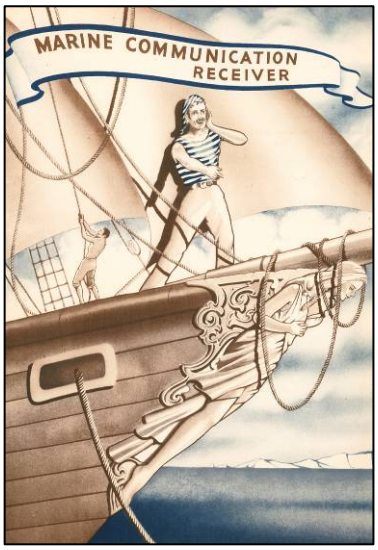
Restoration of a 'Basket Case' Eddystone S.640 – the Bath Tub's first post-WWII set Targeted at the Radio Amateur and Short Wave Listener Market, by Gerry O'Hara, G8GUH/VE7GUH

Introduction

In the concluding part of my S.680/2 restoration article I mentioned that I would be working on a 'basket case' S.640 donated to yours truly by Chris Harmer earlier in 2010 and collected by me during a visit to the UK in July this year… well here is the story of restoring that set to something like its former glory. First though, some background on the Eddystone Model S.640 itself – the first post-WWII communications receiver manufactured at the Bath Tub aimed at the radio amateur/short wave listener market.

Background on the S.640

So, with WWII over and with the post-war radio market a bit of an unknown to the industry, Eddystone turned from producing radios (S.358 series, S.400 series etc.) and components for the military to designing and manufacturing a variety of sets for whatever contemporary and potential future markets that could be identified by the company. The post-WWII market for HF receivers was very different to the 1930's. In particular, it demanded superhets with the convenience of integrated coil packs and simple band-switching – only home-constructors seemed interested in the inconvenience of plug-in coils, trading convenience for lower cost and simplicity.



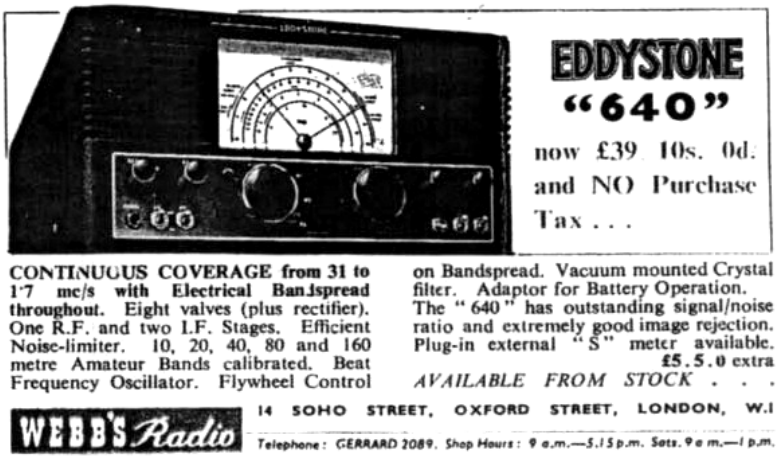
At the time, the markets identified by Eddystone were:

- The need for high-quality, robust and tropicalized receivers in several British colonies to entertain and to bring news and current affairs to ex-pats: the so-called 'Tea Planters' broadcast sets, the S.556 being the first off the production line in 1946, followed by the S.659 in 1947 and S.710 'All World Six' in 1949;
- The civilian (and military) professional communications market: the S.504, introduced in 1946, was pitched at this, based on the S.556 but with an S-Meter, BFO, noise limiter and dual-gate crystal filter;
- Marine radio needs: both for primary and secondary

ship to shore/ship to ship communications, plus entertainment – the latter being the so-called 'cabin receivers', the first of these being the S.670 'Seafarer's Radio' introduced in 1948; and

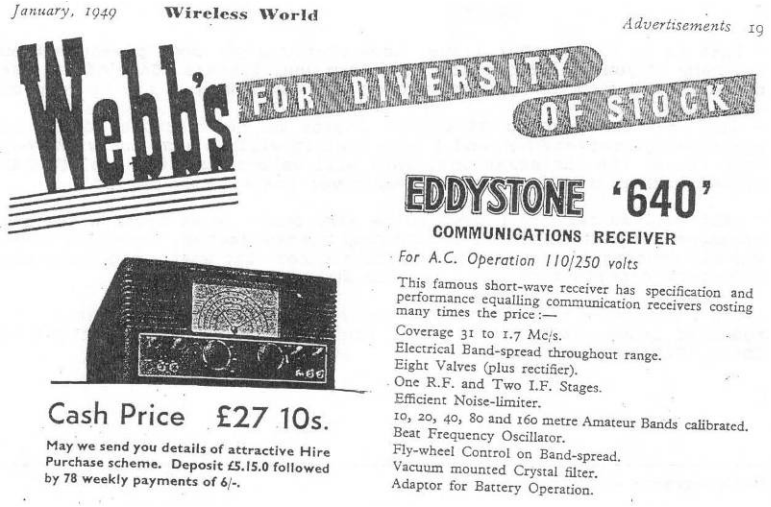
- The amateur radio market: catering for both licensed Radio Amateurs and Short Wave Listeners (SWLs). This was the niche the S.640 was designed for, and it was introduced in 1947.

But the latter was a difficult market – austerity measures were in place in a country (and world) that had been decimated and impoverished by years of war. Although the set was a relatively simple circuit, it used the new range of high-quality parts being manufactured by Eddystone, critical to the performance of the set – the RF and IF coils, power transformer, filter choke, AF transformer, variable capacitors, as well as the die-cast coil box/front panel and the nickel-plated brass power supply/BFO and IF/AF sub-chassis. These were not cheap components and commanded a high price: the set was introduced at £42 (plus Purchase Tax[1]) – a hefty sum for all but the



[1] 'Purchase Tax' was introduced in 1940 as a way of filling the British war chest. This tax was levied on the trade price of items deemed to be 'consumer goods', not clothes food or even Eddystone components, at rates up to 60%. The actual rate was determined by the Chancellor of the Exchequer and varied according to the needs of the economy. In 1946, Stratton's argued that Eddystone receivers were commercial 'communication receivers', not 'consumer goods' but the Inland Revenue did not agree, treating them as domestic (consumer) receivers. So Eddystone took loudspeakers out of the set's specification (the front panel castings of all the sets mentioned above were designed to take one or two 3" speakers as installed in the S.556) - but this did not wash with the Inland Revenue, who eventually determined that the presence of a BFO was needed to define a radio as being 'non-consumer' and thus Purchase Tax exempt.

most well-healed radio amateur or SWL in 1947. Not surprisingly, it did not sell all that well at this price given the state of the nation's economy, with an average weekly wage of less than $5/week and war surplus radio equipment starting to appear on the market. However, the S.640 became tax-exempt in 1948 when the Inland Revenue decided that as it was fitted with a BFO it was a 'communications receiver', by which time the selling price of the set had also been reduced to £27.50 – a rather more attractive proposition for radio amateurs and SWL's, hence the set is quite a common model today - the *Quick Reference Guide (QRG)* notes that a total of over 4,000 were produced. Many radio amateurs built their own transmitting apparatus at that time, but considered constructing a high-quality modern superhet received well-beyond their capabilities (and, maybe more importantly, the much-needed aligning of a homebrew receiver from scratch, given the limited test equipment most had at their disposal) – the thought of investing significant sums of money into components with the possibility of a finished set that did not work well was not a happy prospect – the money was considered better-spent on a commercially-built receiver.

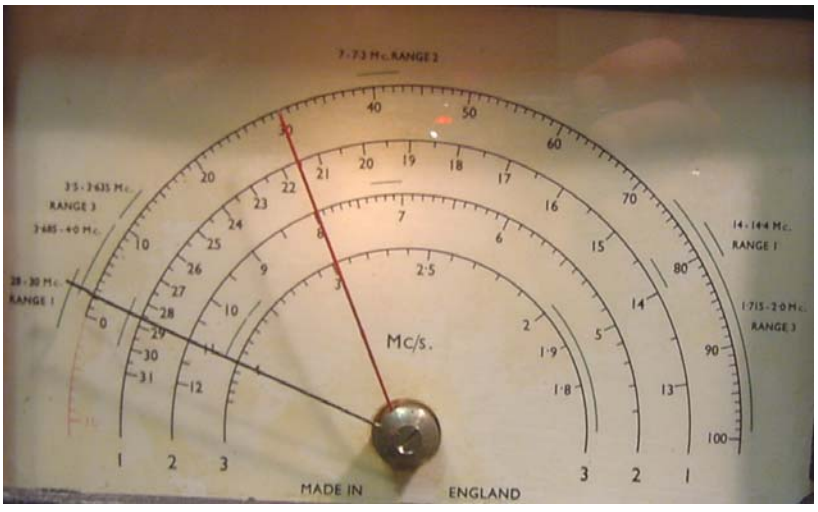


Brief Overview of the S.640

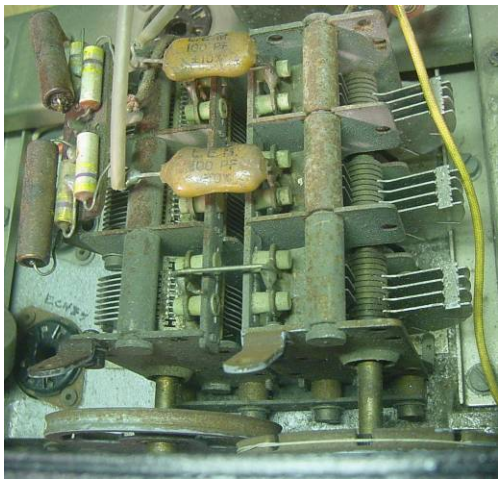
The S.640 covers 1.7MHz to 32MHz in 3 bands:

Band 1 – 32 to 12.6MHz
Band 2 – 12.6 to 4.5MHz
Band 3 – 4.5 to 1.7MHz

Tuning is 'reversed' (photo of scale, right), ie. the higher frequencies are attained when the dial pointer is rotated anti-clockwise, as per the S.680/2 I recently restored[2]. The bands are selected by rotating a chrome-plated lever fitted beneath the left-hand ('bandsetting') tuning knob.



[2] Not all Eddystone 'half-moon' dial sets are like this, eg. the S.740 has the opposite sense tuning (which seems much more intuitive to me).



Separate three-gang capacitors are used for the main tuning (bandsetting) and bandspreading (photo, left – the tuning gangs before cleaning – bandset left, bandspread right). The tuning mechanism is very different to other Eddystone sets, using pulleys and dial cords to effect the reduction ratio, rather than the gears and pinions used in other models, and with the bandsetting and bandspreading pointers being concentric on the same shaft. The tuning shaft is flywheel-loaded and the system works well, but in my opinion is not as good as the geared systems.

Mechanical construction of the set is up to the usual Eddystone high standard, using nickel-plated brass sub-chassis for the IF/1st AF stages and power supply/BFO, with the output stage mounted on its own small sub-chassis bolted to the top of the cast-aluminium coilbox, behind the tuning gangs. This assembly of sub-chassis is bolted together and fixed to the cast aluminium front panel by four bolts tapped into the coilbox casting. Brass rivets are used to fix the chassis side rails and valveholders in place.

Electrically, the set is a fairly standard single-conversion superhet, though using a high IF of 1.6MHz, giving a good image rejection at all frequencies covered, even though only one RF amplifying stage is used. Low noise, variable-µ pentodes (EF39s) are used for the RF stage, two IF stages and the BFO. A 6K8 triode-hexode is used as a local oscillator/mixer ('converter'), a 6Q7 duo-diode triode as detector/AGC and 1st AF, a 6V6 beam-tetrode as audio output, an EB34 duo-diode as noise limiter/S-Meter rectifier and with a 6X5 indirectly-heated full wave rectifier in the power supply. Tried and trusted circuit elements are used throughout, with little innovation/experimentation, however, as in all Eddystone sets of this period, the secret to its performance is in the details: careful choice of circuit constants, high-quality variable capacitors and (high-'Q') RF/IF inductors, coupled with solid mechanical design and quality construction make all the difference. The use of a single-pole crystal filter and phasing control is a useful addition to the standard superhet design – especially for the reception of CW signals. A full description of the S.640 circuit is provided in the manual (also download Tor Marthinsen's excellent re-drawn schematic).

The Chris Harmer Connection

Chris Harmer and I moderate the EUG Forum on Yahoo and therefore I communicate with him (usually by email) from

Gerry O'Hara

From: eddystone_radio_users@yahoogroups.co.uk on behalf of Chris Harmer [chrisharmer@rocknesstrust.co.uk]
Sent: June-01-10 1:10 PM
To: eddystone_radio_users@yahoogroups.co.uk
Subject: Re: [eddystone_radio_users] Re: OC171 repair or replacement

Hi Gerry:

When are you going to be in the UK?
If you're looking for Eddystone's to take home (?!), I have a rather sad 640 that came as a "you can have this as well if you want it" when I collected my beloved 750.
Dial needs restringing, no valves, wavechange lever missing, no case. In desperate need of TLC!
Yours if you want it.

time to time on EUG issues and I also purchased a set from him a couple of years ago – a pristine maroon and cream livery S.870A. I received an email back in June 2010 asking if I would be interested in taking a rather derelict S.640 off his hands – him realizing he would likely never get around to restoring it and wanting it to go to a 'good home'. So, how could I refuse? –particularly with me planning to go to the UK in July to visit my mum – I could bring it back with me! So, Chris packed the set up and shipped it to my mum's house in Cumbria. The set was later packed into my check-in baggage and carted to Manchester airport – no problems: it arrived safe and sound in Vancouver (more than can be said for the suitcase it was in – brand new and for some reason both of the pulling-handle sleeves in the case were bent out of shape on arrival in Vancouver(!). Never mind - the case went in for a warranty repair - glad they did not ask what happened…).

The S.640 prior to shipping to Canada – looking a bit sad

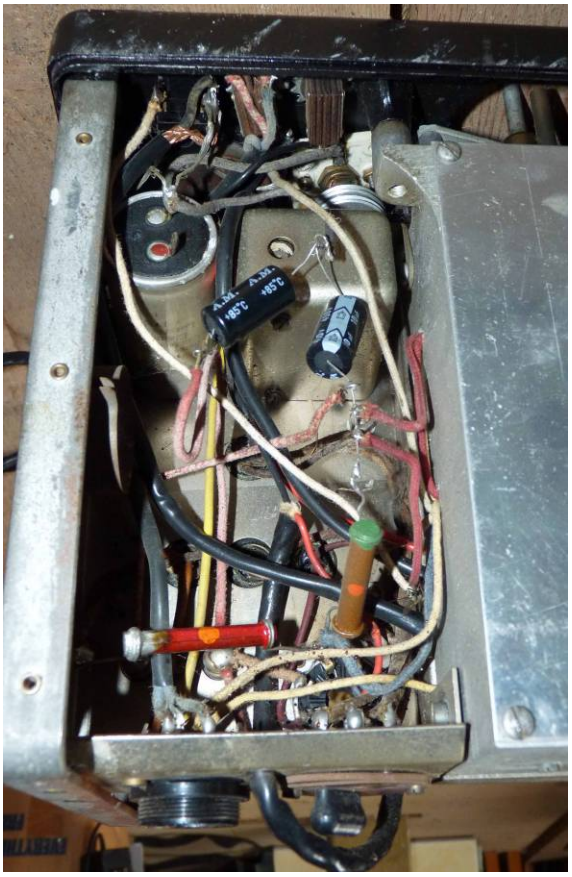
Preliminary Inspection and Tests

So, after me coveting the SPARC museums S.640[3] for the past three years or so and drooling over several sold on Ebay over the years – some at very reasonable prices, I finally had one on my workbench. Some S.640 though – it had no case, rusty pulleys,

heavily pitted/corroded chassis components and tuning gangs, missing dial lights support bracket, knobs, fingerplate, bandchange lever, case and some valves. The condition of the electronic components did not look much better – some 20 wax-coated (and 'drippy') tubular paper capacitors (photo, left), charred resistors and a rats-nest of wires hanging free (photos at top of next page). Some repairs had been undertaken over the years, eg. the filter capacitors had been bypassed with new ones (hanging loose in the wiring) but at least no holes had been drilled in the front panel - only a few into the rear of the coil box. So, altogether, quite a 'real' restoration job in the works here – would this old set ever work again? and could it be made to look respectable and worthy of sporting the proud Eddystone name?

[3] This set is located front and centre in the SPARC museum. It is complete, has reasonable cosmetics, a few components replaced with modern substitutes, but I have never switched it on to give it a try

Below: under-chassis views of the power supply/BFO sub-chassis (left) before shipping to Canada and of the IF/1st AF sub-chassis (right) – both a bit of a 'rat's nest of tired-looking components… note the replaced filter capacitors 'hanging loose'

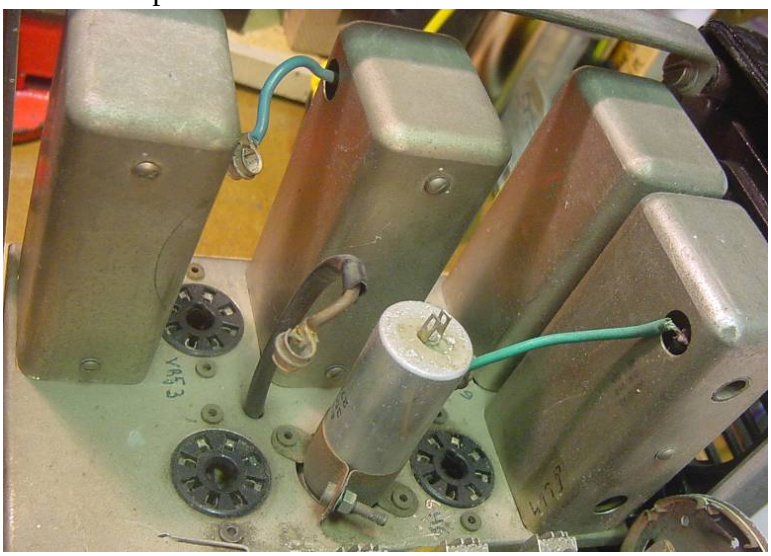


The first question I always ask when a set in this condition is sitting on the bench is 'why was it almost scrapped/used as a parts set?' – often the answer is that the power transformer burned-out due to a faulty smoothing capacitor or rectifier valve, or that a previous repair was unsuccessful in fixing a hard-to-diagnose fault and somebody gave-up trying. So, the first check I made was to the function of the power transformer. With all the valves removed and the power cable and mains switch checked for continuity and insulation, an AC voltmeter was connected to the HT secondary of the power transformer and line voltage applied to the primary via a (fused) Variac. The AC voltage was slowly wound-up and, surprisingly, the secondary voltage was ok – and also found to be equal on either side of the centre-tap. The two 6.3v LT (heater) windings were also checked – they were ok too. I then checked the insulation of the windings to ground and to each other - also good. Phew, no need to source a replacement transformer, so I decided to press-on with the restoration.

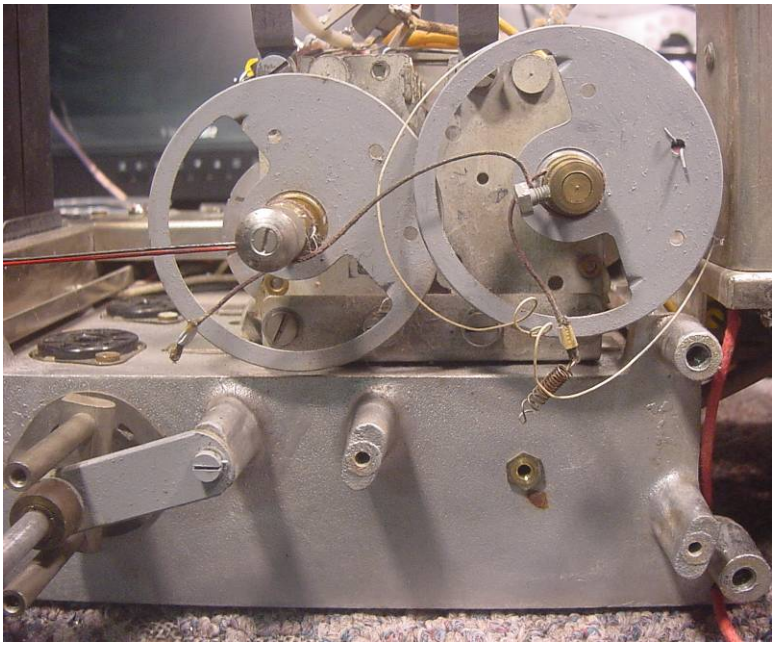
Initial Clean-up

Above: the S.640 on arrival at the VE7GUH shack – front panel not in bad shape but, er, a few vital things are missing…

With the front panel removed, I used a paintbrush, airbrush and vacuum cleaner to remove loose dust and debris (above and below the chassis) and then wiped the chassis over with a cloth moistened in warm soapy water, using alcohol or lighter-fluid moistened Q-Tips where there was a build-up of more stubborn/greasy grime. The nickel-plated BFO/power supply, 1st AF/IF and the AF output sub-chassis were all coated with a thin coat of some sort of varnish, however, this was removed using Brasso and plenty of elbow grease - these came up quite nicely. The aluminium casting for the coilbox was slightly corroded in parts with white oxidization in places - I cleaned off the white oxidation with a small soft brass wire brush and buffed the surface a bit with an alcohol-soaked cloth, deciding not to attempt any further clean-up of this unit. The AF output sub-chassis was badly-pitted/oxidized and did not clean-up as well as the other chassis components. The IF transformers are encased in what the manual describes as 'large brass screening cans' (along with the audio output transformer and BFO unit). These cans were also heavily pitted and oxidized (photo, left) and Brasso did not manage to fully remove all the pitting – still, they now look much better than they did on arrival. I may try some 'brass wool' on them sometime to see if I can improve their appearance a bit more.



With the front panel removed, it was evident that someone had started to paint some components at some time in the past – the front of each tuning gang drive pulley and the



fronts of the bars running across the front of each tuning control location were painted grey – strange (photo, left). I left them as they were found as they are not in view with the set re-assembled.

With the set now looking much more presentable (and pleasant to work on – I detest working on dirty radios) I decided it was time to undertake any component replacement work required…

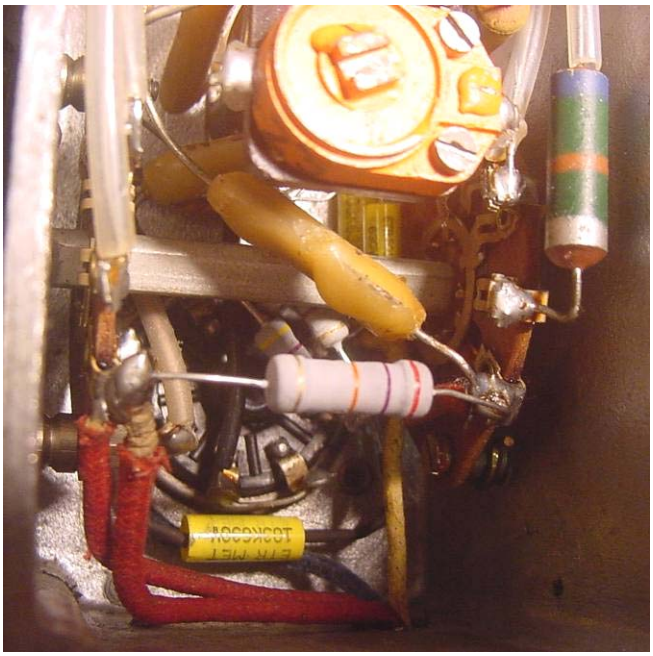
Component Replacement

I checked a few of the 0.01uF waxed-paper bypass capacitors: all I checked were found to be near the marked capacitance value but were very leaky. I also spot-tested a few of the Erie ceramic body resistors (0.5W) and four 'dog bone' carbon rod (1W) resistors: most tested were marginally out of tolerance, though some were way out of tolerance (>50%) – all high. I decided to replace all the waxed-paper and electrolytic capacitors, maybe salvaging one or two of the electrolytics that had already been replaced. The silver micas (wax-coated and moulded types) and ceramic capacitors are usually ok – so I decided to check these when I came to them in the component replacement work (replacing only if needed). I also decided that I would check all resistors as I worked through the set replacing the capacitors, replacing resistors as necessary.

The wiring in the S.640 is mainly of the point-to-point variety, with a couple of bus-bars and tag strips. Access to most of the parts is reasonably good, but a logical sequence and some planning is needed – cutting away some parts to better access underlying ones, etc (especially important in the coil box). It's a pity the wiring to the audio output sub-chassis had not been better thought-out to allow it to be rotated through a full 90 degrees for easy access to the components beneath – still, compared to many sets it is a doddle to work on.

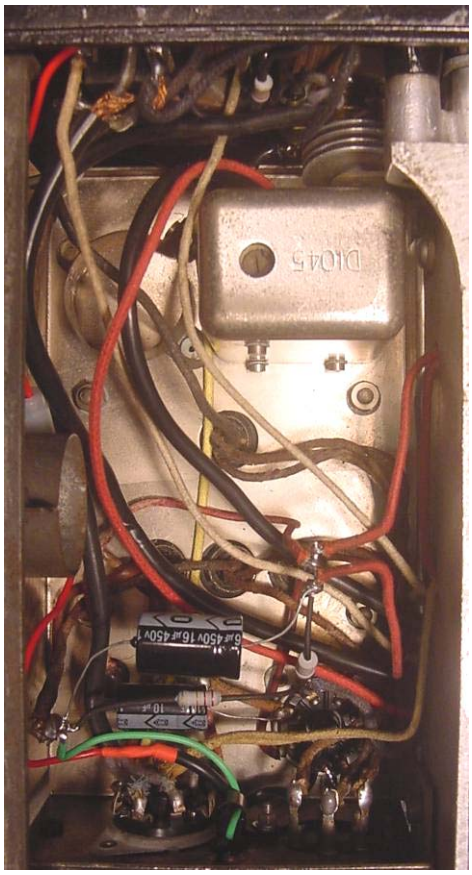
The audio sub-chassis was tackled first – removing the oversized Hunts 25uF 25vw electrolytic opened things up considerably (it tested open circuit) – the diminutive replacement electrolytic looked minute in

comparison. Three of the resistors in this unit were well-within tolerance and therefore left in circuit. The moulded mica capacitors were ok, so only the waxed paper 0.01uF unit was replaced along with the electrolytic output valve cathode bypass capacitor.

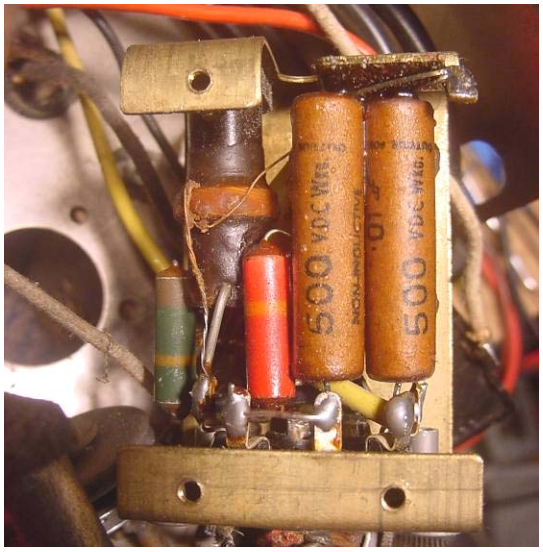


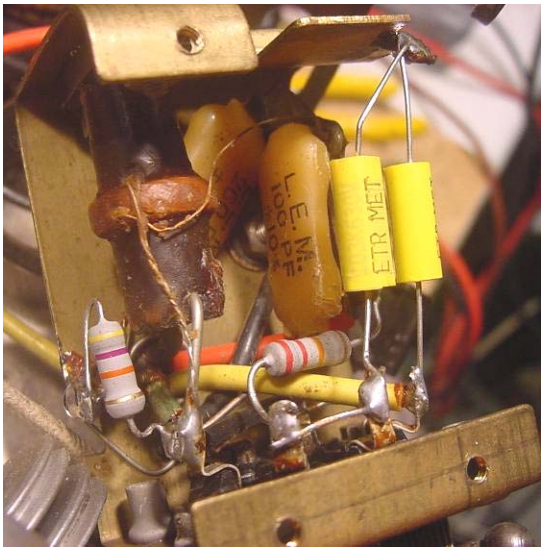
Above: mixer section of the coilbox after replacing paper capacitors and (most) resistors – not nearly as bad to work on as it looks (honest!)

Next, I worked on the coilbox – much more straightforward in this set than in some later, more complex sets (eg. the S.940), but still requiring some thought as to sequence and what to remove/detach temporarily to allow good access for snips, pliers, tweezers, hemostats and soldering iron. I changed-out all paper capacitors and all but three low-value resistors which were well within tolerance. The silver mica capacitors tested were right on the marked value and not leaky (it is very unusual to encounter a leaky silver mica capacitor – they do go open circuit though and can contract 'silver mica disease' where the silvering forms shorts or intermittent shorts within the capacitor).

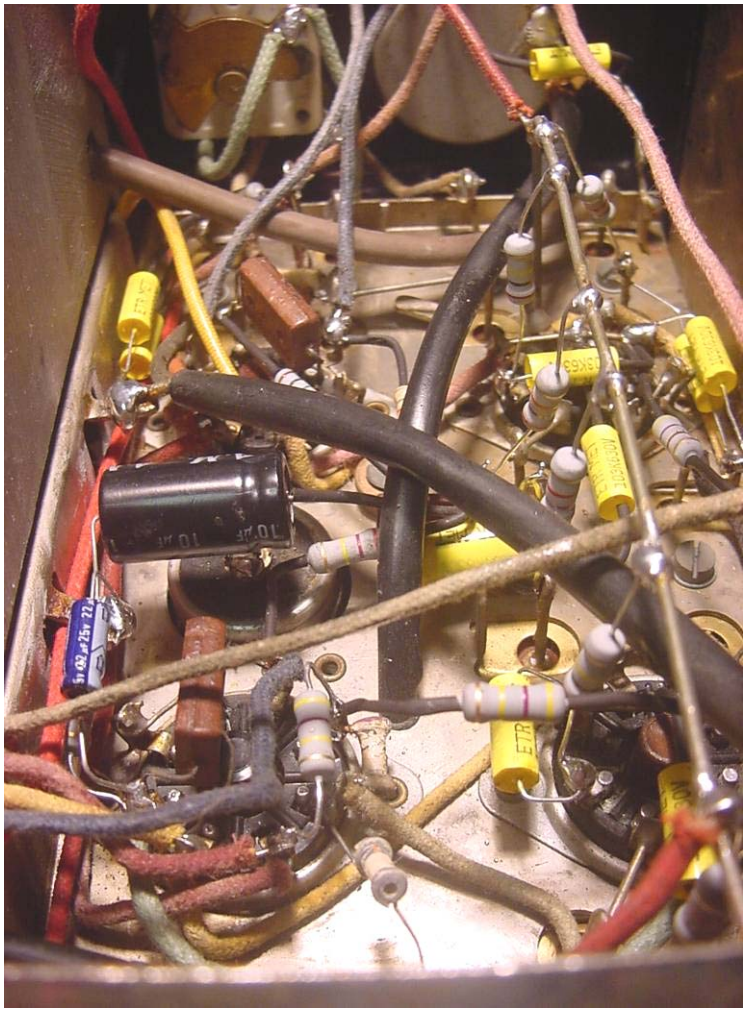


The power supply/BFO compartment was next. One of the original filter capacitors (the 16uF unit) had been removed and the other (8uF unit) was still in place but disconnected (it measured 0.02uF). In their place a couple of fairly new 10uF 450vw units were festooned in the wiring. I tested these (both ok) and replaced one with a new 16uF 450vw unit and re-arranged the wiring a bit to make it a little more secure and neater. I also removed the redundant 8uF can capacitor (but left the holders in place as these are riveted to the chassis). The two 'dog bone' resistors - bias resistors for the mixer stage - located in this compartment (to keep heat out of the coilbox I suspect) were marginally within tolerance but were replaced anyway. I removed the BFO unit and replaced the two paper capacitors and the resistors within before re-installing in the set. I also replaced a couple of plastic-covered wires





Above: BFO unit – before and after replacing the wax-paper capacitors and resistors



with cloth-covered wires. The power lead fitted was a 2-conductor wire (no ground) – I left it for now, but will replace with a 3-conductor lead and fit an internal fuse.

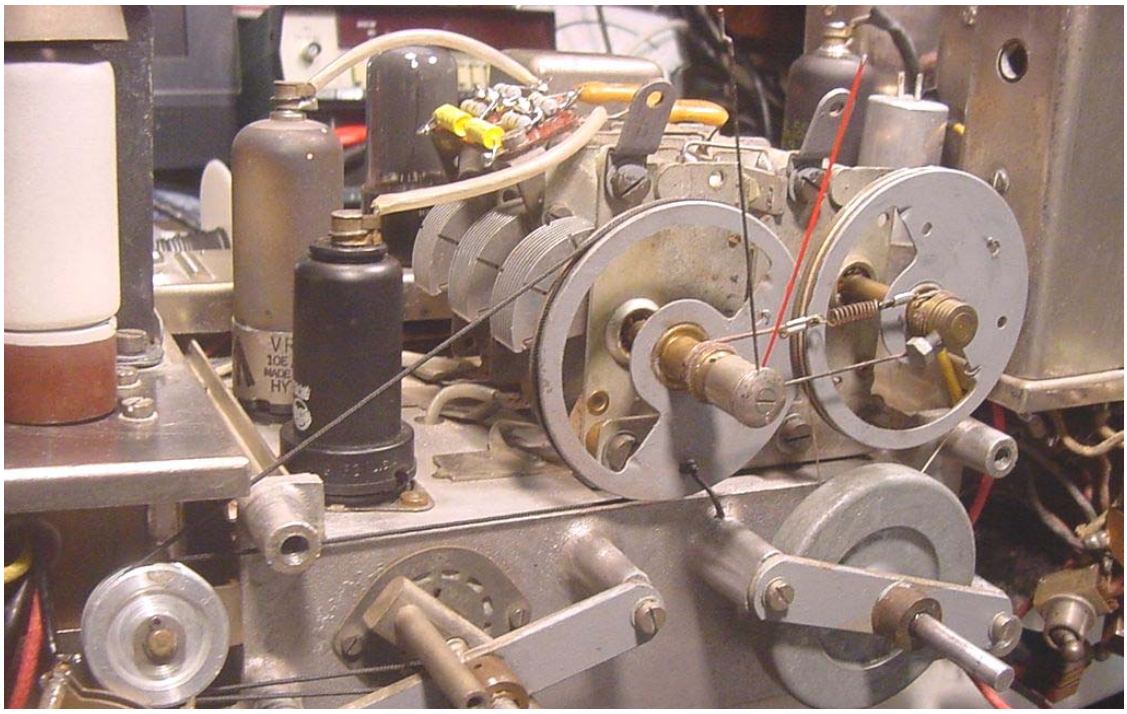
Next-up was the IF/detector/1st AF compartment – the most complicated section of the set. Plenty of room to maneuver though – just needs some planning as to what to tackle first. I started at the back (nearest the rear panel) and worked forward. I ended-up replacing all paper capacitors and all resistors in this unit (photo, left – compare with the photo on page 6). All tubular ceramic and moulded mica capacitors checked-out ok, so were left in place, as was the newish 10uF electrolytic that someone had installed to replace the 8uF unit in the anode supply to V5 (C47).

Above: BFO capacitor repair – careful cleaning, a few drops of super-glue, and two 6BA-tapped spacers carefully cut to the correct length and its as good as new

The switches, others controls and their wiring were then checked-over. The BFO tuning capacitor had not been mounted on the front panel on arrival – it was hanging loose on its connecting wires. On close inspection it was found that the ceramic mounting plate was cracked and had been glued together (poorly). I removed the capacitor and cleaned/ repaired it before fitting two new (6BA tapped) spacers between it and the front panel (photos, above). The length of these spacers is rather critical – too long and the capacitor fouls the two aluminium drive cord pulleys located on the chassis immediately behind. The crystal phasing switch and capacitor was checked next – interesting, as the (non-original) wiring was incorrect: the switch was wired such that when switched into circuit , one side of the crystal was earthed (not much use). I corrected the wiring and cleaned/serviced the capacitor before re-fitting to the front panel (this unit had its original spacers fitted – these are longer than those needed for the BFO capacitor). The RF gain and AF gain pots were checked and found (amazingly) to be in pretty good shape, so these were left as-found. All switches worked ok.

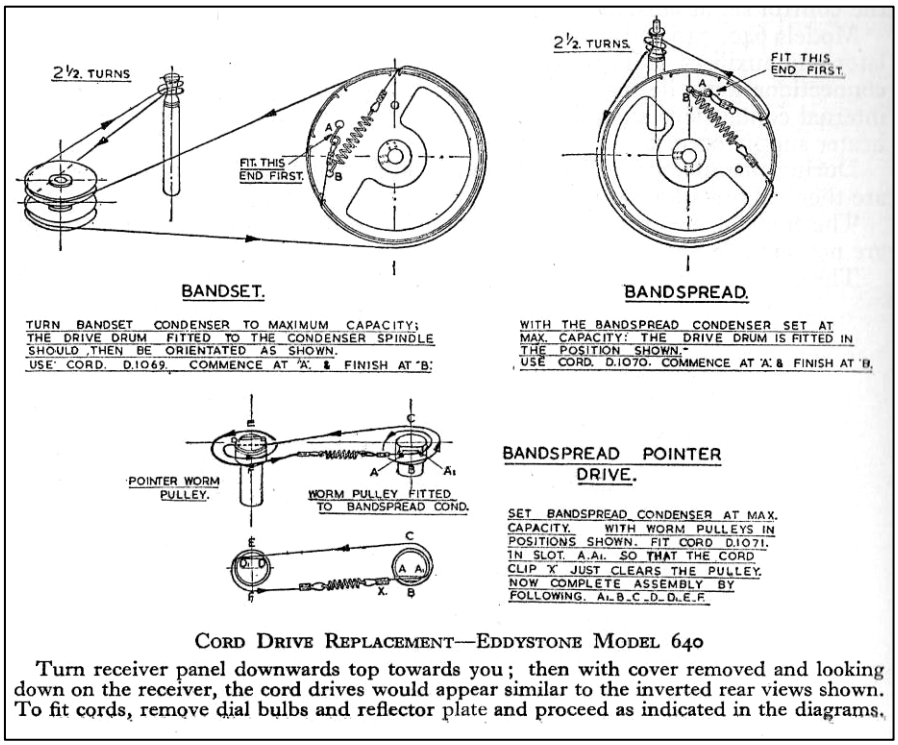
Dial Cords

The S.640 contains three separate dial cords. An explanation of how these are fitted is contained in *Radio and Television Servicing – Pre-1953 Models*, F. Molloy & W.Poole, pp244. There are also some comments here and there in *Lighthouse/EUG Newsletter* (see Bibliography). The diagrams from Malloy and Pool are reproduced below for reference, however, I found these rather difficult to follow and, in the end, I used intuition and a bit of trial and error before I 'got it right'. In this set, the bandspread tuning gang and pointer cords were in place but had to be removed to allow cleaning/servicing of the shafts, etc. I managed to re-use the bandspread tuning cords on re-assembly – which helped a bit as these were both of the correct length. However, the bandset tuning cord (and tension spring) was missing. I only had a thicker gauge of cord in stock and used that (a thinner one would be more suited to this application). It was first knotted at one end and the end of the cord sealed with the tip of my soldering iron to prevent fraying. The cord was threaded through one of the holes in the tuning gang pulley, looped once



Above: tuning drive arrangement after re-stringing. Try reconciling this with the diagrams in Malloy and Poole (reproduced below) – not too easy is it? (and I did a course on applied 3D-trigonometry and celestial mechanics at university!)

around the pulley, then around one of the pair of aluminium idler wheels (mounted on the chassis), then around the bandset tuning knob shaft (2.5 turns), back around the tuning gang pulley and terminating on a (new) tension spring fixed inside the pulley. The length of cord was determined by trial and error – temporarily being tensioned by hand once wound as described and the mechanism tested, the length noted and the knot tied to the spring and the spring then fixed into the pulley under tension. Boy, am I glad Eddystone moved on to all-gear tuning gang drive mechanisms in later sets!



CORD DRIVE REPLACEMENT—EDDYSTONE MODEL 640

Turn receiver panel downwards top towards you; then with cover removed and looking down on the receiver, the cord drives would appear similar to the inverted rear views shown. To fit cords, remove dial bulbs and reflector plate and proceed as indicated in the diagrams.

The bandspread tuning is flywheel-loaded and feels very 'Eddystone' even though the drive is through a cord. However, the bandset tuning leaves something to be desired on the tactile side, being very 'dead' in comparison. I think I would have preferred the bandset to be flywheel-loaded and the bandspread to be 'dead'. Mind you, it would have been even better to have twin flywheels – imagine the S.640 with that!

Initial Power-on and Checks

Having replaced all the waxed-paper capacitors, a cylindrical metal-sleeved paper capacitor and three electrolytic capacitors, all but six resistors (photo, right) plus the odd bit of wire here and there, it was time for initial power-on checks:

- First I (temporarily) replaced the front panel and mounted the pots and switches;
- Next I cleaned and checked all the valves on my Precision valve tester – they all tested ok. I supplemented the ones supplied with the set (three EF39s, two of which had missing screening paint, a 6V6GT and a 6H6) with another EF39, a 6Q7GT, a 6X5GT and a NOS metal envelope 6K8;
- Checked the resistance measurement from HT to chassis – looked good, rising to around 45Kohms on the meter as the power supply filter capacitors charged up;
- Inserted the 6X5GT rectifier and brought-up the mains voltage slowly on the Variac – measuring around 270v DC HT on the rectifier cathode;

- Re-installed the remaining valves and attached a speaker. With power applied I checked the HT current draw at about 75mA (the manual says that an HT supply of 'up to 80mA' is required) – so this seemed ok;
- Noise was emanating from the speaker but there was some banshee-like howling/screaming with the RF gain turned up

beyond half-way;
- Checked all three bands – listening for signals from my signal generator – these were found to be roughly where they should be on all bands;
- Replaced all of the EF39's with NOS valves: the ones supplied with the set had missing/damaged screening paint. This cured the howling and I could now wind-up the RF gain to full without any problems. The set was now bringing in stations on all bands – very well in fact, considering that I had done so much work and not re-tuned anything!;
- Checked operation of the controls – all worked fine, including the crystal in/out and phasing (phew! – I was worried that the mods that had been done were a result of a problem with the crystal unit. No, just someone's incompetence);
- Let the set running for a couple of hours to see if anything showed-up – all seemed fine, nothing overheating and the set was still performing quite well.

Time to work a bit more on the sets cosmetics…

Cosmetic Restoration

Case

Wot' no case?… It's rather difficult to restore a case that is non-existent, so instead I will describe what intend to do: not a bespoke Perspex case this time per my S.750 and S.820, or a scratch-built steel case per my S.940, no, something a bit more serendipitous than that. As I have mentioned many times before, the SPARC radio museum here in Coquitlam, BC, receives 'donations' on its doorstep or into the entrance foyer. Well, a couple of weeks prior to my UK trip, some scrap medical equipment was left there, including a radiation monitor unit of British manufacture – amazingly it had a case that was very close to being an Eddystone look-a-like (photo, below right). Albeit it was made of aluminium and had holes in places that were not needed and no holes where they were, the all-important rounded corners were fabricated into the design… its chassis even had a Mullard EB34 (dual diode) in it suitable for the S.640 in place of the 6H6 that the set came with.

However, on closer examination, the case was found to be an inch too deep, slightly too wide (by about ¼") and was braced with a 2" strip of aluminium spot-welded around the inside of the outer (open) edge of the case, forming a rebate for the front panel to fit into. This strip was also angled on the inside for added rigidity, this reducing the available 'headroom' for the receiver to less than 8" (the S.640 chassis needs $8^1/_2$"). Also, an additional bracing plate was spot-welded internally to the upper centre of the case and two 'runners' were installed internally above the base of the case. All this meant that quite a bit of metalwork was needed to allow the case to be used for the intended purpose: cutting the angle sections from the bracing strip, removing the runners and removing an inch from the depth and ¼" from the width (that would necessitate cutting the case in half). I decided to consult with folks that are better with metalwork than I before tackling this job as aluminium, although easy to work with, can also be easily damaged by attempts at cutting, welding back together, etc. So this part of the project is still a work-in-progress.

In the meantime I tried my S.750 case on the S.640 (my S.750 'lives' in a Perspex case I made for it as its chassis is such a good-looker). The S.750 case has been re-finished in black crackle powder-coat and is the correct size. However, it does not fit the S.640 quite right due to 1) the positioning of the speaker sockets on the S.640 output sub-chassis (too high to fit through the central aperture in the rear of the S.750 case), and 2) the octal power connector on the S.640, which is positioned slightly too high for the right-hand aperture on the S.750 case. Otherwise the case is ok, as the S-Meter octal socket is positioned slightly lower down and an S-Meter plugs in without a problem. So, to allow the S.750 case to fit, I decided to hard-wire the heater jumper behind the chassis-mounted power socket on the S,640, thus avoiding the need to insert the octal jumper plug into the power socket. I also removed the two brass Wander socket extensions that were fitted into the loudspeaker sockets and replaced them with 4BA screws, allowing a short pigtail to be attached to the speaker connections and for this to pass through the central aperture below. Hey presto, a cased S.640! (photo, right). I will continue to deliberate on the aluminium instrument case and will write-up a short note on it if it eventually works out ok. I

also intend to have the front panel re-finished in black wrinkle-finish powder coat as although it looks ok, it could look a lot better.

Scale

The S.640 scale is fabricated on a piece of white translucent plastic. On close examination, it too had unfortunately been given a 'protective' coat of (then) clear varnish – using an old paintbrush I would say. Looks ok at a distance, though a bit of a mess close-up, but after a clean-up with warm soapy water it will do the job until a reproduction one I ordered from Ian Nutt arrives.

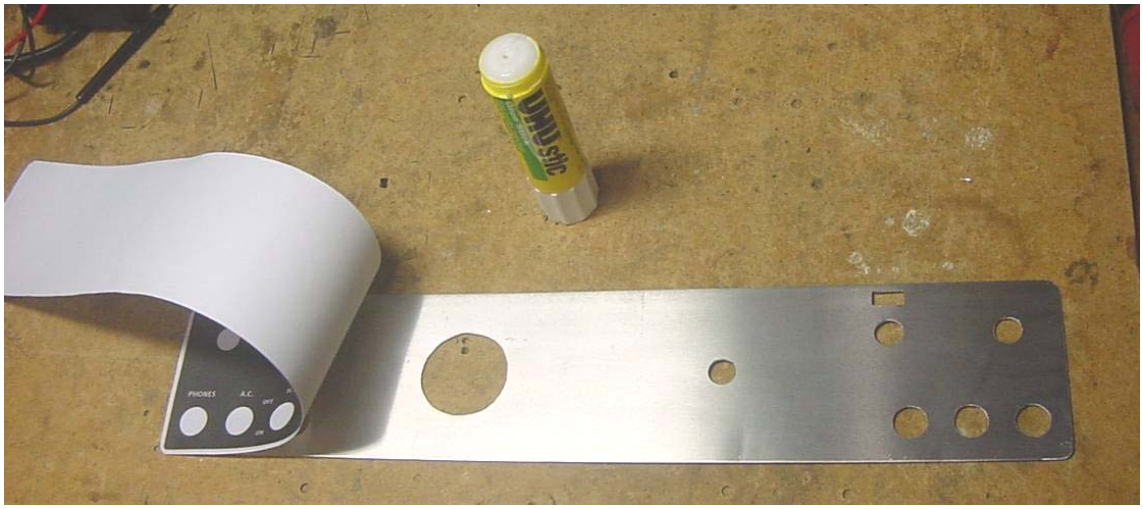
The scale in an S.640 is illuminated by two bulbs mounted on a bracket fixed to the front of the tuning gang frame. This bracket had been (inexplicably) removed from my S.640, so I improvised with a bulb holder that simply clipped to the tuning gang frame – at least the dial was now illuminated. I called-in at the SPARC radio museum and took a pattern from the S.640 on display there – easily fabricated from a piece of scrap aluminium or steel (per the original) – I used a piece of galvanized steel plate removed from a scrap power supply chassis.

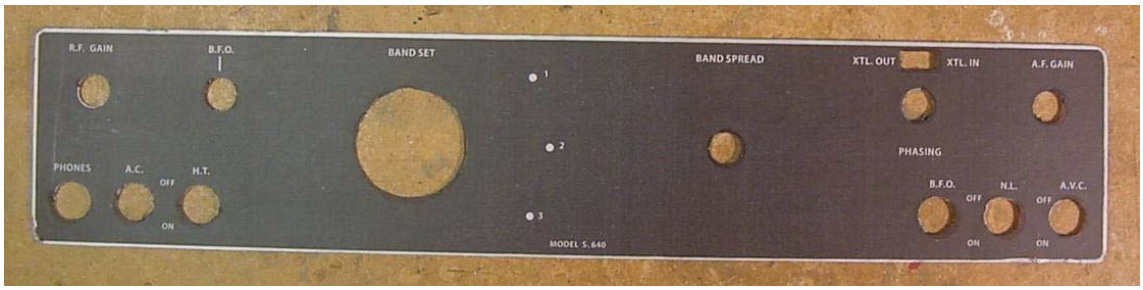
Bandswitch Lever

The bandswitch lever was missing from the set. Ian Nutt had none in stock, so one of my local Eddystone-collecting friends, Pat Jones, VE7PRJ, made one from a scrap piece of steel using one from another S.640 as a pattern. This was chrome-plated and fitted to the set (see photo gallery at the end of this article).

Fingerplate

On arrival, the S.640 did not have a fingerplate (or any knobs for that matter). The fingerplate is the most 'visible' part of the radio after the scale, so I needed to make one or obtain one. As for my S.680/2, I decided on the former as being the most expedient. The local Metal Supermarket store supplied me the aluminium blank cut to the correct size for a couple of bucks. This was worked on - drilling





and filing the required holes, using a 'real' S.640 fingerplate as a template[4]. Not being a whiz with drawing packages, I took the fingerplate in to work and had a chat with our chief drafting guy, George. A short while later he had re-drafted the artwork and then all I had to do was transfer this to the fingerplate. My S.680/2 restoration article identified several ways to do this, with me settling on a simple (and cheap) LaserJet print glued using stick-glue to the aluminium plate. I adopted the same method for the S.640 fingerplate – took around 2 hours to produce, including the metalwork. The artwork is posted to the EUG website for download.

Two large tuning knobs and four small knobs were obtained from Ian Nutt – with these fitted the fingerplate looks acceptable and can be replaced quickly and cheaply if needed.

[4] I noted that in an article by Bryan Cauthery, VE3DFC, on restoring his S.640 back in 2001 (*Lighthouse* Issue 70, page 32) he describes how he refreshed the fingerplate on his S.640. Interestingly one of my Eddystone enthusiast friends at the SPARC museum has just bought this very set on Ebay. This fingerplate was borrowed to use as a template for the aluminium blank. Bryan mentions that his set was S/N EY900 – this is 25 sets before mine on the Bath Tub production line – likely the same week. Bet the folks working on them in 1947 never thought for a second they would both end up in Vancouver being restored in 2010!

Finishing-up

Above: replacement bias resistors and bypass capacitors on the small tagstrip fixed to the top of the tuning gang assembly – neatness is important as this unit is highly visible on opening the case lid

As noted earlier, the set came fitted with a two-conductor captive power cord in ok condition. Although this cord was likely not the original, the sets were supplied from new with a captive cord, having a hole in the rear plate of the power supply section for this to enter the chassis. I replaced the cord with a three-conductor cord and fitted an in-line fuse into the live conductor beneath the chassis.

While I was flicking-through the S.640 manual (BAMA download version) and also some copies of *Lighthouse*, I noted that there were some recommended mods to the original circuitry of the S.640 that were incorporated into later production models. Strangely, the circuit diagram of the set was never modified to show these changes. These mods are:

- Adding a 500pF capacitor across the heater pins of the mixer valve (V2) socket. This is noted as required to remove occasional traces of modulation hum;
- Adding a 500pF capacitor between 'the lower end of R35 and ground'. This is noted as required to reduce amplification of higher audio frequencies; and
- Re-wiring the 'HT' (Standby) switch function. In early production models this switch removed the HT voltage from all the valves with the set in standby mode and also connected pins 3 and 4 of the power supply octal socket on the rear panel (to switch a transmitter on/operate an aerial changeover switch, etc). However, removing the HT from the valves means that the receiver is de-tuned when switched back on as the operating condition of the valves has temporarily changed, taking some time to re-stabilize. This was overcome by using a different approach to muting the receiver in later production models (and as used in many other Eddystone models) by keeping the HT on the valves during standby but reducing the RF/IF stage gain. This was effected by including a 22Kohm resistor between the earthy-end of the RF gain potentiometer (R26) and ground, this resistor being shorted-out in receiving mode by the former 'HT' (now 'Standby') switch. When the 22Kohm resistor is not shorted-out (in standby mode), the RF/IF stage gain is considerably reduced, however, a local transmitter operating on the receive frequency could still be monitored – a useful facility. Another advantage of this approach is that the 'HT' switch no longer switches over 75mA

at 250v DC (not too good for the contacts) and the HT wires are removed from close proximity to the front panel, giving an improved level of safety.

Other mod suggested/described in *Lighthouse* include:

- Replace C52 ('phones coupling capacitor) with a 0.1uF part. The reason given is that the original becomes leaky (true) but it is actually a 0.01uF part (typo?);
- Replace C63 with a 50v rated part (no reason given);
- An alternate standby switching arrangement of simply installing a 22Kohm (0.5W) resistor across the HT switch to keep reduced HT on the valves during standby (evidently this was adopted for a while between the very-early complete removal of HT and the muting arrangement described above);
- Re-wiring the AF gain control. The S.640 circuit uses the 500Kohm AF gain pot (R36) to provide bias to the grid of the triode section of V5 through not having a DC-blocking capacitor between it and the grid of V5. It is noted in *Lighthouse* that it is not good practice to have a DC current passing through a carbon-track potentiometer (which is correct) and the suggested remedy is to include a 0.01uF blocking capacitor between the slider of the AF gain pot and the grid of V5, adding a 500Kohm grid leak resistor between the grid of V5 and ground to apply bias voltage to the valve. However, in my set the AF gain pot was working fine (and as far as I can tell is the original part), the DC voltage on the pot is small (less than a volt) and the current draw negligible, so I decided to leave this circuitry as per Eddystone's design;
- Reducing the frequency range of the BFO. As standard, the S.640 BFO can be swung over a wide frequency range. This wide range makes it difficult to adjust the BFO precisely for good reception of SSB. It is suggested that including a small-value capacitor in series with the BFO variable capacitor improves this significantly – a value of around 15pF being noted as giving the required reduction. I agree that the BFO range is too wide but have not (yet) tried this mod - easy to do and easy to undo, so I may give it a try;
- Increasing the injection level of the BFO. It has been commented that the injection level of the BFO (via a 3pF capacitor, C66, to the detector diode) is insufficient and that the value of this capacitor should be increased to provide a stronger AGC signal. I have not found this to be an issue providing the set is operated as per most sets that do not have a product detector fitted, ie. when receiving SSB, wind the AF gain almost fully up, wind the RF gain down (to better-match the incoming signal with the BFO level) and switch the AGC off (otherwise the BFO signal can de-sensitize the receiver); and
- 'Make it talk' – yes, some folks have actually changed the AF output sub-chassis into a

Above: AF output stage sub-chassis after replacing the 25uF bypass capacitor and 0.01uF waxed paper capacitor (other components test ok) – no transmitter lurking in here as far as I can tell…

transmitter, cut a hole for the audio output valve on the IF/1st AF stage sub-chassis and re-wired the circuits for the set to act as a QRP transceiver … (aaarghhh!!).

Finally I gave the chassis some further attention – cleaning nooks and crannies above and below it with Q-Tips, further work on the tuning gang frame (I stopped short of removal and chrome-plating, but I was tempted) and cleaning the coil box cover plate.

Re-Alignment

The S.640 manual provides all the alignment information needed for IF and RF/Mixer alignment. I will therefore not repeat this method here. Per the manual, this is carried out using an output meter and signal generator/crystal calibrator (though these days a digital frequency meter, synthesized signal generator and/or a synthesized HF receiver are more convenient).

The only issue arising was that the slug in the crystal unit and in the Range 3 aerial coil were stuck tight and had to be coaxed out. I replaced both slugs with new ones and added a touch of Rocol Kilopoise to stop unwanted movement of the slugs. The original slugs are of a design that has a keyway cut into one side, this being filled by a strip of round plastic to prevent unwanted movement when inserted into the coil former (photo, right) – I presume 63 years ago this plastic strip was supple but has now hardened, causing some cores to stick in the coil formers.

Conclusion

I always wanted to add an S.640 to my modest Eddystone collection – for both sentimental reasons and as I think it is a rather unique set in a number of ways, having the dial cord drives and concentric bandspread and bandset pointers in the dial, a bandswitch lever and a single-pole crystal filter without a variable selectivity control. It is also a 'half-mooner', which I find an attractive design (I now have three of these and counting…[5]). I have not been disappointed: performance is pretty good considering the fairly simple design – my set is probably performing as good as (or even better) than new with mostly modern components and all-NOS military grade EF39's fitted. However, I would not like to think it was my main receiver for serious DX'ing on the HF amateur bands of today – variable selectivity would be a nice addition, as would a product detector and higher degree of thermal and mechanical stability. It was very satisfying to have the set donated 'to a good home' and to see what had been an unwanted, derelict 'parts set' brought back from the brink of the scrapheap to a set that is a desirable piece of radio history and into everyday use.

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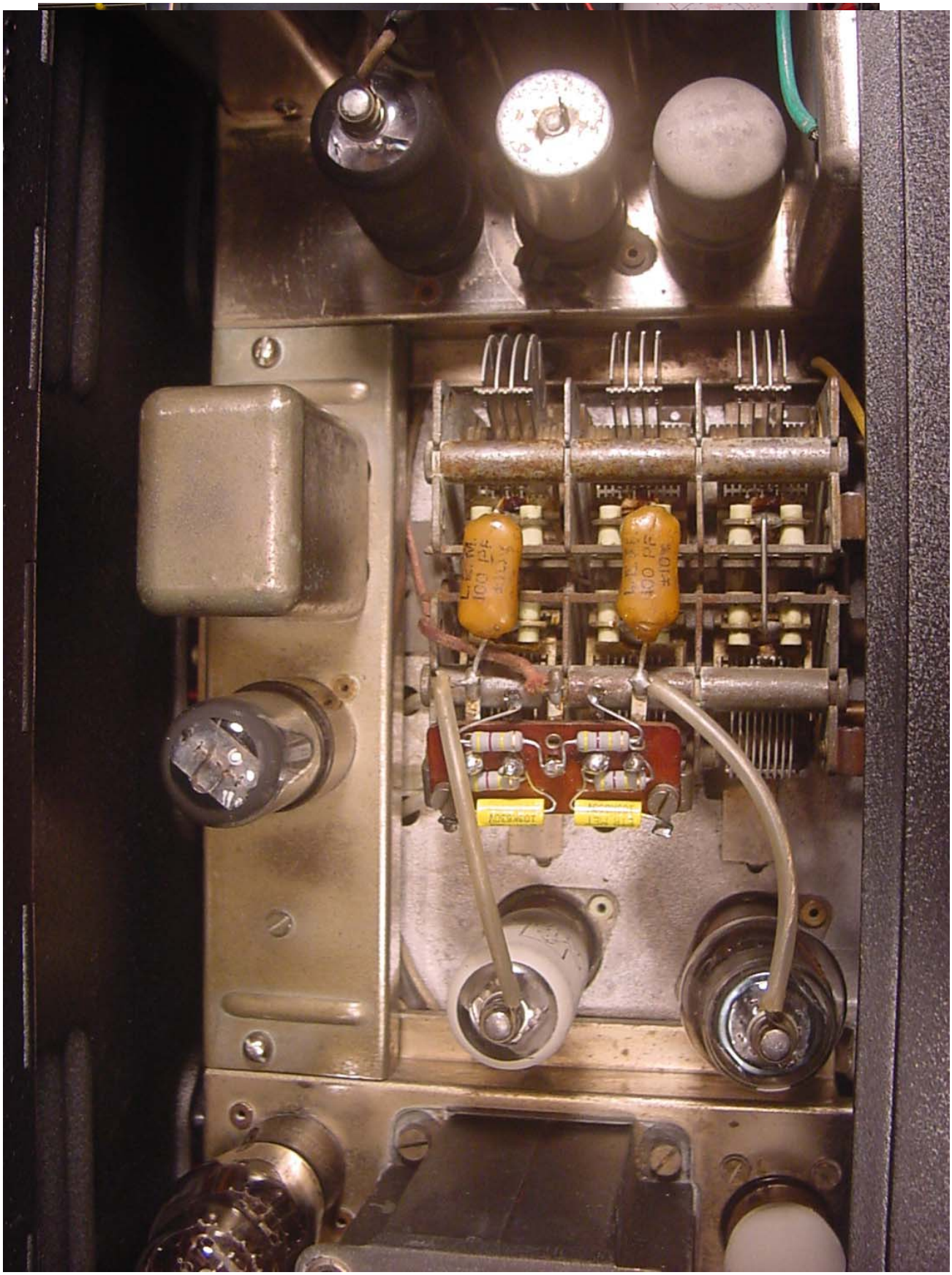
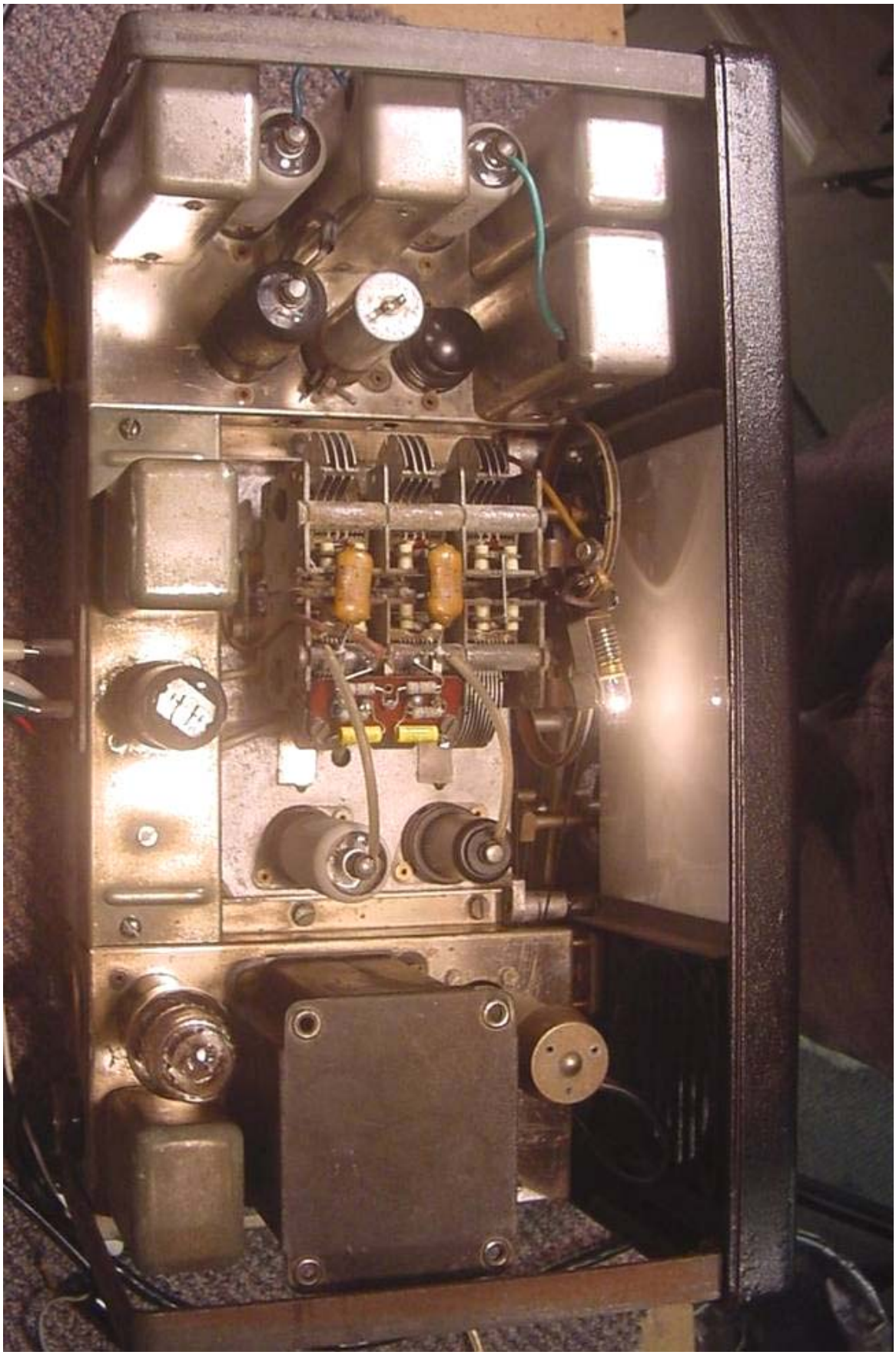
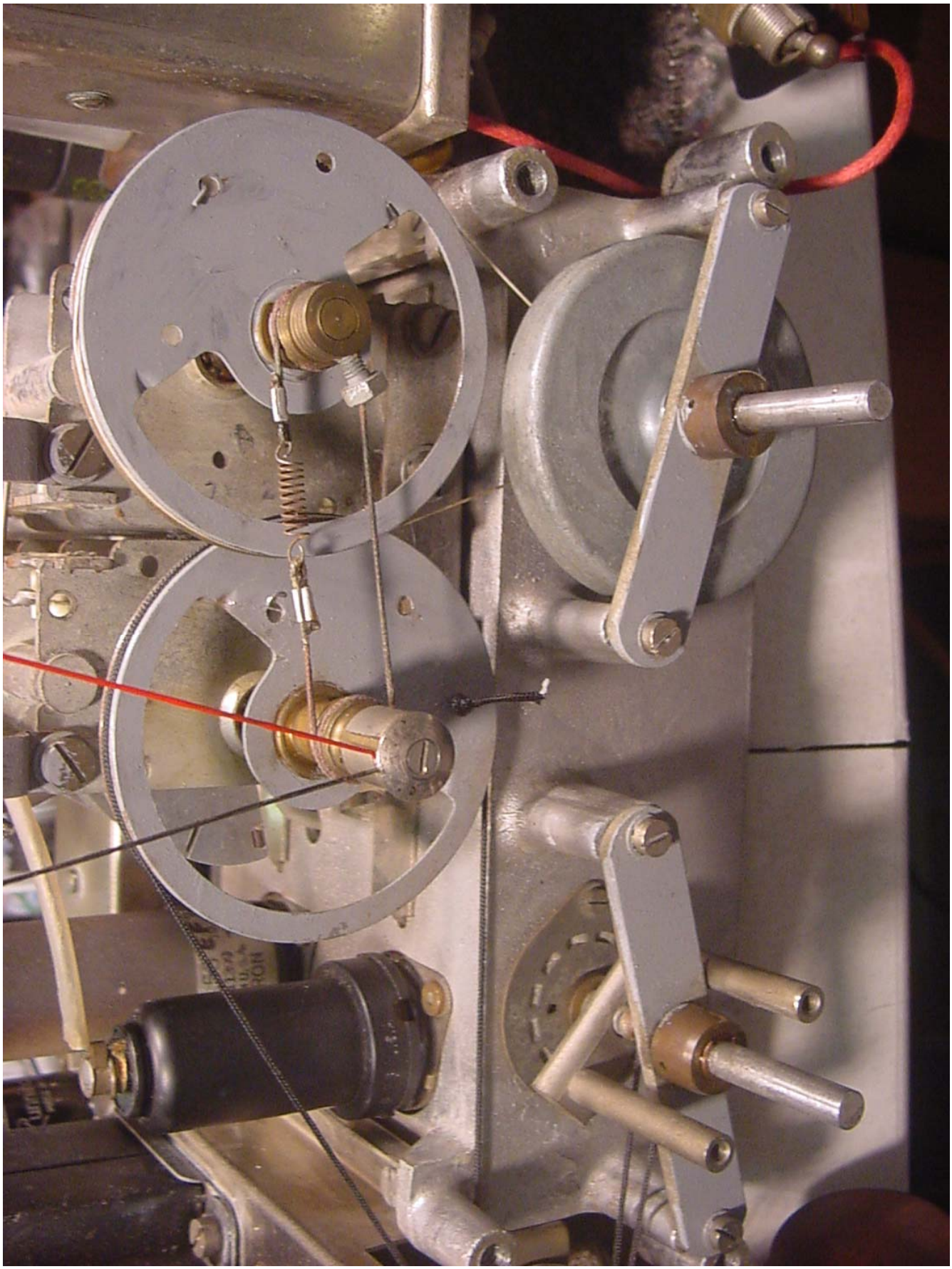
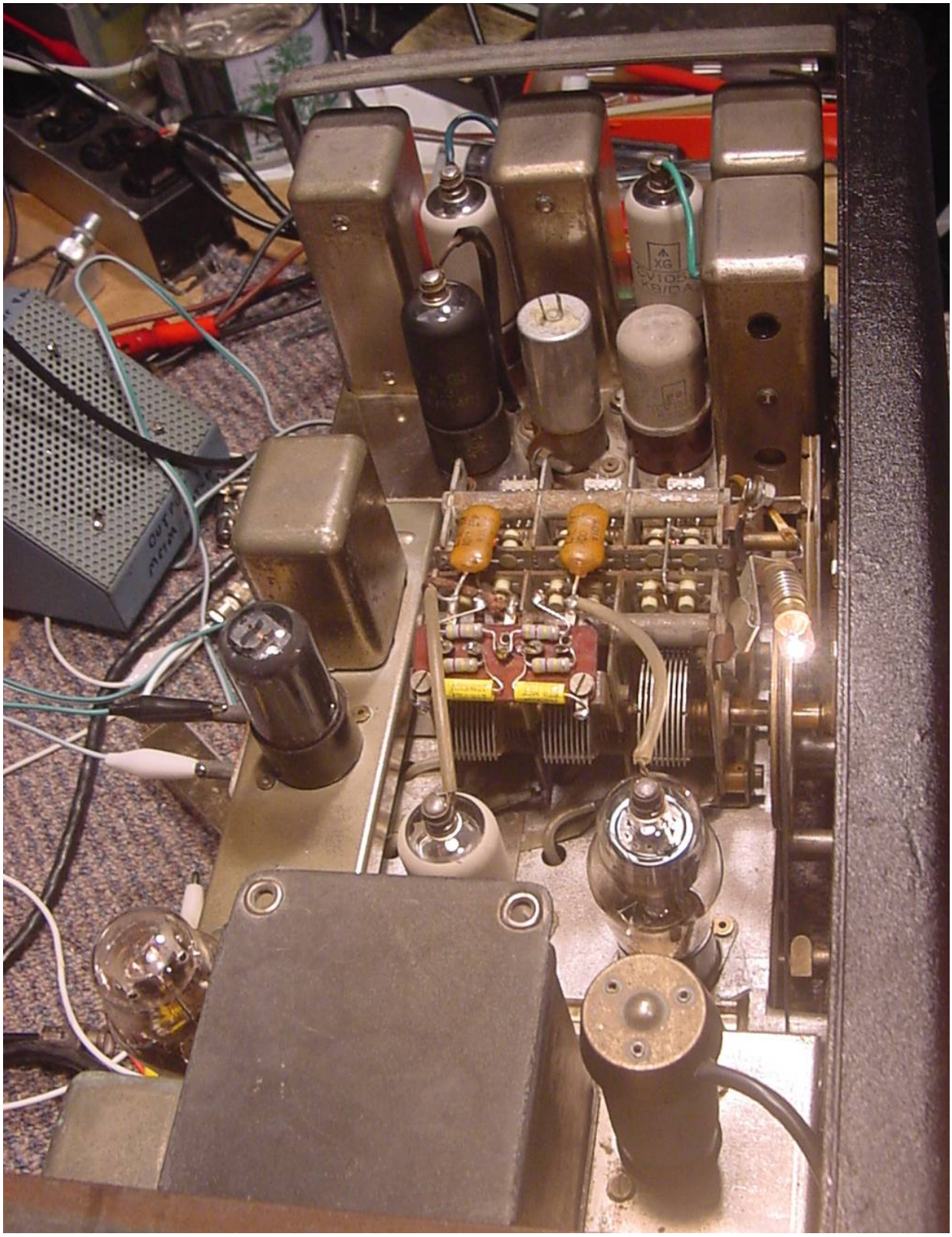
[5] The S.640 an S.680/2 and an S.740.

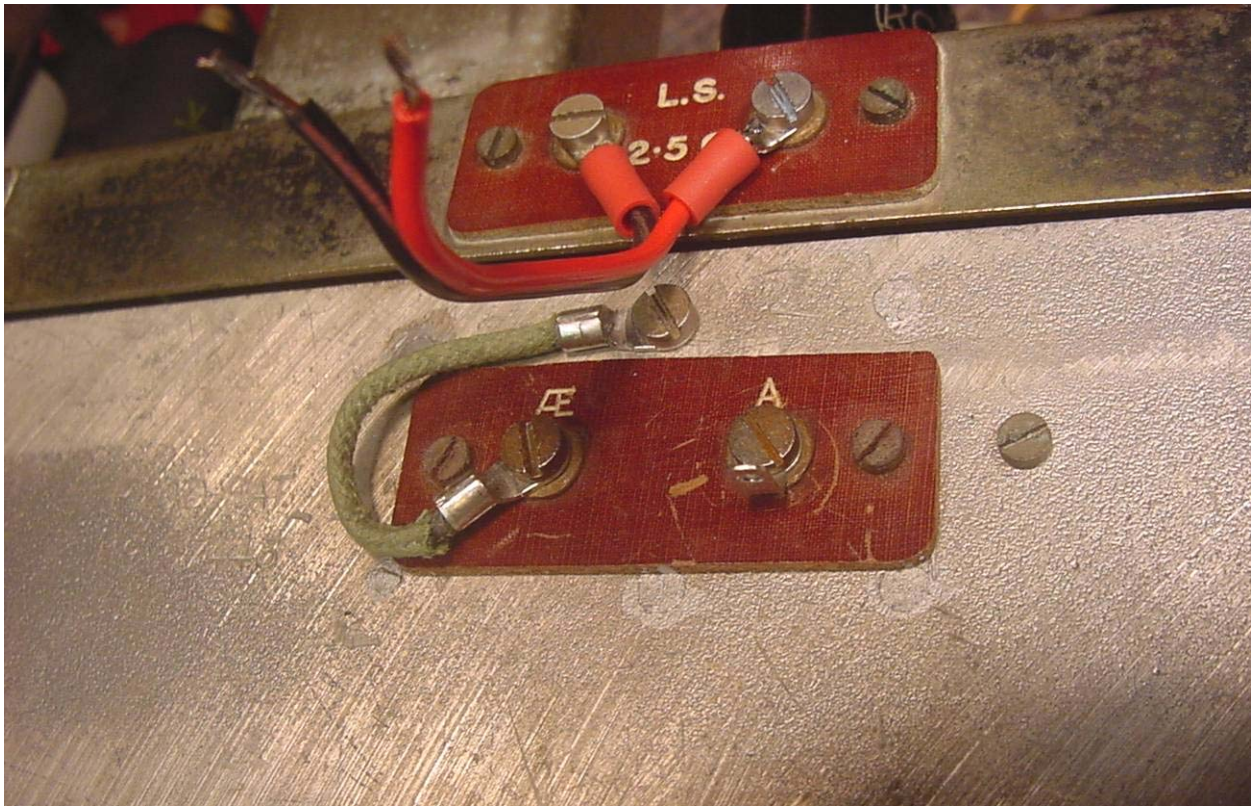




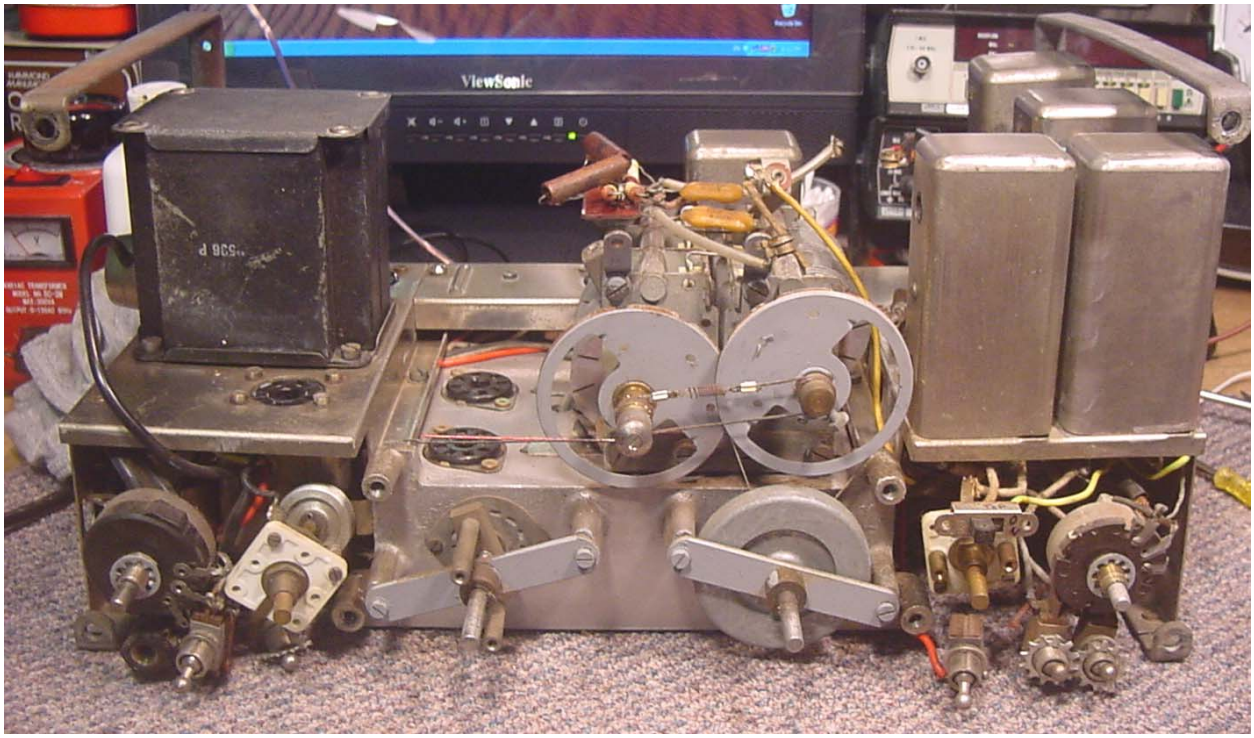


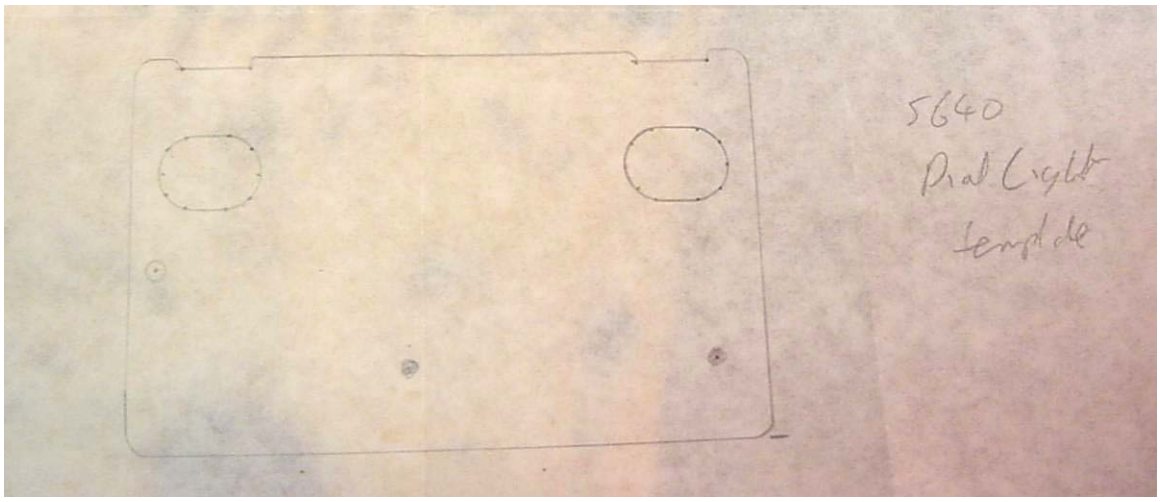


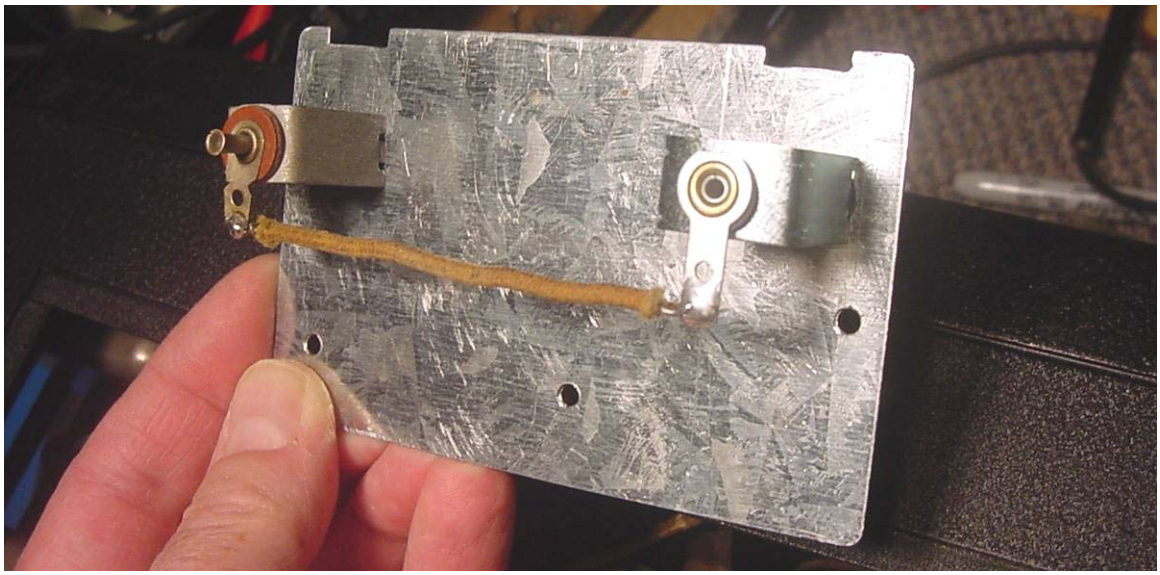
Above: note that the 6H6 dual diode valve has been replaced with a Mullard EB34 and the metal 6K8 converter valve has been replaced with a 6K8GT (glass bottle). The two wax-covered silver mica capacitors on the tuning gang were cleaned and than 'freshened-up' (glossy-finish) by waving a heat gun gently over them to slightly re-melt the wax

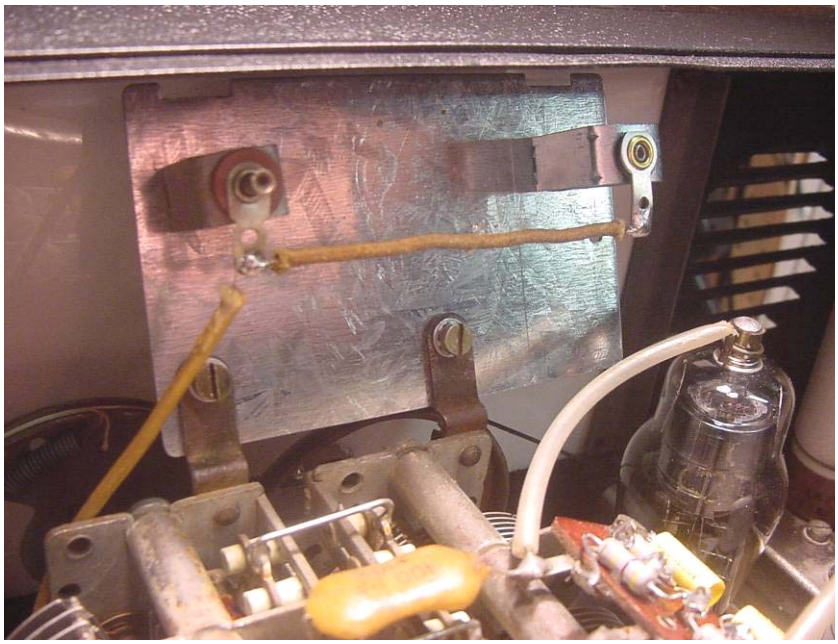


Above: aerial/ground connection strip. The few extra holes that had been drilled through the cast-aluminium coilbox for a PL259 socket, etc. were filled with JB-Weld and touched-up with a silver marker pen ('Sharpie'). Below: front panel removed before commencing work on component replacement – needed for access to the tuning drive pulleys during re-stringing

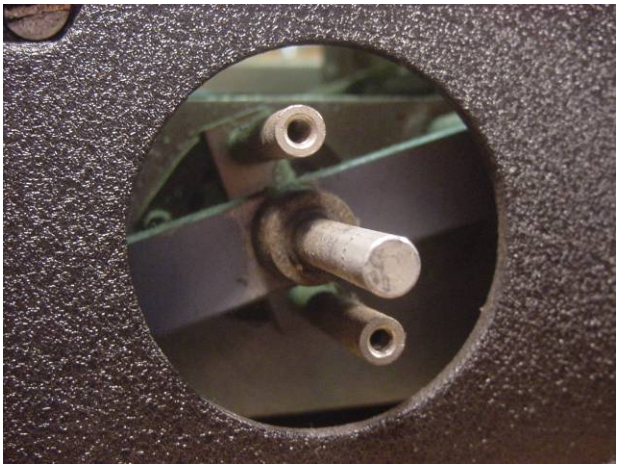








Top: template tracing made from the SPARC S.640 for the dial light mounting plate. Centre: the finished homebrew plate made from a piece of scrap galvanized steel. The holes in the plate are tapped for 4BA screws. The bulb holder on the left is original, that on the right a modern equivalent. Bottom: the plate fitted into the receiver. Note that the wire from the heater circuits is a length of resistance wire with a nominal resistance of 2.6ohms (R41)



Fixing a hole… Left: the wavechange switch and bandset tuning shaft on arrival at the VE7GUH shack…

Right: reproduction bandchange lever made by Pat Jones, VE7PRJ, using another S.640's lever as a prototype. A piece of scrap mild steel, lots of Pat's elbow grease/skill and a local chrome-plating company did an excellent job!

Left: the reproduction bandchange lever fitted to my S.640 using a couple of chrome-plated tapered-head 4BA screws from my junk box

Right: and finally the NOS bandset tuning knob is fitted. It is much better with this lever installed - I had to poke around behind the front panel with my index finger to change bands before!


EDDYSTONE
MADE IN ENGLAND
MCS.
BAND SPREAD
BAND SET
A.F. GAIN
A.V.C.
XTL. IN
XTL. OUT
B.F.O.
R.F. GAIN
PHONES
M.T.

Above: Rear view of S.750 case fitted to the S.640 – note the speaker 'pigtail' (here terminated in a connection block) needed to allow connection to be made to a loudspeaker


Mc/s.
BAND SPREAD
BAND SET
MODEL S. 640

Above: Restored S.640 with matching 7" loudspeaker (Model 688) and Signal Strength Meter (Model 669). Below: serial number stamped on the IF/1st AF sub-chassis.


MODEL S.640
BAND
H.T.
OFF
ON
A.C.

Bibliography

- Radio and Television Servicing – Pre-1953 Models, F. Molloy & W.Poole,
- Various documents downloaded from the EUG website, including:
  - The Ultimate Quick Reference Guide (QRG), 2nd Ed., 2005, Graham Wormald, G3GGL
  - S.640 Manual
  - S.640 Schematic redrawn by Tor Marthinsen
- S.640 Manual downloaded from the BAMA (mirror) website (http://bama.edebris.com/manuals/). This includes additional (modification) information and prints better than the manual on the EUG website
- Websites (as well as the EUG site http://www.eddystoneusergroup.org.uk/)
- *Lighthouse*/*EUG Newsletter* (note - these are per the index on the EUG site – some issue/page numbers have been found to be inaccurate):

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