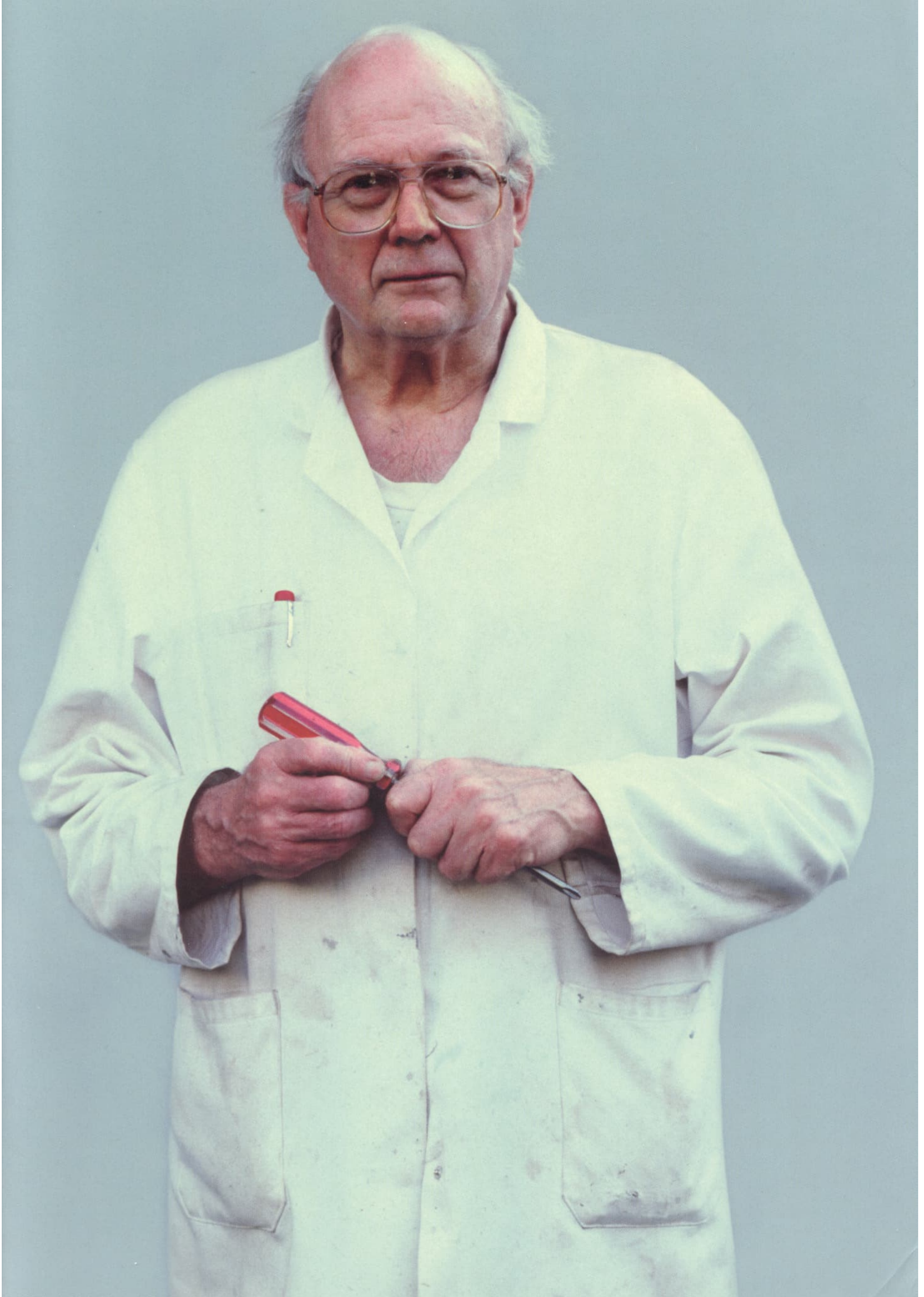

The Bulletin Vol. 40 no. 1 Spring 2015 www.bvws.org.uk

The Bulletin of the British Vintage Wireless Society £5.00 | free to members ISSN 0955-9345

The BVWS Spares Dept

DeoxIT D5 contact cleaner / lubricant £16.50 aerosol can. Not cheap – just the BEST. Available at all BVWS events or by post for an additional £4.00

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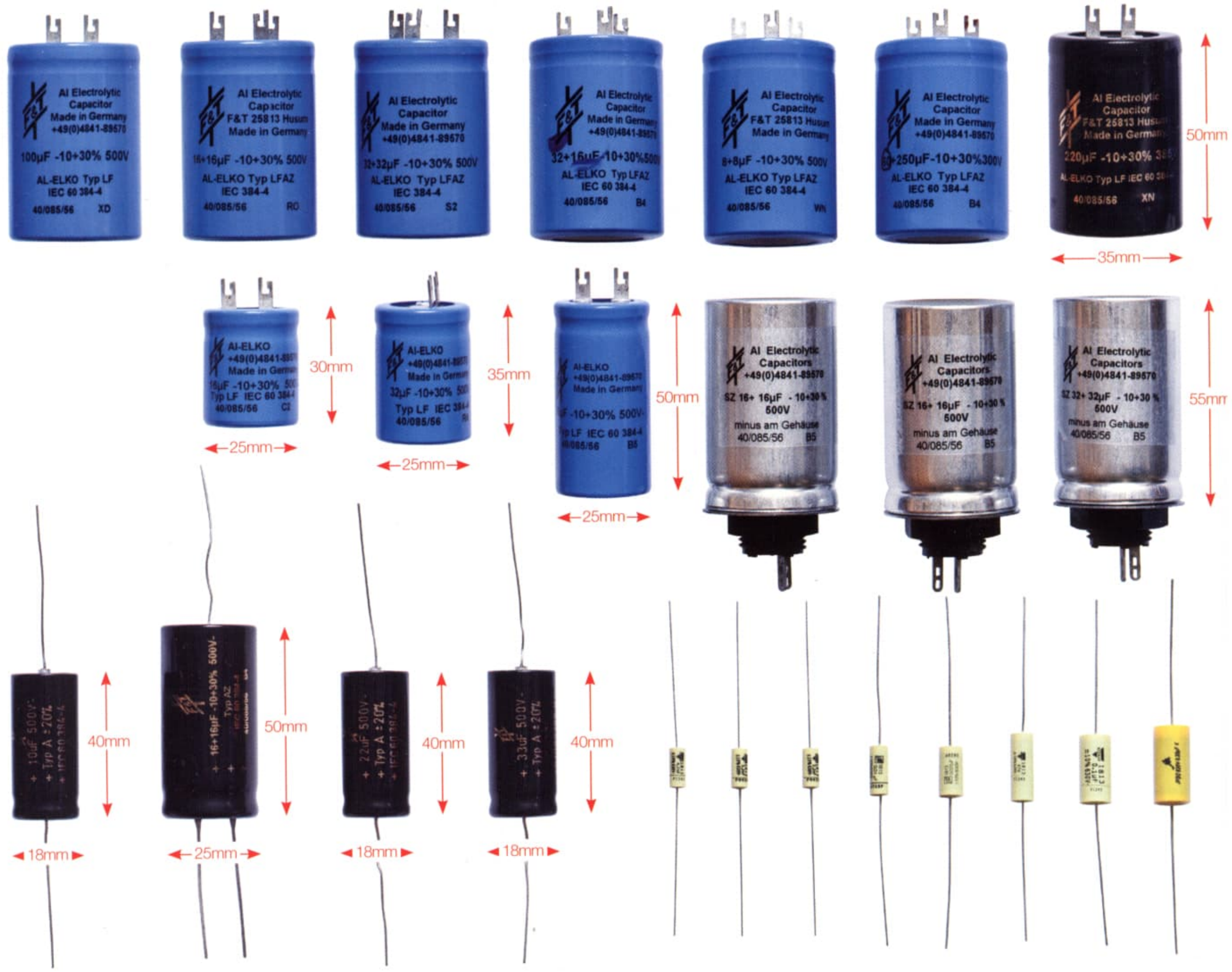

For non UK addresses, please contact Mike Barker for prices, (see below). All orders should be sent (with payment made out to BVWS) to: Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG. Cheques payable to British Vintage Wireless Society. Please allow 14 days for processing, but usually quicker! The above capacitors are supplied as a BVWS member benefit. Anyone found to be reselling these items for profit will be expelled from the Society

BVWS team

Chairman/ Events Co-ordinator:
Mike Barker,
Pound Cottage,
Coate, Devizes,
Wiltshire,
SN10 3LG
Tel: 01380 860787
chairman@bvws.org.uk

Bulletin Editor/Designer:
Carl Glover, c/o Aleph,
33 Rangers Square,
London SE10 8HR
Tel: 020 8469 2904
Fax: 020 8694 4817
bulletin_editor@bvws.org.uk

Sub Editor:
Ian Higginbottom

Vice Chair:
Jeremy Day
62 Sherbourne Drive,
Old Sarum, Salisbury
Wiltshire SP4 6GA
vice_chair@bvws.org.uk

Ordinary Committee Members:
Jon Evans
Tel: 0121 5447006

Terry Martini
terrym@ferrographworld.com

Membership Secretary:
Martyn Bennett
Wood Cottage,
58 Church Road,
Fleet, Hampshire,
GU51 4LY
Tel: 01252 613660
membership@bvws.org.uk

Harpenden Organiser:
Vic Williamson,
Tel: 07805 213369

Treasurer:
Greg Hewitt
54 Linnell Road,
Hillmorton, Rugby,
Warks
CV21 4AW
treasurer@bvws.org.uk

BVWS Archivist:
Lorne Clark
16 Kibblewhite Crescent
Twyford, Berks. RG10 9AX
Tel: 0118 9345606
Archivist@bvws.org.uk

Members' Advertisements Committee Secretary
Guy Peskett,
13 Warneford Road,
Oxford, Oxon
OX4 1LT
Tel: 01865 247971
secretary@bvws.org.uk

Webmaster:
Paul Stenning
Box 170
89 Commercial Road
Bournemouth BH2 5RR
webmaster@bvws.org.uk

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Honorary Members:
Ralph Barrett | Dr A.R. Constable | Jeremy Day | Ian Higginbottom | Jonathan Hill | David Read | Gerald Wells

Front cover: Gerry Wells at The British Vintage Wireless and Television Museum, West Dulwich, London.
Rear cover: Gerry Wells' work bench.

Photographed by Carl Glover
Graphic design by Carl Glover and Christine Bone
Edited by Carl Glover. Sub-Edited by Ian Higginbottom
Proof-reading by Mike Barker and Steve Sidaway

Contents

Gerry Wells 1929 – 2014

It is with great sadness that I tell you of the death of Gerry Wells on 22nd December 2014. Gerry had spent a short time in hospital after experiencing difficulties with his health.

The eventual diagnosis was that Gerry had a form of pneumonia. Ultimately the doctors could do no more than to make him comfortable. Throughout his stay in hospital Gerry was kept company and alert with visits from Museum friends. Even radios were taken in to him. Most importantly to Gerry, he had Eileen with him for many hours each day. Eileen was with him when he finally slipped away late that evening.

The Museum, for now, feels like a powerful radio transmitter fully functional and On Air, but with no modulation signal. With time, this feeling will pass as it was Gerry's express wish that the Museum should not be a sad place but a busy happy place and therefore the message that is being sent out loud and clear on all frequencies is "BUSINESS AS USUAL"!

The wishes of Gerry and the activities that must take place to execute them are now starting to happen. The original 25 year lease for the Museum trust covers only the ground floor of the house, the front and back gardens and all of the sheds. This is how Gerry wanted it so that a material asset was left to his beneficiary. This means that the items in the collection on the first floor will be moved and accommodated into other areas where possible. Some re-organisation will naturally be required.

Gerry did not want lots of people at his funeral and asked that it should not be advertised widely. Only a list that was left for Eileen to contact and the closest of friends were informed.

Although a very sad occasion, the funeral was a simple service conducted by the Rev. Steven Niechcial who is also a BVWS member and radio collector. Instead of any hymns the chapel rang out with the sound of the Radio Normandie Chimes followed by Henry Halls' Radio Times. Speeches by Fred Watts, Nicola Laffey (Eileen's daughter) and myself with some light comedy thrown in made it an uplifting occasion.

Instead of sadness, Gerry wanted a jolly good party, a happy event to be arranged for those who wished to celebrate his life. It is planned that a memorial to 'The Man in the White Coat' will now take place at the Museum on Saturday 6th June. This is the day already on your calendar as the Garden Party.

The day will start at 12:00 noon and run until 6pm. everyone is welcome to attend. There will be no entrance charge but donations will be gladly accepted. It will consist of plenty of live music and vintage equipment running. A part of the afternoon will be spent showing some significant footage of Gerry from various recordings made over the years. There are also other plans to be decided, but these will take a little longer to organise before they can be announced.

Anyone wishing to give donation to the Museum in Gerry's memory can do so. Just send your donation to:
The British Vintage Wireless & Television Museum
23 Rosendale Road
West Dulwich
London SE21 8DS

Restoration of an Atwater Kent 308 from 1934

by Gary Tempest

When I went to collect the radio this is the story that the seller told me:
As a boy, he could remember his Greek father bringing it home. It was a new and expensive purchase for a man who was not particularly affluent. It was used, for some years, up to and including the German occupation of Athens in WW2. This was allowed provided that it was tuned, and locked to Radio Athens on MW which they controlled. The locking was done by a German officer using a tie and an official seal. I'm not sure how, although it could have been around the dial pointer, this being possible as the dial is open and remarkably still in perfect condition. But neither does it have a back cover so from the inside was also possible. There are no witness marks to tell. Had it been unable to be locked then probably the radio would have been confiscated never to be seen again.

The interesting thing is that later it was found that by simply switching to LW, it was on tune for the BBC World Service for clandestine listening. Radio Athens is listed in Reference 1 as being at 666 kHz at 15 kW and 729 kHz at 150 kW. Tuning the radio to this more powerful station, on the MW dial, and then switching wavebands to LW the dial pointer is at 202 kHz and Droitwich was then on 200 kHz becoming 198 kHz in 1988.

Later the vendor came and brought the radio to England and via eBay I became the lucky restorer and custodian.

Atwater Kent history

This is taken from a website and written by Ralph Williams. To visit the site and see a picture of the dapper Mr Kent, see Reference 2.

Atwater Kent was a thrifty New Englander born in Vermont, educated in Massachusetts who invented the closely timed ignition system, and operated the world's largest radio factory in Pennsylvania. Some key dates: Birth 1873, First manufacturing 1896, Philadelphia move 1902, Ignition Systems 1907, First radio instruments 1921, Open set 1922, Mahogany box sets 1924, Metal box sets 1926, Superheterodynes 1930, Closed plant 1936. Kent was always interested in automobiles and, particularly, in the means of igniting internal combustion engines. He patented the Contactor, a breaker point mechanism, and the distributor to enable the use of a single coil. Income from his ignition systems enabled Kent to enter the radio business with a fully equipped manufacturing facility, a national service organization and an appealing concept, the Open Set. (We call them breadboards.) Kent brought the best minds of his time into his organization to do radio design, factory operation, marketing and product advertising. He was demanding of his people, but fair. He was also very careful of his company's reputation. His radios were of very high quality and reliability with strong customer appeal to the middle class. Kent's customers often bought another Atwater Kent radio to replace an earlier one that lacked the newer features. After entering the radio receiver market with Models 1 through 8, Kent put it all together with Model 10. The set had two radio frequency amplifiers, a detector and two audio frequency amplifiers, all assembled on a mahogany board but having neither panel nor enclosure. Its price was moderate, its performance was adequate and its appeal was immediate to the listeners of the twenties and continuing to the collectors of the nineties. The circuit of the Model 10 was continued in nearly all the Atwater Kent radio sets of the middle twenties. It was finally displaced by the screen-grid tube in Model 55 and the superheterodyne circuit of the Model 70 series. During the 1930s Kent brought out a new cycle of about 15 radios each year. Included were: Consoles, Compacts (table models), auto radios, Direct Current sets, Battery sets, and radios using 32 volt power for farm and rural use where commercial power was not available.
In the middle thirties Kent recognized the changing market for radio receivers. His business was based on moderately priced consoles with a tolerance for high-quality table models. However, he did not accept the market for cheap sets and preferred to close down rather than compromise his name and reputation. In 1936 Kent closed the factory and moved to California where he spent a well earned retirement until his illness and death in 1949.

This extract does not say that by this time he was a very wealthy man, and possibly to keep from getting bored, went into expensive real estate which found him hob-nobbing with the entertainment

stars of the time. He also had a collection of fine cars and was reputed to never drive the same one two days running.

A little about the radio

It is a big imposing tombstone measuring 21 inches high. In the USA the equivalent radio would be the model 318 and for this I had the service data. The 308 was the European export model having LW which took the place of the lower SW band (1.6 to 4.5 MHz) of the 318.

The wavebands are: SB (Standard Broadcast) or MW, LW, SW1: 5 MHz to 12 MHz and SW2: 12 MHz to 22.5 MHz.

Other features for a European radio are suitability for a mains voltage of 230V (by two series connected windings) and connections for a pick up, from an external gramophone unit, which wouldn't have been included on the 318. If you needed to play records in the US at that time you probably purchased a large phonograph.

It is an 8 tube set with the aerial input either "doublet" or long wire to a tuned RF stage. Doublet (un-tuned dipole) is an American term, not heard by me before and AK sold a "D" Doublet Antenna Kit. The kit comprised coils of wire for the antenna leads and then spacers, to use on the wire, to create a parallel transmission line input to the house and radio set. Visualising this is easy if you think of the FM window aerials that most of us will have tried. Here, a piece of 300 ohm balanced feeder is opened out at the ends to the desired lengths to make, in this case, a tuned aerial. To make the AK doublet antenna the dipole sections would have been mounted remote from the house, away from mains borne electrical interference, and then the feed in would have been balanced. To do this the kit supplied spacers, standoffs and importantly a dual lightening arrestor. In information given to me the makers say "... noise picked up by one of the two lead ins is balanced out by bucking it against identical noise in the other lead in."

The RF stage is followed by the first detector and oscillator (mixer). Next are two IF stages of 472.5 kHz with a front panel mounted sensitivity switch for the first stage. This allows for gain reduction on local stations. There is a Shadowgraph tuning meter in the anode feeds of the mixer and the first IF stage. The next tube is a double diode triode used for second detection, AVC and AF pre-amplification. This stage has a switched tone control for top and bass cut. The audio output drives a phase splitting transformer for the class A push pull output stage producing about 6 watts. Rectification is full wave with the field coil winding of the electro-dynamic loudspeaker used as a smoothing choke.

The three gang tuning capacitor is built with two sections for each gang. On the lower frequency wavebands the sections are switched in parallel but on the highest SW band only one section is used. This gives a more appropriate sized capacitor, for resonance with the RF and oscillator coils, and provides band-spreading when tuning from 12 mHz to 22.5 mHz.

It uses a fan shaped dial that reveals the frequency marked scales for each band in an arc shaped window. The wave-band switch knob, through mechanical linkage, moves the correct scale into the window for each band.

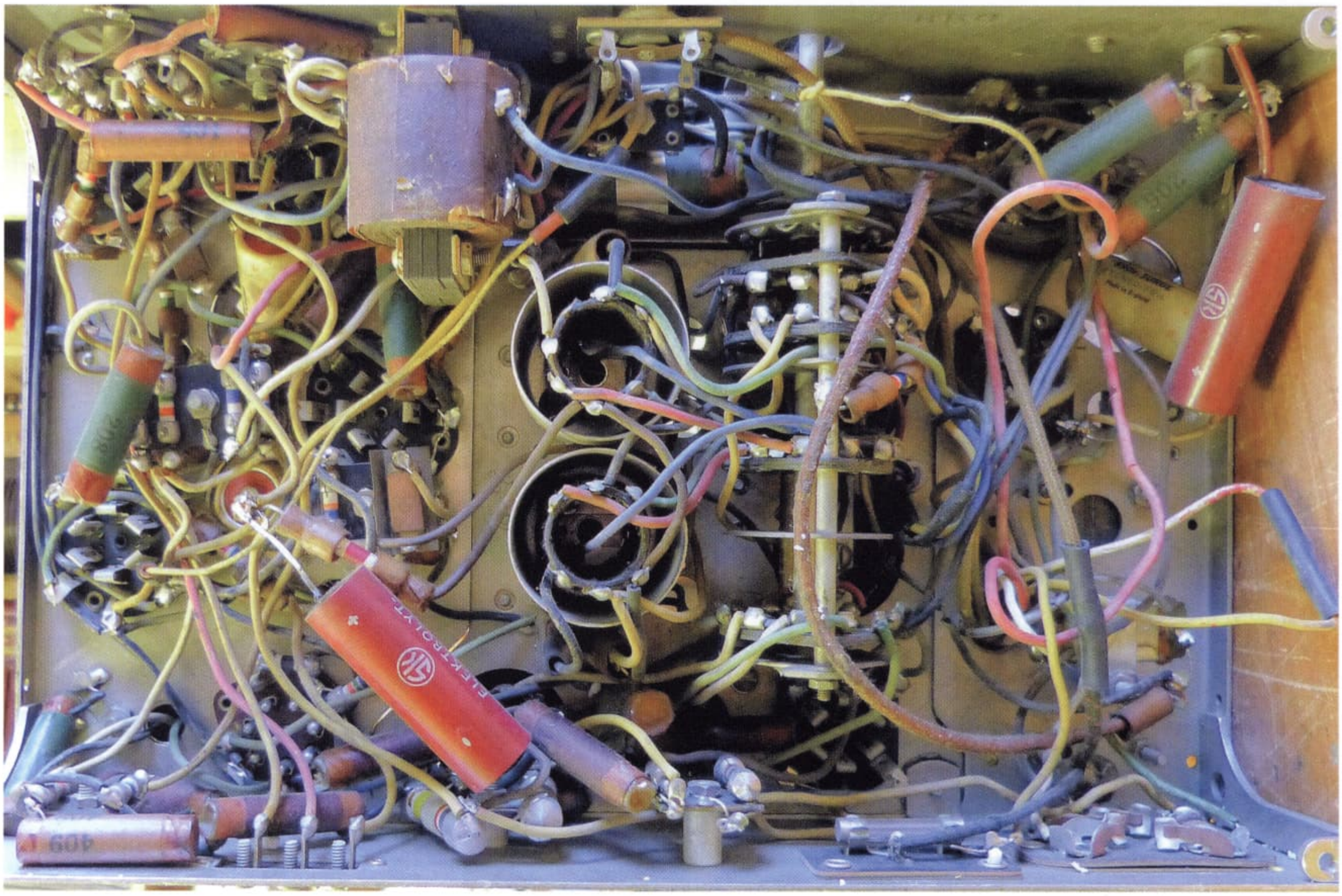
Tuning is two-speed, with part of the tuning mechanism being hinged, with an indent spring that holds it in either position. The speed is changed by the use of rubber tyres against a toothed wheel as can be seen in the pictures. Selection is made by moving the knob in an arc, there being a sufficiently large hole in the cabinet to allow for the tuning shaft movement.

The rubber tyres were, as expected, worn out and crumbling. There are actually three needed but reproduction parts are available (Reference 3).

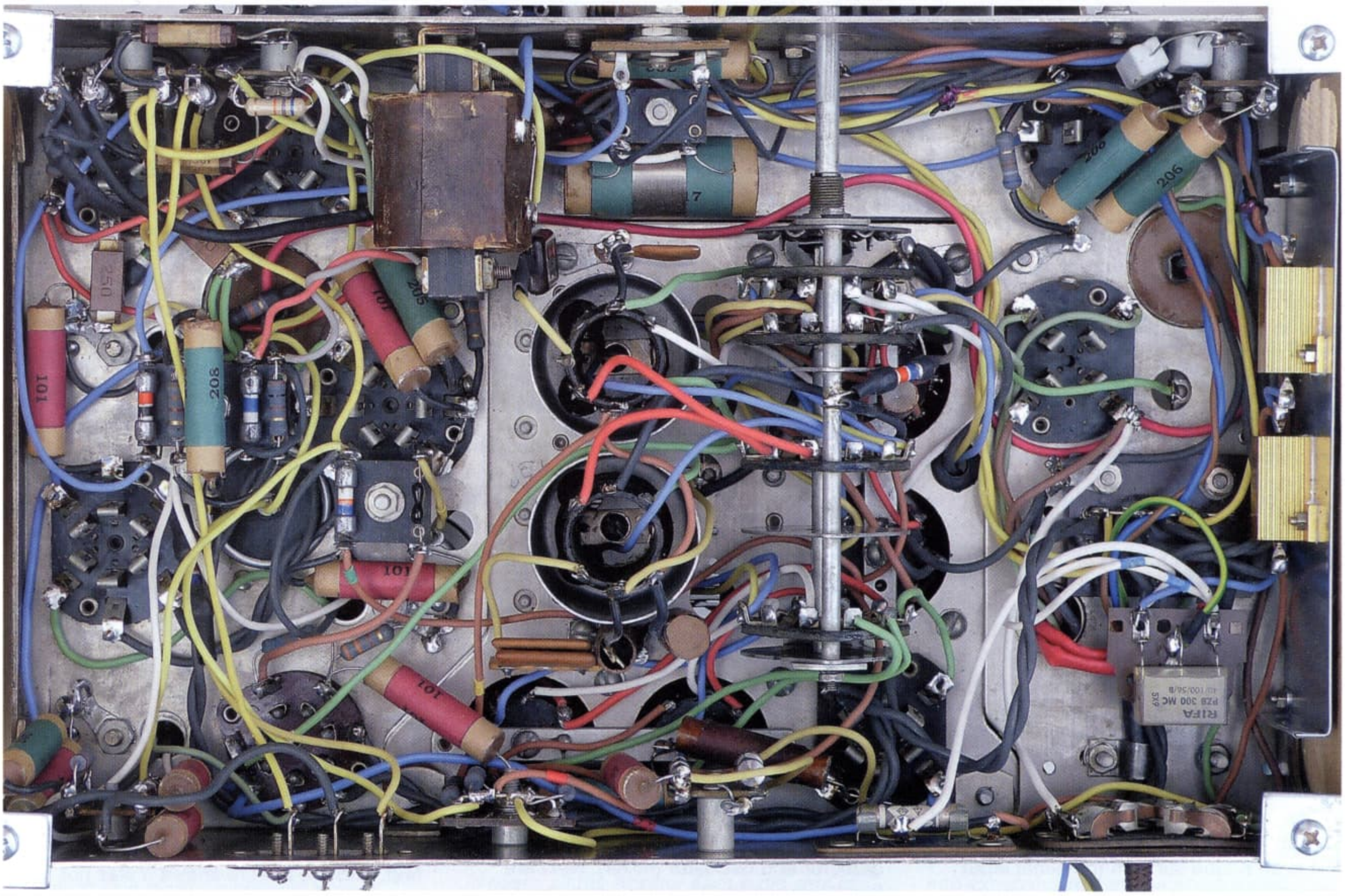
The cabinet

As it was 2013 summer time, and during a heat wave, it was ideal for spraying lacquer, so I decided to start with the Pooley made cabinet. Pooley, like Atwater Kent were located in Philadelphia, and had nearly 50 years of experience in making fine furniture. When the radio business started they were one of the first companies to make exclusively cabinets for radios in a plant that took up a whole city block. This particular cabinet was in very good condition with only minor knocks and dents, a couple of extra socket holes in one side, and a white stain on top probably from a hot cup. It was certainly not going to need a complete strip and refinish and would have been a very complex cabinet to do anyway.

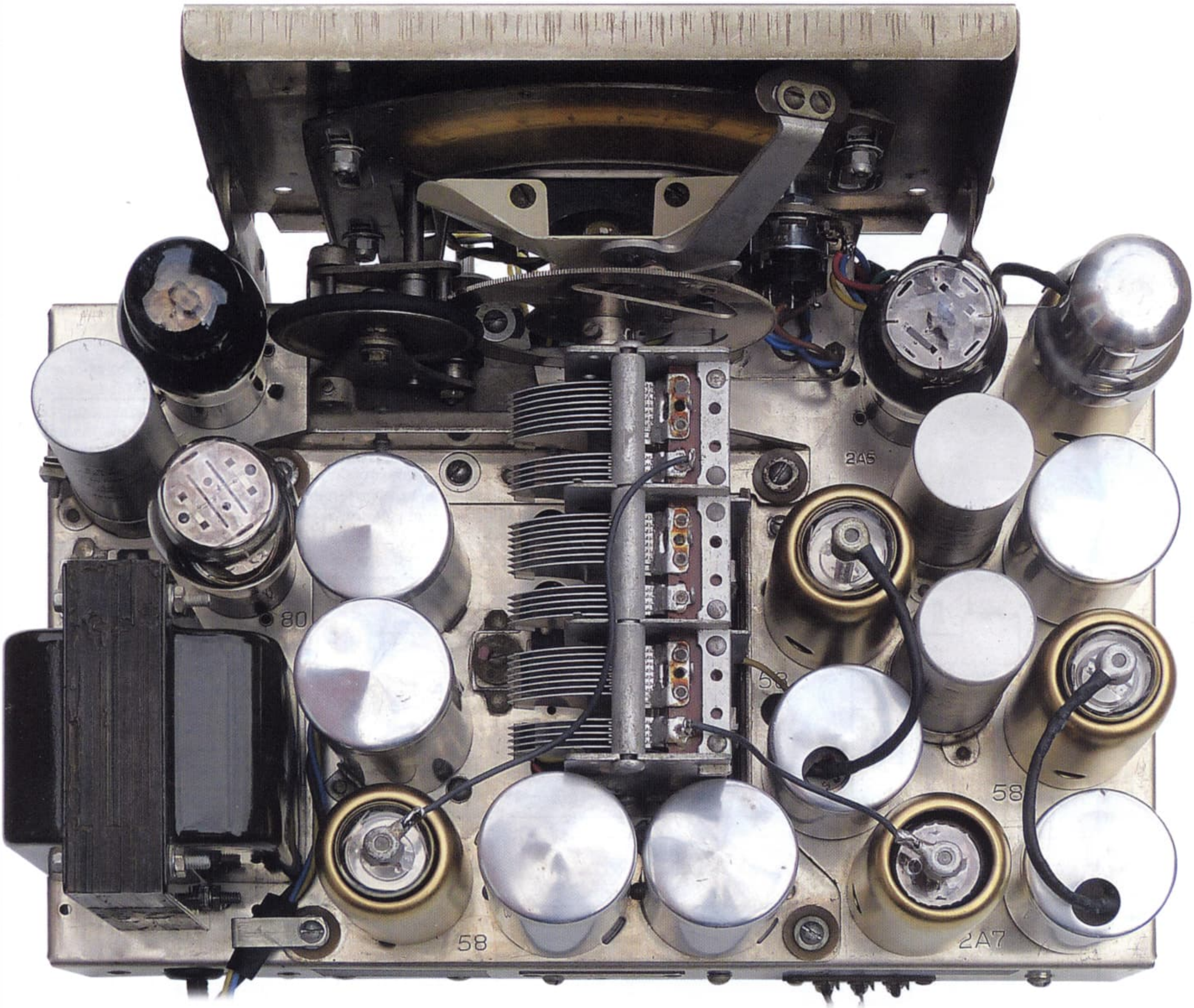
Firstly the cabinet was cleaned inside and out with white spirit and then the outside was 'flatted' with a fine grade of wet and dry abrasive paper. After dust removal and masking I filled the wounds in the black trim with car body filler and then sprayed it with Halfords satin black acrylic. Whilst doing this it could be seen how the cabinet was finished originally. The trim was brush painted first, and the picture shows it was not done with great accuracy. Then it was 'shot' with several coats of already toned



The chassis before restoration



The chassis after restoration



lacquer and that was the job done.

For me, moving on, the holes and wounds in the veneered parts were filled in, mainly with car body filler, and then touched in with artist's oil paints. I attempted to disguise the top white ring in the same way before spraying the whole cabinet with Mohawk satin lacquer. This didn't look good so I very carefully stripped the top, stained it and coloured it with the paints before more lacquer. It's not a perfect match to the original toner but does look fine displayed in normal room lighting.

After a few weeks I rubbed out the cabinet with #0000 wire wool and wax for a low key shine. I was pleased that I had made no attempt to hide the finger nail marks around the control knobs as those to me are truly history.

The knobs

I was told by my friend Peter Lankshear, an AK aficionado, that the fitted Bakelite knobs were not original. Even to me the small one looked wrong against the others. They were of a push fit type packed out with thick cardboard as the spring steel strips had been lost down the years. The alignment instructions show pictures of the knobs and these look identical in outline to wooden ones that I had seen pictures of. Peter very kindly managed to get replica ones made, complete with brass bushes and grub screws, using a set of his as examples. These are really beautiful and those of the same size match exactly.

The chassis

I was really delighted with this the first moment I looked in the back of the cabinet. Not the normal, now often tired or rusty cadmium plating, but nickel plating and not a trace of rust anywhere. The coil cans look as if they are actually made from nickel sheet but the tops are pressed aluminium but again with no corrosion. This radio never spent time in a damp shed or garage.

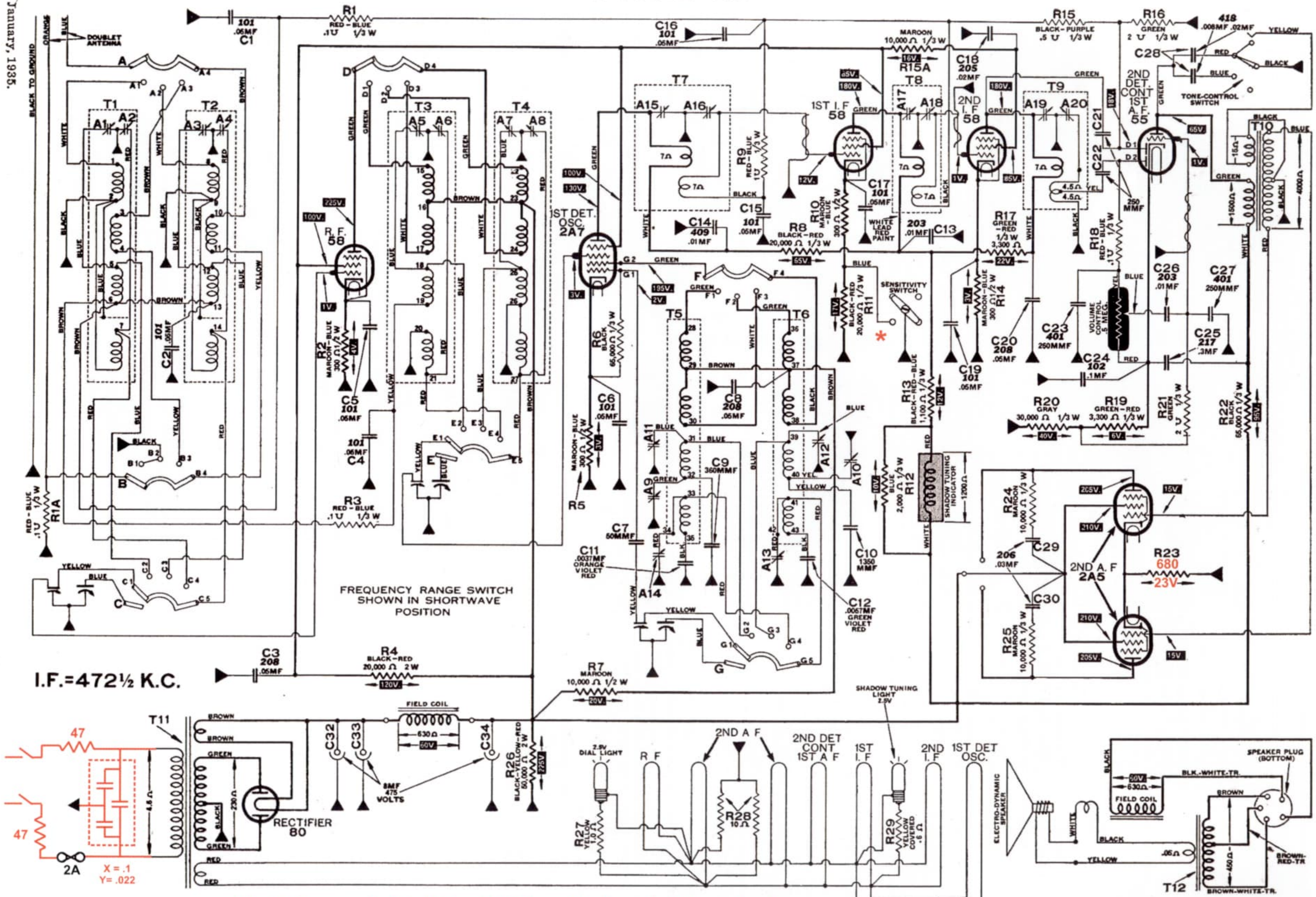
It was going to be an attractive looking chassis when finished as I already guessed I would re-spray the gold painted steel screening cans and the dark brown mains transformer shrouds. A look underneath showed that these would have to be removed as much of the wiring from their exit holes had crumbling rubber insulation. In fact a lot of the wiring wasn't good enough to remain and I decided to do a complete rewire rather than just change the worst pieces.

Refinishing chassis parts is in my opinion acceptable once you have done re-spray work on the cabinet. It is unlikely to look like an aged old radio again. Only once, for me, have I been lucky enough to find a wooden cabinet that was original and hardly marked. I just sympathetically restored the electronics.

Anyway back to the AK, the only missing items were three floating Fahnestock clips for the aerial input and three canned electrolytics but fortunately their clamps had been riveted to the chassis and so were still there. Into them fitted standard 1 ¼" diameter types and these were sourced at a swap meet to be re-stuffed with chunky, confidence inspiring, BVWS replacements.

MODEL 318

January, 1935.



Modifications * See 55 Second Detector and Pre-Amp circuit diagram for changes

I was able to source new Fahnestock clips later and these are simply soldered to the lead out wires and dangle behind the set. I have seen the use of these clips before on Philco and other US radios but then they were riveted to an insulating panel mounted on the chassis.

Something not seen before was a black cardboard heat shield on one output valve next to an electrolytic capacitor. This originally would have been in a cardboard case and possibly had its life shortened by drying out. As the shield was disintegrating I decided not to replace it reasoning that it wouldn't be needed for a modern, high temperature, component inside a large aluminium can.

Starting work on the electronics

The first items to be removed, from the main chassis, were the dial plate and tuning mechanism. After cleaning the new rubber parts were soon in place.

Things just got better, after I had made up a chassis stand, which was actually one modified from EMI sets that I had restored. I was to see that the RF front end, including tuning gang, and the wave-change switch were mounted on a sub chassis supported on now perished rubber buffers. I had some perfect replacements but not enough of them and so ordered some more from the USA (Reference 4). They are ideal being much softer and correct than the often used grommets. If you haven't looked at this web site it is well worth a visit to see the wonderful array of parts available.

All the radio metal parts and the tuning mechanism are of very high quality. Underneath the chassis it looks crowded and not to the same standard but this was early days and two chassis table model sets were never made in the USA (as far as I know). Over here such a radio would have been on two chassis: even the EKCO AC97 is and that has only 6 valves (no tuned RF stage or push pull).

I sent a picture of the underneath of the chassis, as it was originally, to our Editor who made this comment: "That photograph looks like a layout from the mind of a madman! Amazing stuff - I find it fascinating and disorientating at the same time". Well to be fair there were replacement components hooked in there that made it look worse.

Peter defended their wiring methods. "Although it looks like a "rat's nest" it was really planned. The philosophy seems to have been that fancy wiring works no better and by using pre-cut leads on components that didn't need separate mountings a lot of time could be saved. Most owners would not see or care about out of sight wiring."

But it could all be checked and rewired with time and patience. Once I had noted and marked the wires to be disconnected then the sub chassis was removed and could be cleaned and re-wired first.

The sub-chassis, strip and rewire

Mounting it, with easy access to both sides, was achieved using pieces of tube in which I made one end threaded by the use of soldered on T-Nuts. These could be joined together using cut off pieces of studding.

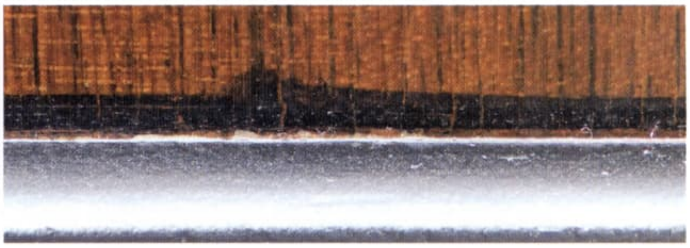
Wanting to proceed cautiously, with a way back, I made a clear diagram of the sub-chassis wiring as photographs never show all the detail. This was done in CorelDRAW before removing the waveband switch for access.

Some would claim it is unnecessary to go to all this trouble and I too could take it apart and just wire it back together with the circuit diagram. But sometimes these are incorrect, often not getting updated with changes which were possibly done by "Dealer Notes" now lost. I did check it to the circuit diagram (note the upside down Ohms symbol to indicate M Ohms) of the 318 model not finding one for the 308, as I proceeded. It all agreed apart from one 'tracker' capacitor but this is due to the change of the 1.6 – 4.5 MHz range to LW.

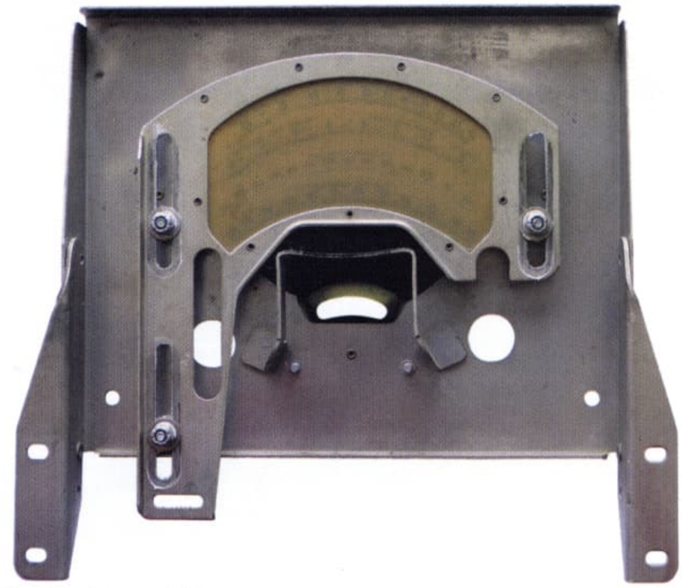
By checking to the circuit diagram, if it was wired differently then I would be aware of it. Then I could decide is the circuit wrong, the original wiring wrong or has somebody changed it? But at least I would know.

The tuning gang

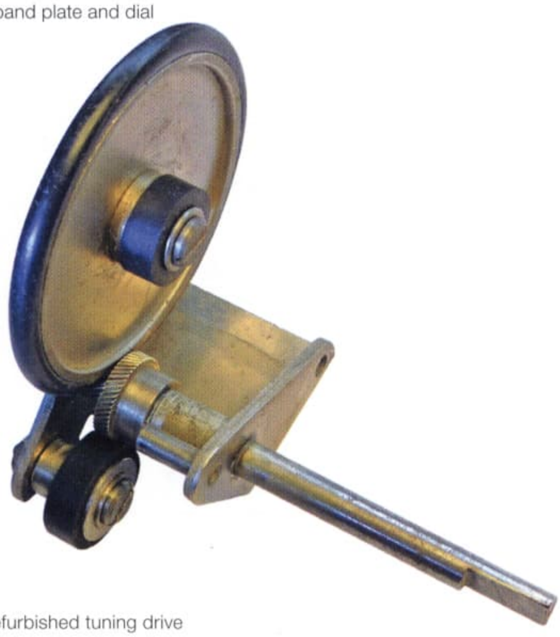
As usual the gang was dirty probably from open fires and tobacco smoke and I began with a wash in hot water with a little detergent and a soft toothbrush. It seemed to come up reasonably clean and was rinsed firstly in cold water and then de-ionised water and left



Cabinet trim side painting



Waveband plate and dial



The refurbished tuning drive

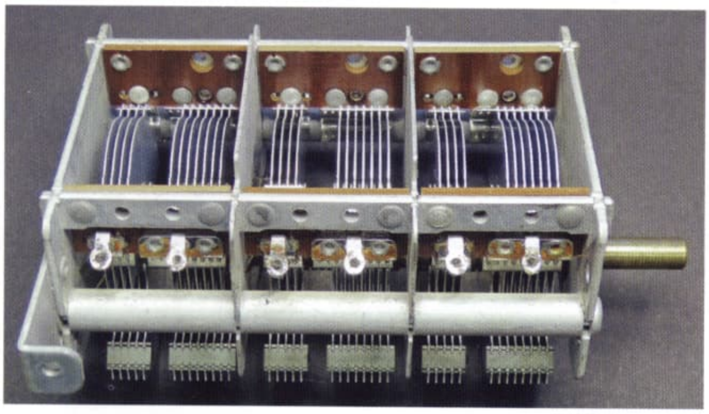
to dry on the central heating boiler. Later, I was disappointed with it as there was still a lot of dark brown crud in places. So it was given the "Quick Wash" cycle in the dishwasher that I knew from previous experience would do it no harm. As can be seen after drying out it was spotless and of course dishwashers leave no residue.

The waveband switch

The switch is well made and even has brass inserts built into the wafer. This stops the wafers being cracked when tightening up the nuts on the switch studs.

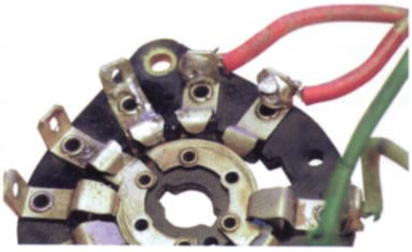
The switch contacts can easily be visualised; just put the nails of the thumb and a finger together. The wipers grip the rotor inner ring and the shorter contacts the moving arm. These small contact areas have now worn away the rotors and in many places go through the plating to the brass.

Examining the switch under a magnifying light it could be seen that one contact had been bent so that the top arm didn't

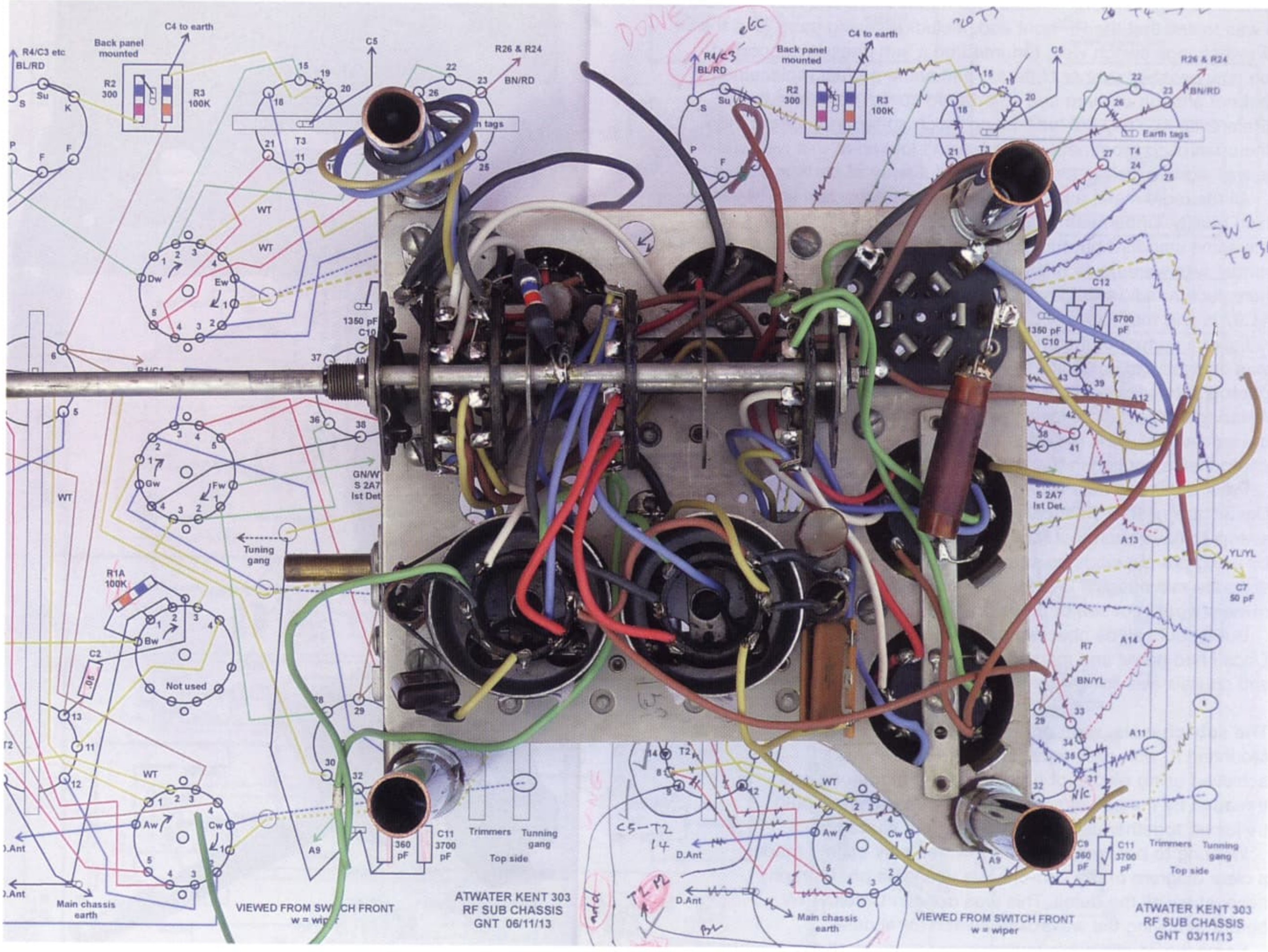


The cleaned tuning gang

The output valve shield



The bent switch contact



The completed sub-chassis

make connection. The contact next to it was covered in solder over the moving arm so it must have been a slip of the soldering iron when the radio was made. The bottom arm of the contact actually still made a connection but I didn't want to leave it like that. I could have attempted to re-dress the contact arm with the wafer in situ but to me that's a very hit and miss way to do it. From experience I need the wafer in my hand and under the 'mag' light again to see what needs to be done.

The first thing to do was to make yet another diagram. Over the years I have taken a number of switches apart and actually used to make them in the early days with Plessey switch kits and it's very easy to get confused. I intended to only remove the back two wafers but made a complete diagram in case I found other things that didn't look right under closer examination. The tendency then is to push on with nothing on paper and trusting to memory which is a bad way to proceed.

Once I had removed all the solder, with de-solder mop, from the adjacent contact it was fairly easy to adjust the other with a small pair of pliers.

The switch was then re-assembled, with each wafer given a tiny squirt of DEOXIT, checked visually and then repeatedly with an LCR meter capable of reading to fractions of an ohm. I was happy that all was now as good as it could be.

The sub-chassis re-assembly

The pitched dipped coils and their screening cans had been cleaned, given new wire and replaced one at a time. Then the lubricated tuning gang was put back with wires hanging free. And so to the waveband switch. This was initially just laid in place on the chassis, allowing a little movement, for better access to solder some of the connections from it. With these done it was bolted in place and the remaining wires, from chassis items, reconnected.

I did change one silver mica (SM) tracker: it measured 100M Ohm but being as I have never measured a SM that didn't show G Ohms, at hundreds of volts, I wasn't happy about it. It was marked "Micamould" and some of these have had bad press on US forums and for larger values are apparently not even mica but wax paper. This one was SM though once I had taken it apart. I could see nothing wrong inside but the first and last plates were mounted on cardboard so perhaps it was this that was causing the minor leakage.

The main chassis

Before starting I did another detailed layout diagram. Because my A4 printer was 10 years old, and on its last legs, I bought an A3 inkjet printer. The larger paper size was very helpful. The layout was checked against the 318 circuit diagram and one resistor was found that was of a different value. This was the cathode resistor for the 1st detector and oscillator, 2A7, being an original 500 ohms (not 300) but being as it measured 650 I changed it.

Another difference to the 318 circuit is the addition of a rear mounted panel that allows connection of a pickup, for a Gramophone unit, a feature not normal for US customers.

The main chassis strip and rewire

I didn't actually strip it completely but firstly took off the mains and IF transformers (the coils again were pitched dipped) giving me a clear top deck. This was then brushed clean in the upside down position before cleaning with thinners used with cotton buds and strips of cloth: all done outside of course.

The mains transformer shrouds were removed, for new wire and a re-spray. Wire gauges may have been rated for higher current carrying capability in the days the radio was made and apparently US ratings were less conservative than British as well. The heater wiring was done in a cascade manner so that the start wires were carrying a lot of current, more than 7A. It used a stranded wire and with them twisted tightly measured 0.7mm in diameter. I had some silicon rubber covered wire of 16 strands that measured 1mm but was only rated at 3A. However, the transformer lead out wires, carrying more than 8A were a larger diameter and I replaced these with three lengths of the 14 strand, stripped of insulation, twisted together and insulated with heat shrink tubing.

Originally the transformer heater wires were wired to the nearest output tube, and then continued from there. It wasn't a great arrangement as the pins on that had 5 wires on each. This included resistance wire, for the dial lamp and for the heater centre taps (5 ohms each). I didn't want to rewire it like this and so made up a connection panel, using Paxolin sheet and eyelets, with 16 SWG bus bars, to solder the wiring. On this I also included new resistors in series with the dial lamp and the shadow meter that were originally resistance wire from another tube. I could see why they had added resistance in series with the lamps: both bulbs are difficult to change and that for the shadow meter is almost impossible without removing the tuning dial assembly. The connection panel was made to mount on the extra long transformer fixing bolts. So as not to need wire of greater load carrying specification than 3A, I changed the arrangement to three separate feeds for the tubes.

From here it was a case of slowly removing wires, tag panels and components. Many resistors, with a proprietary colour code, measured close to the maker's value although some were as much as 80% high and replaced. The resistors, a type not seen by me before, have metal ends that seem to be a high lead content solder. They certainly melt if a 60W iron is held on them for long.

For the wax paper capacitors it was not possible to re-stuff these as the tubes disintegrated. So I made replicas from styrene tube wrapped in gummed brown paper and appropriate labels. As can be seen, they are not marked with actual value, and working voltage, but a 3 digit code. The service data has a sheet that translates this and the resistor colour code. I measured most of the capacitors for value and leakage. A couple were open circuit and the rest had leakages down to 8M ohms at the rated voltage. These were low by modern standards being 100 or 200V with 3 at 450V.

Mains lead and volume on/off switch

The old lead was replaced with a 'silk' covered 3 core PVC cable (Reference 5) so that the chassis now has a mains earth. The volume control was past its best and upgraded to one having a 2 pole switch (Reference 6) so safety has been improved. Of course it wouldn't meet current regulations: "What! it doesn't have a back cover". "It doesn't need it as there are no exposed terminals."

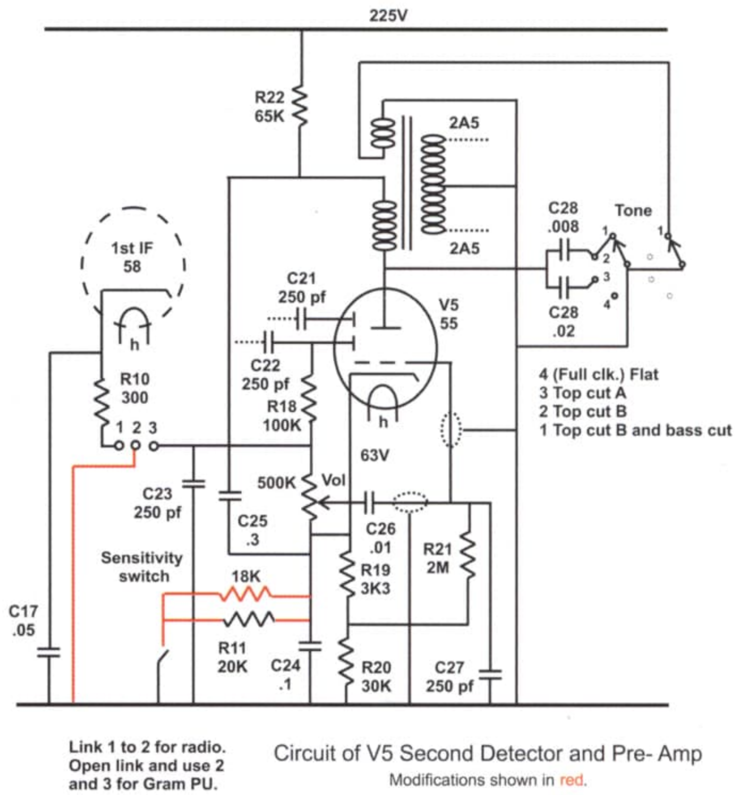
Power up and first tests

At this time there was no point in putting back the complex tuning gang drive and the mechanically moved wave band dial. It would have just made working on the chassis more cumbersome. The first thing was to see if it worked and voltages were close to those given on the AK circuit diagram.

Of course I had fitted a set of cleaned and tested valves. Cleaning to me always includes the pins and sockets some of which I tightened slightly.

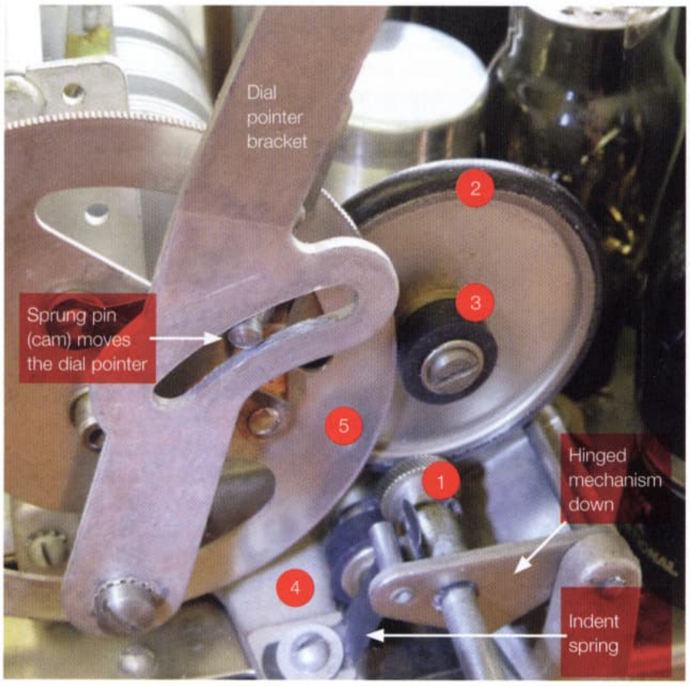
There were no instant, must switch off worries, and most voltages were acceptable. The HT was high (more on this later) but the most important measurements, those of the tube cathode voltages were correct.

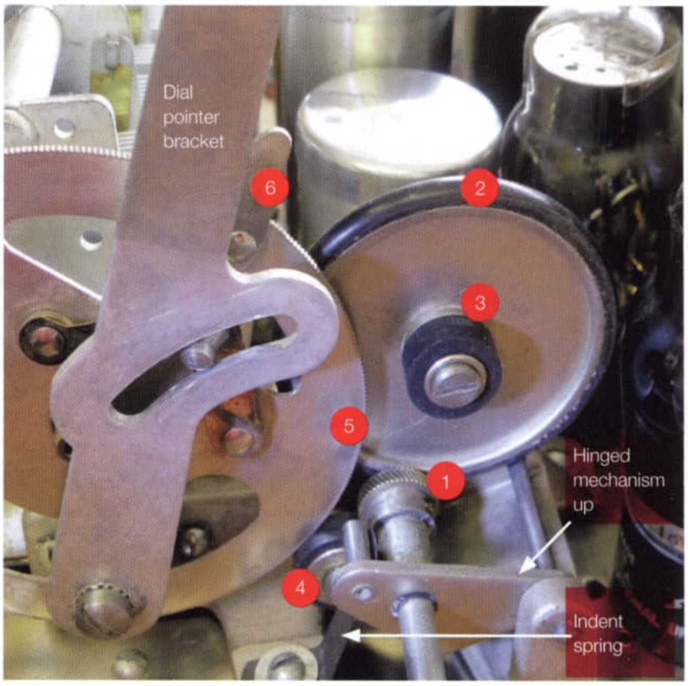
A leaky Micamould cap



Circuit of V5 Second Detector and Pre- Amp

Modifications shown in red.





Drive in slow motion (35 turns).

Toothed wheel 1 drives tyre 4 but this is disengaged from wheel 5. Wheel 1 also drives against the edge of tyre 2 which turns tyre 3. Tyre 3 rotates against the toothed wheel 5 on the tuning gang shaft. The indent spring locks the hinged mechanism in the down position.

Drive in rapid motion (3.5 turns).

Toothed wheel 1 still drives tyre 2 but tyre 3 is disengaged from wheel 5. Tyre 4 is now engaged with wheel 5 and turns the tuning gang. The indent spring locks the hinged mechanism in the up position. The tab on wheel 5 (6) comes into contact with tyre 3 for a positive stop.

Knowing this it was reassuring that the tube currents would be about right.

After casual alignment of the IF trimmers stations could be heard but so could hum with the volume control at minimum. This was with the speaker, which was in perfect condition, on extended leads in an open topped box. I always like to get the speaker away from the chassis when working on it as it is so easy to damage the cone.

Hum hum hum

Experience shows that if hum is unacceptable with the speaker out of the cabinet it will be even more so once it is back in. I now spent a lot of time trying to track it down. It seemed to be a mix of 50Hz and 100Hz and I slowly worked my way through the obvious things. A good check was to disconnect the output valve grids and terminate them with resistors. The hum was now pretty much non-existent. This proved that with the chassis, passing normal HT current, it wasn't from the speaker field coil and that the hum bucking arrangement of the voice coil was excellent.

I rechecked the heater wiring searching for earth loops and trying the balancing of the heater centre tapped resistors to earth to no avail. But doing this did show that the screening of the grid lead to the 55 tube could be improved. Note that with its steel screening can it was well protected from stray electro-magnetic fields.

For me, it's always a good idea to redraw a piece of circuitry for a better understanding. So I redrew the circuit around the AF pre-amp, see diagram. It shows how the makers got around not having reliable high value electrolytics for decoupling and cathode bias as are readily available today.

The anode decouping for the stage, is from R22 using C25 but this does not return to earth but to the tube cathode and, for low frequencies, to the grid via R21. So for HT line ripple all the triode elements 'wobble' up and down with diminished affect from the ripple. It does explain why extra HT line decoupling made little difference to the hum from the speaker and the hum does increase if C25 is disconnected.

And then a breakthrough: I asked Peter how low was the hum level from his AK 447 (a similar cabinet style with single ended output stage but again using a field coil speaker) and sent him details of my findings. Apart from saying that the hum was very low he remarked that the HT was high for my chassis. It's so easy to dismiss this as the valves will easily withstand higher voltages, bias will automatically adjust for tube currents and modern capacitors have been used throughout with a voltage specification well in excess of the requirements.

But what about the heaters? I measured these and instead of 2.5V they were close to 3V. This isn't good and + or – 10% is normally said to be the acceptable limit.

Voltages were high for a combination of high mains voltage and a generously wound mains transformer. At the time the line voltage was 246V so about 7% above the 230V hoped for back in the 30's. This alone should have made the heater voltages around 2.7V.

I was certainly going to reduce the input voltage to the mains transformer and usually the easiest way to do this is add resistance with the metal clad types being the most convenient. Often they can be screwed to chassis somewhere out of sight and have the whole of it as a heat sink.

For this chassis there wasn't a convenient place so I mounted one in each supply leg (two as they were easily obtainable values) onto a piece of aluminium which attached to two existing chassis holes.

The result of adding 47 ohms in each supply lead was to reduce the transformer input to 211V, the heater voltages to 2.52V and the HT voltage to 225V (The AK circuit gives 210V) rather than 285V.

And then a bonus: the hum from the speaker was lower by maybe a half and the signal at the 55 anode down by the same with nearly all the reduction from the more irritating 50Hz component. I was really pleased with this as now I could move on with confidence that the hum at low volume would be acceptable with the speaker back in the cabinet.

Why was the 50Hz component reduced? Perhaps with a lower heater voltage there were less escaping electrons from the cathode assembly to reach the grid of the 55 tube.

Response from the gramophone input

I had already judged that the audio frequency performance of the chassis was good from the 'fun with the hum'. The speaker was obviously still efficient at low frequencies and the phase splitting and output transformers were probably well designed. As I intended to try the input with an EMI playing deck (see Bulletins 2009 No.4 and 2012 No. 3) I tried an audio generator connected to the input. By ear, with the tone control switched to the inoperative position (flat), the radio and speaker were starting to fall off at 60Hz rolling away by 30Hz. At the high frequency end, roll off started at around 4kHz with the chassis becoming deaf by about 7kHz.

There was a mistake on the diagram for connecting a gramophone unit in that the label said to open connections 1 and 2 and use 1 and 3. But this is wrong and it should be use connections 2 and 3 as shown on the new label I made (and placed in the position of the original).

The tone control switch and circuit
The switch, to my mind, seems to be designed in reverse with the most clockwise position being 'flat', that is no tone correction. The next two positions are conventional top cut by capacitors from the 55 anode. The last position gives some top and bass cut (about 6dB at 200 Hz) by shorting out a low resistance winding (15 ohms) on the phase splitting transformer. This lowers the primary inductance from 17H to 12H and hence the response falls off more rapidly with frequency. This seems to me quite clever as with only a little extra transformer wire an additional feature was added that could be advertised at the time.

The loudspeaker and grill cloth
This to me is worth a special mention as it is so beautifully made. For looks it has a two tone paint finish and a neatly and safely shrouded output transformer. Everything can be removed easily as it's all held together with screws and either tapped holes or nuts. Even the cone is held in place by a clamp ring and screws, with no glue, and the AK Items List shows it as a spares item at the time. The attention to detail goes further as the model for the speaker is stamped into a neat gold plated badge rather than nothing or a paper label as other makers might have done. I expected the number to be 318 but it seems they lowered the field coil resistance for this model, by about 15%, and so it got its own particular badge.

The grill cloth was replaced with a closely matching cloth from Bret's Old Radios, who has an Ebay shop. It is best to buy the sample pack of cloths as some are not really suitable for radio replacement being too heavy and difficult to mount. This cloth was just right.

IF Alignment and bandwidth
Now it was time to do a more accurate IF alignment which is particularly nice on this chassis as its all done from the top. The IF cans have removable lids with the trimmers looking upwards. Because the IFs are over-coupled it is necessary to use a damping resistor and series capacitor to shunt the winding not being trimmed. This has been made easy as there are tags to facilitate this.

I did connect the Wobbulator, just out of interest, and the response was a nice smooth curve of about 7kHz wide. Interestingly the shape hardly changed from low level to the AVC being fully operative.

After I had replaced the complex tuning drive, the wave band dial with its bulb fitting and the shadow meter, then I could do the RF alignment.

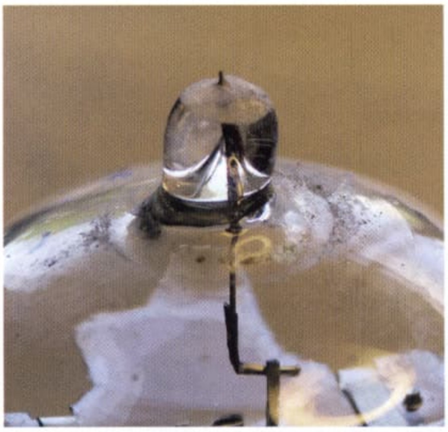
The tuning gang drive, pointer and dial
A description of these items is shown on a separate diagram.

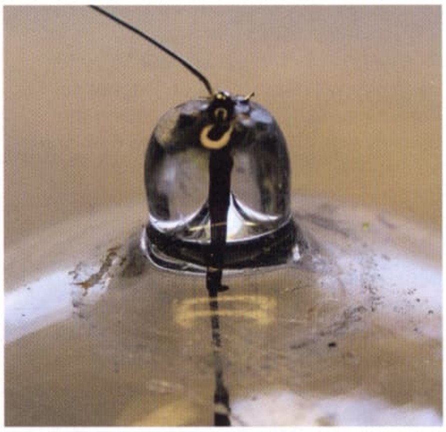
Broken off top cap on the 55 tube !
Now before doing the RF alignment I made an elementary error! Of course I knew that you shouldn't take top caps off of precious valves by just fingers working them free. You should use a flat blade (a screwdriver will do) and lever them off against the base of the cap. But I didn't do that on this occasion. I was taking the caps off to remove the valve cans prior to spraying with Gold Plasticoat. So alas, the grid cap for the 55 pre-amplifier broke free snapping the wire right at the top of the glass pinch.

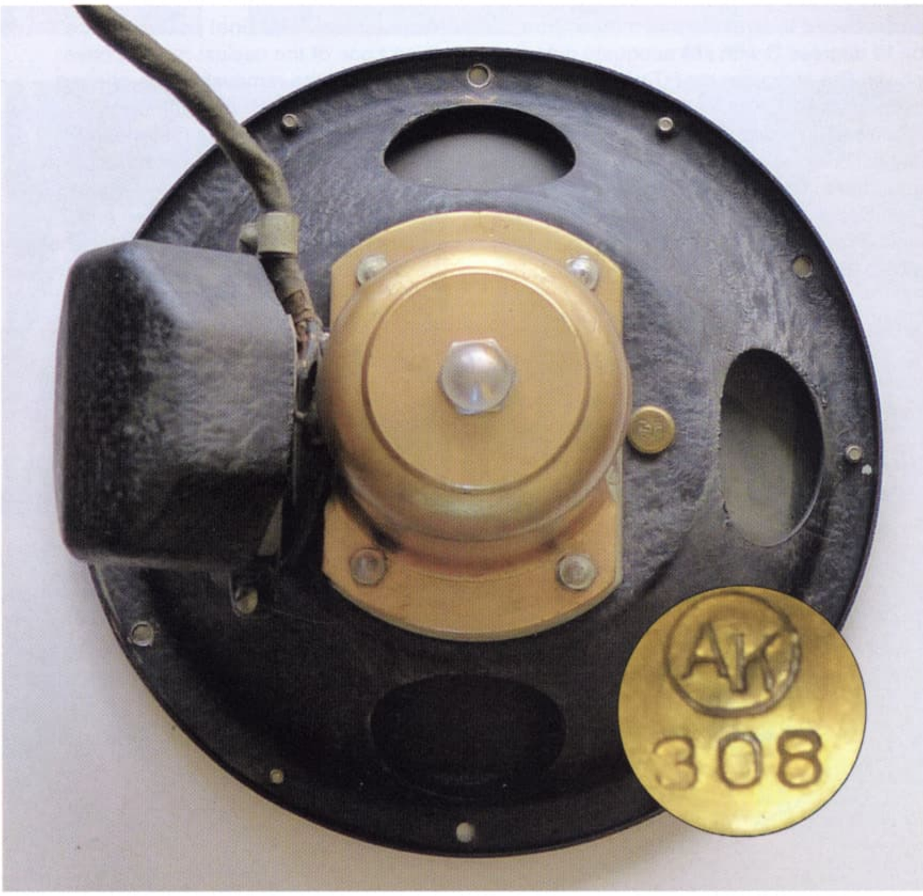
Fortunately all was not lost as I knew it was possible to make a successful repair. For a modest sum I had bought a diamond warding file set. Very carefully, using one of the files, I filled down the top of the pinch by about 1mm to expose the wire. This is best done over a clean bench so that the dust can be blotted up with masking tape for disposal. Once the wire was cleaned and tinned, I wound a few turns around it of a strand of wire from a piece of flexible cable before soldering.

The hole in the top cap was cleaned and some of the old adhesive removed before securing the top cap back in place with a little Araldite Steel and very quickly soldering the thin wire. It was then given a long soak test on the valve tester and works just as before: whew!

The RF alignment
The instructions for this were given for the 318 model and are straight forward to do with all adjustment from the top, in the same manner as for the IF transformers. For LW I simply optimised the trimmers for best reception of Radio Four. I made more of an effort for MW and actually changed the capacitor in parallel with the tracker trimmer. Its value was high and I couldn't get the trimmer set. Once alignment was complete then the tracking was accurate, across the band, to within 3 or 4%.


The 55 tube filed back


with copper wire attached



The speaker and badge

The two short wavebands were easy to do with just peak alignment at one frequency.

Initial performance

This was very good on a 25 foot long wire aerial. Plenty of stations were received on the MW and LW bands and even some on the SW bands. The audio performance seemed pleasant but the speaker was not yet back in the cabinet so this was hard to judge.

The shadow meter had little movement and was disappointingly dim and, which I put down to the celluloid screen being fogged. So I took the meter out again, which meant disassembly of the tuning drive (Groan!), and removed the screen by bending back tags on the case. It was better than any replacement material I tried and even improved after polishing both sides with metal polish. (Actually, with the radio finished and installed in the lounge, where there is not so much light, illumination was quite satisfactory).

It's important to use a tubular bulb that needs to be positioned so that the filament alignment is spot on with the meter vane. On some meters this is adjustable by the lamp bracket being in a slot. But not so here, alignment is made by bending the bracket arm. The only way to do this, and see what is happening, is with the meter on the bench and using external supplies. This meter adjusted very well and with no voltage to the coil the shadow was pencil thin. It needed about 12V for the greatest shadow of around half an inch.

Another thing I didn't like was the temperature of the mains transformer at 50 degrees C. An easy solution was to change the output valve common cathode resistor from 250 to 680 ohms. This reduced the nominal anode currents from 60 to 34 mA and reduced the transformer temperature by 12 degrees C with still adequate output power. But of course the HT went higher to 258V (from 225V). Not seemingly much of a disadvantage but I did recheck the dial calibrations as I didn't know how good the local oscillator stability was.

But back to the shadow meter: it was almost redundant on the aerial I was using. Back in the old days, when 100 foot aerials, 30 feet high were not unusual, enough AGC might have been generated to cause the front end tubes to reduce current such that the meter did something. Sharp eyed readers may have noticed the circuit diagram voltages around the detector. This shows the cathode at 46V which is a lot of AGC delay before diode D1 conducts. With my HT now at 258V there was even more delay with a cathode voltage of 70. Was my higher HT causing this? With the stated HT voltage of 210V, by removing the rectifier and using a bench supply, I measured 57V so higher than given on the circuit diagram.

I asked Peter if his AK 447 actually did indicate and he said it did but it was no use comparing circuits as they are very different around the AGC generation. But he agreed that with so much AGC delay the meter would have a very flat response. So why not reduce R20 the main cathode resistor and possibly rewire the sensitivity switch such that R11 shunted R20 in one position. This to me was a neat idea and it was easy to do and what use was the switch as it was. It's hard to imagine current short aerials needing it. So it was rewired as shown on the attached circuit of V5 but I did connect to the cathode as this was physically easier to do and I could see no disadvantage. R11 was still too high for good meter indications and so I added 18K across it discretely under the tag panel.

In use the switch would still appear to an unknowing user as a sensitivity switch but in reality allows AGC action and shadow meter indication on many stations rather than as before on only one very powerful station. With an HT of 258V the AGC delays (V5 cathode voltage) are now 70V and 23V.

Conclusions and final performance

It isn't one of the easiest radios I have rewired but the removable sub-chassis was a great help as were the layout diagrams I made. Things that made it difficult were items on top of others with some sharing a common fixing. Solder tags could have very large holes and others none at all. Also, the resistors butt up almost to the tag and so soldering has to be from the underside which in some places is tricky because of access. No wonder, originally, many tags had huge blobs of solder. But a real plus point was that everything was robust so there were no problems with broken connection points. I imagine in the time that I took to re-wire this one the 'speedy ladies' would have wired a years supply to the shops.

All the windings were trouble free even the shadow meter. AK of course had many years of making automotive ignition systems before starting into radio. They clearly learnt how to make windings reliable.

In future I shall be looking for the HT being too high, on first switch on, any radio that I restore.

Listening to 78 recordings, with an attached HMV gramophone unit, I doubt that any owners who used the gramophone input would have been disappointed. I had another unit, connected to an HMV 650 radio, which gave less hum and sounded slightly more pleasant. But for that I had spent more time on equalisation and connections.

I did a comparison of performance, on the same 25 foot garden aerial, to the HMV 650. This, for those that don't know it, has a similar valve arrangement having a tuned RF amplifier and again two IF amplifier stages. For sensitivity, and being able to select stations out of the awful noise of the MW band, there wasn't anything to choose between them. Both received R4 on LW clearly.

Peter said that this was to be expected as by 1934 most circuit development had been done and valves didn't change very much internally, apart from the filament. Many of the valves in the 650 would have had similar characteristics to those in the 308. Final thoughts are that it is a very well made and beautiful radio.

References:

1: Guide to Broadcasting Stations, Philip Darrington, 1987/88
2: www.atwaterkentradio.com/atwater.htm
3: www.adamsradio.com/
4: www.renovatedradios.com/parts.html
5: www.lampsandlights.co.uk/flex.php
6: www.blore-ed.com/

Audiojumble!

Photographs by Carl Glover

Chassis design of the Fada *Bullet* range of radios

by Stef Niewiadomski

The Fada* Bullet, or Streamliner, series of radios are highly valued and avidly collected for their brightly coloured Catalin cabinets. The streamliner shape is evocative of high-speed trains, cars and motorcycles being designed all over the world in the 1930s: Fada's innovation was to apply this to a radio. I believe that Fada did use the word 'streamliner' to describe their creation, but probably not 'bullet' which has negative undertones, but it's the latter word which tends to be used today to describe this shape.

Figure 1: The classic pose of a Fada Bullet radio: a model 116 - short and medium wave, five-valve superhet. Photo courtesy of Carl Glover.

In Reference 1, John Sideli (who was a dealer in modern antique collectables) wrote of the early days of Catalin radio collecting, in the US in the 1980s: 'For me, the radios were like warm and wonderful blocks of color in an infinite variety of shapes to be played with and put together in various combinations like an ever-changing collage of color, line and form. I used to tell people that it was totally incidental to me that they were radios, and I think that in large part this was really true. It was the material I was in love with – fabulous colored boxes in Deco and Moderne designs – and certainly not the fact that you could plug them in. I always hated those ugly electrical cords'. Eloquent words: everyone is entitled to their own opinion about any object, and this explains well why the demand for these radios, and hence the price, is so high. Vintage radio enthusiasts - who presumably don't hate the electrical cords - are in competition with collectors of stylish plastic objects, of which radios are just one example.

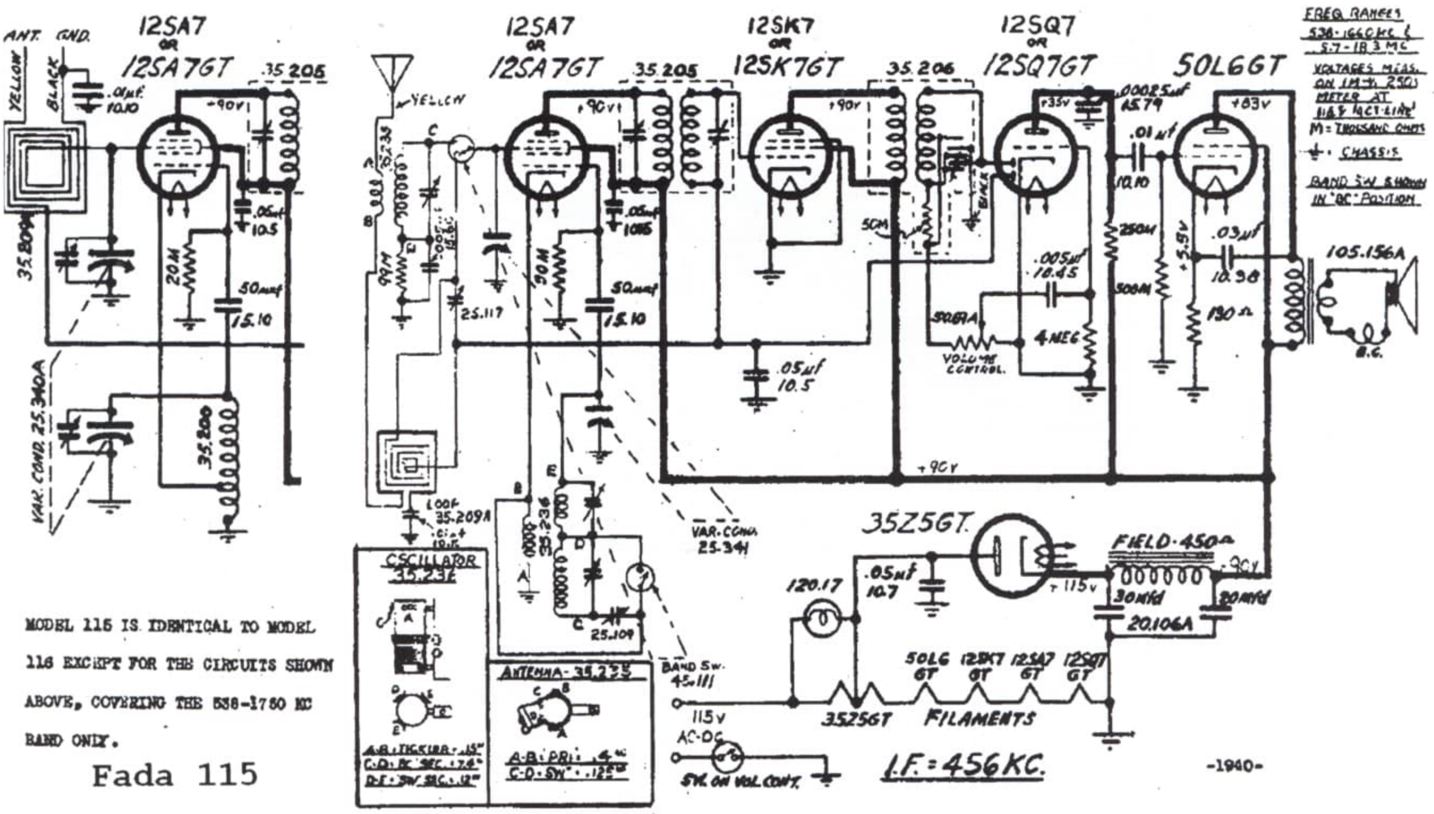
Many pictures of these radios are available in books and on the internet, but the chassis and detailed internal designs are not so well documented, possibly because the owners are hesitant to remove the chassis and risk damaging the cabinet. There is even conflicting information on the internet on what exactly went on inside these bright cabinets. Their electrical design is regarded as being very minimalist in the 'all american five' genre, and of little interest in itself. I disagree with this view: the chassis of the Bullet evolved 'behind the scenes' as radio design and valve technology changed. In this article I want to redress the balance and publish details and pictures of the chassis used inside these radios, to resolve any ambiguities, and to set the record straight.

A Little about Catalin and Fada

Catalin is the trade name of a thermosetting polymer plastic formulation purchased by the Catalin Corporation from Germany, which it then licensed to Fada and many other radio manufacturers. Catalin was transparent, almost colourless, and it could be dyed using bright colours or even marbled if the dye liquid was swirled into the body material, rather than fully mixed. The hot syrupy liquid was poured into lead moulds and oven baked to harden into its final shape. Once set the casting was removed from the mould, and it then needed considerable de-flashing and polishing to achieve the final clean shape and bright finish. Although the production process was still largely manual, it was less labour intensive than making wooden cabinets, and therefore didn't have to result in an expensive radio. Fada coined the term 'FADA-lucent' to refer to their Catalin cabinets, and described them as 'resembling precious stones'. Since the mixing in of colours was a human activity, every cabinet was unique, and that adds to the attractiveness of these radios to collectors today.

Although we tend to concentrate on the use of Bakelite, Catalin and other plastics in radios, it should be remembered that these materials were revolutionising how clocks, pens, jewellery, cameras, electrical fittings, kitchen utensils, toys and any number of other everyday objects were

*Footnote: I believe Fada was pronounced 'fader', at least in the Long Island, New York area, where the radios were made.



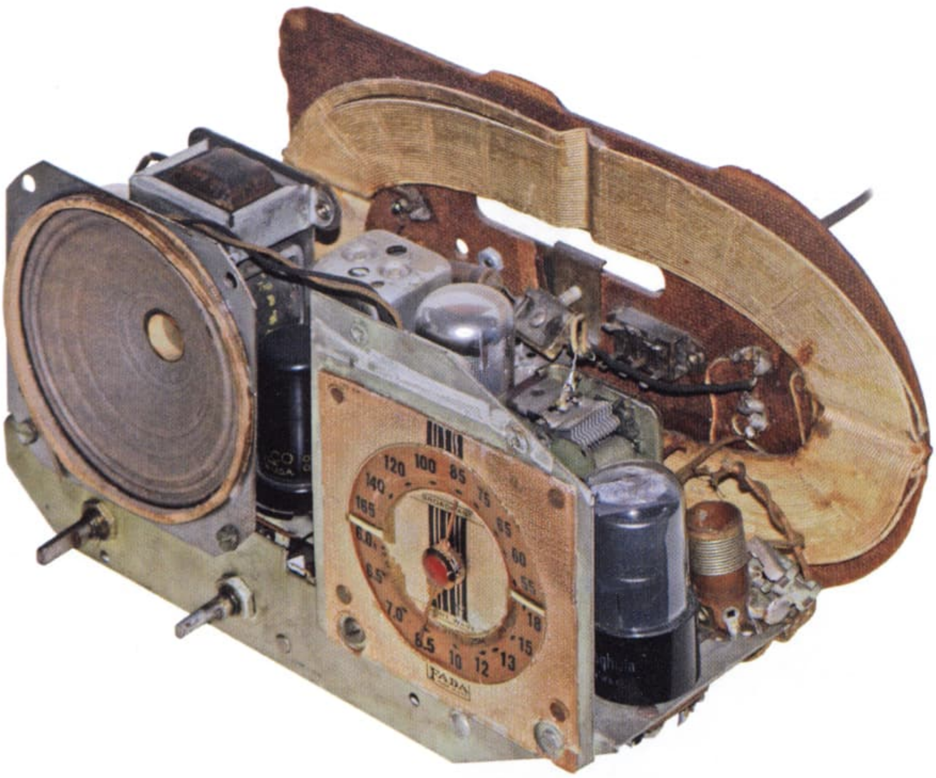


Figure 2 (above): The model 115 schematic, which includes details of the significant difference between the 115 and the model 116. I think this schematic is ambiguous as to which model is equipped with short wave coverage, as well as the medium wave band, and has led to some confusion on the internet.

Figure 3 (left): Three-quarter front view of the model 116 chassis.

produced from the 1930s onwards.

Catalin seems to have been the saviour of the Fada company. A victim of the Great Depression, it had filed for bankruptcy in the mid-1930s, been saved by new investors, and struggled on into the second half of the decade. The company offered mainly wooden-cased radios (along with hundreds of other radio manufacturers), and some in brown and ivory 'plastic' and Bakelite cabinets. It used Catalin for the first time with the model 5F50 in 1938, and then evolved the sales strategy of offering several striking colour versions (typically five) for each model, with the 5F60, also launched in 1938. All of these early Catalin radios, a mixture of TRFs and superhets, and using large envelope valves are very collectable today. By the time the first Bullet model was launched in 1940, consumers had accepted the use of Catalin, and expected to be able to choose their radio from several colour schemes: it was the dynamic shape of the Bullet that excited the market. Reference 2 shows a large selection of Catalin and Bakelite radios, and seems to be kept up-to-date with current auctions of these objects.

One drawback of Catalin was that it was prone to cracking, especially at stress points such as control and screw fixing holes, and this caused some early mortality and returns from dealers and purchasers. Even today, collectors are wary of inducing cracks in their Catalin cabinets, and are careful not to over-tighten screws, or to stress the cabinets in any way.

From a colour stability point of view, Catalin was not a great success, though it's not clear (to me at least) how quickly changes in surface colour started to occur after manufacture, and what the owners of these radios thought about this process at the time. Presumably it depended on exactly where in the house the radio was located with respect to the windows, heat sources and so on. The colour changed drastically over the years, and because of these changes, there appear to be more colour combinations around today than were ever manufactured, and some original colours are very rare. The colour change is a surface effect caused by the UV in daylight. Some collectors strip back the surface by chemical means to reveal the original colour, while others are happy with the altered colours. Ultra keen (and well off) collectors like to have one example of each on their shelves.

The original colours were indicated by a two letter code after the model number: for example a model 115AR had an alabaster (white) with red cabinet.

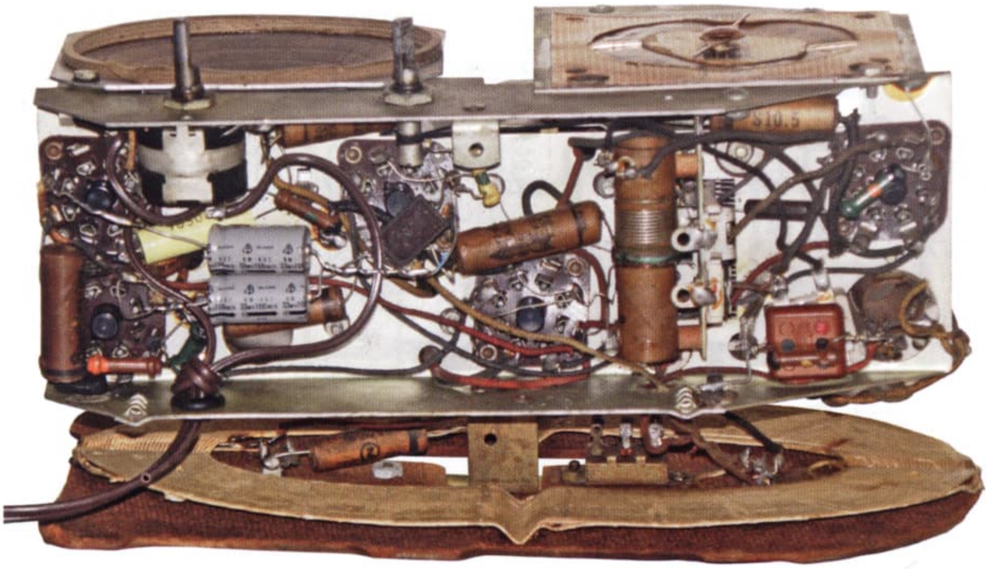


Figure 4: A view under the chassis of the model 116. The chassis has been restored, with some of the capacitors (including the power supply electrolytics) replaced by modern components.

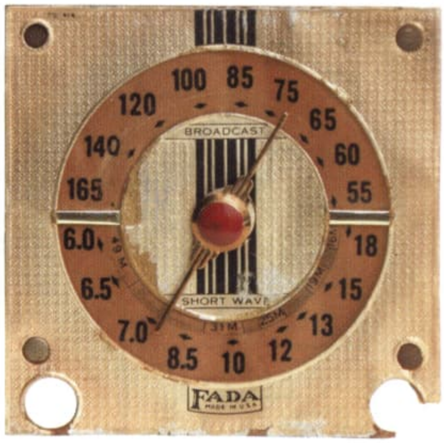


Figure 6: The dial of the model 116, with the top section calibrated for the medium wave band (known as the 'broadcast' band in the US), and the lower section showing short wave frequencies and bands.

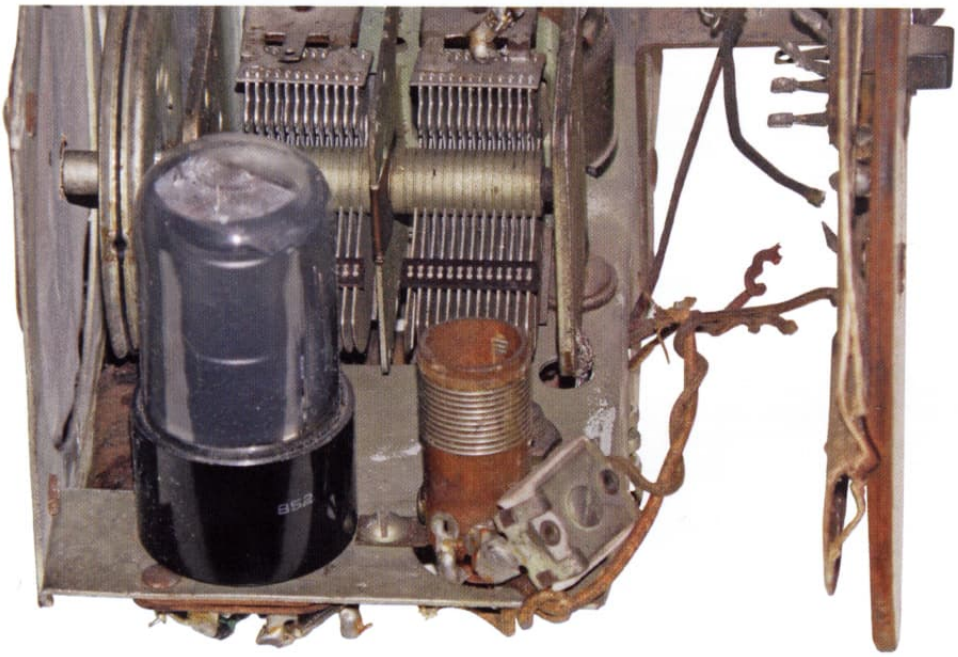


Figure 5: Close-up view of the left-hand side (as viewed from the rear) of the model 116 chassis. The hole to the right of the frequency changer valve (a 12AS7GT) is the subject of some debate, as to whether it was intended that it should eventually accommodate an RF stage, or was there simply to pass wires between the coil and the bottom of the chassis. The equal sized gangs on the tuning capacitor and the wave change slide switch (unconnected on this example) can also be seen.

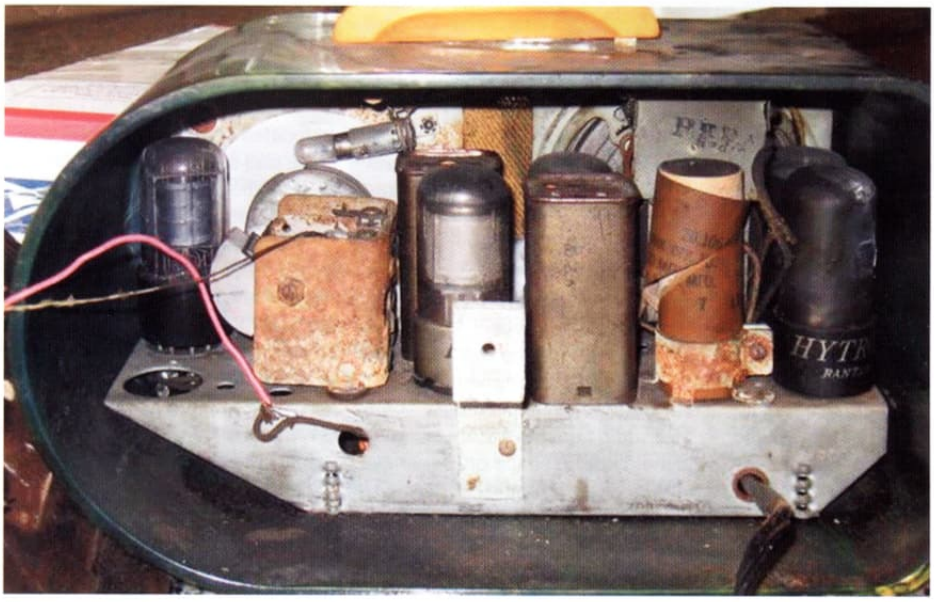


Figure 7: An example of a model 200 on eBay: you can clearly see the hole next to the rather rusty tuning capacitor, still vacant and waiting for an RF amplifier to be fitted.

Models 115 and 116

The first incarnations of Fada's distinctive Bullet cabinet shape were the models 115 (see Figure 1) and 116, introduced in 1940. The radios' chassis employed a conventional five-valve superhet design using octal-based valves as follows: 12SA7 local oscillator / frequency changer; 12SK7 IF amplifier at 456kHz; 12SQ7 detector / AVC / AF amplifier; 50L6GT audio output stage; and 35Z5GT mains rectifier. The 50L6 is a beam tetrode valve with a 50V 150mA heater, not too different in performance from the well-known 6L6, which has a 6.3V 900mA heater.

Fada advertised the radio as 'a powerful 5 tube superheterodyne with 7 tube performance', referring to the valve performing the combined detector, AVC and AF amplifier functions. They used this valve line-up for other very similar contemporary chassis designs, for example in the models 148 and 220, both of which used more conventional brown bakelite cabinets.

Figure 2 shows the 115/116 schematic. The transformerless power supply allowed operation from AC or DC mains at the US nominal voltage of 117V (the wide operating range of 105V-125V is often specified on a label on such a radio), which no doubt varied greatly from location to location. The clever aspect of this combination of valves is that their heater voltages neatly add up to the mains voltage supplied to homes in the US (give or take a few volts) and, at 150mA, their heater currents are all the same. This allows all the heaters to be connected in series. The radio's total power from the mains was about 30W. As was often used in radios at the time, the inductance of the field winding of the loudspeaker was used to smooth the HT supply.

The circuit design was so optimised that considerable thought was even given to how the dial lamp was powered, and rectifier valves were designed to facilitate this. The dial lamp specified was a 6.3V 150mA 'type 47' which was very commonly used on similar radios. The 35V heater on the 35Z5GT is tapped at the 7V/28V point and the dial lamp is connected across this 7V potential. As the heaters warm up, although the current through them initially surges and then settles down, the voltage across the 7V portion of the rectifier's heater stays more or less constant and so doesn't blow the bulb. I believe the circuit also allows the bulb to be blown, and the radio to still work without stressing the valves too much. The user of the radio was supposed to fit a new bulb as soon as possible, but at least the radio could still be used, while a replacement bulb was being tracked down.

Chassis removal

Removal of the chassis from the cabinet is a simple task: the two knobs pull off, and three screws need to be removed from underneath the cabinet. As far as I can see, there was no attempt to isolate these screws from stray fingers that might have attempted to pick up the radio while it was still plugged into the mains and perhaps with its chassis connected to the live feed. I would think that with the US mains voltage of 117V or so, you would have felt a distinct tingle, but not the same bite you get from the UK mains. The chassis then slides backwards - a tilt is needed to clear the handle – and out it comes complete with its built-in aerial and 4-inch loudspeaker. The very compact audio output transformer is accommodated on top of the frame of the loudspeaker.

Figure 3 shows a view of a 116 chassis from the front, and Figure 4 is a view under the chassis. The 30µF and 20µF HT supply smoothing capacitors were originally housed in an above chassis can, which is missing on this example, having been replaced by modern components fitted under the chassis.

The chassis is 9½-inch long by 3¼-inches deep by 5¼-inches high, and as would be expected from such a midget receiver, it is well-packed, above and below deck. The use of octal valves allows close packing of the valves, as their envelopes are slightly narrower than their bases, which wasn't the case with previous generations of valves. The hole to the right of the frequency changer stage (see Figure 5 for a close up view) carries wires from the short wave aerial coil and the bandswitch to the underside of the chassis. The diameter of the hole is 1-inch, which is the right size for another octal valve socket to be added. There is only one small hole - to the side of the big hole - which was used to mount a bracket carrying the coil, and so a valve socket could not have been simply dropped in and fixed with rivets without at least slightly modifying the chassis - see later for more about this hole.

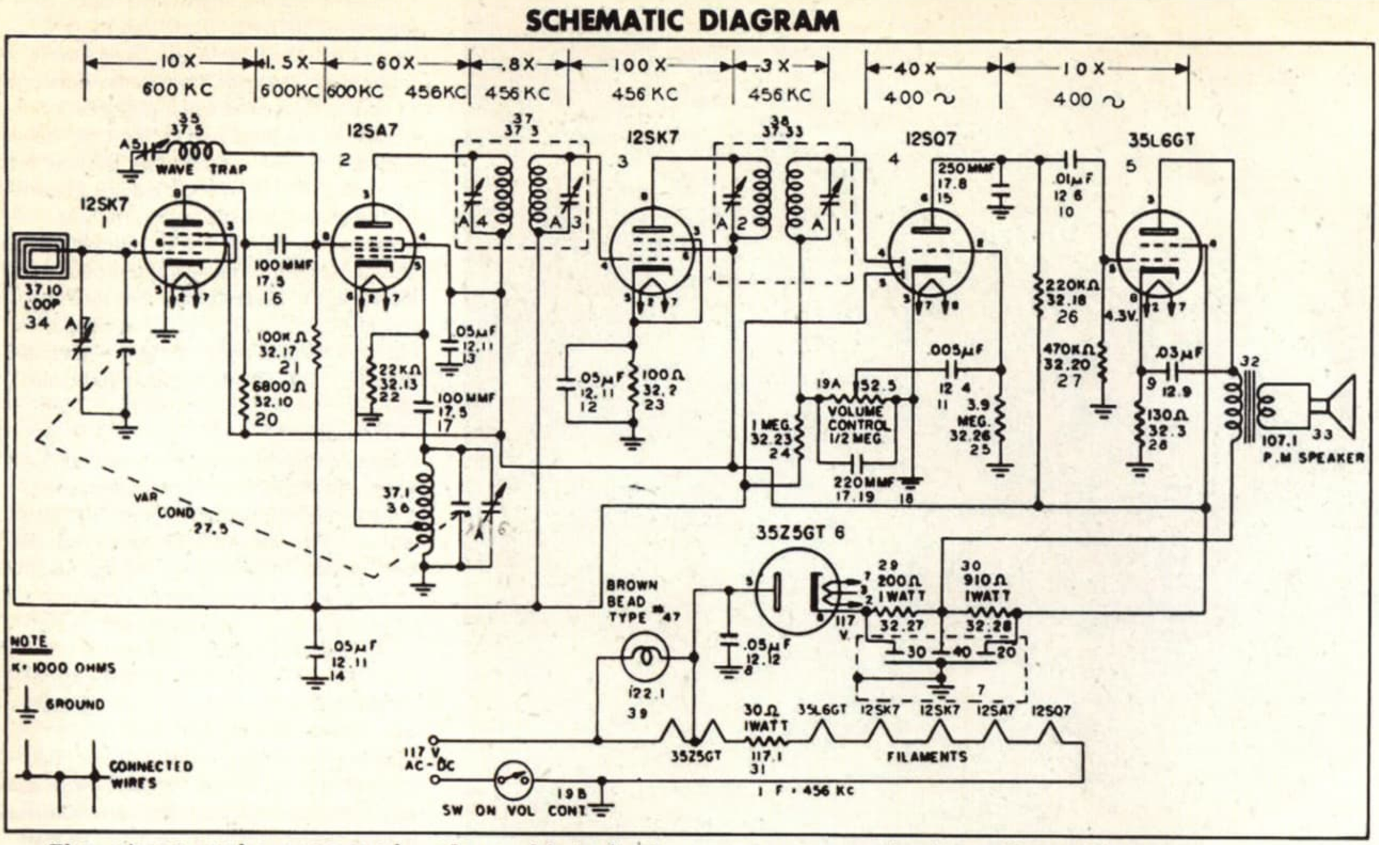
The 115 was fitted with a built in aerial called the 'FA-DA-SCOPE', a loop aerial wound on the inside of the back cover. This is spaced away from the rear of the chassis by about 1½-inches, presumably to prevent the metal of the chassis and the valves themselves from damping the coil and affecting its inductance. If you need to open up the rear of the radio, for example to change a valve, the aerial has to be unsoldered because of the short wires connecting it into the chassis, unless you have very long and thin fingers. Fada adopted the slogan 'Plug-In, Play' (evocative of the 1995 Intel and Microsoft Windows mantra of 'Plug and play' for easy use of peripherals with PCs) showing how easy the radio was to use since it did not need an external aerial.

With its drop-down handle, in itself an innovation which was soon copied by other manufacturers, the radio was designed to be transportable. The hope was that users would carry the radio around from room to room, but eventually see the inconvenience of this, and get to the stage where they purchased extra radios for these rooms. I doubt that modern day owners of Bullets carry them around by the handle.

The FA-DA-SCOPE aerial was also fitted to the 116, as well as a wire dangling out of the back for connection to at external aerial for short wave reception. A slide-action wavechange switch was mounted on the back panel.

Dial markings

The dial markings of the 115 were calibrated with kilocycles in the top segment, and meters in the bottom segment (rather like the dial of the model 1000, see later). Unlike on most UK-manufactured radios, no station identifications were shown on the dial, reflecting the fact that the radio



The stage gain measured values listed above are approximate values for an average operative stage, rather than an absolute value. It should be borne in mind that it is possible to introduce so many variables into the measurement operation, such as, type of equipment used for measuring, handling and placement of probes, the accuracy of alignment, etc., that an absolute reading is impractical. AVC is made inoperative and 3-volt battery bias substituted for measurement.

Figure 8: The schematic of the model 1000. The same basic circuit was used for the variants of the model 1000 chassis, using octal, B8B loctal and B7G valves, details of which can be seen in Table 1.

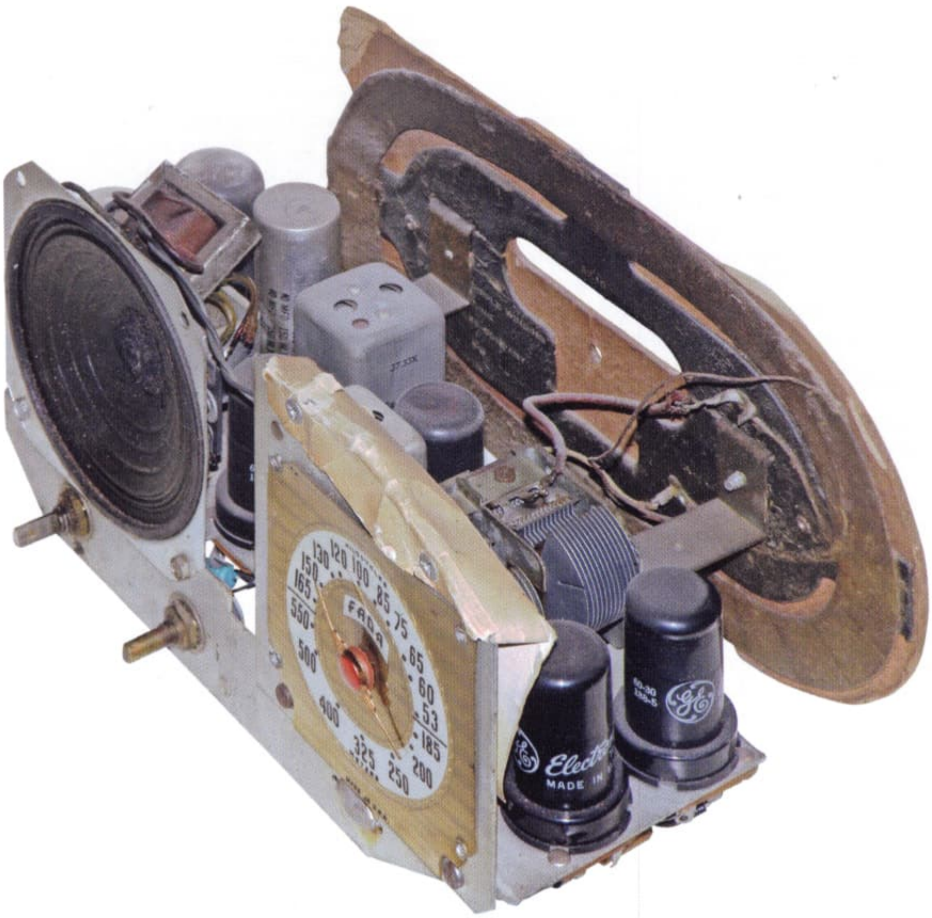


Figure 9: Top chassis view of an all-octal valve 1000-series radio.

Figure 10: Close up of the RF amplifier and frequency changer stages of the 1000-series radio. You can see the different size plates (and hence the different capacitances) on the two gangs of the tuning capacitor, which make it easy to achieve good tracking across the single band covered.

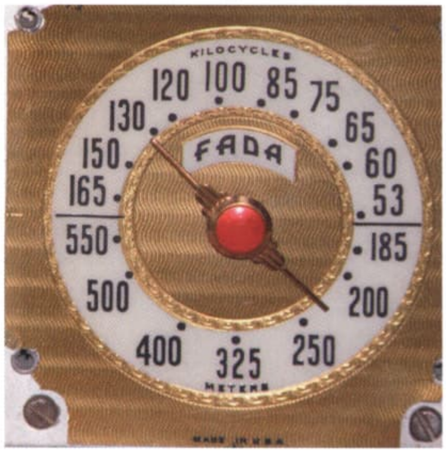


Figure 11: The medium wave only markings on the dial of the model 1000, indicating frequency and wavelength.

could be sold anywhere in the US, and station names and their frequencies would be quite different around the country.

The medium wave coverage of the 116 was slightly less than the 115, and a short wave band - between 5.7MHz (about 56m) and 18.3MHz (about 16m) - was added. This gave access to the 49m, 41m, 31m, 25m, 22m, 19m and 16m broadcast bands - these bands are marked on the radio's dial. The top section of the dial was calibrated for the medium wave band (known as the 'broadcast' band in the US), and the lower section showed the short wave frequencies, see Figure 6. Whether the 116 was intended for export, or simply for use in the US by listeners to the short wave bands is unknown. Suffice it to say that the 116 is very rare in the UK, so very few actually made their way over the Atlantic, although of course there was a war going on in Europe at the time, and by the time the war ended, the 116 was out of production. An interesting list of American radios imported by the Board of Trade during the war, given to me recently by Carl Glover, shows a large number of makes and models, including the Fada models 115 (but not the 116) and 200, though what state their cabinets were in by the time they reached the UK, if indeed any did, is unrecorded.

The model 189

Fada's model 189 (medium wave only) All American in red, white and blue colours, was a response to Emerson's model 400 Patriot (styled by the industrial designer, Norman Bel Geddes, to celebrate Emerson's 25th anniversary, and moulded in Monsanto's Opalon plastic), which appeared in late 1940. War was raging in Europe at the time: the US was still isolated to a large extent, but was supplying much needed war material to a defiant Great Britain. Clearly a US patriotic theme was a good marketing point for the Patriot, as well as an aggressive selling price (see later). Originally there were three colour variations of the Emerson radio, with various combinations of red, white and blue, and rather cleverly, stars were moulded into the control knobs.

Emerson soon introduced more colours - as the Aristocrat range - perhaps as a way of getting people to buy more than one

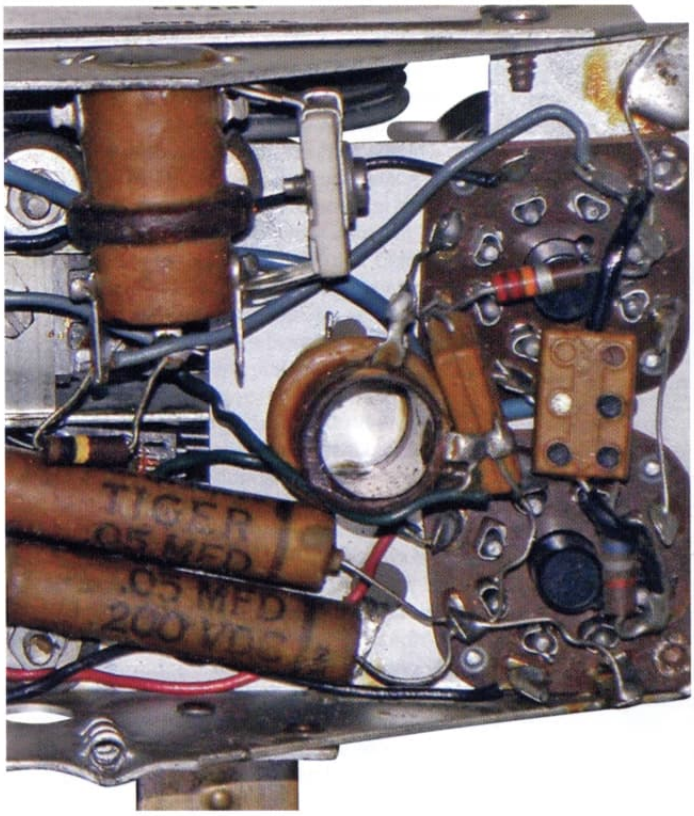


Figure 12: Partial under chassis view of the 1000, showing the area around the RF amplifier and frequency changer valves. The coil and trimmer to the upper left is the IF trap (inductor L35 and trimmer capacitor A4), and the coil to the immediate left of the valve sockets is L36, the local oscillator coil.

Figure 13: Detail from the back panel of the model 1000. The radio's model number and six valve line-up is printed on the panel. Previous models, and some examples of the 1000, had a label stuck onto the bottom of the cabinet containing this information.

radio of the same model. Catalin was not used for the Patriot and Aristocrat radios and unlike most Fada radios, the original red, white and blue (and other) colours have stayed stable over the years. The original combinations can still be found, and are very collectable. If you had looked inside an Emerson 400 you would have seen a very similar chassis to the Fada models, with the same five valve line-up.

Most 189s you now see have a butterscotch yellow (originally white) cabinet, with a marbelised green (originally blue) ring around the dial, and red knobs and handle. Some examples have been restored back to their original colours, which involves removing the surface layer and polishing the revealed colour finish, while some collectors keep their 189s in the state to which they have aged naturally. The 189 seems to have been the model designation specifically for this patriotic colour scheme, and its internals were almost identical to the 115.

The 200-series

America entered the war in December 1941 and domestic radio production slowed as radio manufacturers switched over to military projects. In some literature the 200-series year of manufacture is given as 1942, which is feasible as Fada squeezed out their last domestic radios for the duration, and war production ramped up early in that year. I'm assuming here that Fada did stop domestic radio production at some point during the war, but it may have been that this continued at some reduced level throughout this period.

I believe this was the first time that Fada used the word 'series' to indicate that a range of colours was available for that model. 200-series radios are very rare today, especially in the UK, and it seems likely that only a small number were produced. A single example of a 1942 Bullet radio carrying a model 189 label with a marbelised cabinet – you would expect this to have been labelled as a model 200 - has been seen on an internet auction. Perhaps Fada were using up all the cabinets, chassis, labels, etc they had in stock, before they shut down domestic radio production until 1945.

There seems to be some uncertainty (on the internet at least) as to whether Fada used the 'old' model 115 chassis for these models, or an updated six-valve chassis, as was used for the model 1000 starting in 1945. In the pictures for a couple of eBay auctions of 200-series Bullets I've seen evidence that it used the five valve chassis. See Figure 7 for a photo of the rear of a model 200 on eBay: you can clearly see the hole next to the tuning capacitor, still vacant and waiting for an RF amplifier to be fitted in a later incarnation of the radio.

Fada may have been introducing a permanent magnet speaker at this time, which would have meant a slightly modified power supply from that in the 115, but otherwise the chassis was identical. If anyone reading this has a model 200, perhaps they can open it up (or at least check the label on the bottom) and verify whether it's a five or six valve chassis, and let me know. Reference 3 advises the use of the model 115 schematic for servicing 200-series radios, inferring that it's the five octal valve chassis being used.

Wooden-cased Model 200

As the supply of Catalin dried up, Fada even produced a small number of model 200s in wooden cabinets, finished in red and ivory lacquers to make them resemble shiny Catalin. Even the bezel, grill, and knobs were formed from wood. The wooden cabinet was slightly bigger (perhaps an inch in each dimension) than the Catalin version, but the spacing of the dial and knobs was kept the same, and so the same chassis could be used. The photograph at Reference 4 shows a red and ivory coloured wooden model 200 alongside a Catalin-cased 115.

The 1000-series

When Fada restarted Bullet production after the war, they gave its chassis a refresh to reflect modern practice, and launched the radio as the 1000-series. The radio employed a six-valve superhet design, still with an IF of 456kHz. [As far as I can tell, Fada never got round to adopting the almost universally used (in the US and Japan, at least) intermediate frequency of 455kHz]. The radio was equipped with octal valves of types 12SK7, 12SA7, 12SK7, 12SQ7, 35L6GT and 35Z5GT.

The new sixth valve was an RF amplifier stage, using an octal 12SK7 (in its metal-cased version) in the 1945 version. This migrated to the loctal B8B 12B7/14A7 (dual marked) valve and finally to the B7G 12BA6 when this valve appeared in 1946, and carried forward to the all-B7G model 1000 in 1947-ish. The 12B7/14A7 was also used as the IF amplifier in some builds of the chassis. As you might

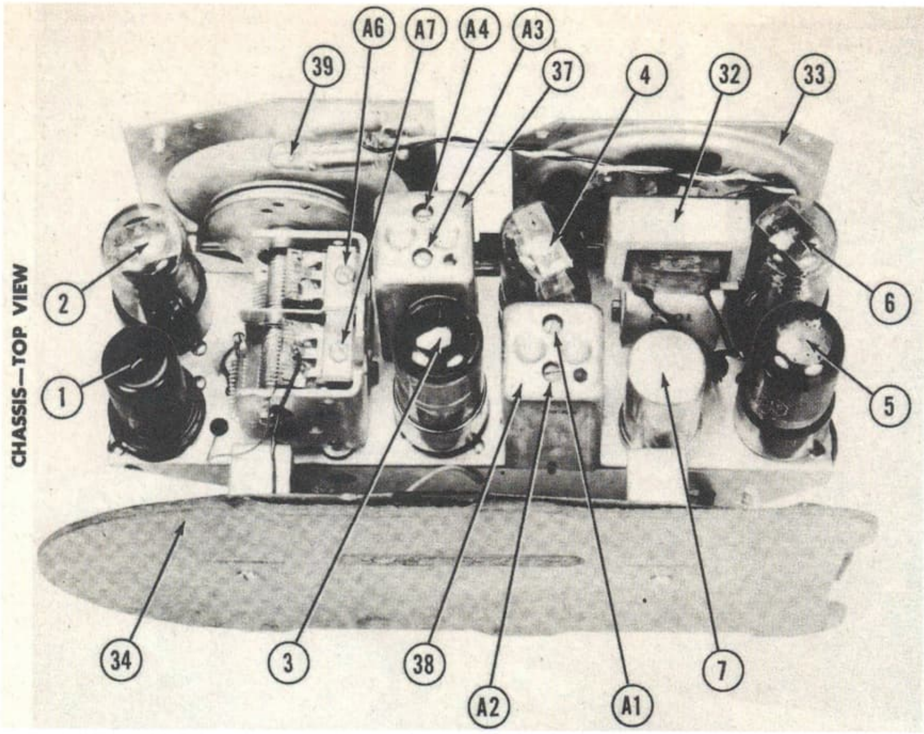


Figure 14: Top of the chassis photograph of the model 1000 from the Photofact Folder service sheet. Note the use of GT octal valves, apart from the RF amplifier which uses a metal-encapsulated valve.

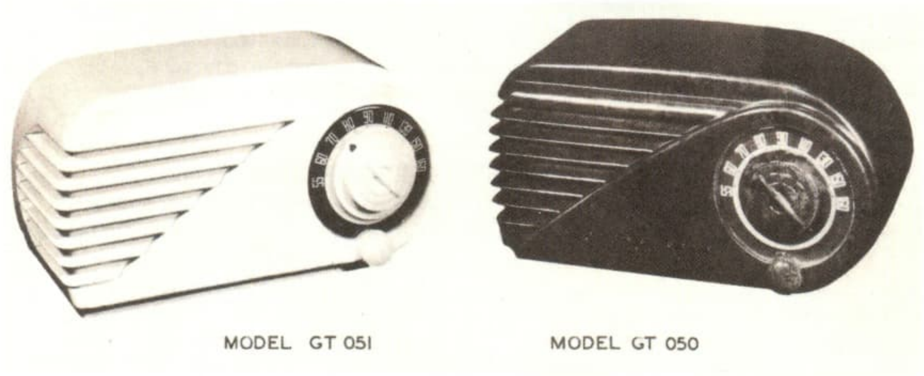


Figure 15: Front page of the Photofact Folder for the Farnsworth models GT-050, 051 and 052 models.

expect, Fada claimed that the six valves gave the radio '8 tube performance'.

See Table 1 for how this evolution to an all-B7G line-up happened. On the internet you sometimes see the model numbers 1000A and 1000B for the variants using B7G valves: I don't believe Fada used these designations. On the back of any of these variants the purchaser would simply have seen 'Model 1000', though presumably Fada themselves must had had some way of distinguishing between the different builds of chassis. In the table I've shown four different valve line-ups for the model 1000, occurring over about two years: there may well be others that I haven't spotted yet. I checked the pinouts of the octal and loctal valves and their B7G substitutes and in some cases they are quite different: this would have meant some juggling of the component positions and the wiring, and the generation of new production drawings.

Re-documenting and re-tooling for the different valve line-ups would not have been a trivial task, and so the volumes of radios being built must have justified the use of at least four different valve line-ups in about two years, presumably for cost savings or to resolve supply shortages.

Schematic

Figure 8 shows the schematic of the model 1000. By this time the speaker had become a permanent magnet type and its field winding was no longer available for use in the power supply circuit. Three capacitors (accommodated in an electrolytic can) and two resistors smoothed the HT lines.

The inclusion of an extra 12V valve in the heater chain meant that the audio output valve's heater voltage needed to be reduced by about the same amount, hence the use of the 35L6GT, which is in fact 15V lower than the 50L6GT. Of course the current through the heater of the 35L6GT was still the same, at 150mA. The lower heater power for the 35L6GT meant that it was capable of about 25% less audio output power than the 50L6GT, which was probably not noticeable in this radio. A 30Ω 1W resistor was also included in the heater chain to drop the extra few volts, and to limit the switch-on current surge.

The RF amplifier seems to have been added to increase the model's sensitivity: an untuned link from the RF stage to the frequency changer stage kept the number of tuned circuits to two, so that the radio needed no more RF coils and still only required a two-gang tuning capacitor, as used in the previous five-valve models. This meant that selectivity was still the same as the five-valve chassis, but presumably more distant stations could be received, which was probably a good selling point in such a large country as the USA, and local stations were louder. In their adverts, Fada emphasised 'the noise reducing RF stage'. The Photofact Folder for the 1000 series shows a gain of x10 for the RF stage. I presume this is voltage gain, that is, what you would see on a 'scope if you probed before and after the stage. An IF wave trap was positioned between the two stages to prevent breakthrough in the vicinity of 456kHz from reaching the frequency changer, and hence the IF amplifier.

There was a convenient position on the chassis to accommodate the new valve, next to the frequency changer, in the form of the hole that carried wires between the top and bottom of the chassis in the models 115 and 116. This hole is too big simply to carry these wires and it's reasonable to assume that the Fada designers always intended to fit this extra valve at some point in the life of the chassis, which of course was somewhat delayed by the war, and didn't happen until the model 1000 in 1945. This may or may not be true, but there was certainly a convenient space on the chassis in the right place into which the RF amplifier stage could be added without disrupting the successful original layout too much.

Figure 9 shows a three quarter view of the front of the model 1000 chassis, and Figure 10 shows a close up of the 12SK7 RF amplifier (to the left) and 12SA7 frequency changer (to the right) stages. You can see the different size plates (and hence the different capacitances) on the two gangs of the tuning capacitor, which make it easy to achieve good tracking across the single band covered, and saves a few cents because no padding capacitor is required.

A closer view of the dial is shown in Figure 11. I like the clear labelling of frequency and wavelength, and as with most US-produced radios, there is an absence of station names.

Figure 12 shows an under-chassis view of the RF amplifier and frequency converter stages in the model 1000. The coil and trimmer to the upper left form the IF trap (inductor L35 and trimmer capacitor A4) and the coil to the immediate left of the valve sockets is L36, the local oscillator inductor.

A small area of the back panel of a model 1000 is shown in Figure 13. This particular example has the radio's model number and six valve line-up printed on the panel. Other examples of the model 1000 (and previous models) had a label stuck onto the bottom of the cabinet, but this seems to have been a more permanent way of recording this information on the radio.

In Figure 14 I have scanned part of the Photofact Folder service sheet for the model 1000, showing how the publisher included a good-quality photograph of the top of the chassis. An under chassis view was also included, as well as a schematic, alignment details, parts list, a voltage and resistance chart, and dial cord stringing details.

Prices

The 115 sold for $19.95 in its first year, and the short wave band on the 116 cost you about an extra $3. $16.95 seems to have been a popular price for many radios with similar specifications, but with plainer cabinets than these Fada models. The Emerson model 400 Patriot sold for a very competitive $15 on its introduction.

In 1939 RCA were selling the 45X1 'Little Nipper' (a name that was used on many of their models), with a brown plastic cabinet, for $9.95, which may have been a loss leader aimed at damaging the competition rather than at making a profit for RCA. In those days you could get about $4.43 for £1, and so $9.95 equated to about £2 5s in old money, which sounds very cheap.

By the time the Bullet shape was re-introduced in 1945, with the model 1000, Fada could ask about $35 for the radio. It now came with one more valve compared to the 115 and 116 models, and so prices had to rise to cover this extra cost. Inflation had run at widely different rates in the US during the war, with annual rates as great as 13.2% in mid-1942, and all this added to the price at which a radio had to be sold immediately post-war. I think the conclusion to take away from this is that Fada were not able to demand huge premiums for these very stylish radios. They had a following because of the radio's styling, but as always in the US radio market, brisk competition forced prices downward.

Impersonations

The Fada streamlined cabinet was such a success that it attracted look-alike competition, for example, in the form of the Farnsworth medium wave only GT-050, 051 and 052 models, introduced rather belatedly in 1948. Figure 15 shows the front page of the Photofact Folder for these three Farnsworth models. With an octal valve line-up of 12SA7, 12SK7, 12SQ7, 50L6GT and 35Z5GT, this was a rather dated chassis in 1948, and made no use of the new B7G valves. As noted earlier, the Fada 1000 now included an RF amplifier stage in front of the frequency converter, which these Farnsworth models did not have.

As far as I can tell, the three Farnsworth models used identical chassis, and differed only in their cabinet and knob colours. The GT-050 had a standard mahogany coloured cabinet with a black outer circle for the dial; the GT-051 was a jazzed-up version, with a 'gleaming white' cabinet, again with the black outer circle for the dial; and I believe the GT-052 was a two-tone green colour.

The cabinet was made of 'modern' (for the time) plastic, rather than bakelite or Catalin, and was about half an inch bigger in each dimension than the Fada 1000-series. Farnsworth referred to the shape as 'teardrop', and these radios are also rare and very collectable today. It may be that by 1948 Farnsworth (and others) had seen the drawbacks of using Catalin for radio cabinets and may have advertised their use of 'modern' plastics, with better colour stability and being less prone to cracking, as a selling point. For me, the design doesn't quite work: the curves look great, but the tuning knob being concentric with the dial leaves only the on/off/volume control to be accommodated and it doesn't look quite right below the dial, but what do I know?

At the time, Farnsworth also made more conventionally-shaped radios (that is, with more upright rectangular cabinets) such as the GT-061, but also offered them in various bright colours, as allowed by the plastic technology they were using. For the more conservative purchaser there was also generally a 'safe' mahogany or ebony coloured version available.

Fada 700 'Cloud'

In 1946 Fada released the model 700 Cloud radio, in a Catalin cabinet, and with a range of at least five colours. This is regarded as Fada's first true post-war cabinet design. Its curves were somewhat similar to the model 1000, but the symmetrical design loses something of the movement of the Bullet's cabinet, and although sought after, is now regarded by collectors as being inferior. The knobs and dial are placed in similar positions and the chassis design is very similar to the model 1000, using the six same B7G valve types (and therefore having an RF amplifier stage), and with medium wave only coverage.

For purchasers who didn't take to the Bullet shape (or maybe they already owned one) Fada offered the Catalin model 652 Temple at the same time as the model 1000, and for about $1 more. The 652 used a similar six valve circuit as the 1000, with an RF stage. Figure 16 shows the model 652 alongside the model 1000 (and other Fada radios) in a trade advert in the March 1946 issue of Radio & Television Retailing magazine.

There was no standing still in this cut-throat industry, and later in 1946 Fada produced the model 711, still with a Catalin cabinet, and of course available in lots of colours. The 711 used a five valve chassis, very similar to the Bullet model 115, but used B7G valves rather than the

Figure 16: Fada's advert in Radio & Television Retailing for March 1946 (by kind permission of the Radiomuseum). The 652-series of radios also use a Catalin 'Fada-Lucent' cabinet.

Model Number	Date Introduced	Frequency Range	RF Amplifier	LO / Converter	IF Amplifier	Detector / AGC / AF Amp	Audio Output	Rectifier
115	1940	538-1750 kHz	Not fitted	12SA7 / 12SA7GT (Octal)	12SA7 / 12SK7GT (Octal)	12SA7 / 12SQ7GT (Octal)	50L6GT (Octal)	35Z5GT (Octal)
116	1940	538-1660kHz and 5.7-18.3MHz	Not fitted	12SA7 / 12SA7GT (Octal)	12SK7 / 12SK7GT (Octal)	12SQ7 / 12SQ7GT (Octal)	50L6GT (Octal)	35Z5GT (Octal)
189	1940	MW only	Not fitted	Same as 115				
200 series	1941/42	MW only	Not fitted	Same as 115				
1000 series	1945	528-1680kHz	12SK7 (octal	12SA7 (octal)	12SK7 (octal)	12SQ7 (octal)	35L6GT (octal)	35Z5GT (octal)
	1946?	528-1689kHz	12B7/14A7 (B8B Loctal)	12SA7 (octal)	12B7/14A7 (B8B Loctal	12SQ7 (octal)	35L6GT (octal)	35Z5GT (octal)
	1946?	528-1689kHz	12BA6 (B7G)	12BE6 (B7G)	12BA6 (B7G)	12AT6 (B7G)	35L6GT (octal)	35W4 (B7G)
	1947?	528-1689kHz	12BA6 (B7G)	12BE6 (B7G)	12SK7 (octal)	12AT6 (B7G)	35B5 (B7G)	35W4 (B7G)

Table 1: Summary of data on the Fada range of Bullet models.

octal ones used back in 1940. When the modern plastic model 845 Cloud, using a six valve (all B7Gs) chassis, appeared in 1947, the 711 became the last of the Catalin designs ever produced by Fada.

Why no long wave band?

It may seem strange to us that these US-manufactured radios are not equipped to receive what we call the 'long wave', that is the range of about 150kHz – 285kHz. In Europe, stations broadcasting in this range typically use very high power and are capable of covering a much wider area than medium wave stations. This means that many European broadcasts could have been heard along the Atlantic seaboard of the US during autumn and winter, and a few long wave stations from Asia would have been heard on the Pacific Coast at certain times of day. Clearly this didn't seem to produce a demand on radio manufacturers to include long wave reception into their radios, except when they were producing a model for export.

In the US, this frequency range was (and still is to some extent) used for military communications (for example, to be activated in anticipation of a nuclear attack – though this was never fully implemented) and other, non-public broadcasts. It may even have been illegal to listen to certain broadcasts on this band, and so presumably radio manufacturers were encouraged to prevent listeners from doing this.

Summary and conclusions

The five models of bullet-shaped radios produced by Fada are but a subset of all the Catalin-based radios they manufactured over the ten years or so from about 1938. Many other radio manufacturers also used this material as they brightened up their cabinets, and added colour to the final years of the Depression. They didn't just replicate the old wooden cabinets, but thought hard about what could be achieved with this new material, and produced some revolutionary shapes, all of which are very collectable today. The reference books described below show some excellent examples of these radios, and they are well covered on the internet.

Whenever I come across a radio, after a few seconds of knob twiddling, I always want to turn it round, take the back off, and take a look inside. There's always something interesting to be seen even in designs that are considered to be standard, and even boring. The chassis lurking inside the Bullet radios were minimalist in their implementation, but certainly not static in their design. As the new B7G-style valves became available after the war, the chassis evolved from being a fully octal-based 'all american five', and with the final design inside the 1000-series of radios, it acquired an extra valve in the form of an RF amplifier. This was not a trend unique to the Fada Bullets, but was seen generally with Fada radios at the time, and those of other manufacturers. American valve companies always co-operated with the radio manufacturers in offering sets of valves whose heater voltages added up to the nominal US mains voltage.

I've speculated to some extent on how Fada produced the model 189 and the 200-series in the early months of the Pacific war, as radio manufacturers switched over to war production. Perhaps I can ask owners of 189s and 200s to take a quick look inside their radios and confirm (or refute) my conclusion that they all used the 115 chassis, or something very similar.

I may be asking the question in the wrong country, and about 70 years too late, but do any readers have any knowledge of how quickly Fada made the transition to war work, and what they actually made in the war? According to Google Earth, a factory still stands close to the railway tracks at 30-20 Thomson Avenue, Long Island, New York, which is Fada's original address. It would be interesting to know if this is the original factory used to manufacture these radios.

Today, Bullet radios, especially the model 1000 in its various chassis variants, come up for sale quite often, and are still highly prized, and hence highly priced. Collectors largely ignore the state of the chassis (as long as it is there) in the collectability and value they attribute to the radio.

The Bullet shape has been copied many times over the years, in modern transistor radios and in non-working miniature replicas. For example, the Crosley CR2 (see Reference 5) was an AM/FM radio and cassette deck designed in the mid-1990s which used ABS plastic for its cabinet. This radio can still be bought in the US for about $80. At that time, Crosley produced a range of 'Made-in-China' plastic replicas of many of the most popular Catalin radios of the 1930s and 1940s.

Acknowledgements

I'd like to thank Carl Glover, Mike Barker and Jim Hambleton for their help with the preparation of this article.

Sources of data for US radios

There is a series of service sheets called Photofact Folder, published by Howard W Sams & Co, in the US, similar to the Trader sheets that were published in the UK. Scanned versions of these are available on-line and many originals can be found on eBay. It's worth buying one or two of these originals and seeing their excellent production quality, usually including a couple of photos of the chassis being described. Although the Fada 1000-series Photofact Folder is commonly available, I was unable to locate the document (if it ever existed) for the other Bullet models.

In the US there was also a series of annually-published booklets called 'Manual of 1940 Most Often Needed Radio Diagrams', and so on for each year, with a gap for some of the war years. These contained a single-page condensed version of the schematic for typically 200 radios each year, and sometimes included the chassis layout and dial cord arrangement. Original versions of these can be bought on eBay.com, and scanned on-line versions can be found on various websites.

The Switzerland-based Radiomuseum at: http://www.radiomuseum.org/ contains descriptions, photos and schematics of many radios with Catalin cabinets, as well as uncountable numbers of other radios from all over the world. I'd like to thank the museum for giving me access to the jpg used for the advert in Figure 16.

Numbered References

Reference 1: 'Classic Plastic Radios of the 1930s and 1940s' by John Sideli, published in 1990 by E P Dutton, New York. A very worthwhile book on Catalin-cased radios, with many excellent colour photos of models from many US manufacturers.

Reference 2: A large selection of Catalin and Bakelite radios can be found at: http://www.collectorsweekly.com/radios/catalin-bakelite

Reference 3: The Universal Schematic Locator advises the use of Riders 12-6 (that is, the model 115 schematic) for the 200-series radio.

Reference 4: A red and ivory lacquered wooden model 200 posed alongside a Catalin-cased 115 can be seen at: http://uv201.com/Radio_Pages/wood_fada.htm

Reference 5: The Crosley CR2-Y, a modern replica of the Fada 115, can be seen at: http://www.aurorahistoryboutique.com/Q000086.htm

Other References

'Bakelite Radios: a Fully Illustrated Guide for the Bakelite Radio Enthusiast' by Robert Hawes, in collaboration with Gad Sassower, published by Chartwell Books, New Jersey in 1996. The author uses 'Bakelite' as a generic term, including Catalin and other plastic materials. Robert was a member of the BVWS and editor of the Bulletin. Sadly, he died in 2014. The book's 128 pages contain many colourful pictures of this type of radio, including Midgets, from all over the world.

'Bakelite Radios', published by Grange Books in 1999 (there is also a 2002 edition). The 64 pages of content is an abbreviated version of Robert Hawes' book (above), and the pictures are printed in a rather smaller format. Second hand, it can be picked up on Amazon for little more than the cost of postage.

'Classic Plastics' by Sylvia Katz, published by Thames and Hudson in 1984, and reprinted in 1988. This book contains many pictures, most in colour, of classic plastic objects. A relatively small number of radios are included, but the book shows the versatility of plastics, starting with pre-Bakelite materials, such as amber and shellac, and working through all the plastics of the 20th century.

An interesting description of various pre-war plastics used for radio cabinets can be found at: http://www.decoradios.com/text.htm#catalin

The chemistry behind Bakelite and videos of the production process can be seen on YouTube. Videos of several Catalin radios, including those made by Fada, can also be seen on the website.

'The Fada 740 – An Amazing American Midget' by Roger Grant, published in the summer 2011 issue of The Bulletin. This radio is a B7G-valved superhet in a Bakelite cabinet.

Roger Grant described his restoration of an American Midget in 'The Air King 23X – An unusually austere American Midget', published in The Bulletin for winter 2010. This radio is a four valve TRF.

'Blonde or Brunette. The Fada 790' by Gary Tempest, published in The Bulletin for autumn 2003. Gary described the restoration of his two AM/FM radios from 1949, with different cabinet colours.

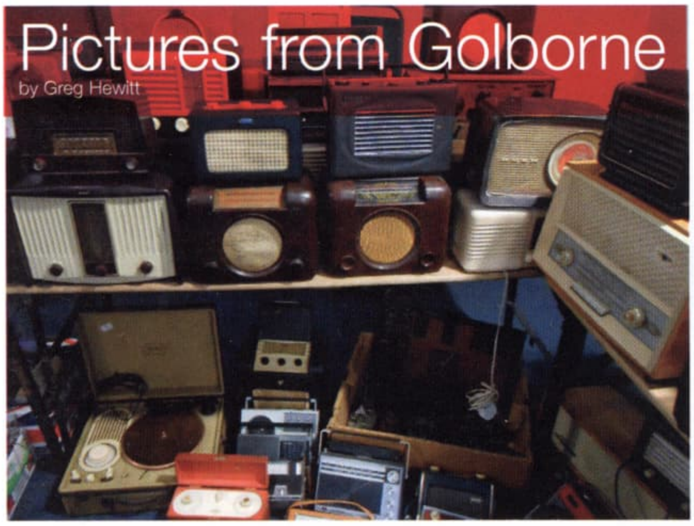
'The Fada Bullet' by Mike Barker, published in The Bulletin for summer 2003. Mike's brief article showed some small photos of Bullet chassis, as well as some Alba and Dulci midget radios.

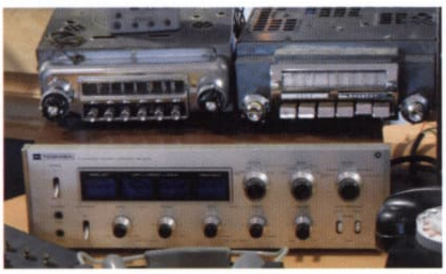
'An Emerson Midget is Re-Born' by Colin Boggis, published in The Bulletin for summer 2002. Colin's article described the restoration of a five valve Emerson TRF of about 1939 vintage.

A rather basic book on the subject of the AA5 is: 'The All-American Five Radio - Understanding and Restoring Transformerless Radios of the 1940s, 50s, and 60s' by Richard McWhorter. Published in 2003, with a later edition in 2011, by Sonoran Publishing.

Pictures from Golborne

by Greg Hewitt





The Philips 274A Superinductance by R.J.Grant

I recently inherited one of these sets from a fellow wireless collector and long time friend Norman Purrott. I remember him acquiring it some twenty years ago and assisting in its restoration. The top of the cabinet was devoid of varnish and the speaker and knobs were missing, luckily I was able to help as I had a few Superinductance knobs in stock but couldn't help with a speaker. Norman restored the set and made a very nice job of it and promised I would get first refusal should he dispose of it. Having received this set I thought I would give it the once over before I powered it up as it probably hadn't been fired up for a while.

On removing the back the first thing that hit me was the very modern speaker that Norman had fitted. I remember scouring the Harpendens with him looking for the right one but didn't get lucky. It's a six and a half inch round speaker, smaller than the usual Superinductance speakers with an output transformer fitted. Apparently these sets are quite rare and a speaker for one a lot rarer, so the temporary modern speaker remained and it looks like I've inherited the quest to get the right one. I ran a few checks and to my amazement all the components were original including the valves and in very nice condition, all checked ok and I powered up the set, which worked very well and left me nothing to do but get the correct speaker. I have a couple of the eight inch versions of Superinductance speakers in stock so I know what it should look like and at a pinch I could rob a transformer off of one of them.

I started by putting an ad in the BVWS members ads sheet and had a prompt reply from a fellow member. The speaker was a little later version than the one required with no transformer but was a 1930's Philips type and very close, (after all, radios did get repaired during their working lives with near enough spares so this would do nicely). A deal was done over the phone and I arranged to collect it at the next Harpenden. At the same event, as the stallholders were packing up to leave I noticed for sale another Philips 274A, very scruffy but untouched. Other than the missing output and rectifier valves it appeared complete, and the set had its original speaker still in its dust cover.

As the set was considered only fit for breaking for spares, it came for less than I paid for the speaker, so I now have two speakers, (a bit like waiting for a bus, you wait for an hour then two arrive).

The speaker complete with its dust cover and output transformer were swapped into Normans set and this set is now complete and a very nice example of this model.

Although robbed it of its speaker I still gave this new acquisition a once over before breaking it up just in case there was a possibility of salvaging it.

I removed the chassis, the top of the chassis was very dirty and corroded where one of the smoothing capacitors had leaked its electrolyte, otherwise it was all there and I decided to keep the chassis complete. The nice copper tuning cans were very grimy but nothing a drop of Vim souring powder couldn't deal with.

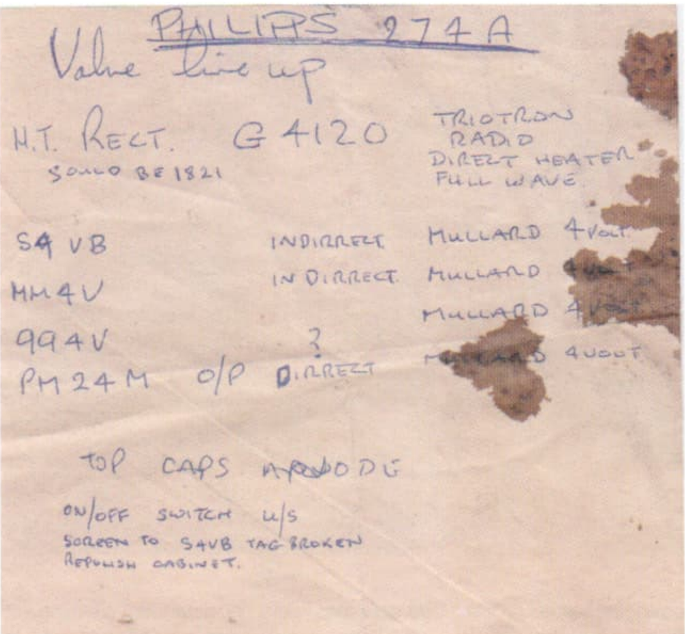
The cabinet was very scruffy but there was still evidence of the original "glass flat" finish on the front panel. I have re-lacquered quite a few wooden cabinets and managed to get very good results, but failed to get the glass flat finish the sets came with when new. This cabinet will be a good opportunity to experiment with and improve my technique. My intention is to treat the finish like the coachwork on an old car, rubbing down with wet and dry cutting paper used wet. I've been reluctant to try this in the past through fear of destroying an otherwise restorable set, I would just lightly sand with fine paper between the thin coats of the new lacquer. This could be a bit difficult as the modern lacquer is designed to have a one coat high gloss finish and doesn't lend itself well to sanding, it tends to stay a bit plastic rather than harden like the old shellac like lacquers. The plan was to just rework the veneered front panel of this cabinet, to work it to death, a no holds barred approach to gain the technique to get the desired finish and then throw it away.

I started in the usual way by completely stripping the original finish with Nitromors, "New formula" Nitromors is nowhere near as good as the old stuff, this took several coats but did eventually do the job. (I think European legislation has a lot to answer for). This revealed the front panel was veneered, the top and sides were just the finished plywood, this plywood appeared quite uneven and rough. Unfortunately, some time in the past, someone had stripped off the lacquer on the right hand side of the set and stained the bare wood with a dark wood stain, and the rest of the set was badly re-varnished.

The very nicely veneered front panel now was completely stripped of its finish, sanded flat and smooth and was ideal for this experiment.

First, a bit of research into the finish. I

Front Panel wear around the controls



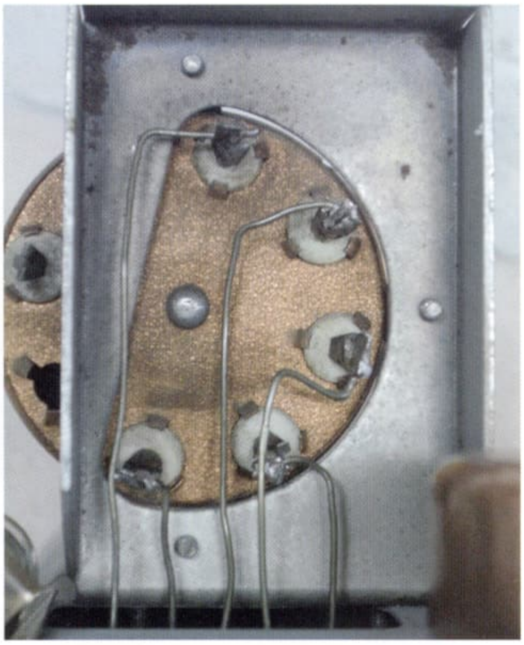
PHILLIPS 274 A
Valve line up

H.T. RECT. G 4120 TRIOTRON RADIO DIRECT HEATER FULL WAVE
SOLD BE 1821

S4 VB INDIRRECT MULLARD 4 VOLT
MM4V IN DIRRECT MULLARD
MULLARD
994V ?
PM 24 M O/P DIRRECT 4 VOLT

TOP CAPS ANODE

ON/OFF SWITCH U/S
SCREEN TO S4VB TAG BROKEN
REPOLISH CABINET.



Tuning can wires

wasn't impressed with the modern quick drying water–based varnish, I've used this in the past, and it tends to stay very soft and unworkable. I ended up stripping it off and starting again. The original oil based varnish is still available, usually referred to as "exterior varnish". The clue is in what you clean the brushes with, if its white spirit, you've got the right stuff. For this job I've purchased a new tin of Wicks Ultra Durable Exterior varnish, clear gloss, the only one available.

The veneer was further flattened with 1000 grade cutting paper (wet and dry from Halfords) used dry, rubbing out the scratch marks around the control knobs. The new tin of varnish is quite thin and didn't require any further thinning and I then applied a liberal coat to the front panel with the cabinet on its back to avoid any sagging or runs, this coat was left to harden for 3 days.

As the veneer was very smooth to start with the coat of varnish was reasonably flat and was just lightly rubbed with 1000 grade to remove the nibs and give the next coat a key. The second coat was applied and also left to harden for 3 days.

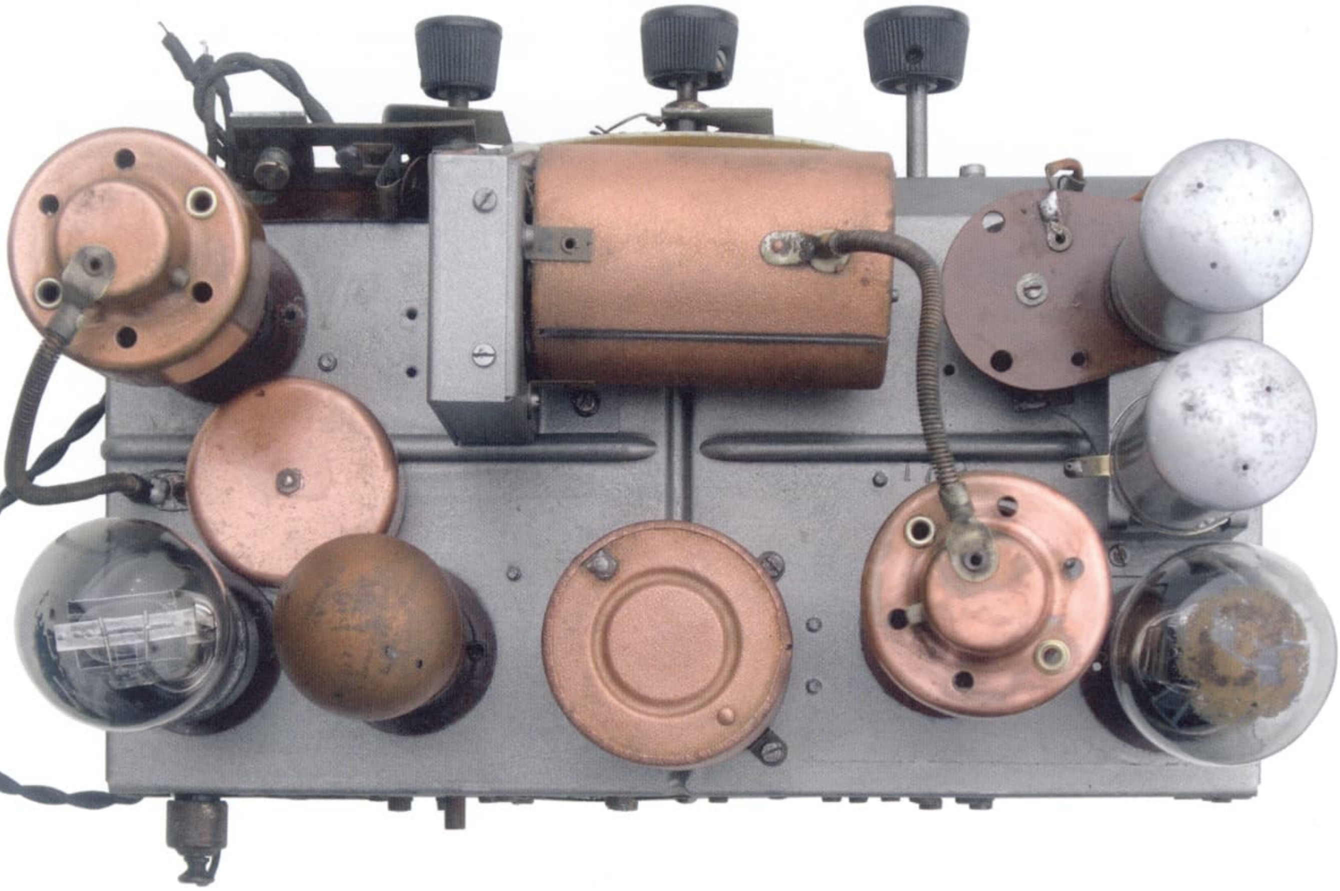
Looking across the surface, the brush lines and dimple effect, small variations in the thickness of varnish were quite visible. These were removed with 1000 grade cutting paper, used wet now that the wood is sealed. This stops the cutting paper clogging, removes the heat due to friction and lubricates the surface allowing a greater pressure to be applied without tearing or scuffing the still relatively plastic new surface.

Having two reasonably thick coats of lacquer the brush lines can be rubbed down without fear of rubbing back to bare wood or even through the very thin veneer. Then after cleaning and drying, third and forth coats applied in the same manner to regain the thickness of the lacquer. Again each coat left to harden for three days, then cut back through the grades of wet and dry cutting paper to remove the brush lines. This time now that I've built up a reasonable thickness of varnish and a bit more confidence, I started with 600 grade to speed up the process. After using 1000, then 1500 grade, the brush lines and undulations are now gone, with a lacquer finish about the same thickness as original. A final rub over with Brasso to give it a bit of lustre, followed with a squirt of ordinary furniture polish, and this had achieved the desired glass flat finish I was looking for. I was very happy with the result, in fact I was so pleased with it I considered re-polishing the rest of the cabinet as the front panel is now much better than my already restored set and I had considered this to be very good.

The dark stain on right hand side of the set had semi-soaked into the wood and there are quite a few deep scratches made by the previous restorers use of very coarse sand paper. Along side the very uneven surface of the wood, the top and left hand side were just raw plywood and there was a cigarette burn on the top. This was one of the worst cases

The Smoothing capacitor end plug with new capacitor

The Re-assembled Smoothing capacitor showing the negative wire



I've seen and is going to be quite a challenge.

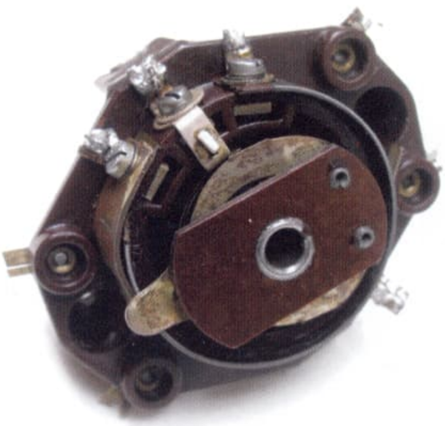
I started on the worst side and cut through the dark stain and deep scratches with 120 grade cutting paper. The plywood laminates were quite thick and much thicker than any veneer, I managed to do this without cutting through the top layer, then changed to 320 grade cutting paper to get the plywood surface flat, and then flattened the top and left side. This followed with 600 grade, no point in going any finer on this relatively coarse plywood, I have now got the top and sides in a state good enough to continue.

The bare plywood was very light in colour so the next stage was to stain it to approximately the same hue as the front. Ronseal medium oak wood stain was a reasonably good match. I then proceeded with the multiple layers of lacquer and rubbing down, using the same procedure I had done originally with the front panel, keeping the cutting paper flat to the surface, avoiding sanding round the edge between the front and sides as concentration on the corner may rub through the lacquer to the bare wood.

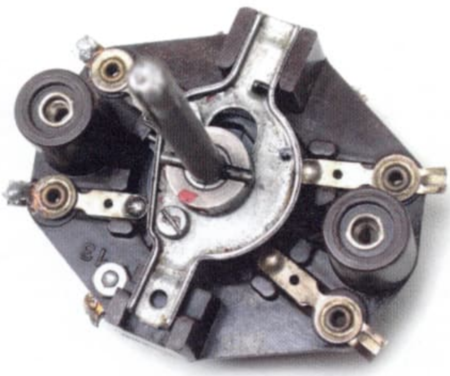
I was very pleased with the end result, there were a few very minor anomalies in the sides and a small shallow dip in the top where I had removed a cigarette burn but you had to look hard for them. I had achieved my objective and got my glass flat finish. Doing the front and sides separately worked very well giving the advantage of manoeuvrability and avoided biting off more than you can chew as when doing the whole set at once. Despite taking a considerable amount of time, it was well worth the effort.

I continued with the rest of the cabinet furniture. The brass and enamel Philips badge was removed from the tuning escutcheon, this was done by drilling a small hole (1mm) through the Bakelite from behind and pushing it out with a piece of stiff wire. It was polished with Brasso and then sprayed with acrylic lacquer. The tuning escutcheon and knobs were cleaned, the knob flutes cleaned out with a fine brass wire brush and then polished with Brasso. The Philips badge was replaced back in the escutcheon, glued in place with Evostick impact adhesive. The tuning escutcheon and speaker baffle were placed back in the cabinet, and the speaker cloth had only required a good vacuum cleaning. This set now looks very good, one of the best I've seen and I'm now considering swapping the chassis from the other set into this one.

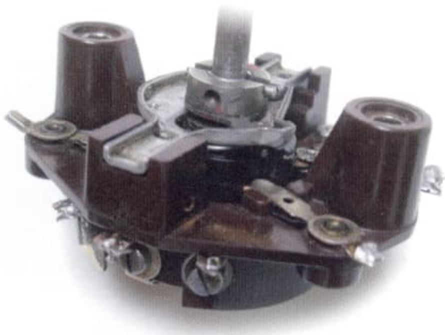
The finished cabinet was now put on one side I'll see if I can rescue the chassis. First I removed the remaining valves and gave it a good vacuum cleaning, this removed some of the leaked electrolyte which had rusted and crusted. I then removed the smoothing capacitor assembly complete with its smoothing choke, removing the four retaining screws and de-soldered the wires. Next I removed the copper tuning cans, one vertical and the other horizontal. The horizontal can is mounted on a tower made from two pieces of folded steel plate, the back plate and its two retaining screws were removed giving access to the connecting wires which I then mapped. I also took a digital photo for good measure and de-soldered, then removed the can and the rest of the tower. This was screwed together and was "Meccano" easy. The vertical tuning can is held on with three screws on top of the chassis. Its connecting wires were de-soldered under



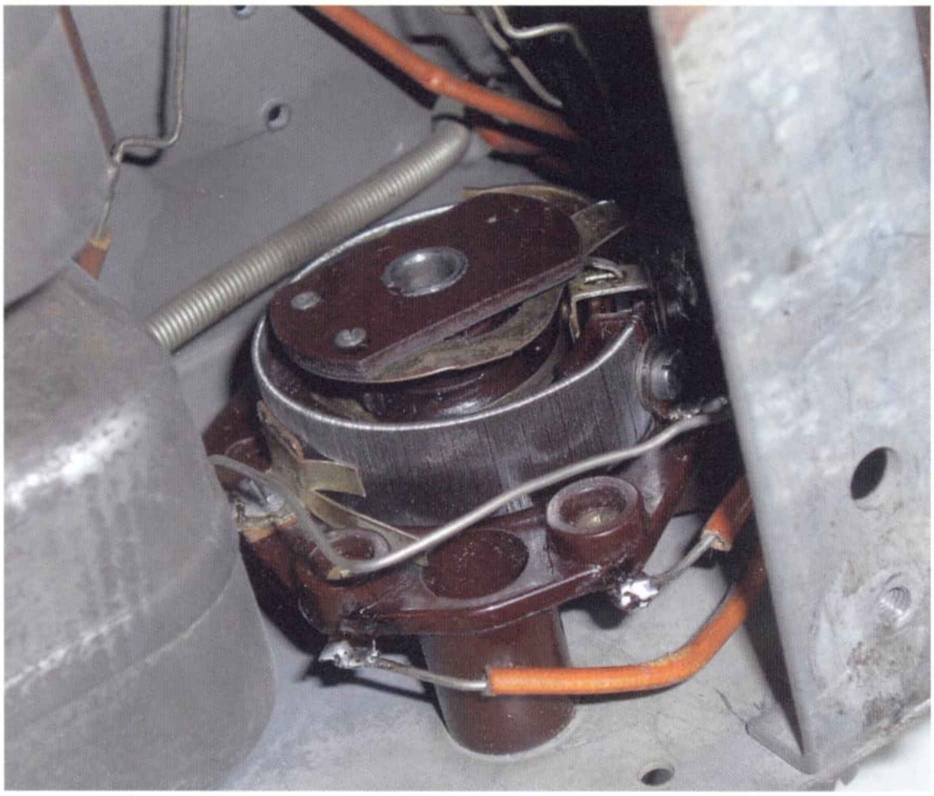
The volume control with a new track



The on/off switch



The on/off central rotor and pincer contacts



Above: The hollow resistor R8 2M

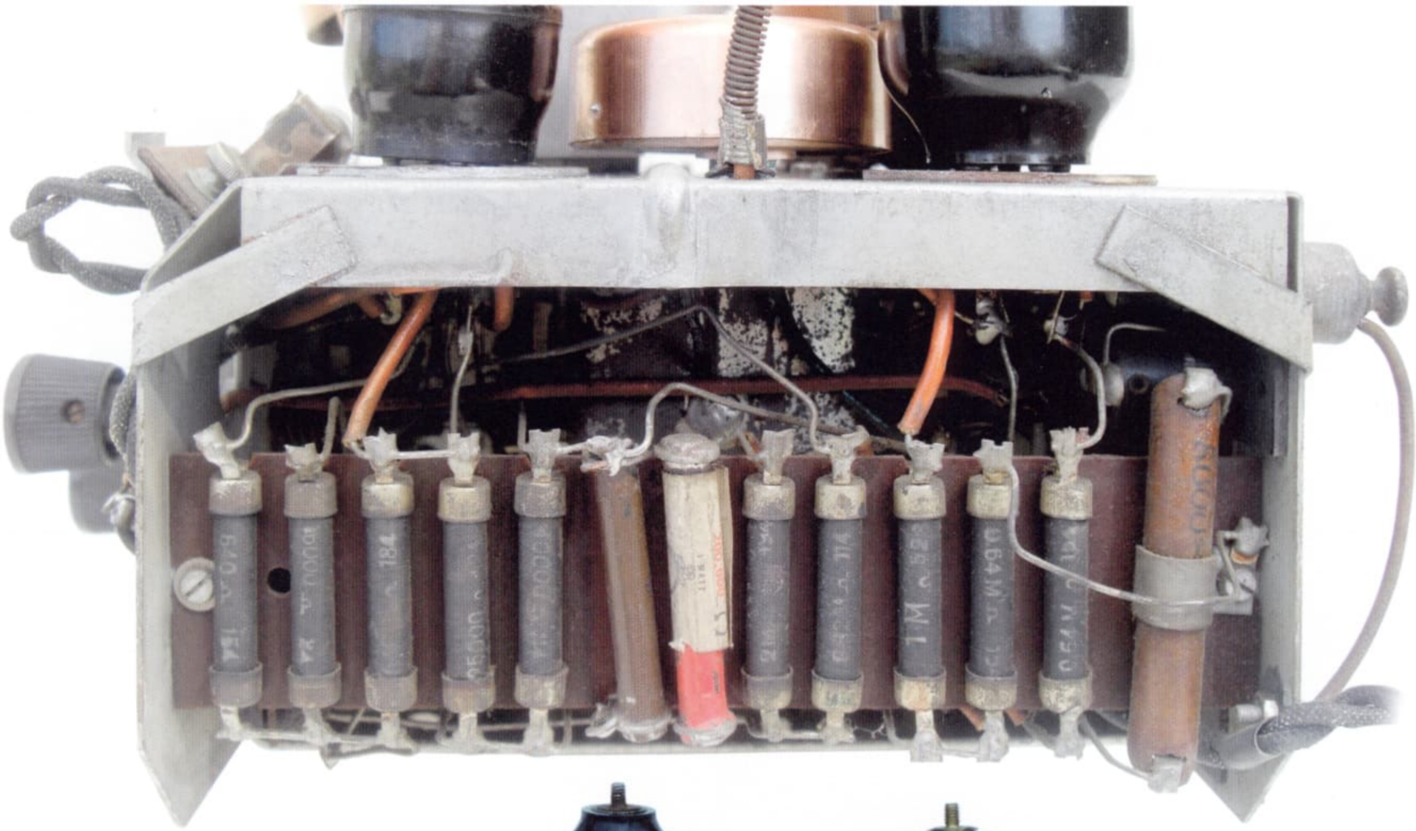
Left: The volume control switch back in the chassis

the chassis, and finally the semi-aperiodic coil assembly S13 and 14. By removing the single nut and threaded rod the copper cover was removed and the coil former and connecting wires masked ready for cleaning and painting. The top of the chassis wass now empty and fully exposed, and this made scraping off and wire brushing the rust and crusted electrolyte quite easy. This was then treated with "Kurust". The valve holders and screened top-cap wires were masked off, the component holes blanked off with crumpled newspaper stuffed in from under the chassis, and the top of the chassis then sprayed with primer and a single light top coat of Plasti-kote Pewter. This is the nearest I can get to match the original cadmium flashing.

Other than a small patch of rust on the front, the rest of the chassis was ok and was left alone. The tuning dial disc was removed and cleaned, and the dial lamp, its holder and control spindles were scrubbed with a soft fine brass wire brush to remove the very light rust and verdigris.

Everything under the chassis was original and untouched and looked in good order. The large smooth copper valve top-caps were cleaned and polished with Brasso, and the crackle finish copper tuning cans with Vim scouring powder. This was dampened into a soft paste and a cut down stiff paint brush used to reach any recessed bits then washed off with water. The tuning cans were then dried and refitted to the chassis. The smoothing capacitors were tackled next, these were removed from their bracket, the bracket de-rusted and treated as the chassis. The paxolin end plates of the smoothing choke were scrubbed off with a soft brass wire brush. The rolled–over edge of the smoothing capacitor can was removed with a small pair of tin shears flush with the bottom of the Bakelite end plugs. The nuts were replaced on the end plugs to protect the threads, the end plugs then placed in a vice and the can pulled free. This was quite difficult as the seals were still intact and I was surprised that one of them had leaked. The remaining very smelly electrolyte was then tipped out and the cans washed out and the outsides cleaned with Vim. The remainder of the capacitor aluminium "+" plate was removed and its threaded rod was drilled out and replaced with a new threaded rod. A small hole (1mm) drilled through the Bakelite end plug for the new smoothing capacitor negative wire. The new smoothing capacitor was then fitted, and the negative wire encircled the face of the end plug for connection with the negative tag washer. The can was then glued back on to the end plug, I used Evostick impact adhesive so the can could be pulled free if required in the future. The smoothing capacitor assembly re-assembled and returned to the chassis.

The next step was a run round with the AVO and all appeared ok. A set of valves was required, The line up is, V1 MM4V, V2 S4VB, V3 994V audio triode, V4 PM24A output pentode, and a 1821 full wave rectifier. The output and rectifier valves were missing, and of the remaining valves the only recognisable one was the 994V audio triode on the valve tester, this read a bit low but was functional. Unfortunately I had none of this line up in stock, so I had to make do with equivalents. In the V1 position, the first RF valve, there was a metallised B5 valve devoid of a large



The resistor tag strip

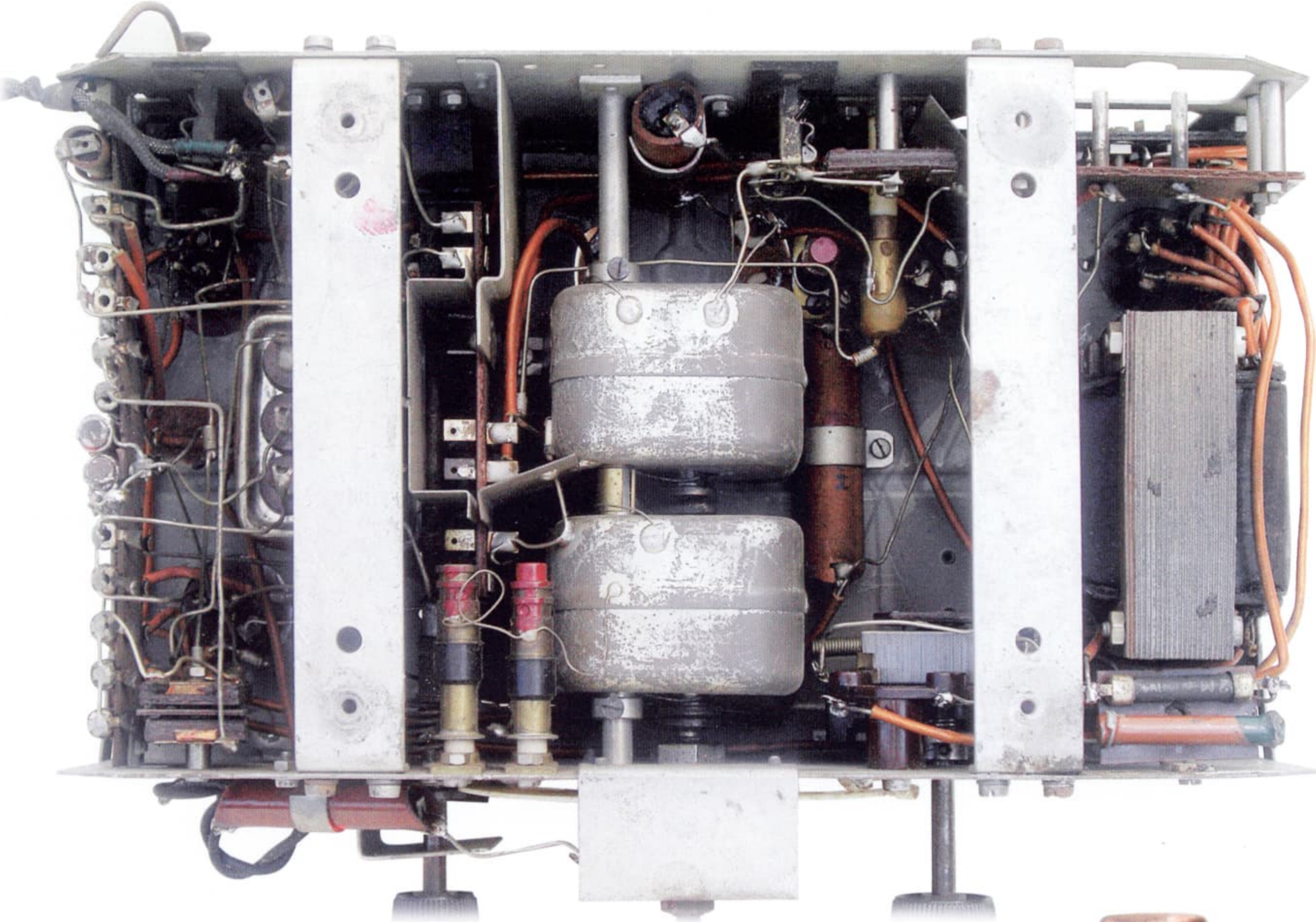
The original dial lamp

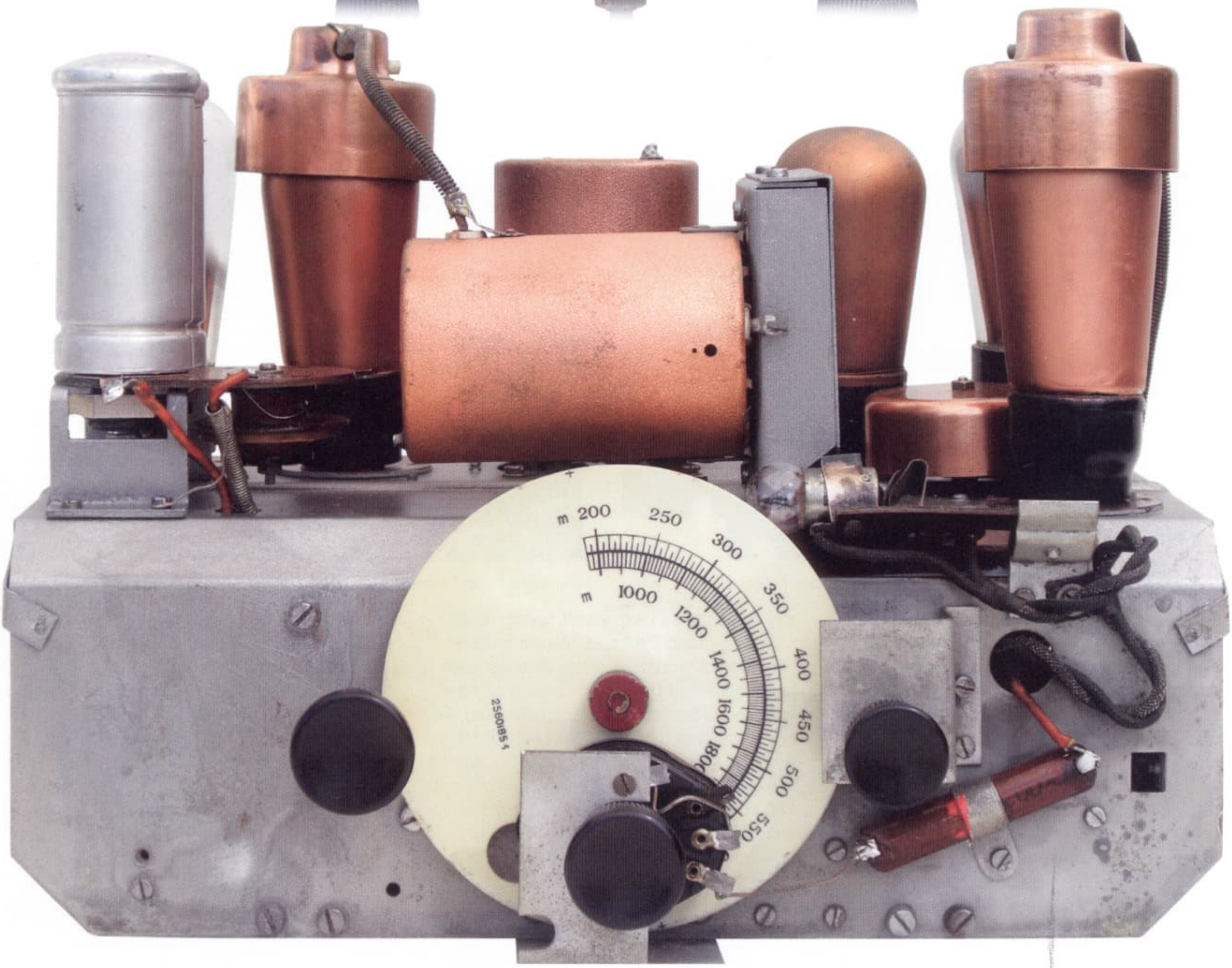
The first RF valve as fitted

One of the re-sprayed Valves with a new water slide transfer

percentage of its grey metallising and no trace left of any number. It looked about the right shape and type so was tested to the spec of a MM4V on the valve tester and it fitted the spec exactly. I removed the remainder of the metallising, masked it off and sprayed it with "Plasti-kote" copper paint. This was a very good colour match to the correct RF valve in the other set. The copper paint probably wouldn't serve as a good screen but I have found in the past many valves working where the metallising has fallen off without making much difference in performance, especially these days where most interference sources are very well RFI screened.

The next RF valve V2 was an AC/SG, a non metallised valve, again I tested this to the spec of the S4VB and again it matched exactly. It was the same shape as the valve in the other set so it too got sprayed with copper paint. These two unmarked valves were furnished with a number label copied and reproduced from the other set. These were made into water slide transfers and this finished them off nicely. Next, replacements were required for the missing output and rectifier valves. In my box of unmarked valves I found a B5 output valve of the right bulbous shape as the correct valve in the other set. The bulb was just slightly smaller, but its internal construction looked about the same so once again it was tested to the spec of a PM24A and was a very good match. I couldn't believe I got lucky three times on the trot. The final valve V5 the 1821 rectifier, is a standard B4, 4 volt rectifier. I have




m 200
250
300
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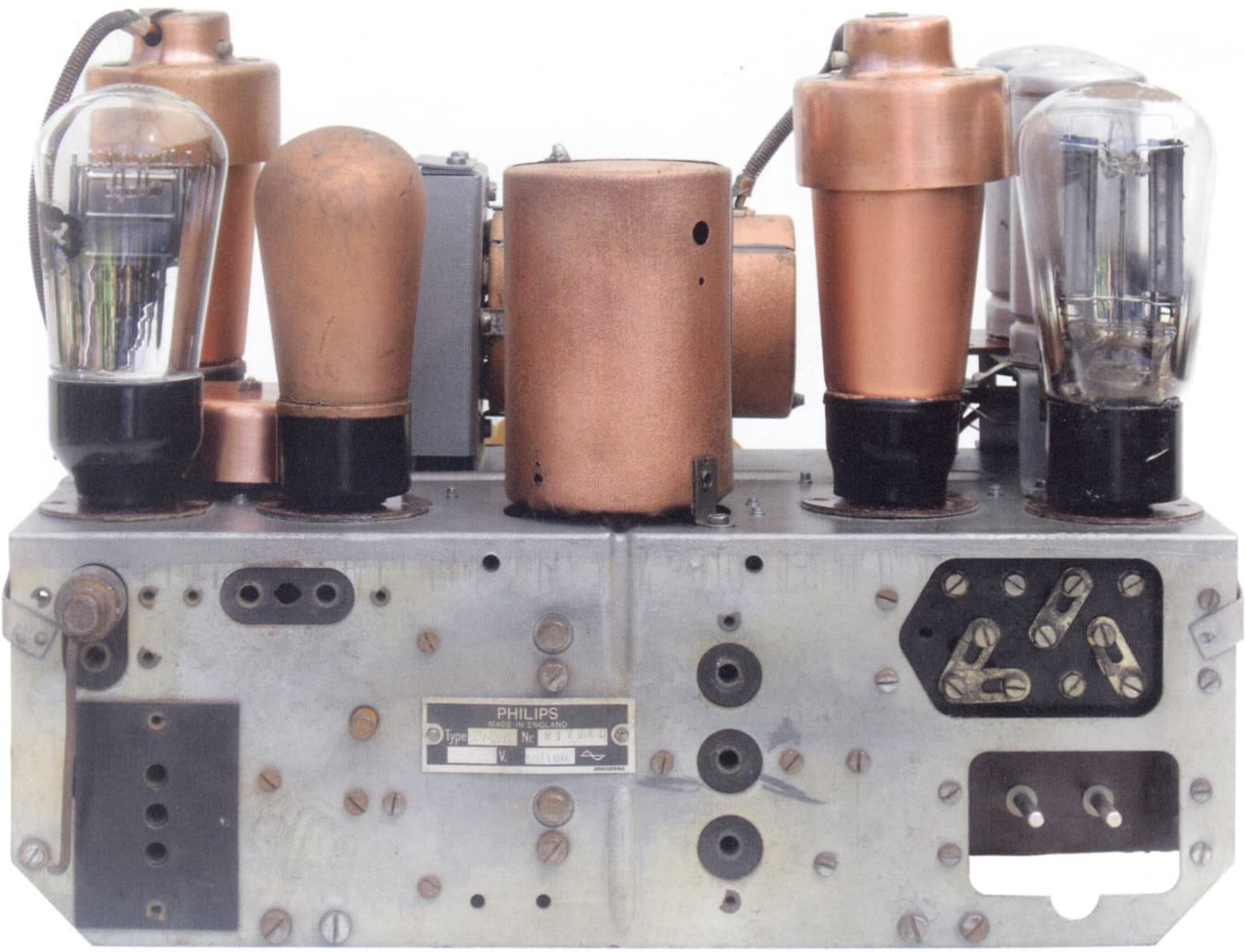
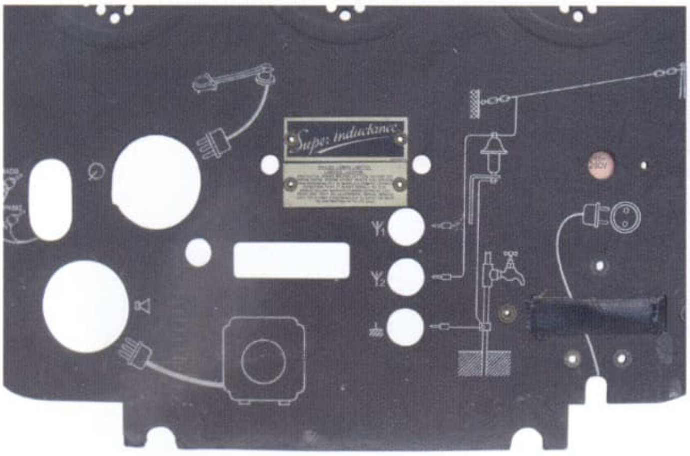
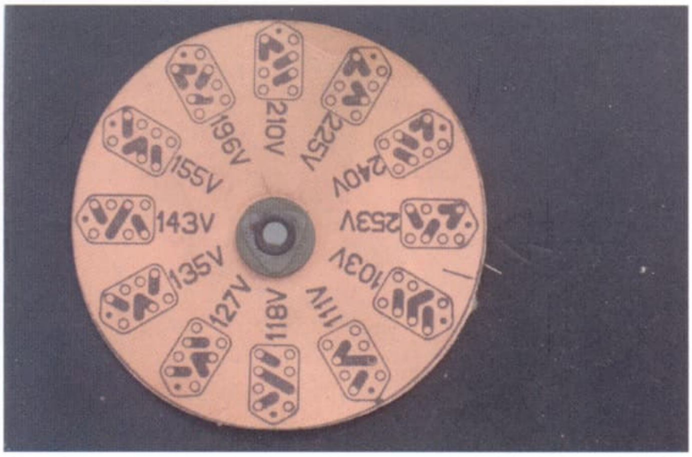
m 1000
1200
1400
1600





The back of the wireless with aerial, earth and mains voltage indicator



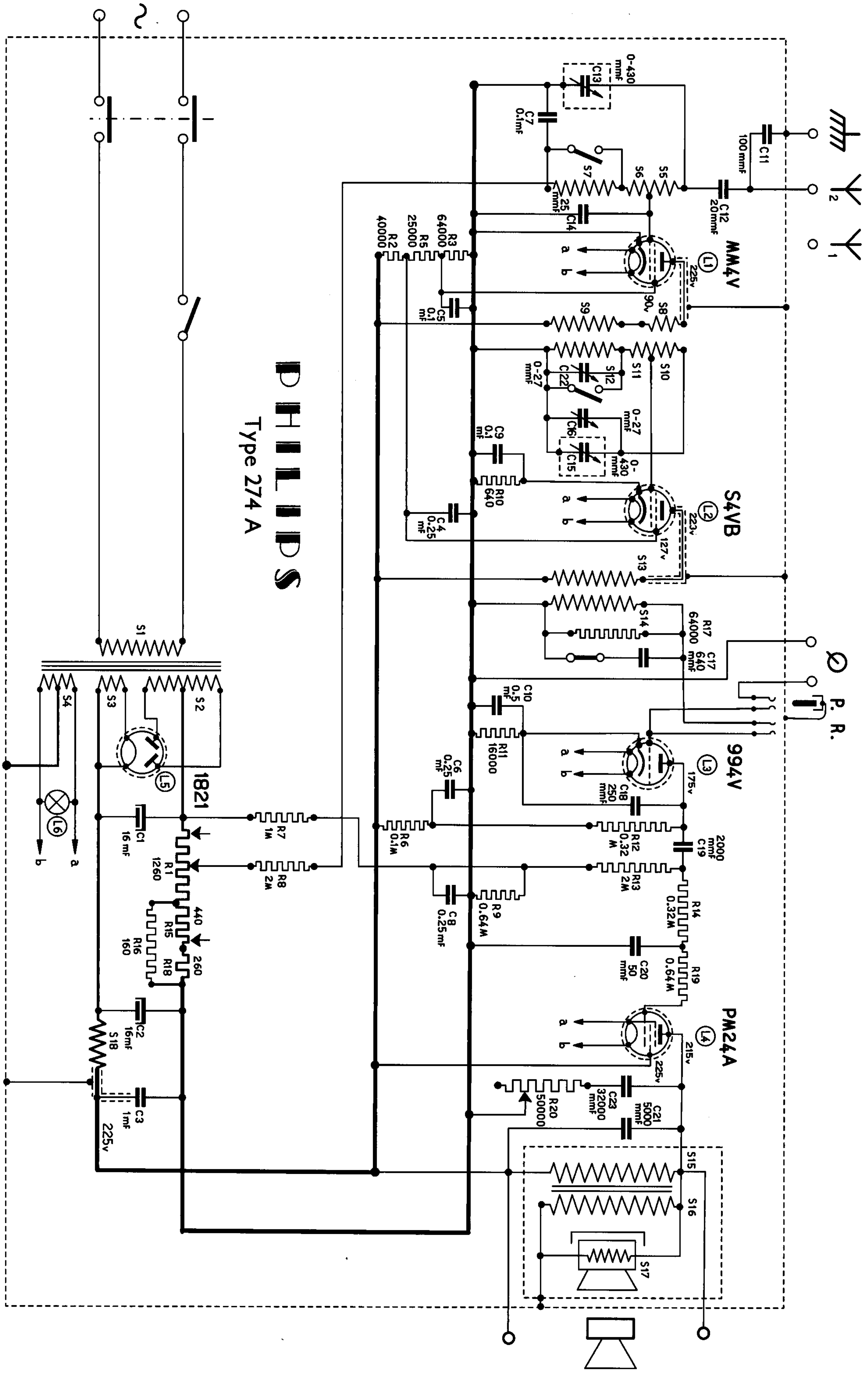
The mains voltage chart

several equivalents of these. The one used was also devoid of a number but had the right bulbous shape and tested to spec ok.

The next step was to apply some power. The first problem encountered was the on/off switch was stuck in the "On" position, it checked out ok electrically so I left it until later. The chassis was connected to my bench high impedance speaker and fired up, the dial light came on and the set came to life. The dial light in this set looks like the original as it's a Philips bulb, an MBC 6 volt car side light bulb. It's being under run at 4 volts so I expect it'll last for ever.

Tuning round the band, the set seemed very lively although all of the stations were just a very loud broken up rasping and the volume control had no effect. I checked the HT, it was less than 150 volts. I checked the HT "-" bias line on the ground isolated negative side of C1, this was around minus 150 volts. This looked like the HT minus chain of resistors R1, 15, 16 or 18, the volume control, are open circuit. This proved to be the case, and the volume control on/off switch was removed. The volume track is a wire wound pot with a centre tap, and according to the circuit diagram this bunch of resistors adds up to around 2k. On removing and checking, the track was found to be open circuit in two places, one break right next to the spring centre tap contact. I attempted to unwind a few turns but the wire looked very brittle and just broke up. The other side of this bakelite moulding is the on/off switch.

The whole thing was dismantled, and the on/off switch was un-jammed and lightly greased. A new volume track was robbed from a 2k Colvern wire wound pot from stock.


PHILIPS
Type 274 A
MM4V
S4VB
994V
PM24A
1821
P. R.
C11 100 mmF
C12 20 mmF
C13 0-430 mmF
C7 0.1 mF
C14 25 mmF
R3 64000
R5 25000
R2 40000
C5 0.1 mF
C22 0-27 mmF
C16 0-27 mmF
C15 0-430 mmF
C9 0.1 mF
R10 640
C4 0.25 mF
R17 64000
C17 640 mmF
C10 0.5 mF
R11 16000
C18 250 mmF
C6 0.25 mF
R6 0.1 M
R12 0.32 M
C19 2000 mmF
R13 2 M
R14 0.32 M
C8 0.25 mF
R9 0.64 M
C20 50 mmF
R19 0.64 M
R7 1 M
R8 2 M
C1 16 mF
R1 1260
R15 440
R16 160
R18 260
C2 16 mF
C3 1 mF
C23 32000 mmF
C21 5000 mmF
R20 50000
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
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223v
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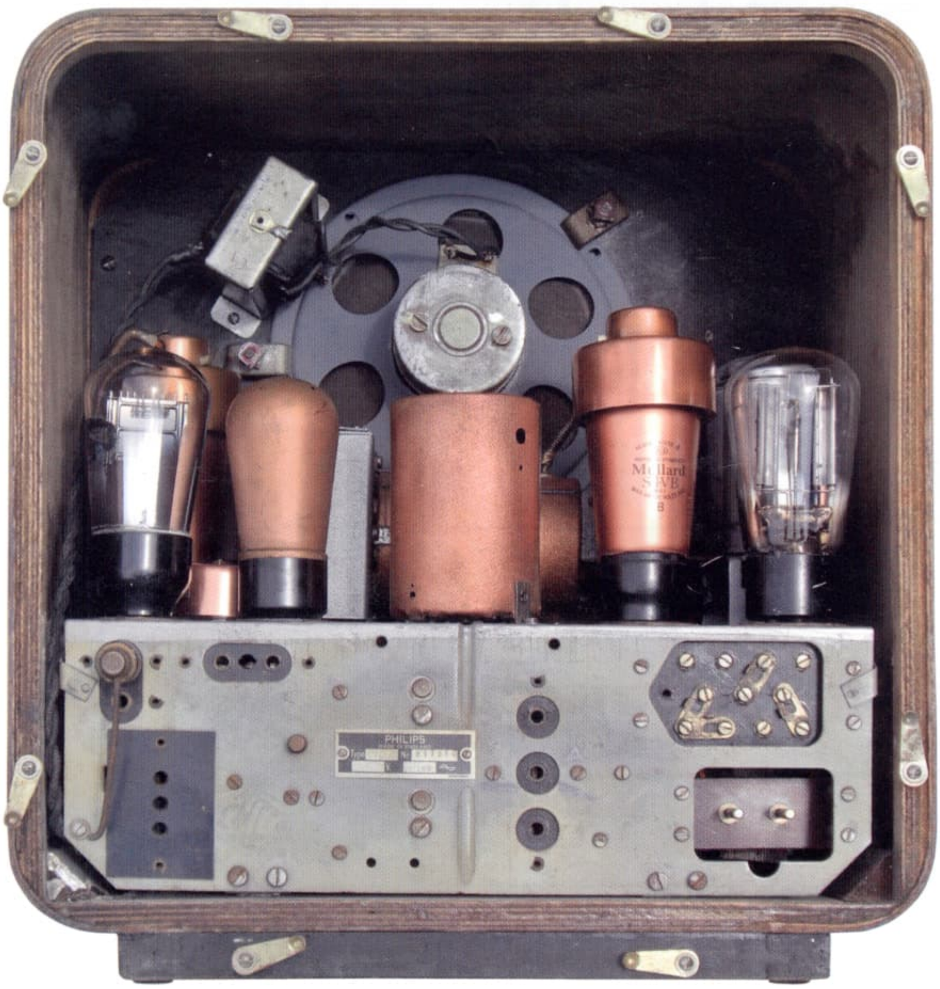
175v
215v
225v
225v



I've pulled this trick a few times before and it works very well. I have a good stock of Colvern pots gathered over the years and its nice to find a good use for them. The new track was a slightly smaller diameter than the original and about 10mm too short, so I fitted a piece of shaped brass plate from the junk box to bridge the gap. This is at the "off" end of the track so is not noticed, and it also stops the wiper dropping off and locking behind the end of the track.

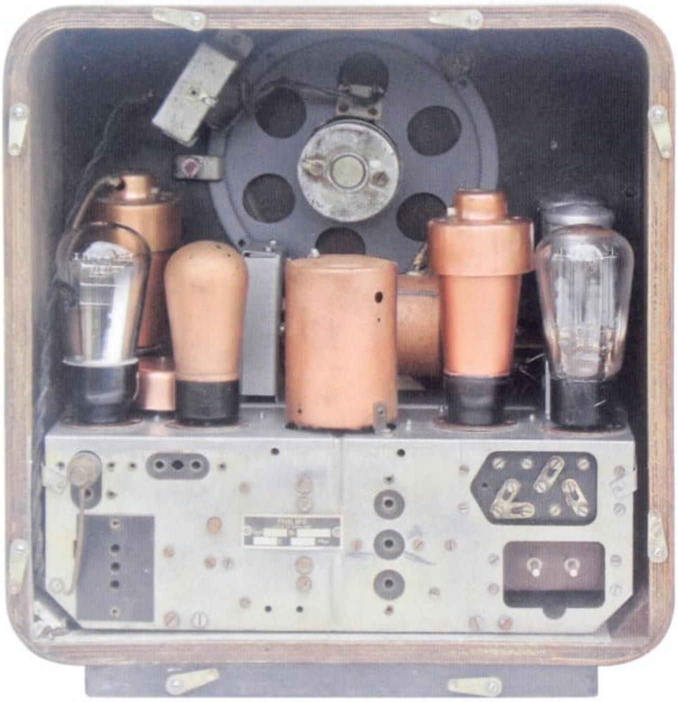
There was only one tap, so R18 appears not to exist and R16 bridges the bottom half of the track to effect a semi-log function. While the pot was out I checked R16, 160 ohms, and this was also open circuit. When I removed it the end fell off. I had a very similar resistor in stock and replaced it. The assembly was refitted back in the chassis and the set fired up again.

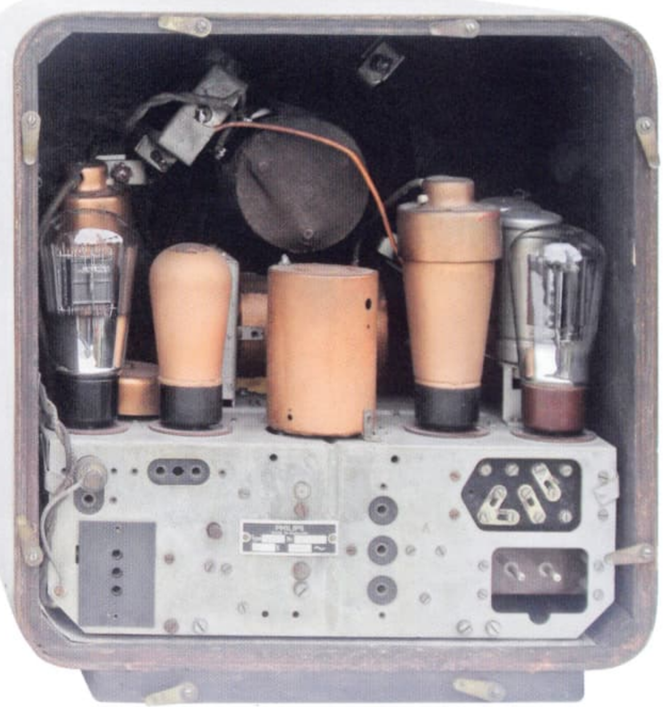
The HT rail now read around 30 volts, 30 volts over 2k equals an HT of 15 m/A about what I would expect. The output still very loud and now only distorted, the volume control still had no effect and I discovered the tone control acts as a volume control and reduces the volume to cut off.

The tone control capacitor C23 0.03uf proved to be short circuit. This was easily replaced inside the paxolin tube of the original. I then measured the voltage on the V1 grid end of R8 2M, this read 0 volts. Disconnected on test R8 proved to be open circuit, this was easily remedied as R8 is a hollow carbon tube and all I needed to do is fit a modern eighth watt resistor through the middle of the original. On power up the volume control still has no effect, and no negative voltage reaching the first RF valve grid. This proved to be C7 0.1uf the RF grid bias decoupling capacitor being short circuit, and again a new capacitor was fitted into the emptied paxolin tube of the original.

The set now worked well and the distortion was due to my 75 ft garden aerial over-loading the first RF stage as it was plugged into the high sensitivity aerial socket.

During this fault finding the on/off switch had jammed "on" again and required a little deeper investigation. You could feel the spring loading but it wouldn't flip over. The volume control on/off switch was removed again, and the centre rotor appeared to be





jammed. Prised with a small screwdriver it snapped free again and now appeared to work ok, I was not prepared to return it to the set until I had found a reason for this intermittent jamming. Working it over several operations it would occasionally jam, and I eventually discovered that the centre rotor would overshoot and the knife contact blade would jam behind the pincer contact. The leading edge of the knife contact had a bevelled edge to part the pincer contact but the back edge was flat and on the overshoot return would hit and jam up against one half of the pincer contact. I considered bevelling the trailing edge of the knife contacts, but this would reduce its area so I remedied this problem by drilling and tapping an 10 BA hole in the bakelite moulding and fitting small brass block to stop up against the actuating lug checking the over shoot. This little mod seemed to do the trick (and is out of sight) so the assembly was placed back in the chassis.

The final job was to re-draw the circuit diagram filling in the component values and recorded voltages. While measuring its vitals I noticed the HT was a little high at 275 volts and required the mains input selection checking. There's a rather elaborate mains input selector panel on the back panel of the chassis with multiple linkages. I could find no reference to this in the manufacturers manual, on the back or inside the cabinet. I had definitely seen a chart somewhere but at this point couldn't find it. It eventually turned up on the back of the voltage indicator disc on the inside of the set back. This is quite small and easily missed and I was surprised it wasn't repeated somewhere more obvious. I find my mains voltage is always high, often over 250 volts so the mains selector was set to the highest range 246 - 260 volts, and this gave an HT of around 250 volts.

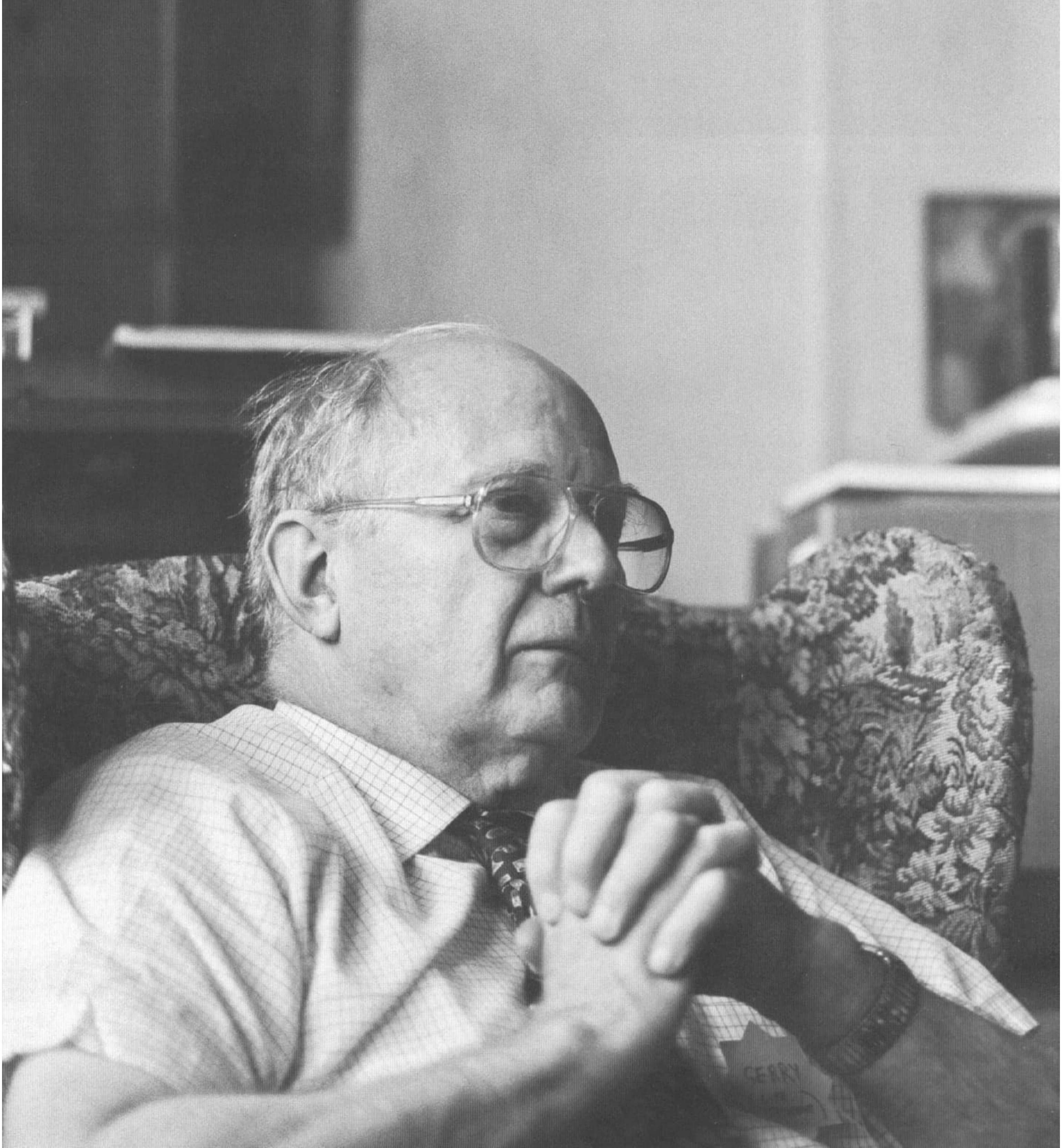
On re-assembling the set back in its cabinet, I discovered the similar Philips 6$^{1}/_{2}$" speaker that I had purchased was a little larger than the original and wouldn't fit inside the three retaining studs. On re-measuring I found that the original speaker was 6$^{1}/_{2}$" overall diameter and the one purchased had a 6$^{1}/_{2}$" cone and was 7" overall diameter, so the set was fitted with a similar speaker of the same period. I won't pursue the correct type for this much restored set.

I quite like this nice looking smaller set of the Superinductance range and have been looking out for one since first seeing it on the front cover of Radio! Radio! and I now have two of them. They both perform very well with a good tone and this second set was very interesting to restore.

Gerry Wells 1929–2014

by Dr Anthony Constable

It was very sad to hear of the death of Gerry Wells on 22nd December 2014 at the age of 85. Gerry was for many years one of the most outstanding members of the BVWS. His home on Rosendale Road in Dulwich became very well known to many of us from 1976 onwards and it later became the location for the annual BVWS garden party. The first garden party gathering took place in 1984 when members of BVWS, the American Wireless Association (AWA), together with representatives from Sweden, Germany, Holland and Switzerland occupied Gerry's house, his garden, his workshops and his museum displays for that most memorable international occasion.



Gerry reading quiz answers at his garden party, West Dulwich, June 2001

Gerry manning the radio shop at the museum, 2002


Gerry in his garden, West Dulwich, 2002


Hosting a visit by the Duke of Gloucester to the BVWTM on the15th March 2012

I first met Gerry when visiting the Antique & Collectors Fair at Alexandra Palace in 1976 with Norman Jackson, Rupert Loftus Brigham and my son Martin. At that time I was very impressed to hear Gerry talking about vintage radio so well that I promptly made arrangements to visit him at his house in Dulwich. His interest in the subject was far more than a mere hobby interest. He had, for many years prior to 1976, pursued a radio business where we could buy and sell various radio sets and where he could restore and rent out TV sets. By 1976 he had also become very interested in the history of radio and had already accumulated a large number of very old well-displayed radio sets. He had the idea of forming a Vintage Wireless Company in 1973 and it was established as such in 1976. His house and company also incorporated what became called 'The Vintage Wireless Museum' which later became the "British Vintage Wireless and Television Museum".

He always helped us collectors to understand how best to restore sets to a working condition and to a well-honed appearance. Gerry and his museum style home soon became of special interest to those of us who were running the BVWS and we were happy that he joined the society in 1978. His house not only functioned as a hugely well stocked workshop and museum, it also provided good

Gerry in repose in his workshop, 2002

Gerry with his new Ford 300E van, 1954

Alan G Carter, Gerry, and Eileen, January 5th 1996

Gerry and Jonathan Hill, garden party, Dulwich 1980s

facilities for the BVWS to hold committee meetings there as often as we wished. Soon after Gerry joined us at BVWS he became the secretary of the society. On arriving at his house we were always inundated with cups of tea which were mostly prepared on arrival by his young friend Eileen who had known Gerry since she was 12, and who became a tower of strength at Rosendale Road. She wrote a wonderful tribute to Gerry which was printed as part of his funeral service on Tuesday 6th January 2015. And, no matter how busy Gerry was, he never failed to discuss with us any topic that was relevant to radio and television history and he also demonstrated such devices as a 625/405 device for converting the newer 625 line TV images to 405 versions for visualising on old TV sets. He also never failed to provide us with craftsman like advice on how to make a really good effort to carry out complex cabinet repairs and genuine restorations.

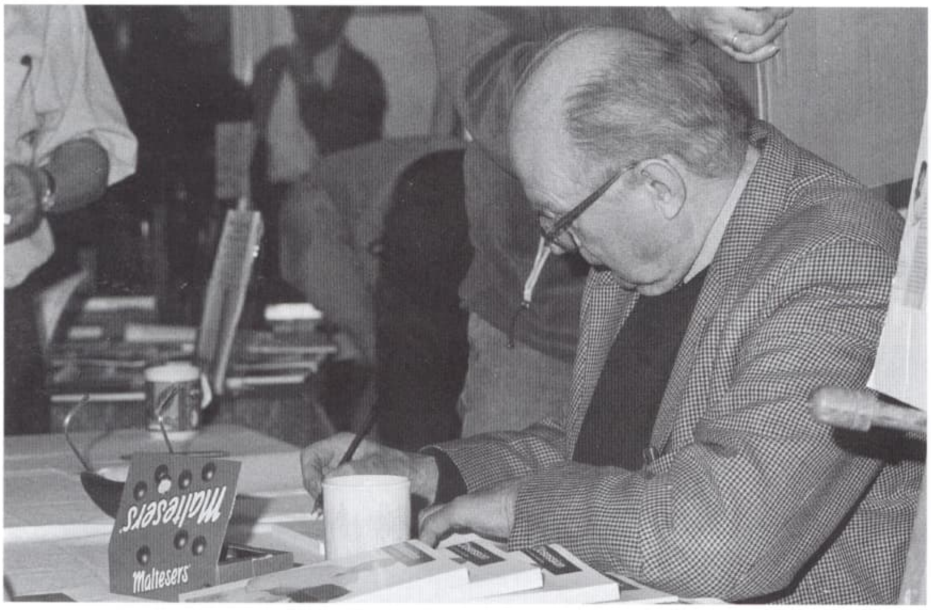
After meeting Gerry Wells at Alexandra Palace in 1976 we all became good friends with this charming man who was so well able to encourage personal friendships. David Read often used to have supper with him in local cafés and has vivid memories of going out with him in his van to deliver (or collect) his own restored wooden cabinet TVs to his rental customers. This often took place after dark and one trip David remembers well was way out to Greenwich. This showed that his rental business did not only apply to his nearby neighbours.

Jonathan Hill was very impressed with Gerry Wells and recently described his friendship thus, "I had the pleasure of knowing this kind and gentle man for nearly 40 years - I've never known him lose his temper with anyone - except with himself, and this usually involved electric shocks or a hot soldering iron! He was always welcoming to visitors arriving to see him at Rosendale Road - one of his many 'Gerryisms' was: 'I welcome anyone here - from knobs to nobility'. He was always the same, always steadfast - always Gerry."

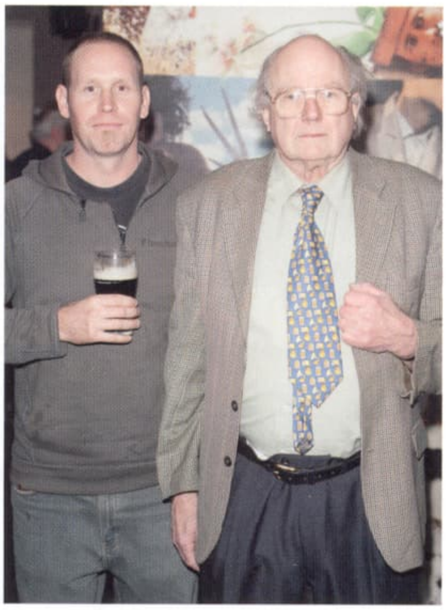
We will continue to have very good memories of such a unique vintage wireless character but at the present time we cannot avoid thinking of his recent death with great sadness.

Gerry making a speech at Harpenden

Gerry with an HMV chassis, November 1995



Gerry signing copies of his autobiography 'Obsession', Harpenden 2002



Gerry with Simon Pattison, Director of 'Valveman'

BVWS Committee meeting 1988. Pat Leggatt, Tony Constable, Ian Higginbottom, Alan Carter, Gerry

Eastbourne 1954

A 120V AC Power Supply Unit

by Stef Niewiadomski

I've been restoring a number of US midget radios recently and I was powering them from an auto-transformer and US-style mains socket in a fairly untidy pile on my bench. I finally got round to tidying this up, and building a neat unit in a box, fitted with fuses and a voltmeter monitoring the output voltage. Typically these midget radios consume about 30W from the US mains: the unit described here is capable of supplying much more power than this, which depends very much on the rating of the auto-transformer used. Figure 1 shows a photo of the completed unit.

Figure 1: Front view of the completed power supply.

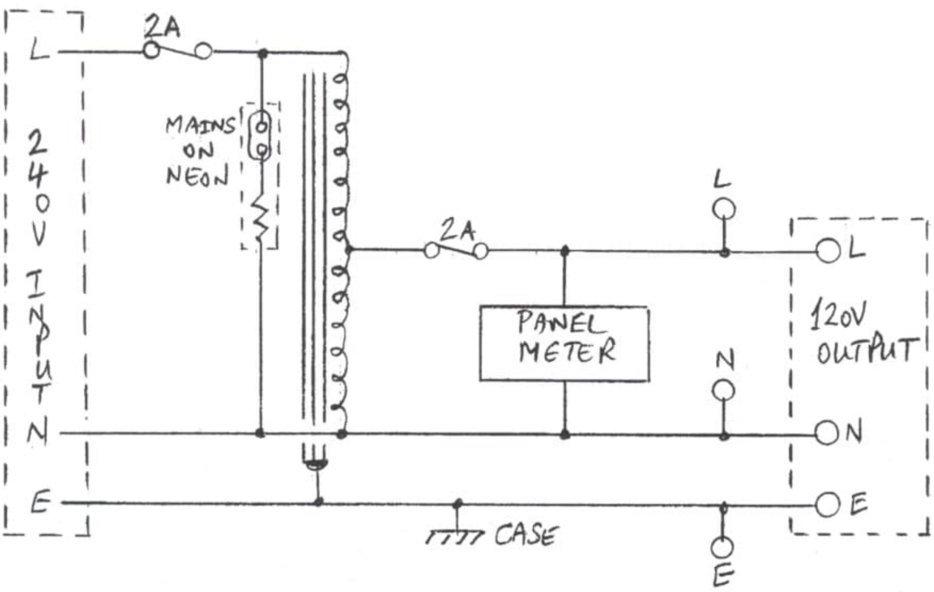


Figure 2: Schematic of the power supply unit.

Mains Voltage and Frequency

I'll refer to the UK mains voltage as 230V: by law, it is allowed to vary by -6% to +10% of 230V, which works out at 216V – 253V. Historically, and rather confusingly, the US mains voltage has been specified as being 110V, 115V, 117V and 120V. Today the US mains voltage is specified at 120V -5% to +5%, that is 114V - 126V. Older radios are very tolerant of mains voltage, especially at the lower end: I've seen US-manufactured radios which specify their operating voltage down to 95V, and I would expect that they would continue to work at even lower voltages, though with reduced performance.

The UK mains comes at a frequency of 50Hz (with a much tighter tolerance than the voltage level), whereas the US mains has a frequency of 60Hz. In theory it would be possible to design a power supply that generated 60Hz, but it practice it makes very little difference if you supply 50Hz to a radio designed for 60Hz. If it's a clock radio, don't be surprised if it shows the wrong time!

Schematic

Figure 2 shows the schematic of the unit. The 230V AC input feeds the primary of the 230V-to-120V auto-transformer and a neon power-on indicator, via a 2A slow-blow (to allow for the high inrush current of the transformer's winding) fuse. The transformer I used had 220V, 230V and 240V taps on its input, and I used the 240V one. Note that an auto-transformer has a single, tapped winding and as such does not provide isolation of its output from its input. The neutral of the UK mains input is connected to the neutral of the output, and if you connect its input the wrong way round, then the output you expected to be neutral will now be live.

The output voltage from the auto-transformer is displayed on a 3-digit panel-mounted AC digital voltmeter. This voltmeter, displaying on 0.56-inch red LEDs, may seem like a luxury, but these units are very cheap on eBay (only £2.64, including postage, from China of course). The one I used is specified to display voltages between 60V and 500V AC, and has the neat feature that it derives its power from the AC voltage being monitored, so it's as easy to use as an analogue meter, and probably cheaper. In reality the voltmeter I used worked down to about 50V. The only slight inconvenience is that a rectangular slot (72mm by 40mm for this particular meter) needs to be cut into the front panel, and this takes a little time and patience to get a neat finish.

The 120V output appears on a US-style socket – actually a pair of these on my unit - and I also brought the output live and neutral connections, and mains earth, to 4mm terminal post connectors on the front panel. The colours used (live – black; neutral – white; earth – green) may seem strange, but these are the standard mains wiring colours used in the US. Make sure you label these to avoid confusion when you've forgotten what the colours mean. This allows a radio without a mains plug to be powered, and also permits an external voltmeter to be connected if desired. This is handy to ensure that the live and neutral connectors are indeed connected correctly, and not the opposite way round.

I did not use any switches on the input or output of the unit. I tend not to trust switches where the mains is concerned, and always switch off and unplug at the mains socket before making any modifications to a radio being tested.

Auto-Transformer and Case

You can often find second-hand auto-transformers at BVWS meetings and radio rallies at very reasonable prices. I used a hefty RadioSpares 500VA auto-transformer, which I bought for £1 at the Dunstable Downs radio rally a few years ago. The seller was relieved he didn't have to carry it back to his car! This is very over-rated for the radios I intended to power, and it just about fits into the metal cabinet into which I built the unit. You can also find very compact toroidal mains auto-transformers, but these are not cheap if bought new.

I had a metal cabinet to hand, which was waiting for a project, and at 220mm wide by 160mm deep by 150mm high, it was the ideal size for this unit. I definitely recommend that you use a metal case for the unit, and you ensure that all its metal panels are connected to mains earth.

Make sure you use a grommet where the mains cable enters the rear panel, and a strain-relief arrangement, such as a p-clip cable clamp, to prevent the cable from being accidentally pulled out of the unit.

Output Sockets

Figure 3 shows the way the pins on modern American three-pin sockets are allocated: note that the live and neutral slots are different sizes, the neutral one being slightly bigger. This means that if the correct modern two-pin plug is used, it can only be inserted one way round.

NEMA 1-15 is the standard for two-wire, non-grounding connectors. Two-pin sockets have been prohibited in new buildings in the US since 1962. NEMA 5-15 is the standard for three-wire, grounding connectors, which have been used for all new sockets since 1974. You can look these standards up on Google if you want more information. The socket is normally rated at a maximum current of 15A. The prongs on older two-pin plugs tend to be the same size, and can be inserted either way round. This is typical of the arrangement with most US-manufactured radios: they have to be capable of working either way round when plugged into an AC outlet and be safe to touch, though some have less hum on their audio outputs with the connection the correct way round.

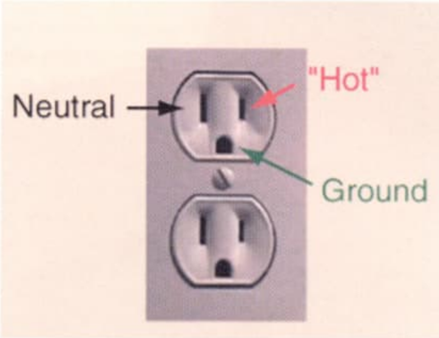


Figure 3: The way the pins on modern American three-pin sockets are allocated.

As you can see from the photograph, I fitted a dual-output US-style socket to the front panel of my unit, with its lead passing through the front panel via a grommeted hole. The dual socket was from an extension lead I picked up from a hardware store when visiting the US recently. I labelled the live outputs, in case I wanted to be sure which way round I had inserted an older plug. Several UK-based vendors, including Maplin, sell various US mains plugs and sockets.

To protect the transformer from possible overloads, I fitted panel-mounted fuse holders for the 230V AC input (on the rear panel) and the 120V AC output (on the front panel). 2A fuses were more than adequate for the loads I was planning to apply. The output voltage can be set to less than 120V by driving the 230V mains input from a variable output transformer. This would allow, for example, the nominally 120V mains input to a radio to be slowly ramped up from zero when powering the radio for the first time in many years.

Summary

I built a neat, safe, fused and metered source of nominally 120V AC for powering US-manufactured radios. By using a second hand auto-transformer and metal cabinet, and a panel-mounted digital AC voltmeter from China, the cost was very reasonable. You can easily adapt the unit to suit an auto-transformer and cabinet you may already have.

A trip down Memory Lane, of 56 years ago by Keith Fishenden

In Project of a Lifetime, I described how an article in the Practical Wireless of April 1958 inspired me to start my career in Electronics Engineering. That article was the start of a series entitled 'A Beginner's Constructional Course – II' written by E V King, that ran up to December 1958 with 'How to Diagnose Faults in the Set' containing test voltages on the valve pins etc.

LIST OF COMPONENTS

Components used for first stage (their function will be explained in the next issue.)
Baking tin or chassis.
Grommets.
Nuts, bolts, soldering tags, push back insulated wire, solder, flux, etc.
V2—SP41 (VR65A) or SP61 (VR65).
Mazda Octal valve base and top cap connector.
MR1—Metal Rectifier, any type rated at 240 v. and 30 mA or more.
C1—500 pF ceramic or mica, 500 v. working.
C7—100 pF ceramic or mica 300 v. working.
C10—.1 μF paper 350 v. working.
C15—100 μF mica or ceramic 500 v. working.
C9—One half of a double electrolytic condenser, 8-8 μF, 350 v. working.
C12 and 13—Another double electrolytic, 16-16 or 32-32 μF 350 v. working.
R4—1 Megohm ½ watt. (Brown, Black, Green.)
R7— ditto. ditto.
R8—470k ½ watt. (Yellow, Violet, Yellow.)
R6—10k ½ watt. (Brown, Black, Orange.)
R11—3k 3 watt. (Orange Black, Red or printed letters.)
TR1—Filament transformer or output transformer used as such. See Text. 240-200 v. to 4 or 6.3 volts.
L1—Wearite PA2 coil.
S1—Single-pole single-way rotary switch with insulated knob.
C5 and C6—Double variable 500 pF condenser fitted with trimmers and a tuning knob (large one or slow motion drive).
Phones fitted with two .05 μF 500 v. condensers as stated in text.

(Note.—The beginner may always use condensers of higher rated voltage than stated and resistors of higher wattage provided there is room for them in the receiver.)

Figure 1: First stage components checklist

So who was Mr E V King, was this a pseudonym? A little bit of research soon revealed that Mr King was a real person. He was a highly respected science teacher at the Sheerwater County Secondary School in Woking, now the Bishop David Brown School. He designed this wireless during the mid to late 1950's. By all accounts he was an exceptional teacher who inspired boys through the Science Club at the school, for third year pupils and above. Mr E V King was a prolific writer for Practical Wireless and other titles and used pseudonyms G K Vine and K Given (anagrams of his real name). It was reported that the school laboratory was stuffed with government surplus equipment, which was used to provide parts for the boys' projects.

In April 1958 when I was 13¾ I came across this beginner's course, it was pretty much pure luck, as in those days you made your own entertainment. Not much entertainment was ready made and packaged ready to use like it is today. My dad worked for a local building firm. At the back of the yard there were a number of small businesses renting space in old *storage buildings (more like grand huts,* a bit better than sheds), and in one of these was a wireless and television repair service. So, when I had time, I would cycle down to the yard, meet my Dad and cycle home with him. If I was early or Dad was delayed, I would sit in the corner of the repair shop and watch what was going on. The 'hut' was like Aladdin's cave, with racks stacked to the ceiling with valves and components like glittering jewels to me. The benches were full of sets for repair or on test, and I could look inside at all the glowing valves and lamps and feel the warmth coming out (nice on a cold winters' day). Very occasionally I would be given an old wireless that had been condemned as beyond repair, and I would take it home for parts, wobbling about on the handlebars of my bike. That's how I had enough parts to tackle Mr E V Kings beginners course. I was lucky enough to have a mother that did not object to my bedroom filling up with 'junk'. Dad built me a fold-away bench that was hinged under my window so that I could 'work' on my projects in good light. In hindsight I was keeping myself occupied, and keeping out of their way, and not getting into mischief.

As soon as I started on this new rebuild, apart from being almost overwhelmed with nostalgia, the grunt–work of bending, cutting and drilling the chassis came to the fore. I thought how well I did at the age of thirteen, tackling this, with no pillar drill, bender and q-max cutters. I remembered leaning on top of the coal bunker with Dads' huge rat tail file in hand opening the valve holder holes up to size. The chassis used in Mr King's design was a tin plate baking pan. Cutting holes in one of those, with all the jagged edges would have been lethal, no doubt I would have cut myself. I remember I used a sheet of aluminium, but not how I came by it.

In April 1958, Mr King quoted that – *Making a chassis is not easy unless you have a well equipped workshop and so the author used baking tins from a popular store for the demonstration prototypes photographed with the series. Oil drum metal straightened, cleaned and aluminium painted makes a good chassis.*

OIL DRUMS? Mr King's store must have been quite a sight. I get the minds eye view of a great stack of Castrol, Duckhams or Esso drums in the back yard. "Take your pick my boy". "Please sir can I take one home to show my mum". "I'm going to make my wireless on one of these mum". "I thought he had a workshop not a garage back yard", and so it goes on. Some of the safety tips given by Mr King were quite humorous (clearly meant as serious) but had a flavour of Spike Milligan about them.

"*The following points may be helpful for the beginner:*

1: The mains switch must be a type which uses an insulated knob or there is a danger of shock if the unit is incorrectly connected to the mains.

2: Do not work on a mains receiver when standing on a garage, shed, concrete, or other damp floor. If you do your work in such a place use a good rubber mat in perfect condition. Do not work near water taps or other earthed objects. Provided the user is not himself wet he is not likely to do himself harm, but he certainly will drop a chassis or valve when 240v is applied to his body! Never touch a mains radio with wet hands or feet.

3: On this receiver if you connect the mains the wrong way round the chassis becomes live, so be sure to connect the lead going via S1 to chassis to the neutral or black wire and connect correctly to the 3-pin socket."

Goodness me! With your Spike humour switched on, one could add - make sure that your wellingtons are in perfect condition, keep one hand in your pocket, and wear your sunglasses so that you don't get blinded by the flash.

It is so simple to change the design slightly and wire up the power supply so that the chassis is isolated from the mains input. I wonder how many schoolboys were electrocuted in their attempt to build this wireless!

In April 1958, transformer temperature rise - Mr King also stated that the transformer must never get hotter than can be tolerated by the fingers. I wonder how long did he wait to find out that he had a short circuit somewhere?

I must admit that with my re-build here, for my own personal safety, I built a valve rectified HT DC supply on a separate earthed chassis.

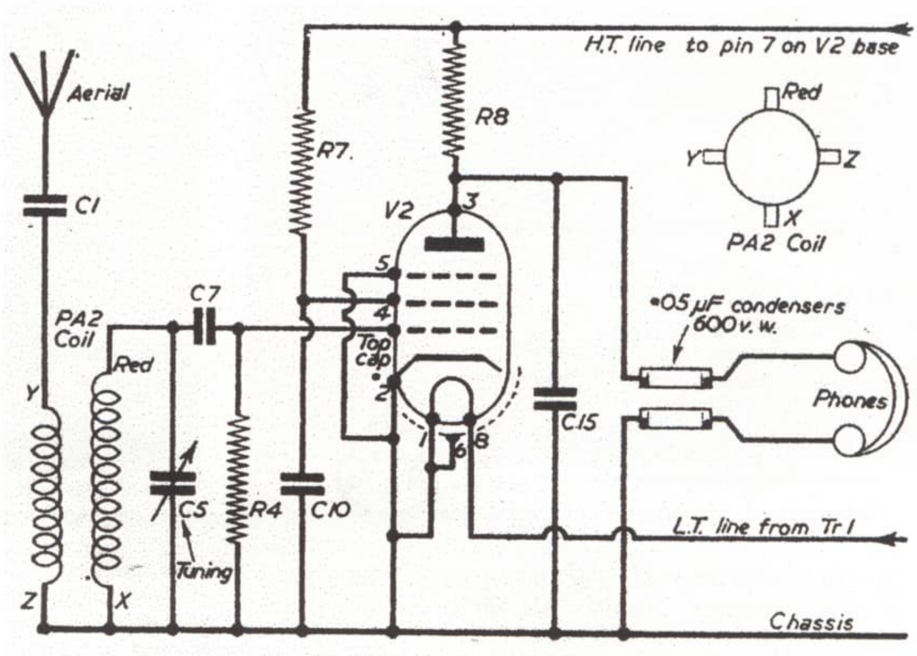
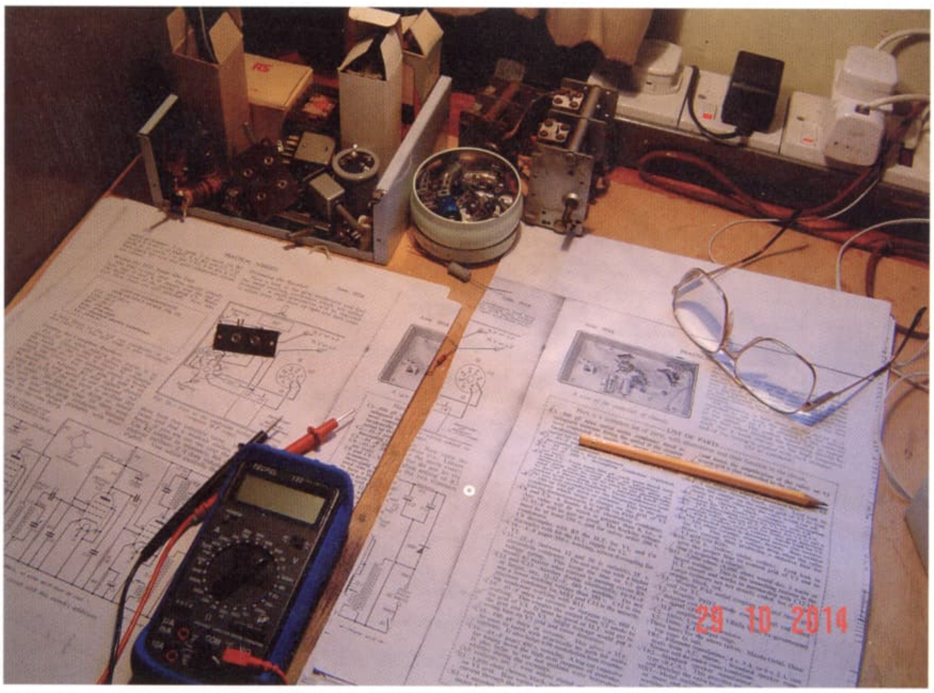


Fig. 9.—The leaky grid detector.

Figure 2



Gathering the 3 valver components

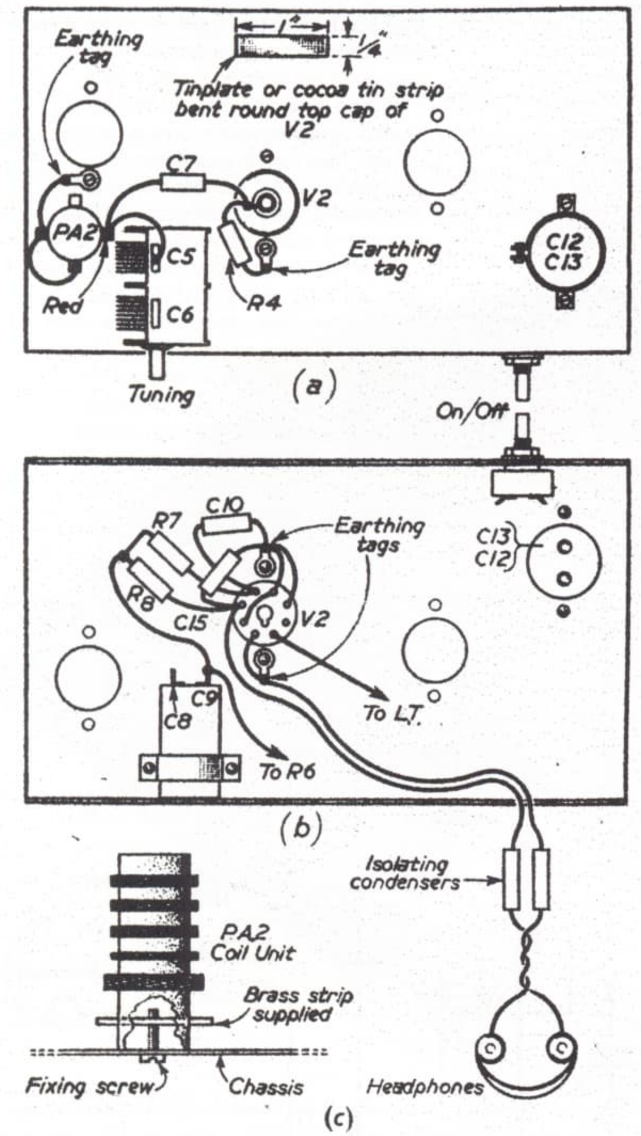
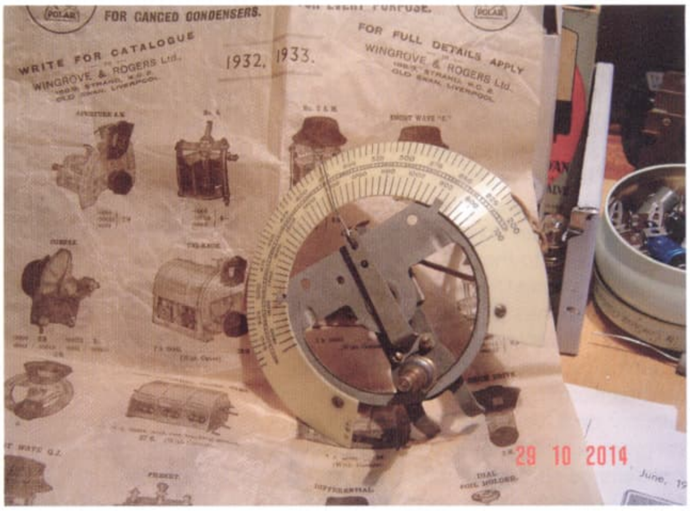


Fig. 10(a).—Wiring for Fig. 9. 10(b).—Underside of chassis (battery supplies not shown and previous wiring omitted). Fig. 10(c).—Details of coil fixing.

Figure 3



The precision slow motion drive

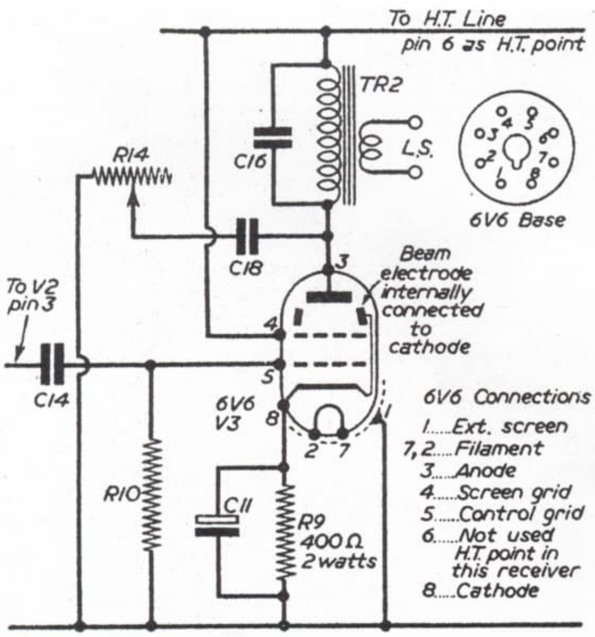


Fig. 37.—Theoretical circuit for 6V6 output stage.

Figure 4

The mains transformer primary is the only connection to the mains through a Yaxley type rotating double pole switch.

Mr King goes on to describe cutting out valve and condenser holes, *"There are various ways of doing this. Special valve hole cutters may be bought at radio dealers, or variable tank cutters may be purchased more cheaply at an ironmongers or borrowed from a plumber. They need, however, to be used with great care or they will tear the tin and spoil the chassis."* What about the danger to the boy himself when cutting thin tinplate with a tank cutter? Unless everything is bolted (clamped) down, this is virtually an impossible task. A hand held power drill with a tin chassis flailing around out of control like 'The Texas Chainsaw Massacre' comes to mind. Mr King goes on to say *"When the holes have been cut out hammer the metal chassis flat on a smooth surface"*.

During the initial phase of the construction of the wireless, where only the one valve is present, there is a test of the HT supply. *"Hold an insulated screwdriver in such a way that it shorts junction of R6 and C9 to chassis. A big fat blue spark should jump across. Always discharge electrolytics in this way."* I always use a big fat 100Ω resistor held with pliers with insulated handles to do this. You don't get a lightning strike or shock the electrolytic condenser.

The published articles in the series were:
Title – A Beginner's Constructional Course – II, A new series written especially for the Amateur by E V King:
1. April 1958. A 1-Valve AC set
2. May 1958. Finishing the 1-Valve set
3. June 1958. Converting the 2-valver into a 3-valve set
4. July 1958. Use of the volume control
5. August 1958. Fitting a separate LF volume control
6. September 1958. More details of fitting a separate volume control and other modifications.
7. December 1958. How to diagnose faults in the set.

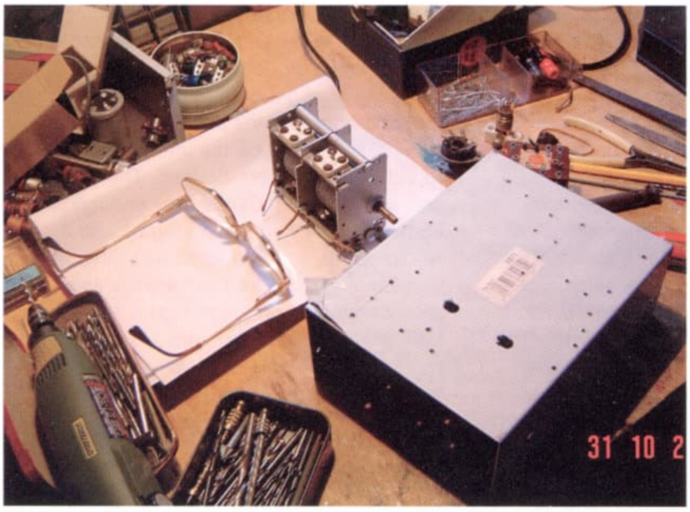
Somebody told me that there was a printing strike at George Newnes Ltd in November 1958, which was the reason for the last of the series appearing in the December issue of Practical Wireless.

I set out to build the final 3-valve version straight off, of course as a boy I worked all through the stages as they appeared in sequence. The first article gave the final form metal chassis design so that you did not have to try and drill and cut holes in a chassis partly populated with components as the build developed.

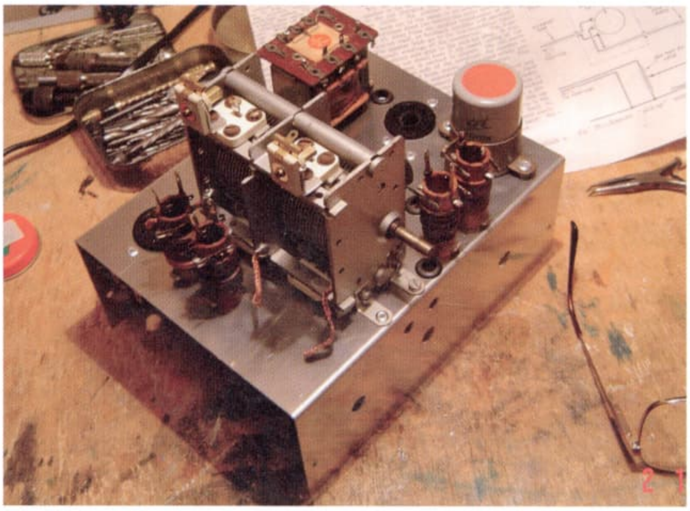
I still had a good collection of Wearite P series coils which was the linchpin of the decision to have another go at the construction, plus I had kept an original 500pf Jackson variable condenser at the back of the shelf just in case. Those Jackson types were very well made with feet and little platforms ready to mount trimmers.

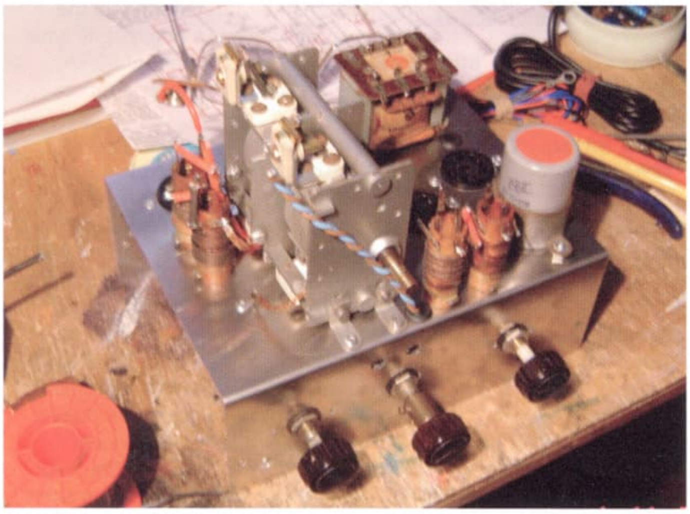
Figure 1. Is the list of components necessary to make the 1-valver as depicted in Figure 2 (actual Fig. 9.), which was the original leaky grid detector version.

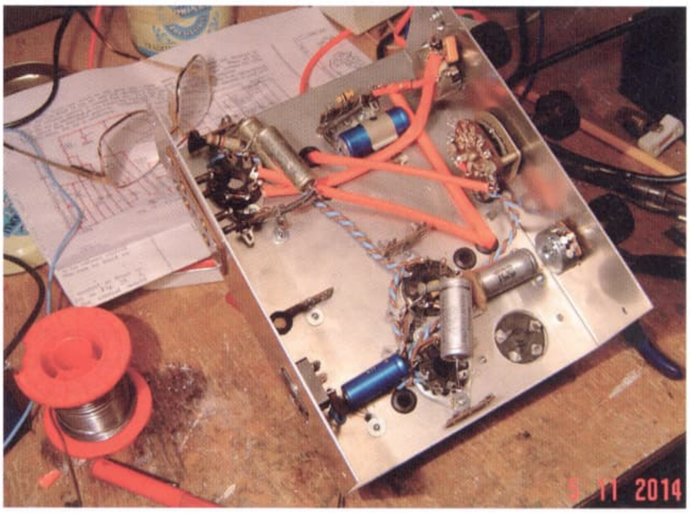
"Two types of detector are common in this type of receiver. The most sensitive is known as "leaky grid" but the system which is probably most widely used in commercial instruments and which gives the best selectivity is known as "anode bend". It is intended to



Marking out the chassis


Mounting the large components


Wiring chassis top



Wiring components underneath

use leaky grid detection in the first instance as it is easy to fix up and get working and requires less expense and components."

The accompanying article warns about the difference between the Mazda and International Octal valve bases, and goes through the wiring connections with colour coding to enable accuracy to be maintained. I have to say at this point that it is clear that Mr King, as a teacher, had the knack of precise description and construction of the English language. Order of thought and avoidance of repetition was natural to him. If you have one of the magazines in this series just have a quick read and you will see what I mean. A hidden lesson for boys in advancing their learning.

The initial switch on and test.

"Connect (condenser protected) one phone lead to chassis and the other to pin 3 of the valve just wired up. Plug in the mains the right way round, switch on at mains and at S1. Wait a minute. Connect a reasonably long aerial (50ft. or more) directly to the red tag of the PA2 coil. You should immediately hear the local station more or less irrespective of the position of the tuning condenser. The tuning is damped by the long aerial. Now attach the aerial to the flying lead from the condenser C1. Tune C5 (the main gang) and you should receive Light and Home programmes easily and probably some Continental stations, but do not expect too much from this stage on its own. It is not even fitted with reaction. There should be very little hum. More will be said about this later."

It was here that I can remember the exhilaration of hearing my wireless work for the first time. I can still remember it was the Goon Show. Before this I had made the 1950 crystal set out of the Eagle Annual, which worked, but not as good as this! If I had a copy of the May 1958 Radio Times I could work out the actual time and day. I bet it was about 6.30 in the evening.

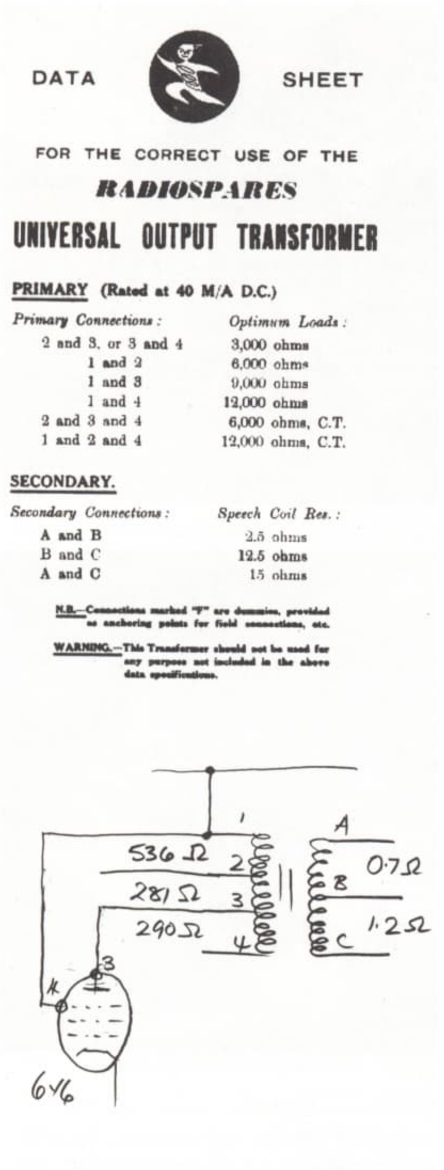
The wiring diagrams were excellent, see (original figs 10(a), and 10(b)) my figure 3. At this point the boy needs to be proficient with resistor colour code reading. No mention of what the colour code actually was though.

"Later details will be given for adding an HF tuned amplifier and anode bend detection. After this the radio will receive dozens of stations on a few yards of aerial at good loudspeaker strength. Later in this series a suggested output stage to give 2 watts of power can be installed. This latter stage uses a 6V6. The use of SP61 valves also means economy in rectifying and smoothing the HT supply, while the symmetry of the bases throughout the set will enable you to build it with a minimum of error." Wow! I could not wait for the next month's article.

A word about leaky grid detection derived in a pentode. The theory of operation is the same as a diode except that the pentode is used for amplification. The grid and the cathode act as the diode. The grid bias is derived through rectification of the carrier at the grid. The grid leak and coupling condenser time-constant are designed to follow the amplitude variation of the modulation. The grid acts as the anode of the diode during positive element of the signal, and as a grid during the negative element of the signal. The grid bias is reduced to a level following the amplitude of the carrier. The negative elements of the signal are amplified in the pentode and appear at the anode of the valve. A resistor and condenser filter shorts the RF component of the signal to ground. The remaining audio frequency remains for passing to the next stage. The diode effect of the valve loads the tuned circuit reducing the Q and widening the bandwidth. As there is no cathode bias resistor, grid bias is produced at the grid itself by the input impedance of the series resistance and capacitance itself in series with the tuning coil. The non-linear characteristic of the pentode creates distortion in the output at the anode.

In the development of the set, the addition of the output stage to drive a loudspeaker takes place before adding the RF stage. A couple of points in the layout and wiring are included for the education of the boy.

"Fix an ordinary (or multi-ratio) output


DATA SHEET

FOR THE CORRECT USE OF THE

RADIOSPARES

UNIVERSAL OUTPUT TRANSFORMER

PRIMARY (Rated at 40 M/A D.C.)

Primary Connections:	Optimum Loads:
2 and 3, or 3 and 4	3,000 ohms
1 and 2	6,000 ohms
1 and 3	9,000 ohms
1 and 4	12,000 ohms
2 and 3 and 4	6,000 ohms, C.T.
1 and 2 and 4	12,000 ohms, C.T.

SECONDARY.

Secondary Connections:	Speech Coil Res.:
A and B	2.5 ohms
B and C	12.5 ohms
A and C	15 ohms

N.B.—Connections marked "F" are dummies, provided as anchoring points for field connections, etc.

WARNING.—This Transformer should not be used for any purpose not included in the above data specifications.

Figure 5

transformer in the position shown in Fig. 14. Note that the laminations are at a right angle to the mains transformer. This is to avoid "hum" pick up from the mains. Make sure it is mounted firmly. The tags on the output transformer must be sorted out first, if it is a multi-ratio type before connection of a loudspeaker. Experiments with tappings on this transformer will do no harm if you are in doubt. With a standard type the thick wires go to the speaker and the thinner ones to the anode and HT. You may test this transformer in a similar way to that described for the filament transformer using a flash lamp and torch battery."

The circuit diagram for the 6V6 output stage is Figure 4. (original Fig. 37.)

"The volume obtainable from the set as constructed to date is much more than sufficient for any ordinary household. For use at a party or in a small hall more volume may be obtained by using a beam type output valve such as a 6V6. With the voltage available about 2 watts of power would be obtained, ½ watt is more than sufficient for ordinary needs so there will be quite a bit to spare.

One change to provide a larger current is to replace the smoothing resistor R11 with an LF choke rated at 10 Henries. The choke is fitted in position underneath the transformer and that the laminates are at right angles to both the mains and speaker transformers. This is to keep hum to a minimum. Using this valve the overloading on full local station volume disappears and the valve gets very hot. This is quite in order. The metal types especially can cause a blister if touched after an hour or so's operation, they are black in colour and should always be left that way to help in radiation. No screen should be used round these valves."

The good old 6V6 worked very well with ample gain, being a very simple circuit to implement. All I needed to do was confirm the Radiospares output transformer connections. I did not have a copy of the data sheet for the standard type. So a quick search on the internet soon found what I needed, figure 5. The slope characteristic of a 6V6 is near enough 8kΩ so the primary connection tags 1 and 3 would do, as actual quoted was 9kΩ. My loudspeaker used for this wireless was 15Ω, so secondary connection tags A and C are the right ones. In recent years Radiospares produced a suitable replacement output transformer type RS 210-6475. Why might a transformer that apparently has the primary to secondary right turns ratio not work? Any standing current will probably saturate the magnetic circuit of the core. That's why you see a stated 'rated at 40mA' for a Standard transformer in the catalogue specification. A heavy-duty type can accept a standing current of 80mA, but has the same tag connection ratios.

To test the detector with the output stage now constructed

"The detector stage should not have been disturbed and should of course still be working. Connect everything up, note the mains is in the right way round and switch on. Note that both filaments light up. If not check the mains supply and filament circuits. Attach a good aerial (50ft will give good volume at this stage) to the positions on the PA2 already detailed. These places are "Y" or "Red" of the PHF2 coil near V2. If the aerial is short it is best attached directly to the red tag of the coil via a small 500pF safety condenser. Your receiver will now receive local stations at good speaker volume. There should only be a minimum of hum from the speaker and speech and

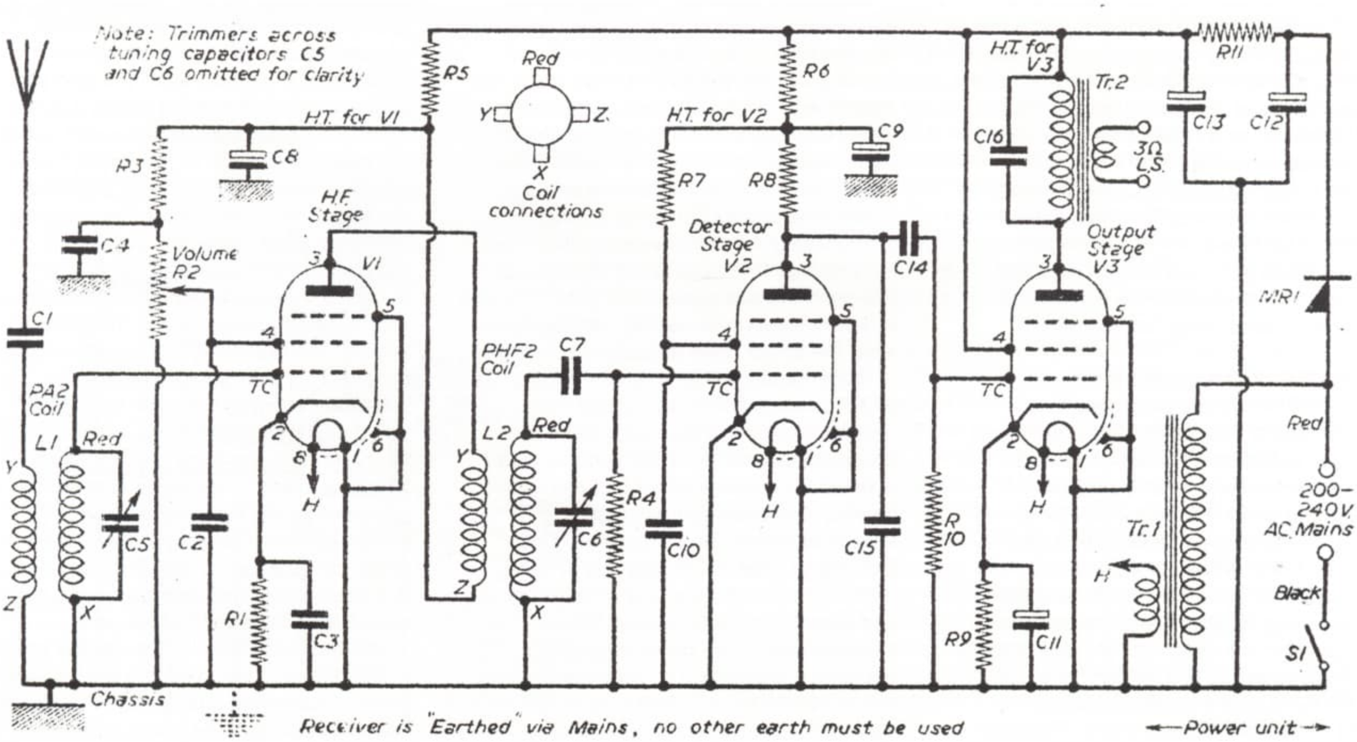


Fig. 22.—The theoretical circuit with this month's additions.

Figure 6

LIST OF PARTS

Here is a complete list of parts, with alternatives and their function in the circuit.

C1—500 pF mica aerial series condenser fitted to safeguard someone fitting the aerial if the receiver were connected to mains the wrong way round. Incidentally, it will also save PA2 burning out if the aerial hit the gutter, etc., under similar conditions.

C2—.01 μF paper, 350 volts working. This is a screen decoupling condenser.

C3—.01 μF 350 v. bias condenser.

C4—.01 μF 350 v. decoupling condenser (optional, see text).

C5 and C6—Twin gang 500 pF, each gang fitted with trimmers. Slow-motion drive an advantage. A three-gang may be used with the middle gang not used (one prototype will be seen in the photographs to have a three-gang in use). Insulated knob with sunken grub screws required. These condensers tune the two coil secondaries to the frequency required.

C7—100 or 120 pF mica or ceramic. This is the grid condenser which stops a charge on the grid of V2 leaking instantaneously to earth via PHF2.

C8 and C9—A double 8-8 μF electrolytic condenser. Any value will do which is greater than 8, i.e., a 32-32 μF will be just as good. The working voltage must be at least 250 v. and for safety order 350 v. condensers.
C8 decouples with R5 the H.T. for V1, and C9 decouples with R6 the H.T. supply for V2.

C10—.1 μF paper 350 v. working, screen decoupling for V2.

C11—25 μF (between 12 and 50 is suitable), 25 v. electrolytic condenser. Do not use one with a higher voltage rating. This keeps the bias on V3 grid steady no matter what current is passing across R9.

C12 and C13—Another double electrolytic, 16-16 μF or larger, say, 32-32 μF, 450 v. working. Do not use a lower working voltage than 350 v. C12 is the reservoir condenser for MR1 and C13 is the smoothing condenser working with R11.

C14—.01 μF mica or ceramic or Sprague type, 600 v. working. This couples the output from V2 anode to the grid of V3. It must be good or H.T. will get to the grid and ruin V3. Slight leakage would put a wrong bias on V3 grid and cause distortion.

C15—100 pF mica or ceramic. This gives a H.F. by-pass to earth with practically no path for audio currents. It also helps with modulation hum troubles.

C16—.01 μF paper 450 v. working. A top cut capacitor for toning down the high note response of pentodes. It also helps to cut out medium wave heterodyne whistles during the evenings.

(All resistors are ¼ watt unless stated otherwise.)

R1—1,000 ohms (brown, black, red). This gives a bias on V1 grid. Bias varies with position of R2 as the current through the resistor thus varies.

R2—1 megohm potentiometer. This is a true potentiometer between H.T. plus and minus. The voltage (and hence the amplification of the valve) on V1 screen grid is thus controlled by the slider.

R3—220 k. (red, red, yellow), a resistor to stop the grid of V1 connected to R2 slider from becoming too positive. The value given is satisfactory, for greater sensitivity adjust as described later.

R4—1 megohm (brown, black, green). Grid leak to allow the charge on the control grid of V2 to leak slowly to earth, otherwise the valve would cut off.

R5—10 k. (brown, black, orange). Decoupling resistor for V1, works in conjunction with C8.

R6—10 k. Decoupling resistor for V2, works with C9.

R7—1 megohm. Screen H.T. dropper for V2 to get a suitable voltage on V2 grid for leaky grid detection.

R8—470 k. (yellow, violet, yellow). Anode load for V2. The detected signal is developed across this resistor.

R9—330 ohms (orange, orange, brown). Bias resistor for V3. This gives a voltage drop when the valve draws current, thus producing a negative bias' for V3 grid (via R10).

R10—470 k. (yellow, violet, yellow). Grid leak to give the proper bias to control grid of V3 and to stop it acquiring a charge.

R11—3,000 ohms (5,000 ohms would do). 3 watts or larger wattage. This is the smoothing resistor in the H.T. circuit and works in partnership with C12/13. Large resistors are not usually coded, but if so it is orange, black, red.

L1—Wearite PA2 aerial coupling coil and tuned grid coil for V1.

L2—Wearite PHF2 anode coupling coil and tuned detector coil for V2.

V1—SP41/SP61 (that is VR65a/VR65 ex-government) H.F. amplifier.

V2—Ditto. Leaky grid detector.

V3—Ditto. L.F. output stage.

Three bases for the above valves. Mazda Octal. Three top caps to suit.

TR1—Filament transformer, 4 v. 3 A. or 6 v. 2 A. (see text) from A.C. mains. Standard speaker transformer will do under some conditions.

TR2—Standard speaker transformer or multi-ratio type (R.C.S.). This provides an anode load for V3 and matches the valve to the speaker.

MR1—Metal rectifier. Any type supplying 30 mA or more and rated at 240 v. input will do. This rectifies the A.C. input to pulsating D.C., which is received by C12 (H.T.48 is a suitable type).

S1—Mains on/off switch. Toggle type not suitable. Rotary type with insulated knob is required. One pole one way will do, or two pole one way can be used (see text).

CHASSIS—See text.

MAINS LEADS—Two core coloured cable with three pin plug, if possible.

AERIAL—50 ft. or more for one-valver, 20 ft. or less for ordinary reception with 3 valves.

Figure 7

music should be undistorted and clear. If the directions have been carefully followed no troubles will arise. A student of 15 built one of these receivers from these instructions and only made one error which he quickly put right." (Having avoided barbed tin plate, oil drums and electrocution)

"Do not proceed to the next stage until your two valver is working perfectly as regards clarity and lowness of hum." The next step in the build description was to add an HF tuner amplifier with reaction.

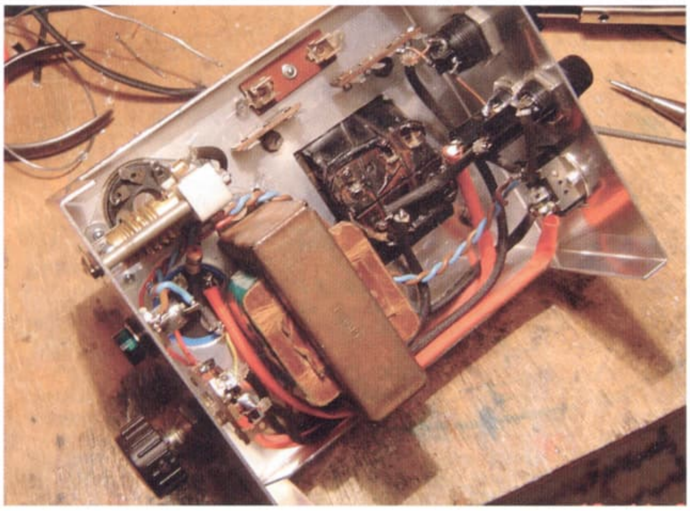
"Adding an HF stage. If we fit an amplifier to increase the aerial signal then we shall get much more volume from the output stage. This volume is, of course limited, or distortion will occur on local stations. So the amplifier fitted must have a variable amplification factor. If the amplifier fitted is tuned like the detector stage we shall have much increased selectivity. Stations near together on the dial will be separated with ease and distant ones received well provided fading troubles are not too bad (these are atmospheric in origin)."

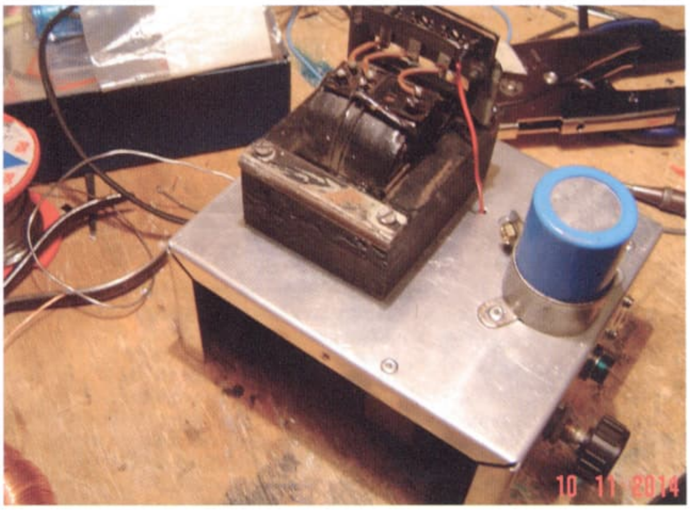
The complete receiver now looks like that in Figure 6 (original Fig.22), with parts list in Figure 7.

"Testing the Complete Receiver. Fix up all leads making sure mains is in correctly. Observe that all valves light up. Advance R2 and signals should be heard. A long aerial is not required. Advance R2 fully, if the set starts to oscillate this is in order. Do not leave it doing so, retard R2 until the oscillations clear (if there were any) and tune the gang condenser. Stations should be heard though probably with interference for the time being.

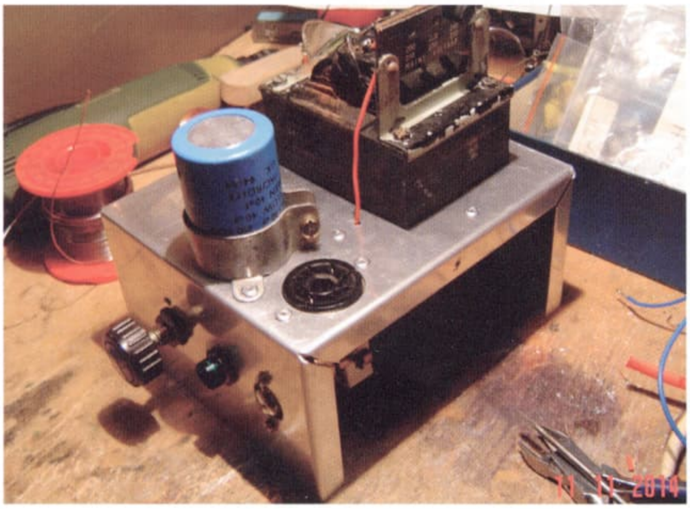
Trimming the Receiver. Have a look at the gang condensers and find the small auxiliary condensers called trimmers. A small screwdriver will be required to adjust these. Do them up tight and then undo them both two complete turns. Now open the vanes and find a weakish station (i.e. Luxembourg, if you are not too near the south coast). Use R2 control as necessary, but do not let the receiver oscillate; if it does reduce setting of R2 slightly. Now adjust carefully the two trimmers one at a time to receive your weak station at maximum volume. If the radio oscillates as you do this retard R2. With care you will get the station loudest at a certain setting of each trimmer and if each screw is moved the slightest either way the signal should be fainter. If this condition is not obtained you must experiment with one trimmer done up more than the other in the first instance. All trimming is best done on the aerial it is intended to use with the receiver as the setting of the trimmer on C5 is affected by the capacity of the aerial. The author would like to repeat again that when finished the trimming should be such that a weak station on the high frequency end of the tuning is peaked with each trimmer."

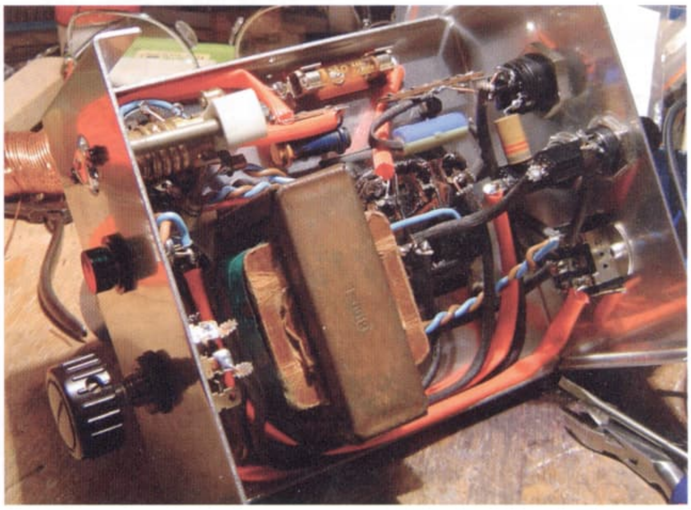
At this point in the description of the development of the receiver, Mr King has to go further into the description of the set up of the reaction control, in order to raise the possibility of having to modify some of the component values to get reaction to occur at the right point. Indeed reaction depends upon circuit sensitivity due to component


Power chassis wiring



Power chassis construction


Power chassis construction


Completed power chassis

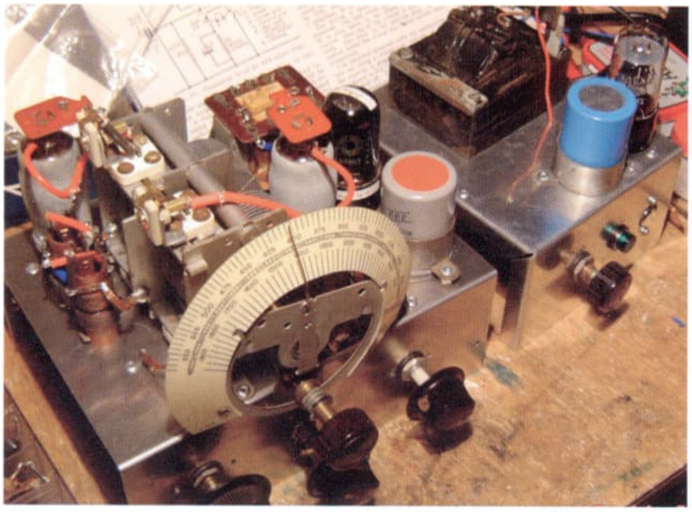
tolerances and physical circuit spacing. "*Use of the Volume control (Page 350). This type of receiver is designed so that there is a certain feed-back effect between V1 and V2, that is why no screening is used. This reaction effect is controlled by the use of the volume control, especially when it is advanced far over. By the way, if your control works in reverse, simply change over the connections to the outside tags. Just before the oscillation point is the most sensitive setting for the receiver when distant reception is required. To get a more accurate setting of the volume control the value of R3 may be adjusted to suit your particular valves and wiring. The value given for R3, however, is a good one, and there is no need to alter it unless you are most particular about long distance work. Generally speaking R3 should be of such a value that when the vanes of the gang condenser are one-third in the set will just oscillate when the volume control is turned full on. To tell if the set is oscillating gently rotate the tuning knob about one-third position. Heterodyne whistles mean the set is oscillating.*

If the set does not oscillate reduce the value of R3 to 100k'Ω and try again. If necessary reduce R3 to zero and use a piece of wire. If this is not effective solder a short length of plastic covered wire to C5 and a similar length to C6; bend these two wires so that they are near together for about ½ in. of their length. They act as a very small condenser. Adjust their distance apart by trial and error to obtain satisfactory reaction. In some cases they may have to be gently twisted together (not connected, however). If the set oscillates too soon, i.e., the set oscillates when the volume control is only half way, it means you are not able to make use of the available amplification (without reaction) of V1. So make sure all grid and anode leads to V1 and V2 are short. Make sure that the leads to C5 and C6 are short and as far apart as possible. Make sure your valves are mounted as shown and not close together. When all this has been done, and not before, increase the value of R3 to 330k'Ω or more as required.

Do not get the idea that this is an old-fashioned reaction type receiver. No reaction is used until the extreme end of the volume control travel is reached. Up to that point the volume control is of the ordinary type. Do not alter R3 until you have trimmed the receiver very carefully. If in doubt put back the 220k'Ω resistor and start again.
Quote - *Elimination of hum. The author has much experience with youth work and he has found that one of the biggest troubles the beginner faces is not knowing how to set about elimination of hum from his loudspeaker.*
When this receiver is finally completed there will be no audible hum two feet from a 5in. speaker, a little only from a 10in. However, the set is not yet complete, especially will the leaky grid detector pick up hum on the top cap of V2. This detector is very sensitive, but later another type will be used (a modification) which will cut out this "pick-up" on V2. At the moment if you bring your finger within 1in. of V2 top cap loud humming will result. This is a good test of the sensitivity of the receiver. This grid will pick up hum from any local electric field (near-by transformer, motor, etc.). A good way to overcome the trouble is to make a cocoa tin shield, fixing the lid to the base around V2 holder and cutting slot down one side for the lead to the top cap. The author in the prototype did not find this necessary unless he used a 12in. speaker which accentuated the hum.

Modulation Hum – If hum is introduced into the V1 circuit it will not show itself until it has a signal on which to superimpose itself, i.e., it modulates a signal. This hum is tuneable and only occurs when a carrier is being received and is especially noticeable just before the oscillation point when R2 is advanced. Modulation hum is one of the most difficult and tricky problems of receivers with the chassis connected to mains."

Mr King goes on to suggest several different fixes that could be tried with this receiver, interesting to interpret for general purposes on other receivers. 1. Use a 0.01µf condenser (1000v) to decouple the live mains side to earth. 2. Use a 0.01µf across the smoothing resistor. 3. Use smaller



The completed receiver

The completed receiver working

aerial feed condenser such as 50pf. 4. Try series resistors and chokes in the aerial feed. 5. Try a 0.01µf from chassis to real earth. The author found no troubles from modulation hum save on one which was completely cured by method 1. above.

"Having now got the receiver working satisfactorily you are now ready to carry out various modifications, the first of which will be anode bend detection. The SP61 is not an ideal valve to use with this method of detection (does the class know? Yes, that's right, the valve needs to be variable µ.*), *but it is proposed to use it for the following reasons:*

1. This type of circuit provides a low reactance path for 50 cycles mains hum through the tuning coil to earth. Condenser C7 prevents this happening with leaky grid detection. The hum is, of course, picked up by the top cap and leads connected to it. Thus screening is not necessary with anode bend detection.

2. It provides less damping on the tuning coil, and thus provides better selectivity. Stations of nearly the same wavelength are thus separated more easily. Tuning and trimming, however, become more tricky and a large knob or slow-motion mechanism are desirable.

3. A point of very great importance to the beginner is the switching used for gram/radio. With anode bend it is possible to get reasonable reproduction using only a simple switch changing the valve to an LF amplifier. With leaky grid this is more difficult as a bias resistor and condenser have to be switched in for gram. Leaky grid detection is more sensitive, that is probably its only advantage. A point to note is that when/if changing over to anode bend detection, R7 changes from 1MΩ to 680kΩ in order to bring V2 back to the correct operating point on the slope characteristic."

*Pentode RF amplifiers are of two types, those with a sharp cut-off and those with a remote cut-off characteristic. Valves with sharp cut-off characteristics are used as audio frequency voltage amplifiers and anode bend detectors. Remote cut-off types are used for RF and IF amplifiers. Just a little more information; remote cut-off types allow the application of AVC with a minimum of distortion. Your homework is to find out how to determine the sharp or remote type from the published characteristics?

"Test the completed receiver. Stations which interfered with one another will not now do so. There will be less hum, but you may have to retrim the condensers C5 and C6. The procedure remains the same as given last month. If you are keen to get every ounce of volume from the receiver you may adjust R3 or use twisted wire capacitor between C5 and C6 to get the utmost feedback at full volume setting as explained last month. This latter is not necessary and would not probably be carried out on most small commercial receivers of this type. The values given are good ones and will suit the beginner well."

A word about anode bend detection.
Detection works when operation is towards the point of anode current cut-off, so that non-linearity occurs and causes rectification. Detection efficiency is small, but the amplification of the pentode makes up for this. Distortion is great at low input voltages. However, the grid input from the tuning circuit is not loaded due to the

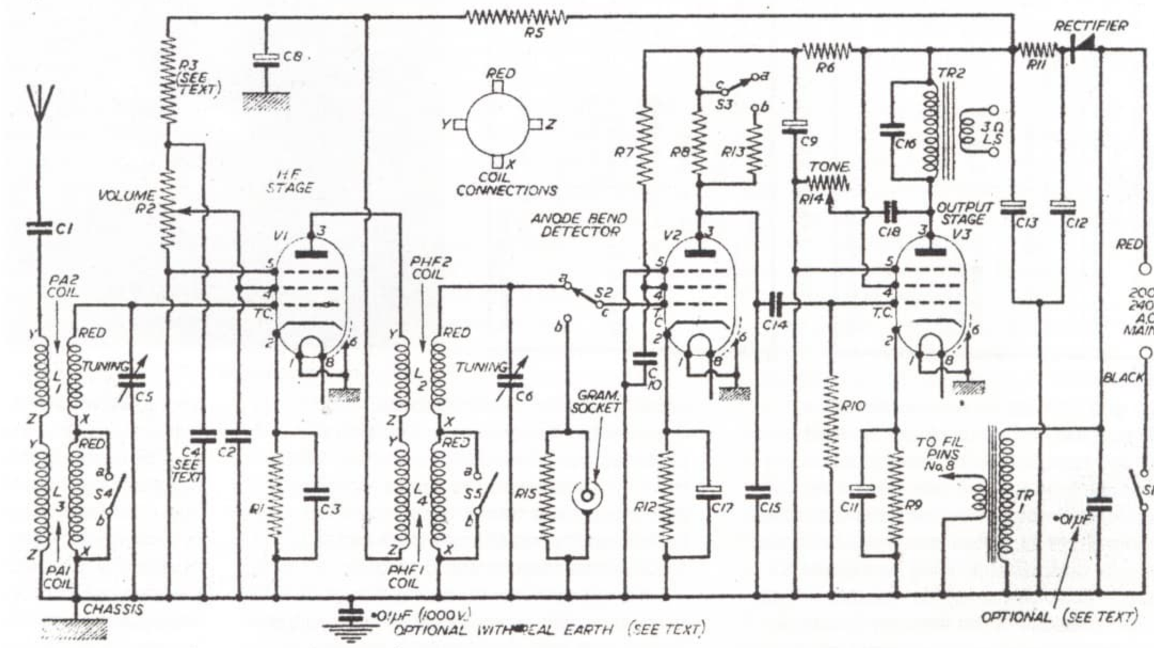


Fig. 23.—Circuit of the receiver as it should now appear.

Figure 8

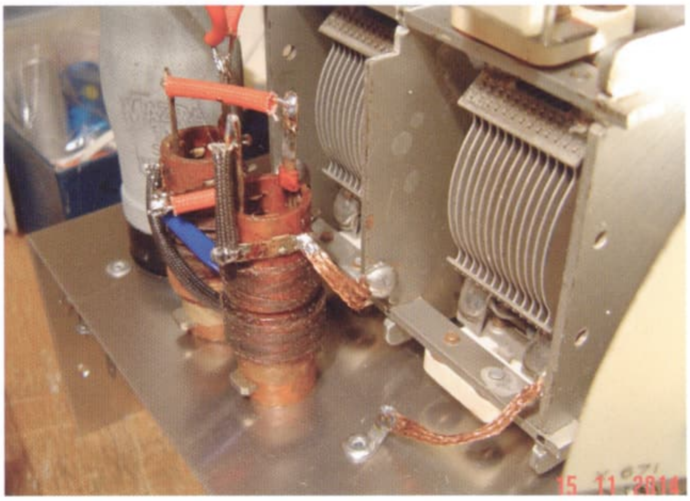
Mains used	240 v. A.C. Mains								200 v. A.C. Mains							
Valve circuit	Anode Bend Circuit as Fig. 23				Leaky Grid Circuit as Figs. 22 or 35				Anode Bend as Fig. 23				Leaky Grid Circuit as Figs. 22 or 35			
Meter used	1,000Ω		400Ω		1,000Ω		400Ω		1,000Ω		400Ω		1,000Ω		400Ω	
Test Points as under	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading
	D.C.		D.C.		D.C.		D.C.		D.C.		D.C.		D.C.		D.C.	
Junction R6/C9 (V2, H.T.) ...	500 v.	225 v.	500 v.	225 v.	500 v.	225 v.	500 v.	225 v.	500 v.	180 v.	500 v.	180 v.	500 v.	180 v.	500 v.	180 v.
Pin 7 (Main H.T.)	500 v.	280 v.	500 v.	280 v.	500 v.	280 v.	500 v.	280 v.	500 v.	195 v.	500 v.	195 v.	500 v.	195 v.	500 v.	195 v.
Pin 2	5 v.	1.5 v.	5 v.	1.5 v.	No test	No test	No test	No test	5 v.	1.2 v.	5 v.	1.2 v.	No test	No test	No test	No test
,, 3	500 v.	50 v.	500 v.	30 v.	500 v.	12 v.	500 v.	10 v.	500 v.	35 v.	500 v.	20 v.	500 v.	12 v.	500 v.	10 v.
,, 4	500 v.	75 v.	500 v.	35 v.	500 v.	40 v.	500 v.	30 v.	500 v.	65 v.	500 v.	30 v.	500 v.	30 v.	500 v.	25 v.
	A.C.		A.C.		A.C.		A.C.		A.C.		A.C.		A.C.		A.C.	
,, 8	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	4/6 v.
Anode Current	1 mA	.3 mA	2.5 mA	.3 mA	1 mA	.5 m	2.5 mA	.5 mA	1 mA	.25 mA	2.5 mA	.25 mA	1 mA	.4 mA	2.5 mA	.4 mA

THE TABLE ABOVE GIVES TEST FIGURES FOR V2 (52 and 53 in "Radio" Position)

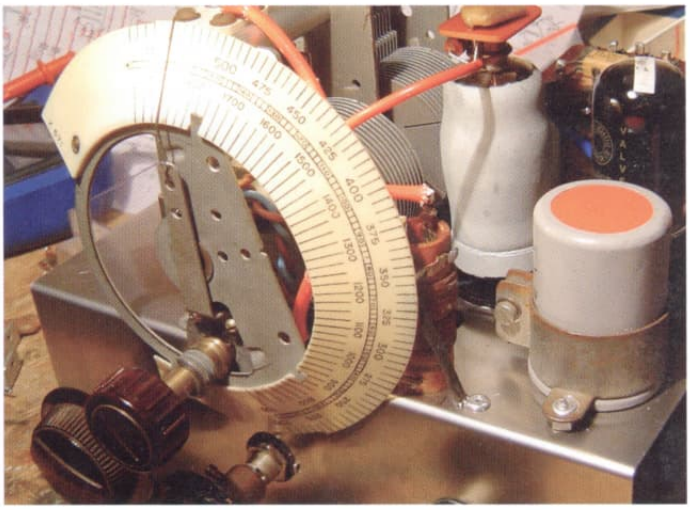
THE TABLE BELOW SHOWS TEST FIGURES FOR V3

Mains Used	240 v. A.C. Mains								200 v. A.C. Mains							
Valve Used	SP41/61				6V6				SP41/61				6V6			
Meter Used	1,000Ω		400Ω		1,000Ω		400Ω		1,000Ω		400Ω		1,000Ω		400Ω	
Test Points as under	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading	Range	Reading
	D.C.		D.C.		D.C.		D.C.		D.C.		D.C.		D.C.		D.C.	
Main H.T. pin 7 (6 on 6V6) ...	500 v.	240 v.	500 v.	240 v.	500 v.	225 v.	500 v.	225 v.	500 v.	195 v.	500 v.	195 v.	500 v.	190 v.	500 v.	190 v.
,, pin 2 (8 on 6V6) ...	5 v.	3.5 v.	5 v.	3.5 v.	25 v.	24 v.	25 v.	24 v.	5 v.	3.2 v.	5 v.	3.2 v.	25 v.	18 v.	25 v.	18 v.
,, pin 3 (3 on 6V6) ...	500 v.	235 v.	500 v.	235 v.	500 v.	215 v.	500 v.	215 v.	500 v.	190 v.	500 v.	190 v.	500 v.	180 v.	500 v.	180 v.
,, pin 4 (4 on 6V6) ...	500 v.	240 v.	500 v.	240 v.	500 v.	225 v.	500 v.	225 v.	500 v.	195 v.	500 v.	195 v.	500 v.	190 v.	500 v.	190 v.
	A.C.		A.C.		A.C.		A.C.		A.C.		A.C.		A.C.		A.C.	
,, pin 8 (2 on 6V6) ...	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	6 v.	25 v.	6 v.	25 v.	4/6 v.	25 v.	4/6 v.	25 v.	6 v.	25 v.	6 v.
Anode Current	10mA	7.5 mA	25 mA	7.5 mA	100 mA	30 mA	100 mA	30 mA	10 mA	6 mA	25 mA	6 mA	100 mA	24 mA	100 mA	24 mA

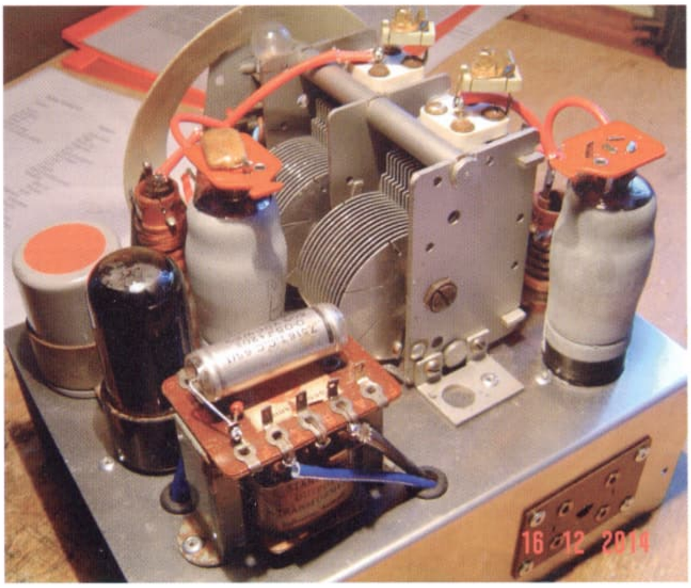
Figure 9



Close-up view of the RF coils



Dial lit up

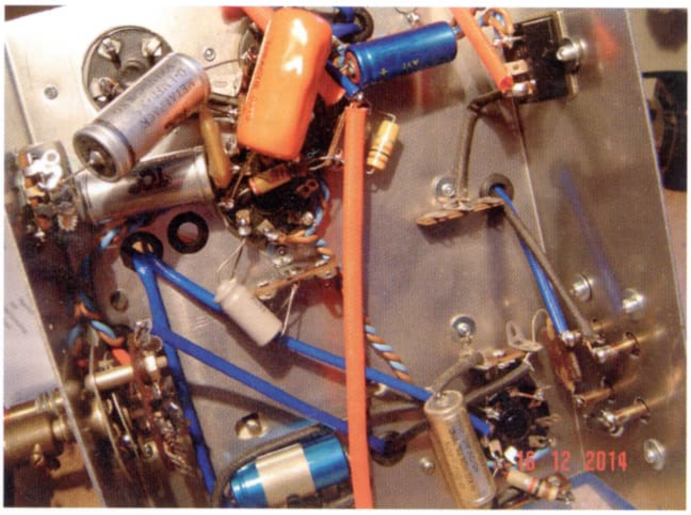


Rear of completed wireless

high grid impedance and positive bias effect of the grid. On a circuit as used on this set, top bend rectification is set up by introducing a high cathode resistance, with feedback eliminated by the parallel by-pass condenser. BUT, better design leads to the cathode bias resistor being by-passed for radio frequencies only, this results in a loss in gain because of the negative feedback, but a great improvement in audio quality. This design then tends towards the reflex detector having 100% feedback, which I used in the design for my 'Project of a Lifetime', published last year in the BVWS Bulletin. If this improved anode top bend detector is used then it would need to be followed by additional amplification. A 6J5 triode stage would do nicely.

I did not bother with adding the gram pick-up modifications included in Mr Kings design as it had no advantage for me. Therefore I did not require to construct the additional volume control in the fifth (August) instalment of the series. Nor did I bother with the baby alarm, as my babies are approaching their 50's! I did have a chuckle about the baby alarm pick-up, an 8in. moving coil speaker hanging overhead out of reach of the child. "*Take the leads out of the room to an ordinary speaker transformer fitted just behind the radio (about 6in to 1ft away from the speaker transformer of the receiver itself, or feedback troubles*

Working power chassis



The wiring of the completed chassis

TEST FIGURES FOR V.1

Mains Used	240 v. A.C. Mains				200 v. A.C. Mains			
Meter Used	1,000 Ω		400 Ω		1,000 Ω		400 Ω	
Test Points as under	Range	Reading	Range	Reading	Range	Reading	Range	Reading
Junction R5/C8 (V1, H.T.) ...	D.C. 500 v.	230 v.	D.C. 500 v.	230 v.	D.C. 500 v.	180 v.	D.C. 500 v.	180 v.
Pin 7 (Main H.T.)	500 v.	240 v.	500 v.	240 v.	500 v.	195 v.	500 v.	195 v.
Pin 2 Full volume ... ... Half volume ... ... Zero volume	5 v. 5 v. 5 v.	1.6 v. .7 v. .2 v.	5 v. 5 v. 5 v.	1.6 v. .7 v. .2 v.	5 v. 5 v. 5 v.	1.5 v. .7 v. .1 v.	5 v. 5 v. 5 v.	1.5 v. .7 v. .1 v.
Pin 3	500 v.	200 v.	500 v.	200 v.	500 v.	175 v.	500 v.	175 v.
Pin 4 Full volume ... ... Half volume ... ... Zero volume	500 v. 500 v. 500 v.	95 v. 50 v. 0 v.	500 v. 500 v. 500 v.	55 v. 20 v. 0 v.	500 v. 500 v. 500 v.	85 v. 30 v. 0 v.	500 v. 500 v. 500 v.	50 v. 15 v. 0 v.
Pin 8	25v. A.C.	4/6 v.	25 v. A.C.	4/6 v.	25 v. A.C.	4/6 v.	25 v. A.C.	4/6 v.
Anode Current (Full volume) ...	5 mA.	1.5 mA	5 mA.	1.5 mA.	5 mA.	1.5 mA.	5 mA.	1.2 mA.

Figure 10

will develop)". A bit of wiring installation is described, and then, *"For added safety you could earth it separately to a water pipe."* Picture it, a (potentially) mains live metal case speaker hanging over a baby in a cot. It's like a start for a horror movie!

The next modification described is the addition of a tone control. *"There are many ways and places in which a tone control may be fitted. It is proposed to fit a simple top cut control which is especially useful with pentodes as they tend to accentuate the higher notes of the musical register. The control will allow you to "suit your ear" by cutting some of the top notes as required. This is also useful for heterodyne whistles so annoying in the evening on the medium waveband*."* This effect seems to have disappeared these days, and I have not noticed this problem as I sat typing this article whilst listening to my new TRF receiver.

It does not matter how sophisticated receivers are, if two broadcast station carriers overlap then this sets up a heterodyne resultant (that is the positive or negative algebraic difference between the two carriers). This phenomenon is halved if the carriers are single sideband. The Copenhagen Agreement of 1948 was supposed to eliminate this interference problem. I have mentioned this to some BVWS members over time and nearly all said that they had never heard of it; that surprised me. The 1948 Agreement, became effective on 15th March 1950, and can be stated as "European LW/MW Conference Copenhagen 1948 (European broadcasting convention" Mostly 9kc/s (8kc/s above 1529kc/s, 7kc/s, 8kc/s and 9kc/s on LW) spacing's but not harmonic multiples – offset 1kc/s on MW and (generally) 2kc/s on LW.

After World War II, the FM radio broadcast was introduced in Germany. In 1948, a new wavelength plan was set up for Europe at a meeting in Copenhagen. Because of the recent war, Germany (which did not exist as a state and so was not invited) was only given a small number of medium-wave frequencies, which were not very good for broadcasting. For this reason Germany began broadcasting on UKW ('Ultrakurzwelle', i.e. ultra short wave, nowadays called VHF) which was not covered by the Copenhagen plan. After some amplitude modulation experience with VHF, it was realized that FM radio was a much better alternative for VHF radio than AM. Because of this history FM Radio is still referred to as "UKW Radio" in Germany. Other European nations followed a bit later, when the superior sound quality of FM and the ability to run many more local stations because of the more limited range of VHF broadcasts were realized. (So the Germans got their own back in the end!) Later, the rest of us realised that the Copenhagen Plan was not good enough, and by 1975, we did it all again.

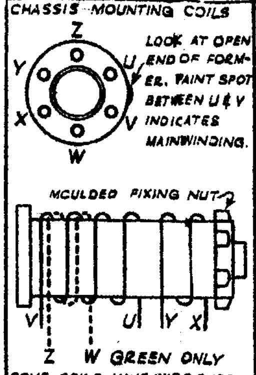
The Geneva Frequency Plan of 1975 ("The Final Acts of the Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3) Geneva, 1975" or simply "GE75") is the internationally agreed frequency plan which was drawn up to implement the provisions of the Final Acts of the Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3) held in Geneva, Switzerland, in 1975. It covers radio broadcasting in the long and medium wave bands outside the Americas (separate agreements being in place for North and South America).

The plan was drawn up under the auspices of the World Administrative Radio Conference (WARC) of the International Telecommunication Union (ITU) with the assistance of the European Broadcasting Union (EBU/UER).

The Geneva plan replaced the 1948 Copenhagen plan. It became necessary because of the large number of broadcasting stations in these frequency ranges leading to ever more mutual interference (Many countries had refused to ratify the Copenhagen plan and compliance was patchy even among those which had). The Geneva plan entered into force on 23 November 1978 and although its intended lifespan was only until 1989 it is still valid (with small modification by mutual coordination between countries) today. The ability for countries to agree

MAXI - Q COILS
CHASSIS MOUNTING AND PLUG IN (OCTAL) TYPE

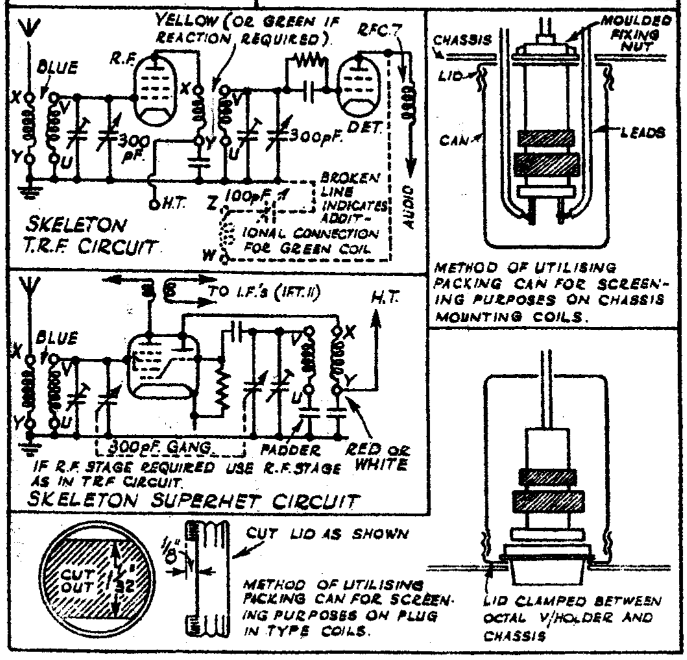
CHASSIS MOUNTING COILS



SOME COILS HAVE WIRE ENDS (NOT SPILLS). IN THIS CASE IDENTIFY CONNECTIONS FROM THIS DIAGRAM.

COIL COLOUR	U	V	W	X	Y	Z
	← CHASSIS MOUNTING COILS →					
BLUE	EARTH OR A.V.C.	GRID		AERIAL	EARTH	
YELLOW	EARTH OR A.V.C.	GRID		R.F. ANODE	H.T.	
GREEN	EARTH OR A.V.C.	GRID	ANODE REAC.	AERIAL OR R.F.	H.T. OR EARTH	REAC.
RED OR WHITE	EARTH OR PADDER	GRID		ANODE	H.T.	
	6 OR * 2,4,5,7 RED, WH.	3	5	1	8	4
	← PLUG - IN TYPE COILS →					

NUMBERS REFER TO THE STANDARD OCTAL VALVE BASE NUMBERING. PAINT SPOT ON BASE SIMULATES OCTAL LOCATOR. TABLE 1 GIVES * CORRECT PIN CONNECTIONS FOR PADDERS ON OSCILLATOR COILS.



DENCO (CLACTON) LTD., 357/9 OLD ROAD, CLACTON-ON-SEA, ESSEX, ENGLAND

FOR BEST RESULTS WE RECOMMEND THE USE OF A GOOD QUALITY, CERAMIC INSULATED CONDENSER WITH A CAPACITY SWING OF 313 pF. AND A MINIMUM CAPACITY OF ABOUT 11 pF.

WHERE DIFFICULTY IS EXPERIENCED IN OBTAINING THE SPECIFIED ·0003μF. GANG CONDENSER, IT IS POSSIBLE TO USE A ·0005μF. CONDENSER, PROVIDED HIGH QUALITY SILVER MICA FIXED CONDENSERS OF ·001μF. (1000pF.) ARE CONNECTED IN SERIES WITH EACH SECTION OF THE GANG TO REDUCE THE MAXIMUM CAPACITY TO THE VALUE REQUIRED.

ACCURATE TRACKING REQUIRES "STRAY" CAPACITIES, INCLUDING CIRCUIT, VALVE AND GANG MINIMUM TO BE MADE UP TO 39pF. (GIVING 39-352pF. CAPACITY SWING) BY VARIABLE PARALLEL TRIMMERS. FIGURES IN TABLE 1 FOR "OSCILLATOR TRIMMER" ARE OVER AND ABOVE THIS 39pF.

ADJUSTABLE IRON CORES GIVE ±15% VARIATION ON MOST COILS.

THE FOLLOWING COLOUR CODE IDENTIFIES THE COILS:
BLUE: SIGNAL GRID COIL WITH AERIAL COUPLING WINDING.
YELLOW: SIGNAL GRID COIL WITH INTERVALVE COUPLING WINDING.
GREEN: GRID COIL WITH REACTION AND COUPLING WINDINGS (6 PIN). THESE COILS ARE AVAILABLE FOR RANGES 1-5 ONLY.
RED: SUPERHET OSCILLATOR FOR I.F. OF 465 kc/s.
WHITE: SUPERHET OSCILLATOR FOR I.F. OF 1·6 Mc/s.
NOTE: RANGE 6&7 RED CAN BE USED FOR VARIOUS I.F.'s, NO WHITE COILS ARE MADE FOR THESE RANGES.

SEE TECHNICAL BULLETIN DTB.1 FOR FURTHER COMPLETE DETAILS AND RECOMMENDED CIRCUITS FOR MAXI-Q COILS ~ 1/6

RANGE	INDUCT. μH. B,G,Y.	COVERAGE 39-352 pF.		465 Kc/s. I.F. OSCILLATOR			1·6 Mc/s. I.F. OSCILLATOR		
		Mc/s.	METRES	PADDER pF.	PIN	TRIMMER pF.	PADDER pF.	PIN	TRIMMER pF.
1	2350	·175/·525	1700/570	140	4	8·5	50	4	21·5
2	271	·515/1·545	580/194	350	5	0	110	5	20
3	27·2	1·67/5·3	180/57	1100	7	6	340	7	11
4	2·9	5·0/15	60/20	3000	2	1·5	960	2	4·5
5	0·65	10·5/31·5	28/9·5	NONE	6	0·6	2000	6	1·5
6	0·4	30/50	10/6	TUNE WITH 50pF. TUNING CONDENSER. CIRCUIT MIN. CAPACITY 23·5pF. I.F. APPROX. 5 Mc/s. ONLY RED OSC. COILS AVAILABLE FOR THESE RANGE.					
7	0·18	45/78	6·6/3·8						

NOTE – FOR HIGHEST POSSIBLE INSULATION POLYSTYRENE FORMERS ARE USED. THREADED PORTION CAN BE TWISTED OFF BY EXCESSIVE LOCKING OF THE FIXING NUT AND SHOULD THEREFORE ONLY BE ASSEMBLED "FINGER-TIGHT".

Figure 11

subsequent amendments to the plan has given sufficient flexibility to ensure that compliance has been far more widespread.

Most existing European radio stations were required to change their broadcasting frequencies following implementation of the plan. In most cases the changes were slight (only one or two kilohertz) but were more drastic in some cases, particularly in the United Kingdom, where all BBC national stations moved to a new wavelength or band. However the increased number of radio services and reduction (in most cases) of interference to radio signals (particularly at nighttime) was considered by most broadcasters to be worth the initial inconvenience.

As a result of the plan most medium wave (and later longwave) stations outside North and South America operate on exact multiples of 9 kHz which helps reduce heterodyne interference.

So there you have it. The UK came off worst (even though we won the war), and that's why there is not much interference about. However, interference these days comes from all that digital stuff around us, it has got to the point where RSGB HF enthusiasts are tearing their hair out, complaining to the Government and threatening to give up. The problem is described as the noise floor being higher than weak long distance signals, therefore these cannot be heard, wiping out much DX communication.

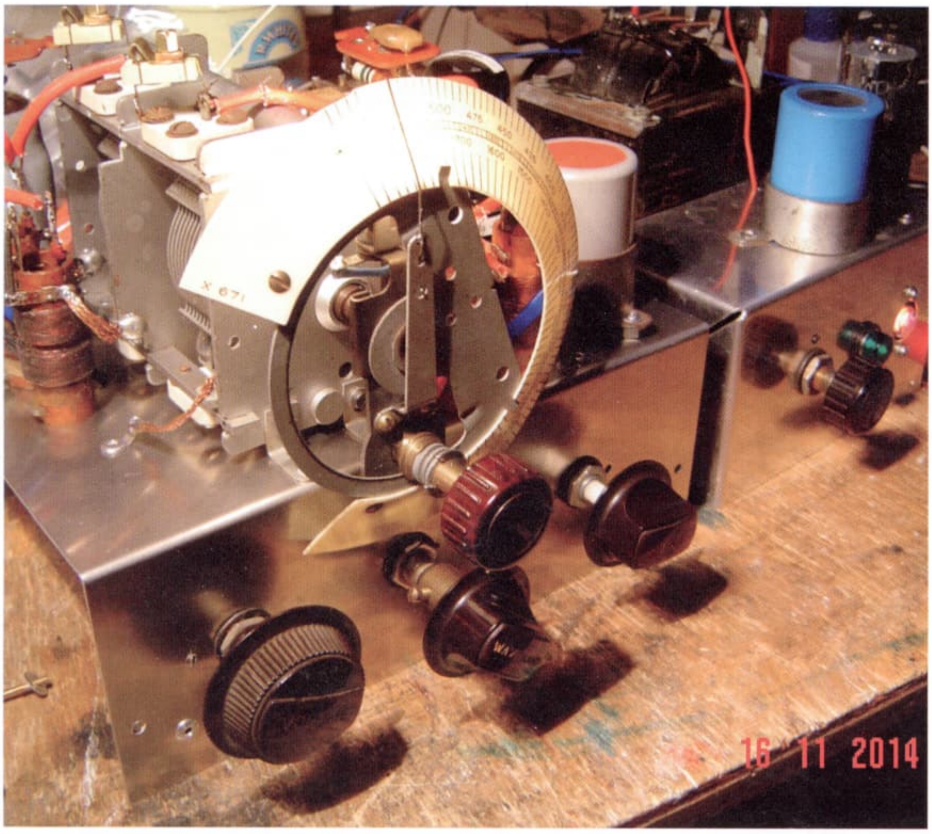
The next modification described is the addition of Long Wave reception.

"A set of this type is best fitted with coils for long-wave reception as the medium-wave reception of the BBC Light Programme is very difficult in many parts of the country due to interaction after dark of the many other stations near by on the frequency spectrum. The real answer, of course, is to use (as the author does in his living-room) VHF FM. This is quite beyond the scope of the beginner. Two more coils are required. They need not be more that ¼ in. from the corresponding medium-wave coils. Be very careful to get the red tags in the correct position or all your wiring could be done wrongly. It is very difficult for the beginner to sort it all out (the author still remembers the muddles he used to get in, in his early days!) Another rotary switch is now required (a toggle switch must not be used). A two-pole one-way switch is required. Examine the switch very carefully, noting the tags which become joined in one position and which are open circuit in the other.

The wiring of the detector for long-waves is described in detail.

Testing the Detector Circuit.

Remove the aerial from the front end of the receiver and switch on. Now attach a good, long aerial to the "red" tag on PHF2. Although the tuning will be flat you should now be able to receive at low volume both long and medium bands. Now attach the aerial via any small condenser greater than 300pf to the "Y" tag of the PHF2. You should now receive both bands with greater selectivity though less volume. Quote – Testing and Retrimming the Receiver. Plug in the receiver, attach the aerial to the proper position and, select the medium wave switch position. You will now receive medium waves as you did before. Carefully adjust the trimmers for optimum strength on a weak station with the gang condenser vanes open as previously stated. Very little adjustment will be required, especially if all leads have been kept as short as possible. When the receiver is finished the slightest movement of either trimmer should cause a drop in volume. If, on trimming the receiver oscillates, reduce setting of R2 and continue trimming. Feed back "wires" may be added if necessary, or reduced



The completed working wireless

or taken away, as previously described.

Now switch to long waves. Adjust the tuning gang condenser and you should receive the Light Programme at fair strength. If you are using a poor aerial reception will not be so good as on the medium waves, but many continental stations can be received. The tuning is flatter and there is not much point in fitting trimmers, but if you wish you fit them across from "X" to earth on each coil. 50pf is a suitable value and all leads should be kept short (say, not much more than 1in.) or feed back trouble will crop up. If these trimmers are added (the author found no need to do so) then they are only adjusted on the long waves and are adjusted after the medium-trimmers have been set. The medium-wave trimmers will affect the long-wave coils, but the long-wave trimmers (if fitted) will not affect the medium-wave coils.

All leads must be kept short. Do not use screened cable as it introduces trimming difficulties which are difficult for the beginner to sort out. Screening increases the stability of the receiver, but at the same time introduces "capacity" to the tuned circuits which have to be compensated for by the trimmers. These would thus have to be altered or paralleled to get the receiver in proper trim. This would be very difficult for the beginner. C18 the tone control by-pass condenser needs to be at least 600v working. If the set should oscillate violently a large voltage can be produced across this capacitor, hence its high working voltage. Needless to say no radio of this type should be allowed to oscillate.

L3/L4 Wearite PA1 and PHF1 Coils. These are mounted and wired in series in all respects with the original medium-wave coils. The primaries are left in series all the time, but the long wave secondaries are cut out by the selector switch when medium-wave is required.

The complete circuit of Figure 8. (original Fig.23) will now have been wired and should be in perfect working order. It is intended in this contribution to give details which will enable the amateur to service and find faults in this receiver.
Microphony - *The beginner may have noticed that if he touches the detector valve a loud drumming sound comes from the speaker. Some valves, especially when in the detector position, show this property to a remarkable degree. About one in six of the SP61's purchased show rather too much microphony, the one showing this property most should be placed in the HF socket. Microphony in itself is not harmful unless the speaker is near the valve or the receiver is being subjected to mechanical vibration such as would be the case with a car radio. When this TRF receiver is placed in a cabinet any tendency to microphony will be aggravated. The author has made up many of these receivers for friends and has always cured any such tendency by swapping valves as stated. Other standard methods are to mount the valve on a sprung base or to damp it, using felt padding, etc. (a bad policy as it can cause overheating. The speaker should not of course be mounted on the chassis directly, but on the wooden "baffle" of the cabinet.*

Fitting a Dial to the Tuning Gang

The finished receiver may be fitted with a commercial type tuning drive which can be obtained at any dealer selling to the home constructor. The author has found that quite a good effect (and good utility) can be gained by soldering a thin black wire pointer directly to the tuning control spindle. A piece of postcard is mounted on pieces of tin plate behind this pointer. A large type knob (or small slow-motion assembly) is then fitted. In the first place a dummy card is fitted, and after trying the receiver on a few stations (i.e. Luxembourg, light and Home) you should be able to plan out an attractive card to be fitted permanently.

If a cabinet is made a cellophane window is fitted with a hole in the cellophane to take the tuning spindle. The knob is then fitted outside the window. A dial lamp may be fitted above the card to provide illumination and tell you when the set is switched on.

Do I need a Meter? – There is no doubt that a 1000 ohms per volt multi-meter is a great help. If you have such a meter be very careful to always start on high voltage or current ranges first. Good instruments, have safety devices working on the principle that if the needle accelerates too rapidly the current is cut off at once. A meter is a "must" for reasonably sure fault finding.

Meter Readings are not always Accurate – Meter readings on valve pins are useful but not always accurate because of voltage drop caused by the current drawn by the meter having to go through a resistance in the valve circuit. On the chart prepared by the author readings are given for an Avo Multiminor and for a 1000 ohms per volt meter. However, if you have another type of meter you can construct your own chart for use with your meter. It is good policy to do this with all equipment made and to put a copy of the chart in an envelope in the back of the cabinet for reference in the future.

How to Use a Meter (for voltage tests) Unless otherwise stated, readings are from chassis to various wiring points. Clip the black negative to the chassis making sure it is in good contact. Switch meter off. Switch onto the highest range and apply the test prod carefully to the test point. The higher the range used the more accurate the actual voltage, but more difficult it is to read the deflection off the scale.

Test figures for V1

How to use a Meter (for current tests) – The meter has to be inserted actually in circuit so it will be necessary to unsolder a connection for each test. Care must be taken not to cause feed-back troubles due to the meter wiring. For instance where possible always insert the meter in series into the most earthy side of a circuit. For protection of the meter start your measurements on the highest range. Continue reducing the range until you get the range which gives the most deflection without the needle going "over the top". Here, the smaller the range selected the better. The range selected has no effect on the current consumed. Current ranges are thus more foolproof and accurate in normal tests. Figure 9."

The article continues with an excellent description of fault finding with and without a meter. A comprehensive test chart is provided that gives voltages at various points and on valve pins, where the mains voltage may be 200v to 240, and the meter may have 1000

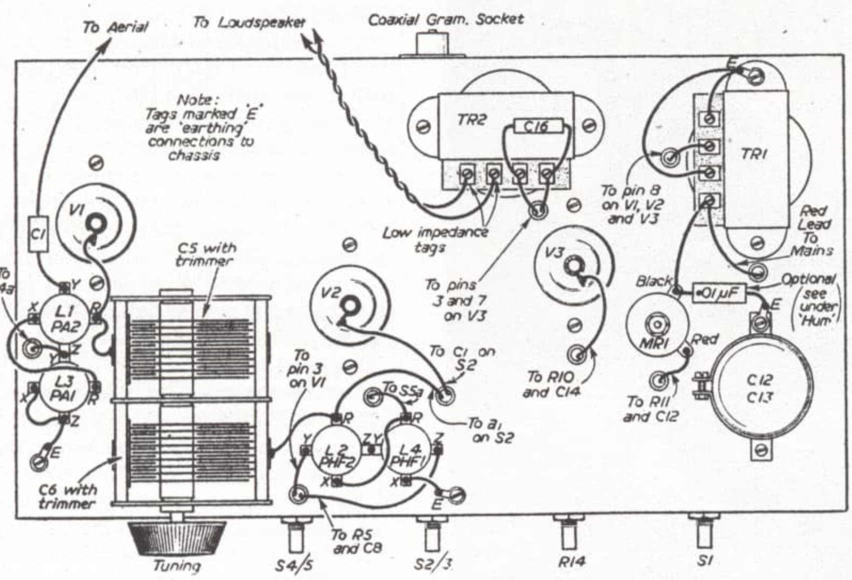


Fig. 28.—Top view of receiver.

receiver makes a very handy baby alarm and a suggested system is now given.

A Baby Alarm System

Fit an 8in. permanent-magnet moving-coil speaker in the baby's bedroom as near as possible to the cot (hanging overhead out of reach of the child). No cabinet is necessary. Take the leads out of the room to an ordinary speaker transformer fitted just behind the radio (about 6in. to 1ft. away from the speaker transformer of the receiver itself, or feedback troubles will develop). The speaker leads go to the low-impedance (thick enamel) windings of the transformer. The high-impedance side goes to the pick-up plug. It may help to cut down hum if the metal casing of the transformer is earthed to chassis. Do not earth the speaker side of the windings; the speaker is thus isolated from mains. For added safety you could earth it separately to a water pipe. This is not at all necessary, however.

The set is switched to P.U. operation and any noises from the child will come out at really loud volume from the speaker attached to the radio. A speaker used in this way as a microphone is very sensitive indeed, ordinary speech being picked up and "broadcast" at good volume from a distance of 9ft. at least. Do not try to fix this up as a "lash up" in one room. So sensitive is the arrangement that "speaker" will feed back to speaker generating vibrations which could easily damage a small one. Always have the "microphone" speaker in another room.

Fitting a Tone Control

There are many ways and places in which a tone control may be fitted. It is proposed to fit a simple top cut control which is especially useful with pentodes as they tend to accentuate the higher notes of the musical register. The control will allow you to "suit your ear" by cutting some of the top notes as required. This is also useful for heterodyne whistles so annoying in the evening on the medium waveband and for needle scratch on old gramophone recordings.

The position of the tone control, R14, is shown in Fig. 26. The wiring is very simple and is shown in Figs. 27 and 32.

Here is a suggested plan to follow. Verify that

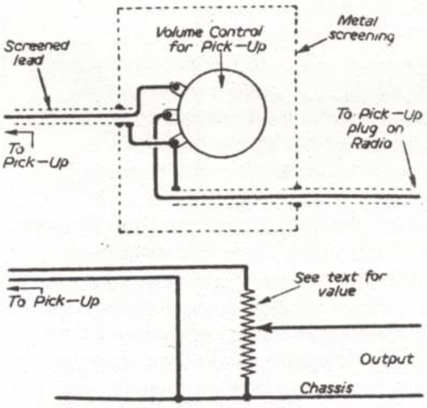


Fig. 29.—Separate "pick-up" volume control.

The modifications for a baby alarm and separate pick-up control

or 400 ohms per volt. Figure 10.

"It is hoped that the beginner will now feel quite confident that not only has he been able to build a good serviceable receiver but that he can service it with some degree of skill. The beginner should try to work out why voltage variations could be caused by the components suggested above. The author makes no pretence that the above fault finding system is absolutely fault proof. He doubts if there is such a system anyway, especially are intermittent and distortion troubles difficult to find without a good technical knowledge.

There is no better aid to good fault-finding than a good brain and a thorough understanding of the receiver under consideration. If you have made the receiver you should have both aids at your disposal.

The receiver may be placed in a wooden or plastic cabinet but not a metal one. A short picture-rail aerial will do for ordinary use so the receiver makes a small convenient bedroom receiver, but some of the author's friends have these operating in their living-rooms and find them very useful. Those who like Luxembourg (oh happy days!) can receive it well, but with some fading (no AVC is fitted and is not really practical on this type of receiver)."

In the last paragraphs the components required for modifications are listed.

The author describes how he takes old radios beyond repair and dismantles them to collect the parts for future construction projects. Some valuable parts like the cabinet, switches, tuning gangs, speakers and transformers are acquired.

Finalé

When you look back on how the construction of the receiver evolved from month to month, you can see how boys interested in building their first radio were inspired. I certainly was. It gave me the idea to pursue electronics rather than get involved in the collapsing aircraft industry. Looking back, I remember how much I enjoyed the series, and the result worked well. It was the tuned RF amplifier that transformed the receiver into a worthwhile radio. Most of the problems with crystal sets and one valvers' disappeared, of course the performance was not up to the selectivity of a superhet receiver, but is certainly very sensitive. The SP61 valve actually has an impressive gain, gm 8.5 mA/V for an MO valve in standard pentode biasing, so it was an excellent choice by Mr E V King. There are all sorts of enhancements to the design for the experimenter could indulge in, such as:

1: Change the anode bend detector for an infinite impedance type with 100% feedback, and follow this with a triode or pentode amplifier to make up for the loss of gain. The reduced tuning coil loading would effectively increase the "Q" and thus selectivity.

2: Try a cascode RF amplifier, and see how reaction is affected.

3: Try EF50 type valves, or some other suitable types. The EF50 emission does tend to go down with use, so what are the chances of finding ones in good condition these days? Are these microphonic when applied as detectors? The good old SP61 was practically indestructible.

4: Add an additional SP61 RF amplifier with a three gang tuning condenser. For strong stations an RF gain control would be required, but easy to do.

5: Add a treble/bass tone control circuit, and negative feedback as the 6V6 valve has plenty of gain.

6: Try different coils i.e. Denco (Clacton) Ltd Maxi-Q plug in types. See Figure 11, reproducing their circuit suggestions and data information.

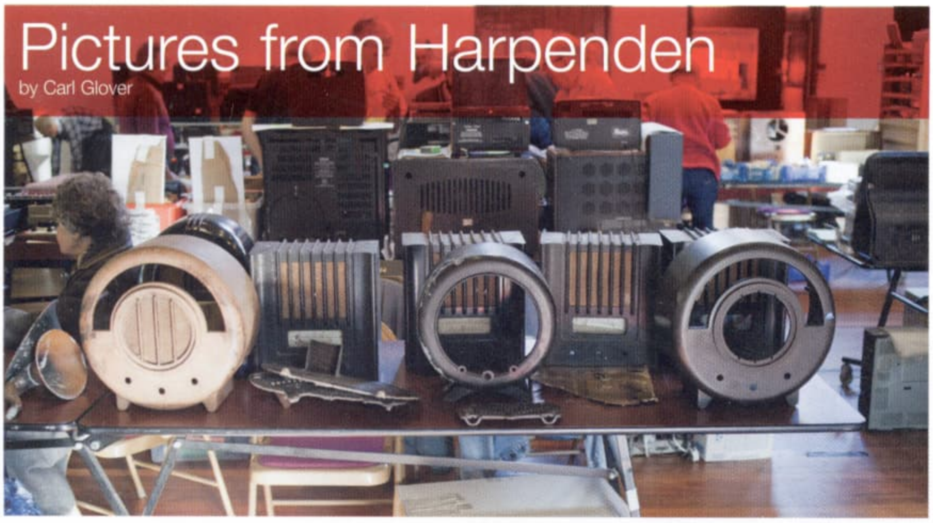
The actual performance achieved with the Wearite P series coils used in this design was: Medium Wave range 1680kc/s(178mtrs) to 500kc/s(600mtrs) Long Wave range 380kc/s(789mtrs) to 134kc/s(2237mtrs) Not one whistle anywhere!

To convert: mtrs=299820/kc/s

My father allowed me to drill a hole in the frame of my bedroom window in order for me to erect a 100ft aerial down to the plum tree at the bottom of our back garden. I soon had to install corks along the aerial to stop the birds committing suicide, especially the pigeons. I got my first mains shock off the selenium rectifier, feeling it to see if it was warm. Lesson number one – don't do that again. Such memories of long school summer holidays, sunshine, my cat Snowy sitting on the bench watching every move, Radio Luxembourg and my wireless that worked.

Pictures from Harpenden

by Carl Glover



Letters

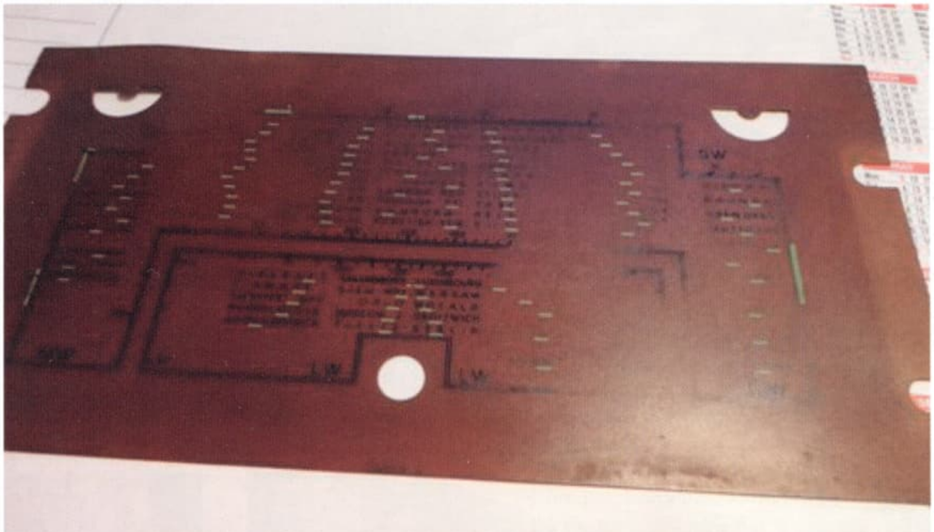
Dear Editor,
I felt that I must write to you about an experience (some pleasant some not). On the 28th Sept 2014 I attended the meeting at Harpenden where I purchased an HMV 499 radio. Because I was feeling quite ill, (I have been diagnosed with CFS/ME), I left with my purchase before the Auction time. As soon as I got home, having completed the normal checks, I switched it on and it was as described, in working order.

Being an impatient man (aren't we all), I couldn't wait to dismantle it, my main intention being to clean the dial – it wasn't bad anyway. Prior to this had been cleaning the valves with methylated spirit, it's my way. To digress just a little, we had been looking after our neighbours cats and my wife arrived at my workshop door, to announce that she had got the cats in and fed them.

Being distracted I picked up the meth's cloth instead of the dampened tissues and cleaned the dial, completely, removing a lot of of the markings. Having remarked a few times "Oh dear" or similar, whilst I decided what was to be done. I subsequently emailed Gary Tempest, who, whilst being sympathetic, obviously couldn't help much. During what was to be some protracted mailings between us regarding the dial, he mentioned a company in the USA who he thought may be able to help They are fantastic and are called "Radio Daze LLC and live at 3870 Rush Mendon Road. Mendon NY 14506 USA.

I am unable to praise them enough. What appeared to me to be a total loss, turned out to be better than a 100% replacement dial. John is their graphic designer and you will find him most helpful and truly works wonders. Should any reader need further details or be in a similar "pickle", I will be pleased to help. The unpleasant bit, apart from wiping the dial, when I sent the dial to the USA, it went missing for some time and it wasn't tracked, it seems that you can track it but at a considerable cost. It appeared but after 20+ days. The pleasant bit – because of the excellent Bulletin I was able to contact Gary Tempest for his help.

Trevor Sargeant



Dear Editor,
With regard to the article by Robert Lozier on the restoration of a 1928 Solodyne receiver, the Siemens bias cells type SG which he replicated were marketed as being 0.9 volt, a copy of a R.Cadisch catalogue for 1932-3 has two types of Siemens bias cells, type GT (1.5 Volts) and type SG (0.9 Volts), the type SG at 1 shilling being more expensive than the GT at ninepence. I also made a replica of the SG cell for a marine Marconi 352A receiver, the missing bias cell is shown on the circuit diagram of the set as 0.9 volt. Luckily a friend also had one of these receivers which had the cell present which I was allowed to remove to make a copy. The later cells seem slightly different than the ones in Mr Lozier's set in having terminals on either end, they also came with cardboard tags at each end for permanent attachment to the baseboard. Does any reader know what type of dry battery technology would be used in a 0.9 volt cell?

Regards, Mike Butt.

Dear Editor,
Thanks to Stef Niewiadomski for the fascinating article on the Champion Emstonette in Bulletin No 39. As Stef correctly pointed out, we have one in the newly refurbished radio room at Seaford Museum (photos of the opening were in the Spring 2012 edition of the Bulletin). But what he, and other readers, may be unaware of is why Seaford is so interested in the history of Champion radios. The answer is that the factory and manufacturing plant were originally based in Seaford, but the premises burned down in the 1940s and production was transferred to a new facility down the coast in Newhaven.

I have been fortunate enough to have a hand in the design, layout and maintenance of the radio room at Seaford (which is housed in a Martello Tower) and we are constantly on the lookout for Seaford manufactured Champion radios to add to the collection. The Museum is much more than just the radio room and is really worth a visit, so if you are down Sussex way, do call in - more information can be found at http://www.seafordmuseum.co.uk and I can be contacted via info@seafordmuseum.co.uk.

With all good wishes,
Bryan McAlley

Pictures from Wootton Bassett

by Greg Hewitt

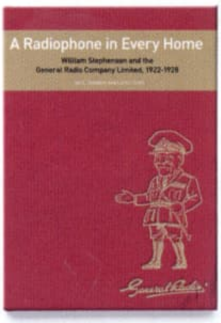
Marconi 703 Mastergram of 1937, it fetched a price of £11,000

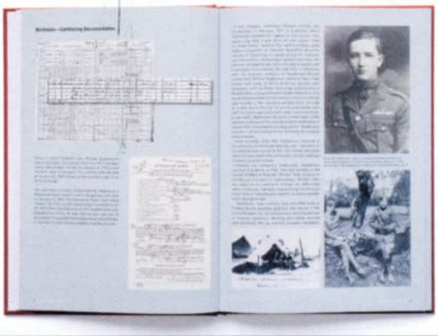
A Wells-coated Ekco aAD65 in blue

Out Now!

A Radiophone in Every Home - William Stephenson and the General Radio Company Limited, 1922-1928

by Ian L. Sanders and Lorne Clark, with foreword by Jonathan Hill. Published by Loddon Valley Press. ISBN 978-0-570773-0-0.



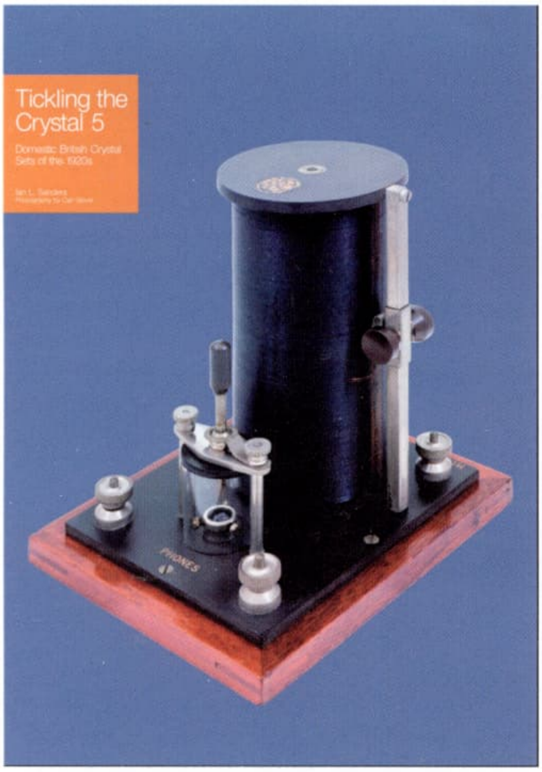


Between 1922 and 1927, during the life of the British Broadcasting Company (forerunner of today's British Broadcasting Corporation), literally hundreds of wireless manufacturing firms sprang up to take advantage of the new craze for 'listening-in'. In the fiercely competitive market of those pioneering days, many of these businesses were to disappear within just a few years. While much has been written on the history of the larger companies during this period of attrition, names such as Marconi, British Thomson-Houston, Burndept and General Electric – very little has been published about the smaller to mid-sized enterprises.

In their superbly illustrated new book, Ian Sanders and Lorne Clark tell the fascinating story of one of these smaller firms, the General Radio Company Ltd., and its enigmatic Canadian founder, William Samuel Stephenson, WWI air ace and WWII secret agent, thought to be the model for Ian Fleming's James Bond character. As well as producing an extensive range of radio receivers, the company also worked on the development of mechanical television.

This high quality publication is available for immediate despatch, price £19.95 (£17.95 for BVWS members) plus £4.95 P&P for UK, £7.50 P&P for EEC. BVWS members should quote their membership number in order to secure the discounted price. Payment via PayPal accepted.
For North America/Asia Pacific enquiries and orders: loddonvalleypress.us@gmail.com or write: Loddon Valley Press (North America), 1175 Teresa Lane, Morgan Hill, California, 95037, USA.
For UK/EEC/RoW enquiries and orders: loddonvalleypress@gmail.com or write: Loddon Valley Press, 16 Kibblewhite Crescent, Twyford, Berkshire, RG10 9AX, UK (note on paying by cheque: only sterling cheques drawn on UK bank, made payable to 'Lorne Clark' will be accepted).
Also available from BVWS stall and BVWS: Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG chairman@bvws.org.uk

BVWS Books



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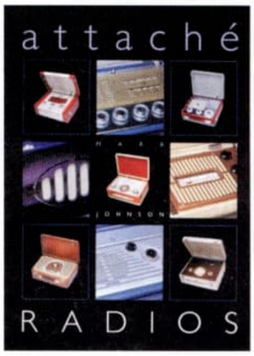

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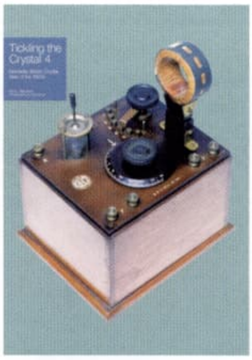

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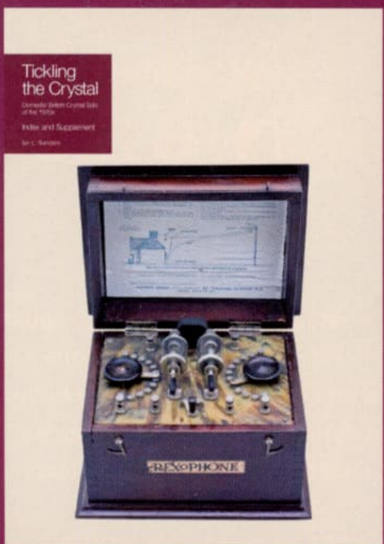
Out Now! Tickling the Crystal index and supplement



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5th July 2015
Royal Wootton Bassett

The Memorial Hall, Station Rd. Wootton Bassett.
Nr. Swindon (J16/M4). Doors open 10:30.
Contact Mike Barker: 01380 860787

Events Diary

2015 Meetings

March 1st Harpenden
April 12th Golborne
May 10th NVCF
June 6th *A memorial to the man in the white coat*
12 - 6pm The Vintage Wireless and Television Museum, West Dulwich
June 7th Meeting at the Cinema Museum.
2 Dugard Way (off Renfrew Road) London SE11 4TH.
See advert in Bulletin insert for further details.
July 5th Royal Wootton Bassett
August 2nd Punnetts Town
September 13th Murphy Day
September 27th Harpenden
October 4th AudioJumble
November 1st Golborne (changed from 8th due to Remembrance Day)
December 6th Royal Wootton Bassett

GPO Numbers

Martyn Bennett is the custodian of the BVWS GPO Registration Numbers list. As many members know, the project of assembling this list was started in the early days of the BVWS and was carried on by the late Pat Leggatt. Members are strongly urged to help build the list, whenever they get the opportunity, particularly as it is something that will help with the identification of vintage wireless in years to come. The list is by no means complete and the GPO no longer have a record of the numbers granted to wireless manufacturers. The BVWS Handbook contains the current listings - one in numerical order and one ordered by name. Please let Martyn have any additions, or suggestions for corrections, by mail or over the phone.

Martyn Bennett, 58 Church Road, Fleet, Hampshire GU51 4LY
telephone: 01252-613660 e-mail: martyb@globalnet.co.uk

The British Vintage Wireless and Television Museum: For location and phone see advert in Bulletin.
Harpenden: Harpenden Public Halls, Southdown Rd. Harpenden. Doors open at 9:30, tickets for sale from 09:00, Auction at 13:00. Contact Vic Williamson, 01582 593102
Audiojumble: The Angel Leisure Centre, Tonbridge, Kent. Enquiries, 01892 540022
NVCF: National Vintage Communications Fair See advert in Bulletin. www.nvcf.co.uk
Wootton Bassett: The Memorial Hall, Station Rd. Wootton Bassett. Nr. Swindon (J16/M4). Doors open 10:00. Contact Mike Barker, 01380 860787
Golborne: Golborne: Golborne Parkside Sports & Community Club. Rivington Avenue, Golborne, Warrington. WA3 3HG contact Mark Ryding 07861 234364
Punnetts Town: Punnetts Town Village Hall, Heathfield, East Sussex TN21 9DS (opposite school) Contact John Howes 01435 830736
Mill Green Museum: Bush Hall Lane, Mill Green, Hatfield, AL95PD
For more details with maps to locations see the BVWS Website: www.bvws.org.uk/events/locations.htm

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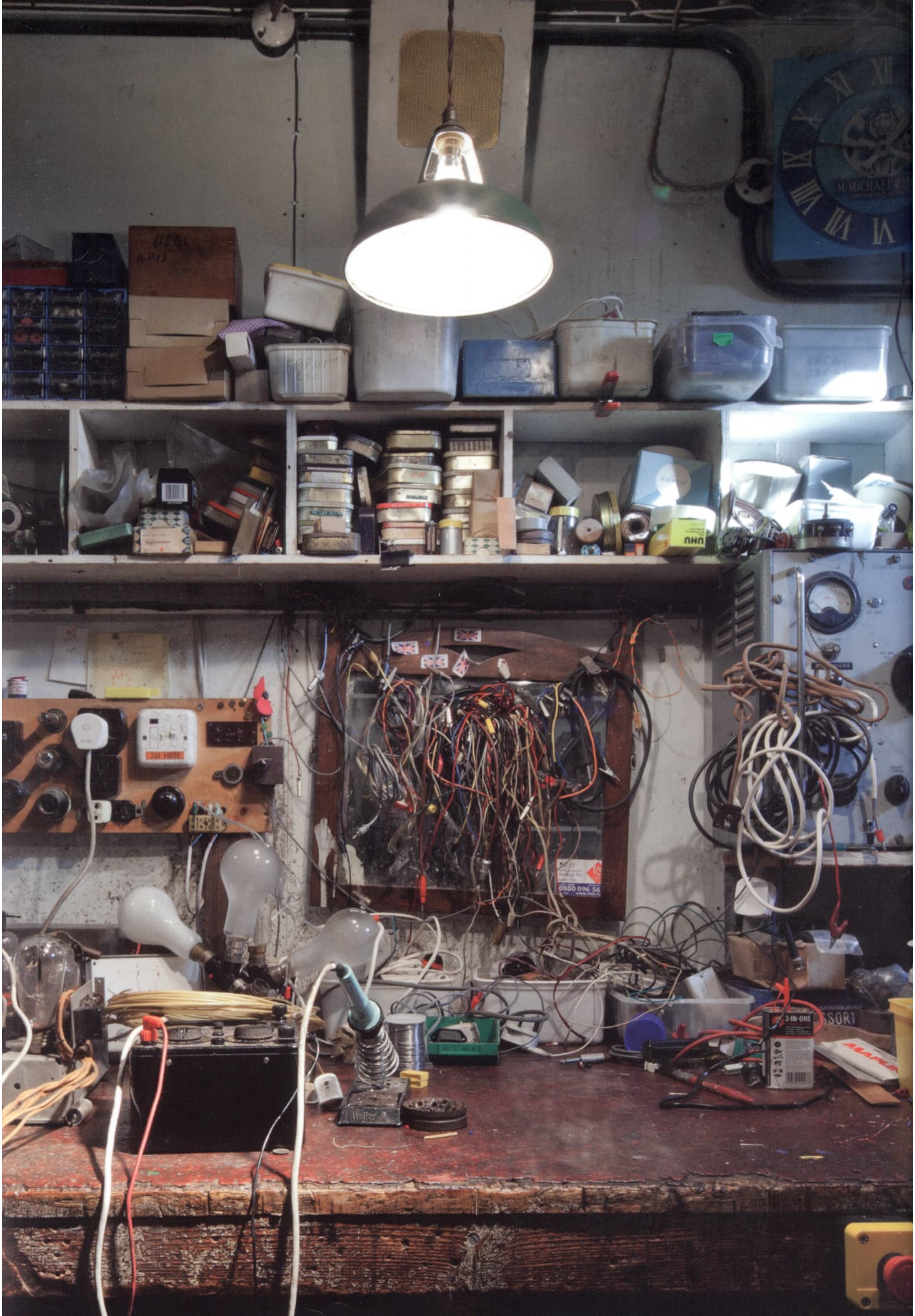
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