The Bulletin

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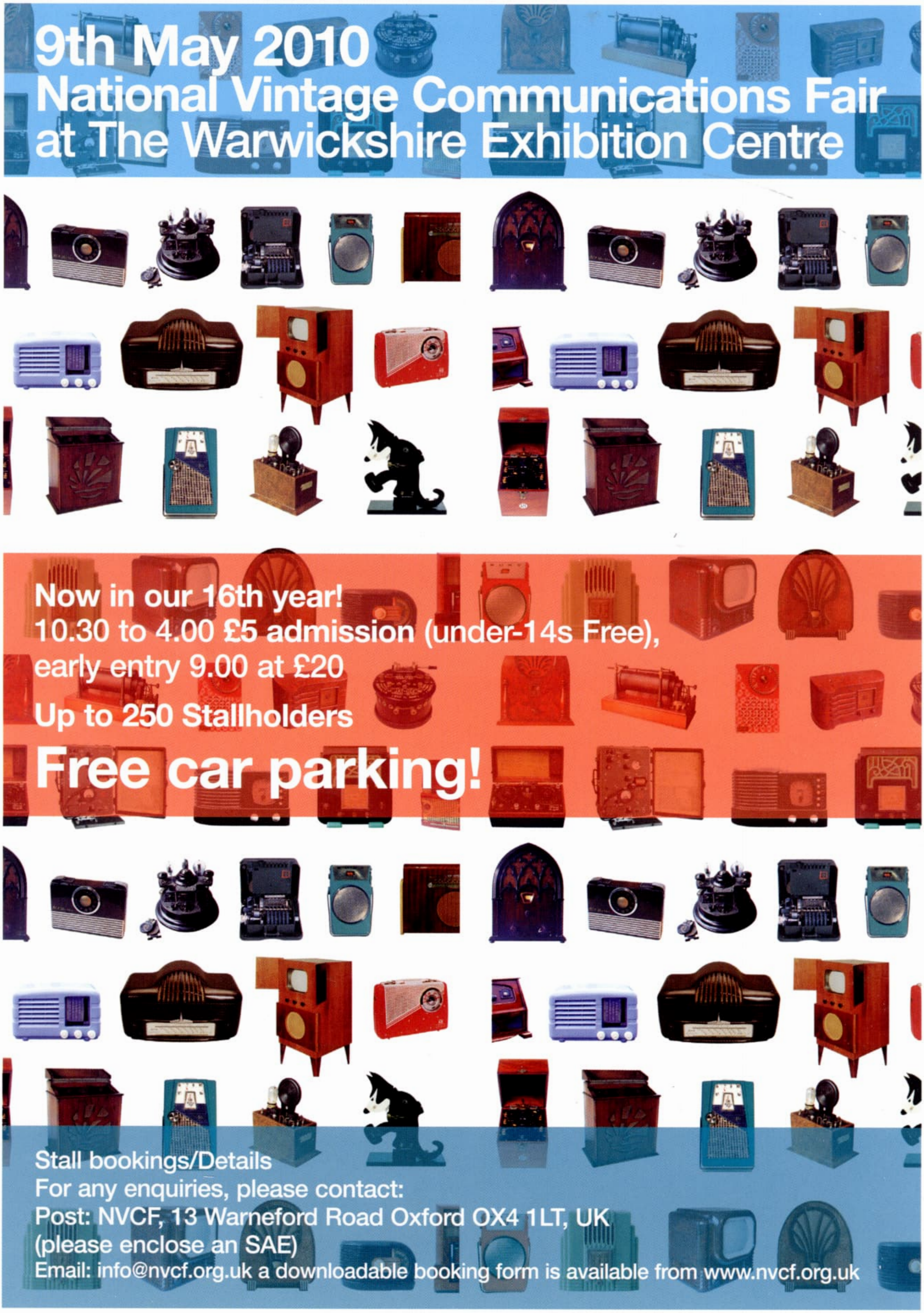
9th May 2010
National Vintage Communications Fair
at The Warwickshire Exhibition Centre
Now in our 16th year!
10.30 to 4.00 £5 admission (under-14s Free),
early entry 9.00 at £20
Up to 250 Stallholders
Free car parking!
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BVWS team

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,
5 Templewood, Ealing,
London W13 8BA
Tel/Fax: 020 8998 1594

Treasurer:
Jeremy Day
3 Sterling Crescent,
Hedge End, Southampton
SO30 0SA
treasurer@bvws.org.uk

Ordinary Committee Members:
Jon Evans
Tel: 0121 5447006

Martyn Bennett
Tel: 01252 613660

Membership Secretary:
Graham Terry
26 Castleton Road
Swindon, Wilts SN5 5GD
Tel: 01793 886062
membership@bvws.org.uk

Harpenden Organiser:
Vic Williamson,
Tel: 01582 593102

Technical TV Correspondent:
David Newman,
405alive_correspond@bvws.org.uk

Electronic Media Production:
Terry Martini,
Tel: 07947 460161

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

Webmaster:
Paul Stenning
webmaster@bvws.org.uk
PO Box 15, Hereford
HR4 9WX

Bulletin of the British Vintage Wireless Society
Incorporating 405 Alive
Volume 35 No.2 Summer 2010

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Separations and Printing by Hastings Print

Honorary Members:
Ralph Barrett | Gordon Bussey | Dr A.R. Constable
Jonathan Hill | David Read | Gerald Wells

Front: 'Table Model' by Radio Acoustic Products Ltd, 1946.
Rear: 'Rexophone' by Morch Brothers, 1924.
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,
Ian Higginbottom and Peter Merriman

Contents

2 Advertisement
3 From the Chair
4 Morch Brothers
10 The Ever ready 5218
15 Pictures from Harpenden
18 More musings on the EBL31, including an EBL31/EL84 Adaptor
20 Selecting a Valve Audio Output Transformer
28 Audiojumble 2010
32 The Hacker that came in from the cold
34 Supersonic Heterodyne
35 Marconi on view
36 The Murphy A362
38 Letters
41 BVWS and NVCF accounts
41 Advertisements
45 Advertisements, back issues
46 News, Advertisements
47 Advertisement

From the Chair

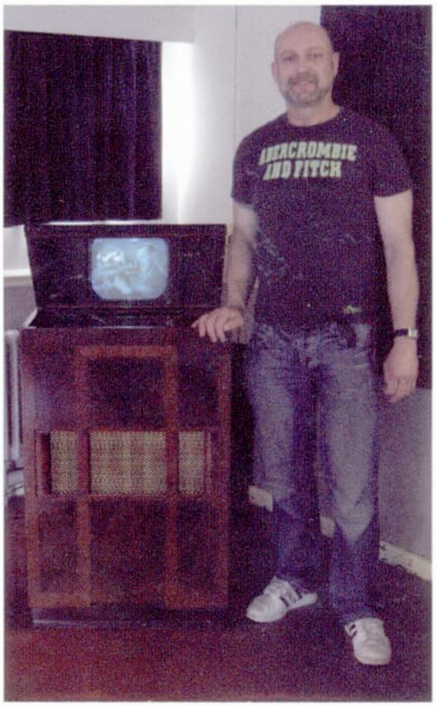
How quickly the time has passed from when I last wrote for these pages and so soon it will be the NVCF. With a good wind behind us and a small amount of luck you may even receive this prior to the event. This year there will be a display of Radiograms running and playing period music from 78's and early LP records to entertain everyone. No, we won't be playing George Formby records all day long!

We have had to delay the production of the Members Handbook until later this year due to other commitments so look out for it and the car sticker with a later Bulletin.

BVWS Capacitor stocks are being replenished and additions to the range to include single value smaller can type Electrolytics for the re-stuffing of chassis mounted screw fixing originals are being stocked. These will be in 16uF and 32uF values and have high ripple current ratings the same as all other dual cans and are very suitable for smoothing applications. So far we are unable to persuade the manufacturers to produce lower values, but we are also looking into getting these made with the chassis screw fixing as I direct replacement for many pre war sets. This may take a while and with the Euro and Pound being near equal the prices of the new stocks may have to increase a little but we will do our best to keep the prices as low as possible to cover our costs.

Ian Higginbottom has been quite poorly of recent weeks and we all wish him a very speedy recovery.

Mike...



Baird 240 Line system at BVWS Lowton meeting.

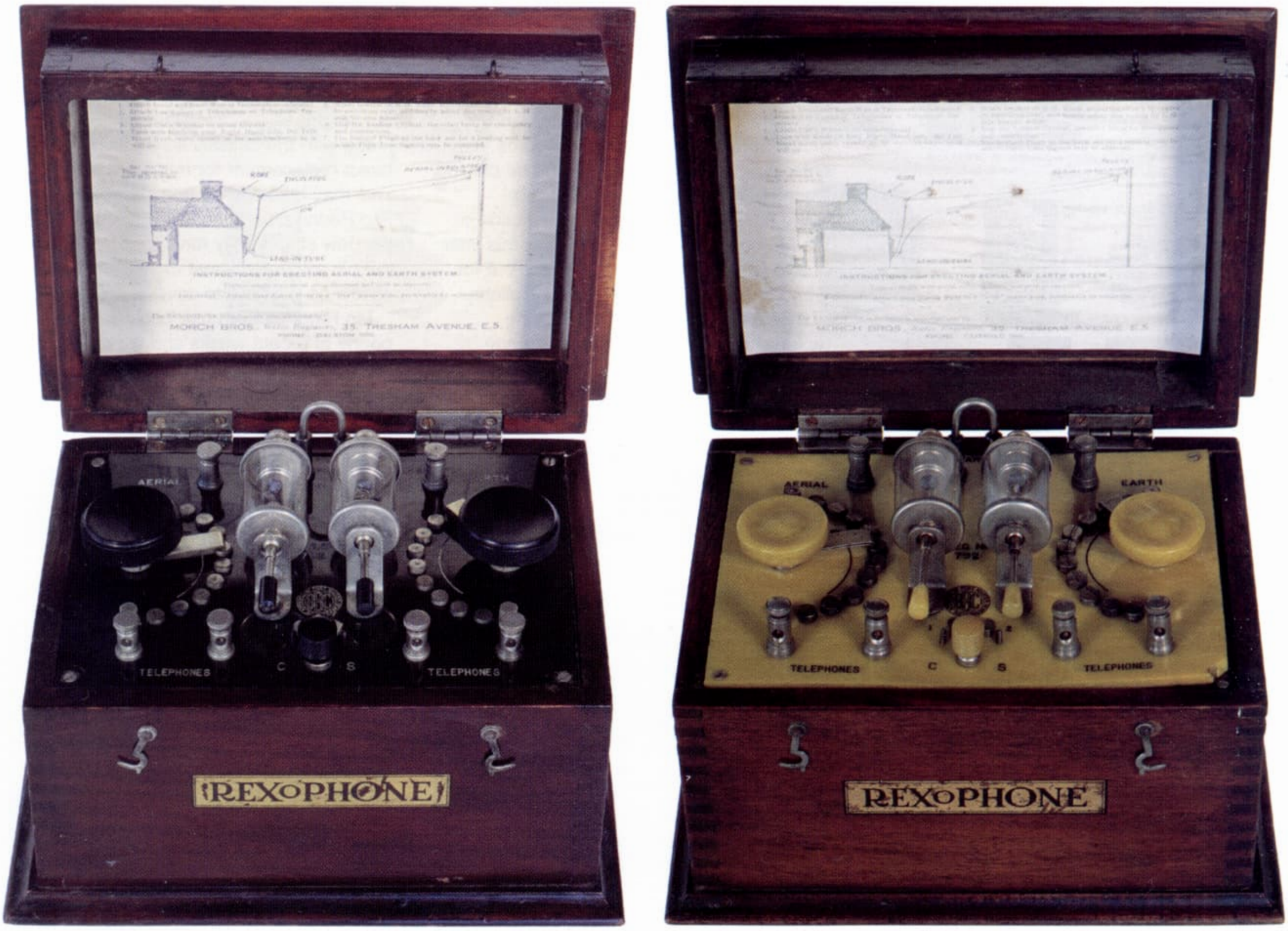
At the recent BVWS Lowton meeting history was made. A fully restored Marconi 702 Television of 1936/37 vintage was displayed running both the EMI 405 Line system and the 240 Line Baird system. The TV belongs to Russell Atkinson and was purchased last September from the Bonhams auction.

It was restored byMike Barker and given that it is 73 years old and has one of the early style Emiscope 6/6 tubes gave a remarkably bright and clear picture.
It was noted that although the 240 line system has significant flicker being 25Hz and no interlace, the picture quality and definition was almost as good as 405 line.
An Aurora world standards converter was used to produce the 240 line source and we would like to thank Jeff Borinsky for loaning the converter for the display.
The Marconi 702 will also be on display at Harpenden in June.

Morch Brothers

by Lorne Clark, Ian L. Sanders and Chris Simmonds

Jacob Johannus Morch was born in Frederikshaven, Denmark on 21st July, 1888, the son of an engineer[1,2,3]. It is not clear when Jacob moved to England, but in the early 1920s he and his brother, Johannes, were engaged as Morch Brothers: Motor Engineers operating at 35, Tresham Avenue, Clapton, East London. The motor business was by all accounts not a success and, in the autumn of 1923, the pair started the manufacture of wireless sets, but were soon handicapped by a lack of capital. Morch sought substantial loans from his wife, Gladys, (who must have had access to an independent source of funds) and from a business associate, Olaf Emil Nielsen, on the understanding that a new company would be formed and debentures created and issued in respect of these advances.

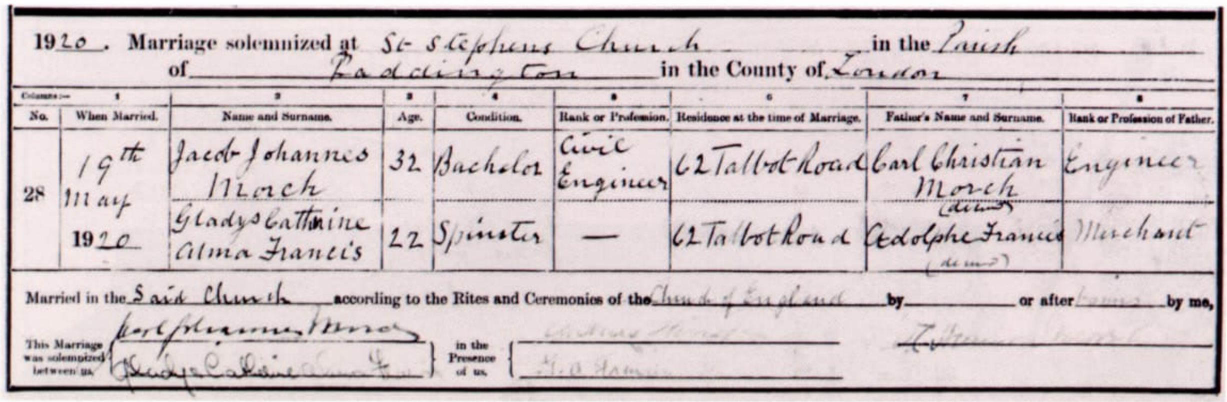


The Rexophone Super Twin crystal receiver by Morch Brothers featured a panel and control knobs fabricated from Xylonite, and was available in an remarkable number of different colours. Black and yellow are the most common among surviving examples. Shown here (page 5) is a rare marbled model.

A wireless company was duly registered by Jacob J. Morch in early December 1924 and the new entity formally incorporated as Morch Brothers Limited on December 31st, with a nominal capital of £1,000. The first Directors were Jacob Johannus and Gladys Morch, both listed as British subjects. Jacob Morch was appointed Managing Director in January 1925 and it appears that Olaf Nielsen also became a director of the company some short time later. Jacob's brother, Johannes Morch, was employed as the company's foreman. The company manufactured wireless receivers under the Rexophone tradename at the original Tresham Avenue premises, and also operated a nearby retail shop on a weekly lease at 32, Lower Clapton Road, London.

Within a few months, the new wireless company ran into financial problems, apparently aggravated by the refusal of a wholesale customer to take a large number of pre-ordered receivers. The petition to liquidate the company was made by Joseph Wyattt, Director of Wireless Warehouses Limited (themselves destined to be in voluntary liquidation by October 1925!) and papers for the closing of the company were drawn up on June 26th, 1925. While the company cited illness of the Managing Director as the cause, the opinion of the Official Receiver was that failure was actually due to an entire lack of working capital. A liquidator was appointed in November of that year. Interestingly, on a list of creditors dated June 17th, 1926 is the Reflex Radio Company, who were owed the sum of £19 12s. 6d. The connection between Morch Brothers and Reflex Radio is not known, but it is interesting to note that the latter operated from 198, Lower Clapton Road, quite close to Morch Brothers' retail premises.

Between 1923 and 1925, the company manufactured crystal sets and a full range of companion amplifiers and one, two, and three-valve receivers. Curiously, very few advertisements for any of these products



1920. Marriage solemnized at St Stephens Church in the Parish of Paddington in the County of London

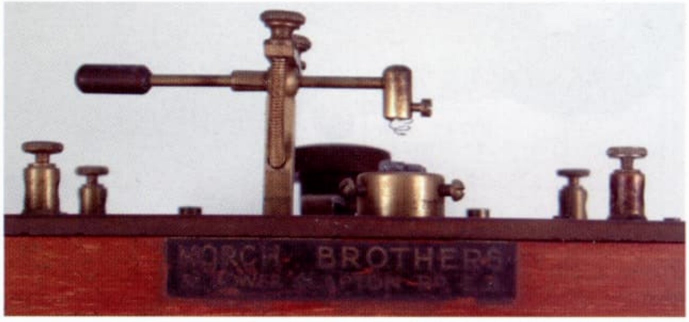
No.	When Married.	Name and Surname.	Age.	Condition.	Rank or Profession.	Residence at the time of Marriage.	Father's Name and Surname.	Rank or Profession of Father.
28	19th May 1920	Jacob Johannes Morch	32	Bachelor	Civil Engineer	62 Talbot Road	Carl Christian Morch	Engineer
		Gladys Catherine Alma Francis	22	Spinster	—	62 Talbot Road	Adolphe Francis (deceased)	Merchant

Married in the Said Church according to the Rites and Ceremonies of the Church of England by ______ or after Banns by me,

This Marriage was solemnized between us, Jacob Johannes Morch, Gladys Catherine Alma Francis; in the Presence of us,

A copy of Jacob Morch's marriage certificate shows his profession as a civil engineer and that of his father as simply an engineer.

Martyn Bennett Collection



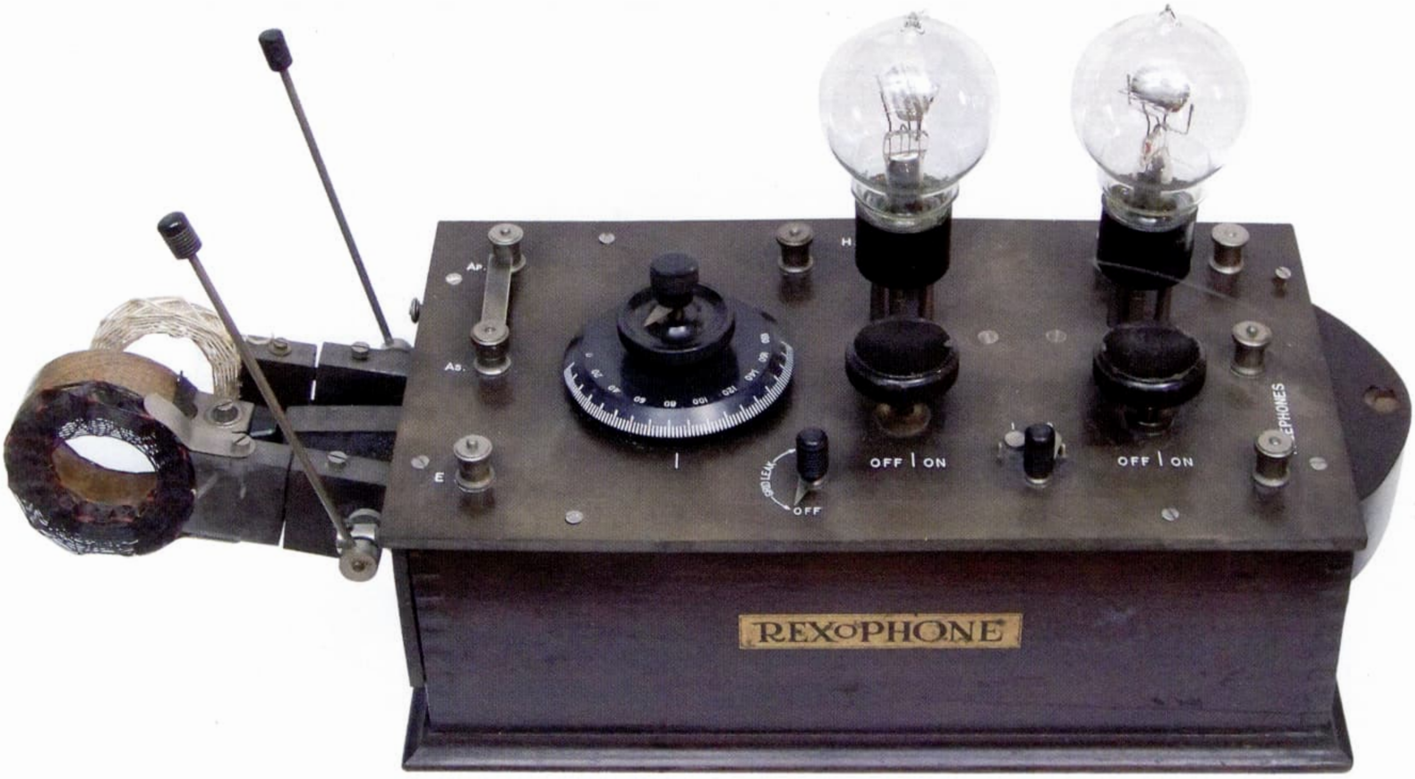
Details of the unusual detector U-clamp detector assembly

Another example of a Rexophone crystal receiver

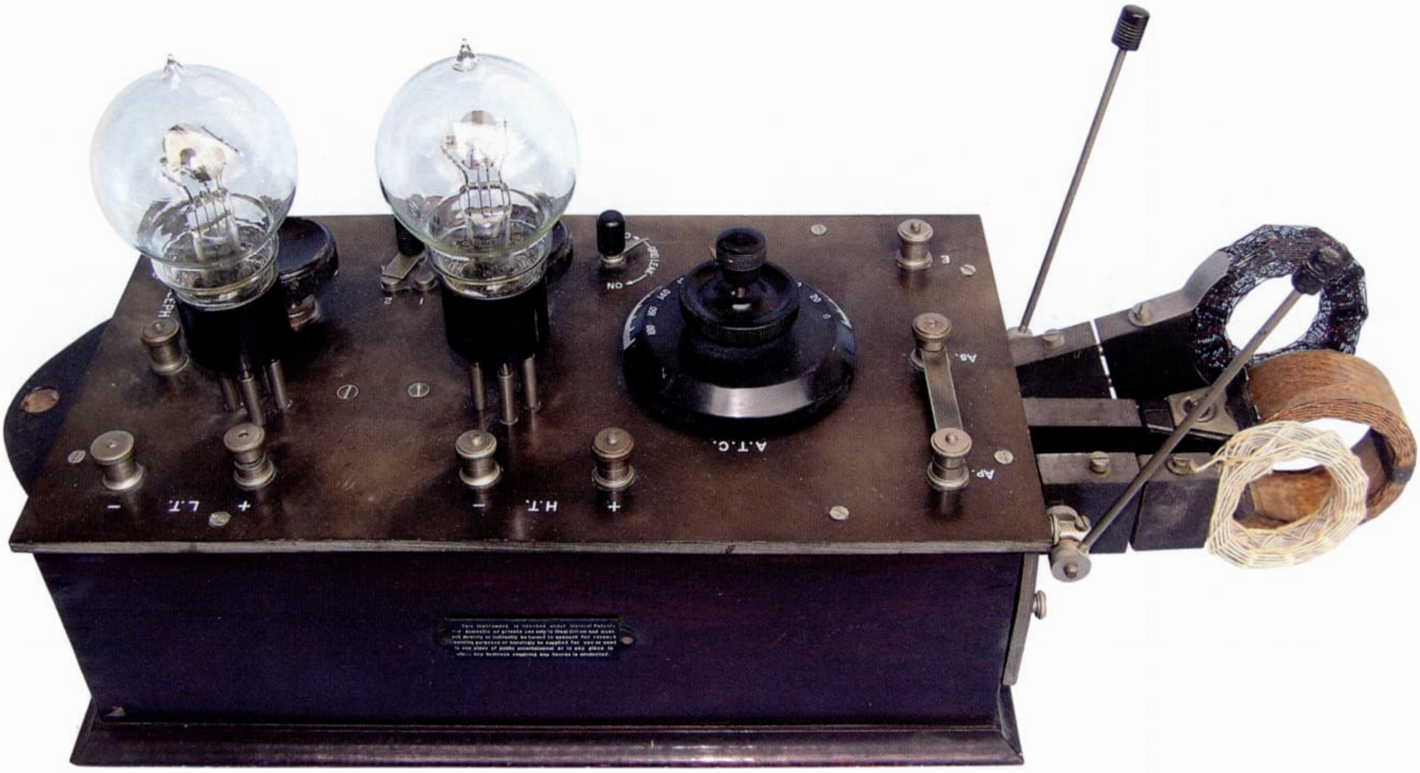
show up in the popular contemporary journals and wireless magazines. (From the list of creditors in the papers drawn up at the winding up of the company, it appears that for some reason Morch Brothers restricted their advertising to the Engineering Supplement of the Daily Mail Overseas Edition and The Wireless Trader and The Wireless Export Trader published by The Trader Publishing Company, London. Apparently the company decided to pay particular attention to the wireless trade and to the export market for sales of their apparatus.)

Four Rexophone crystal set types by Morch Brothers are known. The most commonly found model, the Super Twin – introduced in late 1923 – was of notable quality and housed in a highly finished "Sheraton" mahogany case. The distinguishing characteristic was the use of Xylonite for both the control panel and control knobs, in place of the usual ebonite. Produced by the British Xylonite Company, Xylonite was a cellulose product capable of being coloured, and could be polished to fine finish. Crystal sets were offered in an astonishing variety of colours, including black, yellow, brown, red, blue, grey, tortoise-shell, onyx, marble and even purple[4] – almost certainly the largest selection of any known manufacturer. Another feature was the use of twin glass-enclosed detectors with a selector switch on the panel, allowing rapid changeover if one of the detectors gave trouble. Standard fittings were nickel-plated, but gold-plated ones could be purchased for an additional five shillings. The sets employed coarse and fine tapped inductance tuning with provision for a long-wave loading coil, and carried the Post Office registration number, 792, indicating they were likely first manufactured in late 1923. The retail price of the receiver was £2 5s. 0d. A companion Rextension headphone board, allowing up to four pairs of headphones to be connected was offered in 1924 in colours to match the crystal receiver, priced at 7/6d.

In September 1924, Morch Brothers advertised their oddly named Tuellophone Major and Tuellophone Minor crystal receivers. At £1 9s. 0d. and 9/- respectively, they were significantly less expensive than the Super Twin. (Interestingly, the price of the Tuellophone Minor was reduced to just 6/- a month later, making it one of



Rexophone two-valve receiver. Variable grid leak adjustment is below and to the right of the main tuning control. No GPO registration number, but the set carries the Marconi licence tag on the back of the cabinet. Photograph courtesy of Steve O'Bannon, Plano, Texas.



the cheapest crystal sets on the market.) Both were conventional, variometer-tuned designs of straightforward appearance – the former housed in a mahogany cabinet with a lid and having provision for a long-wave loading coil while the latter was medium-wave only and built in an open oak or leatherette case. The control panels seem to have been of standard ebonite, so it appears that the use of Xylonite was discontinued, presumably to reduce cost.

Morch Brothers are known to have produced a fourth model of crystal receiver, about which little is presently known. For medium wave only, the set had no visible registration number, but carried the company name and address along with the BBC approval stamp on the rear of the cabinet and an oversized, ostentatious Rexophone trademark on the front. While the exact date of manufacture is unknown, it was probably introduced around the middle of 1924 and from the few surviving examples it was likely made in small numbers. Otherwise unremarkable, the model featured an atypical "u-clamp" type detector arm.

One and two valve Rexophone amplifiers were offered in late 1924 to be used with the company's Super Twin crystal receiver. The units were designed to be placed neatly beneath the crystal set when in use, and featured a vertically mounted side control panel. However, priced at £2 17s. 6d and £5 2s. 6d for the one and two valve models, respectively, it is unlikely that they would have been sold in any numbers.

The Wireless Trader, October 1924. This two-page spread shows a comprehensive range of "Rex" products.

The Wireless Trader, June 1924. Morch Brothers seemed to have favoured the trade journal, The Wireless Trader, for their advertisements over other more widely read wireless journals of the period.

Rexophone three-valve receiver. (Frame aerial holder is not present on this example.)

Morch Brothers advertised a number of crystal detector assemblies throughout 1924, including an unusual twin detector unit, known as the Rex Double Rectifier. Consisting of two cat's-whisker arm assemblies contained in one glass enclosure, it was not a true double detector in that both contacts were made to a single crystal. It was advertised as "the only detector which can be used in 52 different ways" for application in oscillatory and double amplification circuits, but was apparently not used in any of the company's products.

The company ventured beyond crystal sets into the production of one, two and three valve receivers in the second half of 1924. The Rexophone valve sets were fairly typical of the period, employing a combination of condenser and variable inductance tuning with reaction by means of a swinging, three-coil assembly attached to the side of the cabinet. However, a panel-mounted, variable grid leak on the detector valve (the so-called Rex Reel – a contact running along a piece of carbon-coated paper) was an uncommon feature on commercial sets of the mid-1920s, and would have added to the complexity of operation. The receivers incorporated a holder for a frame aerial fixed to the right-hand side of the cabinet. The two- and three-valve models also included a panel switch to allow the user to select the number of valves in operation. Considering the price of the Super Twin crystal set and companion amplifier, the retail pricing on the valve receivers was surprisingly competitive compared with other manufacturers of the time: £2 12s. 6d., £4 12s. 6d. and £6 17s. 6d. for the one, two and three valve models, respectively. Frame aerials could be purchased for an additional 7/6d.

Existing examples of Morch Brothers' valve sets are extremely rare and the relatively crude internal layout and construction of the few that have survived almost gives the impression of "one-off" designs. Some idea of production numbers, however, can be gleaned from papers drawn up at the dissolution of the company. These indicate that in January 1925 Morch Brothers ordered twelve sets of parts each for two and three-valve receiver cabinets and twenty-four sets of cabinet parts for one-valve receivers from W. Silk & Sons of Homerton, London. It is quite possible, then, that production of these receivers lasted for only four or five months before the company was disbanded and sales could have been limited. On the other hand, the statement of the Company's affairs dated 21st May, 1925 reveals the sum of £191 17s 6d owing to The Marconi Company – an account dated March 1925. Could this have been for royalty payments which would have been at the rate of 12s. 6d. per valve holder? If so, then it would mean that over three hundred valve holders had been incorporated into the company's products. (In the end, Jacob Morch appears to have reached an agreement whereby the Marconi Company settled for £100.) A further interesting transaction appears in the "Miscellaneous Expenditure" account where there is an entry for "royalties" in the amount of £106 5s. 0d. Could these be BBC Royalties? If so, this would also suggest substantial sales of receivers.

The most impressive of the Morch Brothers products, visually at least, was the "Famous 2-Valve Cabinet Model" – self-described by the manufacturer as the "Sensation of the Season". Basically the earlier two-valve receiver housed in a substantial, consul-type cabinet with doors featuring oversized oval windows and a self-contained battery compartment, the set was offered in December 1924, presumably in time for the holidays. The retail price was just £6 12s. 6d.

At the winding-up, the assets of the company were estimated at £453 6s. 0d. with a total of £354 17s. 10d. claimed by debenture holders and a further £51 13s. 0d. as "Preferential Claims" – rates & wages. This would ordinarily have left about forty six pounds for distribution amongst the various (and numerous) unsecured creditors. In the end, disposal of the company's assets realised only the sum of £183 14s. 3d., leaving nothing for the creditors. Nevertheless, Charles Latham, the official receiver, managed to establish that all the debentures (held by Olaf Neilsen and Gladys Morch) were invalid as they were issued within three months of commencement of the company liquidation. The Preferential Claims were similarly invalid. This released the full cash assets – less legal fees – for distribution amongst the unsecured creditors. Protracted efforts were made to recover an alleged book debt of ninety pounds from a firm in Ireland, but to no avail. Charles Latham also conducted ' … a most thorough investigation into the company's affairs …' as a result of which, according to Latham, '… light was thrown upon several obscure transactions which had taken place shortly prior to commencement of the winding-up …'. However, given the circumstances and available funds, it was not thought worth pursuing them.

Morch Brothers appear in the London Telephone Directory for April 1923 until April 1925, listed as Motor Engineers of 35 Tresham Avenue. A new entry for October 1925 until the final entry in April 1927 is simply for J. Morch, Motor Engineer. It appears that Jacob Johannus Morch actually emigrated to Canada at the end of November 1926 to work as an engineer for the Canadian Pacific Railway in Montreal, arriving in St. John's, Newfoundland in December of that year[5]. His wife Gladys and their two children, Doreen and Ian (Jan), sailed from Southampton aboard the S.S. Pentland in May 1930 to join him[5].

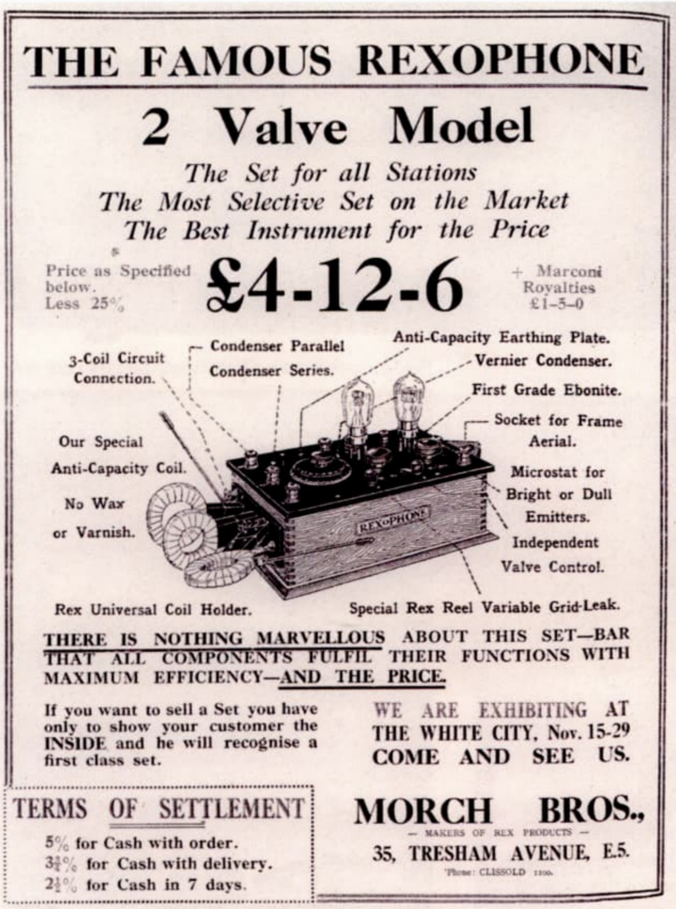
In 1930, Morch traveled via the United States on route to Kingston, Jamaica to work for a period of time for the Stanley Thompson Company (a Canadian company engaged in the design and construction of world-class golf courses), likely connected with the company's interests in the Constant Springs Golf Course in Kingston[1]. Another possible example of Morch's diverse dealings is a Canadian patent dated 15th September 1936 for an ore crushing mill (CA360597A) which may be his.

Jacob Johannus Morch changed his name in later life to John Jacob Morch and died at Bellville, Ontario on 17th February, 1971[2].

The short-lived existence of the Morch Brothers' wireless business was typical of the plethora of small firms looking to break into the new field at the beginning of formal broadcasting. Most entrepreneurs – like Jacob Morch – were unable to compete against the economy of scale that benefited the larger, better established companies. The premises at 35, Tresham Avenue are no more. The flats of Tresham Walk, Hackney now stand on the old location while the Lower Clapton Health Centre now occupies the site of the Morch Bothers' retail shop.

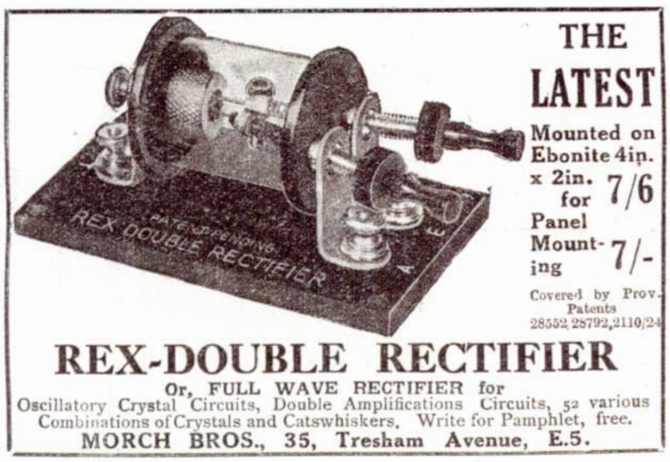
1. Canada to US Border Crossing Records.
2. www.ancestry.co.uk (OneWorldTree).
3. www.ancestry.co.uk (London, England, Marriages and Banns 1754-1921).
4. Hill Jonathan: Radio! Radio! Published Sunrise Press, Devon 1986.
5. Canadian Government Immigration Service Returns (passenger lists).

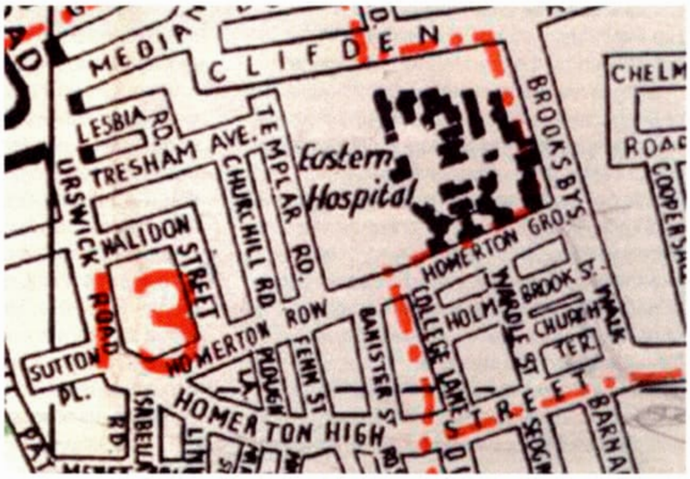
In addition to the above, company-specific information and information relating to the winding up of Morch Brothers Limited was obtained from The National Archives, Kew under the following file references: BT 31/28862/202759, J 13/10873, J 107/228.



The Wireless Trader, November 1924.

The Wireless Trader, December 1924.

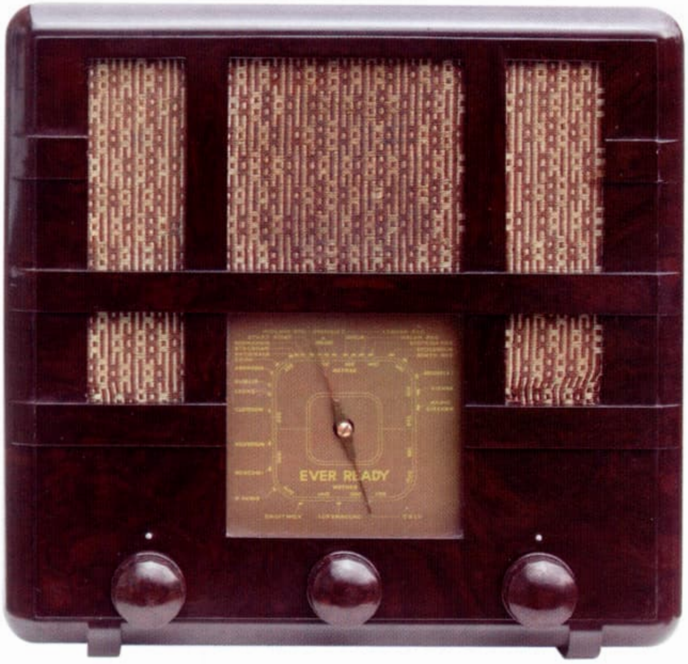


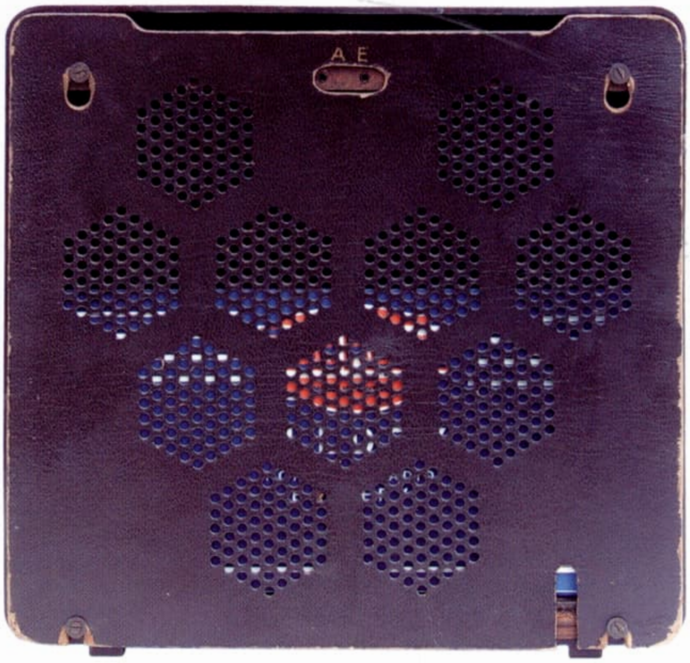


Curiously, one of the only advertisements by Morch Brothers in a popular journal was for the company's *Double Rectifier* – a specialist product with limited appeal at best. *Modern Wireless*, October 1924. Right: Tresham Avenue, E.5. no longer exists, replaced by Tresham Walk, Hackney.

The Ever Ready 5218 A nice little radio full of surprises By Roger Grant.

I first spotted this radio in the window of my local antique dealer, a nice little 1930's Bakelite set was my first impression. The back unhooked from its pegs, an interesting feature, revealing what looked like octal battery valves, on closer inspection they were found to be side contact Ct8 types confirming my initial thoughts.





The DK1, DF1, DAC1 and DL2 series of Ct8 valves, being the first of the 1.4v filament dry battery valves, made this set very interesting. The set's general condition was quite good, just very dusty inside with a few rusty scabs on the chassis and a moderate coating of the usual nicotine protecting the Bakelite. The rubber insulation on the aerial and battery connecting wires was crumbling and falling off, not unusual for a set of this period, the tuning scale celluloid looked a bit yellow and the decal behind it very grey.

Before I start the clean up, a bit of research; the Trader sheet (No 450) says it was first released in 1939, it's the table model version of the Ever Ready portables 5214, 5215 and 5216 with a larger cabinet, frame aerial and speaker. The battery that powers it is an AD3, I've not come across one of these before so I'll have to find its dimensions and what it looks like if I'm going to make one. The circuit diagram looks like the industry standard superhet well established by the time this set was made.

Dismantling the set started with removal of the back, this is just hooked onto some pegs attached to the wooden aerial frame, obviously for ease of battery replacement. At this point curiosity got the better of me and I connected it up to my bench power supply just to see if it worked and it did, very intermittently with a lot of crackle and noise from its very dirty switches, connectors and of course the notorious Ct8 valve holders. Next the knobs, no sign of any grub screws, so they just pull off. The spring clips retaining the knobs are a bit strange, something else I've not seen before.

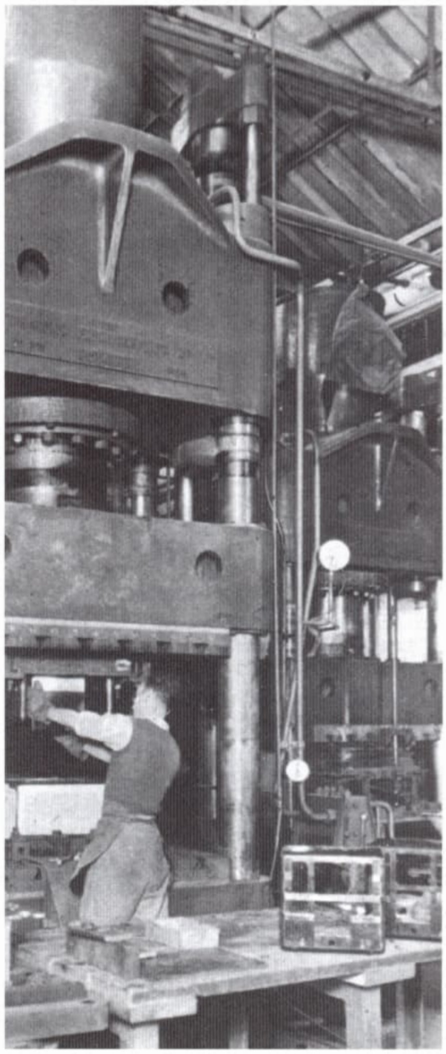
The wooden aerial frame has to be removed before the chassis, this frame is held in place by two woodscrews through the bottom of the cabinet into the bottom wooden support bar of the aerial frame, and two metal arms extend forward to the nuts and washers that retain the speaker baffle.

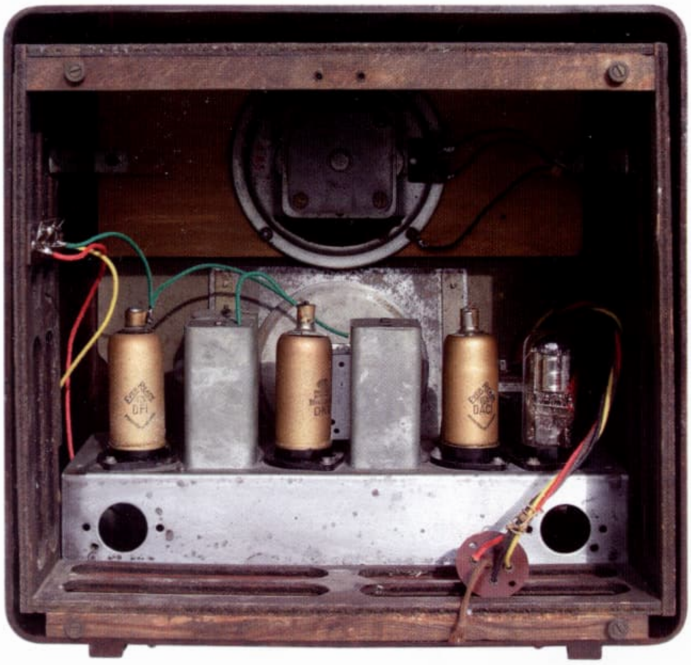
The three connecting wires were unsoldered from the frame aerial, noting which goes to where for when it goes back together, and the frame aerial was removed.
The rear of the chassis is held in place by two 4BA nuts and bolts through the bottom of the cabinet into folded tabs spot welded to the chassis.
The front of the chassis is held in place by the extended threads of the volume control and wave change switch, these are accessed through recesses in the front of the cabinet behind the controls, making the chassis an integral part of the cabinet. These extra volume control and wave-change switch retaining nuts are a bit awkward to get to and required a tube spanner to remove them.

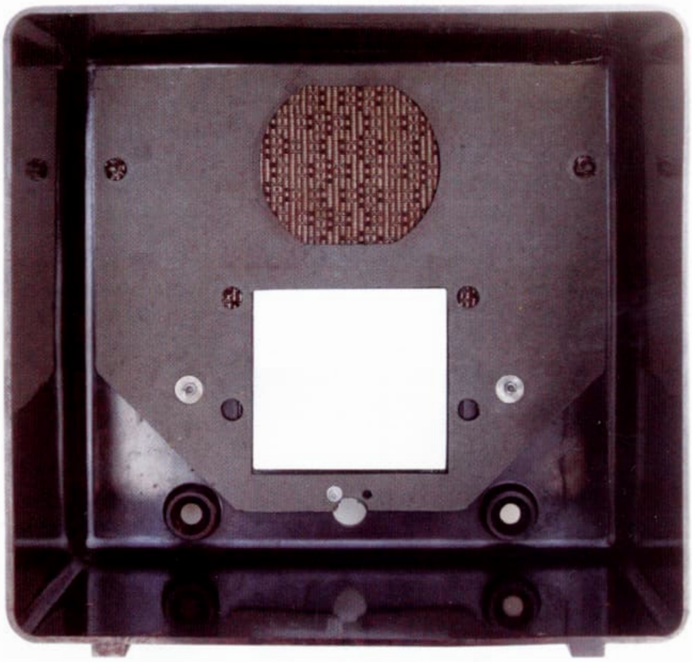
The chassis and speaker on its baffle were removed next. The seventy years of dust and fluff were removed from the inside of the cabinet, the speaker and the chassis, along with the debris from the crumbling rubber wires.

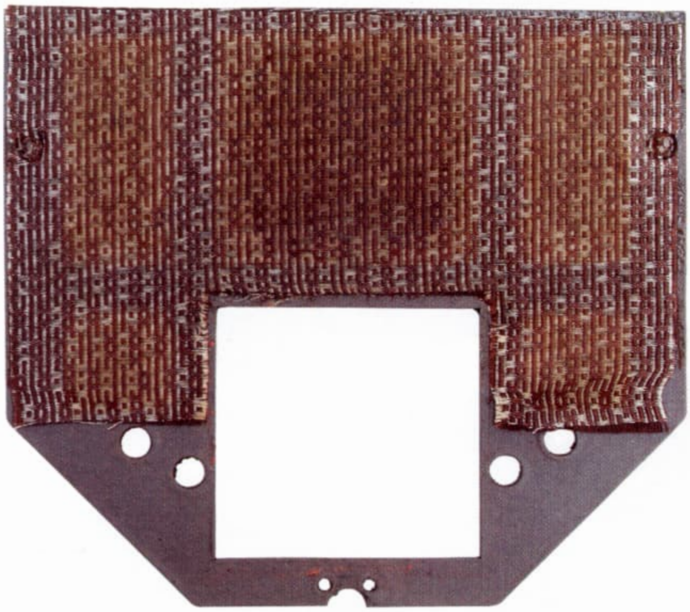
A good look round the chassis revealed no evidence of any repairs. The resistors are the Body, Tip, Spot coded types typical of the thirties, very colourful and all in good condition. A leakage check on the capacitors revealed they were all in reasonable condition, all above 5 megs of leakage, even the 8mfd electrolytic HT de-coupler was

Below: manufacturing Ever Ready bakelite cabinets









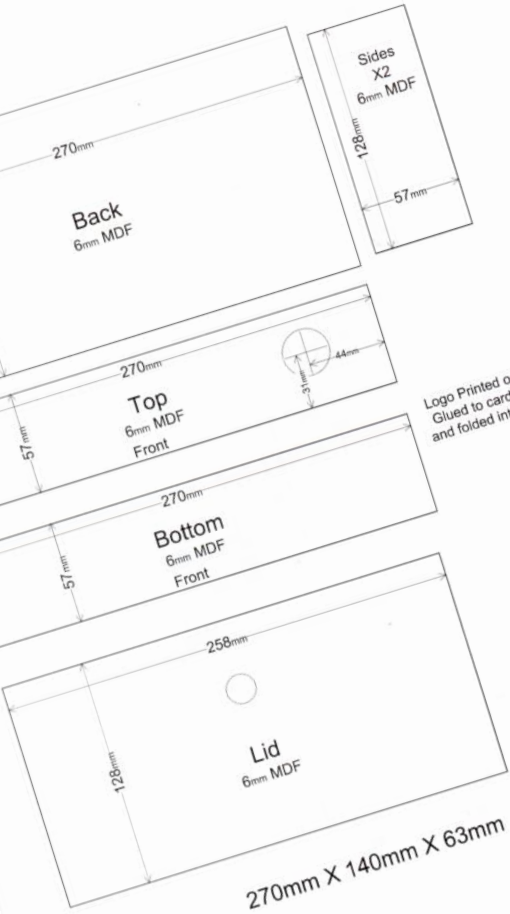
Control shaft recess

still in good shape, a little low on capacity but not enough to warrant changing.

Now with the chassis out of the cabinet the true colour of the tuning scale is revealed, a bronze background with a yellow silk screen scale, not very distinct and a bit of a clash of colours, perhaps it's faded over the years, although it looks in too good a condition for this. It cleaned quite easily and I think I will replace the celluloid window with some thin Perspex to retain the true colour of the scale. (I'll leave the original in an envelope inside the set just in case I might want to return it to original)

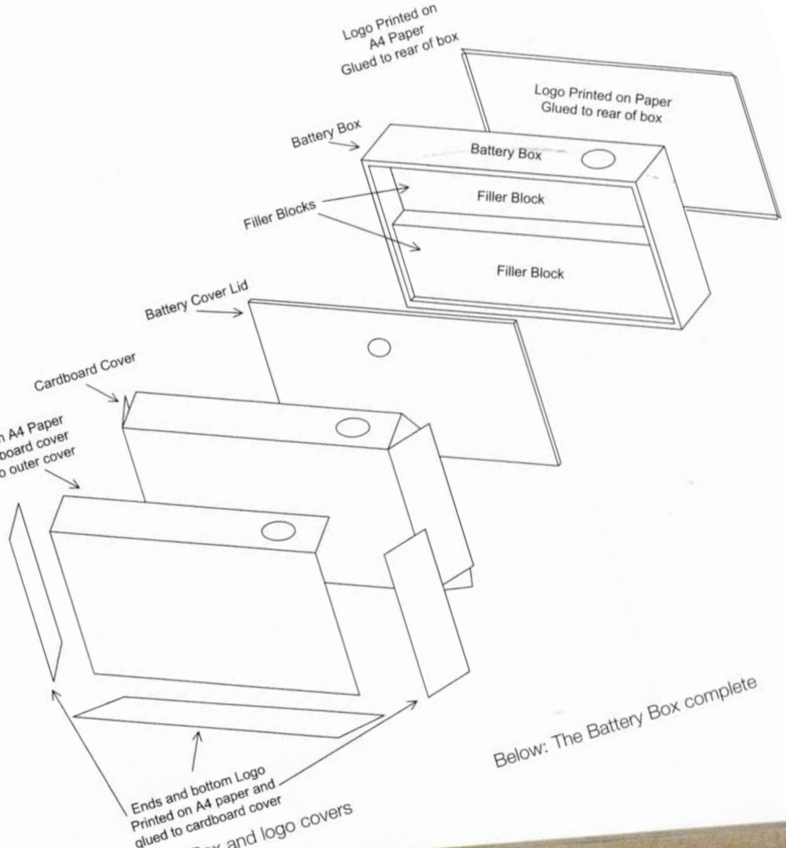
The speaker cloth is glued to a shaped cardboard panel, now out of the set, you can see the cloth is a bit grubby compared to the clean bits hidden by the bars in the speaker fret, I'd like to clean it but I think it might not survive being removed from its cardboard backing panel, it appears firmly stuck down, as it doesn't look too bad in situ I think I'll leave it as it is.

The valves were removed ready for a more in depth clean, Ct8 valve holders are always a problem, causing a lot of crackling and intermittencies and these were very grubby and heavily oxidised. With no evidence of corrosion I decided to clean the contacts in situ, no need to remove them this time. I gave them a wash and scrub with carburettor cleaner on a small cut-down stiff paint brush, unfortunately this time it had little effect, this stuff either works very well or not at all as in this case. My second line of attack was to do the same with white vinegar, this did the job although it does require a lot of flushing to remove all traces of the vinegar and a few days in the airing cupboard to fully dry it out. While flushing out the valve holders I took the opportunity to lightly wash the rest of the components and the top of the



270mm X 140mm X 63mm

Above: AD3 Battery Box



Above: AD3 Battery Box and logo covers

Below: The Battery Box complete

Above: The Battery Box with Batteries

Above: The finished Battery

chassis, the grime here was slightly greasy so a drop of washing up liquid was added and a light scrub with a soft paint brush.

The rusty scabs on the chassis were mainly confined to the back of the chassis and rear of the tuning scale plate, The rust on the back of the chassis was rubbed off with a piece of Scotchbrite and "puffed in" with a touch of matt spray lacquer to stop a re-occurrence. I masked off the rest of the chassis and components to avoid it going everywhere. The tuning scale plate was removed and treated separately.

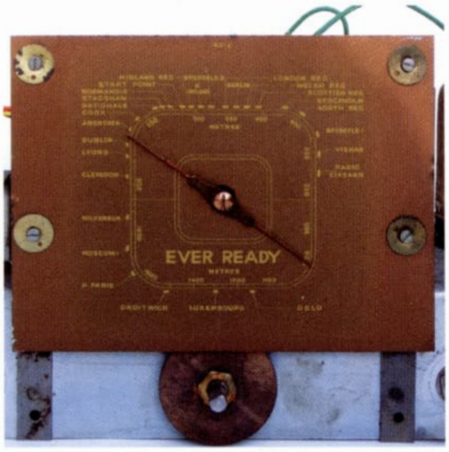
This set uses two types of connecting wire, the chassis is wired using rubberised cotton braid covered solid wire, this is in good condition and is likely to stay that way for some time, unfortunately the flying leads, battery, speaker and aerial wires are the rubber covered stranded flexible type and as previously mentioned, the rubber is very hard and crumbling. Replacement is going to be a bit of a problem as I've depleted my stock of this type of wire, (I now have a very limited range of colours). Modern plastic covered wire is out of the question as to me it looks completely out of place, I did consider using silicon rubber wire but it's too smooth in appearance and the colours a bit too pretty, I would like to get it to look as close to original as possible, it has to look right even if it isn't.

As the chassis is wired using braid covered wire I thought I might use something similar, many sets of this period used braid covered wire and this won't look out of place.

My local D.I.Y. stores have various sizes of braided cord, the 2mm size seemed about right, the central stranded core is easily pulled out and new flexible wire threaded through, this is done in lengths of about 1m. To colour these I just mixed some Humbrol model matt paint with a small amount of white spirit, just enough to thin it so the braid is not lost in the thickness of the paint, then hung up to dry. This makes the flexible wires a little stiffer than I would like but you only notice when you change the battery. The advantage is this allows you to get the colours right and keeps the appearance of the period.

The last component required is a reproduction Battery, an Ever Ready AD3. I don't have an original to work from so it's a browse around the internet. This proved I wasn't the first person to do this and several websites provided enough information on size and logo for me to make one. A basic wooden box with a removable lid was made from 6mm MDF and glued together with PVA glue, held together with masking tape while the glue set and the edges and corners slightly rounded off when the glue was dry. A B4 Paxolin valve holder will serve as the connector socket.

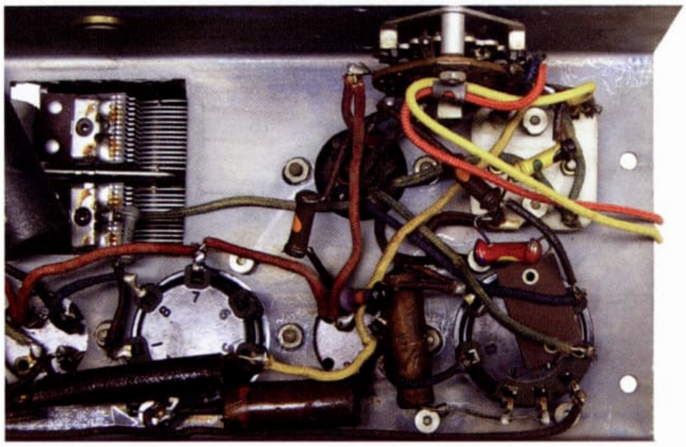
The scale 'before'



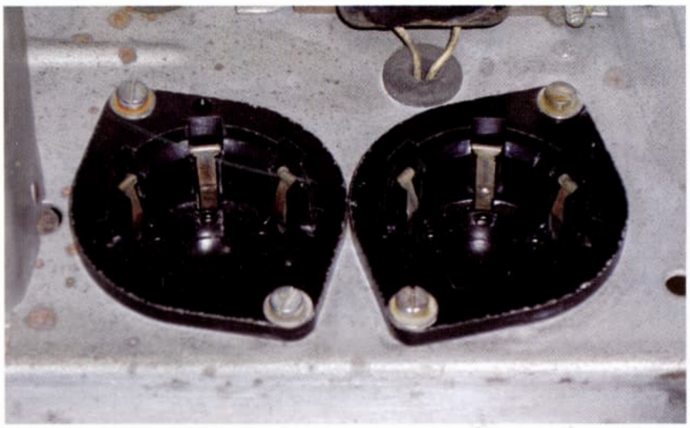
The scale as seen on the chassis

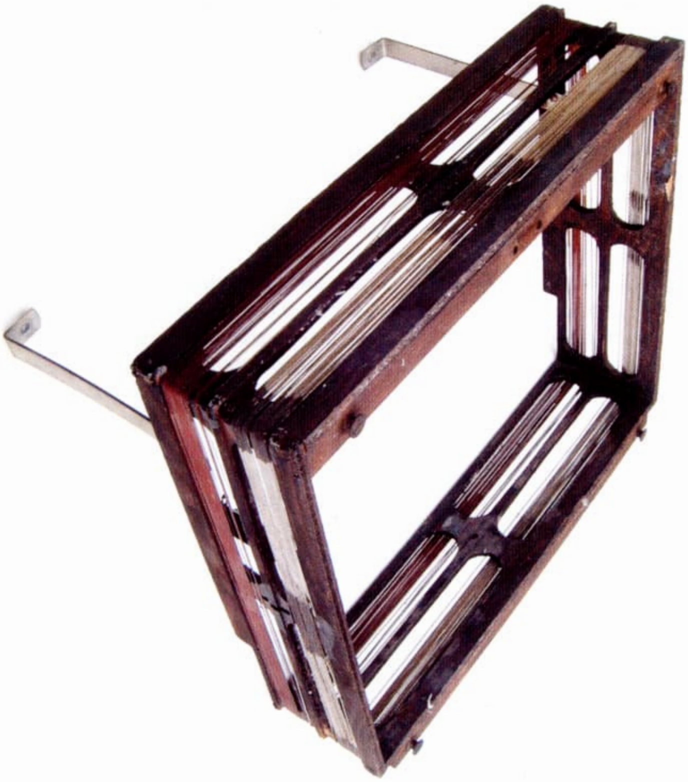
The scale 'after'

Above: New wires Below: The cleaned CT8 sockets



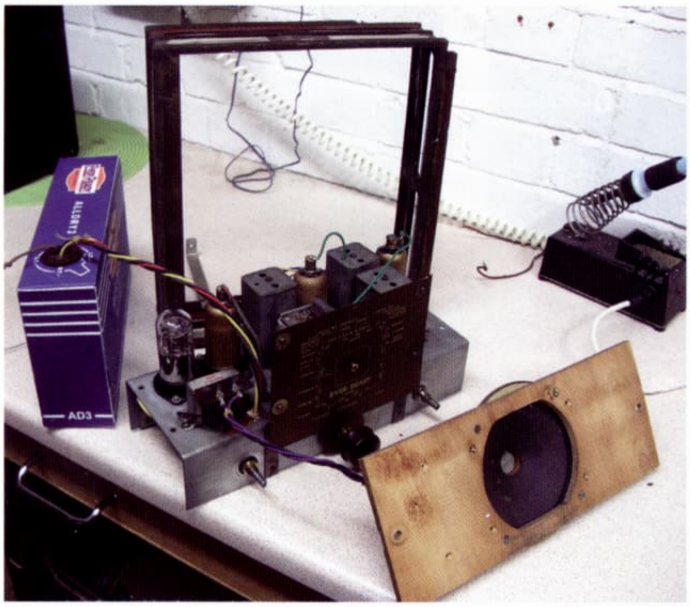
Above: New aerial wires under chassis Below: Knobs and fittings



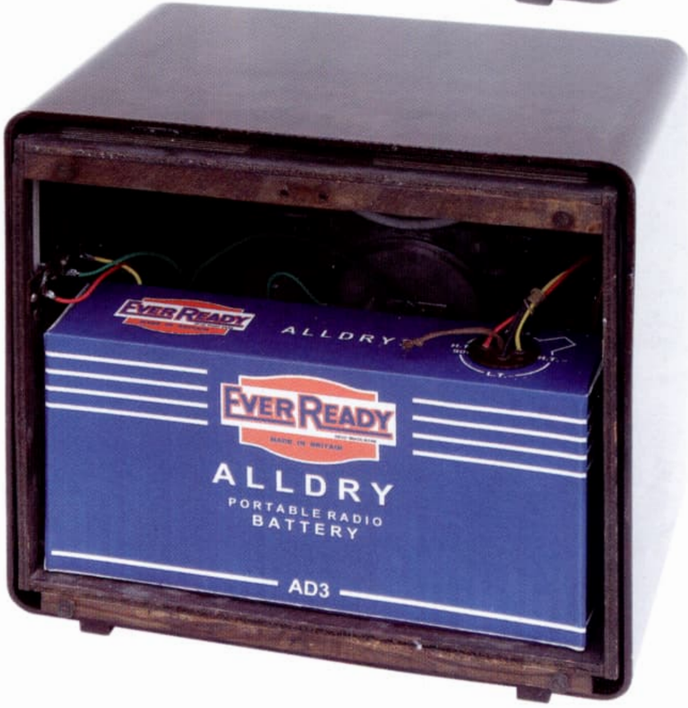


The frame aerial

The finished set



Testing the set



The battery installed

Ten PP3 battery clips and a holder for the single D cell (Maplins) were wired in and batteries fitted, the vacant space filled with wooden blocks cut to size and glued in place to stop the batteries moving about. The lid held down with some strips of Velcro attached to the filling blocks and ½" dia hole drilled about the middle to aid removal.

The cover artwork next, I have to do this in several pieces as I only have an A4 printer, I've tried photo copies and scanning and printing but found the best method is to start from square one and re-draw the whole thing, I do this by scanning in the old cover or in this case from a photograph, import this into a drawing software (MS Visio), adjust the size then re-draw over the top of the original, when complete delete the photograph, just leaving the new drawing. I make the overall size of the outer edges a little larger to allow for overlaps.

The next step is to print these on to cartridge paper (Hobbycraft), this gives the battery surface the right texture and background colour, a creamy white. Ordinary printer paper is too smooth and too blue–white to look authentic. The first piece is glued directly onto the battery box, (the largest surface area), then a removable cardboard cover made to cover the other five sides.

The cardboard cover is made from a large salvaged breakfast cereal box or something similar, (Hobbycraft have a large range of cardboard if preferred). I usually make a template from a sheet of newspaper first and copy from this. The completed artwork is glued to the cover with wallpaper glue then cut to size, the folds are first marked and then grooved on the inside of the cover with a wheeled glass cutter, this doesn't cut, it just leaves a groove to ensure a good clean fold. When folded into a box, the cover is glued or stapled as the original. The cover then fits over the lid side of the battery box.

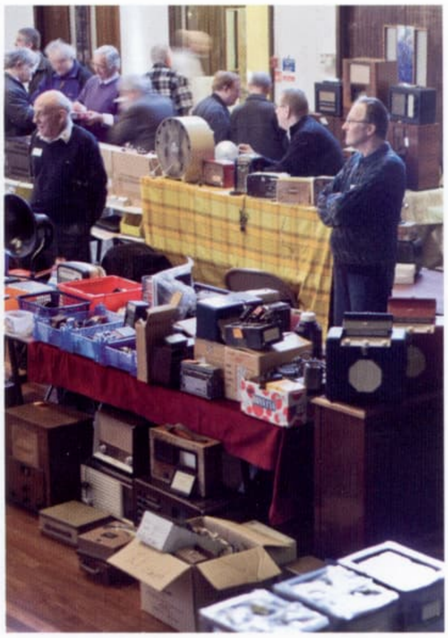
The battery fits in the set very snugly. It had me wondering whether the set was designed around the battery or the battery to fit the Radio (it could be either).

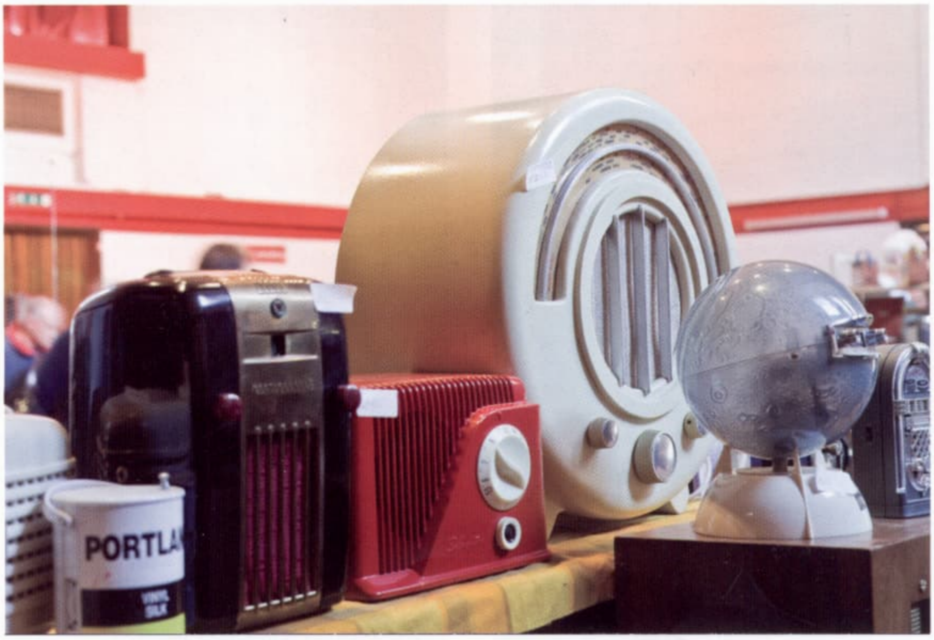
Now all back together and cleaned up this little set worked quite well, the tuning pointer matched the frequencies on the scale, but I did routinely run through an alignment and much to my surprise, this considerably improved its performance, which was quite good to start with.

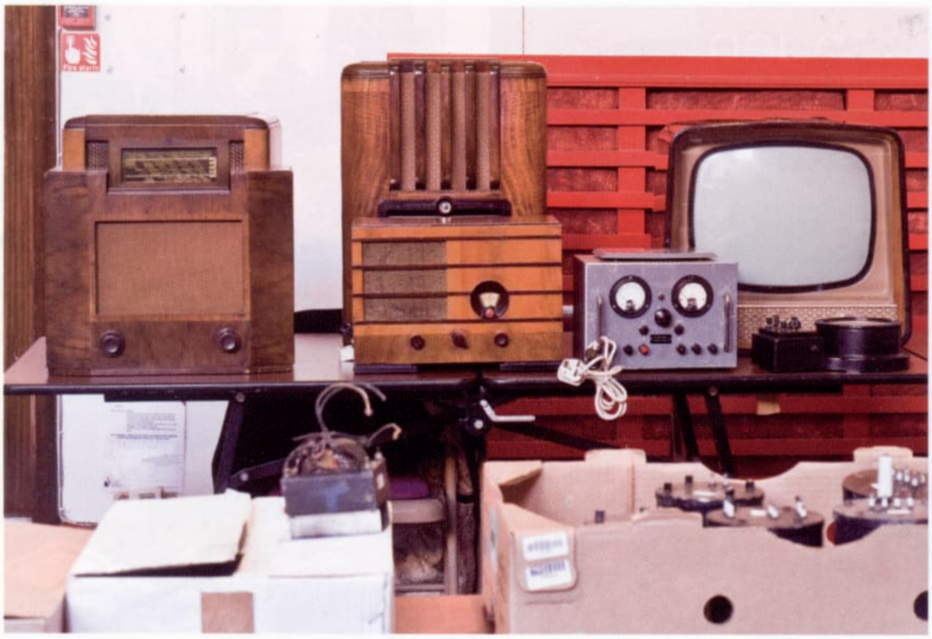
This set has been a lot of fun to play with and listen to, it brings in Capital Gold loud and clear on its 5" speaker. Although not a portable it has accompanied me out in the garden on several occasions on a warm summer afternoon.

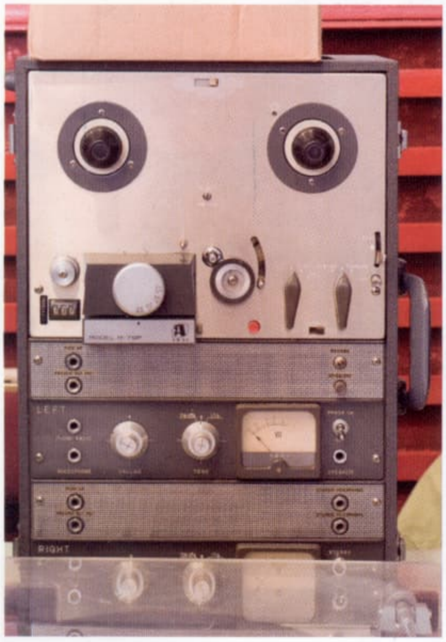
Pictures from Harpenden

by Carl Glover

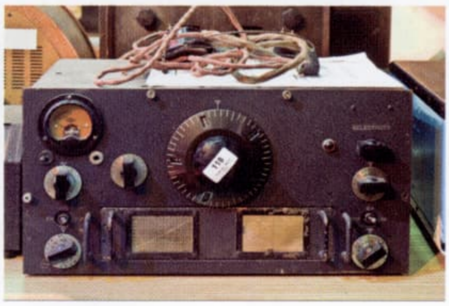









£5-




DELL


BUSH

More musings on the EBL31, including an EBL31/EL84 Adaptor

by David Taylor cotters@cotters.karoo.co.uk

I read with interest the article *Brief Encounters with the EBL31* by R.J.Grant in the Winter 2009 Bulletin. I embarked upon my own voyage of discovery with the EBL31 valve when I set about restoring an Ekco A22.

Having painstakingly restored my A22 - replacing perished wiring, fitting new capacitors, replacing out of spec resistors - when the moment of truth came and I switched the set on, all was well, except that the audio output was very low and it was clear that the EBL31 had run its distance.

It's a great pity that such a useful and versatile valve as the EBL31 – a double diode pentode, which takes care of AGC, detection and amplification all in one envelope, is now so rare.

Several UK valve suppliers do offer EBL31s for sale at about £25.00 each, but those on offer - though appearing to be new old stock - are not original EBL31s, but most likely EBL1s which have been adapted as EBL31s.

The EBL1 valve is electrically identical to the EBL31, but had a side contact base, and I suspect that the 'EBL31s' on offer from valve suppliers have been adapted by replacement of the side contact base with an octal base, as evidenced by the visible join in the valve base where the two are mated.

These apparently modified EBL31s also have a larger diameter top cap. The net effect is that the modified valves are much larger than the original EBL31 valve, as can be seen in the photo, which shows the original sized EBL31 alongside its big brother (or perhaps I should say 'ugly sister'!).

This wouldn't matter in most radios that use the EBL31, where the height of the valve is not an issue, but in the Ekco A22, unusually the valve lies horizontally and the taller adapted valves protrude too far to allow the back of the radio to fit.

Initially, my quest for the smaller valve proved fruitless, so when a member of the UK Vintage Radio Forum suggested that I consider making an adaptor to enable a smaller more modern pentode valve and a couple of germanium diodes to emulate an EBL31, I thought it was worth a try.

This would at least put the set into working order and had the merit of not requiring any alterations to the EBL31 valve-holder or chassis wiring. Hence, when and if a genuine valve turned up – as one later did – the adaptor could simply be unplugged and the EBL31 plugged in.

The characteristics of the ubiquitous EL84 pentode were close enough to those of the EBL31 as to not require any changes in value of any of the components on the A22 chassis, so was a good candidate.

All that was required was to make a bush that would couple an octal valve base culled from a scrap donor valve to a B9A valve holder. The pins from the two would need to be cross-wired as appropriate, and two germanium diodes fitted inside the adaptor. I used OA91 diodes, but any germanium signal diodes should suffice: OA90, OA81, 1N34 etc.

The EBL31 has a top cap - the EL84 doesn't. Hence, it would be necessary for the adaptor to include a 'top cap' to accept the top cap clip. (G1 of the valve).

'Small and large EBL31

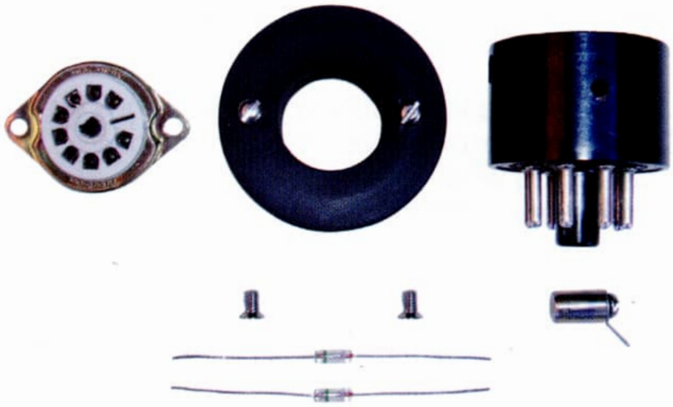
As a woodturner, my first thought was to make the adaptor bush from a close grained hardwood such as yew or box, but I was able to obtain an offcut of 40mm diameter black nylon rod from a local plastics supplier, which turns easily with woodturning tools.

A donor octal valve is needed - wrap it in a an old towel and smash it, taking sensible safety precautions, then unsolder the electrode wires from the valve pins. Octal valve bases appear to come in two sizes. One has an internal diameter of 1.15" (29mm), the other, 1.25" (31.75mm). Either will suffice.

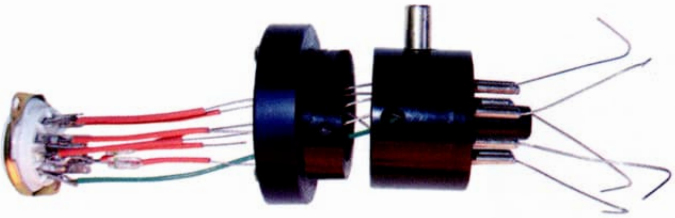
The pictures are self explanatory, but some notes may help.

The nylon rod was mounted in the lathe and drilled out to a depth of 25mm with a 19mm (¾") diameter Forstner bit held in the tailstock, to accept the B9A valve–holder. The rod was then turned down to a diameter to be a push fit into the donor octal valve–base. The bush was then parted off from the lathe, leaving the flange 10mm thick, and the spigot 8mm long.

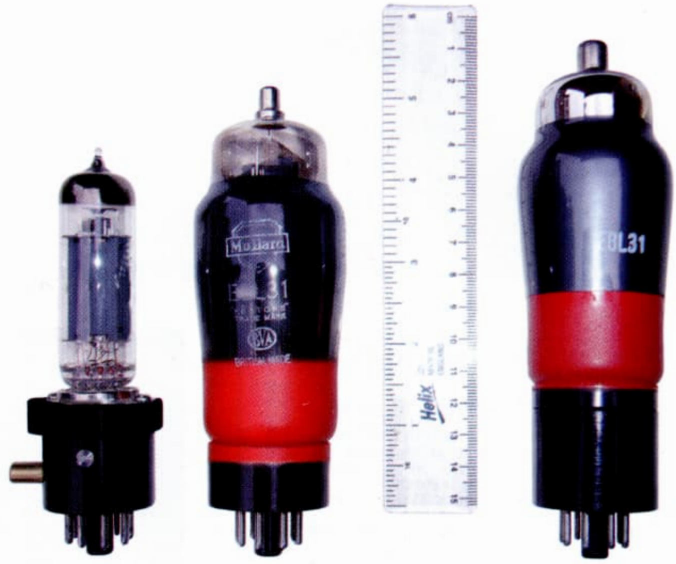
A 15mm (1/2") length of brass rod from a scrap ¼" (6.4mm) diameter potentiometer shaft was drilled and tapped 6BA and fitted to the side of the valve base beneath the depth of the bush, with a solder tag on the inside. This would serve as the 'top cap' and would be wired inside the adaptor to the B9A valve holder.



EBL31 Adaptor Components



EBL31 Valve Base Adaptor wired up



EBL31 valves and EL84 Adaptor

Wiring up the pins of the octal valve base to the B9A valve holder, not forgetting the two OA91 diodes, is a fiddly task. By far the easiest way is to poke a length of tinned copper wire up the inside of each of the octal valve base pins in turn, bending the wire at the lower end to prevent it being pulled out, then slipping a short length of sleeving over the wire, soldering each wire in turn to the correct B9A valve holder pin.

Pin 3 of the B9A valve holder requires three connections - namely, the cathodes (striped end) of the two OA91 germanium diodes, and to pin 8 of the octal valve base. Twist the diode wires together at the cathode ends, but don't cut them too short before soldering them to pin 3 of the B9A as the lower ends of the diodes need to be long enough to poke down inside pins 4 & 5 of the octal base.

A short flying lead (3" - 75mm) of thin flex from the "top cap" solder tag is then wired inside the octal valve base to pin 2 of the B9A base, then the bush can be lowered into place, ensuring that the anode ends of the OA91 diodes are slid down through pins 4 and 5 of the octal base.

By now, you should have seven wires poking out of the octal valve base pins. (Pin 1 being n/c). It's worth double-checking for continuity to ensure that they all mate with the correct pins of the B9A, and that the diodes are the right way round before soldering the octal pins.

When checking for continuity, do remember that when looking down into the B9A valve-holder that the pins number from 1 - 9 anti-clockwise, but from the underside of the Octal Base, the pins number from 1 - 8 clockwise.

The EBL31 and EL84, connections are:

Octal (EBL31) Valve base pins	**B9A (EL84) valve holder tags**
Pin 1 – N/C	-
Pin 2 (Heater)	Pin 5
Pin 3 (Anode	Pin 7
Pin 4 (Diode) OA91 a-[>-k	Pin 3 (Cathode/G3)
Pin 5 (Diode) OA91a-[>-k	Pin 3 (Cathode/G3)
Pin 6 (G2)	Pin 9
Pin 7 (Heater)	Pin 4
Pin 8 (cathode/G3)	Pin 3
Top Cap (G1)	Pin 2

(There are no connections to pins 1, 6 & 8 of the EL84 valve-holder).

It's important to apply the soldering iron to the sides of the valve base pins to ensure that solder is drawn into the pins and a good electrical contact is made. The surplus wire ends can then be snipped off.

It sounds much more daunting and involved that it is – about an hour's work.

Of course, it will look completely out of keeping, but then the integrity and originality of the radio has not been compromised, and the adaptor/EL84 can be unplugged if an EBL31 comes along later.

I claim no credit for the originality of the idea – I'm sure I won't have been the first to do this or something similar. The same concept could apply to many other valves which are scarce or unobtainable – especially output valves and rectifiers.

Similarly, a donor valve base could be used to make a 'solid state' rectifier as a substitute for an unobtainable rectifier valve – for example, using 1N4007 diodes. I know that some restorers resort to soldering diodes across the valve–holder pins beneath the chassis, but by using a donor valve–base to house the rectifier diodes, the unit can simply be plugged into the valve–holder, with no alterations to the wiring of the chassis.

The picture shows the correct sized EBL31 alongside its 'big brother' and the valve-base adaptor with an EL84 fitted into it.

Notes on the photographs:

Small and large EBL31

As can be seen, the original EBL31 valve is about five inches tall – the larger valves currently supplied by at least two UK valve suppliers are probably adapted EBL1s, and are nearer six inches tall. The taller valve base has a neat join, which perhaps provides a clue that the original side contact base has been partly removed and an octal valve base joined to it. These modified valves also have a larger diameter top cap.

EBL31 valves and EL84 Adaptor

Shows both sized EBL31 valves, alongside an EL84 valve in the EBL31/EL84 valve base. adaptor.

EBL31 Adaptor Components

This shows the items needed to make an adaptor, namely:

Octal valve-base removed from a scrap donor valve.
B9A valve-holder.
Plastic bush, turned on the lathe to fit into the octal valve-base, drilled to accept a B9A valve-holder.
Two OA91 diodes.
Brass 'top cap' tapped 6BA, with solder tag and screw.
Two short c/s 6BA screws to secure the plastic bush to the octal base.

EBL31 Valve Base Adaptor wired up

Shows the completed B9A valve-holder wiring including the two OA 91 diodes and internal wire to the 'top cap' solder tag, ready to lower the valve-holder and collar into the octal base for final continuity testing before soldering the wires at the octal valve-base pins, and securing the collar of the adaptor in place with two small 6BA screws through the side of the octal base.

Selecting a Valve Audio Output Transformer

by Stef Niewiadomski

If, like me, you have a good selection of valve output transformers that you've picked up for maybe a pound or two each at radio rallies or BVWS meetings, or extracted from old radios when they were beyond practical repair, you may be wondering when exactly you can make use of them. When the time comes to use one, either to replace a failed one in a radio you're trying to bring back to life, or when building a new valve-based project, it can be difficult to know which one to select. In the 'old days' you would have simply ordered a replacement transformer by post (see Figure 1 for a September 1955 advert for output transformers) but today it's not that easy. This article describes simple methods of testing the transformers you have and assessing their suitability for use with a particular valve output stage.

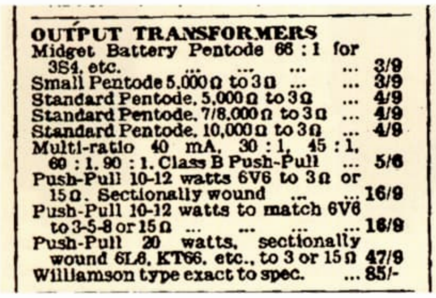

OUTPUT TRANSFORMERS
Midget Battery Pentode 66 : 1 for 3S4, etc. 3/9
Small Pentode 5,000Ω to 3Ω 3/9
Standard Pentode, 5,000Ω to 3Ω ... 4/9
Standard Pentode, 7/8,000Ω to 3Ω ... 4/9
Standard Pentode, 10,000Ω to 3Ω ... 4/9
Multi-ratio 40 mA, 30 : 1, 45 : 1, 60 : 1, 90 : 1, Class B Push-Pull ... 5/6
Push-Pull 10-12 watts 6V6 to 3Ω or 15Ω. Sectionally wound 16/9
Push-Pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω 16/9
Push-Pull 20 watts, sectionally wound 6L6, KT66, etc., to 3 or 15Ω 47/9
Williamson type exact to spec. ... 85/-

Fig 1: Mail order Ad for output transformers Sept 1955

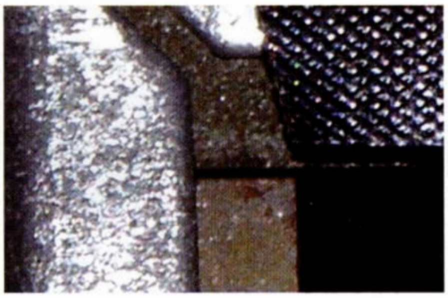


Fig 3

Below Left, Fig 2: An example of a transformer with 'flying' leads coming from the secondary. This sort of transformer is often mounted on the speaker frame so that connections to the speaker are as short as possible.

Left: Fig 3: Air gap on a typical transformer. This is a particularly clear example, but often the gap is covered in paint or dirt and is difficult to see.

Below: Fig 4: A mains-to-6.3V heater transformer which, being about the right size and having four terminals, could easily be mistaken for an output transformer.

Fig 2

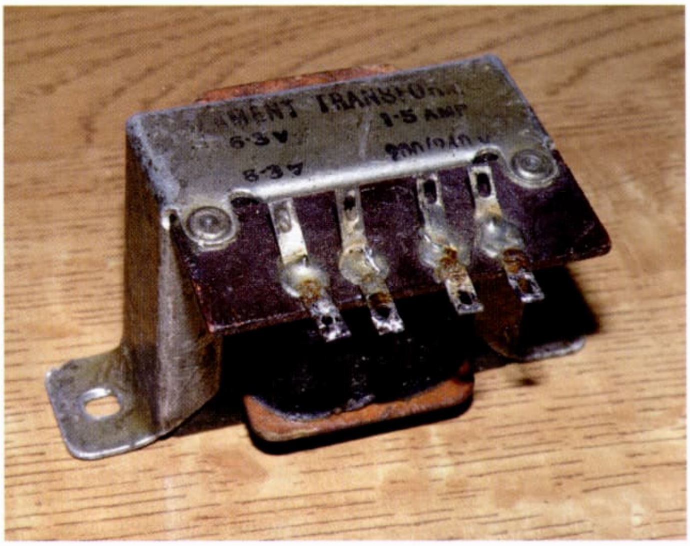


Fig 4

What does the Output Transformer Do?
The main reason why the transformer is there is to perform the impedance transformation from the high impedance (that is, high voltage and low current) valve anode circuit to the low impedance (that is, low voltage and high current) loudspeaker coil, or low impedance headphones. This process results in a matching of the valve's output impedance to the speaker's input impedance, hopefully over a wide frequency range, which results in the most efficient power transfer and best quality sound from the speaker. Note that the term impedance represents the combination of the reactance of any inductance and/or capacitance with any pure resistance in the circuit. In general the impedance of any circuit changes with frequency as the inductive and capacitive components become more and less dominant.

In the 'old days' speakers were produced with high impedance coils, or listeners used high impedance headphones, neither of which needed transformers, and which were connected directly to the anode circuit, most usually in series with a DC-blocking capacitor. Since maybe the mid-1930s, low impedance speaker coils have become almost universal, hence the extensive use of transformers in this application.

Another useful function of the output transformer is to isolate the speaker or headphones from the HT voltage on the output valve's anode, making it safe to plug in headphones or extension speakers.

Some useful notes on valve audio output stages, and what can go wrong with them, can be found in References 1 and 2.

Measure the DC Resistance
It's always handy to carry a multi-meter, digital (DMM) or otherwise, when you're on the look out for transformers and chokes so that you can check the continuity of the windings of any component you are thinking of buying. Reputable stall-holders will always agree to the test, and may even have a meter available themselves in case you've forgotten yours. With an output transformer you're only really out to prove that the windings are still intact, and that the transformer looks a reasonable size for the job it has to do. Sometimes the wire breaks where it comes out from the core, which is a very difficult repair to attempt, or in the middle of the winding, in which case a complete rewind would be the only cure. You should expect to find a primary with a few hundred ohms resistance, and a secondary with a resistance of less that 1Ω. Because one side of the secondary winding is usually connected to ground, it's important that there is no measurable resistance between the primary and secondary windings, which would indicate a breakdown in the transformer's insulation.

A bit of rust on the core and/or the frame of the transformer won't do too much harm, and you can clean it up, straighten out any bent mounting lugs, and apply a coat of paint when you get it home.

Unfortunately the ratio of the DC resistance of the primary and secondary windings isn't

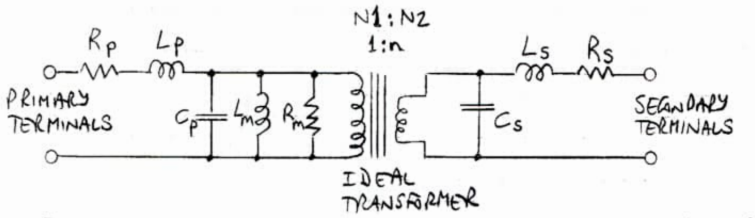


FIGURE 5(a). EQUIVALENT CIRCUIT FOR AN IRON-CORED TRANSFORMER

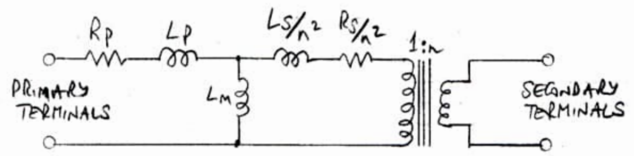


FIGURE 5(b). SIMPLIFIED EQUIVALENT CIRCUIT

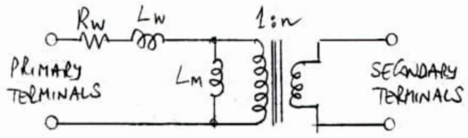


FIGURE 5(c). FINAL EQUIVALENT CIRCUIT

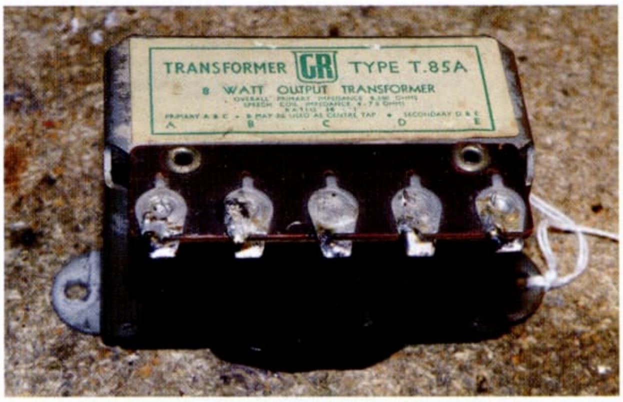


Figure 6: The GR type T.85A 8W output transformer.

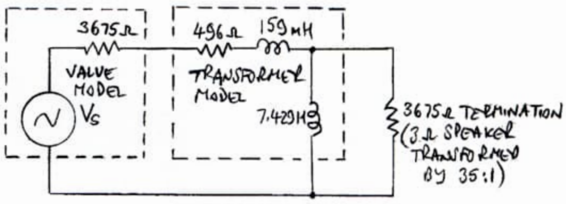


FIGURE 7. SIMULATION MODEL OF VALVE DRIVING 3Ω SPEAKER VIA THE GR TYPE T.85A TRANSFORMER

an indication of the winding ratio of the transformer, otherwise life would be very simple. This is because the two windings will typically be made with different gauge wire. You can often see that the secondary is wound with much thicker wire than the primary, which is what you'd expect since for a given power flow through the transformer, the secondary has to carry more current than the primary.

Sometimes the wire comprising the secondary comes straight out of the winding and connects directly to the speaker, without going through a soldered terminal. I suppose this was a way of reducing the cost of the transformer slightly, and it also has the beneficial effect of eliminating a couple of soldered joints, thereby reducing the chances of dry joints in the path to the speaker. See Figure 2 for an example of a transformer with these 'flying' leads. In some radios the output transformer is mounted on a bracket on the speaker itself, rather than on the radio's chassis, and the unwary can spend a few puzzled moments looking for the transformer above and below the chassis. You may come across a speaker with an output transformer already attached, and if you can negotiate a price of a couple of quid or so, it's generally worth snapping these up to keep for future projects.

Mind the Gap

One of the differences between an output transformer (and a choke for that matter) and a mains transformer is that the primary winding of the former needs to pass some amount of DC current while operating as an impedance translator. This is not true of a mains transformer where the primary is 'excited' by pure AC. In a typical radio the output valve may take an anode current of anything between 1mA (say in valve battery portables) and 25mA or more, which has to pass through the transformer's primary winding, without saturating the transformer, which would have the effect of reducing the inductance of the primary winding. The gap needs to be large enough to prevent this from happening, but not so large that the AC flux has a problem with crossing the gap, which would also tend to reduce the primary inductance and reduce the efficiency of the transformer. A small air gap, typically of the order of a fraction of a mm, in the magnetic circuit solves the DC saturation problem without significantly worsening the AC performance.

See Figure 3 where I've photographed the gap on a small valve output transformer. The gap is particularly easy to see on this transformer: sometimes it's not so easy to spot because it's hidden by the fixing clamp or wax and accumulated dirt.

Beware of Mains Transformers…

You might come across some likely candidates for output transformers, but they could easily be small mains transformers. If they look new, then they probably are 6V or 12V mains transformers (which in themselves can be useful) but some old mains-to-6.3V 'filament' transformers look suspiciously like output transformers. Figure 4 shows such a transformer and being about the right size and weight, and having four terminals, it could easily be mistaken for an output transformer. Hopefully any such transformer you come across will still have its markings intact. Such a 6.3V 'filament' transformer will have a turns ratio of about 36:1, which again is in the right 'ball-park' for an output transformer.

Take a good look for the air gap: if you can't see it, or the seller doesn't know the provenance of the transformer, then it's probably not worth buying.

… but Look out for Chokes

Low frequency chokes are usually easy to identify: they have only two leads or two terminals, since there is only one winding, but again you can look for an air gap which they should have, although it can easily be hidden under paint and the gunge that builds up over the years. Many chokes you come across are ex-MOD components and they are often covered in a black tar-like material, which makes spotting any air gap impossible.

Again it's worth applying the DMM to make sure there's a resistance of a few hundred ohms, which is typical for a mains-driven power supply choke of say 4-10H, across the terminals. If you're keen on valve projects, these chokes of several Henries inductance are very useful for smoothing in power supplies, so it's still worth buying such a component.

Impedance Transformation

A fundamental property of a transformer is to 'reflect' any impedance connected across the secondary winding back to whatever is driving the primary winding. Let's say a transformer has Np turns on its primary and Ns turns on its secondary, then it has a turns ratio equal to Np/Ns , which for an output transformer is usually much bigger than unity. The impedance ratio is equal to the square of Np/Ns. Therefore if the transformer has a turns ratio of 30, then the impedance ratio is 900, and so a 10Ω load on the secondary will be 'seen' as 30^2 times 10Ω = 9,000Ω at the primary.

What's the effect of having no load, that is, an open circuit, across the secondary? This is definitely bad news, especially if the 'volume' is turned up loud, which would probably be the first reaction if nothing could be heard. With no load on the secondary the primary circuit 'sees' a high impedance and this can cause the AC voltage levels to rise to high levels at the anode of the output valve, even to the point of damaging the valve, the transformer and the capacitor often strapped across the primary winding to shape the high frequency response of the amplifier. This capacitor is typically a 0.01µF (or smaller) component, is often rated at 1,000V DC to cope with the high voltage transients seen in this circuit, and

Table 1: Ra (sometimes called Zout) and output power values for some popular audio output valves.

Valve	Close or identical equivalents	Base	Ra or Zout (ohms)	Va (volts)	Output power (W)	Notes
6V6	6AY5, CV510, VT107	Octal	5,000	250	4.5	Class A single-ended.
6V6	6AY5, CV510, VT107	Octal	10,000	250	10	Per pair, in class AB1, push-pull.
6L6	CV1286, VT115	Octal	4,200	350	11	Class A single-ended.
6L6	CV1286, VT115	Octal	6,600	360	26.5	Per pair, in class AB1, push-pull.
ECL80	6AB8, CV10746, LN152	B9A	11,000	200	1.4	Pentode section, class A single-ended.
ECL82	6BM8, 6PL12, CV9167	B9A	5,600	200	3.5	Pentode section, class A single-ended.
UCL82	?	B9A	4,500	200	3.3	Pentode section, class A single-ended.
ECL86	6GW8, CV8297	B9A	5,900	250	4.3	Pentode section, class A single-ended.
EL41	CV3889	B8A Loctal	7,000	250	4.2	Class A single-ended.
UL41	CV1977	B8A Loctal	3,000	170	4	Class A single-ended.
EL84	6BQ5, 6P15, CV8069, N709	B9A	5,200	250	5.7	Class A single-ended.
EL84	6BQ5, 6P15, CV8069, N709	B9A	8,000	250	11	Per pair, in class AB1, push-pull.
UL84	45B5	B9A	2,500	200	5.3	Class A single-ended.
PX4	CV1168	B4	3,500	300	4.5	Class A single-ended.
PX25	CV1040, VR40	B4	5,500	400	6	Class A single-ended.
DL35	1C5-GT, CV1805	Octal	8,000	90	0.24	Class A single-ended. Typically used in battery / mains portables.
DL92	3S4, CV484	B7G	8,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
DL94	3V4, CV2983	B7G	10,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
DL95	3Q4	B7G	10,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
DL96	1P1, 3C4	B7G	13,000	85	0.2	Class A single-ended. Typically used in battery / mains portables.
N18	?	B7G	10,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
N19	?	B7G	10,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
N78	CV3711	B7G	7,000	250	4	Class A single-ended.
N78	CV3711	B7G	9,000	250	9	Per pair, in class AB1, push-pull.
N709	6BQ5, 6P15, CV8069, EL84	B9A	5,200	250	5.7	Class A single-ended.
KT61	CV1438	Octal	6,000	250	4.3	Class A single-ended.
1A5-GT	1A5, CV755, DL31, VT124	Octal	12,000	90	0.115	Power output pentode.Typically used in battery / mains portables.
1P1	3C4, DL96	B7G	13,000	85	0.2	Class A single-ended. Typically used in battery / mains portables.
3S4	DL92, CV2370, CV484	B7G	8,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
3Q5	CV819	Octal	8,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
3V4	DL94, CV1633, CV2983	B7G	10,000	90	0.27	Class A single-ended. Typically used in battery / mains portables.
6BW6	6061, CV2136, CV4043, CV8048	B9A	5,500	180	2	Minitaure beam power pentode..
6AM5	6P17, EL91, N144	B7G	16,000	250	1.4	Output pentode. Class A single-ended.
50	CV2533, VT50	UX4	4,600	300	2.4	Power output triode.
25L6	CV552, CV553, VT201	Octal	3,000	200	4.3	All-metal beam power amplifier.
34GD5	34GD5A	B7G	2,500	110	1.4	Minitaure beam power pentode..
35B5	?	B7G	2,500	110	1.5	Miniature beam tetrode.
35L6	CV561, CV562	Octal	4,500	200	3.3	Beam power amplifier.
50A5	?	B8B Loctal	3,000	200	4.3	Beam power amplifier.
50B5	?	B7G	2,500	120	2.3	Minitaure beam power amplifier.
50C5	CV1959	B7G	2,500	110	1.9	Minitaure beam pentode..
50L6-GT	50L6, CV2534, CV571	Octal	13,000	110	2.1	Power output beam tetrode.

is a common point of failure in old radios.

In theory at least, the impedance ratio of the transformer is independent of the actual number of turns on the primary and secondary windings: it's just the ratio that matters. In reality this isn't quite true because whether the transformer actually works or not depends on some other transformer fundamentals. I don't intend to cover transformer theory in great detail, but it's worth looking into this in some more detail. Hopefully this will explain why if you need a 10:1 turns ratio transformer (to give you a 100:1 impedance ratio) you can't simply put 10 turns on the primary and a single turn on the secondary, which is a question that puzzles most transformer 'virgins'.

Before I answer this question, let's take a look at speaker and valve impedance.

What is the Speaker's Impedance?

To ensure that the transformer makes a good impedance match, you first need to determine what the impedance of the speaker is. This is usually straightforward and hopefully one of a couple of methods will result in the answer. First of all, look on the speaker itself - it may be marked! If not, measure the DC resistance of the speaker's coil (after disconnecting it from the output transformer, of course). A useful rule-of-thumb is that if you multiply this resistance measurement by about 1.2, you'll get the AC impedance. I measured the resistance of a speaker in my Vidor CN431 'Marquisa' portable at 2.6Ω, so multiplying by 1.2 gives me 3.1Ω, which is pretty close to the 3Ω I suspect it is.

Another way is to consult the maker's original service sheet, or the 'Trader' sheet for the radio and this should tell you the speaker's impedance. It should also tell you the DC resistance of the output transformer's primary and secondary windings (presumably so a service man could check these in case of a suspected fault), but strangely and most annoyingly, not the winding ratio.

See Reference 3 for where you can buy a vast range of makers' and 'Trader' service data from. I'm not associated with the supplier of this DVD-ROM, just a satisfied customer and user of this data.

What is the Valve's Impedance?

To make the impedance transformation calculation you will need to know the anode impedance, often abbreviated to Ra, or sometimes Zout, for the output valve driving the transformer.

When I'm looking for information on valves these days I tend to use two main on-line sources. The first is the Tube Data Sheet Locator (TDSL, see Reference 4), and the second is the National Valve Museum (see Reference 5), to which TDSL often links so that a high quality photograph of the valve in question can be seen. TDSL displays a short form data sheet of the valve, a list of equivalents, and very usefully, often links to several scanned manufacturers' original data sheets for that particular valve.

In Table 1 I've listed a few valves often used in audio output stages, along with their Ra values. You can see the range of

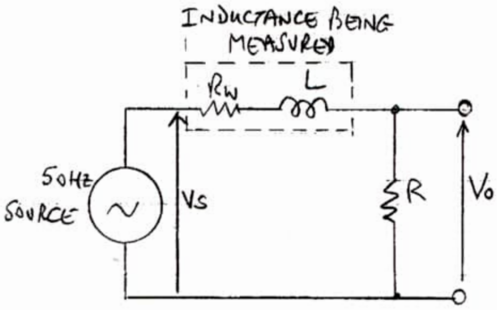


FIGURE 8. SET-UP FOR 'BACK TO BASICS' MEASUREMENT OF INDUCTANCE

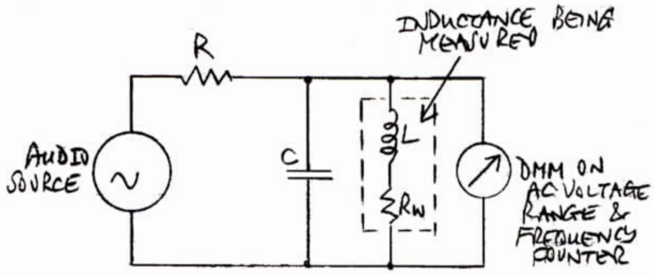


FIGURE 9. SET-UP FOR MEASURING INDUCTANCE BY DETERMINING RESONANT FREQUENCY WITH A PARALLEL-CONNECTED CAPACITOR

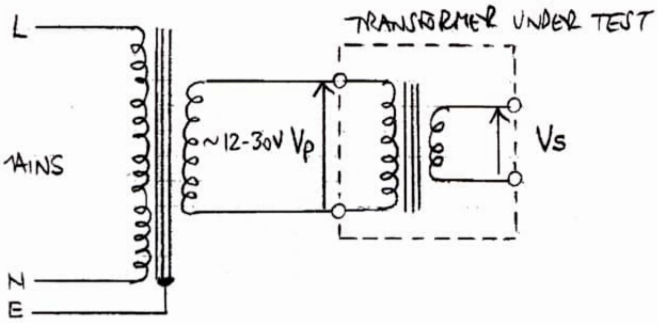


FIGURE 10. TEST SET-UP FOR MEASURING TRANSFORMER TURNS RATIO AT 50HZ

Fig 11: A 'family portrait' of the transformers I tested

typical values, from about 2.5kΩ to 13kΩ. I've tried to limit the list to valves you might find in a typical 'table' or portable radio, and medium power/quality amplifiers, but I have not included valves normally found in Hi-Fi or 'classic' guitar amplifiers (for example, Marshall, Fender, Gibson, etc), such as the EL34, KT66, and so on. Those who repair and restore these pieces of equipment will probably have their own ideas about how an output transformer should be replaced or rewound, to maintain the 'sound' and frequency response (typically 20Hz – 20kHz) of the original. If your valve isn't there, then take a look in the reference sources above, or I've shown a few other sources at the bottom of this article.

Primary Inductance and Equivalent Circuits

It is fairly commonly known that any output transformer must have a reasonable value of primary inductance for the best frequency response. But why is this so, and what does 'reasonable' mean in this context?

Figure 5(a) shows a typical equivalent circuit of a transformer (taken from Reference 6). What exactly is an 'equivalent circuit'? In general terms, it is an electrical model of how a component (in this case a transformer) behaves in practice, and is usually the basis of a simulation model so that, for example, the frequency response of the component can be predicted using an analogue simulator such as Spice. A component that is typically complex to predict its behaviour (like a real life transformer) is reduced to a grouping of several much simpler models (like ideal resistors, capacitors and inductors) which are measurable (in theory at least, see later). Another example of a useful equivalent circuit is that of a quartz crystal, where the complex mechanical behaviour is again modelled by an equivalent group of ideal resistors, capacitors and inductors. Note that an equivalent circuit isn't a kind of a 'breakdown' of what is actually inside the complex component: it is purely a model.

In Figure 5(a) the components represent the following properties of a generic transformer:

On the primary side:
Rp = primary winding resistance
(often called 'copper losses')
Lp = primary leakage inductance
Cp = primary winding capacitance
Lm = primary mutual inductance
Rm represents core losses (ie, hysteresis and eddy current losses, often called 'iron losses')

On the secondary side:
Cs = secondary winding capacitance
Ls = secondary leakage inductance
Rs = secondary winding DC resistance
(often called 'copper losses')

The transformer in the equivalent circuit is an ideal N1:N2 (or 1:n, where n= N2/N1) component.

Clearly this is quite a complex model and it would be helpful if it could be simplified. The equivalent circuit can be simplified by making some reasonable assumptions: for example the winding capacitances Cp and Cs can be assumed to be very small for most practical purposes and so in our model we will assume they are zero. Also let's trust the designer of the transformer and assume that it is fairly efficient and therefore Rm, representing core losses, can be removed. It would also be handy if we could bring the components connected to the secondary winding over to the primary side, by transforming their impedances by the ratio of the transformer, and this has been done in the modified circuit of Figure 5(b).

A further step can be taken by merging some of the components to give the final circuit of Figure 5(c), where:

$Lw = Lp + Ls / n^2$
and
$Rw = Rp + Rs / n^2$

The model now contains quantities, or parameters, we can measure. For simulation purposes we could even omit the ideal transformer altogether, as long as we terminate the circuit in the transformed load impedance, as would be 'seen' by the primary circuit.

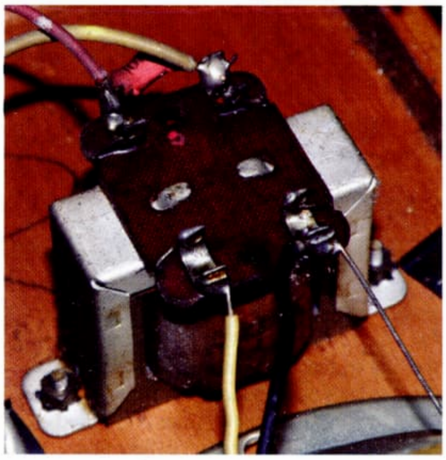
The neat thing about 'moving' the components representing the secondary winding over to the primary side is that we can now just make measurements on the primary side to determine Rw, Lw and Lm and then go ahead and simulate the transformer to see how it behaves over a certain frequency range.

You can see from Figure 5(c) that the mutual inductance of the primary winding (Lm) of the real transformer is connected in parallel with the primary of the ideal transformer and so since for an inductor, $XL = 2\pi fLm$, for any given frequency, the greater the value of Lm, then the greater the value of XL and therefore

Table 2: Summary of Test Results							
Inductance Measurement							
Method Used	**Admiralty choke**	**GR Type T.85A**	**Transformer no. 3**				
Peak Atlas LCR Meter	5.34H @ 1kHz	7.43H @ 1kHz	2.922H @1kHz				
4070L LCR Meter	5.47H @ 100Hz	8.91H @27Hz	3.66H @27Hz				
Reference 8 Method (Figure 8)	7.5H @ 50Hz	22H @ 50Hz	9.4H @ 50Hz				
Resonant Frequency Method (Figure 9)	5.55H @ 700Hz 4.88H @ 210Hz	8.58H @ 169Hz 8.60H @ 527Hz	3.44H @ 267Hz 3.27H @ 854Hz				
Transformer / Choke Tests							
Transformer / Choke Tested	**Primary DC resistance (ohm)**	**Secondary DC resistance (ohm)**	**Primary Inductance (H) with sec o/c**	**Primary Inductance (mH) with sec s/c**	**Mutual Inductance / Leakage Inductance**	**Turns Ratio**	**Weight (gms)**
'6H' Admiralty choke	142	Not applicable	5.34	Not applicable	Not applicable	Not applicable	750
Transformer GR Type T.85A	496	0.6	7.43	159	46.7	35:1	620
Transformer no. 1 DL92 Battery	529	0.2	9.23	216	42.7	90:1	170
Transformer no. 3 'small pentode?'	272	0.5	2.92	75.8	38.5	45:1	270
Transformer no. 8 Vidor CN431 DL94	608	0.3	6.86	177	38.8	57:1	180
Transformer no. 6 UCL82	438	0.4	5.39	151	35.7	38:1	280
Transformer no. 9 'small pentode?'	272	0.3	2.48	70.4	35.2	30:1	180
Mains - 6.3V transformer	320	0.8	6.62	126	52.5	35:1	340

Table 3: Vrms values for a series of speaker impedances and output powers. Note: this is the RMS voltage across the secondary winding. The voltage across the primary will be greater by the factor of the winding ratio.

R (ohm)	P (W)	Vrms	R (ohm)	P (W)	Vrms	R (ohm)	P (W)	Vrms
3	0.25	0.87	8	0.25	1.41	15	0.25	1.94
3	0.50	1.22	8	0.50	2.00	15	0.50	2.74
3	0.75	1.50	8	0.75	2.45	15	0.75	3.35
3	1.00	1.73	8	1.00	2.83	15	1.00	3.87
3	1.50	2.12	8	1.50	3.46	15	1.50	4.74
3	2.00	2.45	8	2.00	4.00	15	2.00	5.48
3	3.00	3.00	8	3.00	4.90	15	3.00	6.71
3	5.00	3.87	8	5.00	6.32	15	5.00	8.66
3	7.00	4.58	8	7.00	7.48	15	7.00	10.25
3	10.00	5.48	8	10.00	8.94	15	10.00	12.25



Above, right Fig 12: The Vidor CN431 portable DL94 output transformer. The power output from this set is only 270mW and so the transformer is very compact and light.

the smaller the 'shunting' effect this has on the signal passing through the transformer. As the frequency gets higher, even a smallish inductance has a high reactance and therefore Lm has the greatest effect on the low frequency response of the transformer, typically what goes on below say 200Hz.

Similarly Lw is in series with the primary of the ideal transformer and so we want the value of Lw to be as small as possible so that it contributes as small an reactance as possible in this series path. Again as frequency gets higher, even a smallish inductance has a high reactance and therefore Lw has the greatest effect on the high frequency response of the transformer.

Even a fairly complex equivalent circuit (and I classify the transformer model in this category) may in itself be a simplification of the real world. For example the transformer equivalent circuit makes the assumption that the circuit elements, and therefore the transformer itself, behave linearly over a large range of voltage amplitudes, and that the circuit element values do not change over frequency. Neither of these assumptions is likely to be true in real life, but the model is close enough to give results accurate enough for most practical purposes.

Measuring the Transformer's Parameters

So let's look at how we measure Rw, Lw and Lm. In fact with the right instrument these can be measured very easily by two simple measurements of the primary winding, one made with the secondary open circuit and the other with the secondary short circuited.

I have a Peak Atlas LCR40 component meter, which I bought a few years ago, which is a very useful and compact instrument. I measured the primary parameters of a GR Transformer Type T.85A (see Figure 6) which I picked up at a BVWS meeting a while ago, with the secondary open circuit and then short circuited, using the LCR40. The results were:

Primary Inductance	Resistance	Secondary
7.429H	496Ω	Open circuit
159mH	496Ω	Short circuit

The LCR40 automatically 'decides' the best frequency at which to make these measurements, and for this component it 'chose' 1kHz.

From these measurements we can say that for this transformer:

Rw = 496Ω
Lw = 159mH
Lm = 7.429H

Now we can substitute these values into the equivalent circuit, giving the circuit shown in Figure 7. As well as showing the transformer model, this diagram also shows an AC driving source, Vs, with its source resistance, and a terminating resistor. Note that the ideal transformer has been removed and the terminating resistor value of 3675Ω represents a 3Ω load transformed by the square of the turns ratio of the transformer (in fact about 35:1, see later for how this was determined), and that I have made the driving impedance equal to this same value. I simulated this circuit using LTspice IV (available free of charge by courtesy of Linear Technology, see Reference 7) and the model indicated -3dB points for the transformer to be at about 40Hz and 20kHz, which indicate a good quality transformer.

As you can see from Table 1, 3675Ω looks a little on the low side for a typical pentode output stage, although a 6V6 (at 5kΩ) or a 6L6 (at 4.2kΩ) aren't too far away. Setting the driving impedance to that of an EL41 (7kΩ, and keeping the terminating resistor value the same at 3675Ω) gave -3dB points at about 52Hz and 11kHz, which is still a reasonable response despite the impedance mismatch.

So hopefully that explains why transformers have to have lots of turns on the primary winding: in general, the more turns on the primary then the higher the primary inductance and the better the low frequency response. Of course having more turns makes the transformer bigger and more expensive, so there's definitely a compromise that has to be reached which the transformer designers at GEC, Pye, Ekco, Philips, etc, knew very well, always working to a tight overall cost budget for their sets.

Other LCR Meters

I've recently acquired a digital LCR meter, type 4070L, bought from China via eBay at what I think is the very reasonable price of £15. Maplin stock a DMM with capacitance and inductance ranges, but if you want these along with voltage, resistance and current, then the meter can cost in the region of £50. It seems to be much more cost effective to buy the LCR meter as a separate item.

The 4070L LCR meter also automatically 'decides' on the test frequency: for inductance it makes the measurement at 100Hz. There are other 'professional' LCR meters available, with prices in the £200-£300 range, but I'm not sure they are good value for money for amateurs.

Having a meter like the Peak Atlas LCR40 component meter made the act of measuring the inductance and resistance of an inductor very easy: you just connect up the inductor, press the 'Test' button, wait for about five seconds and there both values are. The LCR40 has the advantage that it automatically compensates for the capacitance and inductance of its leads, which is useful when measuring very small values. Using a more modern LCR meter such as the 4070L, is even easier and the inductance answer appears immediately.

'Old Fashioned' Methods of Measuring Inductance

Unlike resistance and voltage, inductance is a quantity most of us don't measure very often, and in fact most meters (digital or analogue) don't have convenient inductance ranges we can switch to, and you may not possess an LCR meter like the Atlas LCR40 or the 4070L. As I found out when investigating a few methods of measuring inductance, it turns out to be a rather elusive quantity, the value of which seems to depend on how you measure it. In the context of output transformers the exact value of the primary inductance isn't too important, as long as it's reasonably high, as explained earlier.

I thought I'd try a couple of 'old fashioned', back to basics, methods for measuring inductance suitable for those who do not possess LCR meters. Using these methods, you need a little maths to get the final answer but it's not too fearsome. 'Classical' LCR meters consist of bridges where the component being measured is compared with a known 'standard', whether this is a resistor, capacitor or inductor. Since I didn't have a known 'standard' inductor (unless I believed the value from my two LCR meters), I rejected this method.

Figure 8 shows my set-up for a 'back to basics' measurement of inductance. For the AC source I used the nominally 12V winding on a mains transformer, so Vs was about 12.5V AC. The resistor, Rw, in series with the inductor represents its winding's DC resistance. R completes the circuit, across which the output voltage, Vo, is measured. You can see that the reactance of the inductor, in series with Rw, forms a potential divider in association with R. The full maths of how the value of the inductance is calculated can be seen in Reference 8, but the value of L in Henries is given by:

$$L = \frac{\mathrm{Sqrt}\,[(R/x)^2 - (Rw + R)^2\,]}{2\,\pi\,f}$$

where: $x = Vo\,/\,Vs$

When I have a number of calculations to make I tend to make a table in Microsoft Excel of the results and enter the equation in a cell that calculates the answers. I find this saves lots of time. Of course you can simply use a calculator if you don't have access to Excel. See Table 2 for the results obtained

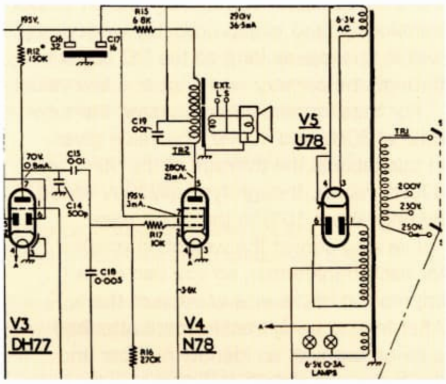


Fig 13: The arrangement used by GEC in its BC5445 radio to combine the audio output transformer and the power supply smoothing choke.

for this method. The results don't seem to correspond with those obtained from the LCR meters. See later for why this might be so.

Measuring Inductance by Resonance

Another way to measure the primary (and the secondary for that matter) inductance of a transformer is to determine its resonant frequency when connected in parallel with a capacitor. Figure 9 shows my set up for making this measurement. An audio source (an old Heathkit Sine-Square Wave Generator in my case) drives the parallel-connected capacitor and inductor (represented by an inductor and a series resistor, Rw, representing its DC resistance), and the AC voltage developed across them is monitored by a DMM switched to its AC voltage range. As the frequency is varied a point is found where the voltage across the parallel tuned circuit is at a maximum. The value of the drive resistor, R, isn't too critical and I found with it set to 33kΩ the peak in voltage was quite sharp and easy to spot on the DMM. Once the point of resonance had been found I connected a digital frequency meter across the DMM to measure the exact frequency. Because we are dealing with relatively low frequencies and high values of parallel capacitance and inductance, the input capacity and lead inductance of the DMM and frequency counter make very little difference to the resonant frequency.

These days, some DMMs are capable of measuring frequency directly, which would simply need you to change range on the instrument. You may not need to make this frequency measurement if you're confident of the calibration of your audio generator.

The value of the inductor is found simply from the formula:

$$L = \frac{1}{4\,\pi^2\,f^2\,C}$$

You may have noticed that the equation above makes no mention of Rw, the inductor's DC resistance. I carried out a few simulations to see how a comparatively small value of Rw affected the resonant frequency of the parallel tuned circuit and the effect was negligible, hence why it is ignored in the formula. You may recognise Rw as being a measure of the 'Q' of the inductor and the major effect of a reduction in 'Q' is a flattening in the amplitude peak around the resonant frequency.

The problem of measuring inductance is now reduced to measuring frequency (which is measured using a frequency counter, or with a 'modern' DMM) and capacitance. Again many low cost modern DMMs have capacitance ranges, but if you do not possess a DMM with such ranges, you can probably simply trust the marking on the capacitors you use. I measured a couple of new metallised polystyrene film capacitors (obtained from the BVWS) and 0.01μF and 0.1μF capacitors actually measured 10.6nF and 103.4nF respectively, so using the marked value isn't going to spoil the inductance measurement by too much.

Again I 'programmed' this formula into Excel, but a calculator is perfectly acceptable.

One neat feature of this approach is that you can choose the frequency at which you are measuring the inductance by selecting a capacitor value that resonates at that frequency. In practice it's best to choose several capacitor values, measure them, make the resonance tests and plot a graph of inductance versus frequency to make sure you cover the frequency points or range that you are interested in.

Again, see Table 2 for the results obtained for this method.

How to Determine the Turns Ratio

We know that the turns ratio of a transformer is key to knowing its impedance transformation ratio, so presented with a fairly anonymous transformer, how do we find out what the turns ratio is? It would seem that all we need to do is to apply a known primary voltage and measure the secondary voltage, and calculate the ratio of these voltages. I thought I'd start by testing a 'known' quantity in the form of the GR Transformer Type T.85A mentioned above, which helpfully states on its label:

8 watt output transformer
Overall primary impedance 8,500Ω
Speech coil impedance 4 – 7.5Ω
Ratio 38:1

Figure 10 shows the test set-up I used to measure the turns ratio of this transformer. T1 is a standard mains transformer: I used a nominal secondary voltage of 12V for my tests, but somewhere between 12V and 30V should be OK. Do not even think about connecting the output transformer directly across the mains. This would be very dangerous.

Of course this test set-up results in the transformer being tested at 50Hz, which is probably below the reasonable operating frequency for these mostly non-Hi-Fi transformers. I thought I'd test a couple of transformers at 400Hz, which is the standard frequency at which many speakers' impedances are specified, and is also well within the band of frequencies at which the transformer would be expected to work well, to see if there was much difference from the 50Hz value.

With smaller transformers the effective turns ratio at 50Hz was about 10% higher than at 400Hz, indicating a drop off in performance of the transformer at the lower frequency. This is because at 50Hz the secondary voltage was lower for a given primary voltage than at 400Hz, and so the step down ratio, and therefore the effective turns ratio, looks higher. It is therefore recommended that if the 50Hz value is measured (which is probably much more convenient than making the measurement at 400Hz), you simply add on 10% to this value to give the 'true' turns ratio.

The Test Results

I tested a number of transformers for winding resistance, inductance and turns ratio. There were ones I knew the origin of (for example one from a Vidor CN431, which uses a DL94 output valve; one with 'DL92' and another with 'UCL82' written on them), and others of unknown origin picked up at rallies, etc. I also measured the inductance of an ex-Admiralty choke which was conveniently marked 'Adm Patt W3662A 6H 70mA 140Ω', so it was a good indicator of whether the inductance measurements were giving reasonable results. See Figure 11 for a 'family portrait' of the transformers I tested, and a few others. The results of these tests are shown in Table 2.

The 'Inductance Measurement' section of the table shows the results for the Admiralty choke, the GR Type T.85A transformer and an anonymous small pentode output transformer, which I had labeled 'no. 3'. As you can see the results correspond pretty well, except for what I call the 'Reference 8 Method', so I suspect there's either an error in the formula, or more likely, I've measured or calculated something incorrectly. This shows the value of making measurements by various methods, rather than blindly accepting a single set of results. The variation of the inductance measurements for each component is interesting: you certainly wouldn't expect that spread for example when making a measurement of resistance. But let's remember that these inductance measurements are made at difference frequencies and voltage amplitudes, both of which are likely to affect the results.

The ratio of mutual inductance (that is, the primary inductance measured with the secondary open circuit) to the leakage inductance (that is, the primary inductance measured with the secondary short circuited) works out pretty consistently between about 35:1 and 47:1, across all the output transformers tested. The GR Type T.85A had the highest value, at about 46.7:1, indicating a high quality transformer, which I'm defining as one with high mutual inductance and low leakage inductance, but the others didn't lag behind by too much.

The measured turns ratio of 57:1 for the Vidor CN431 DL94 transformer (see Figure 12 for a photograph of this compact transformer), to give an impedance transformation of about 3250:1 (that is 10kΩ to 3Ω), looks correct, whereas the DL92 transformer measured turns ratio, at 90:1, looks on the high side. Maybe I need to check that result again. It looks like I've got a good selection of turns ratio with the other transformers. You can see from the measurements that the mains-to-6.3V transformer 'looks' remarkably like an output transformer and would probably work pretty well in this role as long as the DC current through the primary was kept at a low value.

For transformers where I tested the turns ratio at 50Hz and 400Hz, the value given in this table is the average of the 50Hz and 400Hz values, though typically they varied by only about 10% in the worst case.

I've also shown the weight (in gms) for each transformer, so you can get an impression of the size of each of them. After testing each transformer I attached a tie-on tag with an identity number and the measured details (winding resistance, inductance and turns ratio) written on it so that I could access the information quickly next time I needed a transformer.

Multi-Tappings

Radiospares (and others) sold replacement output transformers with multi-tappings on the primary and secondary windings to suit 3/8/15Ω speakers and various primary impedances between about 4kΩ and 15kΩ. These are very useful and so if you see one, it's worth snapping up. It probably won't match the style and appearance of the original, but it's quite possible you could hide it beneath the chassis and leave the failed original transformer unconnected in place for cosmetic purposes.

Push-Pull Amplifiers

Higher power and higher quality amplifiers often have a pair of output valves in a push-pull arrangement, driving the primary of a single output transformer. In Table 1 I have shown push-pull (as well as single ended) values of Ra (or Zout) for valves which are commonly used in push-pull mode, though they not very often encountered in domestic radios. I suppose the closest you would get to this in domestic usage would be in a good quality radiogram. It is this value of Ra that the output transformer needs to match to the speaker impedance.

Push-pull transformers are usually wound so that the magnetic flux from the DC current components feeding the anodes of the two valves cancel out, and therefore they do not normally have an air gap.

Transformers for push-pull amplifiers are still available new and second hand on the internet (eBay and other sites): don't be surprised by the high prices they command, especially ones with 'ultra linear' tappings on the primary.

Power Rating of the Transformer

Table 3 shows the secondary voltage (expressed as an RMS value) for various values of power delivered to the load, for different load impedances. Clearly this power 'passes through' the transformer and so it has to be capable of handling this. Note that this isn't the same as saying that the transformer dissipates this power: clearly it doesn't, otherwise no sound would come out of the speaker.

There are analytical ways of assessing the power handling capacity of an output transformer, which take into account the cross sectional area of the core, the core materials, etc, but we'll take the simple pragmatic approach that you should use a replacement transformer at least as big as the original. If you're constructing a valve radio from new, then use the biggest transformer you can fit in, consistent with it's having the correct winding ratio of course, unless you only want to drive headphones, in which case a small transformer should do the job.

Combined Output Transformer and Smoothing Choke

One clever way radio manufacturers saved cost was to combine the audio output transformer and the power supply smoothing choke. Figure 13 shows the arrangement used by GEC in its BC5445 radio, and you will find this arrangement from many other manufacturers. If you can untangle the rather badly drawn diagram you can see that the supply to the tap on the primary winding (which represents the 'top' of the primary winding from the point of view of the audio output valve) is smoothed only by C17, a 16μF electrolytic. The HT current to the rest of the radio passes through the remaining of the primary winding (which is acting as a choke), then R15, and is then smoothed by C16. The rest of the radio therefore gets a much smoother HT DC supply that the audio output stage.

The BC5445 I have has a rich deep sound, typical of these wooden cased radios, and there's no sign of any mains hum on the audio output, so the arrangement seems to work well. The data sheet for this radio shows the resistance for the whole primary winding (at 460Ω) and does not show a breakdown (maybe the wrong word to use) for the transformer and choke sections.

Looking at a number of GEC table models, this arrangement was pretty common (but by no means universal as there are many models which have separate smoothing chokes) and the ratings of this transformer seems to be different from model to model, even if the same output valve (the N78 was typical for several years) was used. Since these radios are not greatly collected, and therefore not highly priced, it might be worth trying to pick up a couple of scrap chassis to keep in case you have a more valued model go wrong. You can at least try a non-exact replacement to see how well it works, or split the functions into separate parts, maybe hiding the new components beneath the chassis.

Conclusions

As I'm sure anyone who has been involved in transformer design or testing would have told me, they are rather more complex animals that I originally imagined, and I have to admit to going rather further than I first anticipated when starting this article. Because the behaviour of a transformer depends on the interaction of electrical and magnetic fields with iron and air across a wide frequency range there's a lot more going on (and potentially more to go wrong) than the unwary (like me) would first expect.

Even an apparently simple concept such as the turns ratio of the windings turned out to be trickier to measure than I expected. Surprisingly I found that this ratio, which I had expected to be a constant number, 'varies' depending on how you measure it. Obviously the actual number of turns of wire on the primary and secondary isn't changing, but I clearly got different results depending on how I measured it, particularly on the frequency at which I made the test.

Using a simple test set-up, it's fairly easy to measure the 'effective' turns ratio at 50Hz, and for better quality transformers this was found to be accurate to within a few percent of the same measurement made at 400Hz. Although 400Hz is closer to the true operating conditions of the transformer, it is a more difficult measurement to make, because you need a source of AC at 400Hz. With smaller transformers the effective turns ratio at 50Hz was about 10% higher than at 400Hz, indicating a drop off in performance of the transformer at the lower frequency. It is therefore recommended that if the 50Hz value is measured, you simply add on 10% to this value to give the 'true' turns ratio.

When it came to measuring the inductance of the primary winding of a transformer, although modern (and not so modern) methods were relatively easy to use, four different methods gave four different answers. This can be explained partly by the fact that the measurements were made at different frequencies, which is unavoidable because the two LCR measuring instruments 'choose' the frequency at which the measurement is made outside the control of the user, and the other two measurements were made at either 50Hz or the resonant frequency of the inductor connected in parallel with a capacitor. For the investment of about £15 you can now buy a good quality digital LCR meter, which will be a useful companion to your standard DMM.

The fact that audio output transformers work, and work well in most valve radios and amplifiers, is a tribute to the theoretical and practical skills of the unsung engineers who designed them all those years ago. I'm sure at the time it was the RF designers who were seen as the innovators and the design of something as 'simple' as an output transformer was left to the 'less skilled' designers.

Hopefully this article will help in choosing the right transformer for a valve output stage. I suspect that most output stages are pretty tolerant to the exact specification of the output transformer and so if you can't make the tests described above, just choose a replacement about the same size as the original and give it a go!

I hope the article will also inspire you to investigate the properties of these deceptively simple looking components a little more, which I think will turn out to be more complex and intriguing than expected.

References

Reference 1: 'Practical Handbook of Valve Radio Repair' by Chas E Miller. Published by Newnes Technical Books in 1982. Contains a useful section on trouble-shooting and repair of audio frequency amplifier and output stages. Also lists a large number of audio output valves with their electrical parameters.

Reference 2: Some useful notes on valve audio output stages, and what can go wrong with them, can be found at: www.vintage-radio.com/repair-restore-information/valve_output-stages.html

Reference 3: Radio service data DVD-ROM. www.service-data.com/.

Reference 4: Tube Data Sheet Locator: http://tdsl.duncanamps.com/tubesearch.php.

Reference 5: National Valve Museum at www.r-type.org/static/museum.htm.

Reference 6: University of Pennsylvania, Department of Electrical and Systems Engineering: Transformer Lab. www.seas.upenn.edu/~ese206/labs/Transformer/TransformerLab05.pdf.

Reference 7: Linear Technology's LTspice IV software download site: www.linear.com/designtools/software/ltspice.jsp.

Reference 8: 'A Simple Procedure for Measuring Inductance' by Guillermo Rico. See: http://technologyinterface.nmsu.edu/fall96/electronics/induct/induct.html.

Here are some other references on valve audio amplifiers, transformer matching, loudspeakers and measuring inductance. If you have the magazines or books mentioned, it may be worth digging them out and taking a look.

'Radio Coil and Transformer Manual' by 'Radiotrician'. Published by Bernards (Publishers) Ltd, 1944.

'Coil Design and Construction' by B B Babani. Various editions published by Bernard Babani Ltd. Includes chapters on Output Transformers for Single Valve; Air Gap Determination; Push-pull Output and Loudspeaker Transformers; and others. Overall I found the book to be less useful than I expected, but it's probably still worth the £6 or so you should expect to pay second hand.

'Choosing an Output Transformer' by Eric Lowdon. Radio Constructor September 1951. A brief, but useful, article covering the basics of output transformer operation.

'Finding Transformer Connections' by F G Rayer. Practical Wireless August 1956. Covers mainly mains transformers, but also suggests useful techniques for output transformers.

'A Transformer for a Single-Ended Output Stage' by N P Fish. Practical Wireless February 1957. Discusses in detail the design and construction of an output transformer, and is a useful source of the rules governing the magnetic properties of the core.

'A CRL Bridge' by J Hillman. Practical Wireless January 1958. Shows the design and construction of a valve-based CRL bridge, including a 'magic eye' balance indicator.

'Loudspeaker Matching' by K Royal. Practical Wireless January 1959. Discusses impedance transformation and measuring turns ratio, and also covers driving multiple loudspeakers in series and parallel.

'An Inductance Measuring Instrument' by D Saull. Practical Wireless March 1960. Describes a simple method of measuring inductance which allows a DC bias to be applied to the inductor under test.

'Audio Transformer Design' by D Saull. Practical Wireless July 1960. Covers the design of transformers for mainly class 'A' transistor output stages, but has some information relevant to valve output stages.

'Selecting Output Transformers' by J Gray. Practical Wireless November 1960. Discusses impedance matching and calculating the turns ratio in single-ended and push-pull output stages.

'About Loudspeakers' by P J Good. Practical Wireless October 1961. Covers some of the things that go wrong with loudspeakers and tests that can be performed on output transformers.

'How to Measure Inductances' by S Jacob. Practical Wireless December 1961. Shows a simple method of measuring the inductance of AF and RF inductors.

'The Multitest' by R D Owen. Practical Wireless August 1966. Describes a comprehensive analogue multimeter and LCR bridge, capable of measuring inductance up to 4000H at 50Hz or 1000Hz.

'Understanding Radio: Parallel and Push-Pull Output Valves' by W G Morley. Radio Constructor July 1967. Contains a useful discussion of transformer air-gaps and laminations.

'Build Your Own Audio Valve Amplifiers' by Rainer zur Linde. Published by Elektor Electronics (Publishing) 1997. Contains many useful chapters on valve audio amplifiers, but surprisingly little information on the design and choice of the output transformer.

'Valve and Transistor Audio Amplifiers' by John Linsley Hood. Published by Newnes of Oxford, 1997. Contains many useful chapters on valve and transistor audio amplifiers, including discussions on the design and effect on overall performance of the output transformer in valve amplifiers.

Other sources of valve data:
'Radio Valve and Transistor Data' by A M Ball. Various editions, Published by Iliffe.

All 'valve era' editions of the ARRL Handbook had a useful valve reference data section at the back.

There are many editions of the Mullard Technical Handbook around which contain useful valve data.

Audiojumble 2010 Sunday 14th February Photographed by Carl Glover





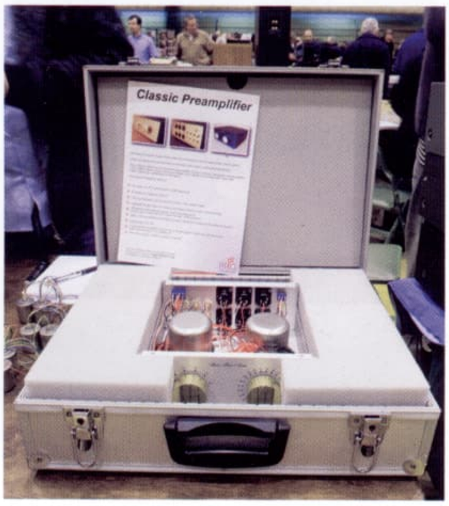


211
Amp
399-
AUDIOROMY


SERVICE ENGINEER
THE MOST POPULAR


A20 HIGH FIDELITY
Armstrong
LONDON ENGLAND


WEIGHT
SIZE
240V

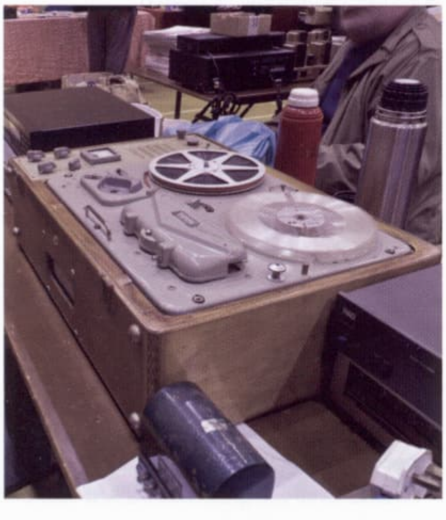

Classic Preamplifier


LEAK
LEAK

ALBA

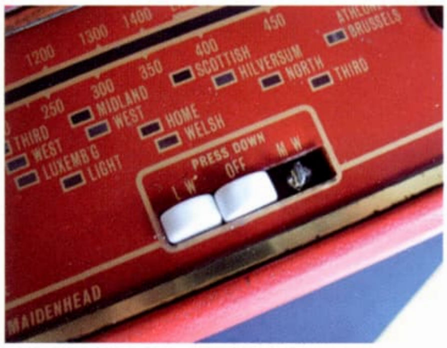
Leak POINT ONE STEREO
Bass
Treble
Balance
Volume
SERIOUS OFFERS ONLY!

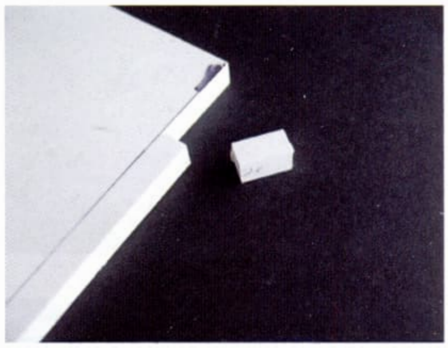
VOLUME 1
BASS
TREBLE
VOLUME 2

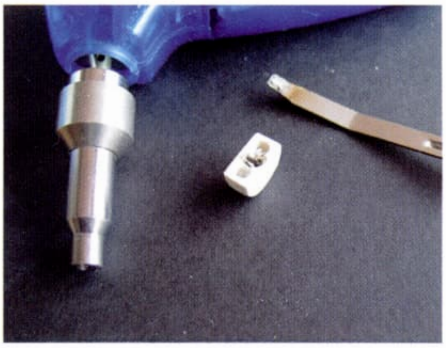



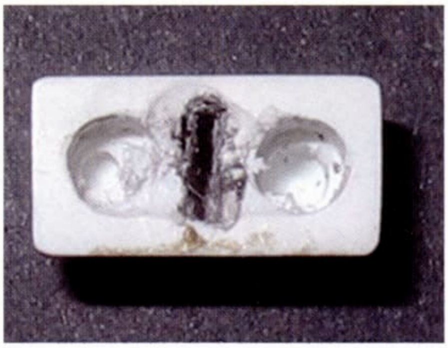
The Hacker that came in from the cold by John Panton

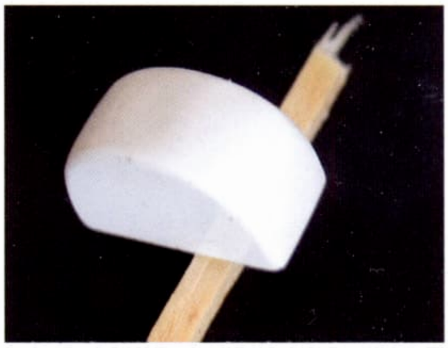
Looking round the unheated workshop in the middle of winter is not my favourite occupation. Still, the exceptionally bad weather had presented so many opportunities for restoring radios that the supply in the "museum" upstairs had run out. Luckily, I found a few items that had been stored in the workshop since our last move some five years ago.











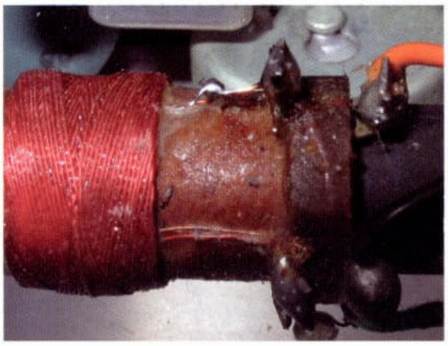
One of these was a Hacker RP17 Mini Herald. Whereas most hackers nowadays are aggressive and despised virus spreaders, this Hacker looked neglected and demanding TLC. The LW button was missing, neither knob had the brass insert and everything was dirty and lack-lustre. The good news was that the tuning scale was in perfect order and there were no tears in the vinyl. Hacker radios are recognized as being high-quality sets with excellent low frequency response and, rather strangely, their reputation has grown with age. Altogether worth restoring.

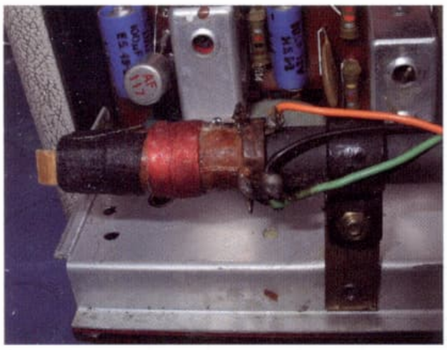
I decided to start by trying to replicate the MW button which could easily be pulled off for study. They are made of white plastic 6 mm thick, generally hollow with a centre rib to fit onto the switch pin. A piece of 7 mm solid white plastic was lying around in the workshop just waiting to be useful. A piece was cut with a width equal to the required height of the button and long enough to make two buttons in case a second attempt was necessary. The first step was to drill three small holes into the bottom of the piece along its length and drill out the outer ones as much as possible without weakening the walls. For the centre slot a small flat rod was ground to a size matching the slot of the MW button, heated and pushed into the plastic, melting out a channel. This then had to be extended and deepened with the help of a Dremel mini power tool. It fitted firmly onto the switch pin, so the top could then be shaped using a mini diamond wheel, and the thickness brought down to 6 mm with 320/600 wet&dry. Brasso gave the plastic a suitable gloss finish.

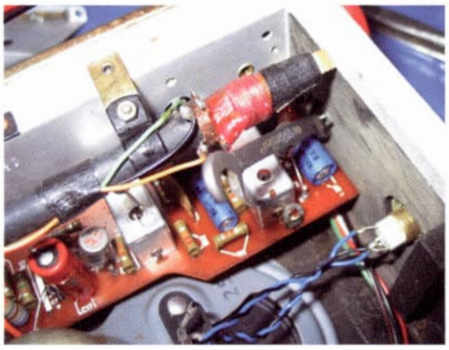
Next, the two knobs were pulled off, cleaned with Brasso and two brass-finish discs cut from a plastic card. The discs were polished, clear-spray lacquered and stuck into the knobs. I can't be quite sure how well it matches the original.

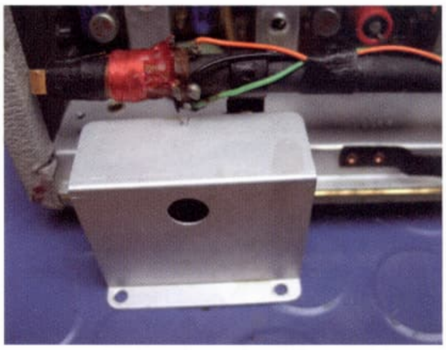
While the knobs and buttons are all off, it is good idea to clean and polish the dial scale.

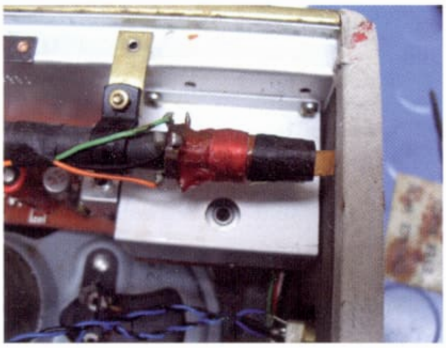
I connected a couple of 9V batteries and found that, apart from scratching from the volume control, MW reception was quite satisfactory, but absolutely nothing came from the LW band. No circuit diagram was available to me for this set – not one Hacker in the thousands I have; amazing... Since MW functioned, it was obvious that the AF amplifier (on a separate PCB) had to be good and I was going to be looking at the tuner stages. Nevertheless, on principle I checked out all the transistors, electrolytics and relevant diodes. No problems, even

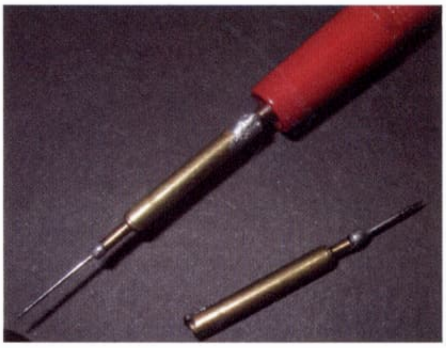












the infamous AF 117's with their screen leads were good. Maybe it was too cold in the workshop to grow crystals.

I needed to extract the tuner chassis. Now you'd think that removing the separate tuner PCB would be too easy to merit mentioning – wrong! The handle holders have welded bolts which are so long that they block the removal of the tuner unit. First, take out the two wood screws and remove the aluminium shield. Unplug the leads to the external aerial socket and disconnect the 5-pin plug at the amplifier PCB. Remove the right hand side of the handle by pushing the handle to the front of the radio, hold a ¼" open-ended mini spanner on the nut and pull the handle to the back of the set. Swing the handle forward again and repeat the process. If you're lucky, the nut will soon be loose. Now the two 4BA screws fixing the tuner chassis can be removed and the chassis worked out towards the back. Immediately turn round the two brass trims on the tuning scale since they will be in better condition underneath.

The tuning caps and trimmers looked undisturbed as did the oscillator and IF cores. My signal tracer (see http://www.pasttimesradio.co.uk/build/diyradio.html - thanks, Richard) picked up no signal on any stage on LW. Interestingly, though, an injected signal went through to the amplifier from every relevant point of the tuner PCB. No signal from the set but I couldn't find anything wrong.

After some thought I decided there had to be a faulty connection between the LW coil and the tuning caps or the switch. Every single connection checked continuous and the switch was perfect. Suddenly, I had the 'eureka' experience – I was measuring from the tags of the coil connections and the injected signal went through from the tags. So maybe there was a broken connection between a coil wire and its tag? I couldn't see any break, even with a powerful magnifier. However, I've made extension pieces for multimeter leads etc, out of brass ball-point refills and stiff pins.

These helped to connect to the extremely thin coil wires without damaging anything. One wire turned out to be disconnected from the tag, despite adhering tightly to the former. A joint was made by scraping off the lacquer from a single strand of the thinnest multi-cable and from the coil wire, tinning both and soldering together. Melted wax sealed and secured the result.Finally, Long Wave reception!

Don't forget: push the centre button to switch off - UP IS ON!

Supersonic Heterodyne By Lisa Koning

A Philips BX998 stands prominently in the centre of my living room. Another name for a Philips BX998 is a supersonic heterodyne, or, in layman's terms, an early valve radio. In 1955 it cost about the same as a small car. It is a big piece of furniture, almost regal in appearance, and its presence seems to command homage from any visitors to our home. I call it furniture because it doesn't look mechanical. The exterior is a glistening wood veneer and as you get close you can smell the varnish. In the centre a green eye glows brightly; I know little about old radios but I do know that the green eye fades over time and is extremely rare to replace. The knobs show no trace of wear, the stations and frequencies on the tuning scale boldly stare back at you, and even the loudspeaker cloth at the front denies any sign of wear.

I'll be honest, its presence and condition has little, if anything, to do with me. Radios are not my passion, at most I look on with mild amusement, for radios are the domain of my husband Albert. I have used the plural, radios, as there is more than one radio in our home. If you'd asked me prior to writing this piece I would have guessed maybe six or eight, but a quick census revealed: three in the conservatory, two in the kitchen, four in the living room, two in the bedroom, ten in the garage (admittedly in various states of disrepair), four in our son's bedroom, and rather disconcertingly, one in our two year old daughter's play box. A sum total of twenty-six, in various shapes, sizes, colours, ages, makes and designs. So how did my home manage to get filled with vintage radios, without me really noticing? In my defence, they were rather like stray moggies that arrive on your doorstep one morning and by the afternoon have become permanent fixtures. But these weren't your typical unwanted strays; they might have arrived bedraggled, unloved and ready for the RSPCA, but within no time their fur would be lovingly returned to its former glory. They would be cleaned and preened, buffed and pampered and finally given the best cushion (or shelf) in the house. It's not that I was completely uninterested, I would smile and listen as Albert informed me of his latest acquisition, though let's be honest, when you're married you each need your own outlet. After fourteen years of marriage I decided it was time to understand this obsession of my husband's.

Albert's first response at my request to write about his hobby was, "sure, but it's not an obsession."

"So what is it then?"

"Just an interest."

Albert's interest began as a child. Radios and televisions have always fascinated him. This led to working in an electronics shop on the weekends. He explained to me that, during the eighties, it was very fashionable to be into Hifi, just as it is now in computers. Albert was drawn into vintage radio as he realised that many of the so-called latest techniques were already applied in the thirties for both radio and TV. "To have the latest and greatest equipment was a race I could never win." And then he said something that set alarm bells ringing. "The fun with old radio is that when working they are just as useful as a modern day radio. But you know, I also like old cars".

A vivid image of 26 old cars cluttering up our front yard came to mind. I quickly moved on.

"What fascinates you about radios then?"

"The history, the years of work by the lone inventors to reach a point where the invention was made, even if the invention was not going to be successful. Also it fits in nicely in my interest in listening to radio ... and it's a link to home."

The news from the Netherlands is playing in the background as we speak.

"What do you see when you look at a radio?"

"A piece of antique furniture, state of the art in its day, a piece of useful equipment today, a piece of nostalgia, my childhood."

"And what do you feel when you restore a radio?"

"Respect for the people who worked in the factories making it, respect for the designers of the past. But sometimes it feels like repairing a toaster."

At this point I sensed that Albert was going to test my sudden interest in his hobby; it was an opportunity that he wasn't going to let slip. "There's a vintage wireless fair in Birmingham next month, why don't you come along?"

One Sunday afternoon I found Albert huddled over a radio that looked to be in the midst of major heart surgery. The case lay on its front, the back was removed and a mass of wires, cables, and what looked liked light bulbs, exposed. All rather contradictory to its glorious casing; I wondered if I shouldn't look away. But my attention was caught; despite the array of wires and metal devices, the surface was pristine clean. No trace of dust at all.

"Can I have a go?" I ventured.

"I'd like to repair a radio."

I caught the slightest movement of Albert's shoulders stiffening.

"It's not that easy, you need to be trained to repair a radio." I knew I was treading into sensitive territory. Showing an interest was one thing, but messing around with a radio was another.

"How about I explain the insides to you, to begin with anyway?"

So for the next hour we looked inside various radios and I discovered that those light bulb-y looking things were called valves and the tension carousel sorts out the input voltage. Radios also have electrolytes, oscillators, amplifiers, condensators, wires and transformers. But to be honest, my interest in radios is definitely more to do with its ability to play music than its internal workings. One phrase did however leap out at me, perhaps because I'm a writer and

it's a lovely word to say: Supersonic heterodyne. The supersonic heterodyne was a major advancement in radio technology perfected just after the Great War, whereby signals could be converted down to a lower frequency which in turn simplified processing of the signal. All radios today are still based on this.
My lesson on the entrails of a radio was fascinating but I still wanted to get my hands dirty.
"What happens on the inside when I turn the tuning knob?"
"Give it a try."
So I twisted the tuning knob and watched inside as the condenser, something that looks like a comb, moved. We then turned the radio on and I watched as the valves slowly came to life providing a light display not unlike turning your Christmas tree lights on. With the back off, I could smell the valves and wires as they warmed up. It was like an orchestra preparing for a performance.

Some weeks later we arrived at the Vintage Communications fair, held once a year in Birmingham. There was a queue to get inside. In the car park I'd noticed many number plates from all over Europe, and as I looked at the people around me I sensed this wasn't just any old antique fair. There was a buzz, an excitement in the air. The early arrivals were leaving with precious bundles tucked under their arms. Those not yet privileged to get inside watched on with envy, nervous anticipation and sheer worry that all the best items might be gone. Once inside, I joined the crowds of young and old, men and women, all wandering around looking in admiration at a snapshot of history: vintage telephones, gramophones, televisions, video recorders, record players, and of course radios.

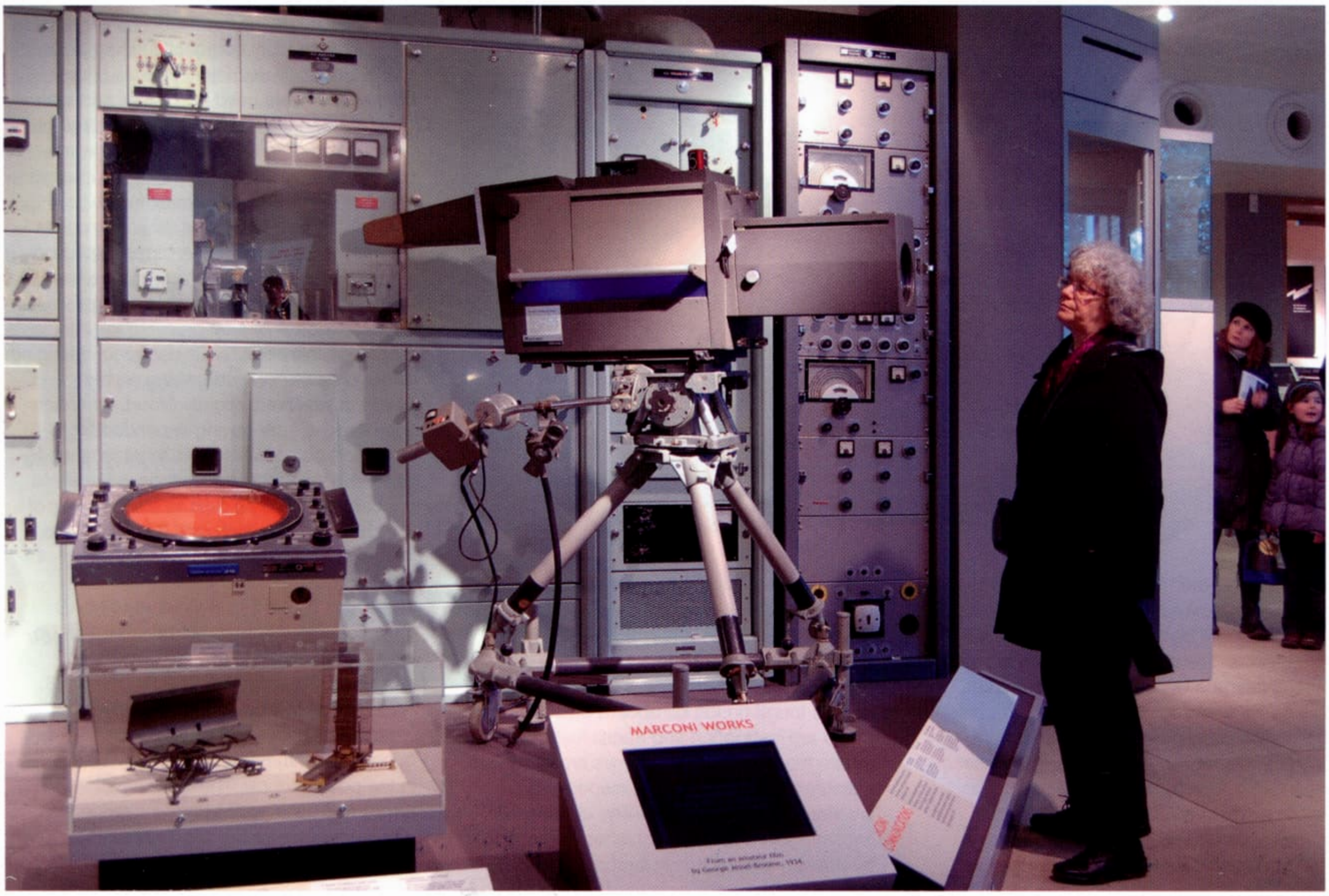
As I paused to look at various models their owners would wander over for a chat, telling me about their history, or its owners, or how it had been discovered in a rubbish tip and then restored, or they would encourage me to press buttons and see how it worked. I quickly discovered that people didn't just come here to buy; they came to share a passion. This was something they really enjoyed. As Albert said in the car on the way to Birmingham, "You know, this is one of my favourite days of all the year." There is something about vintage radios that goes beyond being functional and nice to look at; they are a piece of history, a link to the past, they connect you to the world and bring the world into your home, and they do all this via a mass of wires and things called valves.
Did I buy a radio? I have to admit that I was tempted by a pretty little radio from France. Yes, I managed to find the equivalent of a Christian Dior in the form of a vintage radio, but it also came with a similar price tag.
There was one conversation that caught my ear as I eavesdropped that day.
"I'm very tempted you know, I really am trying to be constrained… it's a beauty, an early supersonic heterodyne!" Well, at least I knew what he was talking about!

By the time I completed this piece the count had risen to twenty-eight.

Marconi on view

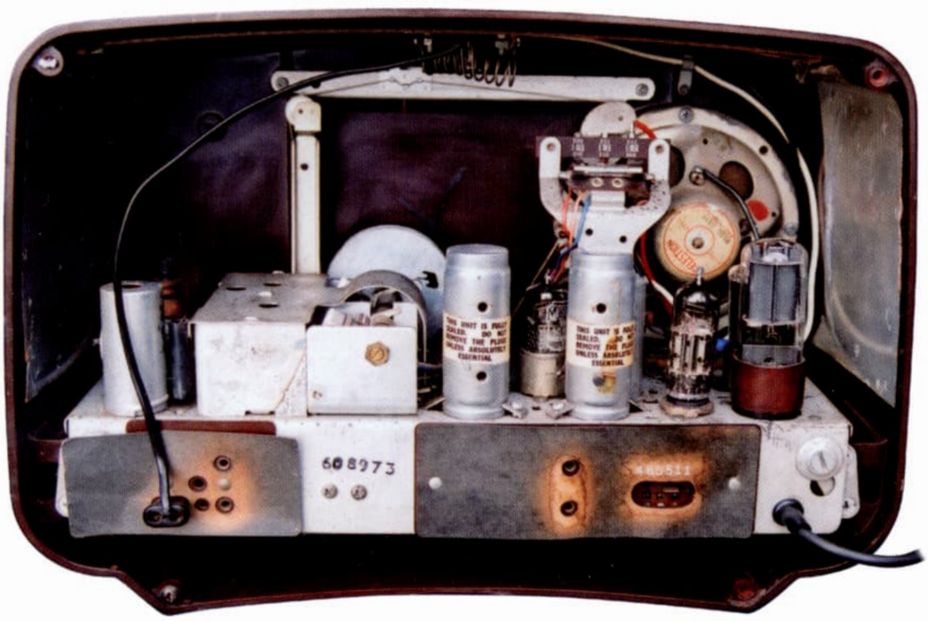
Dicky Howett Reports

Things are looking up these days in Chelmsford "Birthplace of Radio" (sic). A impressive new wing of the local museum now houses exhibits from 'Chelmsford's Industrial Pioneers'. These include Crompton, EEV, RHP Bearings and of course Marconi. Not before time, in fact rather a long time. Still, we mustn't snipe. On display is a Marconi Mk VII four-tube colour camera plus I.O. tubes and other bits. Also radar and transmitters. Running as part of the display is a short but fascinating amateur b/w film shot in 1934 by George Jessel-Broome of the Marconi works (now boarded up) in New Street.



The Murphy A362 by Peter Nash

In 1955, after the BBC's new VHF service had been inaugurated, there was fresh impetus for radio designers to create something new, not just technically but also aesthetically. There was popular interest in the so–called 'continental' style, typified by Grundig and Philips, highly polished cabinets abounding with gold trim, piano key wavechange and concentric knobs at each end of an elaborate glass dial. Of course, there were always the more conservatively styled receivers bearing very close relation to their older AM only predecessors. Then there was the subject of this article, the Murphy A362, which was unlike anything which had been issued before.



According to the 'Trader' sheets, The Murphy A632 was released in June 1955 so it was around almost from the start of the new broadcasts. The pricing suggests a product aimed near the budget end of the market, but as we shall see, the receiver incorporated some decidedly non–budget features. Visually, the reason why the receiver is set apart is not due to the bakelite cabinet as such, which is quite plain, but the way in which a simple piece of perspex (forming the dial) is mounted symmetrically across the speaker louvres. It is a clever but simple device which makes quite a visual impact. There were few designs which merged the dial and speaker grille with such success.

A clue that this receiver is not run of the mill can be found on the cardboard back. Printed in red are installation and transit instructions where the chassis fixing screws are to be slackened off (or tightened, respectively) by three quarters of a turn. The chassis mountings are rubber–cushioned and not having the screws tightly fastened allows the rubber to do its job. We now remove the back cover and inspect the 'works'. One of the first things to spot are the two IF transformers mounted prominently on the chassis, each sporting a label which declares 'this unit is fully sealed, do not remove the plugs unless absolutely essential'. The plugs in question are small rubber bungs which fit into the adjustment apertures. Unfortunately, human nature being what it is, many that read the label will suddenly be tempted to pluck out the little rubber bungs and lose them. But, anything to help keep dust and dirt from entering IFTs has to be a good idea. A few other touches of thoughtful design evident from a cursory inspection include a good job made of a voltage selector panel, inclusion of an HT fuse, dial light leads properly secured, last but not least, insulative plastic shrouds which slip over the potentially live control shafts.

We now remove the chassis for a more detailed perusal. Before the chassis can be withdrawn, the dial pointer, which remains fixed to a rail in the cabinet must be unhooked from the drive cord, reminiscent of some Philips sets. it is not a difficult chassis to work on, but being fairly compact it is inevitable that accessibility is tricky in places. Hunts condensers were used in quantity and appear to have been fitted during an early stage of assembly, calling for some dexterity when replacements are needed. Once the chassis is out of the cabinet, it is easy to see how well reinforced the chassis mounting points are with sensible thickness of material used.

When reinstalling the chassis, it needs to be held firmly and at a certain angle. It doesn't follow a natural groove back into its place and this adds to the danger of snagging under chassis parts and wiring on the brackets which are slightly proud. I mention this because after having expended time and effort on a chassis, it is most irritating to hear something 'twang' as it goes back into the cabinet. It will be best to hold the rear of the chassis a little high until it is fully home.

The circuit

The circuit is that of a 6 valve AM/FM AC mains operated superhet. The valve line–up is UCC85, 10C1, 10F9, EABC80, 10P14 and U404. The pilot light is 6.5v 0.3A MES. A mixture of Mazda and Mullard valves have been used. The circuit broadly follows convention with departures mainly being in the power supply. The valve functions are as follows. The FM tuner (covering the standard range for the 1950's of 87.5 to 100 MHz) is headed by the UCC85, RF amplifier and mixer. 10C1 acts an IF amplifier on FM and frequency changer on AM. 10F9 is an IF amplifier on both systems. The EABC80 facillitates AM automatic gain, AM and FM demodulation and first AF amplifier. The 10P14 is used in the output stage whilst the U404 supplies HT current.

Now for some detail. The power supply uses a curious mixture of AC and AC/DC technique. Most of the valve heaters are series operated but one is parallel fed. In common with other Murphy models, an auto transformer is used which is an improvement over a mains dropper. Tappings on the single winding feed everything. Although most of the valves are series fed from the autotransformer, there is still a series ballast resistor, used to cushion the switch on surge caused by cold heaters. The EABC80 alone is supplied via its own private tapping (as is the pilot light). It would be interesting to know why a UABC80 was not used in this position because having a 0.1 A heater rating, it could have been added into the existing heater chain without problems, then the special tapping would not have been needed. One guess is that at the time the receiver was designed, the UABC80 may not yet have been available. In any case, an admirable solution has been found. As well as the HT fuse mentioned earlier, a thermal fuse energised by the transformer core temperature and placed in the mains input circuit is also employed. A double pole mains switch is fitted along with a three core mains lead – but the chassis is not earthed. It can be seen that much care has been taken with the power supply design.

Some care has also been taken in the AF amplifier to ensure a balanced audio response. There is a two position tone switch fitted at the rear of the chassis, but this works nothing like the usual top cut affair. The switched positions could more accurately be called 'wide' or 'narrow' rather than 'high' or low'. The wide position is intended for FM reception where a bass lift is applied to balance the upper ranges. The narrow position cuts treble response and removes the bass lift to retain the balance. It could be useful in minimizing adjacent channel interference on AM. The tone switch works by selecting one of two frequency selective negative feedback networks and applying the result to the bottom end of the volume control. For interest, I thought it would be worth plotting the receiver response for both tone settings to gain a fuller appreciation of its action. The input was applied from a flea-powered FM transmitter (see later) driven by an AF generator. The output was measured on an oscilloscope connected to the extension speaker sockets via an isolating transformer. The volume control was advanced by 90 degrees from minimum. Using 1 KHz as a reference point, the following responses were obtained (see figure 1).

As can be seen, the narrow position gives fairly flat results to about 5 KHz, then the response tails off quite sharply. The wide position introduces a couple of peaks into the response, the first one being centred around 120 Hz and the second at 4 KHz. The slight dip in response at about 500 Hz indicates the natural frequency of the negative feedback network. Even in the wide position, I measured the response as falling away above about 7 khz. Obviously, the final acoustic response depends upon the speaker and cabinet.

Repairs

My own example of the Murphy required the following routine work to return it to normal working order. Replacement was needed of around a dozen capacitors which were among the most leaky that I had seen in a long time. These were mainly in audio coupling and HT decoupling positions. Also up for replacement was the double section electrolytic can which failed after appearing to succesfully reform. A new rectifier valve U404 was needed as someone had previously fitted a UY41, although this 'worked' the heater ratings do not match. A new mains lead and entry grommet together with the usual cleaning and polishing completed the job.

In use

VHF pick-up is quite good from the internal foil aerial although in some locations creative routing of the mains lead is called for to maximise signal strength. For some reason, I found the internal aerial markedly better if just one pin of the connector were to be used. After prolonged listening to various stations along the dial in differing ambient conditions, I have never found tuning drift to be any problem whatsoever, it remains very stable. MW and LW pick-up is less efficient although to be fair, it is stated that the internal foil aerial is intended for local station use only. However, there is provision for an external aerial, just a few feet of wire here makes all the difference, it now being well up to standard. I think that this receiver would have benefitted from the inclusion of a ferrite rod aerial, they were just beginning to gain popularity at the time.

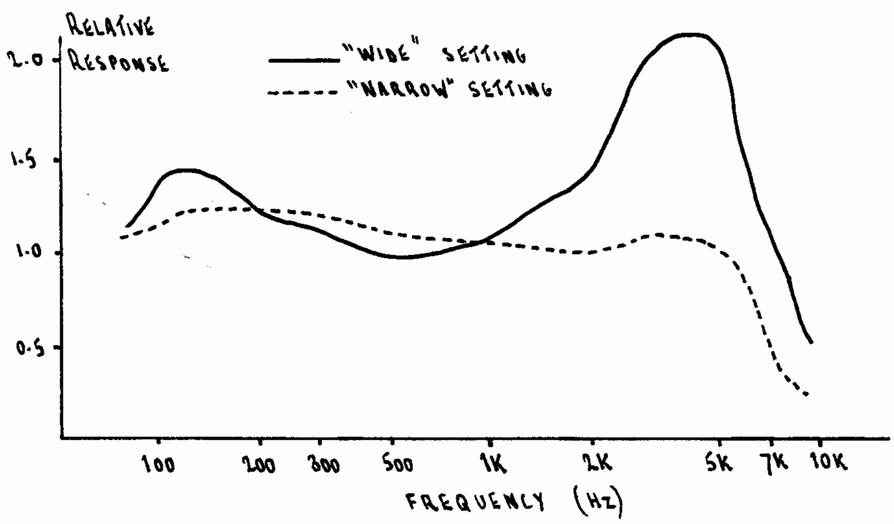
Tonally, the receiver is slightly restrained. Owing to the limited upper range, speech does not suffer from excessive sibilance but music still has presence because of the carefully tailored response. The filtering effect means that VHF sounds very clean too, with lack of background hiss.

A little while ago from one of the high street electronic chains, I bought on special offer an FM transmitter. This is a small unit, about 2 x 3 inches, powered by a couple of AAA batteries, complete with a backlit digital frequency display and short lead terminated in a stereo 3.5 mm jack plug. When the unit is connected to a personal CD player etc. it produces a high quality stereo multiplexed signal on a selectable frequency. With no aerial as such, the whole ensemble is highly portable, has a range of a few feet and runs economically from easily obtainable batteries. I find this incredible value for money for about £10 especially after finding the CD player on top of some rubbish in the local car park. Dried off, it was found to work well and has provided hours of music for the Murphy (and me!). I heartily recommend one of these transmitters to anyone engaged in repairing or using vintage FM receivers, they really are useful.

With the Murphy operated in a darkened room, the entire frontage glows weakly, a little like the Philips sunburst but less spectacular. The illlumination is more for effect than function as it is not very easy to read the dial by it.

In passing, mention must be made of the Murphy A372 which appears to be a later development of the A362. It uses a modified circuit. One of the changes is the substitution of the 10F9 valve by the higher slope 10F18. All of the A372's that I have seen differ in appearance from the A362 by the addition of the Light, Third and Home positions being marked on the VHF scale. I have not yet worked on one of these, therefore could not say how they compare.

To conclude, I find this an interesting receiver; good, clean styling, sound engineering and though not strictly hi-fi, is nevertheless very satisfying to listen to.



Letters

Piano radio and Mr Colin G Mansfield's letter in the Spring Bulletin

Dear Editor
Firstly the Piano radio. It has been pointed out to me that I have put the keyboard on the wrong way round. How prescient of me that I only attached it with small pieces of Blu Tack so it's easy to correct.

With regard to Colin's letter and his preference "... nothing short of original will do", I prefer the statement, nothing short of original if at all possible. Lets assume the radio is complete which is often not the case, then wound items can be rewound, capacitors may be re-stuffed but not resistors. Only occasionally is it possible to make replicas of those. Normally it's a NOS period item or a large sized modern one, which doesn't look too offensive to me. As for rusty chassis, you can't get cadmium but nickel plating (ask for the old type) is close. Not many radios have enough value to warrant this and so paint has to do. Then there are items like a volume and on/off switch I need for a Philips. This wonderful arrangement of track, levers, cams and worn out contacts will never be any use again. Where can I get a good replacement for that?

Of course I could leave the set alone, as he also suggests but I'm not much into radios sitting on the shelf. The hobby, for me, is about making the radios look acceptable and perform again to at least as good as they came from the factory. There are exceptions to this and I have two radios that have an excellent cabinet, with a rust free chassis, are totally original and have never had a soldering iron on them from new. I will leave them untouched.

The Philips certainly isn't anywhere near that condition having been got at in a most unsympathetic manner (like many radios I come across these days). If I replace the potentiometer with a later 30's item, I baulk at new plastic ones, is a future historian going to be bothered? It's doubtful, for a good restoration that the chassis will ever be taken out of the cabinet again.

Anyway, I was intrigued to see some of Colin's exemplary restorations but as the BVWS doesn't have a reference of articles and authors I had to look back through past Bulletins but couldn't find any. I went as far as Spring 2005 and apologise if I missed one, if not maybe he's been having a rest since then.

Comparing radios, with an age of just a few score years and ten, with centuries old historic buildings, is nonsense to me. For a start there are thousands of radios and certainly less than a tiny fraction of that for stately piles. That alone makes them considerably more valuable, and worth spending the huge sums demanded by English Heritage. They become rare references for historians and places that thousands visit and spend money at. No one visits my radio collection and pays entrance money or buys tea and cake. The few that get in for free don't show much interest either.

Yours truly,
Gary Tempest

Dear Editor,
I have been a member of several vintage radio societies for the past 30 years and throughout this period I have noticed that there has been one consistently recurring subject from letter writers to their bulletins. It is the restoration/repair debate.

In his letter in the Spring of 2010 issue, of the "Bulletin", Colin Mansfield asks for views on restoration, but I am puzzled by his own opinions regarding radio restoration.

He insists that radios must be either "restored to original condition" or left alone. Apart from the term being virtually an oxymoron, such a restoration is an impossibility. The only way that a radio could be in original condition after half a century or more would be for it to have been taken off the factory's final conveyor belt and vacuum sealed. Even if it had been left in an unopened carton there would be some deterioration.

In real life, even the most pristine example will have seen some service, and moisture in the air will have taken its toll of original resistors and most paper capacitors. Electrolytic capacitors will have dried up, metal finishes oxidised and rubber perished. Colin states that patience and persistence will locate original components. To find in original condition specialised components from individual manufacturers who have been out of business for years would be very difficult, if not impossible. Furthermore, the brand and style of original components often varied during production .

He then goes on to suggest that modern components could be placed inside old capacitors and resistors as many restorers do now. But hello – this is in complete contradiction to his previous insistence of being in original condition. Is his philosophy really to have components with their original appearance? Some contributors to the "Bulletin do this as a matter of course and I personally agree with this procedure, but we can no longer claim complete originality. However, this is unlikely to be a major factor for future electronic archaeologists. There is a wealth of literature with innumerable illustrations and specifications available to researchers already. The exact details of original components would be unlikely to hold any mystery for them.

What is likely to be of considerable importance to researchers would be the performance of a radio and how it sounded. Illustrations, specifications and inside views cannot substitute for the actual operation. This can only be achieved by having all components, especially resistors and capacitors. in "as new" condition and meeting original specifications.

Colin has oversimplified the situation. To illustrate my point, I have a decision to make in a genuine case which provides a conundrum for him:

In 1978 I acquired, in completely original and excellent condition, a 1930 Majestic 90B TRF radio. The high performance 90B is important historically as it was the final development of the neutralised triode TRF receiver that had been the mainstay of the 1920's American market but which by 1930 had been rendered obsolete by the screen grid valve and the improving superheterodyne. Grigsby Grunow enthusiasts will know that the massive Majestic 90B receivers with four tuned R.F. stages can be likened in size, weight and durability to the proverbial battleship. There are no electrolytic capacitors to deteriorate, all paper capacitors are sealed in wax in metal cans, practically all resistors are wire wound and all transformers and chokes are sealed in pitch filled cans. As a completely original example of a technology that faced rapid obsolescence 80 years ago, it is an ideal candidate for preservation, and with a potentially extremely long life expectancy. Now however, a problem has arisen. In the laced wiring loom, the heavy heater leads to the five type 227 valves have recently suffered from disintegrated rubber insulation and are therefore prone to being short circuited with potentially disastrous results. It would not be wise to apply power in its present condition.

My question is: do I leave the receiver untouched, and have a non operational but original "boat anchor", or do I make the 90B again fully operational by renewing the perished wires? Similar rubber insulated cable which has a limited life anyway, has been long out of production. To replace it with a more modern and available type of cable would make the revived and working radio of much greater interest and value to researchers than at present, but it would no longer satisfy Colin's criteria.

I would like to know which action Colin would recommend.

Yours sincerley
Peter Lankshear
New Zealand

Dear Editor,
I keep getting asked the question why don't I attend meetings and wonder if I am the only member with a strong objection for not doing so?

My reason for not attending or supporting meetings is because I feel very strongly two tier entry fees are not only totally unfair but morally wrong. I'm reliably informed; many years ago a small number of members would book tables at a meeting to gain access early but with no intention whatsoever of selling anything. The members could then pick out all the best items in peace whilst their tables remained empty.

Obviously this was very unfair so the BVWS committee had a long meeting to discuss this problem and the outcome was the two tier entry fee which at the time appeared to be a good solution.

I would never attend any meeting to stand outside having paid my standard entry fee knowing that other people were already inside selecting and purchasing the best items just because they had paid a higher entry fee for the privilege of doing so.

I would love to attend the Lowton meeting which has the fair single entry fee but feel all meetings to be tainted by association with this two tier entry fee practice which is supported by the BVWS through advertisements in The Bulletin.

Submitting this letter has not been easy for me because I do not wish to be regarded as a trouble maker neither do I intend any offence by doing so but would welcome other member's opinions on this subject.

Kindest regards,
Colin Wood.

Reply to Letter by Colin Wood in Summer BVWS Bulletin:

To answer some of the points put here and to clarify other points I offer the following:

The BVWS members meetings at Harpenden, Wootton Bassett, Lowton etc. have never operated and will never operate a two tier entry fee system. These are member's only events for the benefit of the membership.

It was however noted some years ago that members were booking tables and then leaving them empty to gain early access and unfair privilege, usually at Harpenden. We quickly acted upon this by out-ruling this activity and having monitors walking the floor of each meeting, as we still do. Stall holder set up time was reduced from one hour down to thirty minutes ensuring that there was insufficient time to allow this to happen, and stall holders know the rules on buying before the start time of the meeting and the consequences of doing so and being caught, ejection from the meeting!

I now turn to the NVCF at the Warwickshire Exhibition Centre which is a wholly commercial event open to the Public and not falling under the membership code of practice of the BVWS. There is the option of early entry for this event. The BVWS, although the owners of the event did not instigate the two tier entry system, it was running for many years prior. We treat the NVCF as a completely separate entity although we do give specific benefits to all BVWS members at these events.

Since the NVCF has long ago paid for itself and is operating without loss, the money raised is used to fund specific projects at the British Vintage Wireless and Television Museum, Dulwich which is a registered Charity, and also to stage the exhibitions held at the NVCF events which have been very varied and popular. Many commercial exhibitions run with the same entry conditions, and money raised here is certainly for a good cause.

I do hope that you will now feel able to attend further meetings as you are most welcome.

Mike…

Dear Editor,

Please find enclosed a photograph I showed to Mike Barker at Harpenden. The photograph is of my working display of wartime wireless. The display is a mixture of mains and battery sets which would have been used during World War II. The battery sets are run from a two volt Exide accumulator for LT and 10–12 volt dryfits for the HT. A 1940's Aerial is strung from a chimney and pole using two egg insulators.

The sets, from right to left on the bottom row consists of: A Philco 444 mains–powered 'Peoples Set', a McMichael 363 five valve set with QPP output battery set, a Murphy 1939 B69 four valve battery set, and a 1934 Ekco AC74 five valve mains–powered set. I have a wartime advertisement in a wireless magazine for the Ekco, saying how after six years it was still giving sterling service. The set is now 76 years old and still works well.

On the top row, right to left consists of a wartime U8 four valve, medium wave only civilian mains receiver made by Philips in 1944. The valves are the original BVA Type.

Next in line is a wartime U7 civilian battery set made by Murphy in 1944 which has long and medium wave. I have tried to find a full set of BVA valves but have only managed to locate a BVA162 (Pen25) output valve.

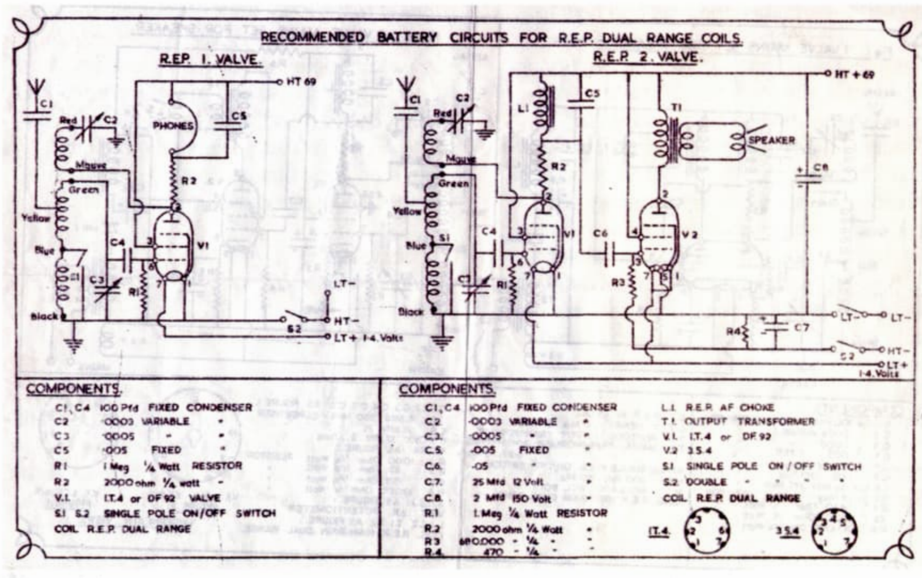
Next is a Pye baby Q portable from 1937 with long and medium wave, followed by an American model 47 midget set made by General Television and Radio from 1943.

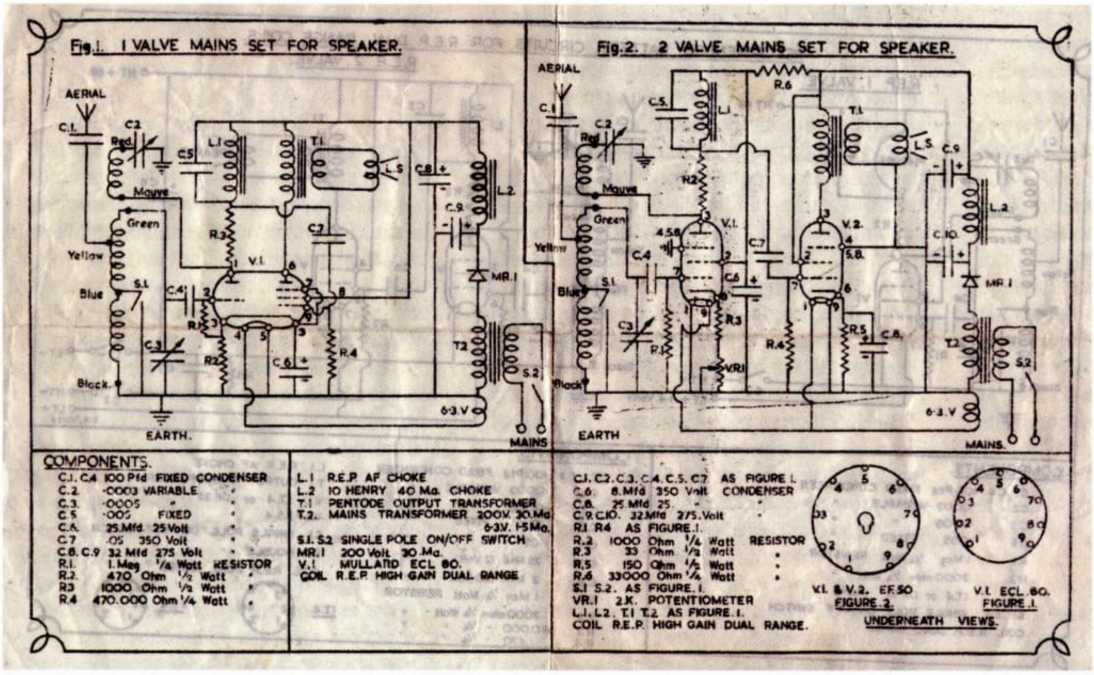
Another American midget set, this time a model 201 'Little Corporal' manufactured by Bestone. It is a mains powered, four valve TRF set with long and medium reception.

I have a selection of accumulators, grid bias and HT batteries which have come from sets I have bought over the years. Batteries from the wartime period are hard to find these days but I'm still searching.

In the past I've had the radios on display at Ickworth House near Bury St Edmunds courtesy of The National Trust. It had sets going back to the 1920's under the title of 'Wireless way back' but I discovered that people were more interested in wartime wireless and I have changed

Above: Chris Brown and his display Below: the circuit for the battery set with one or two valve options





Above: Chris Brown's circuit for the mains set with one or two valve options

the display to suit popular opinion.

Last year I took the display to a Dad's Army day at Bressingham Steam Museum near Diss in Norfolk. Some of the original cast of the show turn up at this event, this year Jimmy Perry, David Croft, the warden, the vicar and Mrs Fox had turned up. I used a small MW modulator to lay favourite wartime songs and speeches through the sets, sometimes three or four were in operation simulateously.

The next display the sets were present at was an event organised by the royal British Legion to commemorate 70 years since the start of World War II. The display was set up in the communications room, it was mainly the elderly who were interested in seeing and hearing the display. A common memory among the interested parties was hearing Neville Chamberlain's declaration of war speech and taking an accumulator to be charged at the local radio shop or garage.

I have been interested in wireless since I was eight years old when my grandmother gave me a crystal set. We had a neighbour who used to be a wireless and radar operator in the RAF, who showed me how to connect an aerial, earth, headphones and how to tickle the crystal to get the best results.

When I was older I asked my neighbour if he could show me how to build a valve wireless; he showed me an advert in Practical Wireless for a Repanco dual–wave coil with reaction, which cost four shillings. You could build a one valve battery set utilising headphones or add an extra valve to drive a loudspeaker. He found a piece of tin in his garage, marked it, cut it out with tin snips and folded a chassis. He put solder onto the corner joints and placed it above the gas ring on his cooker to hold the corners together. A tank cutter was then used to cut the holes for the valve holders. He managed to find me most of the components to make the set except for the valve, which was a DF92 for a single valve set. My neighbour showed me how to use a soldering iron which was heated on the gas ring in my parents kitchen.

I sent for the first valve, which cost me seven shillings (35 pence in todays money), purchased the 67.5 volt HT, 1.5 LT battery and finished the set! It worked well with headphones. A second valve – a 3S4 was ordered using money earned from my paper round. The valve and a loudspeaker was added and it worked perfectly. Later I decided to modify it to being powered from mains electricity which would use an ECL80 triode output pentode. I stripped the battery set down and made the mains powered wireless using a large quantity of components from the previous set. It did not work too well because of the lack of output.

I decided to upgrade to a two–valve mains set using a pair of army surplus EF50 RF pentodes, which were used on radar equipment in World War Two. These valves could be purchased between three shillings (15p) and seven shillings (35p). I also purchased a pair of valve holders for the EF50's, they were sixpence each ($2^1/_2$p) from Practical Wireless. When the holders arrived, I discovered that they were too large for the holes in the much–used chassis. I took it to my neighbour who produced a Q–cutter and made a pair of perfect holes to accomodate the new valve holders. Shortly after I finished the set and it worked much better than the one–valver. I still have the original coil and circuit diagram fifty years on and hope one day to make one of these sets again with my grandson.

Yours sincerely,
Chris Brown
G0JRM

Dear Editor,
I was interested to read the article by Dicky Howett on page seven of the Spring Bulletin.

In the 1960s/70s I was responsible for the maintenance of five EMI 203 Image Orthicon monochrome cameras in a studio complex.

The 203 was of very robust construction with its accompanying CCV and power unit. Fitted with valves by the dozen it presented quite a commitment to keep functioning. Some valves were replaced routinely to improve reliability, especially those that were 'worked hard'.

Faults did occur with these cameras – some quite 'meaty' in nature that you could really get your teeth into, resulting in the satisfaction of curing the fault!

Ah, happy days of real engineering and repiaring.

Regards,
Laurie Jones

Dear Editor
Do any members have examples of 1920s valve receivers manufactured by General Radio Company that they would be willing to have photographed for a future Bulletin article? Also, copies of any catalogues or literature relating to the company would be most welcome for a research project. Full credit, of course, will be given to the source.

Sincerely,
Ian L. Sanders
author@crystal-sets.com

Dear Mr. Chairman,
Thank you for returning my Gold ring which was handed in at the last Harpenden Meeting and would be obliged if you would print the following in the next Bulletin.

I would like to thank the person who handed in my Gold wedding ring at the last meeting at Harpenden. This ring has great sentimental value to me as it belonged to my father and is irreplaceable. When I realised I had lost it I was greatly distressed and I was very relieved to be told it had been handed in. Again my sincere thanks to the person who found it.

Yours Sinceerely,
Tony Bottrill

British Vintage Wireless Society Statement Of Accounts - Year To 31st December 2009

	year ended 31st December 2009		year ended 31st December 2008	
Receipts		£		£
Subscriptions		37,173		34,200
Sale of publications		2,085		2,534
Capacitor sales		3,453		2,132
Meetings		2,503		2,819
Estate sales receipts		27,040		54,493
Valveman DVD sales		260		659
Donations		451		224
Bank interest		24		728
Advertising		873		943
Miscellaneous		185		68
NVCF Profit		2,600		3,561
Total receipts		**76,647**		**102,361**
Payments				
General expenses	8,658		12,108	
Stationery	2,480		-	
Storage Facilities	2,400		-	
Meetings	2,563		2,633	
Bulletin costs	26,890		28,793	
Estate sales payments	21,825		47,692	
Capacitor costs	5,979		3,480	
Donation to BVWATM	191		166	
Other donations	170		-	
Valveman DVD sale proceeds transferred to BVWATM	140		938	
Other publication costs	1,698		972	
Corporation tax	151		146	
Total payments		**73,145**		**96,928**
Surplus for the period		3,502		5,433
Total assets at beginning of period		47,928		42,495
Total assets at end of period		**51,430**		**47,928**
Assets				
HSBC current account		7,206		7,328
HSBC deposit account		33,166		32,142
NVCF assets (held for the benefit of the B.V.W.& T.V. Museum)		11,058		8,458
Total assets		**51,430**		**47,928**

At 31st December 2009 £468 (2008 - £966) was owed by the BVWS to the authors of various publications that the BVWS sell on behalf of these authors. These liabilities are not recognised in the accounts.

The accounts of the Society reflect the receipts and payments on a cash basis and do not reflect any prepaid or accrued income and expenditure. As an unincorporated club, all surplus is passed to members by way of bulletins, supplements and events. At the same time a prudent asset balance is maintained in order to provide for the unexpected.

Jeremy P. Day

Treasurer

Auditors Report To The Members of the British Vintage Wireless Society

We have examined the above Accounts and the attached Accounts of the National Vintage Communications Fair for the year ended 31st December 2009 together with the accounting records and supporting documents and vouchers and confirm the same to be in accordance therewith.

Christchurch House, Upper George Street, Luton Beds LU1 2RS

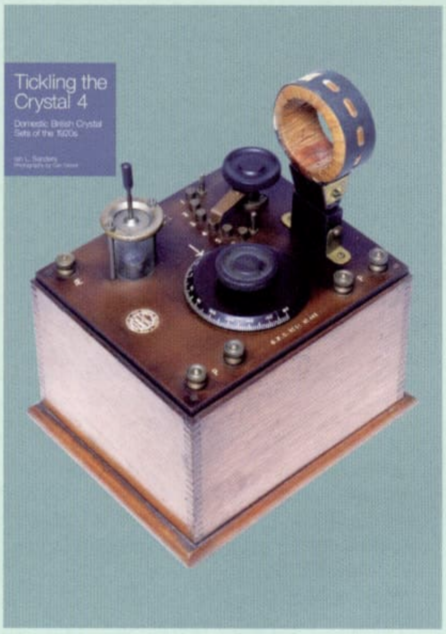
Keens Shay Keens Limited
Chartered Accountants
6th April 2010

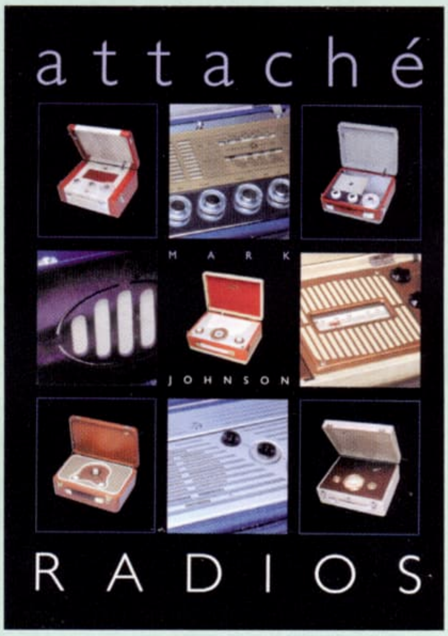
National Vintage Communications Fair Statement of Accounts - Year to 31st December 2009

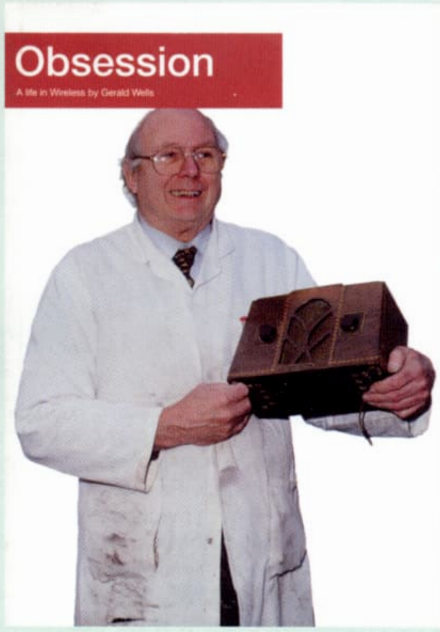
		year ended 31st December 2009		period ended 31st December 2008	
Receipts			£		£
Table bookings					
	Members		4,336		6,261
	Non-Members		8,894		7,364
Bank Interest			-		1
Total receipts			13,230		13,626
Payments					
Event management		10,062		9,291	
Miscellaneous		568		774	
Interest and Charges		-		-	
Total Payments			**10,630**		**10,065**
Surplus for the period			2,600		3,561
Total assets at beginning of period			8,458		4,897
Total assets at end of period			11,058		8,458
Assets					
HSBC current account			11,058		8,458
Total assets			**11,058**		**8,458**

BVWS Books

Out Now!







Tickling the Crystal 4

More Domestic British Crystal Sets of the 1920s

by Ian L Sanders. Photography by Carl Glover

Full colour throughout.
Strictly Limited Edition! only 500 copies printed
£5 discount for BVWS members

280 pages of GPO No. era British crystal sets. Over 200 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £15)

Attaché Radios

by Mark Johnson

An 80 page colour paperback guide to the Attaché portable

- **Detailed specifications**
- **140 radios in full colour**
- **Over 200 additional photos of sales literature, trade ads etc.**

£12.00 (+ £2.50 p&p UK)
£3.50 EEC (rest of world £5.50)

Obsession

by Gerald Wells

Gerry Wells had led an extraordinary life. Growing up in the London suburb of Dulwich in the inter–war years, he shunned a conventional 1930's childhood, preferring wireless and other household items. After the war he managed a career as a radio and TV service engineer and even designed and managed amplifiers, PA equipment and TVs. Today he runs the Vintage Wireless and Television Museum from the same family home from where he was born in 1929.

In this book Gerry brings to life his colourful past. This is the story of one man's dedication to wireless

£6.00 196 pages paperback

Slipcase to house the first 3 volumes of 'Tickling the Crystal' £9.95. Buy all 3 and get slipcase free! (postage £12 UK, £35 EEC £55 US)
BVWS Members buy 2 and save £12! (postage £9 UK, £24 EEC £28 US)

Tickling the Crystal
256 pages. Over 200 full-page photographs. £14.95 for BVWS members plus £7 p&p for UK, £13 EEC (rest of world £15)

Tickling the Crystal 2
Limited, Only 750 copies printed. 208 pages. Over 200 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £15)

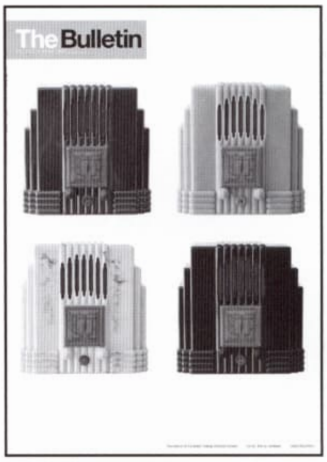
Tickling the Crystal 3
Limited, 500 copies printed. 240 pages of GPO No. era British crystal sets. Over 200 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £15)

BVWS, 26 Castleton Road, Swindon, Wilts SN5 5GD
Tel: 01793 886062

BVWS Books

Eighth page advertisements cost £22.50, quarter page advertisements cost £45, half page: £90 and full page: £180. Cheques made payable to 'BVWS' please

Eighth page advertisements cost £22.50, quarter page advertisements cost £45, half page: £90 and full page: £180. Cheques made payable to 'BVWS' please



Back issues

Vol 10 Numbers 2, 3 & 4 Inc. The KB Masterpiece, Extinct Species "A Monster Defiant".

Vol 11 Numbers 1, 2, 3, 4 Inc. BTH VR3 (1924) receiver, Marconi's 1897 tests, Origin of the term 'Radio', Baird or Jenkins first with TV?

Vol 12 Numbers 1, 2, 3, 4 Inc. the Emor Globe, The Fultograph, Ekco Coloured Cabinets.

Vol 13 Numbers 1, 2, 3 Inc. Direct action tuning, The Philips 2514, Noctovision.

Vol 14 Numbers 1, 2, 3, 4 Inc. Cable broadcasting in the 1930's, The story of the Screen Grid.

Vol 15 Numbers 2, 3, 4 Inc. The wartime Civilian Receiver, Coherers in action, Vintage Vision.

Vol 16 Numbers 1, 2, 3, 4 Inc. The Stenode, The Philips 2511, Inside the Round Ekcos.

Vol 17 Numbers 1, 3, 4, 5, 6 Inc. Wattless Mains Droppers, The First Philips set, Receiver Techniques.

Vol 18 Numbers 3, 4, 5 Inc. The First Transistor radio, The AVO Valve tester, The way it was.

Vol 19 Numbers 1, 2, 3, 4, 5, 6 Inc. The Birth of the Transistor, Super Inductance and all that, reflex circuits, A Murphy Radio display, restoration.

Vol 20 Numbers 1, 2, 4, 5, 6 Inc. Radio Instruments Ltd., Japanese shirt pocket radios, Philco 'peoples set', notes on piano-keys, the story of Pilot Radio, the Ever Ready company from the inside, the Cambridge international, the AWA Radiolette, this Murphy tunes itself!

Vol 21 Numbers 1, 2, 3, 4 Inc. Marconi in postcards, the Defiant M900, GPO registration No.s, Personal portables, the transmission of time signals by wireless, the Ekco A23, historic equipment from the early marine era, the birth pains of radio, inside the BM20, plastics, Ferdinand Braun, pioneer of wireless telegraphy, that was the weekend that was, the first bakelite radios, BVWS - the first five years, the world of cathedrals, Pam 710.

Vol 22 Numbers 1, 2, 3, 4 Inc. Another AD65 story, the Marconiphone P20B & P17B, listening in, communication with wires, the story of Sudbury radio supply, French collection, Zenith Trans-oceanics, Farnham show, Alba's baby, the first Murphy television receiver, AJS receivers, Fellows magneto Company, Ekco RS3, Black Propaganda.

Vol 23 Numbers 1, 2, 3, 4 Inc. Sonora Sonorette, Bush SUG3, RNAS Transmitter type 52b, North American 'Woodies', Why collect catalin, Pilot Little Maestro, Theremin or Electronde, The Radio Communication Company, Early FM receivers, an odd Melody Maker, Black propaganda.

Vol 24 Numbers 1, 2, 3, 4 Inc. The Superhet for beginners, Triode valves in radio receivers, History of GEC and the Marconi - Osram valve, KB FB10, Great Scotts!, Riders manuals.

Vol 25 Numbers 1, 2, 3, 4 Inc. Repair of an Aerodyne 302, Henry Jackson, pioneer of Wireless communication at sea, Zenith 500 series, Confessions of a wireless fiend, RGD B2351, John Bailey 1938 Alexandra palace and the BBC, Ekco during the phoney war, Repairing a BTH loudspeaker, The portable radio in British life.

Vol 26 Numbers 1, 2 Inc. How green was your Ekco?, The Amplion Dragon, Crystal gazing, The BVWS at the NEC, Installing aerials and earths, novelty radios, Machine-age Ekco stands of the 1930s, Volksempfänger; myth & reality.

Supplements:

1 'The story of Burndept'.
2 'WW 1927 data sheet'
3 'Seeing by wireless' the story of Baird Television
4 Reproduction Marconi catalogue

Earlier Bulletins and supplements are priced at £2:00 each + postage. Bulletins from volume 21 onwards are priced at £2.50 each. + postage.

Postage: for individual Bulletins add 50p, for 2-5 bulletins add £1, for 6 or more add an extra 20p each.
23 Rosendale Road, West Dulwich
London SE21 8DS
Telephone 020 8670 3667.

Cheques to be made payable to 'The Vintage Wireless Museum'.

News and Meetings

GPO registration 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 GU13 8LB telephone: 01252-613660 e-mail: martyB@globalnet.co.uk

2010 meetings

May 9th NVCF
June 5th BVWS Garden Party
June 6th Harpenden AGM & Auction
July 11th Wootton Bassett
August 13th Friday Night is Music Night at The British Vintage Wireless and Television Museum
September 12th Table Top Sale at The British Vintage Wireless and Television Museum
September 19th Murphy Day at Mill Green Museum
October 10th Audiojumble
October 17th Harpenden
November 21st Lowton
November 26th Festive Music Night at The British Vintage Wireless and Television Museum
December 5th Wootton Bassett

Workshops, Vintage Wireless and Television Museum: For location and phone see advert in Bulletin. 11:00 start.
Harpenden: Harpenden Public Halls, Southdown Rd. Harpenden. Doors open at 10:00, tickets for sale from 09:30, Auction at 13:30. 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 10:30. Contact Mike Barker, 01380 860787
Lowton: Lowton Civic Hall, Hesketh Meadow Lane, Lowton, WA3 2AH
For more details with maps to locations see the BVWS Website: www.bvws.org.uk/events/locations.htm

We want your articles!

Share your interests with your fellow BVWS and 405 Alive members.

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Send your articles to:
Carl Glover, 33 Rangers Square, London SE10 8HR
Tel/Fax: 020 8469 2904
bulletin_editor@bvws.org.uk


1. Attach Aerial and Earth Wire in Terminals as indicated.
2. Attach 1 or 2 pairs of Telephones to Telephone Terminals
3. Adjust Cat's Whisker on either Crystal
4 Tune with Knob on your Right Hand side, the Left Hand Knob being turned so far anti-clockwise as it will go.
5. When loudest on R.H. Knob, adjust both Cat's Whiskers by switching over, and finally affect fine tuning by L.H. side Vernier Knob.
6 Use the loudest Crystal, the other being for emergency and comparison.
7. The bridged Plugs at the back are for a loading coil, by which Paris Time Signals may be obtained.
Reg. No. 792. Type approved by the P.M.G. & B.B.C.
ROPE
INSULATOR
AERIAL INSULATOR
100'
LEAD-IN-TUBE
INSTRUCTIONS FOR ERECTING AERIAL AND EARTH SYSTEM.
Typical single-wire aerial using chimney and pole as supports.
Important.—Attach your Earth Wire to a "live" water pipe, preferably by soldering.
The REXOPHONE is exclusively manufactured by:
MORCH BROS., Radio Engineers, 35, TRESHAM AVENUE, E.5.
PHONE: DALSTON 1100.
EARTH
REG. No 792
TELEPHONES
REXoPHONE