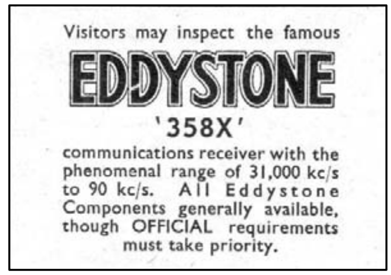
Serendipity - Restoration of an Eddystone S.358X for the SPARC Museum Collection, by Gerry O'Hara, VE7GUH/G8GUH

Introduction

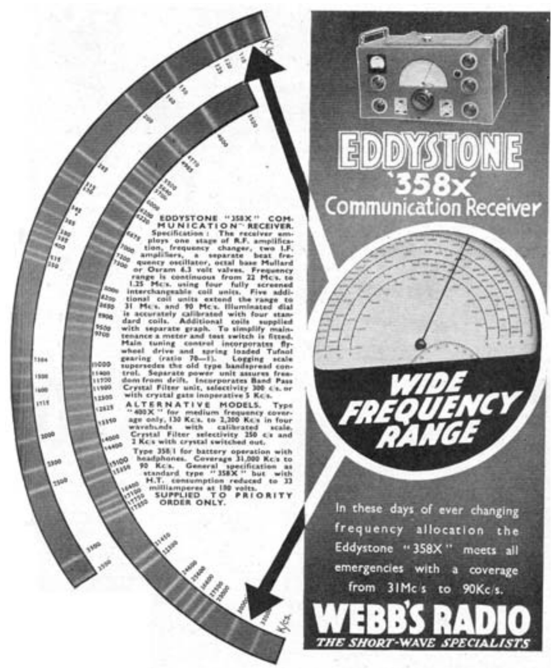
It was one of those serendipity moments – I was talking radios with another member of the SPARC museum here in Coquitlam, BC, when the conversation drifted towards Eddystone sets. "Oh, and I think there is another one on the top shelf in the communications receiver section" said Bruce. "Really" I said, somewhat in disbelief, as I had pottered around that section of the museum several times and thought I had 'clocked' them all. "Ah, here it is" said Bruce pointing to the top shelf – "Oh!" I exclaimed, realizing he was pointing to an Eddystone S.358X. This set is actually visible in the museum photo I included in my S.770R restoration article – see circled radio in a copy of that photo, above. I guess I am a bit of a 'short-house' so somehow missed it way up there… We heaved the set off the shelf and discovered the 'coilpack coffin' behind it, complete with a full set of 10 coilpacks. Unfortunately there was no power supply, but hey, I was over the moon just to see another Eddystone in the museum – and one not in my collection to boot! Taking a closer look, the set was in pretty rough shape (photo, below, right), sporting two additional controls to those found on an S.358X front panel, together with some randomly-located holes. On opening up the lid, it was obvious that several significant modifications had been undertaken on the set over the years, including fitting what appeared to be a Q-Multiplier, an additional RF stage and replacement of the RF stage valve (EF39) with a miniature valve (6BA6). Of course I offered to restore the set to its original specification and close to its original good looks…

Background to the S.358

The 'Quick Reference Guide' ('QRG') notes that the S.358 was a 'private venture' receiver, designed in 1940, built throughout WWII and supplied only to 'priority customers' - see extract, right, from a 'Webb's Radio' advert in Wireless World dating from June, 1943 (note that the lower end of the cited frequency range of the receiver in this advert is 90kHz, whereas the lowest-range coilpack, Range 'J', accompanying the SPARC museum's S.358X, covers 40kHz to 90kHz, as is also noted in the manual). The QRG also reports that around 5,000 of these receivers were built, with the S.358 and S.358X being by far the most common. Strangely, the S.358X advert (left) actually depicts an S.358, ie. without the selectivity control). Its other variants, the S.358/1 (fitted with a low-consumption output valve, a 6J5 or 6C5, for battery operation), and the low-frequency only S.400, S.400X and S.400B models, these having a 110kHz IF, are much rarer. Interestingly, the S.400B – a specialized low-frequency receiver intended for CW use only - was the first commercial receiver fitted with a product detector[1]. The S.400B was reportedly used by the RAF Air Sea Rescue Service, listening for signals from 'Gibson Girl' emergency dinghy transmitters[2].



Although the origin of the S.358 lies in the earlier L.P.C./R101 (the R101 was a version of the L.P.C made for the British Army) and later E.C.R. designs, these sets did not have that much in common, electrically or mechanically. However, the L.P.C. (itself a communications version of the mid-1930's 'All World Eight' design) used plug-in coilpacks very similar to those used in the S.358 (see the R101 manual available on the EUG website), though covering only between 530kHz and 22MHz. Minor elements of these circuits were also similar to the S.358, such as the BFO unit in the E.C.R. design, however, the E.C.R. contained an internal power supply, had four switchable ranges and was fitted with US-type valves.



[1] An ECH35: the hexode acting as the product detector and the triode section as the BFO (permanently on, so this the set was only useable for CW transmissions) – see article by Peter Lankshear in Lighthouse Issue 71, p39, including schematic of the product detector and audio stage of the S.400B

[2] Bright yellow self-contained dinghy transmitter carried by all Allied multi-engined aircraft by 1943. It was about a foot cubed with a scooped 'waistline' (hence the name), which could be gripped between the knees. The operator cranked a handle on top and generated HT and LT for a 6V6G crystal oscillator on 500kHz, with 'SOS' being keyed automatically (note courtesy of Peter Lankshear/Graeme Wormald)

There are many references to the S.358 series in EUG Newsletter and Lighthouse (see references) and these make good-reading. Some period adverts for the S.358 taken from Wireless World are included here by way of illustration (courtesy of Tor Marthinsen).

Circuit Description

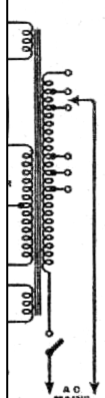
The S.358 is an (extended) general coverage single-superhet design - see advert on previous page - having 7 valves and requiring an external power supply (nominally 180v DC at 65mA and 6.3v at 1.4A). The circuit is fairly straightforward, comprising:

- Single-tuned aerial transformer coupling to a single RF stage (EF39 variable-mu pentode);
- Single-tuned transformer coupling the RF stage to the signal grid of the heptode (mixer) section of an ECH35 triode-heptode, the triode section of which acts in a parallel-fed Armstrong-type local oscillator circuit;
- The anode of the hexode mixer is connected to the 1st IF transformer (split) tuned primary winding via a short length of coax cable (as they are physically located on opposite sides of the chassis). In the S.358X, the 1st IF transformer comprises two separate circuits: with the crystal filter switched out, the grid of the first IF amplifier (EF39) is connected to the tuned secondary transformer winding of the 1st IF transformer. With the crystal filter switched into the circuit, the transformer secondary is disconnected from the circuit and the hexode anode is connected to the 'Cyldon' twin crystal unit[3], this being connected directly to the grid of the 1st IF amplifier;
- The two nominal 450kHz IF amplifiers (2 x EF39) are in a conventional arrangement, coupled via double-tuned IF transformers, the 3rd IF transformer feeding one of the diodes in the detector/AGC/1st audio amplifier (EBC33);
- The detector diode connects to the 1st audio stage (triode section of the EBC33) via the AF gain control, and the anode of the audio output valve (EL32) is connected to an output transformer providing low-impedance output and also, via a capacitor, to a high-impedance (phones) output;
- AGC is provided by the second diode in the EBC33, this supplying signal-controlled bias to the RF and two IF amplifier stages;
- Manual control of RF/IF gain is also provide

Simmonds-Robinson
Crystal Filters

Double Crystal Band-pass Couplings for Telegraphy and Telephony

ARRANGEMENTS have now been made by Simmonds Aerocessories, Ltd., Great West Road, Brentford, to go into production with two types of crystal band-pass filters, one for telegraphy with band widths of 300 to 500 c/s ± 50 c/s, and the other for telephony with band widths up to 3,000 c/s and tolerances of + 250 c/s and – 500 c/s. Normally the mean operating frequency is 465 kc/s, but other frequencies between 440 and 480 kc/s can be supplied. A filter for 1,600 kc/s has also been developed.

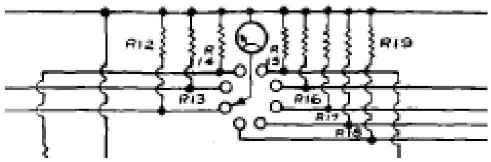


The filters are made up in conventional screening cans with external adjustments for the circuit trimmer and balancing controls, and can be readily substituted for existing IF couplings. Circuit constants have been worked out for input and output loads usually met with in RF pentode valves.

[3] EUG Newsletter No. 42, p20 notes that the crystal filters used in the S.358X were manufactured by Simmonds-Robinson – see extract from Wireless World from November, 1940 reproduced above, right.

by varying the cathode voltage of the RF and IF amplifier stages;

- A tone control is provided via a simple ('top-cut') variable resistor/capacitor arrangement on the anode of the output valve;
- A simple Hartley oscillator functions as the BFO, loosely-coupled to the detector diode via a small capacitor;



- An unusual feature of the circuit is the ability to monitor the anode current of each stage – a little complication to the wiring arrangements of the set, but a good diagnostic tool for identifying a weak valve or otherwise faulty stage. In addition, the anode current of the RF stage can be used as a simple (reverse-acting) S-Meter;

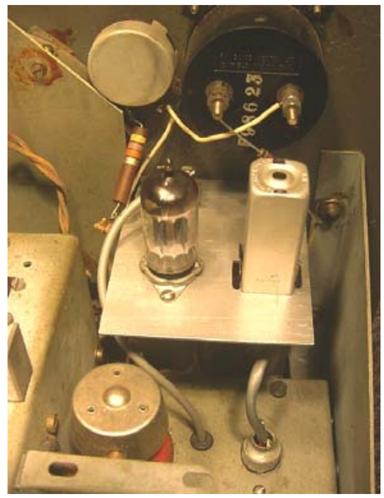
- Instead of having a complicated and problematic band-switching arrangement (switching 10 ranges), the design incorporates plug-in coilpacks, each one including the aerial, mixer and local oscillator tuned circuits – similar to the HRO receiver design - simple and very effective (Note that the HRO arrangement had the coilpack compartment located below the receiver chassis, reportedly to mitigate heating effects, whereas the S.358 arrangement has the coilpack sockets mounted above the chassis on a raised platform);
- Also similar to the HRO design concept, the receiver does not contain a power supply – indeed, it could be battery powered (and a version with a triode output valve was available to reduce the power consumption). A separate supply was available, however, either the Type S.390 or S.390B. One of the claimed benefits of keeping the heat-generating power supply components separate (as in the HRO) was improved thermal stability;
- Unlike the HRO, however, the S.358 was constructed as a series of modules (see illustration in the advert, right):
    - o Main chassis, with the RF and mixer-oscillator stage located to the left

and the tuning gang/coil mounting platform centre, with
- Each of the two IF stages, detector/AGC/1st audio, and output valves constructed on four small separate sub-chassis bolted into the right-hand side of the main chassis,
- The BFO as a separate unit mounted on the front panel, and
- Ten plug-in coilpacks containing the RF tuned circuits.

This arrangement must have facilitated construction (and, potentially, servicing) of the set a great deal, as each of these modules could be assembled separately with minimal effort when connecting into the main chassis.

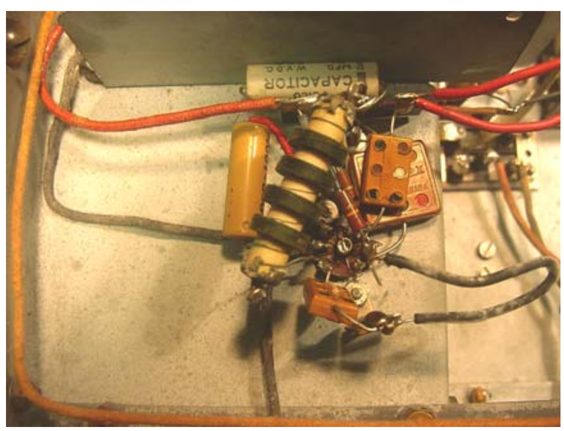
Initial Inspection and Decision-Making

As noted above, from external appearances it was obvious that several modifications had been made to the set over the years, evidenced by extra knobs and switches as well as additional holes here and there. Closer inspection of the chassis revealed that the modifications were more extensive than I first thought, including:

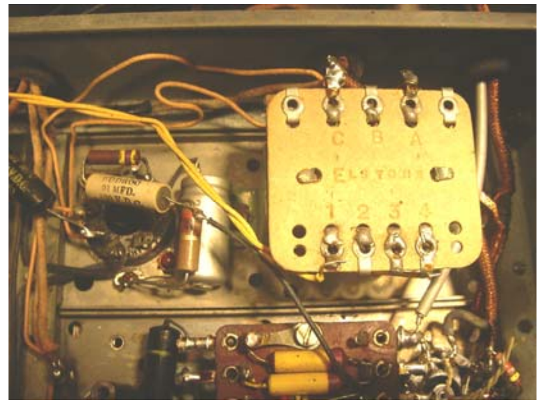


- A Q-multiplier fitted to the converter stage – built on a small aluminium sub-chassis (ok, 'chassis' is probably too grandiose a term, a better one would be 'bracket' – photo, right) mounted beneath the front panel meter. The circuit was built around a dual-triode (an ECC82 (12AU7)) ;

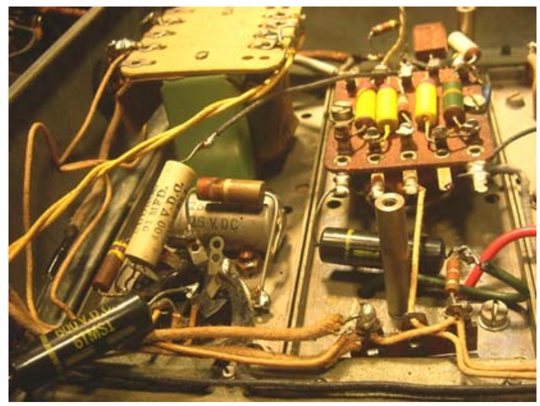
- Octal RF stage valve (EF39) changed to a miniature type (6BA6) and associated passive components changed (photo, left);
- Un-tuned RF stage fitted (missing a valve - 6BA6?) – located in the space on the chassis behind the original RF stage (photo, below);



- Audio output stage modified to take a 6V6G (instead of the original EL32);
- The front panel meter had been modified to be used only as an S-Meter, with modifications to the second IF stage wiring to allow this;
- The original valve anode current monitoring circuitry had all been removed, including the meter switch and shunts, the HT being hard-wired to each valve;



- A replacement audio output transformer had been fitted – photo, right (actually this was not such a bad thing as it matched to 8 ohm instead of 120 ohm of the original fitment), but whoever did that also replaced the phones/speaker sockets and, finding that the collars on the new sockets were not quite long-enough to fit through the front panel and the escutcheon, cut part of the escutcheon away… (!);
- Replaced many of the 0.1uF by-pass capacitors with 0.01uF parts of varying appearance, quality and voltage (photo, below, right). Several resistors had been replaced with whatever had been a 'near-enough' replacement from a junk box likely filled with bits rescued from old TV chassis etc…, and not forgetting the *RadioSpares* capacitors with deep splits in their cases (photo, below) – altogether, not a pretty sight;



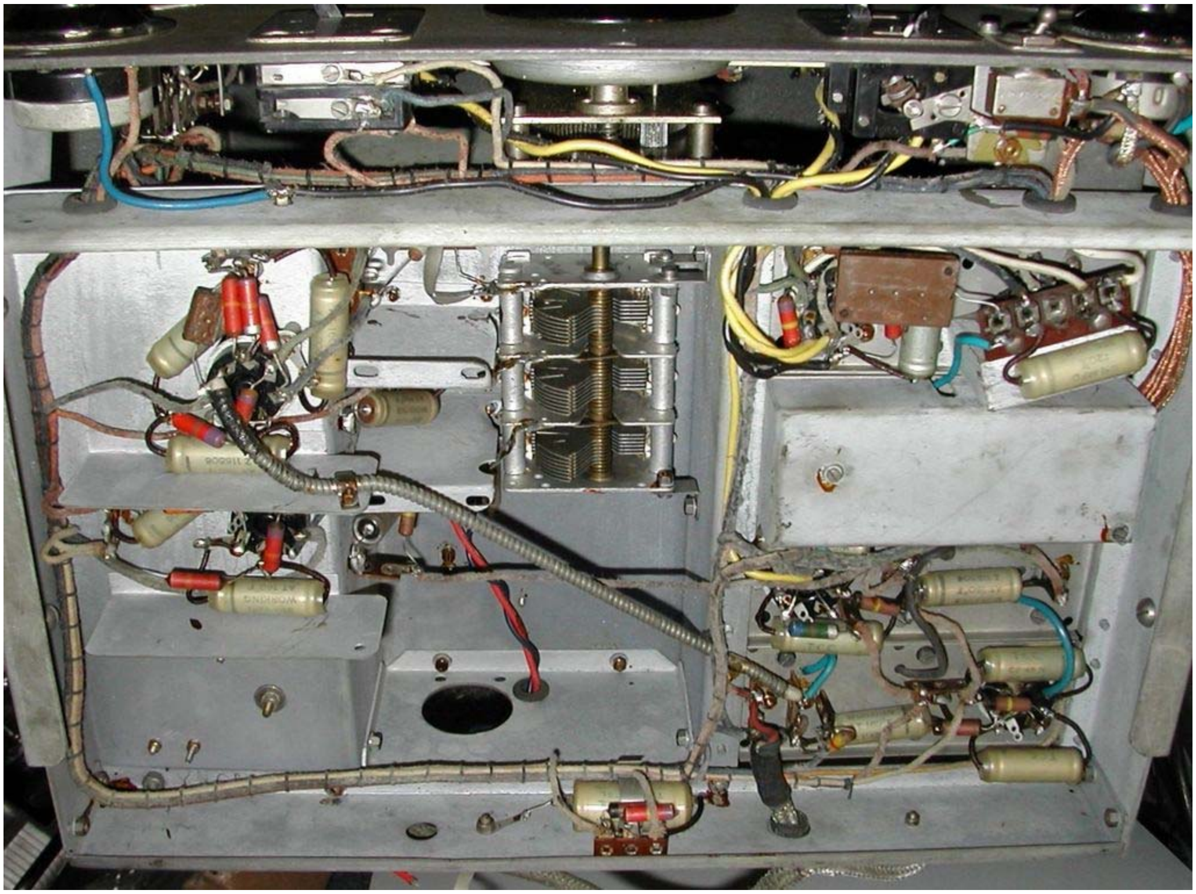
- Replacement of some wiring with 'modern' plastic-covered types of varying quality, along with some very thin cloth-covered wire in the AGC, HT and phones circuits;

- The flexible drive to the crystal filter switch was broken – the switch now being accessible only by lifting the lid on the case; and
- Missing under-chassis screen covering the detector/AGC/1st audio stage.

Decisions, Decisions…

So, what to do? Make it operational as-is and preserve the 'history' of the set, modifications and all? or reverse the modifications as best as possible and restore to near factory-condition? (the serial number of this set is '358X HV2549', indicating that it dates from August, 1944, so that factory would have been the 'Bath Tub', just…). It did not take too long to decide on the latter course of action, however, not before sketching-out the modified circuits for posterity.

Having undertaken a few random measurements of resistor values (many quite a way out of tolerance), not trusting the replaced or original paper/electrolytic capacitors, and



Above: under-chassis view of one of Alan Ainslie's S.358X sets in (almost) ex-factory condition. Not the screen covering the detector stage on the right (missing on the SPARC museum's set) and all those large 0.1uF by-pass capacitors

wanting a more uniform/professional look, I decided to replace all the passive components, with the exception of silver-mica and ceramic capacitors if they tested ok.

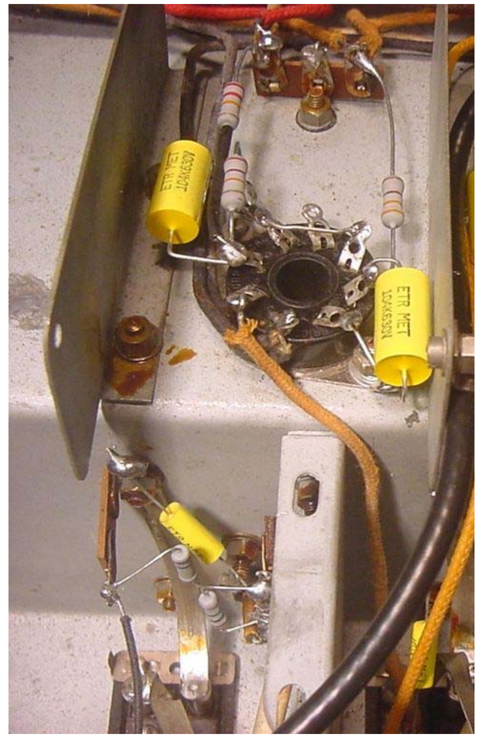
In order to retain a semblance of how the set looked originally, I asked Alan Ainslie[4] if he could take some detailed photos of an S.358X in reasonably original condition (photo, above), which he most kindly did (thanks Alan!). These photos were very useful during the restoration, however, I must admit to using some 'artistic license' in dressing components, particularly where smaller replacement parts allowed shorter grounds etc.

Modification Reversals

The first job was to strip-out the un-tuned RF stage – not too difficult, but it left three holes where the valveholder had been and another where a tagstrip had been mounted. The Q-multiplier sub-chassis (bracket) came out next. This had been mounted onto the

[4] Alan Ainslie has an unofficial 'Eddystone Museum' that contains the remnants of the Eddystone factory museum as well as a very large personal collection of Eddystone sets and paraphernalia. See Lighthouse Issue 93 (October, 2005), 'Visit to Ainslie Towers' by Graeme Wormald

front panel with a couple of screws and by its toggle switch. One control for it passed through the panel where the meter switch used to be. The heater and HT supplies were fed via a three-way plug and socket mounted on the main chassis (very 'professional') and the signal leads through holes drilled in the chassis (still with drilling burs on them).

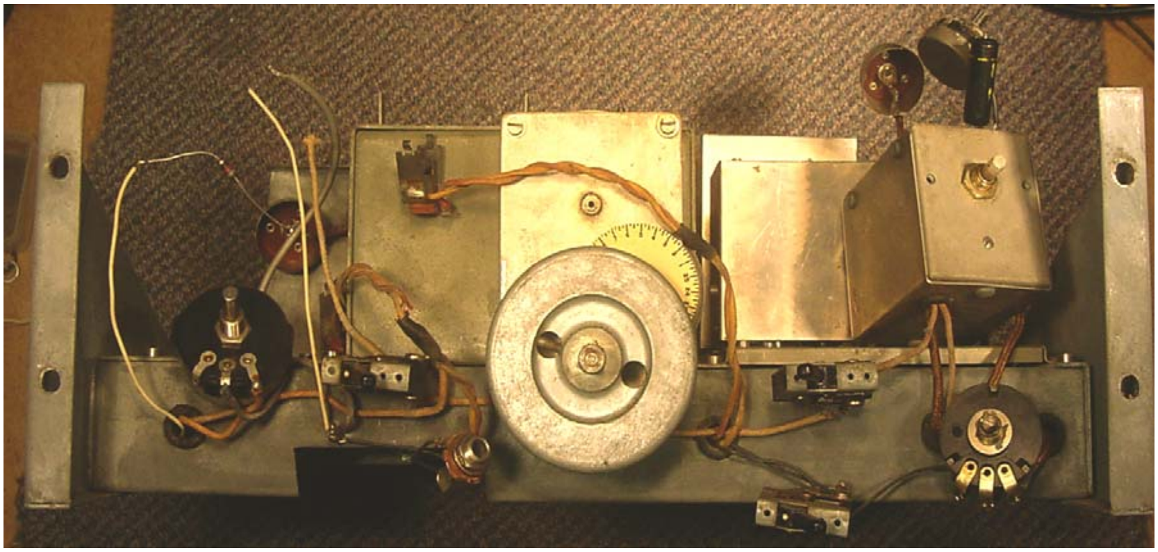


Having got rid of the extra bits, the next job was to reverse the modifications. The RF stage was the first – I removed all the components, including the B7G valveholder and (very-homebrew) adapter plate, installed an International Octal valveholder and then rebuilt the stage using all-new parts (630v rated metalized poly film capacitors and metal-film 1 Watt resistors) – photo, right.

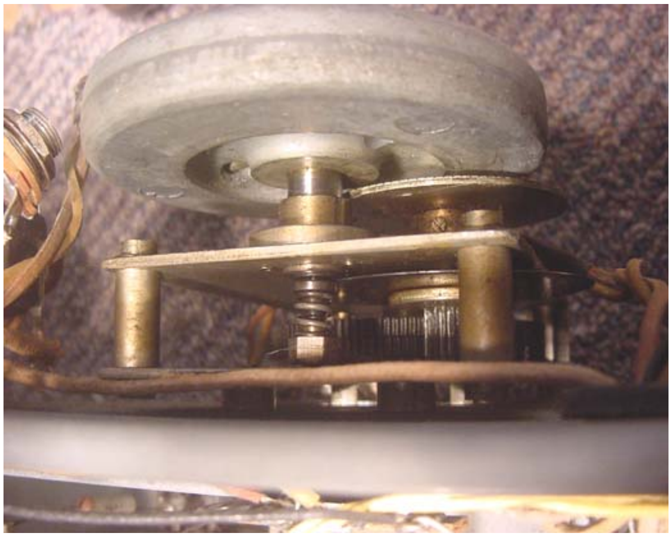
Next came the output stage – the valveholder stripped clean (apart from the heater wiring) and all-new components fitted – photo, left. The S-Meter modifications were removed next (easy), but re-establishment of the anode current metering circuitry was left for the time-being.

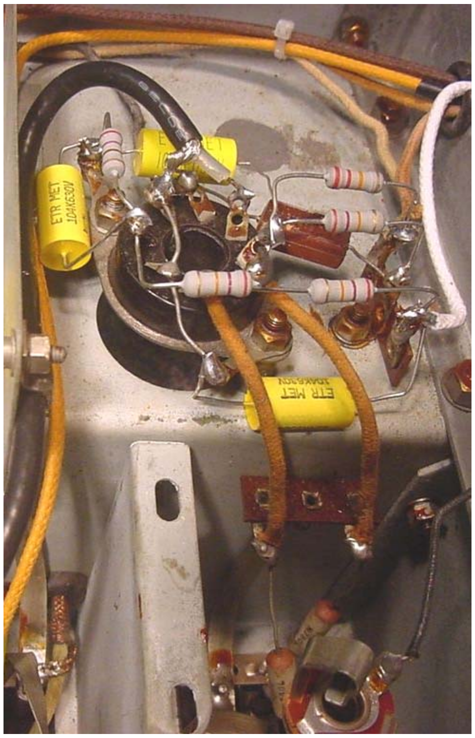
Strip-down and Re-Build

I decided to remove the front panel next (photo, top of next page). This was easier said than done of course. Two of the knobs were seized onto their shafts and their grub screws had been gnarled and drilled at in someone's failed attempt to remove them in the dim-distant past. I applied penetrating oil to the grub screw holes/directly onto the shafts and left it to soak in for 24 hours. I then managed to extract the knobs by pulling them off, levering them from underneath with a pair of bent-nosed pliers. I was very relieved when they eventually came off and the knobs were undamaged (apart from the bodged drill-holes and gnarled grub-screws that were still in place). With the front panel removed it was an opportune time to give the chassis a thorough clean – actually it was not too bad (just the usual grease, wax, grime and spider webs – the cadmium coating had done its job in preventing rust taking hold).

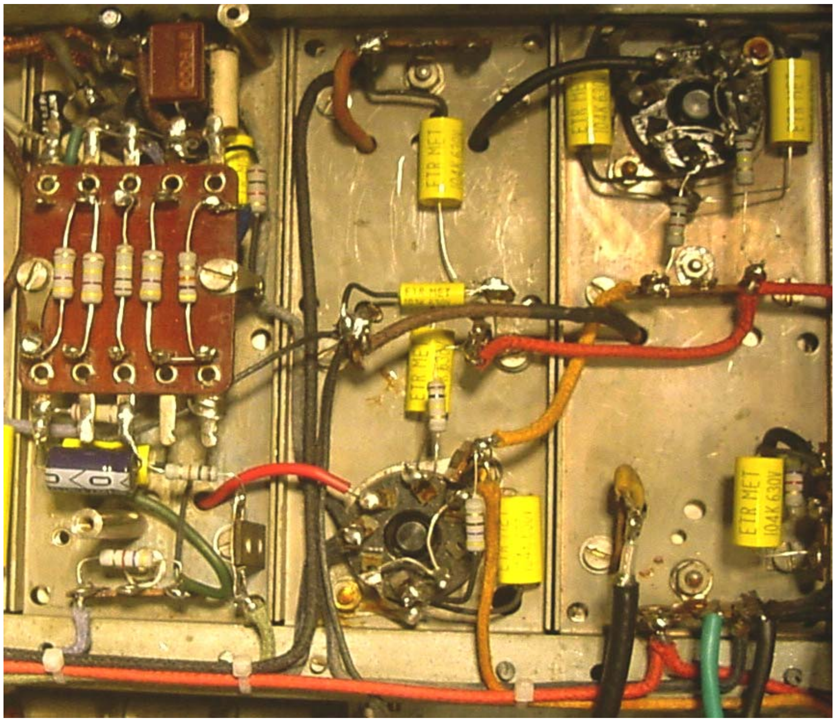


The gearbox (photo, right) was inspected and looked to be in remarkably good shape – no missing or damaged teeth on the 70:1 ratio Tufnol gears – just rather clogged-up with gummy oil and grease. I cleaned it out with alcohol and lighter-fluid on the more stubborn deposits, and re-applied some light machine oil (not 3-in One) to the bearings and a touch of molybdenum grease on the gears – it now ran very smoothly, so a complete strip-down of the gearbox was not necessary – phew!



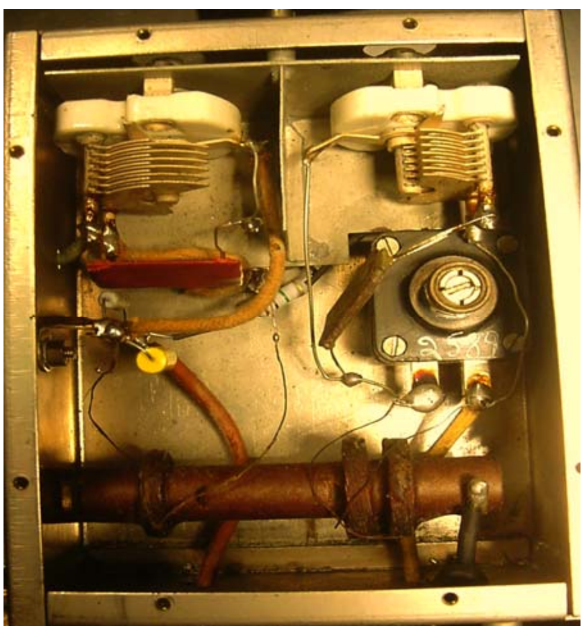


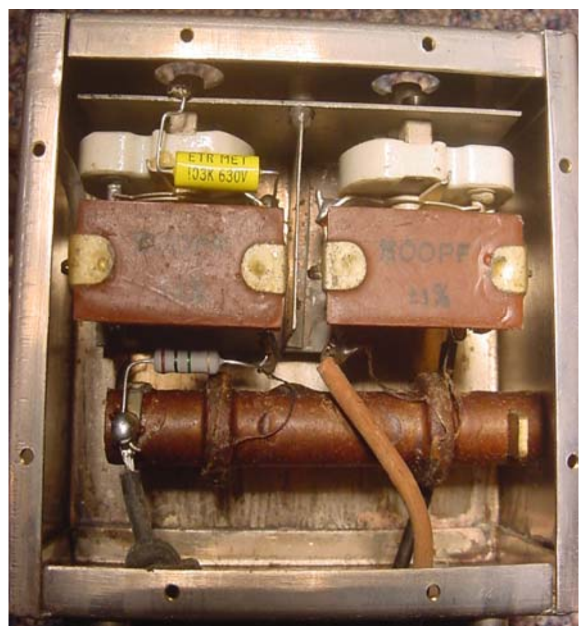
I then decided to start the main electronic component replacement work, together with re-wiring where needed. Having already completed the RF stage work, I started on the mixer/local oscillator stage (photo, left), working my way back through the set towards the audio output stage (which I had also already completed). I took my time, carefully dressing the components and wiring to be at least as neat as the original would have been when 'Bath Tub fresh'. Once the main under-chassis component replacement work had been



Above: Re-built IF stages (right and centre modules) and detector/AGC/1st audio stage, left. Below: 1st and 2nd IFTs

completed, I removed the 2nd IF transformer (photo, below right) and removed the side off the 1st IF transformer (photo, below left), as these units house several passive components that I wanted to test/replace. Just as well, as there were also a couple of dry joints in the 1st IF box, as well as the crystal filter switch to clean (De-Oxit, applied with a Q-Tip). Not too bad a job to gain access into these units and well-worth the effort.

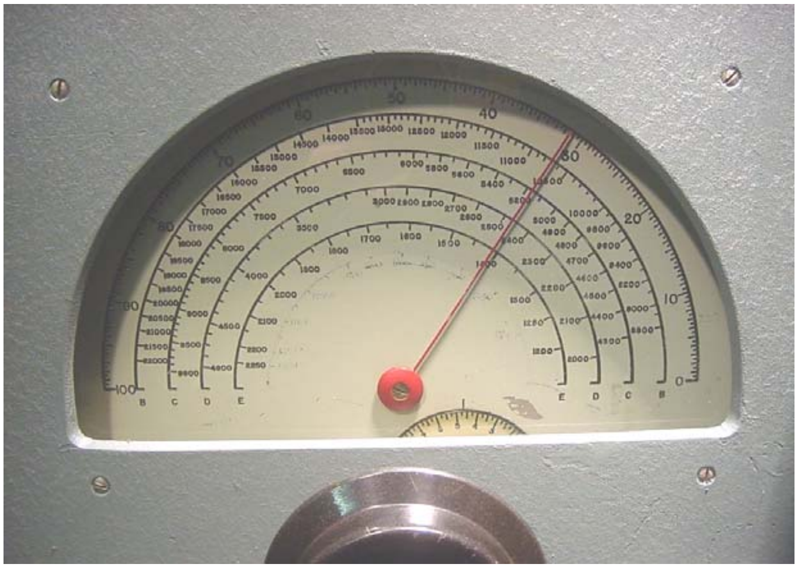




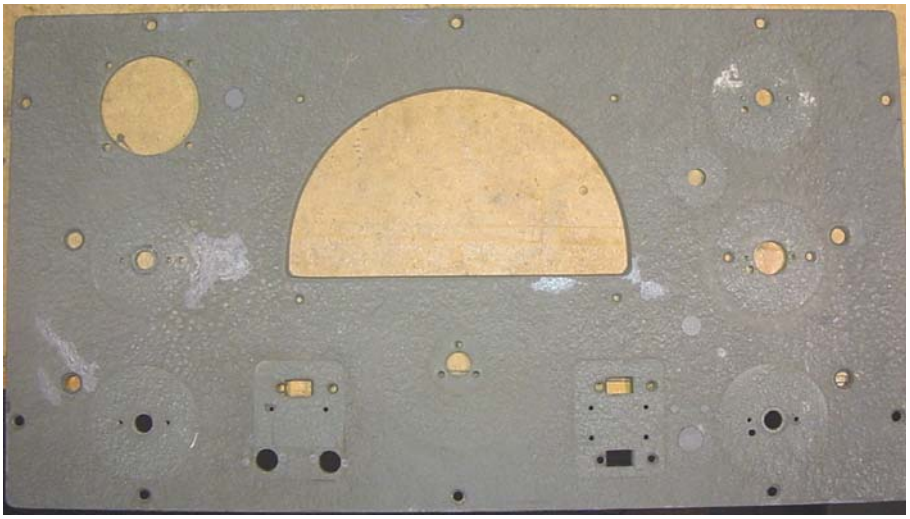
The BFO is housed in a separate compartment (box), mounted on the front panel. This was opened-up and resistors/paper capacitors replaced, along with the heater and HT flying leads. The variable capacitor was cleaned with De-Oxit, adjusted to mid-travel and the shaft marked such that I knew what setting the capacitor was at once re-assembled.

The next job was to restore the original anode metering wiring, switching arrangement and shunt circuits. The switch was missing, so I needed a single-pole, 8-way Yaxley type as its replacement. Not finding anything suitable in my junk box, I checked-out the parts store at SPARC. I did not find exactly what I needed, but managed to cobble-together a suitable switch using the indent mechanism from one switch and a 12-way wafer from another, installing a stop (a 6BA screw and solder tag) through the indent mechanism at the 8 way point. Now, what about those shunt resistors – the originals had been bespoke wire-wound types and not easy to replicate. A trip down to one of the local electronics stores on Main Street in Vancouver solved this – I managed to obtain stock value 5% resistors that were very close to the original values (some non-preferred values that they, luckily, had in stock) – all sold in packs of 10, so I was able to hand-select resistors even closer to the original fitment values. The finished arrangement is shown on the photo, right. Note that I used cloth-covered wire in various colours (obtainable from Radio Daze or Antique Electronic Supplies) for the new wiring harness, as well as for other re-wiring in the set, including replacement of the nasty plastic-covered assortment and some original fitment rubber-covered wiring. I used standard plastic cable ties to hold things together neatly temporarily (this also allows for changes to be made easily), but plan to eventually lace the wiring to get a more original look.

The tuning gang was rather clogged with dust – a brush and vacuum cleaner soon sorted that out, and the bearings were cleaned and re-lubed with molybdenum grease. The contact surfaces on this and the front panel switches were cleaned with De-Oxit, and a squirt of same fired into the AF-gain, RF-gain and tone control pots.



The (rather thick) dial glass was cleaned using lens-cleaner fluid and the scale cleaned using warm soapy water and a cotton wool pad. Unfortunately the scale has had two additional ranges scratched into it: most of the Broadcast Band (Range 'F'), on the inside of the five factory-engraved ranges ('B' through 'E' plus logging scale), and Range 'A' (21 MHz to 32MHz) to the outside of the logging scale engraving. I decided to leave these 'as-found', along with a scuff mark present near the bottom of the scale plate that had removed the paint. In my opinion, the only really satisfactory remedy for this degree of damage to such a highly-visible part of the set would be to remove all the original paint from the scale/engraving and repaint the entire scale white, along with re-filling the engraved markings with black enamel paint. I decided that the visual appearance as-found was more acceptable than risking making a mess of such an extensive cosmetic job – at least for the time being.

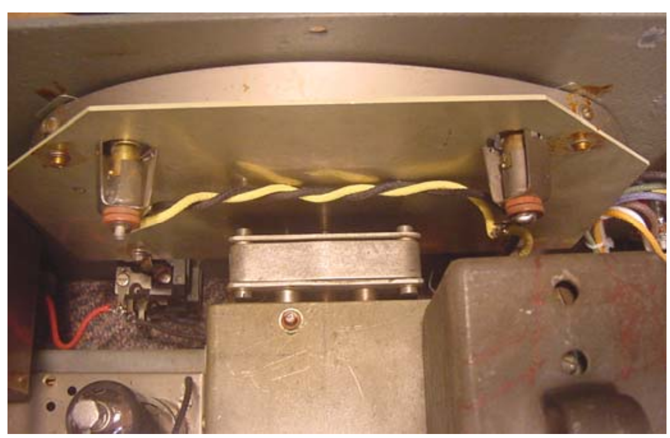


Next I needed to address all those surplus holes and paint chips in the front-panel, plus the holes left from removing the valveholder, socket and extra tagstrip mounts etc. from the main chassis. For this job I decided to use the same technique as I had used for the restoration of my HRO a couple of years ago, ie. infilling the holes with 'JB-Weld' epoxy. This is easily done by placing masking tape over the side of the hole that will be the viewed side and then pouring sufficient of the JB-Weld mixture to brim-fill the hole – 24 hours later the masking tape can be removed and the JB-Weld sanded-down if necessary (it dries to a mid-grey tone) – photo, above. The filled-holes on the chassis were then coloured with a 'silver' felt-tipped pen to blend them in better to the overall chassis colour. The front panel was lightly roughened with fine grade steel wool, cleaned using alcohol and then four thin coats of a blended-colour

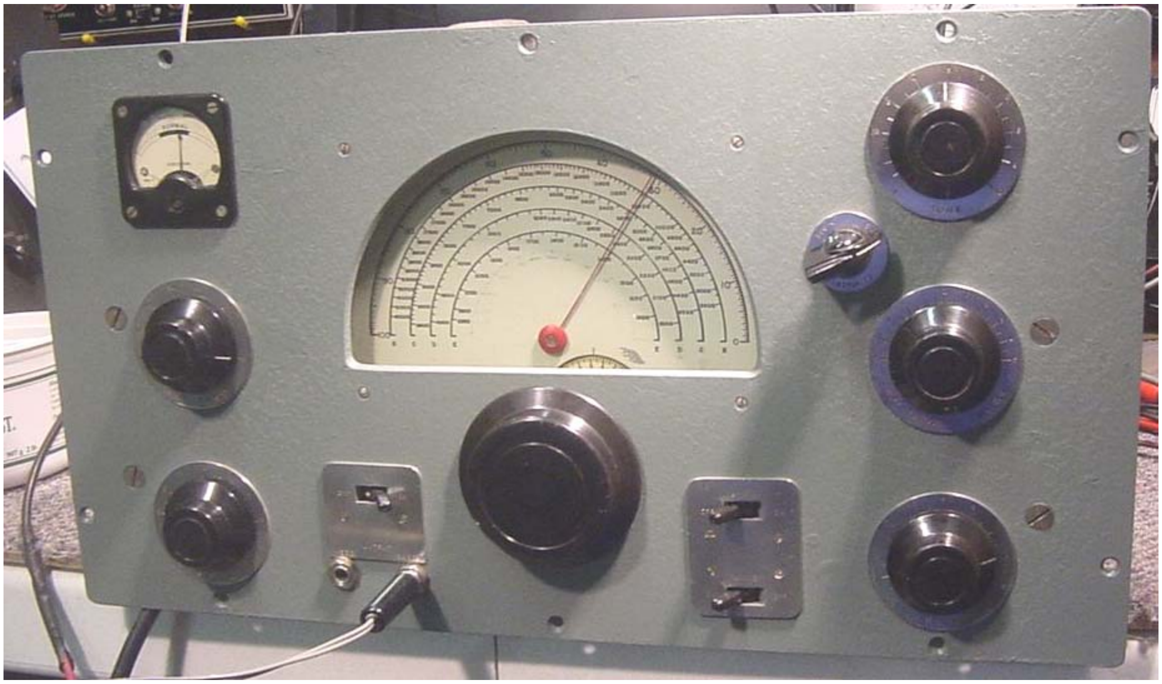
enamel paint (Humbrol model paint) applied with an air-brush, thus retaining most of the wrinkle finish of the underlying original paint. I used a satin-matt blend to give a more acceptable visual look over the repaired areas. The finished result is not perfect, but much better than the panel in its as-found condition (photo, above).

The control escutcheons had all been covered with a coat of polyurethane varnish at some time in the past and this had now started to chip and was yellowing with age. This was stripped off using lacquer thinners/stiff toothbrush and the metal then lightly polished with Brasso. The lettering and markings were then restored by painting enamel paint over the engraved areas, allowed to partially dry and wiping the surplus paint off with a rag dampened with paint thinner. The lettering was completed in red and the gradation markings in black per the originals.

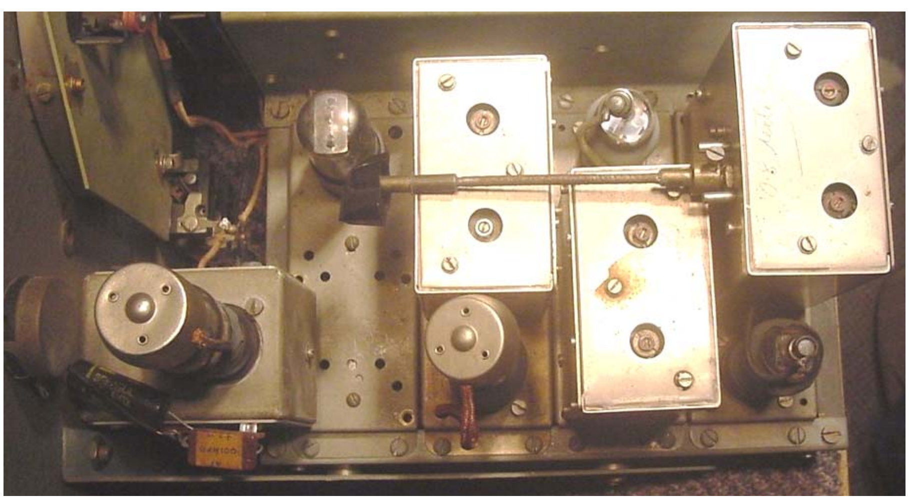
The panel meter was cleaned-up externally but not dismantled as it was working fine, albeit I noticed that the zero screw is slightly damaged. The knobs were washed in hot soapy water and then polished using Novus #2 and #1. The two knobs with damaged grub screw holes were examined and new holes drilled and tapped for 4BA grub screws (I have a small supply of original Eddystone grub screws obtained from Ian Nutt).



Having allowed the paint on the front panel to cure for three days or so, I re-mounted it back on the chassis, then re-fitted the various controls, BFO unit, dial glass and scale plate, escutcheons etc. Re-fitting the scale and dial glass takes some effort – getting the scale plate in place and then fitting the pointer and (heavy) dial glass takes some careful manipulation. I found that the flywheel snagged slightly on the first attempt and some careful 'fine tuning' of the screws, glass mounting brackets and spacers was necessary to avoid this. Re-wiring of the metering circuits was then completed, along with the phones/speaker sockets, the tone control and other switches. The dial bulb sockets had been wired with rubber-insulated wire which was falling apart. This was replaced with new cloth-covered wire (photo, bottom of previous page). The coaxial aerial circuit was similarly re-wired.



Now, to the valves. The receiver had a set of valves fitted on arrival at my shack, including three EF39's (but one had a broken top cap that proved impossible to repair), an ECH35 (ARTH2) and an EBC33 (actually a Rogers VR55 equivalent), but the others were miniature types (no longer suitable) and the 6V6G output valve. The ECH35 converter valve tested as unserviceable. I recalled that 6K7's could be used at a pinch as a direct substitute for EF39s (though with lower transconductance and higher heater current) and also that a 6K8 could be used in place of an



Above: Chassis on arrival, showing some of the valves fitted – note damaged top cap on the 2nd IF valve (EF39) and the 6V6G output valve

ECH35[5] (though reportedly noisier and again with a higher heater current requirement). One of my friends at the SPARC Museum stepped up to the plate and provided the 6K7s and 6K8 (in both glass and metal versions to try) and I found a NOS EL32 (VT52) and EBC33 (VR55) in the SPARC tube vault. I would also note that a 6Q7 can be used in place of the EBC33 (and one was tried once the set was working to check this out). The remaining two EF39's tested ok in my Precision valve tester – albeit with their metalized paint flaking off – so much so that I removed the remnants, intending to try some of that highly-conducting rear window demister repair fluid if there were feedback or interference problems with the 'naked' valves. I ended-up using an EF39 in the RF stage, a 6K8G as the converter, two 6K7G's as the IF amplifiers, a RogersVR55 in the detector/AGC/1st audio stage, an EL32 (VT 52) in the output stage and a second EF39 as the BFO (note, a 6K7G will not physically fit in this position when the chassis is in the case (metal body 6K7 and 6K8 types are smaller than the glass bottle versions and are inherently screened, but do not 'look the part' at all). All original-fitment valve types may be obtained at a later date if museum funds allow.

With the chassis restored, re-assembled and valves fitted, it was time for some checks and initial power-up… But first I needed to install a power cord – I had removed the original metal braid-covered cord as it was in a very dangerous condition – besides it kept snagging my hands as the metal braid was badly frayed. Then oops, nothing to plug it into – I remembered that the set did not come with a power supply! I recalled I had made a power supply for my HRO that was more than capable of powering the S.358X – it needs around 180 Volts HT at 65mA and 6.3v AC at around 1.4A for the heaters – actually, somewhat more heater current in this case with the set fitted with the 6K7 and 6K8 valves. So the HRO supply (photo, below - next to my restored HRO) was brought into service for the S.358X. Constructing a replica power supply will be a future project.

[5] But see comments in the EUG Newsletter Issue 49, page 3, citing the original Servicing and Operating Instructions, dated July 21, 1941 – quote "…for this receiver the 6K8G must not be considered a suitable equivalent for the ECH35 valve." Interesting, as it seems to work ok in this set on all frequencies.

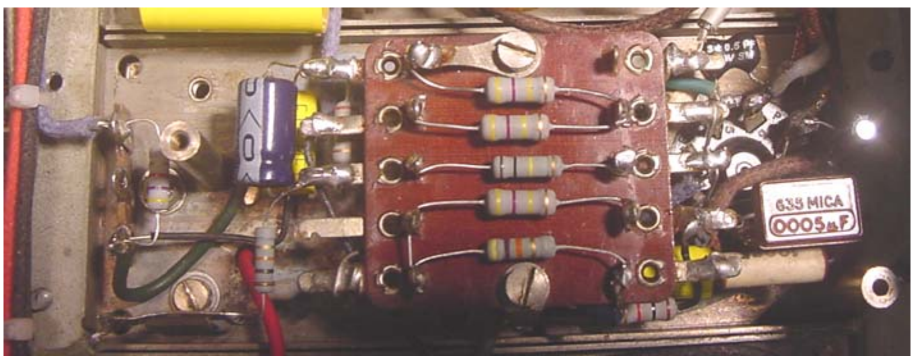
Initial Testing and Power-on

With the chassis sitting on its end:

- Checked the resistance measurement from HT to chassis – reading around 25k ohms – seemed about right. The heater circuits had been checked during my restoration work, so no need to re-check those;
- The HRO power supply was connected to my Variac and the power cable on the S.358X connected to the appropriate terminals on the HRO power supply;
- I installed the Broadcast band coilpack (Range 'F') and coupled a speaker to the low-impedance output jack and an aerial to the RF stage;
- With a voltmeter and milliameter connected to the HT supply to the S.358X, I slowly wound up the AC voltage to the HRO power supply to around 100volts AC – I could hear some noise from the speaker (phew!) and no blue smoke (phew again!). No stations were heard though – well, that would have been all too easy wouldn't it?;
- After some playing around a bit I finally heard a (normally strong) local station but coming in only very weak and distorted. I decided I needed to investigate…

Electrical Inspection and Voltage Checks

- The S.358 manual has a voltage table (Page 28) – a good place to start, along with some signal tracing. So I wound up the Variac until the correct HT voltage was being applied (the resultant mains voltage to the Variac was close to the full 117v mains supply voltage, so the heater voltages were also very close to 6.3v);
- There was a slight 'buzz' when I touched the top cap (grid) of the output valve, but there was hardly any response when touching the top cap (grid) of the 1st audio stage (the triode section of the EBC33). I found that if it was left a few minutes and it was then touched again, I was rewarded with a fraction of a second of loud signal – weird. This effect indicated maybe a duff valve or bias problem. I had a 6Q7 available from my junk box and tried that as substitute for the EBC33 – same effect…Hmmm;
- Up-ending the chassis once again, I checked the voltages on the EBC33 – almost full HT voltage (180v) on the anode of the triode (should be 50v) and around 25v on the cathode (should be 1v). A few seconds later I found the problem – I had forgotten to fit the 1k ohm cathode resistor (oops again). The wiring around the EBC33 is rather cramped (photo, below) and the circuitry a little more complex than the rest of the receiver – so come on give me a break! I popped in the resistor and wow! – the signal nearly blew the cone out of my bench speaker;



- On checking the BFO, I noted that the note was rather 'raspy', but decided to defer sorting that out until later;

- I continued with the voltage checks on the other stages and all seemed in order. I left the set on 'soak test' for a few hours and monitored the temperature of various resistors – especially the screen grid and cathode ones, as the circuit did not specify wattage and some of those removed were on the large side (though many of the old carbon composition types were much larger physically than modern resistors of equivalent dissipation rating). One or two were getting somewhat hot to the touch but well within their rating (I used 1 Watt types throughout the set). All good so far…

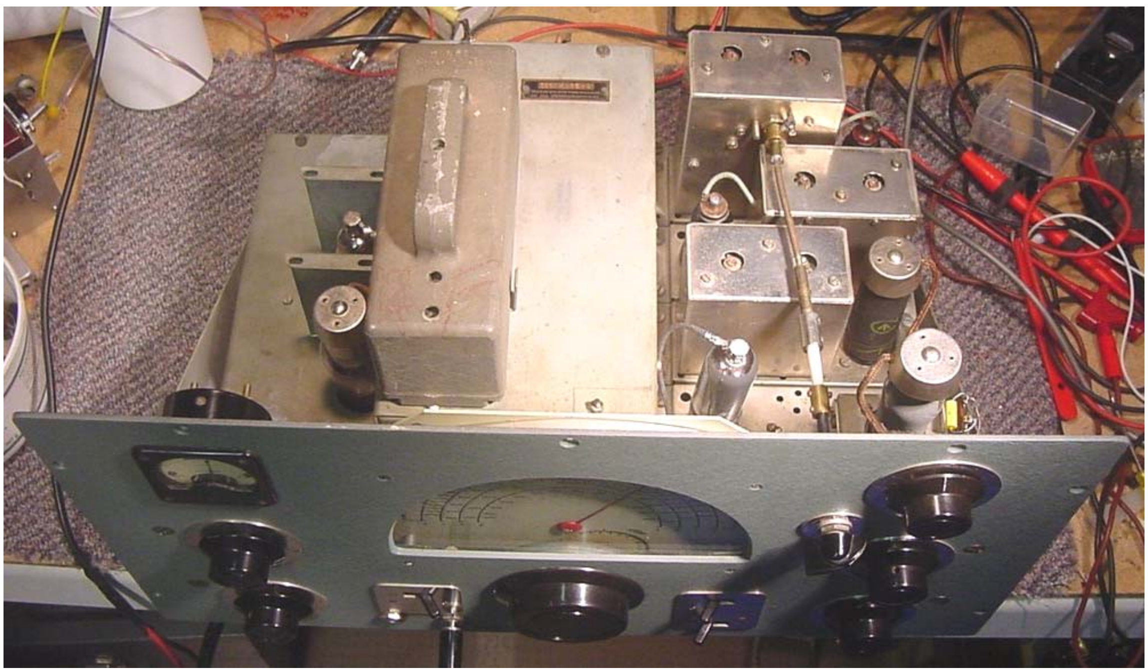
Preliminary Re-Alignment – IF Stages

Having now had the set running for a couple of days listening around the Broadcast band, it was time to check alignment. I knew the IF stages were not too far out, but suspected that the crystal filter needed adjustment and that would likely mean a full IF re-alignment. The 10 coilpacks would have to wait until I was happy with the IF section. Here is the procedure used:

- Switched on the receiver and the signal generator for an hour or so to thoroughly warm up. Set the signal generator to 30% modulation and the attenuator backed off about half way;
- Connected a pair of 'phones to the receiver speaker output, and connected the output meter across the high-impedance (phones) output – this allows audio monitoring when needed/wanted while also using the output meter;
- Disconnected the grid lead to the hexode section of V2 (converter stage) and connect the attenuated signal generator output to the top cap (grid) via a 0.1uF capacitor;
- Set HF and AF gains to maximum, switched off the BFO and AGC;
- As the set is the 'X' version (fitted with the dual crystal filter in the 1st IF transformer), the actual IF frequency must be adjusted to match the resonant frequency of the filter crystals, rather than the nominal 450kHz frequency. This necessitates a procedure that involves sweeping the signal generator frequency across a band of frequencies close to the nominal IF frequency of 450kHz with the crystal filter switched into the circuit, observing when a peak occurs in the output meter – this corresponding to the resonant frequency of the crystal filter. To 'see' any output on the meter, the BFO must be switched on, as the signal generator should not have the modulation switched on as the

Above: BFO unit with new resistors and capacitors fitted. Note new flying leads passband of the crystal filter is very narrow (500Hz or so) – bit of a chicken-and-egg situation this one as the BFO could be way-out given the uncertain provenance of the set and the degree of tinkering it had been subject to…;

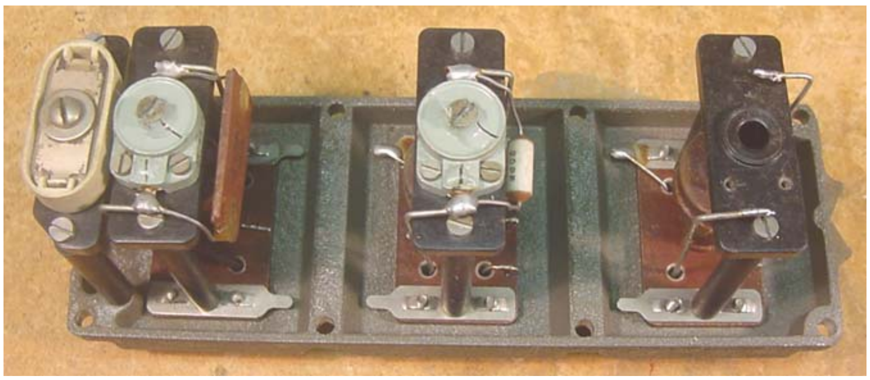
- So before I started, I made sure that the BFO was at least working at the IF the set was adjusted to before re-alignment;
- I then followed the procedure for aligning the IF section as described on page 21 of the manual – that worked fine, with the actual IF per the crystal filter resonant frequency found to be at 453.5kHz;
- The Broadcast band coilpack (Range 'F') was still in place (photo, below, centre-left), and I tried to re-align that one that using the procedure on page 24 of the manual – however, I noticed quite a thick deposit of fluff and dust on the trimmers, so I decided to leave re-aligning it until I had worked on servicing the coilpacks – I knew they contained resistors that may have gone out of tolerance and intended to go through each one in turn, replacing those, cleaning out the dirt, checking the wiring/other fixed components/trimmers and cleaning the contacts – now seemed like a good time to start…



RF Stage Re-Alignment - Coilpacks

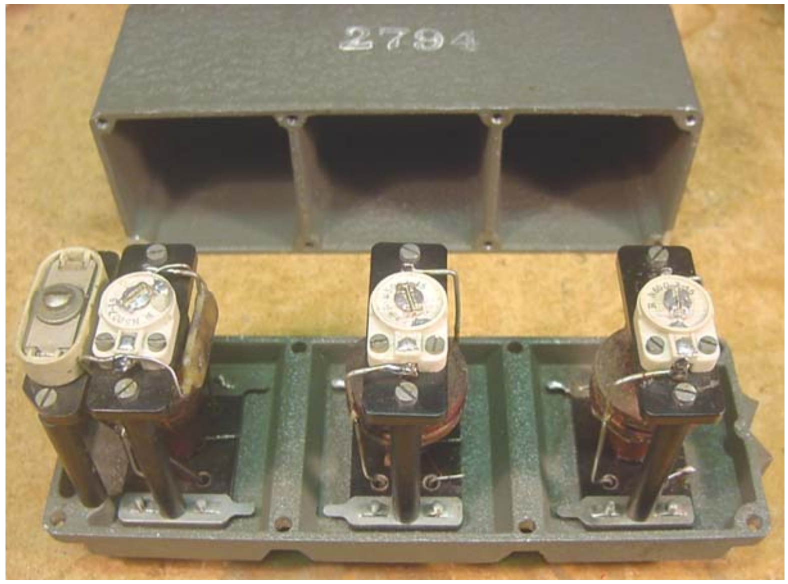
- There are 10 coilpacks, each comprising a three-compartment die-cast aluminium housing with the aerial, mixer and local oscillator tuned circuits housed in separate compartments, providing excellent screening. The ranges of each coilpack are listed on page 2 of the manual – the tuned circuit arrangements and fixed resistors are slightly different, depending on the range, for example, Ranges 'A' through 'D' do not include padder capacitors in the local oscillator tuned circuit, and Range 'G' includes IF trap circuits with separate trimmer adjustments for these on the aerial and mixer circuits (confusingly the IF trap trimmers are located in the same positions as the regular tuning trimmers on the other coilpacks, with the tuning trimmers offset (physically) to the side on the Range 'G' coilpack. Details of each coilpack circuit and their respective alignment procedures are provided on pages 22 – 27 and 30 of the manual;

- I worked my way through each of the coilpacks, removing the 8 x 4BA screws holding the upper (compartmentalized) casting onto the bottom part of the casting, to which the plugs and coil formers are attached. I noted that several of these screws were missing, indicating that some none-too-careful person had been there before me and lost some screws (not surprising in 66 years I suppose, and given the shoddy workmanship on all the mods undertaken). All resistors were replaced with new 1W metal film types, all internal items cleaned and the prongs on each of the 5-way plugs cleaned with a soft wire brush where needed and then all prongs wiped with De-Oxit;
- All went well until I came to the Range 'I' coilpack (90kHz to 150kHz, photo below), where I found the aerial tuned circuit trimmer missing (a ceramic type) – it had simply been removed and no attempt made to bridge-over the tuned circuit with a capacitor had been made – I concluded that someone had 'robbed' the part to replace a trimmer in one of the more-frequently used coilpacks, and that they had not been interested in using Range 'I'. Then I opened-up the Range 'J' coilpack, only to find that all of the tuned circuit trimmers (except the padder) had been removed. Nothing was found that was an exact match for these ceramic trimmers in my junk box, but I tried some air-spaced ones as a stop-gap – these just squeezed in between the coil formers and the upper housing of the coilpack when re-assembled. In addition, I noted that one of the prongs was broken off the 5-pin aerial plug (one of the aerial connections). To fix this I removed an adjacent earth prong (not really essential) and relocated it in the correct position, gluing it in place with epoxy. I then noticed that the aerial coil had been damaged (photo, left) by someone attempting to drill the old prong out at some point (aaargh! was there no end to that maniac's ineptitude?) – of concern was that there were several of the extremely fine Litz wires sticking through the damaged section of coil – virtually impossible to repair – so I decided to just

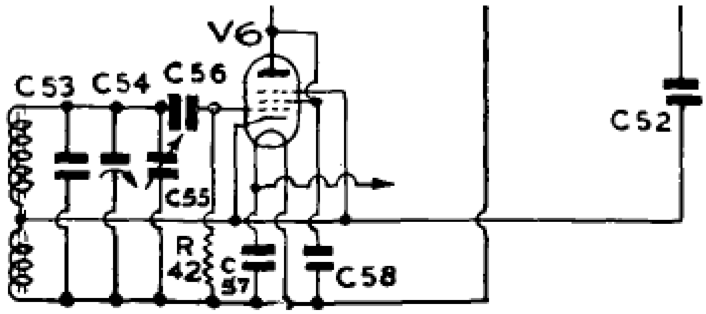


leave it and see what happened when I tried to tune the circuit (the aerial coil could be bypassed if needed, making the RF amplifier grid circuit aperiodic – probably not a big deal at these low frequencies);

- All this extra work meant that undertaking the full RF re-alignment was delayed – probably not a bad thing as it allowed for a visit to the SPARC museum where I found some suitable ceramic 7 – 45pF trimmers in the 'spares warehouse'. These were an exact fit, so the (now very) temporary air-spaced ones were removed and the ceramic ones fitted to the Range 'I' and 'J' coilpacks (photo right);

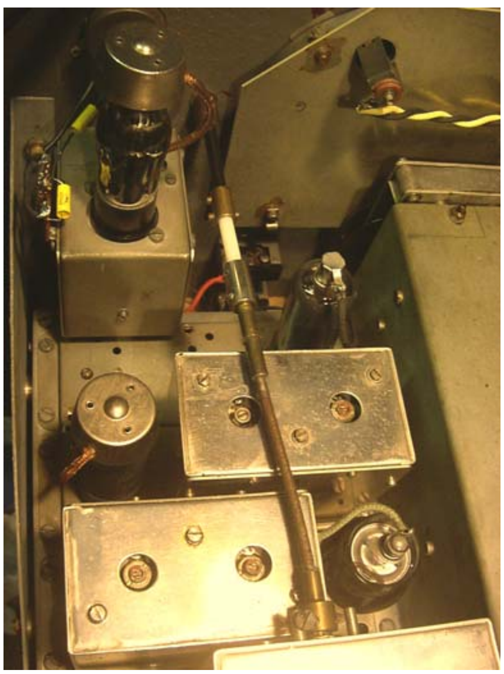


- I then set about the RF re-alignment – no mean task with 10 coilpacks to tune up, most of which have a graph to refer to rather than the scale markings. The procedure specified for each range was followed (most differ slightly), and all went well until I installed Range 'H' (150kHz to 300kHz), where I found that I could not tune the mixer stage. Off came the Range 'H' coilpack lid and the problem traced to a broken trimmer – the central adjusting screw should be soldered to the upper (silvered) face of the ceramic rotor, but the solder blob was missing (I had not noticed during the earlier servicing work). I repaired the trimmer, but thought it better to replace it with a known good one in case it broke again, so this was done (good job I had packed a spare from SPARC). That fixed, I managed to re-align Range 'I' and moved on to Range 'J' (the one with the busted aerial coil) – strangely it seemed to tune up ok;
- I then decided to check the stability of the set, so left it tuned to WWV on 10MHz (Range 'B' coilpack) – it held it steady for a full day, drifting a couple of hundred Hz above and below, but nowhere near sufficient to drift outside of the (non-crystal filter) bandwidth – quite pleasing for such a simple circuit;
- I finished off by tuning around the 20m and 40m amateur bands – plenty of signals about, but the SSB and CW sounded awful – time to check that BFO note again…
- Coupled a scope to the BFO output – plenty of output (4v at the IF frequency), this being coupled to the detector via a 3pF silver mica capacitor. I had noticed that this capacitor was missing from the set on arrival and had been replaced at some time with a wire 'gimmick' capacitor (two wires twisted together to form a low-value adjustable capacitor). I thought that the injection level may be too high with the 3pF capacitor fitted and that it was causing clipping/harmonic generation somehow in the EBC33, so I tried replacing the capacitor with another gimmick – no improvement, so I put the 3pF capacitor back in circuit. I then took a close look at the BFO waveform on the scope - it looked ok at first, but when I checked at a slower sweep rate I could see



that the output was being modulated by 60 Hz. I immediately suspected the heater-cathode insulation of the EF39 in the BFO (V6, see schematic, left) –I replaced this valve with a NOS 6K7G – no improvement, so that theory was shot! I resigned myself to removing the BFO unit and checking the wiring – bit of a fiddly job with the front panel re-fitted to the set. Once dismantled though, it was immediately obvious what the problem was – the grid bias resistor (R42) had been connected to the valve heater connection on a tagstrip instead of the adjacent ground tag – working late at night I had replicated the as-found wiring instead of double-checking against the schematic: someone had effected a repair at some point and made that mistake and must have lived with a horribly raspy BFO note ever since! Only a minute to fix and then replace the BFO unit – hey presto, a lovely clean-sounding BFO note. Note to file – always double check your wiring against the schematic – do not trust someone else to have done this (including the manufacturer – there are several instances of mistakes being made there. Mind you, I have also noted mistakes on schematics and component lists – can't win I guess).

Final tidying-up and Air Testing



The last thing to repair was the crystal in-out control ('selectivity' switch) – this had originally been a length of flexible drive cable, but had been truncated at some point in the past. As a stop-gap during the restoration work I had cobbled together a few pieces of shafts cut from potentiometers (photo left)– not very pretty, but serviceable. To tidy this up I obtained a length of ¼ inch steel rod from Home Depot and cut a piece to length, using a shaft-coupler to join onto the remnant length of flexible shaft – that worked reasonably well and looks much better (see later photos) – at least until more flexible shaft can be found. Now, if only I could find the correct type of knob in place of that ubiquitous 'chicken head'... (help please someone!).

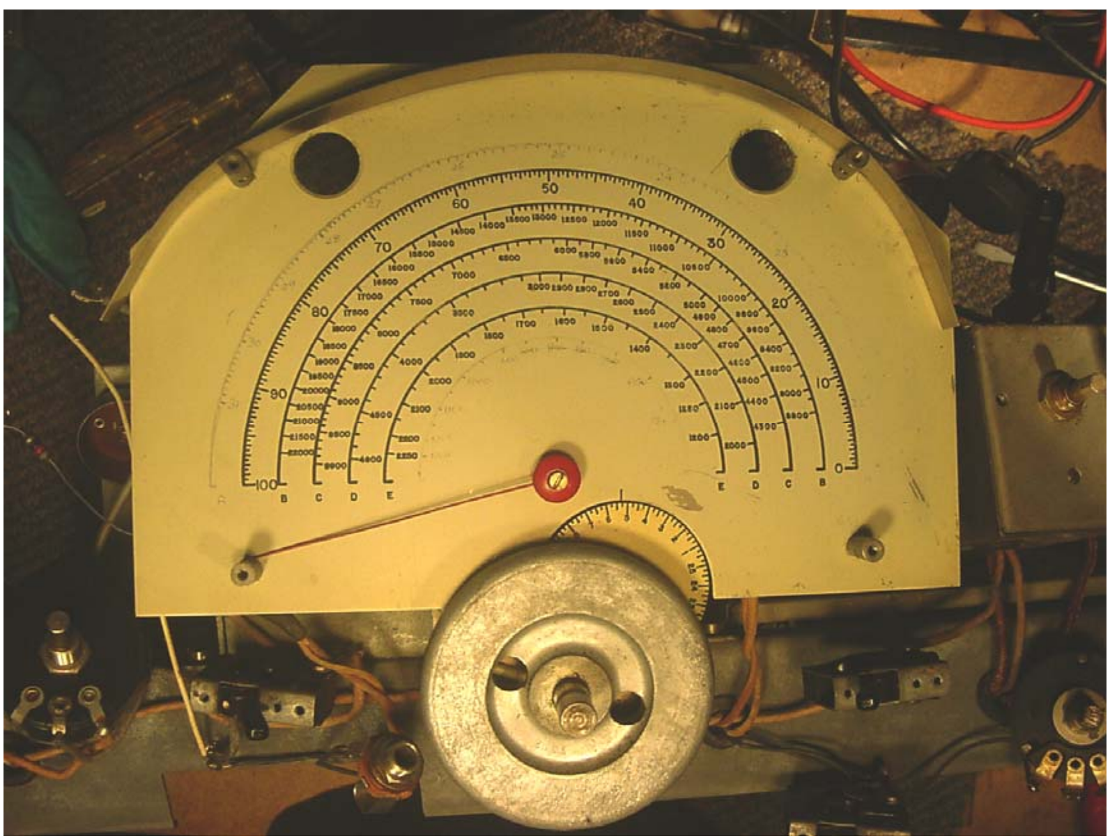
I decided to fit a chassis-mount fuseholder in the HT line (fitted with a 150mA fuse) – this was easy as there was a spare hole of the correct size in the rear panel. I also decided not to try to reproduce the truncated metal escutcheon over the HT switch and phones/speaker sockets, leaving it in its 'modded' state, at least for the time-being – I will consider options for this (maybe someone reading this article has a suggestion, or even better, one they can donate to the SPARC museum?).

I spent some hours trying the set out on various ranges, but concentrating mainly on the amateur bands and some of the shortwave bands – I found that although the S.358X is not a stellar performer, it accounts for itself very well, and the crystal filter is good – though I must admit that I like the flexibility afforded by a single crystal with phasing control to peak wanted signals and/or to cancel nearby interfering signals (the inherent 'tweaker' in my blood I am afraid...). See comments on the use of the S.358 in Postscript 2, below.

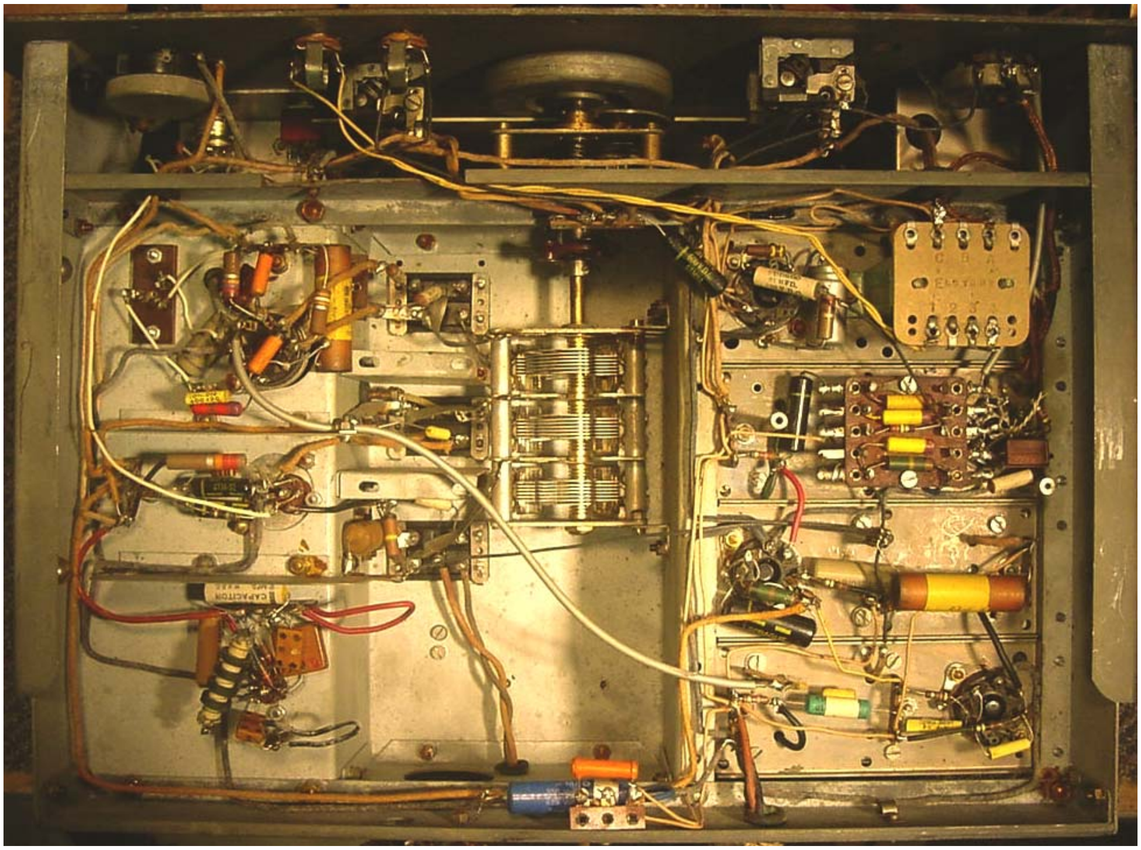
Conclusion

Of course, like the S.680X, I am somewhat reticent to hand the S.358X back to the Museum…. it looks and works great and is another icon of the Eddystone marque – my oldest Eddystone restoration yet and, better yet, one that helped win WWII. Now, I wonder if SPARC will let me take a look at their S.640 next?

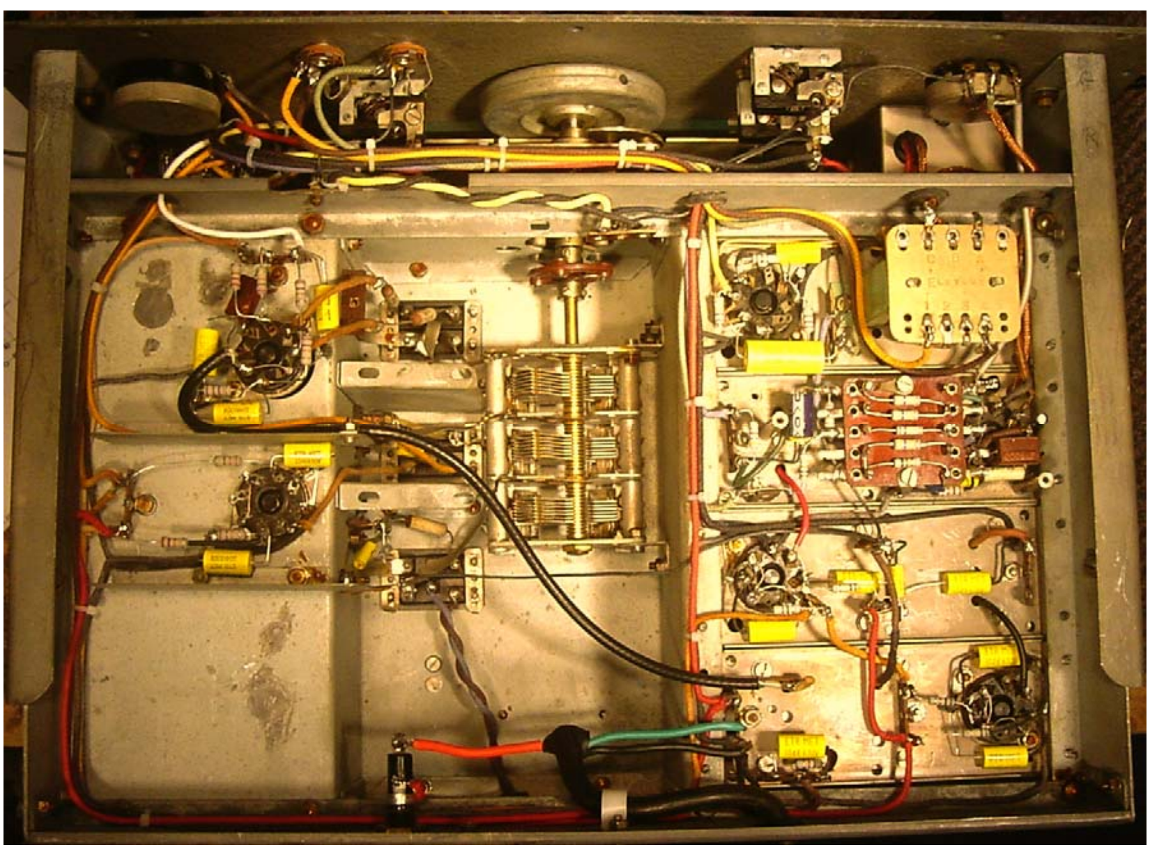
73's

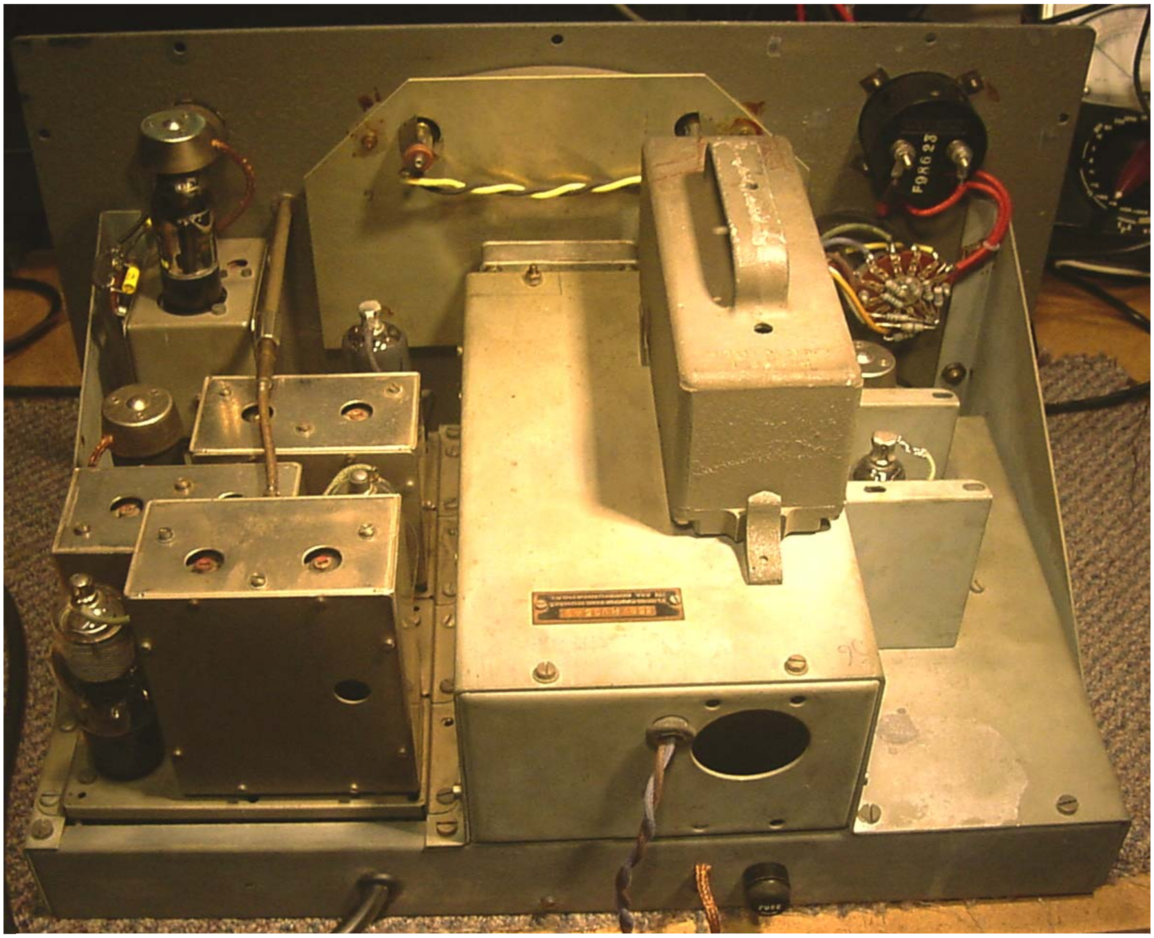


Above: Front panel removed and lots of bits and bobs now dangling away – note the additional scale markings scratched into the paint on the scale plate (ouch!). From the looks of the pointer, it appears that the set can tune those so-hard-to-reach frequencies in this state - very handy…(!)

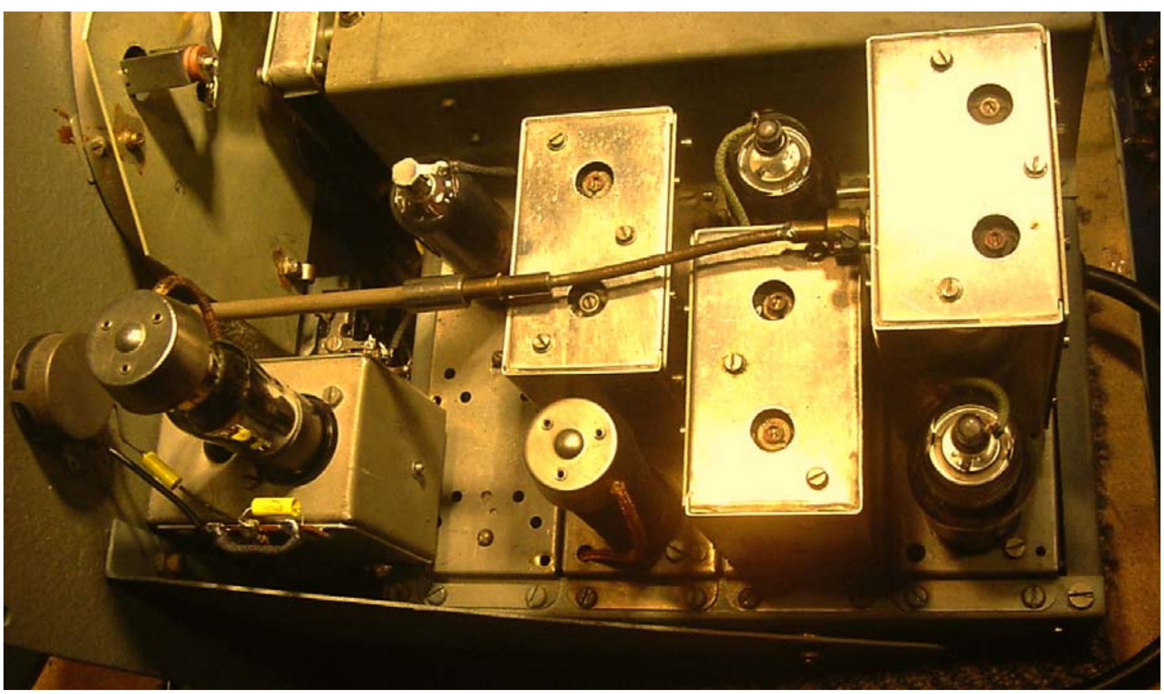


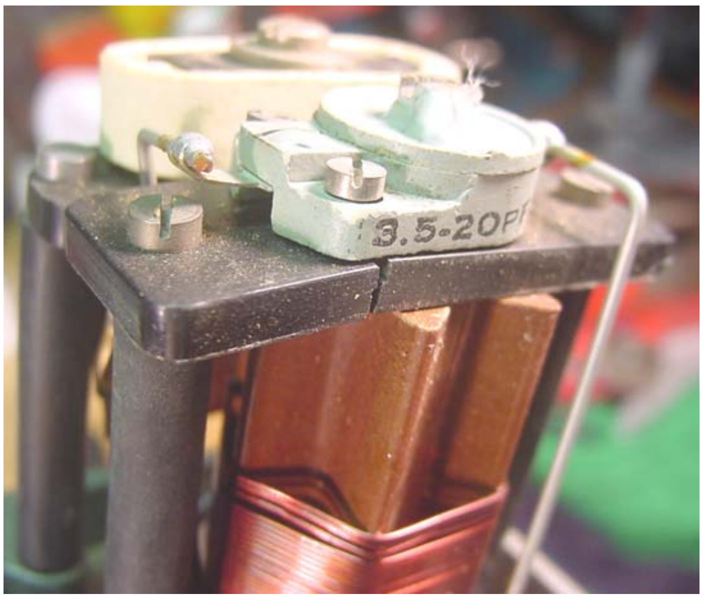
Above: Under-chassis of the set in its un-restored condition. Below: Same view, this time of the restored set. Compare with that of Alan Ainslie's 'unmolested' set on page 7

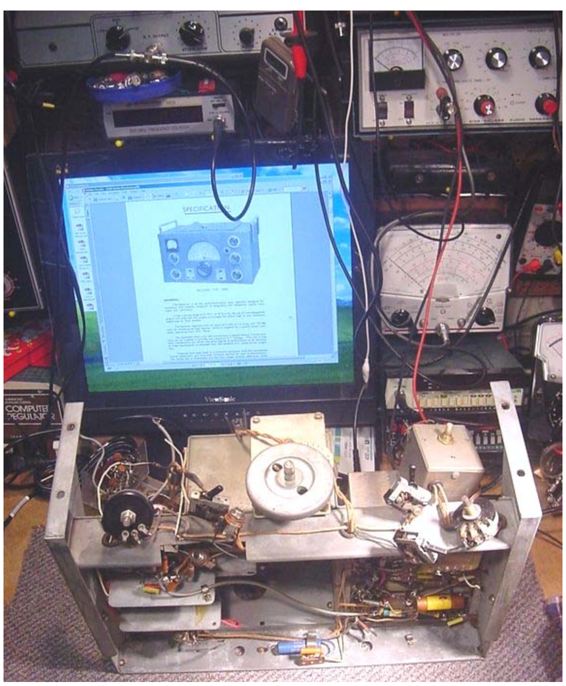




Above: Above-chassis view of restored receiver. Below: Detail of the modular construction of the IF, detector/AGC/1st audio and AF output stages. Note new ¼" steel shaft and flexible driveshaft to the crystal filter switch in the 1st IF can (right)

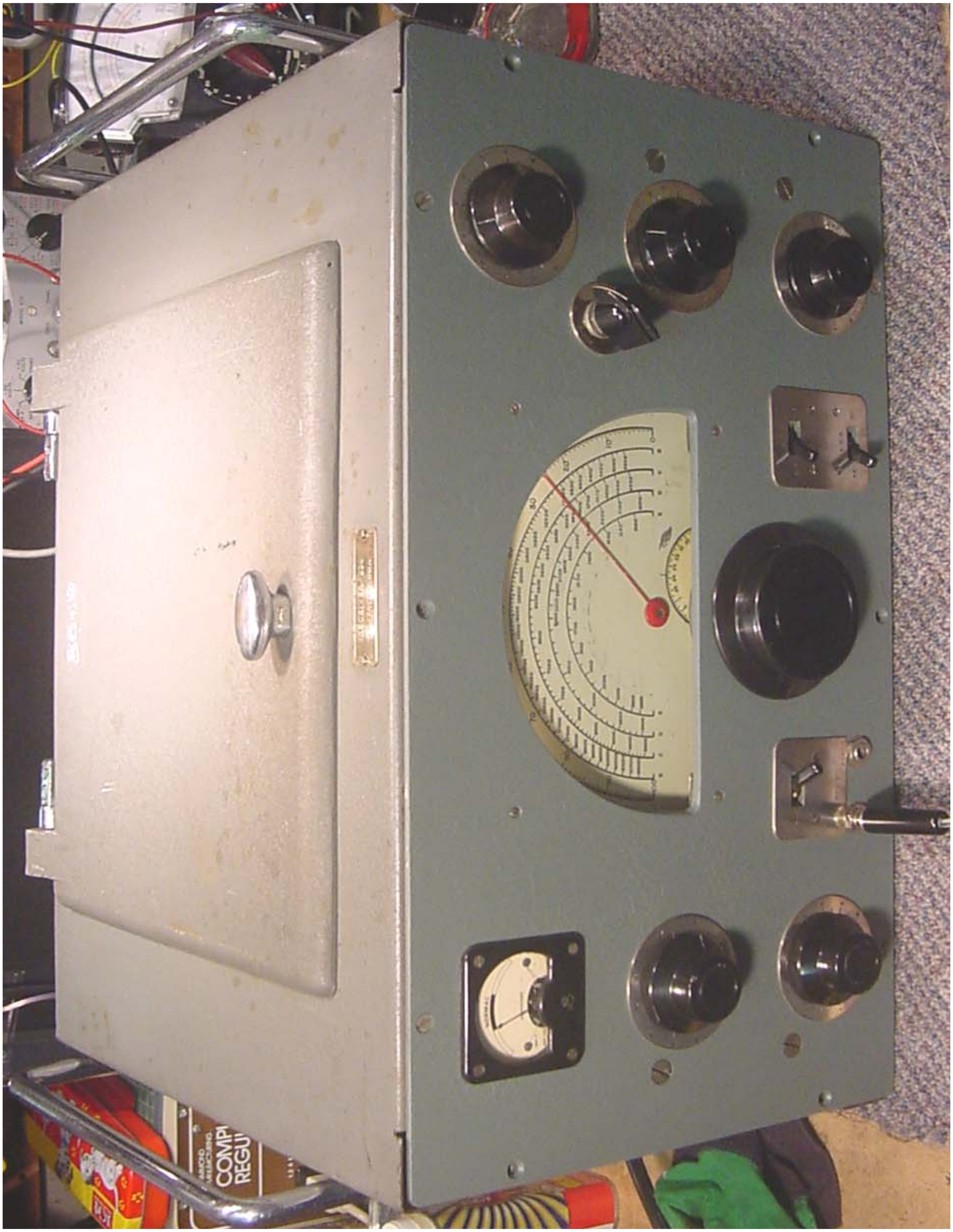




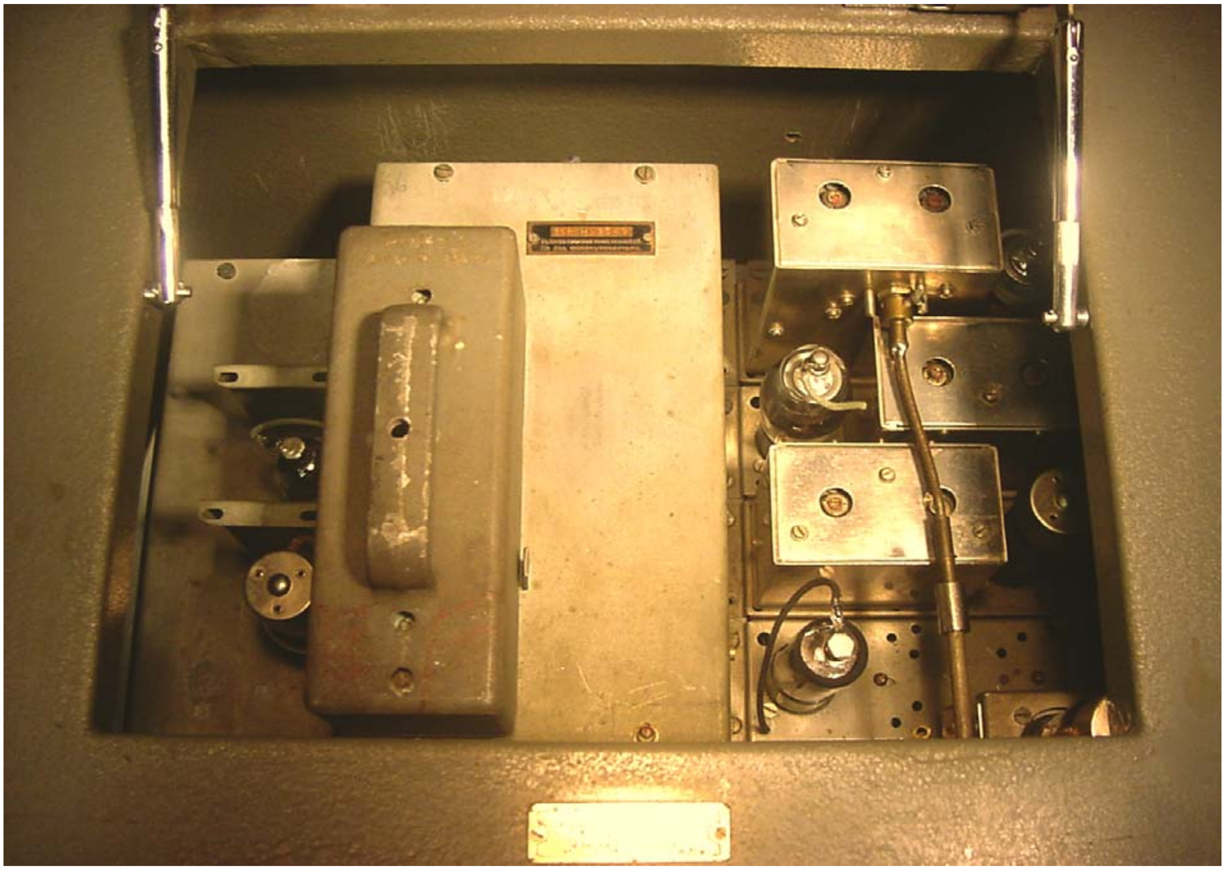


Above left: Five-pole plug on coilpack – proudly displaying 'Eddystone Made in England'. Above right: New resistor fitted into local oscillator section of a higher-frequency coilpack. Left: broken coil former in same coilpack. Below left: chassis under repair – note LCD monitor behind – very useful tool in front of you in the workshop for pulling up schematics, manuals and photos of the set. Below: Rubberized insulation in the screened cables was in poor condition – replaced with new cloth-covered wire pushed into the original braided copper screen.

Above: Coilpack chest (‘coffin’) – a full set of 10 coilpacks, but none that were supplied originally with the set (serial number suffix ‘2549’). Below: Eight of the coilpacks are marked with a serial number suffix ‘2794’, as is the label on the chest (inset, below). There are two imposters, Range ‘B’, labeled ‘1538’, and Range ‘F’, labeled ‘2393’ (owners of these sets need not apply to have them returned anytime soon… sorry)

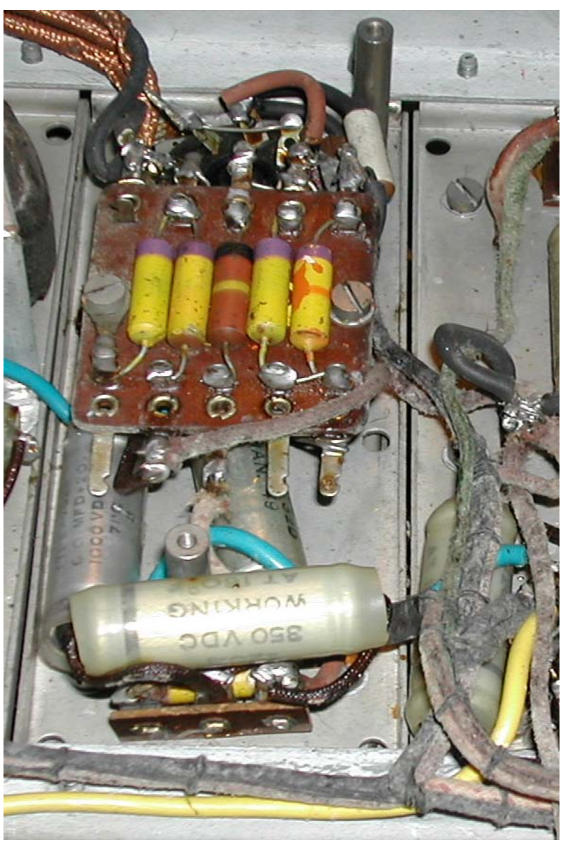


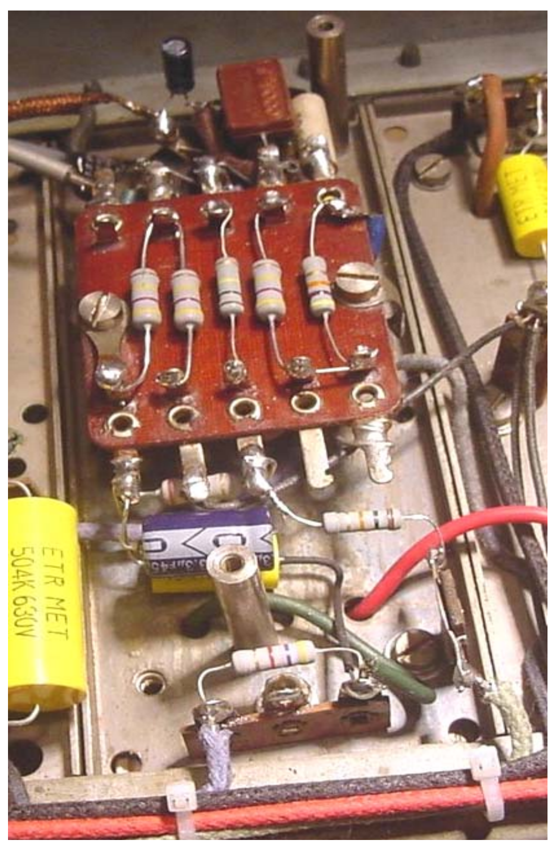
Above: The serial number stamped on the lid is ‘2549’, matching the chassis serial number suffix. The brass label at the front of the case top indicates it is was originally supplied to the Navy as Admiralty model ‘B34’

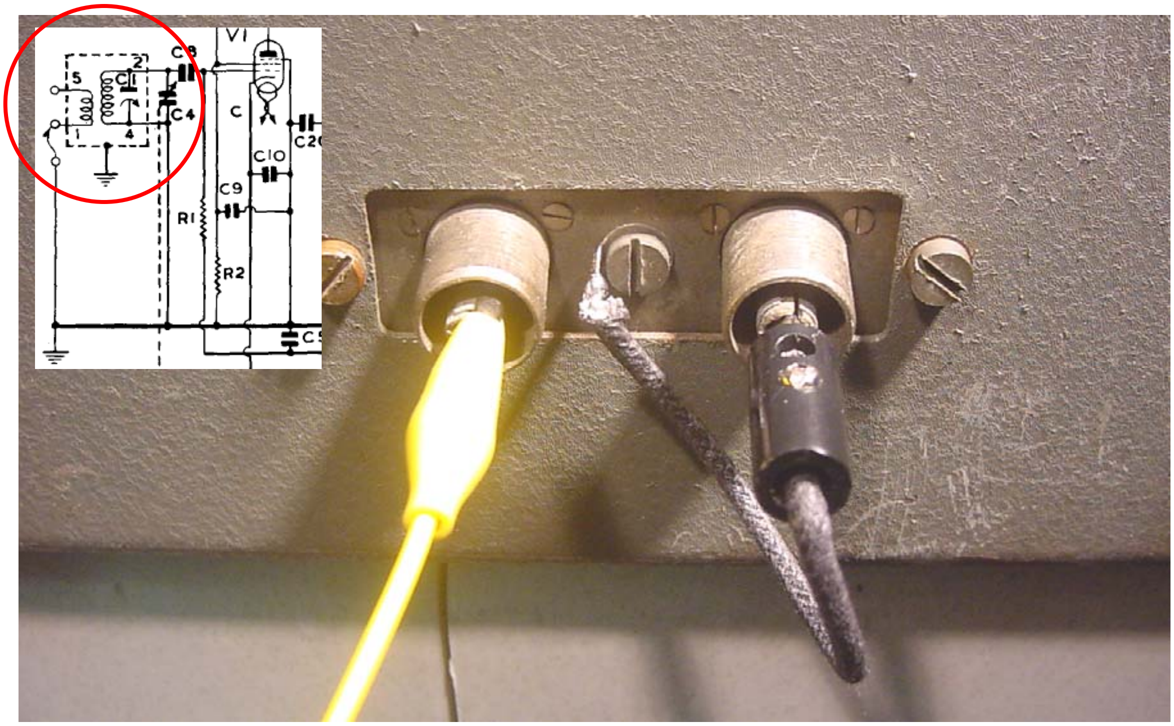


Above: View through the opened lid of the restored receiver. Below: Boxed-up, working well and ready for the rigors of a new life being gawked-at on display in the SPARC museum

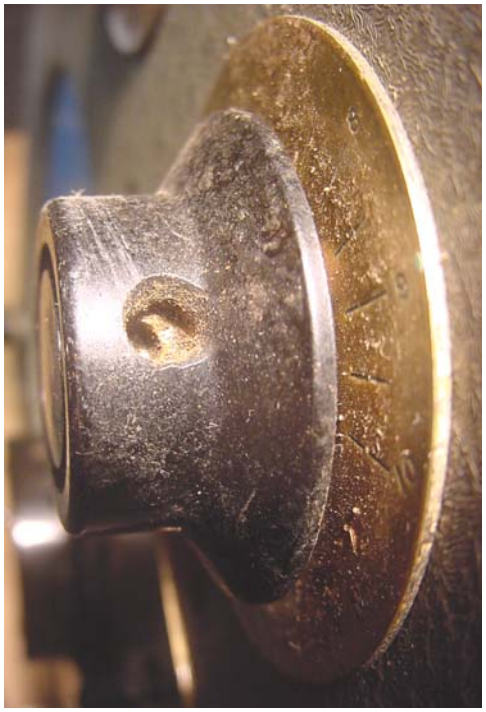
Above left: original meter shunts and switch (per Alan Ainslie’s set), Above right, replacement meter shunt circuits in the SPARC museum set built using standard components. Below left: original detector/AGC/1st audio stage module (beneath the shield per Alan Ainslie’s set), Below right: replacement components in the SPARC museum set

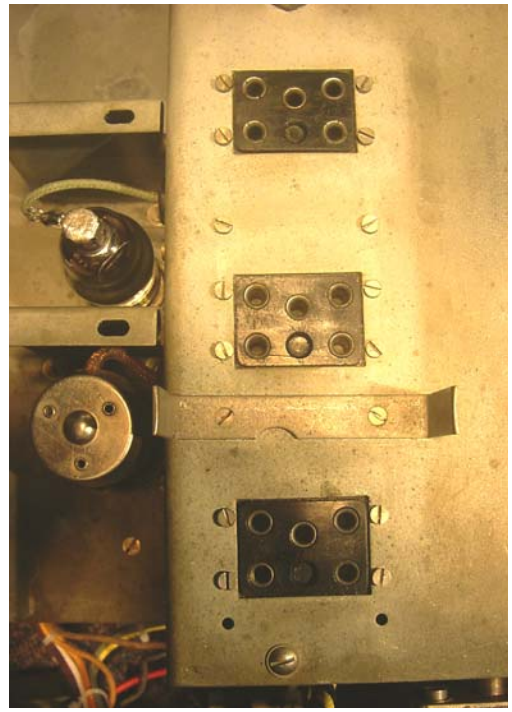




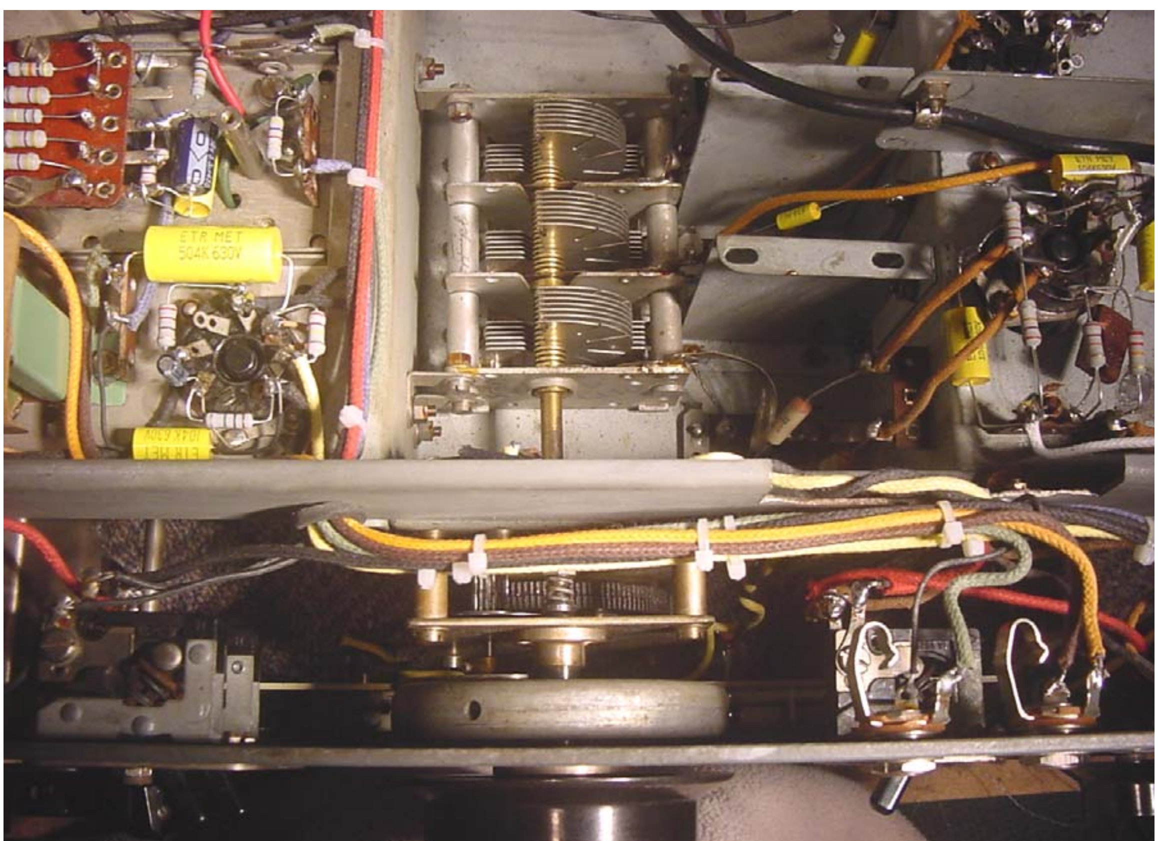


Above: The correct way to connect a random-length wire aerial to the set. As in most Eddystones, the aerial transformer primary is designed for a balanced aerial/feeder (eg. doublet or dipole aerial) – see inset schematic. To use the set effectively with an unbalanced aerial (eg. random length or long wire), one of the connections to the aerial socket must be earthed – here a banana plug on a (grounded) flying lead (black wire) is used for this purpose. Without this connected, the set will appear 'deaf'. Below: my homebrew HRO power supply doing a stalwart job of running the S.358X.



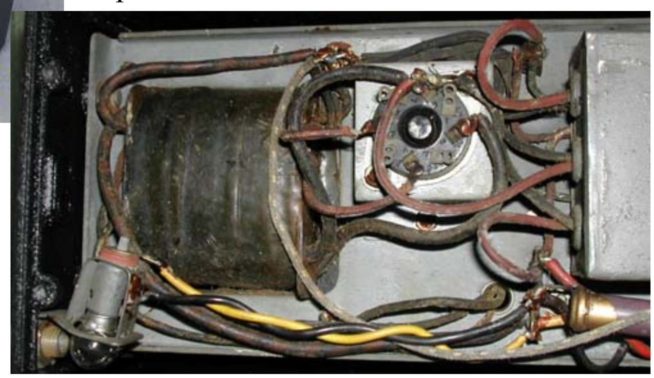


Above left: One of the 'stubborn' knobs – note the gnarled grub screw and the messy (and failed) attempt by someone to drill it out. Above right: Coilpack sockets on the raised central portion of the main chassis. Below: under chassis view showing new wiring loom, switch and phones socket wiring. Note the cut-out that someone has made in the chassis member behind the phones sockets – I have no idea what purpose this served...



Postscript 1 – Power Supply

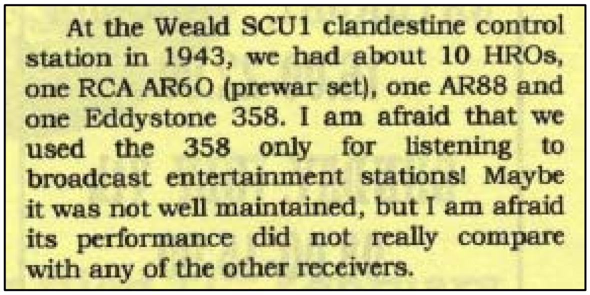
Two different power supply models were available for the S.358 series: the S.390 was the standard issue. Cosmetically, this is a no-frills utilitarian design (see photo, left from a recent Ebay auction, where it is described as an S.451, although looks identical to the S.390B model in the manual, there described as a 'replacement unit' with the same electrical characteristics as the S.390. The S.451 is not mentioned in the manual or the QRG) – externally a steel box with louvers for ventilation, a power switch and indicator lamp. The circuit was equally no-frills, though the HT was well-filtered by two chokes and three capacitors.

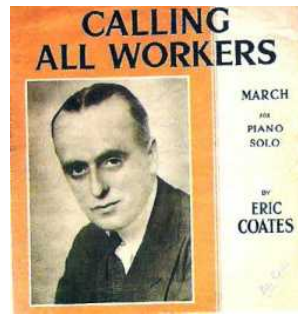


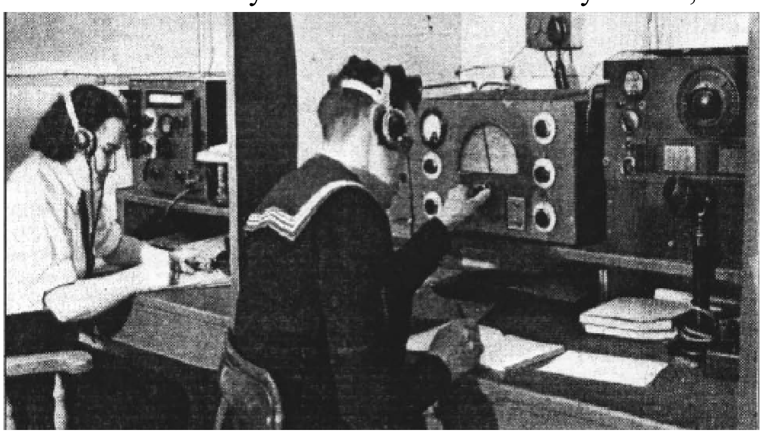
Above left: Power supply external appearance. Left: power switch and indicator lamp (bottom left), Above right, under chassis view (Alan Ainslie's set) – triple smoothing capacitor unit to the right, Below: above chassis view – power transformer to the right, rectifier (5Z4G) centre and smoothing chokes to the left.

Postscript 2 – Historical Context

With this being a museum-related article, I thought it would be appropriate to set a little 'historic context' to the date of manufacture of this Eddystone S.358X… August, 1944 (exactly 11 years before yours truly rolled-off the production line…), so all WWII-related stuff. Just what part the S.358 played in WWII depends on what you read and what recollections folks still have. If Pat Hawker, G3VA, is to be believed (and I am a big fan), probably not a lot (see extract, left, from Lighthouse Issue 72, p47) with operators preferring the HRO (apparently because of the 'PW' dial – (an elegantly simple and excellent mechanical device, I must admit) and the RCA AR88 (not sure why in this case) to the S.358 - maybe because both of these US-built sets sported two RF stages and that helped overcome the noisy hexode mixers of the day? Well, at least the Navy used them (photo left) – but was this guy just really just tuning in to 'Listen While You Work' (http://www.turnipnet.com/mom/mwyw.htm) while writing to his girl back home – the 'real' signals being received on the HRO to his right? I am sure not…


At the Weald SCU1 clandestine control station in 1943, we had about 10 HROs, one RCA AR60 (prewar set), one AR88 and one Eddystone 358. I am afraid that we used the 358 only for listening to broadcast entertainment stations! Maybe it was not well maintained, but I am afraid its performance did not really compare with any of the other receivers.





August 1944 (mostly courtesy of Wikipedia)

- August 1 – WWII: The Warsaw Uprising begins. Szare Szeregi Scouts fought in the Warsaw Uprising.
- 
- August 2 – WWII:
    - Turkey ends diplomatic and economic relations with Germany.
    - The First Assembly of ASNOM is held in the Prohor Pchinski monastery.
- August 4 – The Holocaust: A tip from a Dutch informer leads the

Gestapo to a sealed-off area in an Amsterdam warehouse, where they find Jewish diarist Anne Frank and her family.

- August 5
  - The Holocaust: Polish insurgents liberate a German labor camp in Warsaw, freeing 348 Jewish prisoners.
  - Over 500 Japanese prisoners-of-war attempt a mass breakout from the Cowra POW Camp.
- 
- Jewish prisoners of Gęsiówka liberated by Polish soldiers from Batalion Zośka, 5 August 1944
- August 7 – IBM dedicates the first program-controlled calculator, the Automatic Sequence Controlled Calculator (known best as the Harvard Mark I).
- August 12 – WWII:
  - The Allies capture Florence, Italy.
  - Operation Pluto: The world's first undersea oil pipeline is laid between England and France.
- August 15 – WWII: Operation Dragoon lands Allies in southern France. The U.S. Army 45th Infantry Division participates in its fourth assault landing at St. Maxime, spearheading the drive for the Belfort Gap.
- August 19 – WWII: An insurrection starts in Paris.
- August 20 – WWII: American forces successfully defeat Nazi forces at Chambois, closing the Falaise Gap.
- August 22 – WWII: Tsushima Maru, a Japanese unmarked passenger/cargo ship, is sunk by torpedoes launched by the submarine USS Bowfin off Akuseki-jima, killing 1,484 civilians including 767 schoolchildren.
- August 23 – WWII: Ion Antonescu, prime minister of Romania, is arrested and a new government established. Romania exits the war against Soviet Union, joining the Allies.

- August 24 – WWII: The Allies liberate Paris, successfully completing Operation Overlord.
- August 24 –WWII : Japanese attack the USS Harder. Massacre of 129 people (70% women and children) by the Gestapo at Maille (Indre-et-Loire)
- August 25 – WWII: Hungary decides to continue the war together with Germany.
- August 29 – WWII: The Slovak National Uprising against the Axis powers begins.

And that was some of what happened in August 1944 – quite a month!

References

Lighthouse:

358/358/1/358X:

358/358/1/358X (cont):

And its cousins, the 400/400X and 400B:

- Various documents downloaded from the EUG website, including:
  - The Ultimate Quick Reference Guide (QRG), 2nd Ed., 2005, Graham Wormald, G3GGL
  - S.358X Manual
  - E.C.R Receiver Service Manual
  - R101 Type C Receiver Manual
  - Various copies of the EUG Newsletter and Lighthouse as noted above

- Various copies of Wireless World (WW) from 1940 through 1945 (scans courtesy of Tor Marthinsen)

Practical and Amateur Wireless, April, 1939: "A Review of Communi-Receivers"