So, to resolve all the above in a single stroke, why not dispense with the mains transformer? – this would allow the 110v (or 240v) mains to be applied to a half-wave rectifier that would provide a suitable DC output for the HT supply with either AC or DC applied to the set, albeit rather on the low voltage side (eg. about 90v or so for a 110v AC supply) compared with 250v to 300v or so for a typical AC-only HT supply. Not too much of a problem, providing valves with suitable characteristics were used and bias supplies designed accordingly. Ok, so the HT is taken care of, but what about the valve heater supplies? – well, why not string 'em together in series (or series-parallel) just like a set of Christmas tree lights? In theory this works, but in practice it not too easy with the low-voltage heaters as used in many pre-WWII valves (eg. 2v or 6v), unless you wanted to use 18 or more (!), or connect a large-wattage wirewound resistor, an iron-wire 'ballast' resistor or even a resistance wire in the power cord, to dissipate the excess volts (and heat). To mitigate this complexity and inconvenience, higher-voltage heater valves were developed in the mid-1930's, including the 12v types such as the 12AS7 pentagrid mixer, 12SK7 pentode RF/IF amplifier, 12SQ7 detector/AGC/1st audio, along with higher voltage still output and rectifier filament types (eg. 50v and 35v) such as the 50L6 output pentode and 35Z5 rectifier (12v+12v+12v+35v+50v = 121v), often with the dial lamp included (4v or so) to give a 125v drop across the entire heater string at the desired filament current, ie. generally ok for operation at 110v to 120v. The higher voltage heaters were assigned to the output stage and rectifier valves as, with the current through the heater string being the same through each heater (ranging from 50mA to 300mA, depending on the valve types used), unless shunt resistors were used, more energy was needed in these two 'power-hungry' valves compared with the small-signal stages: this was the typical 'All-American-Five' valve (er, 'tube') line-up. Where valves with different heater current requirements had to be utilized, manufacturers paralleled some valve heaters and/or shunted them with resistors (eg. the DM70 tuning indicator in the Eddystone S.840C). Later, in the quest to reduce power consumption further for battery operation, a series of nominal 1v (eg. 1R5) and 3v (eg. 3Q5) heater valves were produced and used in portable or 'universal' AC/DC/Battery sets such as the famous Zenith 'Transoceanic' series in the US (these extremely popular sets have many variations and even have their own dedicated web sites, eg. http://www.transoceanic.nostalgiaair.org/ or sections of websites, eg. http://www.antiqueradio.org/transoceanics.htm). The circuits of these Zenith sets changed somewhat over the years, but the earlier models used a 117v heater rectifier valve, separate from the main valve heater chain, that was disconnected from the circuit when on battery power, leaving only the string of low voltage valve heaters to be powered from a low voltage battery and the HT supply from a 67.5v battery. This series started with the 'Clipper' (Model 7G605) in 1942 and lasted into the 1960's (I have an early-model Zenith universal set from 1941 - a 5G500 - that was the forerunner of the Transoceanic sets: it is broadcast band (MW) only, but uses a similar valve line-up, power supply and case style (see photo, above, with its chassis out of the case) – it actually works very well. More sophisticated sets utilized a negative temperature coefficient thermistor to reduce the current surge through the heater chain at switch-on and/or provide some degree of voltage stabilization; others relied on the dial lamp to provide surge protection.





Typical AC/DC Set Stages

As alluded to above, the 'epitome' of AC/DC receiver design was the ubiquitous 'All-American-Five' sets manufactured from the late thirties through the sixties: these were 'cheap and cheerful' sets that all used almost the same basic circuit no matter which manufacturer made them, comprising a mixer-oscillator, a single IF amplifier stage, combined detector/AGC/first audio stage, an output stage and half-wave rectifier (five valves, hence the generic name). The circuit shown on the 'Detect-o-Scope' poster (see photo, below) is a typical design of such a receiver: a total of only around 40 electronic components!

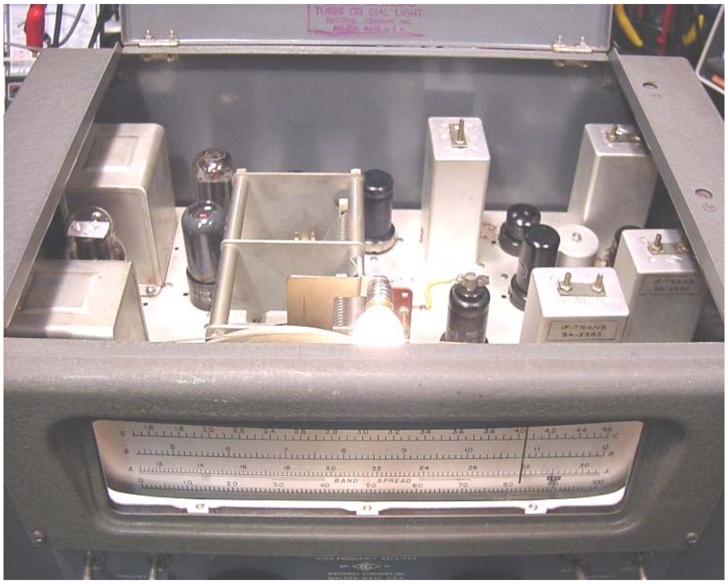


This type of set essentially comprised:

- A mixer/oscillator: typically a pentagrid (eg. 12SA7) fed by a loop aerial as part of the input (and the only) RF tuned circuit. The anode of this stage being fed into the primary of the first IF transformer, the secondary of which formed the grid circuit of;
- A single IF stage, usually operating at around 465kHz, the anode of this stage was fed into the primary of the second IF transformer, the secondary of which fed the;
- Diode detector within a combined detector/AGC/1st audio stage, typically a duo-diode-triode, the detector diode feeding;
- A 1st audio stage via the volume control, the anode of which was capacitor-coupled to the;
- Output stage, usually a pentode, the anode feeding into the primary of the output transformer, all this being fed power from;
- A half-wave rectifier with capacitor/resistor filter.

AGC was developed from the detected signal and usually applied to the mixer and IF stages. In order to provide the maximum possible flexibility of input voltage options, some manufacturers, eg. Eddystone, included a switch and a multiple-tap high-wattage mains dropper/ballast resistor to allow 200v or 240v to be applied to the set.

More sophisticated AC/DC sets were manufactured: some of the Eddystone models noted in the introduction to this article came in this category, with the 8-valve S.840 series being the most complex in the line-up, sporting an RF stage, triode-hexode mixer/oscillator, BFO and a tuning indicator. The S.670A and S.840 series RF, IF and



My National NC-46: an AC/DC 'boatanchor' communications receiver (sort of)

AF circuits were almost identical to those in the AC-only S.740 model, except for the BFO design (not present in the S.670A) and the inclusion (or not) of a 'magic-eye' tuning indicator. The 10-valve National Model NC-46 I own (photo, left) was probably about as sophisticated as this form of set became, with features such as bandspread tuning, two IF amplifier stages with manual gain control, a BFO, amplified AGC, noise limiter, tone control, and, incredibly, a push-pull output stage.

Fault-Finding and Repairing AC/DC Sets

The most important thing to consider when working on AC/DC sets is that when they are operating, their circuits are connected directly across the mains supply and this practice has an inherently higher electrical shock hazard associated with it than in a 'conventional' transformer-isolated supply – particularly when the set's case is removed and the metal chassis is exposed. The use of an isolation transformer is therefore recommended during servicing operations – both as an increased safety measure and to avoid grounding problems when mains-powered test equipment is being connected to the set (eg. VTVM, signal genny etc). Also, it should be remembered that the biasing circuits in some of these sets result in the chassis floating several volts negative of electrical ground – although this is not a safety concern, this can be confusing when measuring circuit voltages or when replacing polarized (electrolytic) capacitors: study the circuit diagram very carefully before starting (I have 'popped' at least one electrolytic in the past by not taking account of this). Also, in many US sets, the on-off switch is usually in the supply 'neutral' to chassis connection.

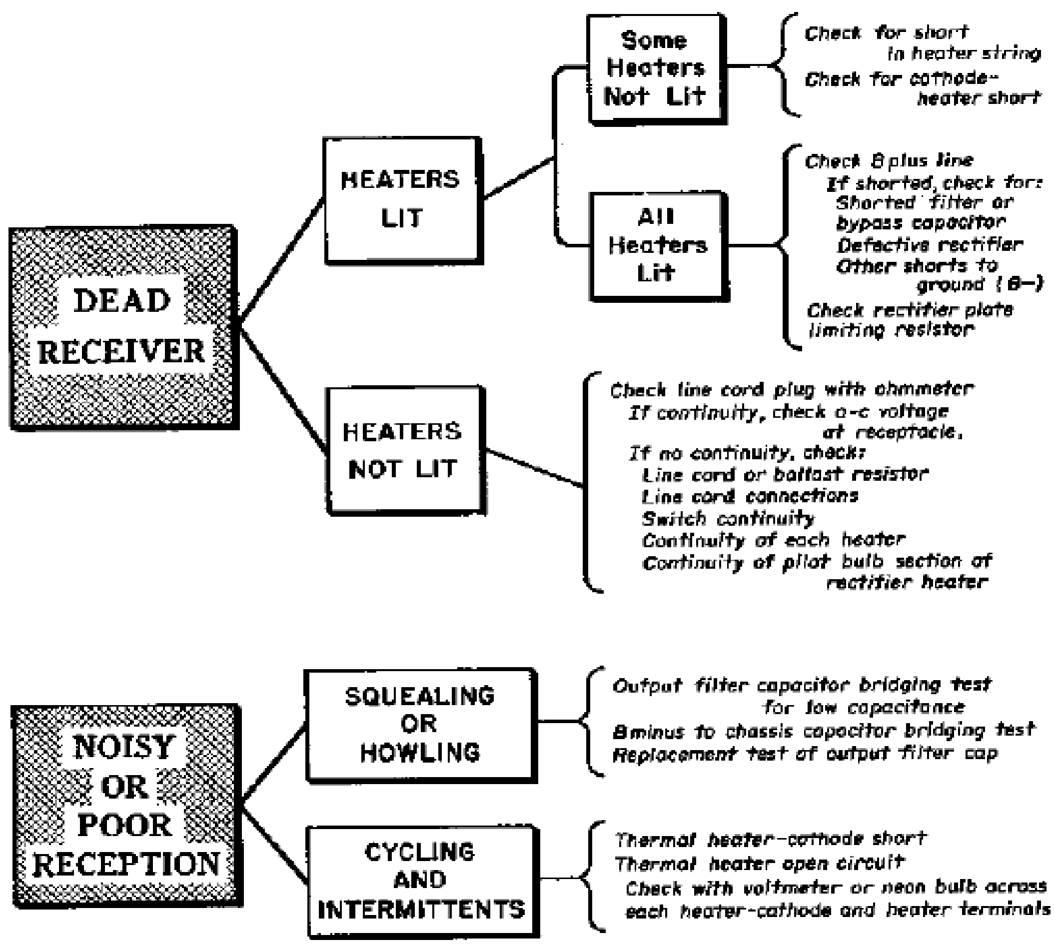
General receiver RF, IF and AF stage fault-finding and alignment procedures for AC/DC sets are virtually identical to those for AC-only sets. As such procedures are dealt with in other 'Tech Short' articles, they will not be repeated here, although reference may be made to the 'Detect-o-Scope' poster and 'Procedures' tables attached to this article. So what are the main differences in servicing AC/DC sets compared with AC-only ones? – the power supply of course, though to be honest, there is not that much to go wrong, this being either:

- An open-circuit valve heater: with the heaters being in series, if one fails (breaks), all the valves stop working as no heater current flows – just like an old-fashioned

Christmas tree light circuit (except here there are only five or so valves and a dial lamp to check, not umpteen fiddly little bulbs when you are half-cut on Christmas 'cheer'). Heater failure tends to be a much more prevalent valve failure mode in AC/DC sets than in sets with a transformer, this likely attributable to:

- Switch-on current surge;
- Out of tolerance voltage across individual valve heaters due to current draw imbalance of other valve heaters and dropper resistors due to valve and other component ageing;
- More susceptibility to voltage spikes/surges in the mains supply

- A shorted or open-circuit filter capacitor(s) or metal/selenium rectifier;
- Burnt-out or out-of-tolerance dropper resistor, ballast resistor or thermistor; or
- A 'physical' problem, eg. a blown fuse, broken or faulty power cord, faulty on-off switch, dry joint, faulty valve socket, shorted or loose connections etc.

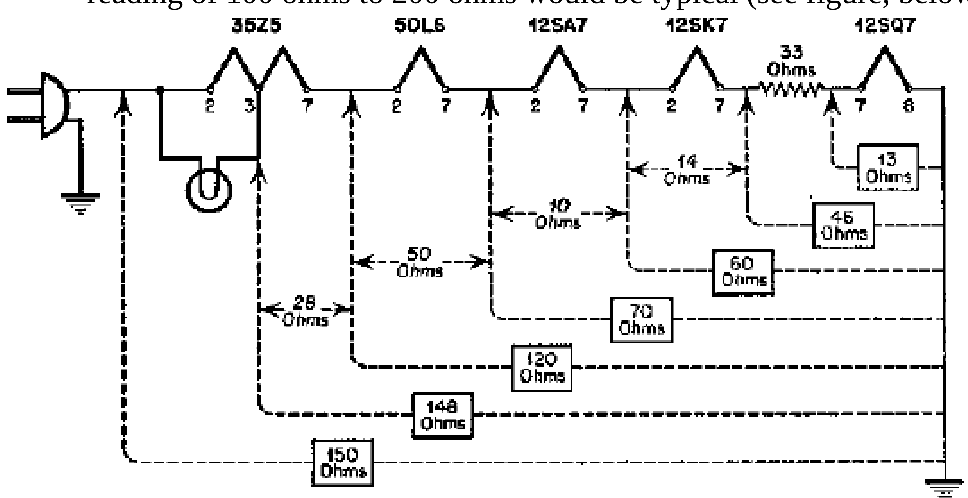


Servicing chart showing appropriate service checks particularly applying to a-c/d-c receivers, arranged according to the symptoms of the troubles involved.

The techniques for identifying the problem in the power supply circuit are fairly straightforward and logical, see summary diagram, above.

Here is my simplified procedure:

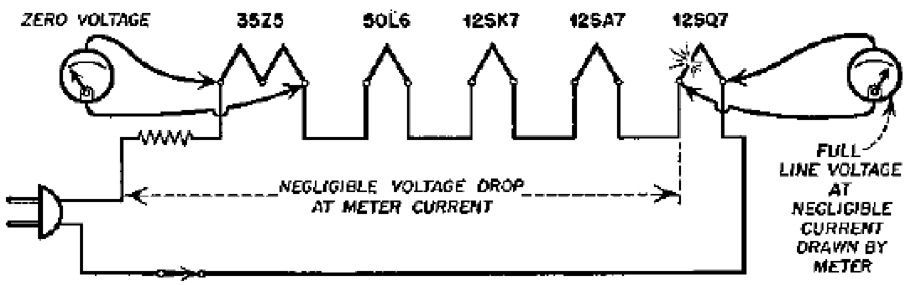
- A power supply fault is evidenced by one or more of the following:
  - The set produces no noise when switched on (after allowing time for the valves to heat up);
  - The valve heaters do not light up, the dial light does not glow and the valves do not get warm;
  - Some valve heaters glow (too) brightly and others are unlit;
  - No HT voltage can be measured on the smoothing capacitors;
  - The set 'motorboats' (produced 'put-put' sounds) or 'squeals', or
  - Produces a loud hum, either continuously or when a station is tuned in.
- If the set appears 'dead', first undertake some simple continuity and resistance checks with the set disconnected from the mains power:
  - Connect the ohmmeter (x1000 range) between the rectifier cathode and a common negative point (note: this may not be the chassis – check the circuit diagram) – the meter needle should first swing across to a low resistance and then rise to a reading of ~100kohm (or more) showing that the HT circuits and the power supply filter capacitors are probably ok. If a lower resistance reading is evident, then suspect a shorted filter or HT bypass capacitor – this must be corrected before proceeding with further checks, or replacing another component identified subsequently, eg. a rectifier, as failing to do so may result in the newly installed component(s) suffering the same fate as the original… an expensive and frustrating way of discovering the 'real' fault;
  - Connect an ohmmeter across the mains plug with the set switched off – the ohmmeter should read open circuit. Switch the set on – the resistance of the heater string and other resistive components in the set should now be measured by the ohmmeter (the resistance may change in value if the test meter leads are swapped over if a solid state rectifier is present) – a reading of 100 ohms to 200 ohms would be typical (see figure, below). A



Heater circuit of a typical popular a-c/d-c receiver design, showing the resistance values which would represent normal ohmmeter readings when the heaters are cold. By observations of these resistance values, and comparison with readings actually obtained, troubles in the heater circuit can be quickly located.

resistance of thousands of ohms to open circuit would indicate that a fault is present in the supply (in this case, first check any fuses, if fitted, the continuity of the power cord to the set and then the heater chain). A short would indicate a physical problem – eg. frayed insulation or shorted component leads. With the ohmmeter still connected, remove a valve and see if the measured resistance changes – if it does by a significant amount, then the chain of valve heaters is probably ok, and likewise, if it does not, there is likely a valve with an open circuit heater present (be cautious here though as this is not a definitive test: the presence of thermistors or internal valve electrode short may influence the response).

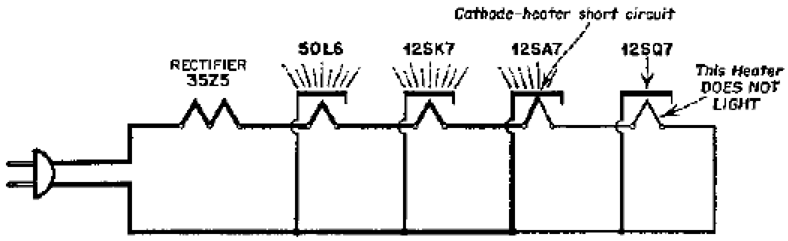
- If a defective valve heater is suspect, check for this further by (assuming an AC supply);
  - With the power applied and all valves installed, carefully connect an AC voltmeter across each valve heater in turn, taking care not to short



When the heater of a tube in a series a-c/d-c heater circuit opens up, the full line voltage appears across it, as shown here.

  anything out in the process: if there is an open circuit heater, the voltmeter will read a voltage when placed across it (figure, above); or
  - With the power removed, remove the valves and check each of the heaters using an ohmmeter, though be careful doing this on the low voltage (eg. 1v) valve heaters as these can be blown by the voltages in some multimeters, or, better still, use a valve tester.
  - If an open circuit heater is identified, replace that valve (but note the caution below first).
  - Sometimes a valve heater filament can be 'intermittent' – opening and closing as the filament heats and then cools (acting a bit like a bi-metal strip type 'flasher' on a string of old-fashioned Christmas tree lights) – this can be fast or slow: when slow, the radio can work for a few seconds or minutes and then cut out for a while and then re-start – the dial light often blinking on and off in the process. If this type of fault is present, the meter method noted above can be used to check which valve is acting up, alternatively a small neon panel indicator lamp can be connected across each heater in turn – the neon lamp will illuminate when it is connected across the valve with the intermittent heater filament as the filament opens.

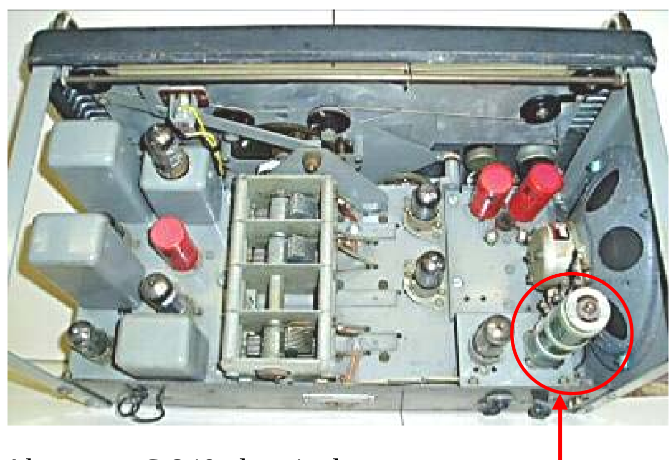
- Another symptom to watch for is one or more valve heaters glowing too brightly while others are unlit. This condition is indicative of a heater to cathode short in a valve (see figure, below).



How a cathode-heater short circuit can cause some heaters to go out while others glow overbrightly.

Of course, a valve heater may have failed for a reason other than old age or fatigue – it may have blown due to over-voltage, possibly a result of a defective series or parallel resistor, ballast resistor, thermistor, or even the dial light when included in the heater chain. Therefore check these components and remedy any defects before installing the new valve.

- Next, suspect the high wattage dropper/ballast resistors, especially if there are variable (sliding) taps present on them – these can become high-resistance or open circuit as these components endure a lot of heat-related stress. With the power removed from the set, a simple ohmmeter check is all that is normally needed here to check these components are within tolerance.
- If a solid state (metal, selenium or silicon) rectifier is present instead of a valve rectifier, eg. as in the S.670A, suspect this next (selenium rectifier failure is usually easy to smell…). With the power removed from the set, remove one end of the rectifier and test using an ohmmeter: high resistance in one direction, low resistance in the other. If faulty, check the smoothing capacitors and other



Above: an S.840 chassis: better than your typical AC/DC set construction… below: my Northern Electric 'All-American-Five' (much more typical)

Multi-tapped ballast resistor

circuits in the radio for a short across the HT line that could have caused the failure and correct that before replacing the defective rectifier.

- Next up are the HT smoothing capacitors: if the set is working but loud hum is present (and is largely unaffected by the volume control), or the set is 'motorboating' or squealing, this may indicate one or both of these components have reduced in capacitance or have gone open circuit. With the power removed, check by removing one end of each in turn from the circuit and test using an ohmmeter – on connecting the meter (observe correct polarity), a sharp 'kick' of the meter needle should be observed, with the measured resistance then increasing over a few seconds to a value of 200kohms or more if the components are working in a satisfactory manner. Instead of doing this, if you have a similar value and voltage rating component handy as a spare, connect this spare across each of the smoothing capacitors in turn (with the power removed) and, with the set then switched on, observe whether the hum disappears – if it does, replace the capacitor being bridged using a replacement with approximately the same capacitance value and at least the same working voltage rating (and do not be tempted to just solder it in across the old unit – take the old one out of circuit!). If resistance checks indicate that a capacitor has shorted, and no fuse is fitted (often the case in low-cost sets) this will likely have blown the rectifier and/or the associated resistor(s)/choke: all these components should then be checked and replaced if necessary.
- Another cause of loud hum can be a partial heater to cathode short on one of the valves – this condition can be checked in a valve tester or (better) by substitution for a known good valve of the same type.
- If the set is working reasonably well, but hum appears only when a station is tuned in ('modulation hum'), suspect a line filter capacitor if one is fitted, if not, suspect a bypass capacitor. Simply replace the suspect part with a component of similar capacitance value and at least the same working voltage.

EDDYSTONE

MODEL "870A" RECEIVER

Introduction

The EDDYSTONE Model 870A is a high performance receiver designed primarily for personal use in situations calling for compactness and wide coverage. The receiver tunes the long, medium and short wave bands, has an internal loudspeaker and may be operated from any standard AC or DC mains supply. Ease of tuning is assured by the gear driven drive mechanism which is provided with a vernier bandspread device for accurate station logging. Troublesome mains borne interference is reduced to a minimum by an extremely efficient internal filter circuit not normally found in receivers of this type.

The receiver may be used in all areas regardless of climatic conditions and this feature together with the small size of the unit makes it particularly suited for cabin use aboard ship.

The five frequency ranges are as follows :—

Range 1	..	7·5 Mc/s. to 24 Mc/s.	(40 to 12·5 metres).
Range 2	..	3·2 Mc/s. to 7·5 Mc/s.	(93·9 to 40 metres).
Range 3	..	1·3 Mc/s. to 3·5 Mc/s.	(230·7 to 85·7 metres).
Range 4	..	510 kc/s. to 1400 kc/s.	(588·2 to 214·3 metres).
Range 5	..	150 kc/s. to 380 kc/s.	(2000 to 789·4 metres).

A 'Typical' Eddystone AC/DC Set

The circuit diagram of an S.870A set is shown at the end of this article and is described below. This particular model effectively represents the Eddystone version of the 'All-American-Five' set outlined above, here comprising:

- A 12BE6 mixer-oscillator front end: nothing too extraordinary in the circuit design here – an electron-coupled oscillator circuit - except the aerial input arrangement is more flexible than in the 'All-American-Five' sets; the aerial and oscillator tuned circuits are switchable for the number of frequency ranges covered (in this case five) and a wave trap is present, designed to reject IF frequencies that may be picked up by the aerial system. However, the main thing that sets it apart from the cheaper AC/DC sets is the quality of the parts used in its construction and its careful layout, designed to allow useful and reliable operation on short waves up to 25MHz;

- A 12BA6 IF amplifier: again, nothing extraordinary at all (except for the superior quality of the IF transformers);
- A 12AT6 AM detector, AGC and 1st audio amplifier: separate diodes are used for detection and AGC circuits (many low-cost sets used a single diode for these functions);
- A 19AQ5 audio output stage of conventional design – though the 19AQ5 valve choice is a bit odd – see article in Lighthouse Issue 92, pp36 for an explanation; and
- A 35W4 half-wave rectifier in the power supply circuit: the main improvements over a standard domestic AC/DC set's supply being the installation of an effective supply-line noise filter and two thermistors, the latter providing both surge protection and a degree of HT stabilization to the set, this being desirable for improved oscillator stability when the set was used on its higher frequency ranges (up to 25MHz).

Although housed in a 'miniature' case, the quality of the tuning mechanism, chassis, front panel, outer case and other components used in this and other Eddystone AC/DC models were of the usual Eddystone high standard. Thus many of these sets are still in use today and some have become very 'collectible' – even for the non-EUG'er - especially the S.870 sets that were produced in a variety of colours, work well and look very 'cute'.

Discussion

So, there you have it, AC/DC sets 'in a nutshell'. Whole books have been written on them (eg. 'Practical Radio Servicing' by Marcus and Levy) and whole chapters in others (see references below), demonstrating just how popular these sets were in the forties through the early sixties, when the market for them eventually disappeared due to the introduction and popularity of broadcast and multi-band AM and FM transistor sets – of course Eddystone twigged this and introduced various ranges of transistorized sets themselves (ok, I admit it, I own an EC10!); until then however, the AC/DC set was the 'bread and butter' of many radio service engineers of this period.

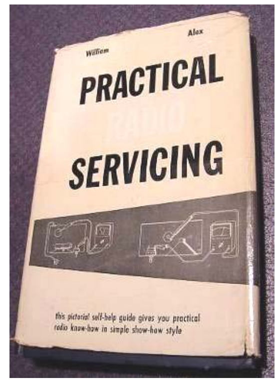
Gerry O'Hara, G8GUH, Vancouver, BC, Canada, December, 2006

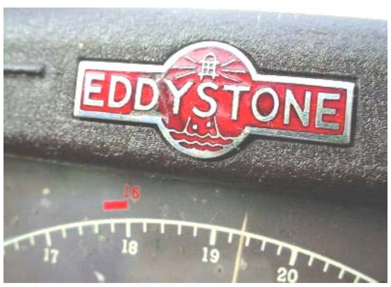
Acknowledgement

Pat Jones, a member of SPARC (http://www3.telus.net/radiomuseum/) for allowing his dinky little S.870A to pose (albeit fully clothed) for this article.

Some Useful References

- Practical Radio Servicing, W Markus and A Levy, 1st Ed. 1955 (this book is devoted entirely to servicing AC/DC radios – all 559pp of it! – this type of radio was just so prevalent in those days…)
- 'Radio-Detect-O-Scope' Poster, W. Marcus, 1957 (in part reproduced in this article)
- Radio Servicing Made Easy, L.C. Lane, Vol. 2, 1962, (esp. Ch.s 6 & 10, a figure reproduced in this article)
- Elements of Radio Servicing, W Markus and A Levy, 1955 (2nd Ed. esp. Ch. 18)
- Profitable Radio Troubleshooting. W. Marcus and A Levy, 1956

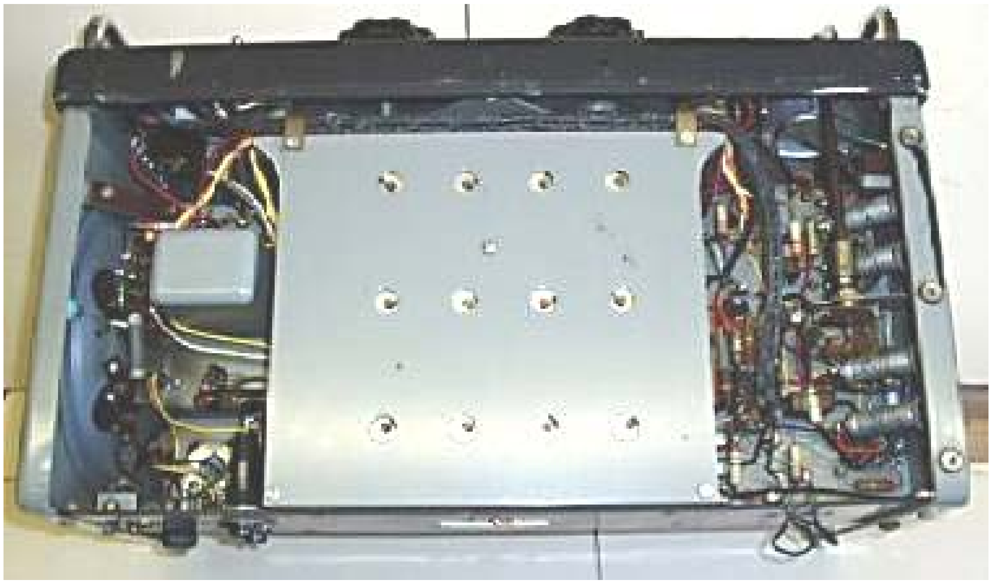




- Radio and Television Receiver Troubleshooting and Repair, Ghirardi & Johnson, 1952, (esp. Ch. 7, some figures reproduced in this article)
- Radio and Television Receiver Circuitry and Operation, Ghirardi & Johnson, 1951 (esp. Ch. 10)
- Radio and Audio Servicing Handbook, G.K. King, 2nd Ed., 1970 ('Procedure Charts' #1 to #3 reproduced in this article)
- Downloads of Eddystone manuals from the EUG web site, the EUG 'Ultimate Quick Reference Guide' (2nd Ed.) and specific articles in Lighthouse including:

Some web-based articles/resources on subjects covered in this article include:

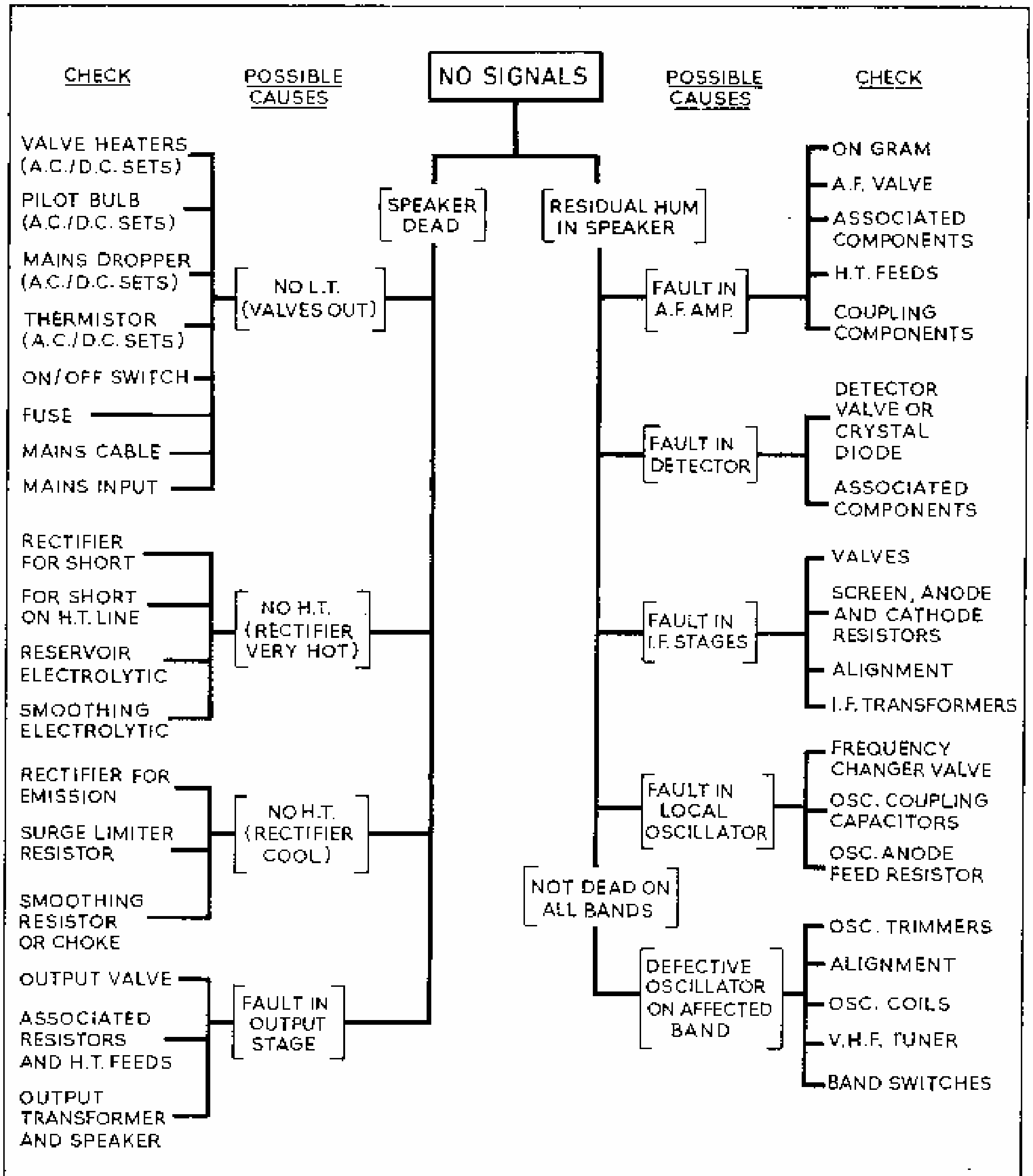
- http://www.cs.uu.nl/~gerard/RadioCorner/ (see AC/DC set links)
- http://www.cs.uu.nl/~gerard/RadioCorner/Sets/Eddy670.htm
- http://www.dxing.com/
- http://www.io.com/~nielw/nat_list/nc46.htm



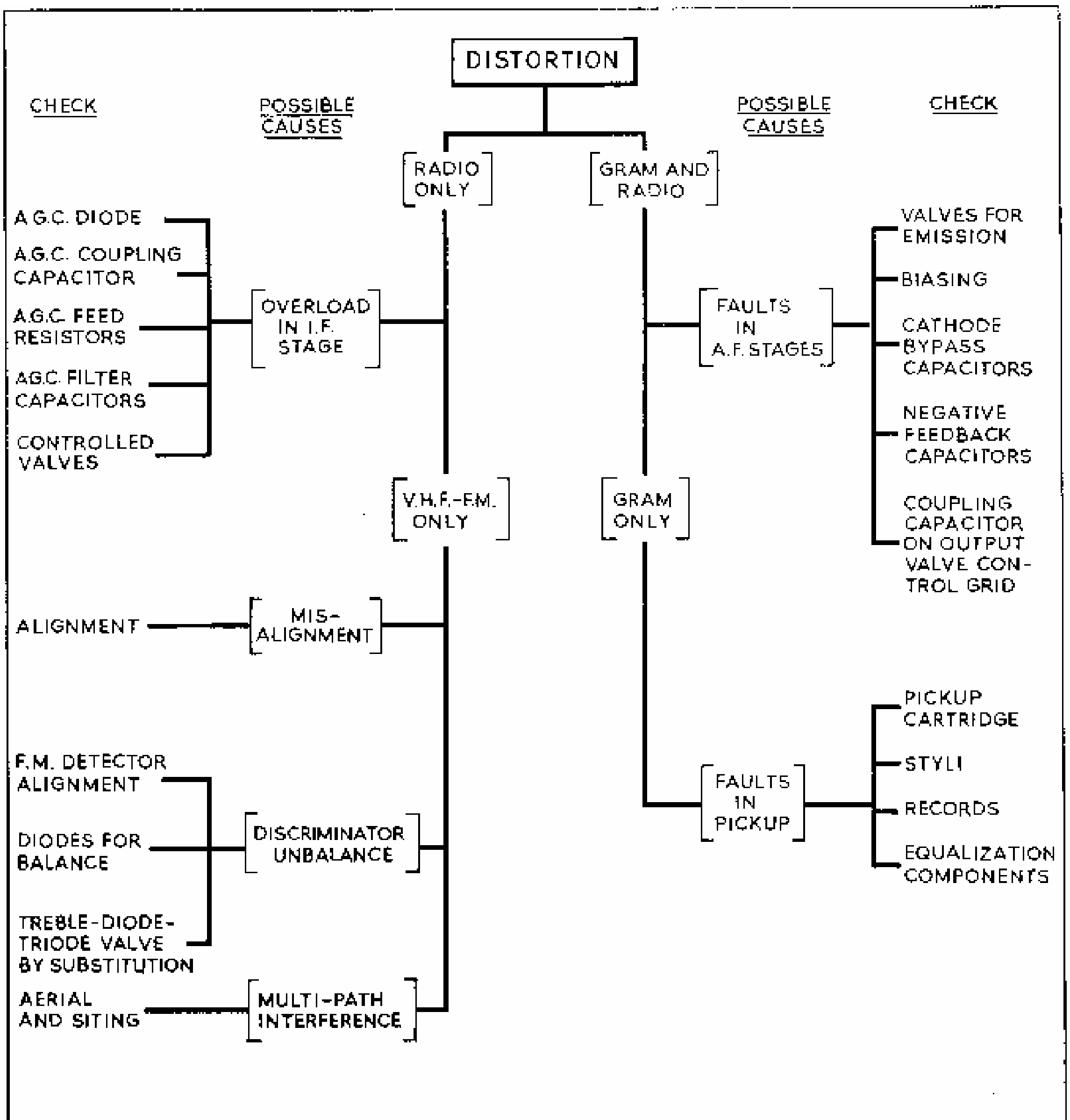
Underneath an S.840A chassis – very similar construction to an S.740 AC-only set…

An S.670 inside and out: note the finned selenium rectifier (circled) beneath the multi-tapped dropper resistor (this set is missing its circular logging scale plate and has a 'mongrel' knob)

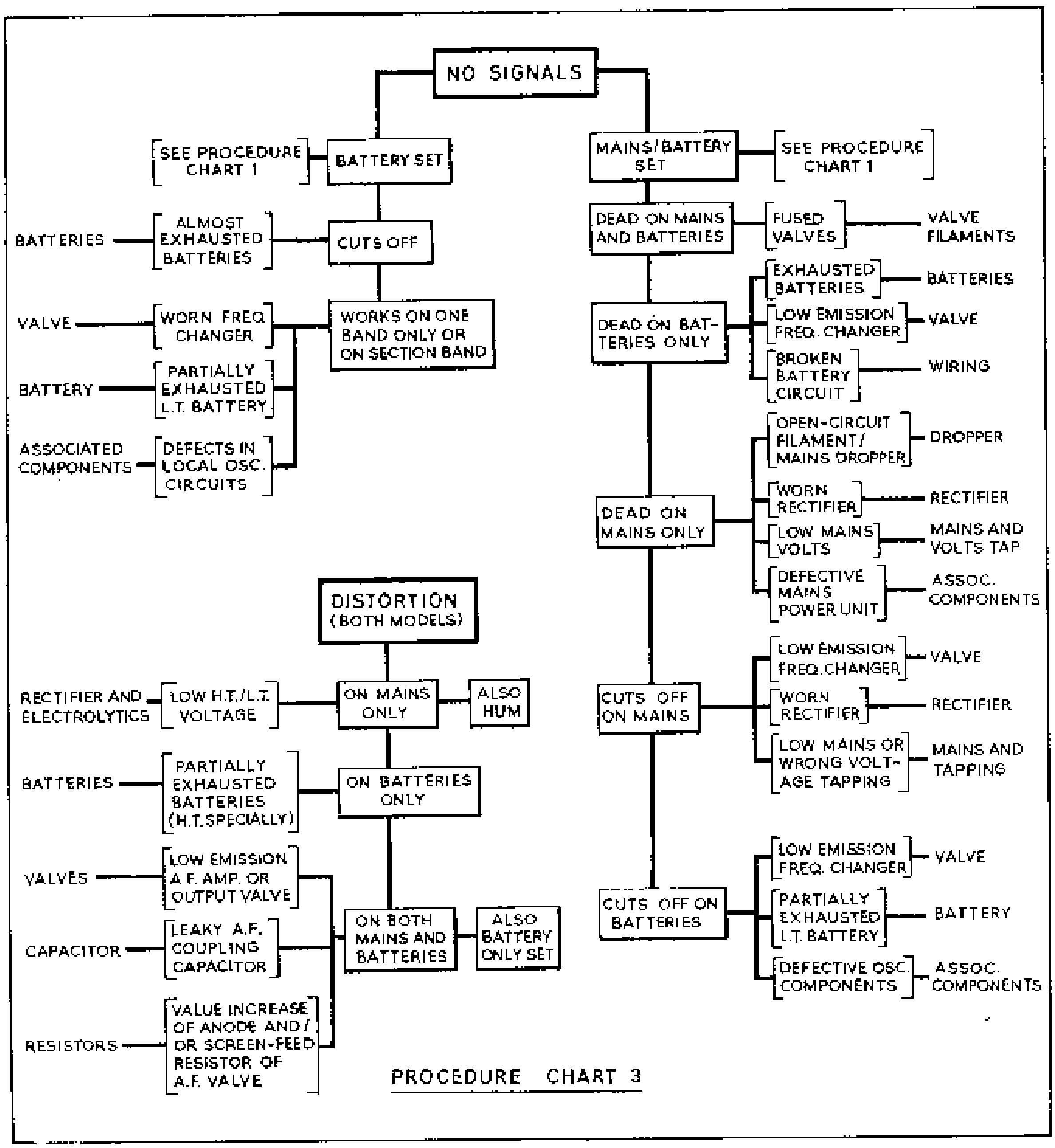
Radio Fault Finding 'Procedure Charts' (reproduced from G.J. King, 1970) – Note: Chart #3 deals with AC/DC set power supplies

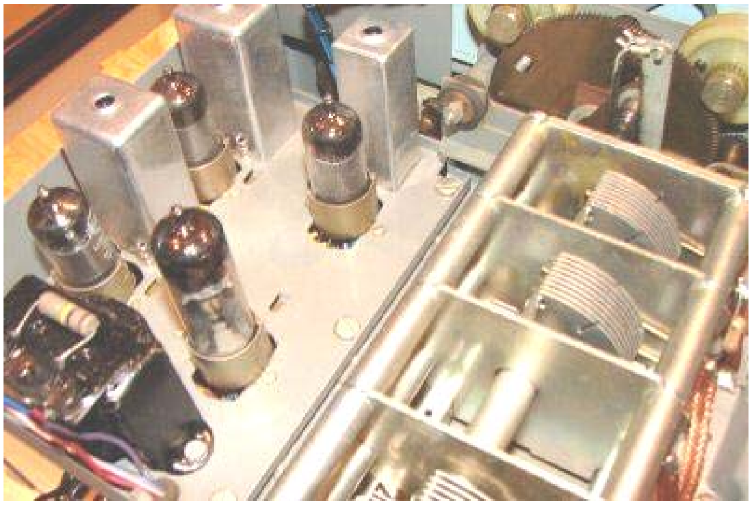


PROCEDURE CHART 1



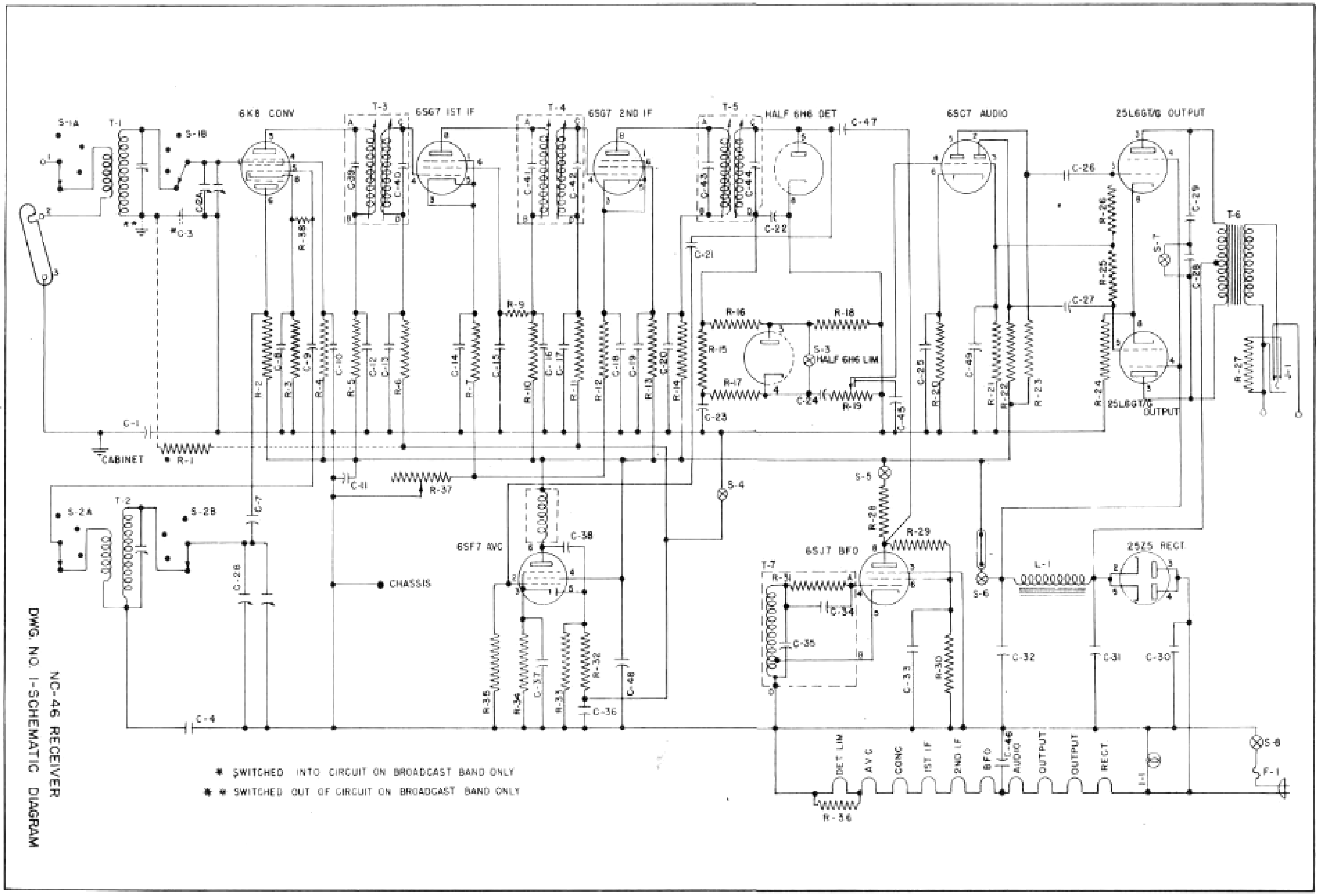
PROCEDURE CHART 2


NO SIGNALS
SEE PROCEDURE CHART 1
BATTERY SET
MAINS/BATTERY SET
SEE PROCEDURE CHART 1
BATTERIES
ALMOST EXHAUSTED BATTERIES
CUTS OFF
DEAD ON MAINS AND BATTERIES
FUSED VALVES
VALVE FILAMENTS
EXHAUSTED BATTERIES
BATTERIES
VALVE
WORN FREQ CHANGER
WORKS ON ONE BAND ONLY OR ON SECTION BAND
DEAD ON BATTERIES ONLY
LOW EMISSION FREQ. CHANGER
VALVE
BROKEN BATTERY CIRCUIT
WIRING
BATTERY
PARTIALLY EXHAUSTED L.T. BATTERY
ASSOCIATED COMPONENTS
DEFECTS IN LOCAL OSC. CIRCUITS
OPEN-CIRCUIT FILAMENT/ MAINS DROPPER
DROPPER
WORN RECTIFIER
RECTIFIER
DEAD ON MAINS ONLY
LOW MAINS VOLTS
MAINS AND VOLTS TAP
DEFECTIVE MAINS POWER UNIT
ASSOC. COMPONENTS
DISTORTION (BOTH MODELS)
LOW EMISSION FREQ. CHANGER
VALVE
RECTIFIER AND ELECTROLYTICS
LOW H.T./L.T. VOLTAGE
ON MAINS ONLY
ALSO HUM
CUTS OFF ON MAINS
WORN RECTIFIER
RECTIFIER
LOW MAINS OR WRONG VOLTAGE TAPPING
MAINS AND TAPPING
BATTERIES
PARTIALLY EXHAUSTED BATTERIES (H.T. SPECIALLY)
ON BATTERIES ONLY
VALVES
LOW EMISSION A.F. AMP. OR OUTPUT VALVE
LOW EMISSION FREQ. CHANGER
VALVE
ON BOTH MAINS AND BATTERIES
ALSO BATTERY ONLY SET
CUTS OFF ON BATTERIES
PARTIALLY EXHAUSTED L.T. BATTERY
BATTERY
CAPACITOR
LEAKY A.F. COUPLING CAPACITOR
DEFECTIVE OSC. COMPONENTS
ASSOC. COMPONENTS
RESISTORS
VALUE INCREASE OF ANODE AND/ OR SCREEN-FEED RESISTOR OF A.F. VALVE
PROCEDURE CHART 3



Above: a 'pristine' S.840C chassis and below: an S.840A looking as good as it did in ~1954 (alas, neither are in my collection)

Below: looks like someone is getting a ' new-in-box' S.840C for Christmas (alas, not me)



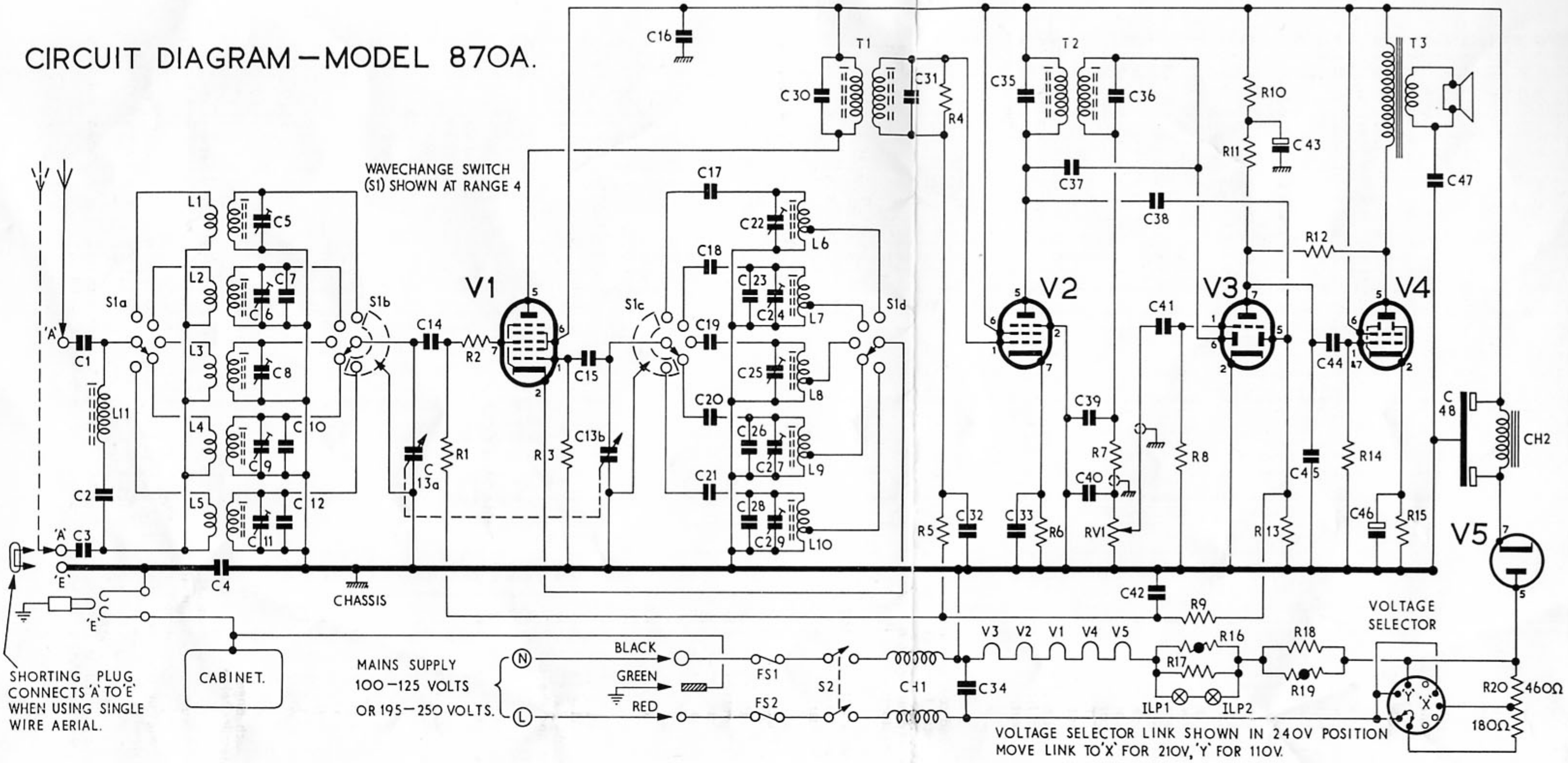
The National NC-46 circuit: one of the more complex AC/DC sets in my collection

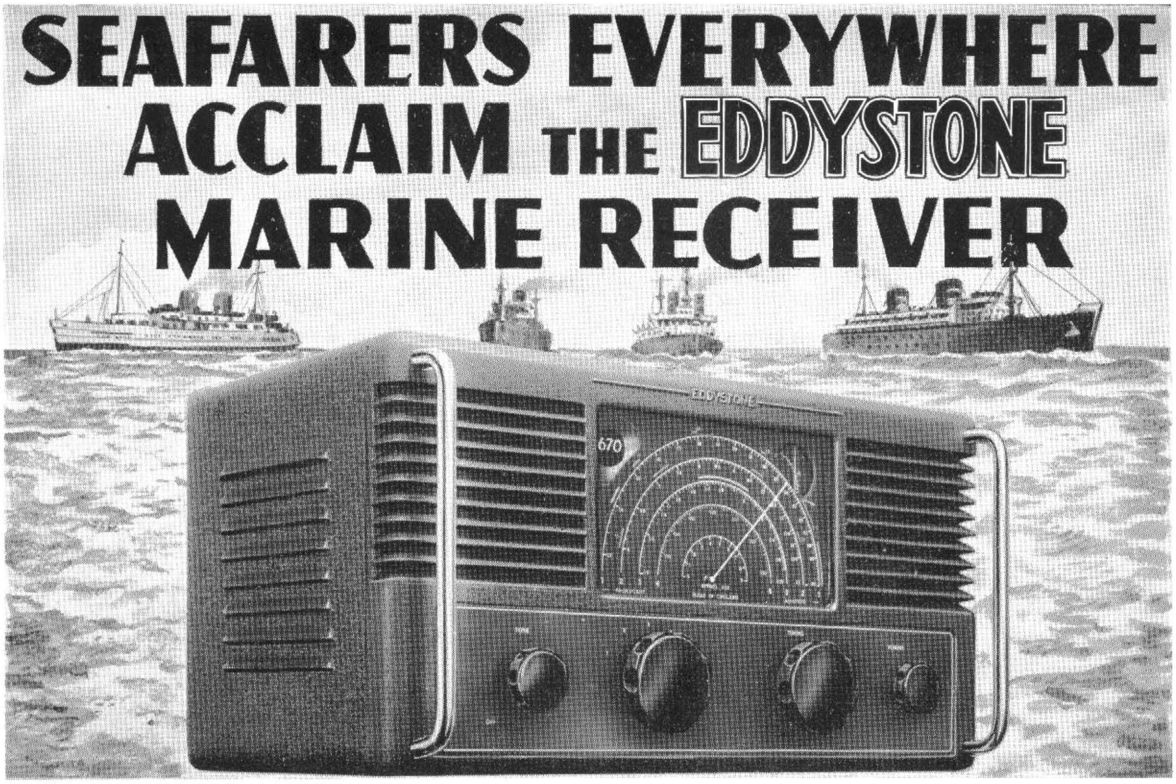
Common Radio Trouble Symptoms and Probable Location of Bad Tubes and Bad Parts

Symptom	Abnormal Test Condition	Look for
Set does not play. Tubes do not light.		Dead outlet. Defective line cord or plug. Tubes in wrong socket (check 12SQ7). Open tube heater. Defective heater wiring.
Set does not play. Tubes light.	Voltage at rectifier cathode checks zero.	Dead rectifier tube (probably caused by a shorted input filter condenser C-10).
Set does not play. Tubes light.	Voltage at rectifier cathode is high. Voltage at B plus is zero.	Open filter resistor R-10 (probably caused by shorted output filter condenser C-11 or a short in the B-plus circuit).
Set does not play. Tubes light.	Voltage at rectifier cathode is low. Voltage at B plus is zero. Filter resistor R-10 overheating.	Shorted output filter condenser C-11. Short in B-plus circuit.
Set does not play; signal check places trouble in the second a-f stage.	Plate voltage on second a-f tube is 120 volts; cathode voltage is zero.	Dead second a-f tube.
	Plate voltage on second a-f tube is 120 volts; cathode voltage is high (20–30 volts).	Open cathode resistor R-9.
	Plate voltage on second a-f tube is zero; cathode voltage is low (2–3 volts).	Open output transformer primary L-9.
	Plate voltage on second a-f tube is low (20–30 volts); cathode voltage is high 20–30 volts).	Shorted plate condenser C-9.
	Voltage check shows normal readings.	Open or shorted voice coil in the loudspeaker.
	Voltage check shows normal readings; speaker tests as good.	Short in the grid circuit of the second a-f tube.
Set does not play; signal check places trouble in the interstage coupling circuit.	Voltage check shows normal readings.	Open coupling condenser C-18.
	Plate voltage on first a-f tube is zero.	Shorted plate condenser C-17.
Set does not play; signal check places trouble in the first audio stage.	Plate voltage on first a-f tube is zero.	Open plate resistor R-17.
	Voltage check shows normal readings.	Dead first a-f tube.
	Voltages normal; first a-f tube is good.	Short in the grid circuit of the first a-f tube.
Set does not play; signal check places trouble before the first a-f stage.	None.	Open coupling condenser C-15. Open volume control R-16. Short in the volume-control wiring.
Set does not play.	I-f plate voltage is zero.	Open i-f output transformer.
	I-f cathode voltage is high.	Open circuit from i-f cathode to common negative.
	Voltage checks give normal readings.	Defective i-f tube. Defective detector tube. Opens or shorts in the i-f transformer. Open or shorted volume control. Shorted i-f filter condenser C-16.
Set plays intermittently—pilot lamp blinks on and off.		Tube heater that opens intermittently (check with neon lamp tester).
Set hums.	Rectifier-cathode voltage low (approximately 50 volts).	Open input filter condenser C-10.
Set hums, squeals, or motorboats.		Open output filter condenser C-11.
Set plays—hums on some stations.		Open line condenser C-13.
Hum.		Open loop winding L-2.
Modulation hum.		Defective converter tube.
Set hums.	Voltages are low.	Open filter condensers.
	None.	Defective tubes.
	Hum clears up when checking grid voltages.	Open grid resistors R-15 or R-15.
Low volume.		Weak tubes. Defective speaker or output transformer. Leakage in plate condenser C-17.
Set plays weakly.	B voltage below normal.	Weak rectifier tube. Leakage in filter condensers C-10, C-11.
Set plays weakly.	B voltage normal.	Open output filter C-11.
Weak reception.		Weak converter tube. Misalignment. Open avc condenser C-14. Need for outside antenna.
Weak reception.		Weak tubes. Misalignment. Open avc bypass condenser C-14.
Distorted reception.		Defective tubes. Open i-f filter condenser C-16. Leaky or shorted avc bypass condenser C-14.
Set has poor tone quality.	None.	Defective loud speaker.
	Plate voltage on second a-f tube is low; control grid on second a-f tube shows positive voltage.	Short or leakage in coupling condenser C-18.
	Cathode voltage on second a-f tube is high.	Leakage in plate condenser C-9.
	Plate voltage on first a-f tube is low.	Leakage in plate condenser C-17.
	Grid voltage on first a-f tube is low.	Leakage in coupling condenser C-15.
Set develops poor tone quality after playing for awhile.	A positive voltage develops on the second a-f grid.	Grid emission in the second a-f tube.
	None.	Speaker warping due to lack of ventilation in cabinet.
No stations over part of the dial.		Shorts in tuning condenser. Weak converter tube. Leakage in oscillator tuning condenser. Wrong value of oscillator grid leak R-4.
Squeals when tuning certain stations.		Image-frequency interference (realign).
Squeals or oscillation.		Open output filter condenser in the power supply. Open ground connection to shielding. Open avc bypass condenser C-14. Open i-f filter condenser C-16. Tube shielding is missing or poorly grounded. Incorrect wire dress. Misalignment.
Noise.		Condenser plates touching. Need for outside antenna.
Noisy reception.		Defective tubes. Corrosion in i-f transformer windings.

Developed in conjunction with
the McGraw-Hill TV, Radio and
Changer Servicing Course

CIRCUIT DIAGRAM — MODEL 870A.





FOR PERSONAL CABIN USE

PROOF of the efficiency with which the Eddystone "670" Marine Receiver fulfils the Seafarer's particular requirements for a radio receiver is amply demonstrated by the many congratulatory letters which are reaching us from users who have installed this set on board ship. The following are typical examples :—

S.J.G. *"The '670' receiver I have had now for five years is fully to my satisfaction and I have had more than its money's worth of pleasure out of it. I am in Anglo-saxon-Dutch section and many of my friends have bought Eddystones lately in Hong Kong and Singapore."*

K.W.N. *"I have used one of your Eddystone '670' receivers for eighteen months and have been very pleased indeed with the results obtained in the Near East and Mediterranean Sea. Among my colleagues the '670' is a very popular ship's receiver and we are all very satisfied with its good performance in all areas."*

H.J.M.A.W. *"At the same time I want to let you know once again how content I am with your Eddystone, and even after having the set now for nearly three years, I am still as happy with it as the first day it was in my possession."*

A.B. *"I am pleased to say that my Eddystone '670' receiver has been giving yeoman service!"*

W.H.B. *"I may state I am very pleased with the results being obtained from my Eddystone '670' receiver. I have owned many sets and now at last I am satisfied with the performance given by this wonderful receiver."*

H.J.S. *"For nearly two years I have been the proud owner of one of your Marine receivers. It has given me sterling service all over the world and has provided me with many hours of listening pleasure."*

F.A.W. *"With my Eddystone '670' receiver I can receive the B.B.C. Overseas Programmes almost at any time. The volume is good and the tone excellent."*

G.S.H. (U.S.A.). *"I had the pleasure of listening recently to one of your '670' Marine receivers and must say the performance is an excellent recommendation of your products."*

D.S. *"Your products are held in high esteem by many of my radio officer acquaintances."*

J.C. *"About six months ago I bought one of your Eddystone Marine receivers from ———. Now I am writing a short note to let you know what I think of your set, as radio is my hobby. Well, in the first place, there is no radio set on this ship that has a look in on this one for range. I think it is the best on the radio market to-day and is money well spent. I am very proud of my receiver."*

R.T. *"I am a user of one of your Eddystone Marine Receivers Model '670' and have recently acquired a record player for use with the set. As far as I can remember the receiver was bought late 1948 and I might mention that it has given extremely satisfactory service."*

J.K. *"I would like to say that this receiver has given me wonderful service in all parts of the world and I wish I had bought one earlier."*

K.Y. *"Three years ago I purchased an Eddystone Marine receiver. It has provided me with excellent reception and I have had no trouble of any kind."*

S.S. ———. *"I bought your Eddystone Marine Receiver '670' from your local Agents and have had perfect results all the way up the coast to Korea. I have owned upwards of 20 radios out here in the last twenty years and yours is definitely the best. Passengers during this last voyage were amazed at its performance."*

S.S. ———. *"The '670' receiver has been working very satisfactorily and is a really wonderful set in my opinion. On board ship with the mains suppressor there is no interference whatsoever and the tone is indeed grand."*

M.V. NEAERA. *"I have had excellent results from my '670' receiver. Since joining this ship I have had perfect results and the radio far surpasses any I have heard at sea before, including a very expensive ——— and similar sets."*

RADIO PRODUCTS EDDYSTONE TRADE MARK

Manufactured by

STRATTON & CO LTD

EDDYSTONE WORKS · BIRMINGHAM · ENGLAND

CABLES: STRATNOID BIRMINGHAM

FACTS CONCERNING THE EDDY

A personal radio receiver for use at sea must necessarily differ from a domestic receiver if the special requirements of the Seafarer are to be met. For long periods the ship may be outside the range of medium-wave broadcast stations, in which case satisfactory reception can be obtained only from short-wave transmitters. Therefore, to obtain programmes with real entertainment value, at almost any time and place, consistently reliable short-wave reception must be an essential feature of a seaborne receiver.

The electric supply may vary when changing ships, and occasionally, the receiver may be wanted for use ashore. A truly Marine receiver must therefore be designed to operate off either DC or AC mains of various voltages, with the minimum of adjustment.

Normally, the loudspeaker built into the receiver will be used but, on occasions (e.g., when it is desired not to disturb sleeping personnel) headphones or a pillow speaker can easily be plugged in, the internal speaker being automatically silenced.

Cabin space is restricted and it will be desirable to have a receiver which is compact and self-contained. Robust construction and full tropicalisation are other qualities called for.

The Eddystone "670" Receiver is specifically designed for Marine use. It meets all the requirements outlined above and is unquestionably the ideal receiver for those who "go down to the sea in ships."

The name Eddystone is world famous for performance and reliability and the "670" Receiver upholds that tradition to the full.

FREQUENCY COVERAGE

Four switch operated coil ranges cover the principal short and medium wave broadcast bands. The exact coverage is :—

Band 1 ...	30-12·8 megacycles	(10–23·5 metres).	Band 3 ...	2·75–1·2 megacycles	(110–250 metres).
„ 2 ...	13-5·8 „	(23·1–51·7 metres).	„ 4 ...	1220–522 kilocycles	(246–575 metres).

CIRCUIT AND VALVES

A seven valve (plus selenium rectifier) superheterodyne circuit is employed, with modern miniature valves, which have been specially selected to give optimum performance. The R.F. stage ensures results well above the average and is particularly beneficial when long distance reception is called for or when only a short aerial can be used.

The push-pull output stage, in conjunction with negative feedback and a high efficiency speaker, gives adequate volume and excellent quality. The speaker connections are so arranged that it is an easy matter to use an external speaker or headphones. Sockets are provided for the connection of a gramophone pick-up. All necessary plugs are included.

TUNING MECHANISM

A gear-driven, flywheel-loaded mechanism, having a reduction ratio of approximately 140 to 1, controls the tuning which is smooth, positive and free from back-lash. In the top right-hand opening of the dial is an auxiliary bandspread scale which expands each range to the equivalent of ninety inches. It is thus possible to re-set the tuning quickly to any station previously logged.

SAFETY PRECAUTIONS

The mains leads and all plugs and sockets are completely insulated. Particular attention has been given throughout to insulation, and the metal cabinet may be directly earthed. All components are of the tropical grade, so necessary in a set of this kind which is almost sure to be used in every conceivable variety of climate and weather.

RADIO PRODUCTS EDDYSTONE TRADE MARK

The EDDYSTONE "670" MARIN

STONE "670" MARINE RECEIVER

POWER SUPPLIES

The "670" Receiver can be operated off mains having voltages within 10% of 110, 200 or 230 volts. In actual fact, good results can be secured when the mains voltage is down to 90 volts or even less. It is immaterial whether the mains are AC or DC. On AC supplies, power rectification is by a selenium rectifier. A device known as a "Thermistor" prevents high initial surges when switching on, and the dial lamp lights up gradually, without any tendency to burn out.

GENERAL CONSTRUCTION

The aluminium diecastings which are used for the front panel and tuner unit chassis form an extremely rigid foundation for the receiver as a whole. The sub-chassis are made of heavy gauge brass or steel, finished to prevent corrosion and securely attached to the main castings. The cover is steel, thoroughly rust-proofed and stove enamelled a dark ripple brown of pleasing appearance and possessing extreme durability. Chromium plated handles are fitted to the front panel and serve both for protection and for carrying the receiver.

Should it be necessary to obtain access to the interior, the receiver chassis can be readily detached from the cabinet by simply removing four large screws at the rear.

PERFORMANCE

The performance is first class in all ways. Special attention has been paid to the sensitivity, selectivity, image ratio and other technical characteristics, to ensure the finest possible results.

MINIMUM INTERFERENCE

The metal cabinet, in conjunction with the internal screening, has two distinct advantages. Direct pick-up of electrical interference is eliminated and there is no interaction between the "670" Receiver and other receivers that may be in use in the ship.

With the use of the Eddystone Filter Unit, mains-borne interference from electrical machinery is reduced to a minimum, whilst still better results are obtainable when the Eddystone Doublet Aerial is used. The aerial terminals are arranged to take either a doublet or a single wire aerial.

CONTROLS

The controls comprise :—

- Tuning Knob
- Band Selector Knob
- Volume Control
- Combined Tone Control and On/Off Switch

WEIGHT AND DIMENSIONS

Weight : 32 lbs. unpacked
Overall length, 16¾ inches : depth, 10 inches
Height, 8¾ inches

Comprehensive Instructions and a 12 months Guarantee are provided with each receiver.

E RECEIVER - *a 1 in every respect!*