VINTAGE RADIO

1940 RME model 69 communications receiver

By Fred Lever

This communications receiver was designed in the mid-1930s. It appears to have been updated by the manufacturer to keep up with competing products. It's a hefty bit of kit, packed with parts, with many functions and some interesting quirks. One of these is a complete lack of labels for the front panel controls! A matching tuned 'pre-selector' unit was eventually acquired; it too required repair and restoration.

I was asked if I would like "an old radio" as the owner, a senior gent, wanted it to go to a good home. I am up for just about anything, so I said yes without even laying eyes on it. When I finally got my hands on the set, I could not get it home fast enough!

It was heavy (15kg), in a steel box with a lift-up lid. The front panel had two big dials and a bunch of knobs, but there were no markings to indicate which knob did what. The only text was on a rear nameplate, advising that this was a Model 69, serial A98 made by Radio Manufacturing Engineers in Peoria, Illinois, USA.

RME radio

Thus I was introduced to RME and a type of receiver I have never had any interest in before, a wideband commercial radio receiver with a pedigree and high performance, at least for 1940. I searched the web and found many references to the model and a history of the company, including model numbers and employees.

At a later stage, I was delighted to receive the matching DB-20 pre-selector unit. I believe these two items were rack-mounted in a complete 'ham' setup, and are the only surviving pieces of what would have been a comprehensive transmit/receive installation.

The pre-selector also came with a treasure trove of books, notes and personal papers belonging to the owner. These items I have simply stored and not investigated at this time.

The 'restored' RME-69 receiver; sadly, the front dials are still cracked.

I downloaded a comprehensive operating manual from a website called "Boat Anchor". This helped me to recognise what I had and figure out what was original.

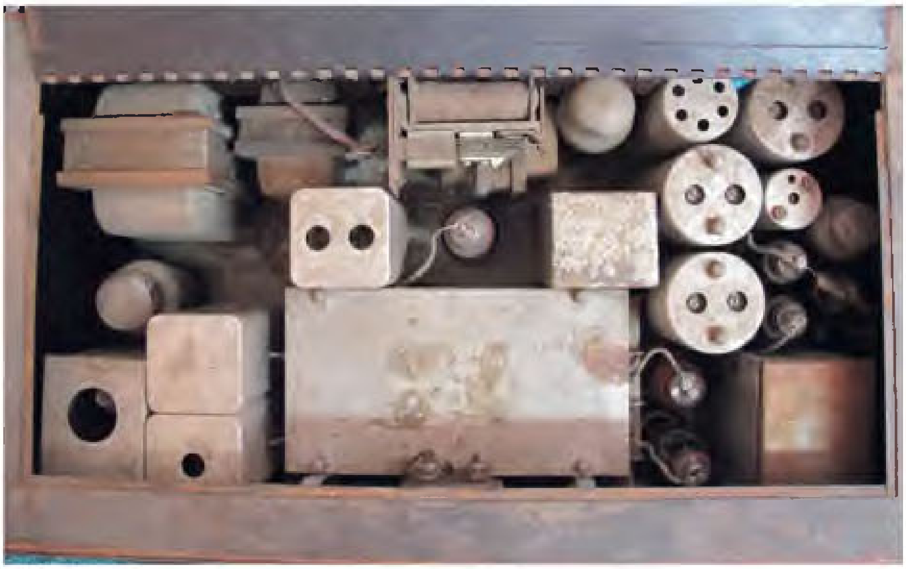
The handbook describes serial number A98 as a late production unit with a "Lamb Silencer" in the front end. The octal valve types and the history of the company mean that it was manufactured around 1940. The original production radios had 6-pin valves and no Silencer.

My first move was to survey every part of the set and take photos. While parts of it were undisturbed, other parts had been replaced or looked like they had been modified. After some investigation, I elected not to try to refurbish the set but just make it safe to turn on and work in some fashion on the AM 500-1800kHz band only.

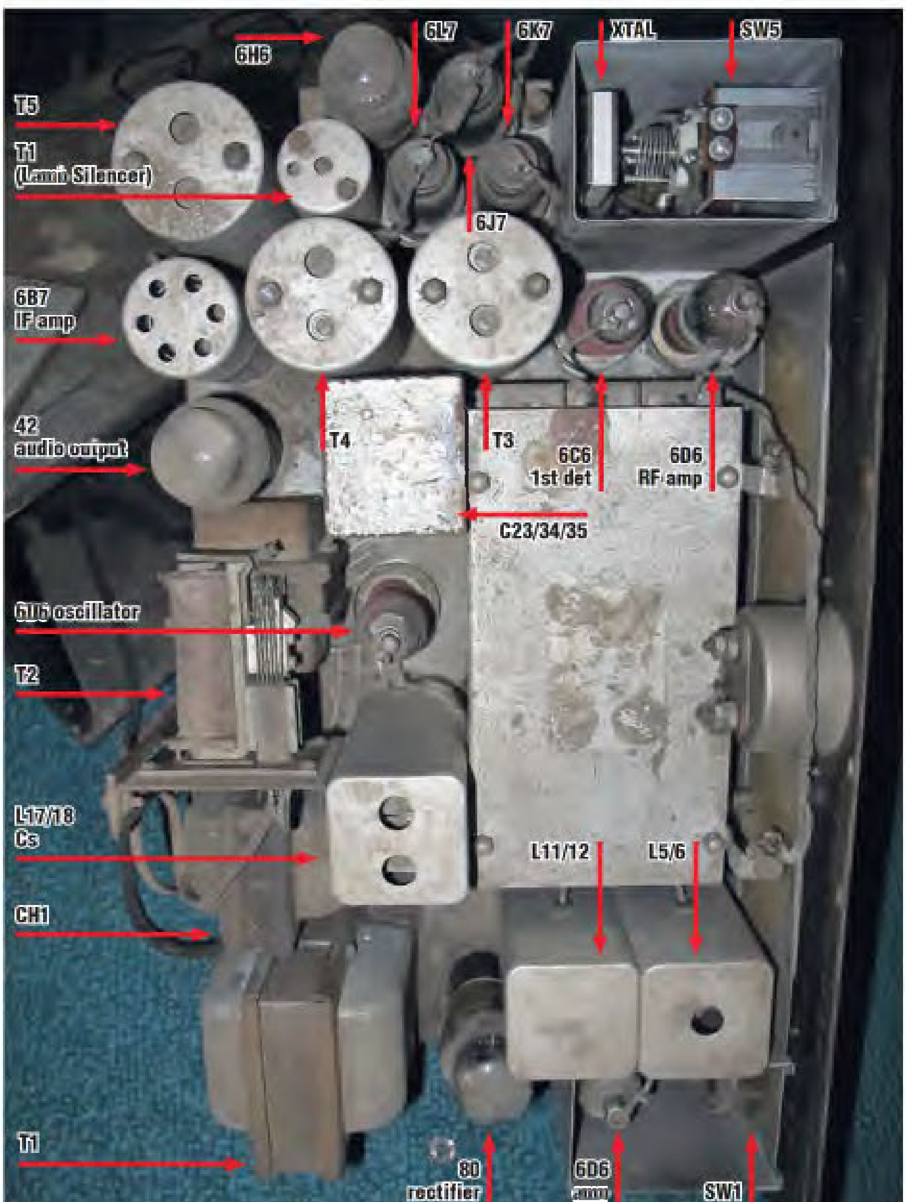
I achieved that by replacing obviously faulty parts and removing some strange modifications. I then carried out what I confess to being a cosmetic 'tart up' on the set and the matching pre-selector, by cleaning them and misting with a light coat of gloss black, over the faded wrinkle finish. The insides and chassis were cleaned, masked off and a light coat of silver misted over the rust and patina.

The accompanying photos show the dusty old thing as I received it, then in its cleaned-up state, as well as a view of the underside of the chassis post-cleaning.

Not having any markings on the panel controls intrigued me. It seems that RME never marked their model 69



The inside of the receiver, as originally received, was full of dust and showed some surface rust.



front panels. The legend goes that the builders reckoned that if you could not figure out what knob did what, you did not deserve to own the set! I am not sure about that; I suspect more likely they did not possess the equipment to etch or engrave plates, and preferred not to spend the money to buy it.

Circuit details

The set's circuit diagram is shown in Fig.1. It has a pretty conventional superhet arrangement for the time, with a 6D6 RF stage, a 6C6 mixer, two 6D6 IF stages, then a 6D7 as a combined detector, AGC and audio preamplifier and a type 42 based output stage. One 6D6 forms a separate oscillator while another acts as a BFO. A type 80 serves as the HT rectifier.

All of that should add up to a high-performing design.

One great feature of the set design is the careful sub-assembly of the tuning coils and wave change switch. The wiring of the coils is effected with heavy solid core leads in a very rigid assembly, and with the rigid cast chassis gives a stable platform for the front end. The tuning gangs operate with low-geared reductions and large, heavy knobs. This construction ensures stability and repeatability.

I am not sure how far this set has been modified from the original design. The old lower-gain 6-pin valves in the RF and mixer stage had at some point been replaced with EF36 octal valves. These are sharp cut-off types that would not be so amenable to AGC control.

The set also sported the aforementioned optional "Lamb noise filter" assembly with 6K7 and 6L7 octals in place of the 6D6. These seem to be factory modifications, perhaps in an attempt to keep up with other manufacturers' new designs at the time.

The two EF36 sharp cut-off audio valves did not sit very well with me, and the shield paint was flaking off, so I replaced them with 6K7 octals. These perform more similarly to the originally fitted types.

Fixing the RME up

My first job was to remove all the existing mains wiring as it was not safe, due to rotting rubber and cracked insulation. I wired in a three-core cord with a chassis gland. After testing the insulation and Earth conductivity of the mains side of the circuit, I powered it up with low-voltage AC and ramped up the voltage while monitoring the power consumption, HT and heater voltages.

The power draw settled at 70W with 250V DC HT. Nothing smoked or caused concern, so the next job was get the audio section to work.

The output transformer is a monster, with only 4kΩ and 600Ω output taps. I connected a 4kΩ:4Ω transformer to this so that I could use a 4Ω speaker for testing. I connected my audio signal generator to the cap of the 6B7 and wound the level up until I could see clipping on the output wave. At that point, the output was a couple of watts.

I measured the stage voltages and noted that the type 42 cathode bias resistor had 20V across it, indicating a 50mA tube current. That seemed a bit high to me, so I checked the control grid and measured +12V. I found the wax coupling capacitor to be leaky (it measured 12MΩ). After replacing it with a new one, the grid voltage was then less than 0.1V, and the tube current dropped to about 34mA.

That had the effect of taking some load off the type 80 rectifier, so the main HT rose to 260V.

Poor performance

At this stage, I hooked up an aerial to the set, worked out which switch position selected the AM broadcast band (no panel markings!), and tuned in very faintly station 2RPH that in my locality (Toongabbie, Sydney) is usually overwhelming.

So the set was working in some way, but producing less output than even a crystal set! I then re-read the handbook to work out what control did what, and with a bit of fiddling, could receive a few more stations at very low volume and at odd places on the dial.

Even with low-gain tubes such as the 6K7 in the tuner, with one RF and two IF stages, the set should be highly sensitive, and stations should pull in from everywhere with a short aerial. I checked the AGC feedback loop, and the best voltage from the 6B7 diode was about -5V, with a couple of volts of 465kHz injected on the preceding IF valve plate.

I measured the resistance from the AGC line to ground and found it to be low at 2MΩ, so I replaced all the time constant capacitors. Out of the circuit, they each measured about 10-20MΩ, so replacing them did lift the AGC voltage a bit.

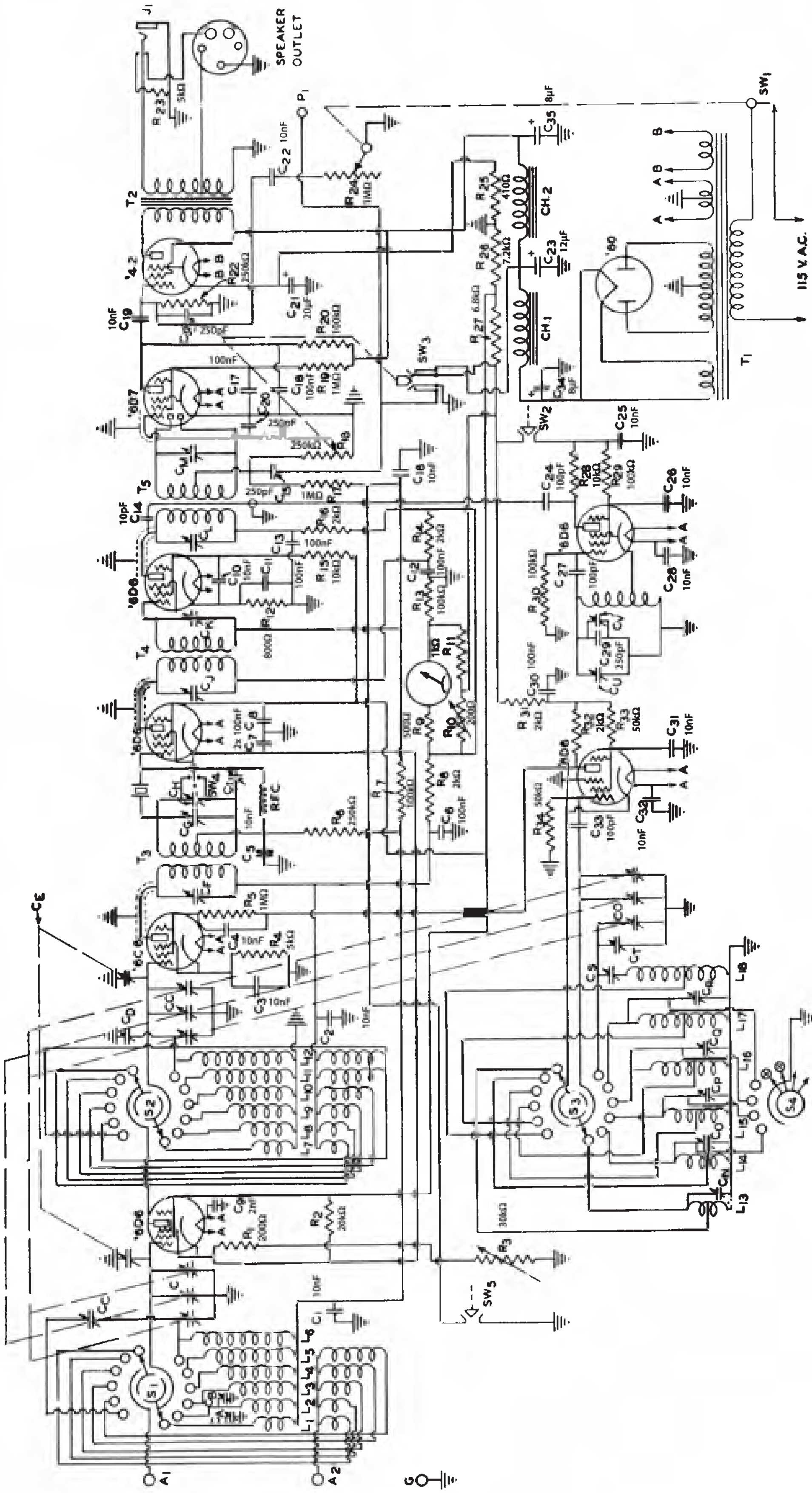


Fig.1: the circuit diagram for the RME-69 receiver. Values for resistors and capacitors have been added. Note that there were some errors in the original service manual, such as C18 missing (estimated at 100nF) and C15 is listed as 0.00025µµFd rather than 0.00025µFd (250pF).

The original mains wiring in the receiver was unusable and unsafe, as shown. It was replaced with three-core cord with a chassis gland.

The IF section

I then did another check of the plate, screen and cathode voltages of each IF stage. Measuring the gain from each grid to plate made it plain that the IF strip was low on gain.

I injected a 465kHz sinewave and checked the peaking of each trimmer in the IF cans. All six were off frequency a bit, but importantly, each had a definite peak point with a drop-off one-quarter of a turn each way. That indicated to me that all the coils were active and resonating, and most likely, the low gain was a system problem and not due to the coils.

What I found a bit odd was that the IF strip had oodles of gain when fed with the 465kHz signal, but the set was a lame duck when I let the oscillator control the frequencies. Then the penny dropped. The broadcast band oscillator frequency was way off, outside of the peak of the passband of the IF coils. This was why the stations were appearing at weird places on the dial.

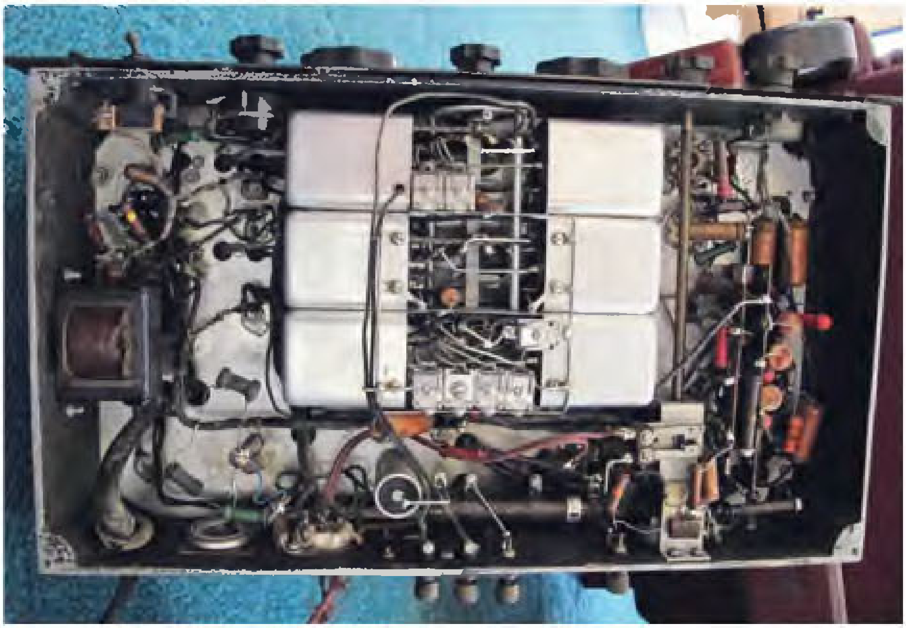
A screw loose!

I manually forced the oscillator valve to run at the correct frequency by padding the tuning circuit with capacitance, and the set came alive with lots of background noise and stations all over the dial, in the correct order. That led me to conclude that something was badly adjusted or faulty with the oscillator tuning.

I needed to check the padder and trim components and after much searching, realised that they were fitted inside the broadcast coil can. It was a heck of a job to get the can off, but once exposed, I found the adjusting screws on the calibration trimmers had simply unwound from vibration. You can see this clearly in the photo below.

Simply recalibrating the settings made the receiver work in a lively manner with gain, not loss, from the IF stages. Therefore, those two loose screws crippled the receiver on the AM band! From the corrosion on the parts, I think they had been that way for a long while. Possibly, the receiver was not used on the broadcast band in its ham duty, so this fault was never found.

Now that the receiver was working better, I turned my attention to some of the other aspects of this set. My experience in radio to this point has been



Above: the underside of the RME chassis before any restoration work was done. Right: the calibration trimmers inside the broadcast coil had their screws unwind over time due to vibration.

The carrier level indicator dial ("S" meter) needed to be checked for correct operation.

with AM broadcast band receivers, so all the extra functions and knobs in a commercial set like this were mysterious to me.

That "S" meter

The meter circuit bugged me as it is not clear how it operates, and the zero adjustment (null) control did not do anything sensible. I was not sure if the meter was working, so I decided to pull it out and hook up to a bench test circuit that mimicked the set circuit. I found that the meter had an internal impedance of 32Ω and needed about 1.5mA for full-scale deflection (FSD). That seemed about right.

The meter is actually in a bridge circuit with ~1kΩ upper arms and 100kΩ lower arms. The upper arms connect to the HT, with one of them being adjustable via the 500Ω zero-set pot. One lower arm is a fixed 100kΩ resistor passing about 2.5mA, while the other is formed by the current draw of the AGC-controlled valves of about 3-15mA, being equivalent to a resistor of about 20-100kΩ.

The circuit is balanced like a seesaw, and if not set correctly or the wrong currents flow, the meter can easily go in reverse. The null control sets the meter to zero with no signal. The presence of a signal causes the valves to draw more current, so the meter reading goes up.

The set had some prominent non-original parts fitted with strange values. I replaced them with the original values, and the S meter then worked sensibly.

The crystal filter

Without the filter, tuning on the broadcast band is inherently very sharp, and the set will separate Sydney stations 2CH (1170kHz) and 2RPH (1224kHz) with ease. The set rides up and down the different signal strengths with AGC control (meter readings S9 to S3), and despite the vast S-difference, the audio output is level, and there is no adjacent channel chatter.

The crystal (a BLILEY type CF1 465kHz, serial no. G20326) is supposed to resonate and provide a narrower pass filter at the intermediate frequency, to sharpen the selectivity for sorting out really close stations. There are panel controls to vary the insertion effect.

The problem was that with the crystal switched in, there was no real resonant point around the nominal frequency of 465kHz, and the IF response was worsened.

I stripped the crystal, thoroughly

The old carrier meter zero adjustment is shown above with its replacement circuit at right (200Ω potentiometer R10).

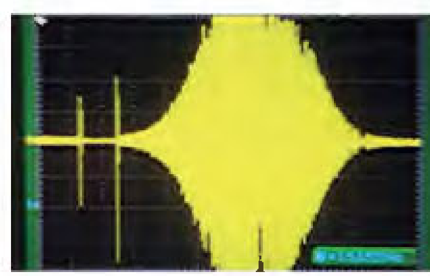


Fig.2: an IF pass response without the Bliley crystal filter

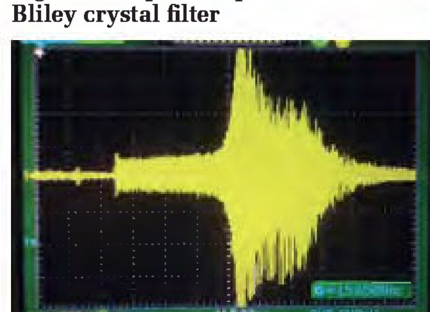


Fig.3: the same IF pass with the crystal filter switched in.

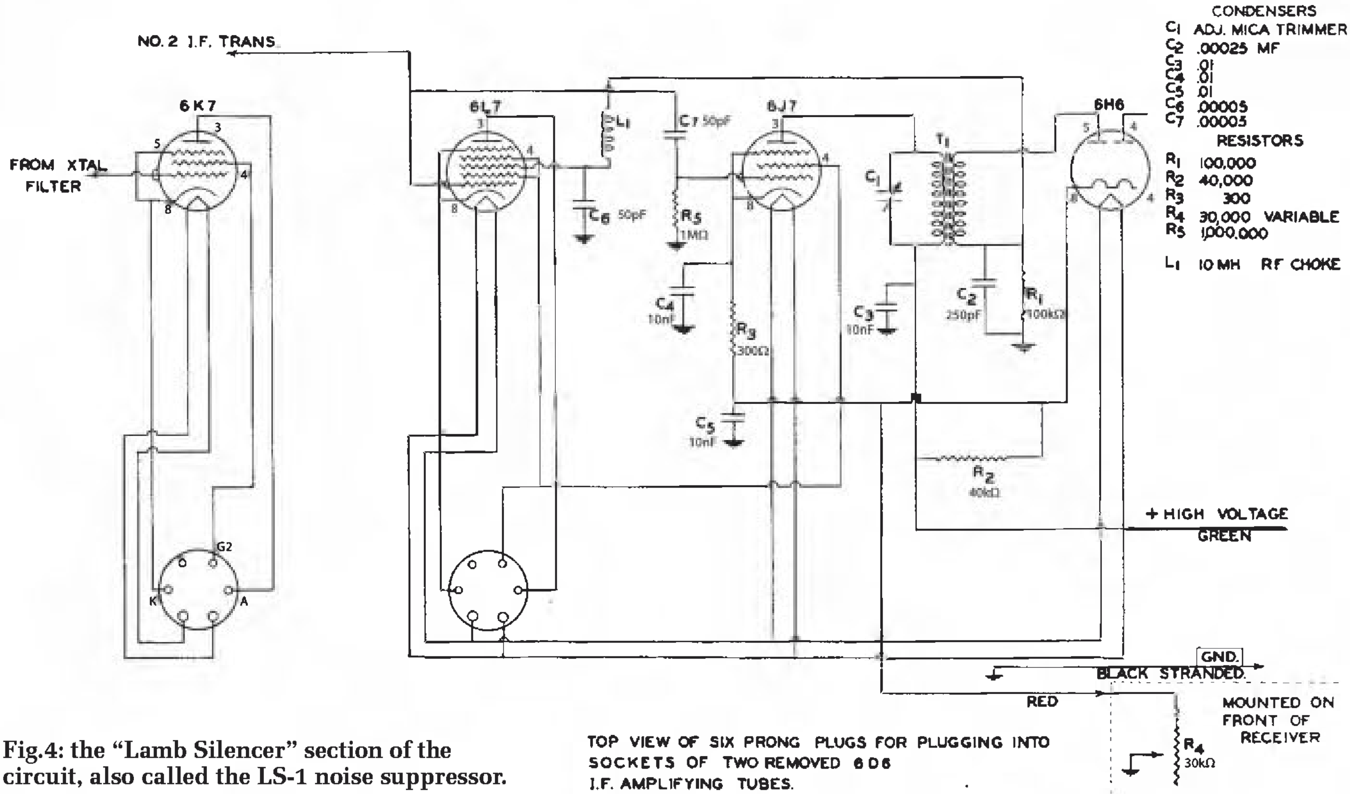


Fig.4: the "Lamb Silencer" section of the circuit, also called the LS-1 noise suppressor.

cleaned and refitted it. This produced a result where the crystal does 'something' to the response of the IF strip, but I did not believe that it was working correctly. The IF pass response with filter out is about 10kHz (Fig.2) while with the filter switched in, the response is about 5kHz (Fig.3).

What I expected to see was a mirror-image of the left side on the right, with maybe 1kHz width, not a ringing decay stretching the response out. The filter circuit is certainly not a narrow crystal resonance, but surely, this is not the best it can do. I think the crystal may be too old to work properly, but not having a replacement, I left it at that.

Silencer of the Lamb

So far, I had ignored the Lamb Silencer section. I had disconnected the IF feed to the control valve for all my testing so far, but now that the set was running, I decided to see what it did.

The circuit diagram of this Lamb Silencer is shown in Fig.4. Upon reading a bit about this type of circuit, I determined that it is a type of 'impulse blanker'. The Lamb patents are a treat to read; my eyes glazed over by the end of the second page.

Ignoring all the scientific gobbledygook, it seems to me that the filter samples the IF 465kHz carrier, detects bursts of interference such as from vehicle ignition systems or lightning and gates an IF pass valve off during the interference burst.

In this version, the IF signal is sampled from IFT2 to the grid of the 6L7. This 6L7 amplifies the IF signal in the usual way using control grid G1, but one of the other pentagrid inputs of the 6L7 is used as a back-fed DC gating control. The sampled IF signal is fed to a 6J7 wired as an amplifier, and the output of the 6J7 is fed to a resonant IF transformer.

This is where the clever bit comes in. The output of this transformer, with the 465kHz removed, is rectified by a 6H6 diode to give a negative gating voltage. Some smart time constants ensure that the gating voltage is a derivative of the interference, and persists long enough to gate the 6L7 off during the interference burst.

This gating is timed so that a 'hole' is 'poked' in the main IF signal right where the 'pop' was; therefore, you do not hear it.

Upon testing it, I found that this filter was simply not doing anything.

The Bliley 465kHz crystal filter is shown enlarged for clarity, with an actual size of 30 x 40mm. Serial number: G20326.

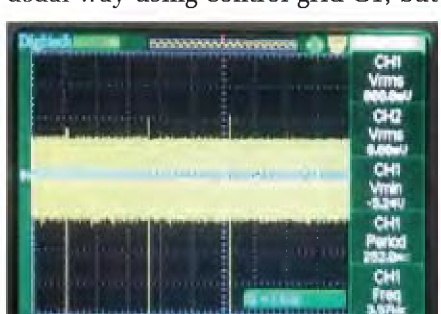


Fig.5: with the Lamb Silencer switched out, spark interference is visible in the output.

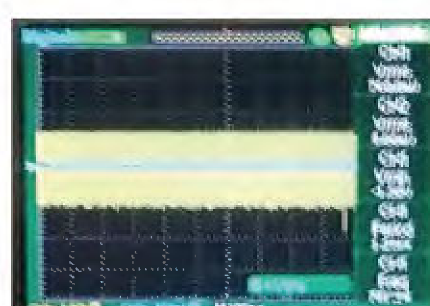


Fig.6: with the Silencer switched in and threshold set, the interference spikes go away.

The DB-20 pre-selector had a very worn filter choke hanging off the lower left of the chassis. This choke, the power supply transformer and the type 80 rectifier valve were removed and replaced with a π filter.

With some signal tracing and testing, I found leaky capacitors; resonant IF transformer T1 needed peaking at 465kHz; and worst of all, the 6H6 was dead.

Once that lot was fixed, the threshold control now suddenly cut the IF response at too high a setting, so the circuit was clearly active. I then rigged up an "interference tester" involving a magneto air spark gap next to the set, to simulate automotive ignition interference, and was delighted to see Mr Lamb's patent theory vindicated. See the sweeps without (Fig.5) and with (Fig.6) the filter.

Pre-selector

The pre-selector looks like a baby version of the main set, with similarly styled metalwork. It also has a flip-top lid and many large parts shoved into a small space. Its circuit is shown in Fig.7. The range switch and coils looked just like those in the main receiver, but the circuit is a tuned radio frequency (TRF) receiver with manually adjustable gain.

The first thing I noted inside was a huge filter choke held down by gravity! I eased the chassis out of the case and found that the choke was connected with BB points through a bit of figure-8 wire. It seems that the original had failed, and anything handy had been pressed into service.

I again replaced all the mains wiring and removed the substantial floating choke. Next, I pulled the filter block can off, thinking of either re-stuffing it or just replacing the new units underneath.

The power supply transformer and choke were big enough to run a small village! All it has to do is run two valve filaments at 0.6A, supply about 20mA of HT plus the type 80 filament current.

I decided to ditch the choke altogether, wire in some silicon diodes in place of the type 80 valve and mount some appropriate filters and dropping resistors on some tag strip. In place of the choke, I put a 3.3kΩ 5W resistor and a pair of 150μF 400V capacitors in a π filter arrangement. I left a dud type 80 bottle plugged in the rectifier socket to fill the space.

Left: the original underside of the DB-20 pre-selector. The DB-20 provides continuous coverage from 550kHz to 32MHz in six bands, and has a gain of ~20-25dB which is the basis for its name. The DB-20 was also used by the US Navy under the name CME-50063.

Below: a replacement switch for gain control "A" on the front panel.

I ramped up the mains input voltage to form the electros, and once I reached typical mains voltages, the set drew 25W. The total HT draw is 30mA, and this arrangement gave me 270V DC at the HT feed point to the valves.

A quick check with RF signal applied showed the TRF circuit amplifies the signal from the aerial and provides "pre-tuning", to upgrade the overall specifications of the receiver to match the performance of later competing units.

The overall gain is in the order of 16 times at maximum setting, but the unit was unstable, self-oscillating at the tuned frequency. This turned out to be a valve shielding problem, as one of the valves was a glass EF39 fitted in place of a 6K7. The red metallic shielding paint had flaked off. Swapping back in a 6K7 with a metal shield fixed that.

I gave the cabinet and front panel a mist of black paint, burnished the knobs, cleaned the glass and put it all back together. When stacked onto the main receiver, I could hook the two together via the receiver antenna wires, and found they worked as a

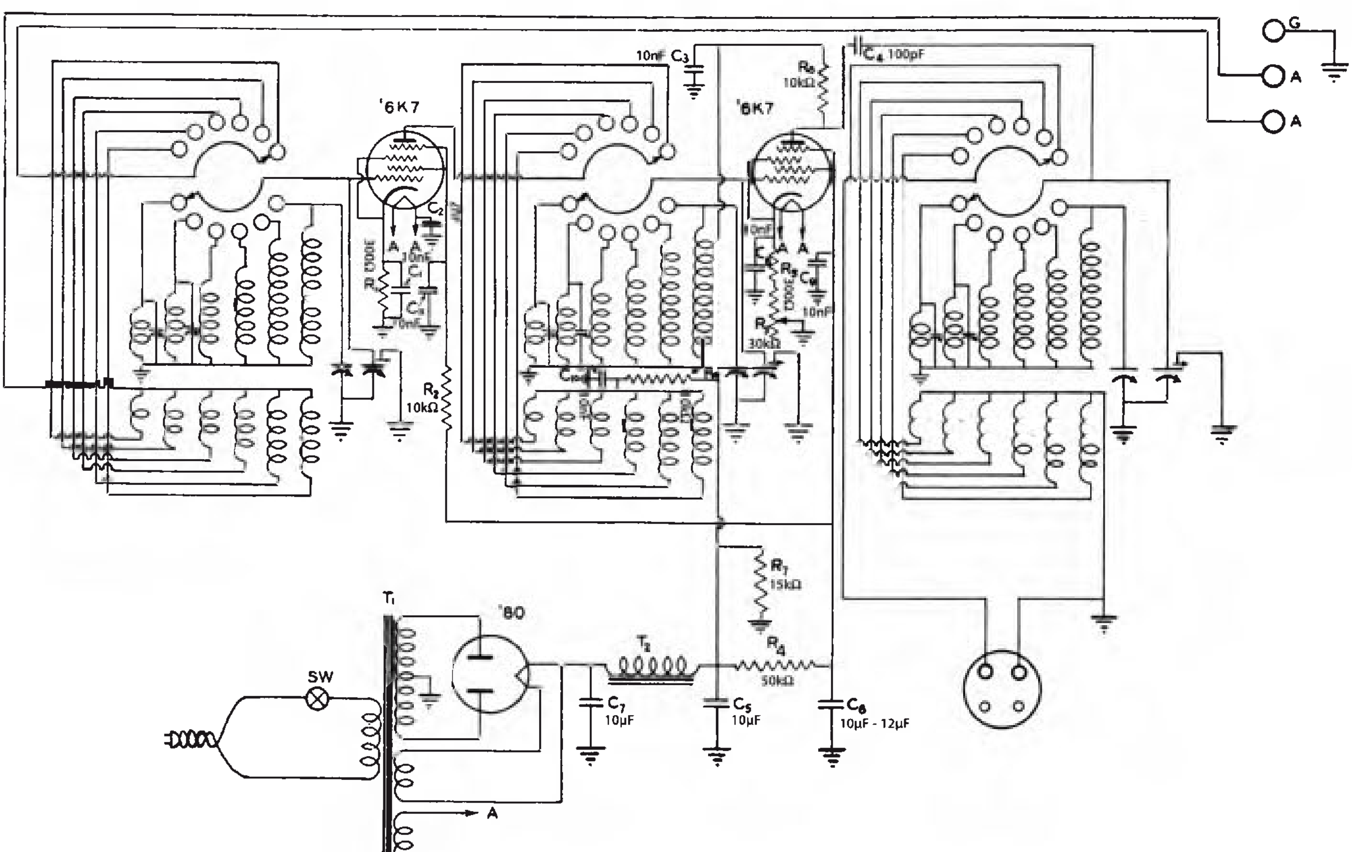


Fig.7: the circuit diagram for the DB-20 pre-selector. It's a pretty simple 3-valve companion unit for the RME-69. This circuit has alternative versions around with most using two electrolytics to filter the power supply, while this one has three. There is no parts list to confirm it, but the capacitor C6 should likely be around 10-12µF 450V as noted here.

A Jaycar Cat. MM2007 transformer was rewound to act as the matching transformer for the speaker unit.

pair, giving four tuning controls to play with!

Making a suitable speaker

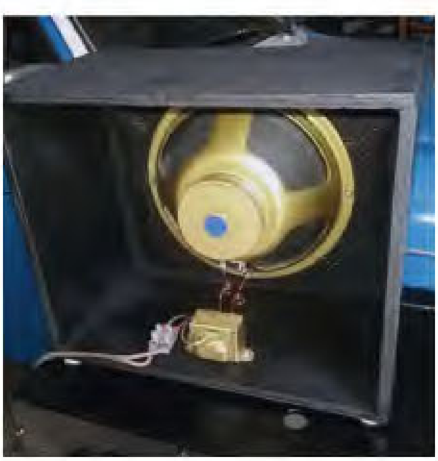
One thing the set up did not have was its own speaker box. I sorted through my junk speakers, looking for a sensitive unit around eight inches (~20cm), and came across a Goodman Hi-Fi mid-range driver from the 1960s that had a very light movement.

The frame was rusted, and the rubber surround had perished with splits and cracks, but the inner suspension was sound and a test showed that it played music.

I painted a couple of layers of my favourite water-based latex over the cracked outer ring of the speaker, left that to dry and turned my attention to sourcing a matching transformer. I had an old Jaycar MM2007 240:30V AC transformer from a junked power supply. That gave me a primary winding capable of handling hundreds of volts, and a secondary that I could rewind to suit the speaker and radio.

Having rewound it, I restacked the lamination with an air gap.

I masked the speaker up and found a "copper" gold rattle can, so I gave the speaker and the assembled transformer a dose of that. That covered the rust and dirty bits nicely. I made a small open-backed cabinet from scraps of five-ply and bolted the speaker and transformer into it.



Since the speaker was an optional extra, one was made in lieu, with a black cabinet to match.

I had some automotive rocker cover "crackle" paint, so I applied three coats of that over the ply, and that dried to a matte wrinkle finish not far off the RME radio wrinkle finish. A light coat of gloss black on top put some shine on it. Finally, I had a 'matching' speaker for the set.

The present state

I removed the headphone socket and moved the BFO on/off function to that hole using a period switch. That put that function adjacent to the BFO pitch control.

A new power on/off switch is now in the hole below that. Previously, the mains switch had been part of the audio "top cut" control that is located within the BFO shield box. Crazy stuff!

The complete primary mains circuit is now short, well-insulated, Earthed and fused. It's much safer than it was when I got it.

The whole set-up is now operational, and most parts of it work. I decided not to replace any more parts and not pursue repair any further. Many of the capacitors left were dripping with wax, but had no measurable leakage and close-enough capacitance values.

Editor's note: these capacitors can have age-related failures which damage other components, so ideally they should be replaced anyway.

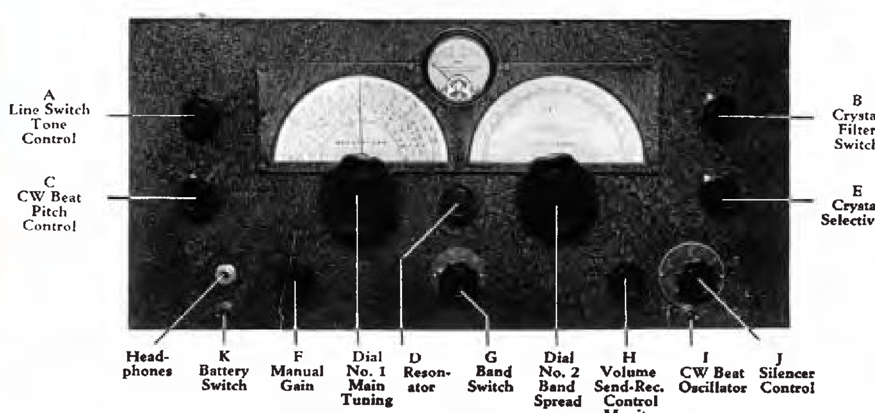
The wax dripping seems to be related to the type of wax used. It has a very low melting point, so in Australian summer temperatures, the wax simply runs, forming stalactites. The large carbon resistors seem very stable and generally were within 10% of the colour value.

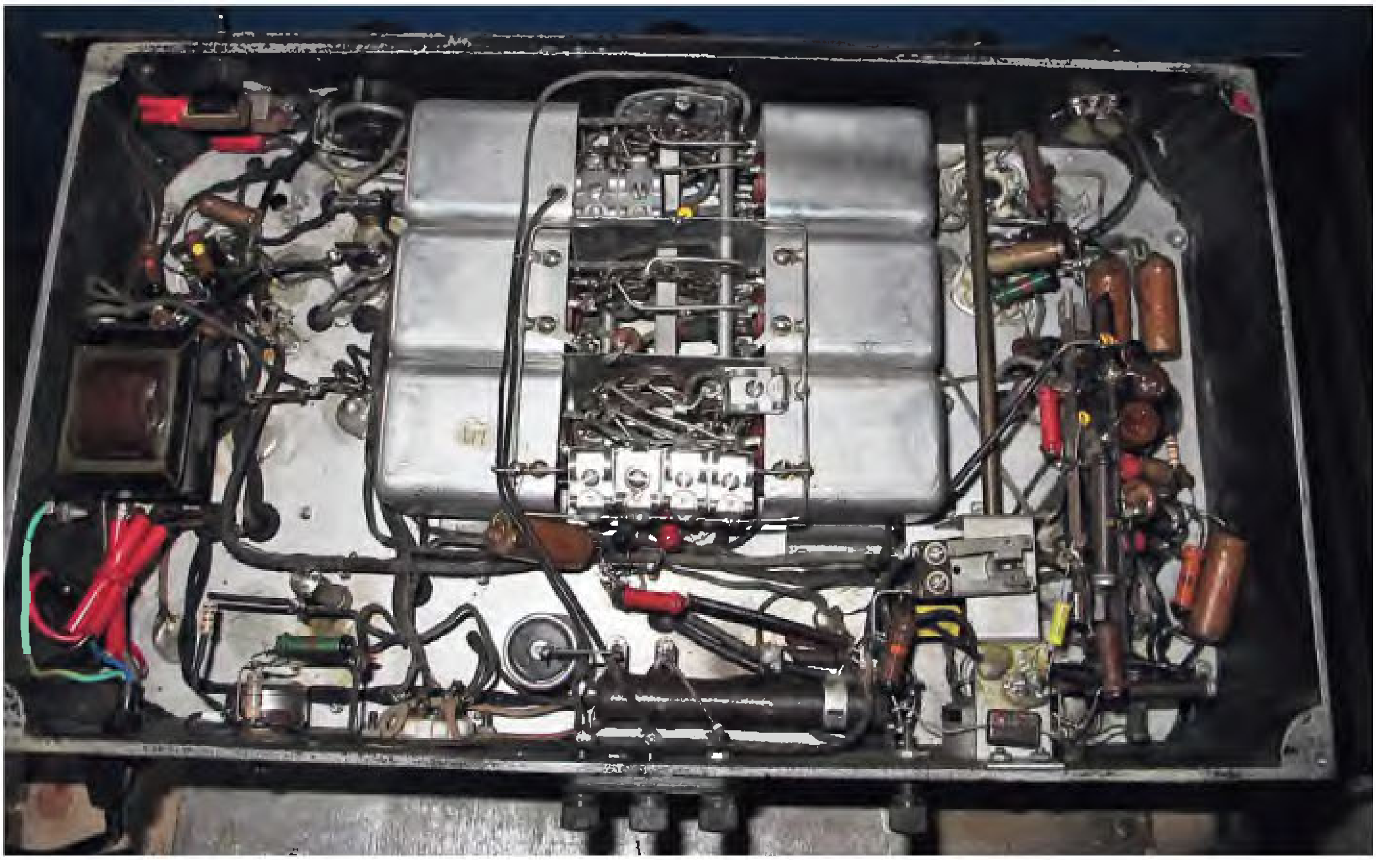
Conclusion

As my first look at a commercial communications receiver from the 1940s (although in a sense, this is really a 30s design), I learned a lot about communications valve circuits. I also had the pleasure of preserving a serious piece of gear that was made over 80 years ago.

This article is a shortened version of a series of vintage radio website posts in six parts, replete with much more tedious information and blow-by-blow accounts of troubleshooting and testing. These posts can be seen at the following links:

siliconchip.com.au/link/ab5a
siliconchip.com.au/link/ab5b
siliconchip.com.au/link/ab5c
siliconchip.com.au/link/ab5d
siliconchip.com.au/link/ab5e
siliconchip.com.au/link/ab5f **SC**





The 'restored' underside of the chassis can be seen above, with the topside shown below. This receiver was manufactured by RME at 306 First Avenue, Peoria, Illinois USA as stated on the label on the rear of the set. Around 1953, RME merged with Electro-Voice who are still around today.