The Bulletin
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The Bulletin of the British Vintage Wireless Society £5.00 | free to members ISSN 0955-93

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

**Hundreds of stalls**

# Free car parking!

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For any enquiries, please contact:
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(please enclose an SAE)
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Bulletin of the British Vintage Wireless Society
Incorporating 405 Alive
Volume 34 No.4 Winter 2009

www.bvws.org.uk



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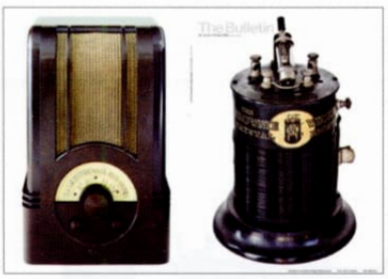


Front cover: Brownie Crystal Set, 1923.
Rear cover: Radio Rentals 588 1936
Photographed by Carl Glover

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**



# From the (festive) Chair

Next year will see the re-introduction of the BVWS car stickers. We have been asked for these on numerous occasions and all stocks have long been depleted, therefore new ones will be sent out to everyone in an early 2010 Bulletin.

This years Christmas DVD contains a number of interesting manufacturers publicity films. One film, the Ultra "Radios Richest Voice" you may remember from our very first video CD.

This film has been re-mastered to give better quality and placed together with two other Ultra films for completeness. Although two of the films may appear to be the same, they are significantly different and were originally edited for different marketing purposes. I should remind everyone that the Ultra films are 'silent' and unless you have your own Wurlitzer to rise out of the living room floor to accompany them you will hear nothing.

The Committee would like to thank Gordon Bussey for making these films and several others available for future year's productions.

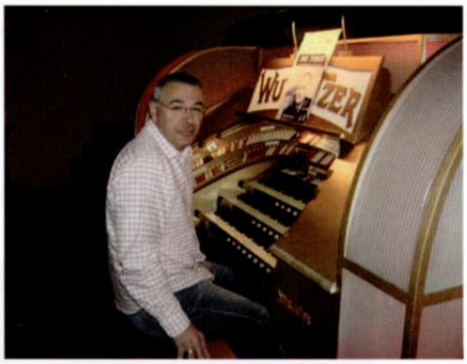
With this Bulletin you will find the usual "Vintage Wireless Events" Calendar. Make sure you pin it up prominently by your house Calendar or in your workshop!

It is amazing to think that we are nearing the end of another very busy and successful year, and so you will find herein your membership renewal form. Please fill this in straight away and send it back to Graham Terry. The first Bulletin of 2010 is due out in February so unless you have sent in your membership you will be missing out.

We continue to receive many requests from members and their families to auction off part or all of their collections. We offer a special service for this and anyone can use it. Where whole collections are to be auctioned we are able to collect everything and take it to our storage unit where it can be catalogued and photographed for a later auction. Where we have a great many items to dispose of and the quality of those items warrant it, we will set up special auction days at Wootton Bassett where we have many nation wide and often international visitors.

On behalf of myself and the Committee, I would like to wish everyone a very happy Christmas and the very best wishes for a busy collecting year in 2010.

Mike...



# Pictures from Gerry Wells' 80th birthday celebrations

# History of The Brownie Wireless Company - a Family Affair

by Ian Sanders, photography by Carl Glover

Kate Brownie, the driving force behind the Brownie Wireless Company, was born in 1853. From an historical perspective, Kate Brownie must have been a most extraordinary and far-sighted business woman. The original family business was established in 1808 in the North London suburb of Uxbridge by Mr. Wrightson Ward Brownie, a sail-maker from Dover and the great-grandfather of Kate's husband, William Herbert Brownie.

The company's earliest premises were part of the George Hotel, a coaching inn, before moving to 149, High Street Uxbridge. Trading under a Royal Warrant awarded in the reign of William IV as 'Robert Brownie and Son', the company established a reputation locally as a quality supplier of ropes, sacks and rick covers to local farmers. The firm also hired out tents and marquees for major events and supplied flags and bunting to decorate the Uxbridge High Street and was very successful for several generations. In her memoirs[1], Kate's daughter Edith recalls the company erecting marquees for the wedding of Sir Stafford Cripps (Chancellor of the Exchequer in the post–war government of Clement Atlee) in nearby Denham.

William Brownie died in 1901 at the age of 52[2], leaving his wife Kate to continue the family business for which she engaged Mr. Henry Edwin Cocks to manage the firm. Cocks had moved to Uxbridge in 1886 at the age of 20 to work for his uncle, also Henry Cocks, and – like Robert Brownie & Son – a rope, sack and cocoa fibre manufacturer. Following the death of his uncle, it seems that Henry Edwin went to work for Kate Brownie.

Unfortunately, with the arrival of the motor car in the years immediately following the Great War, trade gradually began to decline. Apparently undeterred, the company diversified in the early 1920s into the rapidly growing wireless business under Kate's watchful management, with the assistance of her son, Herbert (Bert) and daughter, Edith. Kate Brownie was by then in her 70s. (Bert Brownie (1887-1956) was also the licensee of the Dolphin public house in Rockingham Road, Uxbridge for a few years). According to her obituary, Kate Brownie's company was the first in the area to offer crystal sets to the public, suggesting that she entered the business sometime in 1922 around the start of broadcasting.

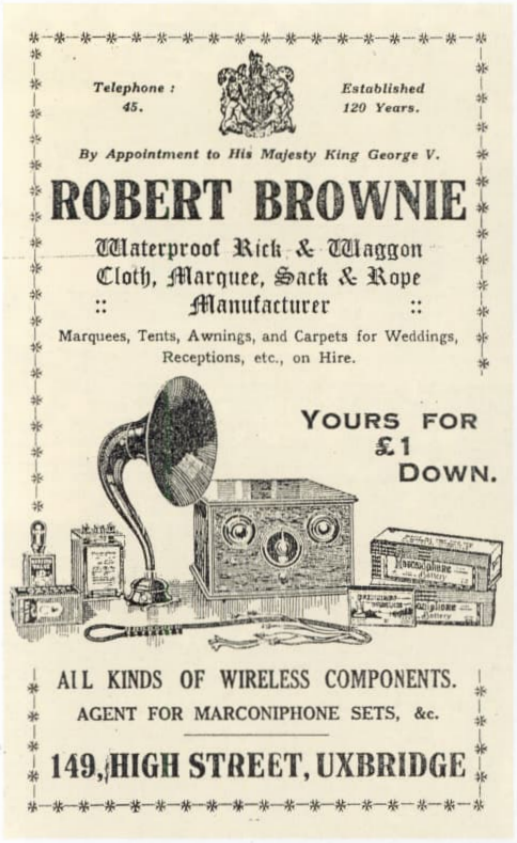
Oposite, right: Early advertisement for wireless apparatus while the company was still operating from premises in Uxbridge (Courtesy of Shane Brownie).

Oposite, far right: A middle-aged woman "listening" to a Brownie crystal set – apparently staged as there are no aerial or earth wires to be seen. Could this be Edith Brownie – Kate's daughter?

1

2

The original Brownie crystal set of 1923 (1) was sold as a kit with a discrete detector assembly mounted on a cardboard panel. Later sets featured an ebonite panel with





3 4

either an open (2) or glass-enclosed detector (3). A loading coil was available for side mounting for reception of Chelmsford, 5XX on long-wave. (4).


Brownie's Uxbridge shop at 149, High Street decorated for the coronation of Edward VII in 1902. Kate Brownie is standing at the entrance holding the family's dog. Her son Herbert (aged14) is to her right and daughter Edith (aged 21) to her left. The royal coat of arms can be seen above the door (courtesy of Shane Brownie).

Kate Brownie's daughter, Edith is shown seated in the front row at left in this 1960 photograph of the Deacons of Providence Church. She was 79. (courtesy of Shane Brownie).

# PATENT SPECIFICATION

Application Date: Jan. 23, 1923. No. 2055/23.
" " Feb. 16, 1923. No. 4617/23.
One Complete Left: Oct. 23, 1923.
Complete Accepted: April 17, 1924

**214,005**

## PROVISIONAL SPECIFICATION.

No. 2055, A.D. 1923.

## Improvements in and relating to Wireless Receiving Apparatus.

I, JAMES WILLIAM BARBER, of 19, Garrick Street, London, W.C. 2, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to wireless receiving apparatus, and has for its object to provide a simple form of apparatus which will be portable as a single unit, of relatively very light weight, and which can be easily packed for transport.

According to the present invention the base of the apparatus comprises a hollow container made of non-conducting material, such as cardboard, fibre and the like. The container is closed at one end and has a detachable closure member at the other end. The aerial inductance coil is wound on the outside of the said container which is also provided with a sliding contact in a manner well known in the construction of the drum type of aerial inductance coils. The closure member of the container may be made of insulating material such as ebonite, fibre, and the like, and it is adapted to have a current detector device together with the terminals for making the various connections, mounted thereon. Or, the current detector device and other parts may be mounted on a separate insulated base which in turn is adapted to be mounted on the closure member.

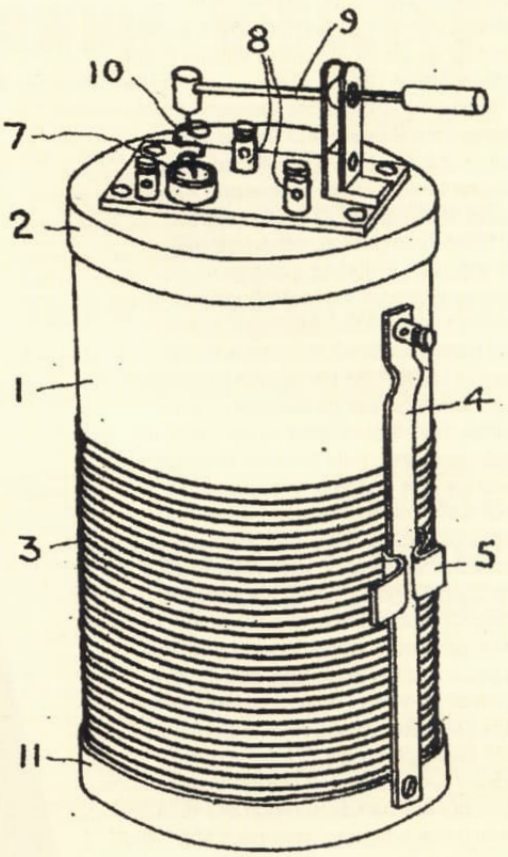
In one form of the apparatus the component parts, including the aerial inductance wire and sliding contact, are packed inside the container and sold in the dismounted state together with instructions regarding the correct assembling of the said parts. In this form the whole apparatus may be made ready for transport by merely enclosing it in ordinary wrapping paper.

In another form of the apparatus the current detector device and connecting terminals may be ready mounted on the closure member, which in this case is reversible and is adapted to fit inside the open end of the container, said end being specially shaped for the purpose. With this arrangement when the apparatus is not in use the detector device and terminals may be placed out of sight within the container simply by reversing the said closure member.

With the construction according to this invention the base of the apparatus is formed of material which will be strong enough to allow of its being made ready for transit with a minimum of packing. The base of the apparatus thus additionally serves as a container for holding the component parts when the apparatus is not in use, and as a " former " for the aerial inductance coil.

Dated this 23rd day of January, 1923.

ARCHD. SHARP,
Chartered Patent Agent,
231, Strand, London, W.C. 2,
(Agent for the Applicant).




Above: Patent issued to James Barber describing his tubular crystal set. Brownie Wireless was not a co-inventor at this time.



The later set at right carries the "Entirely British Manufacture" version of the BBC approval stamp.

The first Brownie crystal sets – simple cardboard, tubular-style receivers – were advertised in early 1923 by the J.W.B. Wireless Company of Garrick Street, London, named for its principal: James William Barber (see *Tickling the Crystal* Volume 1, pages 68, 69, 70; Volume 2, page 58). The connection between Kate Brownie and Barber is not known, but it must have developed into a close partnership, since Barber and Brownie Wireless were named as co-inventors on at least three patents issued between 1925 and 1927, including a design for an inexpensive crystal holder. Both parties give the same Euston Road address in London on the patent applications. Interestingly, the earliest patent for the tubular crystal set was issued to Barber as the sole inventor. It seems, then, that in order to get into the wireless business, Kate Brownie must have teamed up with Barber who presumably provided the engineering skills while Brownie probably put up the capital and contributed her years of retail experience.

The crystal sets for which the Brownie Wireless Company became better known were of moulded ebonite construction and were produced between 1925 and 1927; a companion two-valve note magnifier, also of moulded ebonite construction, was offered in 1926 (see *Tickling the Crystal* Volume 1, pages 71, 72, 226)[3]. In contrast to the majority of sets manufactured at this time, the Brownie moulded cases were plain and rather utilitarian in appearance. Nevertheless, their low cost ensured popularity with consumers and the sets are known to have been sold

continued on page 11


THE
"BROWNIE WIRELESS"
MONEY BACK
GUARANTEE

THE BROWNIE WIRELESS

*This voucher guarantees the "Brownie Wireless" sold herewith to operate under the same conditions and to equal the results obtainable with any Crystal Receiver retailing up to and including*

*£10 (Ten Pounds)*

*Money will be refunded in full if the "Brownie Wireless" fails to do this and is returned undamaged within one month of purchase*

*Name of Supplier*.....

*Date*.....

Sole Manufacturers, Patentees and Trade Mark Holders:
The J.W.B. Wireless Company
London, N.W.1
FACTORIES:
Metal Turning, Stamping and Plating - - - BIRMINGHAM.
Moulding and Ebonite Work - - - - BERMONDSEY, S.E.
Inductance and Impregnating Work - - - ISLINGTON, N.
Offices & Assembly Workshops, EUSTON RD. N.W.1

So confident was the manufacturer in their product that J.W.B. Wireless Company offered to refund the full purchase price if the set failed to measure up against the best on the market.

Two-valve note magnifier unit designed to accomodate the Brownie No.1 crystal receiver.

# Build Your Own Wireless Receiver

**SPECIFICATION.**
Set comprises solid best ebonite drilled detector panel, wound induction coil, tuning slider, screw clamp crystal cup, best quality crystal, universally jointed detector giving accurate and easy adjustment, terminals, screws, and all parts for assembling by our patent method.

## "THE BROWNIE"

**7/6 COMPLETE by post 8/6**

Patent 2055/23 applied for.

A Scientific Achievement.

Guaranteed equal to sets costing many times the price.

Full and complete instructions enclosed with each outfit.

London make.

Money returned if not as advertised.

**J. W. B. Wireless Supplies,**
**19, GARRICK STREET,**
**LONDON - - W.C.2**
(First Floor)
**Near Leicester Square Tube Station**

(When writing mention "Popular Wireless.")

*Popular Wireless Weekly*, March 3rd, 1923.

# THE "BROWNIE WIRELESS"

**THE MOST EFFICIENT OF CRYSTAL RECEIVERS**

THE new improved "Brownie Wireless" with its solid moulded ebonite cap and highest grade nickel fittings, coupled with its tested merits endorsed by nearly twenty thousand users, makes it the most attractive crystal set on the market *irrespective of price.*

**Now supplied erected and with B.B.C. stamp. Requires :: 10- licence only ::**

*Endorsed by Editors of "Popular Wireless," "Amateur Wireless," "Electricity," &c.*
*Trade Enquiries Invited*

**7/6**
Plus B.B.C. Royalty, 1/-
*By post 6d. extra*

**THE J.W.B. WIRELESS CO.,**
**10a-312a, Euston Road, N.W.1**
*(Facing Warren Street Tube Station)*

*Amateur Wireless and Electrics*, August 2nd, 1924.

# THE "BROWNIE" WIRELESS

For three half-crowns you can buy the latest "Brownie" model—the crystal receiver favourably compared by Press and Public to sets costing twelve times the price. The money-back guarantee given with every set is *your* protection.

**7/6**

An Ebonite Base, to fit any model, of substantial and attractive design, is now supplied at an extra cost of **1/6.** Just slide the "Brownie" into the hollow centre and fix with the three screws supplied.

**THE J. W. B. WIRELESS CO.,**
**310a/312a, Euston Rd., N.W.1**
*Facing Warren St. Tube Station. Telephone: Museum 3747*

*Popular Wireless and Wireless Review*, November 29th, 1924.

# THE "BROWNIE WIRELESS"

**7/6 COMPLETE BY POST 8/6**

A complete Crystal set containing every part necessary for simple erection. Guaranteed equal to the most expensive sets. Full and complete instruction enclosed with each outfit. London make. Money returned if not as advertised.

*Read what "Amateur Wireless" says, February 24th:*

**"It was tested by a member of our staff in the north of London, and with four pairs of headphones attached in parallel gave clear and sufficiently loud speech. . . . We can answer for the excellent results to be obtained."**

Send postcard for folder. "The Brownie Wireless and all about it."

*(When writing mention "Amateur Wireless.")*

**The J.W.B. WIRELESS COMPANY,**
Sole Manufacturers:
**19, GARRICK STREET, LONDON, W.C.2**
**Near Leicester Square Tube Station.**

*Amateur Wireless and Electrics*, May 26th, 1923.

**SPECIFICATION:**
Set comprises solid best ebonite drilled detector panel, wound induction coil, tuning slider, screw, clamp crystal cup, best quality crystal, universally jointed detector, giving accurate and easy adjustment, terminals, screws, and all parts for assembling by our patent method

## The "BROWNIE WIRELESS"

**CRYSTAL RECEIVER.**

**7/6 COMPLETE.** BY POST 8/6.

Contains every part necessary for simple erection. A scientific achievement. Guaranteed equal to sets costing many times the price. Full and complete instructions enclosed with each outfit. London make. Money returned if not as advertised.

*Read what "Amateur Wireless" says:* **"It was tested by a member of our staff in the north of London, and with four pairs of headphones attached in parallel gave clear and sufficiently loud speech. . . . We can answer for the excellent results to be obtained."**

Send postcard for folder "The Brownie Wireless and all about it."

**The J. W. B. WIRELESS COMPANY,**
**19, GARRICK STREET, LONDON, W.C.2.**
(First Floor). Near Leicester Square Tube Station.

*Amateur Wireless and Electrics*, June 30th, 1923.

# Four days and then—

January 1st, 1925, and time to think about our New Year resolutions. Here's one you'll *enjoy* carrying out. ***Brighter evenings for 1925.*** Simple, too. Get a "Brownie" Wireless, at the moderate cost of 7/6, and enjoy a splendid concert in your home every evening. At a distance of 25-30 miles from a broadcasting station or with loading coil attached up to 120 miles from Chelmsford, it gives perfectly clear, sweet reception. Complete with solid moulded Ebonite cap, high grade nickel fittings, glass protected Detector, D.L.5. Crystal and "Pallmadium" Catwhisker .. .. .. **7/6**

**The "Brownie Wireless"** *An attractively finished Ebonite base is supplied at an additional cost of* **1/6**

Two large pieces of crystal and the essential "Pallmadium" Catwhisker carefully packed in dust-proof case .. .. **2/-**

*From most Dealers or direct.*

*Telephone:* Museum 3747.

*—and the crystal that gives such clear reproduction*

The D.L.5 Crystal, in conjunction with the "Pallmadium" Catwhisker, is an astonishingly efficient combination. Responding to the most delicate variations, it gives clearer, sweeter-toned reception and a remarkable degree of sustained volume. *Get a box to-day.*

**THE J. W. B. WIRELESS CO.,**
**310A/312A, EUSTON ROAD, N.W.1.**
*(Facing Warren Street Tube Station).*


**D.L.5. CRYSTAL and "Pallmadium" Catwhisker**

*Popular Wireless and Wireless Review*, December 27th, 1924.

# A new and better "BROWNIE"

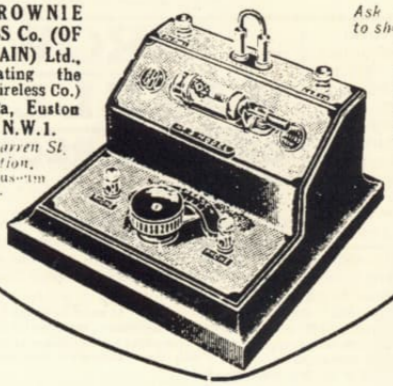
EMBODYING all the features of the Standard "Brownie" this model is of unique and pleasing appearance, moderate price and capable of resisting extreme climatic conditions. The outer casing is hydraulically moulded under a pressure of 60 tons, forming a pleasing and substantially designed piece of apparatus. The receiver has a natural wave-length up to 600 metres and a standard plug and socket coil attachment, which, with the aid of suitable coils, makes the set adaptable to 5XX or any other wave-length. The complete set is mounted on rubber shock-absorbing buffers, and all fittings are nickelled.

PRICE - - - £6

## BROWNIE WIRELESS MODEL No. 2

The Standard "Brownie" will not be superseded but is to be as successful as ever. Complete, with moulded cap and base and all fittings nickelled.

PRICE - - - 7/6



THE BROWNIE WIRELESS Co. (OF GT. BRITAIN) Ltd., (Incorporating the J.W.B. Wireless Co.) 310a-312a, Euston Road, N.W.1.
*Facing Warren St. Tube Station.*
'Phone: Museum 3747.

*Ask your dealer to show you these and other "Brownie" specialities, including the famous D.L.5 Crystal.*

*Popular Wireless and Wireless Review*, September 5th, 1925.

# "As good as a four-guinea set—

that I already have," says Mr. Studdert, of Chelsea. And his is the popular opinion amongst all "Brownie" users. Whatever other crystal receiver you compare it with—the result is unvarying—the "Brownie" stands supreme. For crystal reception of unvarying excellence—insist on a "Brownie." All good Dealers stock it and will be pleased to show you one.

The "Brownie" Wireless Model, No. 2, embodies all the features of the Standard "Brownie" Receiver. It is capable of resisting extreme climatic conditions. The outer casing is hydraulically moulded under a pressure of 60 tons, forming a pleasing and substantially designed piece of apparatus. The receiver has a natural wave-length up to 600 metres, and a standard plug and socket coil attachment is provided, which, with the aid of a special coil (price 2/9 extra) makes the set adaptable to 5 X X. Complete, including the famous D.L. 5 Crystal and Pallmadium Catwhisker, Price **10/6.**

The Standard "Brownie." Just as good as ever, but now sold complete with moulded ebonite base .. .. .. .. **7/6**
5 X X Loading Coil for the Standard .. .. .. .. .. **2/-**
The remarkable volume obtained from a "Brownie" is in no small measure due to that wonderful rectifying combination, the D.L. 5 Crystal and Pallmadium Catwhisker.
A natural Crystal, possessing rare sensitivity, it adds volume and distance to any crystal receiver. Try it in your set.
2 large pieces and Catwhisker .. .. .. .. .. .. **2/-**
1 large piece of Crystal .. .. .. .. .. .. .. **1/-**

**The BROWNIE WIRELESS Co. (of Great Britain), Ltd.**
(Incorporating the J.W.B. Wireless Co.),
**310a-312a, Euston Road, London, N.W.1.**
*'Phone: Museum* 3747.

*Popular Wireless and Wireless Review*, October 3rd, 1925.

The Brownie No.2

The Brownie No.3

*Popular Wireless and Wireless Review*, October 17th, 1925.



*Popular Wireless and Wireless Review*, November 21st, 1925.


Continued from page 7

well into the 1930's (see *Tickling the Crystal* Volume 2, pages 28-31)[3].

Moving into the design and manufacture of valve radios, Brownie Wireless introduced a low-cost two-valve receiver at the Olympia Wireless Exhibition in 1927. Priced at just £2 10s. 0d., the receiver was the cheapest of its type then available on the market. In order to control the retail cost to customers, the Brownie Wireless Company boldly challenged the Marconi Company's right to exact patent royalties of twelve shillings and six pence per valve on wireless receivers (as was the accepted practice at the time) in a landmark 1928 test patent infringement case. A further aggravation as far as Brownie was concerned was the fact that – because this payment was only imposed on wireless receivers making use of Marconi-owned patents – the Brownie two-valve note magnifier had hitherto not been subject to any royalties. However, because the amplifier could now be used with the company's valve receiver, it also now became liable for royalty payments! Although the case was initially decided in favour of the Brownie Wireless Company – a remarkable achievement in itself for a comparatively small company – the Marconi Company appealed and the original decision was reversed. By 1929, however, on the pretext of goodwill, Marconi reduced the royalty premium to five shillings on condition that the agreement be maintained for five years. Given her reputation, one can only assume that Kate Brownie was behind the company's tough stand against the industry giant.

Kate Brownie died in 1938 at the splendid age of 85, a largely forgotten contributor to the wireless industry of the United Kingdom.

1. Uxbridge History Society.
2. Genealogy source: UK Census Online. Middlesex 1891 Census; Reg.Dist. Uxbridge: Piece No. RG12\1020.
3. Sanders, Ian and Glover, Carl: Tickling the Crystal, Volumes 1 and 2. BVWS Books (2001, 2004).

The author is grateful to Shane Brownie for supplying information on his relative, Kate Brownie.

Official Catalogue of *The National Radio Exhibition*, The New Olympia Hall, September 4th – 18th, 1926.

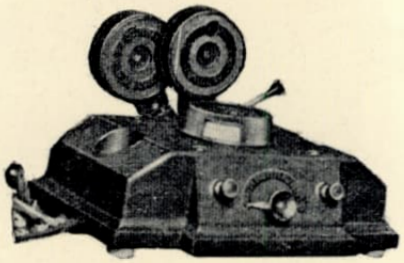

The Wireless World, November 16th, 1927.


Below: The Wireless World, September 28th, 1927.

**(145) BROWNIE.**

Styled "a valve set for the million" the two-valve Brownie receiver represents extraordinary value. Selling at £2 10s. complete with coils, but plus the price of valves and Marconi royalty, it is a thoroughly robust set, of good appearance and sound technical design. Its circuit is the typical two-valve arrangement, using coupled plug-in coils of durable construction having carefully arranged air spaced windings. There is a tuning condenser with attractive indicating scale. The set is in the form of a large moulding in good black material, possessing a matt surface comparable with sand-blast ebonite. No screw leads are to be seen. Connection to H.T., L.T. and grid batteries is made by a coloured multi-wire cable.

*Brownie Wireless Co. of Great Britain, Ltd., Nelson Street Works, Mornington Crescent, London, N.W.1.*



**An inexpensive two-valve Receiver on the Brownie stand. The novel form of condenser scale is of interest.**

The two-valve receiver of 1927 – the subject of the landmark patent infringement case between Brownie Wireless and the Marconi Company. The receiver with its exposed valves and swinging coil tuning – while very inexpensive – was primitive by the standards of the day.

Sales leaflet included with the Brownie No.2 receiver.


Patent jointly issued to James Barber and the Brownie Wireless Company for a crystal holder.

**PATENT SPECIFICATION**

*Application Date: April 6, 1926. No. 9117/26.* **239,450**

*Complete Accepted: Sept. 10, 1925.*

COMPLETE SPECIFICATION.

**Improvements relating to Crystal Holders of Wireless Receiving Apparatus.**

We, JAMES WILLIAM BARBER, a British subject, and THE BROWNIE WIRELESS COMPANY OF GREAT BRITAIN LIMITED, a British company, both of 310A—312A, Euston Road, London, N.W. 1, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a crystal holder for wireless receiving sets, and its object is to provide a holder which can be easily inserted in place or removed, and which permits the easy insertion and removal of the crystal.

The invention consists in a crystal holder consisting of a detachable spring clip adapted to grip the crystal resiliently and to fit resiliently in a socket or the like on, or fastened to, the stand of the receiving set.

The spring clip is made of bent wire, or from thin sheet metal suitably cut, pierced and stamped into shape, somewhat like a pair of sugar tongs. The crystal is held resiliently between the projecting ends of the arms or limbs of the clip, which is adapted at its base to fit resiliently in a cup or socket on the stand of the receiving set. The said cup may be adapted to hold one end of a protective glass tube within which the crystal and spring clip are enclosed, in a manner well known.

We append drawings illustrating diagrammatically by way of example one form in which our invention may be carried into effect, the spring clip being made from thin sheet metal.

Figures 1 and 2 are elevations of the spring clip at right angles to each other, Figure 3 is a plan of the flat blank cut to shape and pierced, and Figure 4 is a section of the cup or socket fastened to the stand and in which the spring clip fits.

The flat blank is cut to shape as shown in Figure 3, with two arms or limbs 1, and the ends 2 are stamped with concave surfaces and may be pierced with holes 3. The flat blank has two projecting tongues 4 and two slitted tongues 5, and is stamped or pressed into the shape shown in Figures 1 and 2, in such manner that the tongues 4 and 5 may fit easily or resiliently inside the cup 6 or a protective glass tube T within which the crystal and spring clip are enclosed, the usual catwhisker being mounted at the other end of the glass tube, in a manner well known.

It is obvious that the spring clip may be made in many forms having the functional features above specified. For example, it may be made of a single piece of wire bent to shape, one end of the clip gripping the crystal the other end fitting in the cup or socket.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A crystal holder consisting of a detachable spring clip adapted to grip the crystal resiliently at one end and at its other end to fit resiliently in a socket or the like on the stand of the receiving set.

2. A crystal holder as set forth in Claim 1, made from thin sheet metal cut, pierced and stamped to shape.

3. Crystal holders substantially as hereinbefore described or illustrated.

Dated the 6th day of April, 1925.

ARCHD. SHARP,
Chartered Patent Agent,
231, Strand, London, W.C. 2,
Agent for the Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1926.

Fig.1.

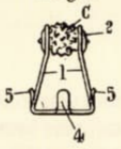



Fig.2.

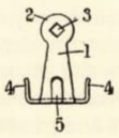



Fig.3.

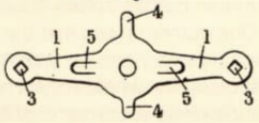
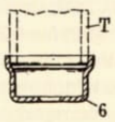



Fig.4.




BY common consent the "Brownie Wireless" is considered the World's best Crystal Receiver. In competition with the radio factories of all countries this Receiver has forged ahead until to-day it stands alone – impregnable and without a Peer. "Brownie Wireless" apparatus is to be found in the radio markets of every corner of the globe and, to mention but two representative European Countries adjacent to the German manufacturer, the British "Brownie Wireless" is as well known in Sweden and Switzerland as it is in Great Britain and the Colonies.

The London "Daily Express" has stated of "Brownie Wireless" Sets, that, they are "probably the best known in the world of wireless." It is surely a National achievement of no mean order that, in these days when it is asserted in so many quarters that Great Britain is losing ground in the spheres of industry and commerce, other countries have found it impossible to compete either in Price, Quality of Workmanship, or Effectiveness of results with British made "Brownie Wireless" Specialties.

# 70 years old & still going strong

## An Ekco with American Valves! The SW86, from 1937 by Peter Lankshear

The cover picture of an Ekco AC86 on the Bulletin no 34 prompts me to write about a unique Ekco model. As it was not marketed in Britain, many BVWS members will not be aware of its existence and, of further interest, it used American valves as original equipment.

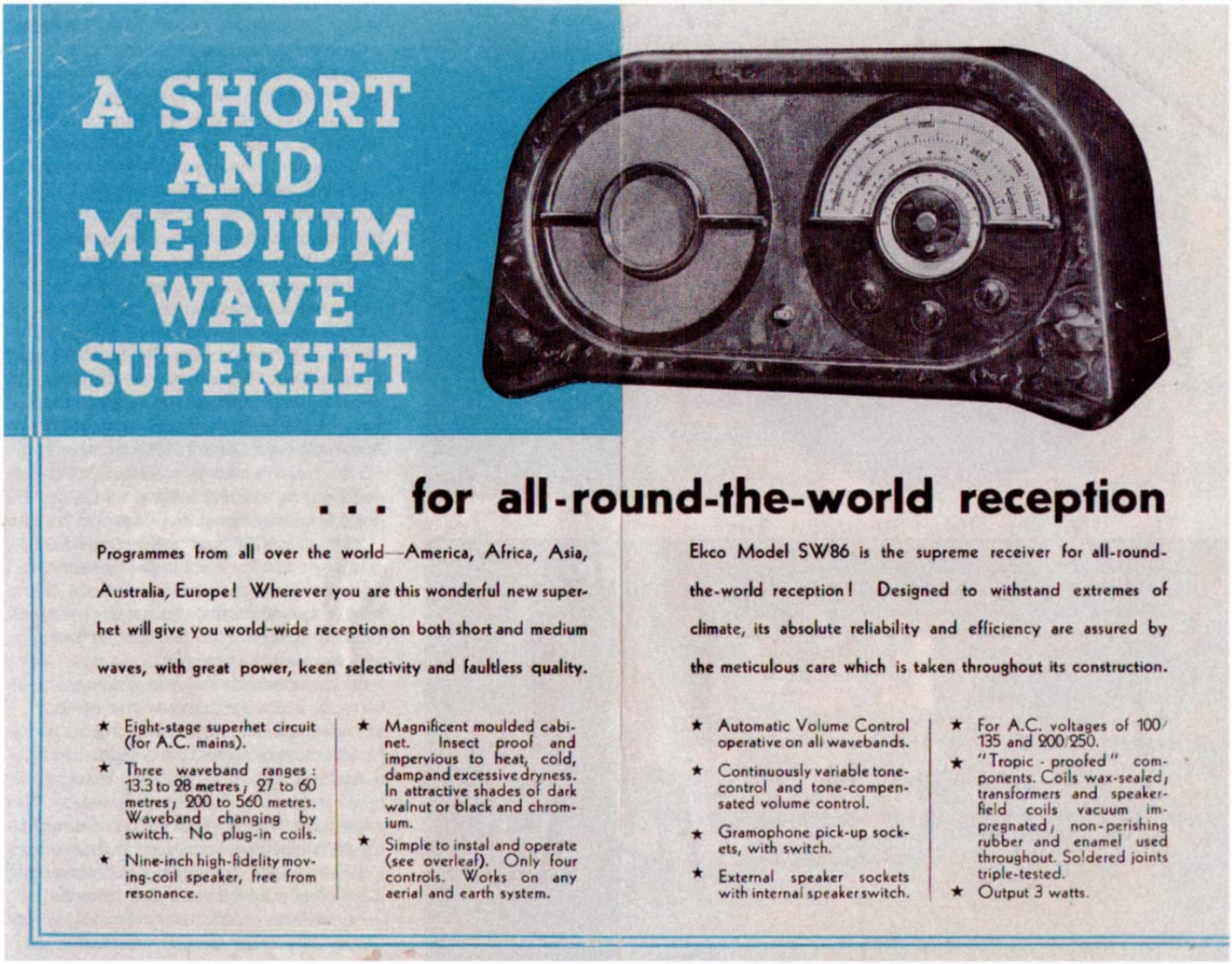

**In the Beginning**

By 1930, broadcasting was fairly well established in New Zealand, but conditions were quite unlike those in England which had a large population, and a smaller and more compact land area. Consequently radio coverage was far less of a problem; a large number of Britain's listeners could enjoy primary signals of adequate field strength from high powered transmitters and simple receivers were generally adequate. New Zealand on the other hand is one thousand miles from north to south, mountainous and at the time had a population of about one million. Geography and economics meant that the majority of radio transmitters were relatively low powered, so that much of the population lived in areas of low signal strength.

In this, New Zealand had much in common with North America and Australia whose radios were generally more elaborate than those from Britain. Although some larger British radios were imported, according to contemporary trade comments, British manufacturers were not very interested in what to them was a small and remote market, and anyway, sets with fewer than four or five valves were restricted as to where their sensitivity was adequate. Consequently the great majority of New Zealand radios were superheterodynes, either locally made, or from the USA, Canada and Australia. Their large and efficient manufacturing facilities made American models especially, affordable and good value. Philco, Atwater Kent, Stewart Warner, Pilot, Gulbransen and Majestic were plentiful and are today common brands in New Zealand collections.

One outcome was that the New Zealand trade was very familiar with American valves that used the simple RMA's method of standardised valve naming. All the popular types were available from each of the various valve makers and in the mid thirties not much more than a dozen different types catered for 90% of replacement valves in American (and New Zealand made) radios. Contrast this to the confusing practice of the British manufacturers each having different naming systems with an apparent lack of interchangability. Also, their valves were often higher priced and not available when a replacement was needed. (In the late thirties the situation regarding English valves was eased by the introduction of the International Octal series although there was still the complication of the Mazda Octals which we never saw in New Zealand. If anyone could enlighten me as to the logic or merit of Mazda's introducing their own non standard octal system I'd love to hear from them.)

Another factor that steered the radio traders away from English radios were servicing requirements. In New Zealand, as in America, centralised and specialised repair and servicing facilities were restricted to large cities. Small towns and rural communities had to be self sufficient with repairmen who needed to be versatile but often without specialist training. Ease of servicing was essential. One factor that made the American style of radio popular was ease of access. It was just a matter of undoing a couple of chassis bolts, pulling off or loosening the grub screws of 3 or 4 knobs and the chassis was on the bench. Contrast this with the bother




of first removing a fibre back, sometimes with the inconvenience of a physically attached mains plug. Then the possibly of having to disconnect part of the dial drive and overcome little traps fitted to deter the casual fiddler before work could start.

**Changes**

During 1936, New Zealand introduced import restrictions and tariffs which favoured Britain and seriously inhibited the import of American receivers. British radios became viable and it seems that a major New Zealand importer, Spedding Limited approached E.K.Cole Ltd. There is no record of what actually happened in the negotiations but the outcome seems to be that Ekco agreed to make a model available. Now there is nothing unusual in this but what was unusual was that they were prepared to make a special model for New Zealand. How Speddings convinced them to make what was by Ekco's standards a small special run is anyone's guess, but it is likely that there was the possibility of other markets in other parts of the Empire, although there seems to be no evidence that this ever eventuated. One clue to this is that the power transformer of what was to be called the SW86 caters for a wide range of mains voltages, unnecessary in New Zealand which was already standardised at 230 volts. It would appear that Speddings provided a specification that reflected their preference for American style receivers, a significant detail being that American valves were to be used. Although Ekco were at the time making their own Mullard style valves, they were nevertheless persuaded to take this radical step.

**Enter Wells Gardner**

An important American receiver maker in the 1930's was Wells Gardner who incidentally, 70 years later, as Wells Gardner Electronics, is still a major manufacturer! Wells Gardner radios were never sold as such, instead their chassis were fitted to cabinets supplied by other firms. For example, one well known mail order company, Montgomery-Ward sold Wells Gardner chassis under the Airline brand. Wells Gardner chassis had been popular in New Zealand. They were good performers on shortwave and models with an R.F. stage had plenty of sensitivity for weak signal areas.

It appears possible that E.K.Cole's engineers had a good look at a Wells Gardner radio whilst planning the New Zealand receiver. One detail that is immediately obvious is the pattern of the valve shields. It is, of course, probable that Ekco never had any previous need for valve shields. Each radio maker had his own pattern of shield, and consequently the ancestry of a chassis is immediately obvious. Physically, the aluminium SW86 shields are identical to their contemporary Wells Gardner pattern. The only difference was that the latter were generally made of zinc. It seems more than likely that Wells Gardner, who were also metal fabricators, made the shields for E.K.Cole Ltd. who were unlikely to have set up machinery to make their own.

Further evidence of possible Wells Gardner influence comes from the front end of the SW86 circuit. By 1936, Britain and Europe were well into using triode hexode and octode mixers, but the only frequency converter valve in the American range was



the pentagrid 2A7/6A7, (the 6K8 and 6J8G triode hexodes were about to appear). The pentagrid had limitations above about 10 MHz, where it suffered from oscillator frequency pulling and noise. It was, however, in practically universal use in American domestic radios , although rarely used in serious communications receivers . Wells Gardner was a rare exception and used instead a separate triode oscillator and biased pentode combination in their better grade of chassis. Although this configuration required an extra valve and would have been of little special benefit at medium frequencies, it was a superior performer at frequencies above about 10 MHz, with minimal oscillator "pulling" by strong signals, and generating lower noise than a converter valve. Diagram 1 shows the similarity between a Wells Gardner and SW86 "front end" configurations. This similarity is of course, not conclusive, and we will never know the true facts, but the SW86 was clearly not a standard Ekco design, and significantly, I have not been able to find any other examples of their receivers having separate oscillator and mixer valves. Finally, the SW86 dial indicator is very similar to that used by Wells Gardner, each scale having its own switched pilot lamp providing a butterfly shaped cursor.

**The Contribution of the AC86**

Ekco was a leader in the design of innovative cabinets, and it was to be expected that they would use an existing cabinet for the SW86, They chose an excellent design used in the 1936 model AC86, a 6 valve long and medium wave receiver. A display in the Victoria and Albert Museum reported the cabinet as being designed by the noted leading industrial designer Serge Chermayeff. With its curves and chrome, the pure Art Deco cabinet, available in black or walnut, never fails to attract comment, generally favourable.

The technology of the AC86 receiver has received a fair degree of adverse comment. Both Gerald Wells and the "The Wireless and Electrical Trader" service sheet have criticised the design and its headaches. At first glance the circuit looks like a typical medium sized superhet, but differences soon become apparent. Very obvious is the use of separate diode detector and triode audio amplifier valves. Closer inspection shows even more novelty. The cathodes of the converter, I.F. and detector valves are about 60 volts positive! The reason is that the I.F. valve doubles as a direct coupled Automatic Gain Control (AGC) amplifier and R8 is a squelch control, controlling the overall sensitivity so as to minimise inter-station noise in interference prone locations.

When the AC86 was in new condition, it was a good performer, but the inevitable ageing of some components created some very serious and puzzling problems. Unequal aging of V1 and V2 played havoc with the noise suppression and it was recommended that these valves should be replaced in pairs, despite their being still adequate for conventional service! Now in most receivers, the deterioration of electrolytic capacitors results in increased hum or reduced gain or bass response, irritating perhaps, but not serious. But with the AC86, the consequences could be dire. If the electrolytic cathode bypass capacitor C3 lost capacitance, the system created uncontrollable motorboating. Similarly, failure of the cathode bypass C21, common to the audio valves, V4 and V5, created a cathode coupled multivibrator. Just why Ekco's engineers chose to eliminate a separate bypass capacitor for V4 is another puzzle. Surely it wasn't for economy. There were other difficulties too and "Trader" Service Sheet 656 on the BVWS circuit diagrams CD describes in detail the complicated operation of the AC86 and some of its shortcomings.

In short, although the cabinet was a winner, the chassis of the AC86 could fairly be described in automotive terms as being a lemon!

**A Success**

Apart from the same speaker and some of the metalwork of the AC86, the SW86 was a fairly radical departure from Ekco's usual design, but it proved to be a good receiver. The dial was very clearly and fully calibrated with the shortwave scales on the two outer sections of the dial. This favoured shortwave tuning as did the tuning capacitor having split stators that provided a measure of band spreading. A split stator capacitor was occasionally used in receivers intended for serious shortwave reception. The standard tuning capacitor was based on the approximately

3:1 ratio of the medium frequency band, but this ratio could make shortwave tuning somewhat critical. By switching in only some of the stator plates for shortwave reception, tuning was easier. The two shortwave ranges covered those of most interest to listeners: 5MHz – 11MHz and 10.5MHz – 23 MHz. Around the large tuning knob that needed 28 turns to cover each tuning range was a logging scale. The innermost scale was of course for medium wave reception, 520kHz – 1.5MHz. The coils were of large diameter and there was plenty of ceramic insulation. One admirable and all too rare feature is that all resistors carrying more than a milliampere or two were wirewound. Although New Zealand is a temperate country, all paper capacitors were metal cased tropicalised TCC brand, rather than the usual waxed cardboard cased type. The label on the back panel gives precedence to shortwave coverage. Were these indications that the SW86 was aimed at further overseas markets?

**The SW86 Circuit in Detail**

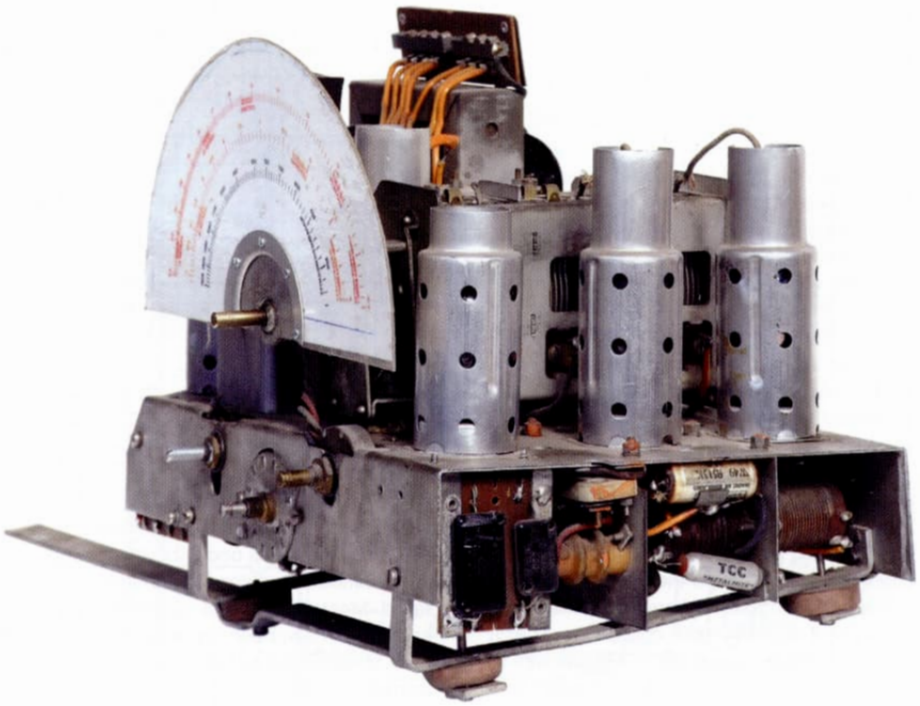
Electrically the SW86 had little in common with the AC 86 whose clever features, were let down by the inevitable ageing of components. Conversely the SW86 used proven and conventional technology which was more tolerant of less than perfect components. Later, we will look at a minor weakness in the AGC system, but overall the design was good and well executed.

Provision was made for either a conventional wire aerial or for shortwave, a doublet, connected through appropriate tuned circuits to the input valve, a standard 6D6 variable mu pentode. There was an additional cathode bias resistor to reduce gain for the Medium Frequency band. Unusually, there was no AGC applied to this stage. For shortwave operation, the R.F. stage anode was coupled to the frequency converter coils by low impedance windings, but for medium frequency operation, a 4k ohm resistor provides resistor capacity coupling

As already mentioned, frequency conversion was carried out by a 6C6 sharp cutoff pentode, cathode biased to cutoff, its companion Hartley oscillator being a standard general purpose type 76 triode. This arrangement could hardly be improved on for good all wave performance.

A pair of well made 460kHz I.F. transformers and another 6D6 valve (V3) served as a conventional I.F. amplifier. Two resistance coupled audio stages comprising a diode/ high mu 75 triode and 42 pentode are conventional and typical of the amplifiers used in countless receivers of the period. The 42 is coupled to the 9 inch loudspeaker by a generously sized output transformer. A minor criticism is the value of 7K ohms for the 75 bias resistor. This would be correct for a medium mu British audio valve, but ideally that for the hi gain 75 would be nearer 2K ohms.

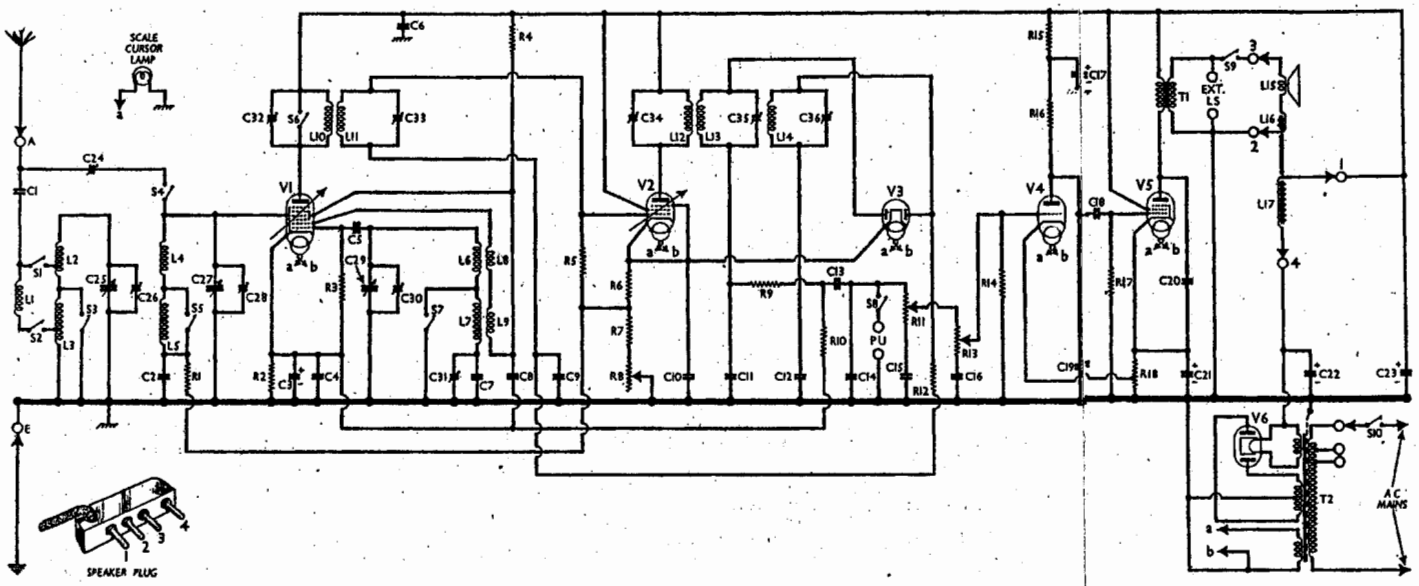
A conservatively rated and conventional power supply, with the classic type 80 rectifier had a very husky and cool running transformer tapped for operation on mains voltages from 105 to 255 volts.

**An Odd AGC System.**

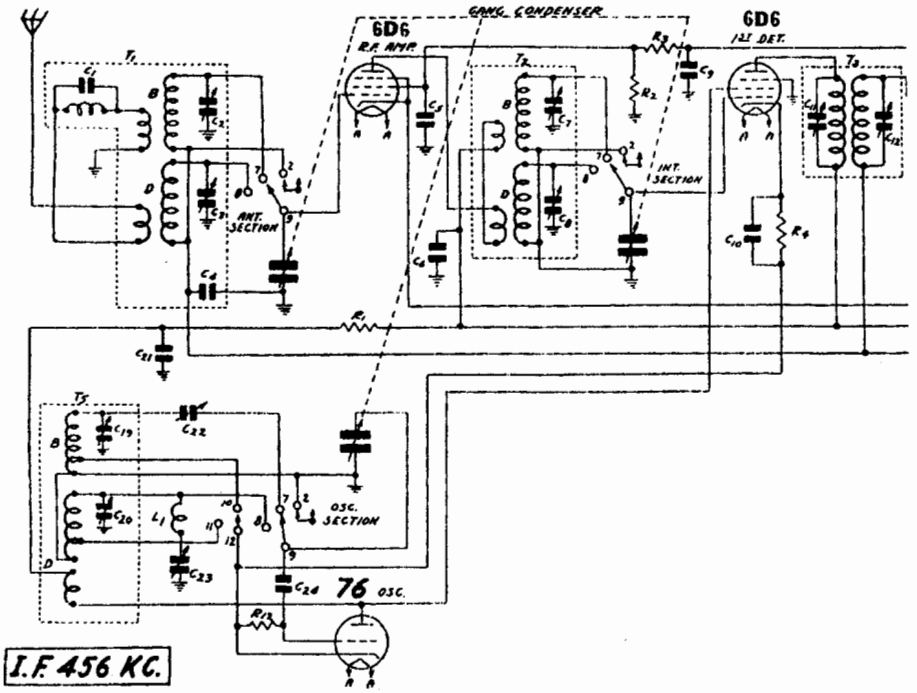
The AGC system of the AC86 was somewhat unconventional, but that of the SW86 simply broke the rules! The use of a separate diode fed by C33 is good practice. The three resistors R8, R9 and R10 form the load but it was usual to return R10 to earth. In so doing there would have been a few volts AGC delay, so that very weak signals would not be controlled. Instead R10 is connected to the 75 cathode, removing any delay in the onset of AGC, and incidentally, putting a small residual positive voltage on the AGC line.

In a high gain receiver, it was desirable to apply only partial voltage to the I.F. amplifier. With the SW86, practically full AGC was applied to the I.F. stage, thereby cutting off the valve when handling strong signals and so creating serious distortion. In the SW86, some AGC voltage was applied to the converter valve, which was pointless with a valve already biased to cutoff. However, the real problem with the SW86 was that there was no AGC control of the R.F. stage. This allowed strong local signals to overload the following stages. It is possible that Ekco's engineers felt that any R.F. stage grid control could degrade the shortwave signal to noise figure, and therefore it was better to let the R.F. stage run at full gain all the time. For a bit of headroom, the RF stage cathode bias on the medium wave band was increased but this proved to be inadequate, and city dwelling users of SW86's




AC86 Circuit

The Wells Gardner mixer circuit




often found it necessary to disconnect large aerials when listening to local stations.

The remedy was straightforward. Transferring the AGC line from the converter to the R.F. stage changed the SW86 to a very good and docile receiver, with especially good shortwave performance. At the same time, the additional medium frequency bias resistor for the R.F. stage could be eliminated.

**Living with an SW86**

The venture was successful. During 1937, the SW86 was well advertised nationally and sold well with black cabinets being the most common. Some chassis and speakers were received without cabinets. These were fitted into locally made console cabinets, with the decorative chromed ring and bar fitted in front of the speaker grill. Proof of their popularity and durability is indicated by the fact that the writer was able 10 years ago, to account for the whereabouts of at least 20 of the by then 60 year old sets, most still in working order.

By 1938 there was still some unsold inventory and someone had the bright idea of "modernising" them by fitting 6E5 tuning indicators and calling the "new" model the SW76.

It is not often that we know the complete history of a receiver in our collections, The writer's SW86 is an exception. My late wife's father bought it new in 1937, and it was his pride and joy for 30 years. I came on the scene in 1950, and clinched my suitability as a potential son-in-law by demonstrating my ability to provide the SW86 with a bit of TLC. When father no longer had a use for it, my wife insisted that it become our working domestic receiver, up to about 12 hours a day. It has been in practically daily use as such for about 40 years and it is still going strong. It has occasionally needed attention but no major component has ever failed. Most of the metal cased TCC paper capacitors have been replaced, fittingly with TCC Metal Packs or Metal Mites, the post war equivalents. The electrolytic capacitor cans have of course been fitted with new contents. There have been a couple of new volume controls needed due to on/off switch failure. The two most major renewals have been the perished speaker cloth and the warped original dial scale which was replaced by a laminated photo copied scale with a polycarbonate backing. There has been only one fault attributable to Ekco workmanship, a dry soldered joint on the oscillator injection capacitor C29 caused an intermittent drop in level until it was tracked down.

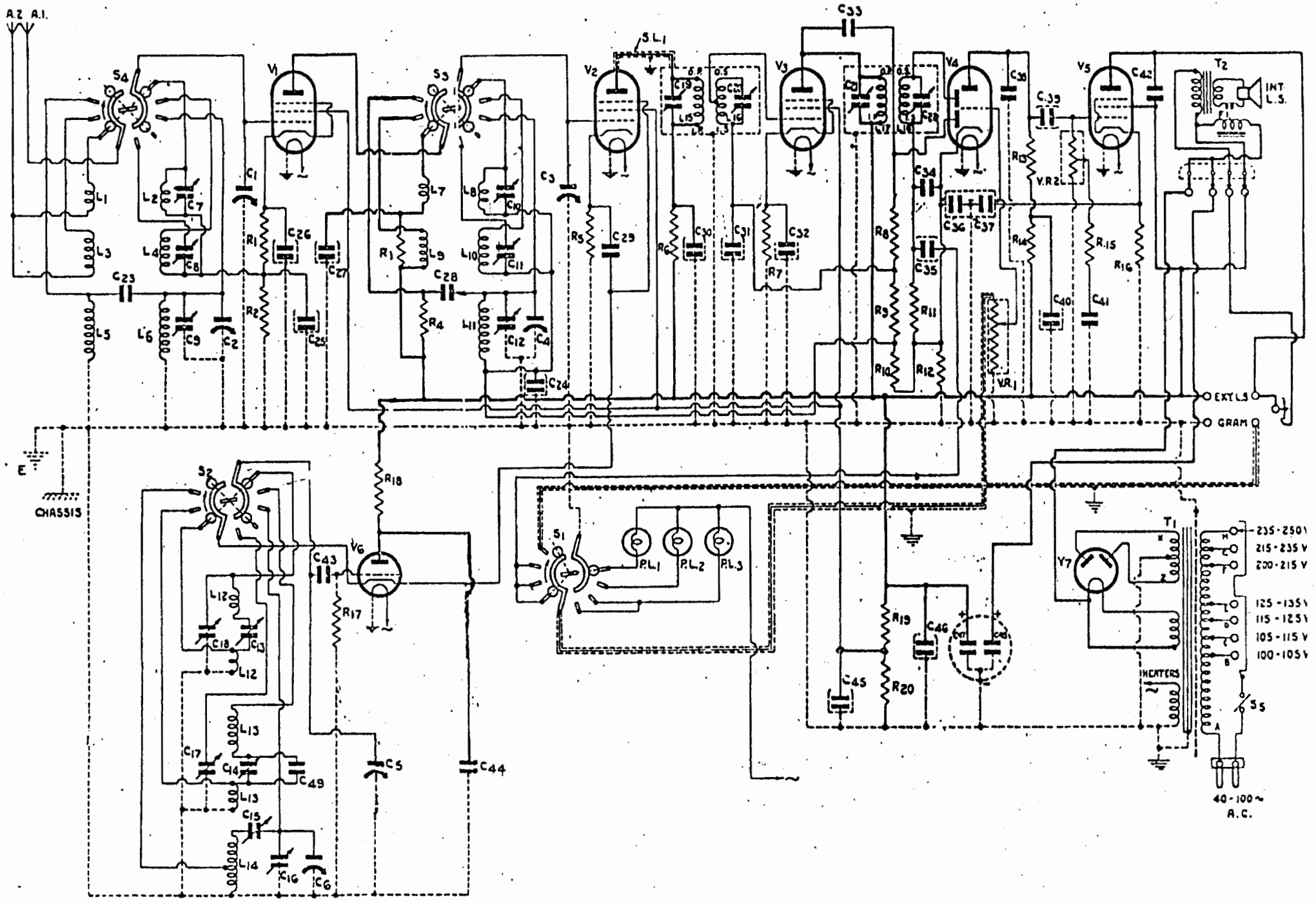
There have been surprisingly few valve replacements. I still have the Tungsol branded originals to go back sometime. I understand that these were replaced after about 10 yrs, but my AVO Mk IV valve tester says that their transconductances are still within 90% of new. Subsequently there have been no valve failures and very few renewals.

E.K.Cole Ltd certainly made a durable product.

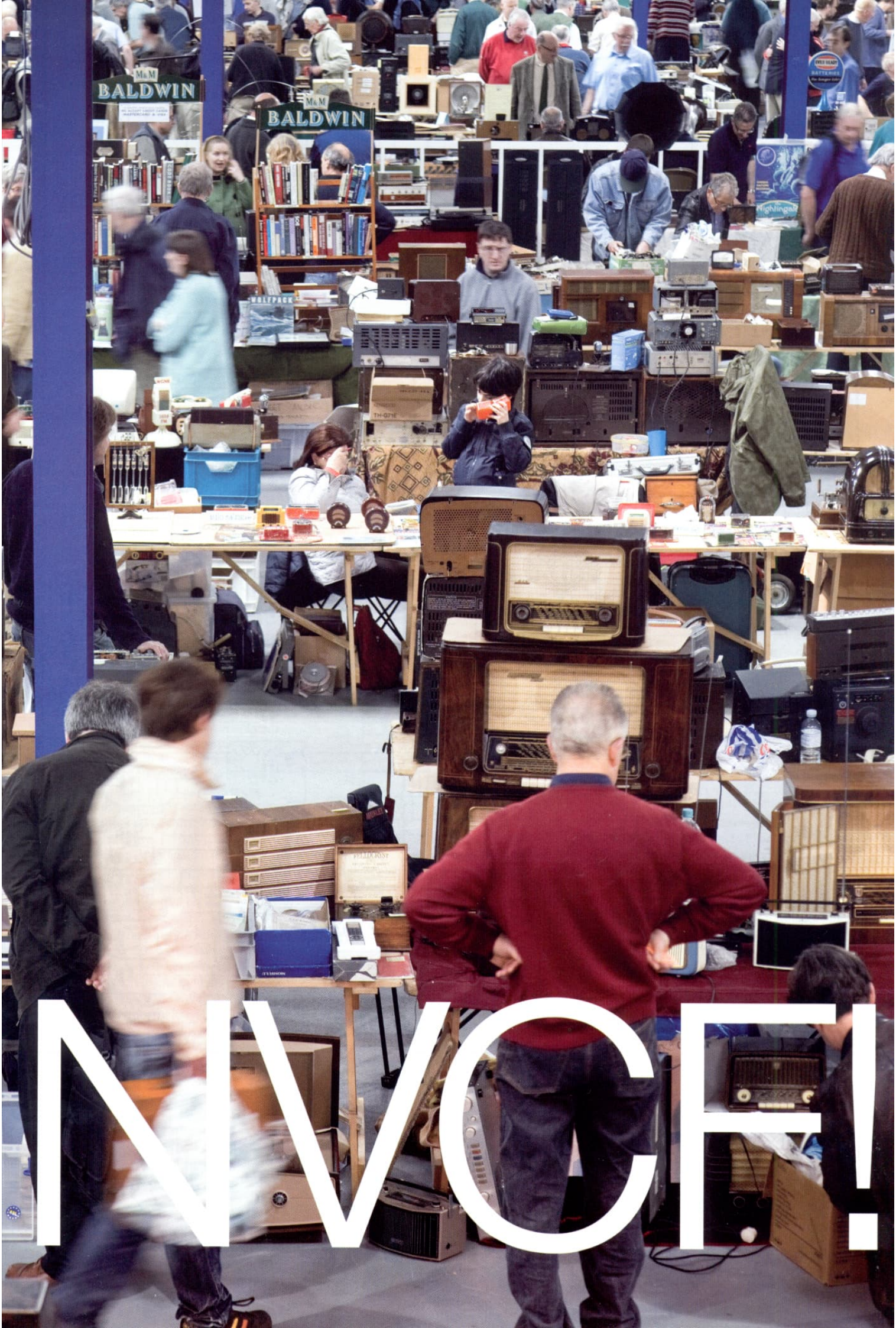
**SW86 Components**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **R1** | 325 ohms | **R10** | 250 kohms | **R20** | 8.0 kohms | **C29** | 500 pf | **C38** | 500 pf | **C45** | 0.1 mfd |
| **R2** | 1.5 kohms | **R11** | 500 kohms | **VR1** | 250 kohms | **C30** | 0.02 mfd | **C39** | 0.02 mfd | **C46** | 0.25 mfd |
| **R3** | 1.0 kohms | **R12** | 7.0 kohms | **VR2** | 250 kohms | **C31** | 0.02 mfd | **C40** | 0.1 mfd | **C44** | 0.002 mfd |
| **R4** | 4.0 kohms | **R13** | 200 kohms | **C23** | 5.0 cm | **C32** | 0.1 mfd | **C41** | 0.005 mfd | **C45** | 0.1 mfd |
| **R5** | 15 kohms | **R14** | 40 kohms | **C24** | 0.25 mfd | **C33** | 5.0 cm | **C42** | 0.003 mfd | **C46** | 0.25 mfd |
| **R6** | 1.0 kohms | **R16** | 420 ohms | **C25** | 0.05 mfd | **C34** | 500 pf | **C43** | 100 pf | **C47** | 8.0 mfd |
| **R7** | 500 ohms | **R17** | 75 kohms | **C26** | 0.05 mfd | **C35** | 0.02 mfd | **C44** | 0.002 mfd | **C48** | 8.0 mfd |
| **R8** | 100 kohms | **R18** | 30 kohms | **C27** | 0.02 mfd | **C36** | 25.0 mfd | | | | |
| **R9** | 250 kohms | **R19** | 10 kohms | **C28** | 5.0 cm | **C37** | 25.0 mfd | | | | |

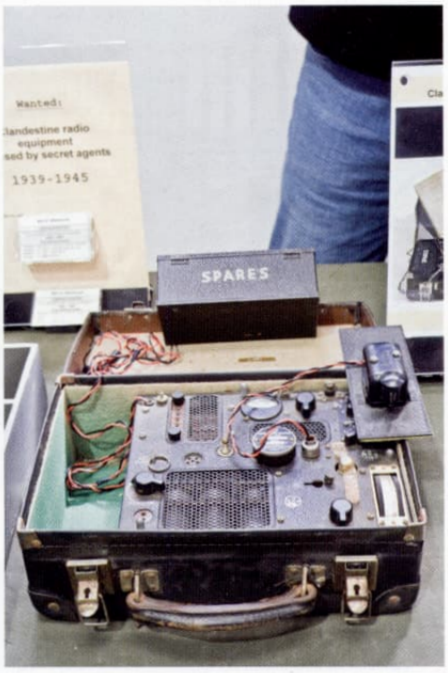
N.B. Capacitors 1 – 22 are variable or pre set.




SW86 Circuit


BALDWIN
BALDWIN
NVCF!


WALL TABLE


Wanted:
1939-1945
SPARES

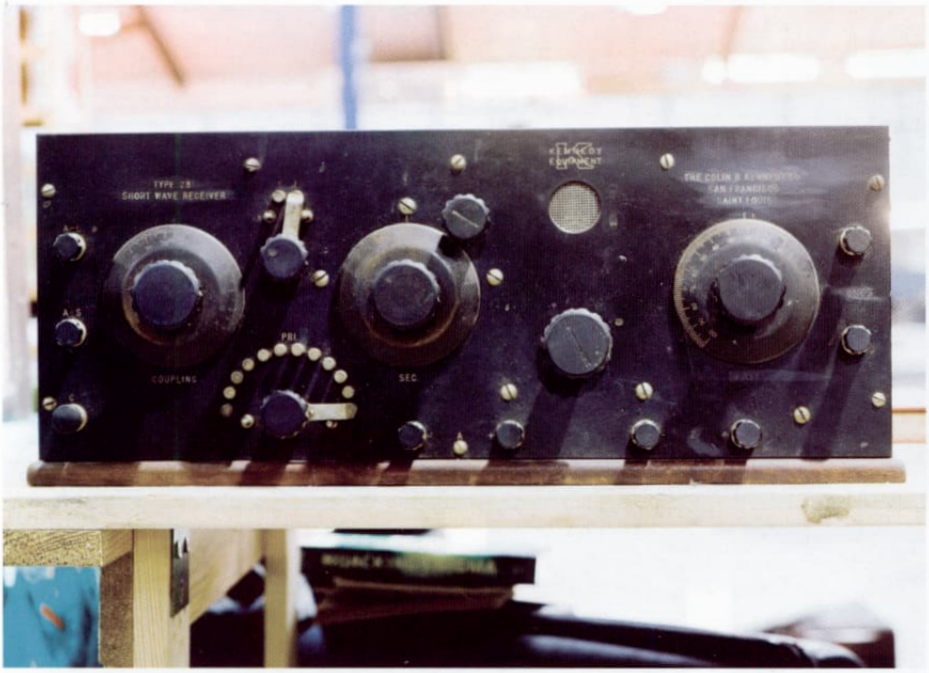

ARCHIVE BOX


TOILETS


ZENITH


WIRELESS WORKSHOP


DAN DARE
RADIO
STATION


SHORT WAVE RECEIVER
COUPLING
PRI
SEC

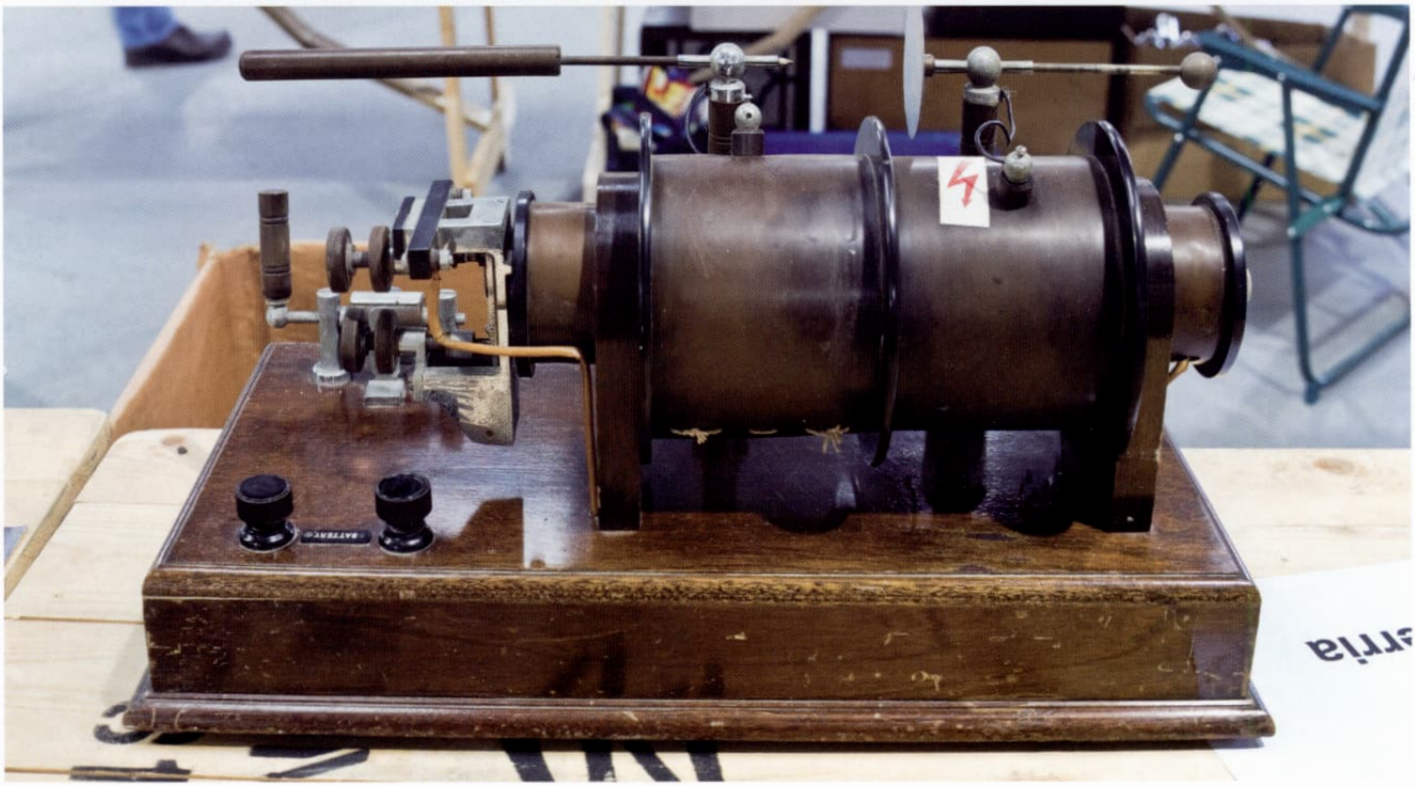

COARSE TUNING
FINE TUNING


MARCONI PP3 - 250
£800 A PAIR


B1
On The Air


EVER READY
BATTERIES
for longer Life!
BALDWIN


6 TRANSISTORS
CONTINENTAL
GLOBAL




TELEPHONES
SUPERVISORS GCT


BBC


METER BALANCE
FILTER
IN
METER AMPLITUDE
INCREASE VOLUME
TUNING INDICATOR
METER DEFLEC.
AURAL SENSE
LOW
SWITCH SPEED
A.V.C.
BALANCE
VISUAL
RECEIVER
TYPE R.1155 A
REF N° 100/1477
A M
SERIAL N°
FROM LOOP AERIAL
TO VISUAL INDICATOR
FROM TRANSMITTER

# An HMV Record Player, Model 122, from 1939 by Gary Tempest

This seemingly simple player shows that once again you don't have to buy expensive items to get a lot of enjoyment from a restoration. It actually came free from a fellow member.

It's designed to be connected to the 'gram' sockets of any radio that had them. That way you could enjoy another source of entertainment from your set. It was sold for just under two old pounds, presumably at minimal profit, as the idea was to boost the sale of 78 RPM records. It was a cheap option compared to going out and buying a radiogram, which would have been typically ten times as much for a modest purchase.


I have a copy of an article, from HMV's in house magazine "The Voice", which was published in the run up to Christmas 1939. It tells of the huge demand and that the production target was 1000 a day. Increase record sales it did and 50,000 were sold in the same period. It was estimated that if every purchaser only bought 6 records a year then around 300,000 records sales would ensue.

To us, with all the complex musical apparatus available, it does look simple but none the less the pickup alone is said to contain 97 separate parts. At 1000 a day this amounts to 97,000 parts, 33,000 assembly operations and 12,000 tests. I can't help but think of all that employment, mostly of ladies, many wearing turbans, to keep their hair out of the 'works'. Then think of all the motors that were needed, the end of record automatic brakes and the cabinets.

The cabinet was of an ingenious construction consisting of a band of thin plywood, bent into a circle, with the ends held together by gluing into a strip of grooved wood. The base, with an access panel for the motor etc, was grooved so that once glued into position it forced the circle into the shape of the unit. The motor board was attached in similar fashion. It was interesting to see, between the top and bottom panels and the sides, the use of lengths of rope saturated with glue as reinforcement.

Surprisingly, with so many being made you would think that there would be still plenty around but they don't seem that common, far less so than windup record players. Certainly a lot would have been damaged by not having a lid and the rest, being cheap and unvalued, were simply thrown away after the War when fortunes brightened.

**Work done: Initial**

I started this in the winter; unusual as the cabinet was going to need refinishing and that's a Summertime task. However, I had the urge to make it play and so decided to do the electronics even if that meant stripping it out again. It's actually an awkward thing to assemble so gaining the experience on an unfinished cabinet was worthwhile. Also, once inside, I found some heavy mould growth that I wouldn't have wanted indoors over the winter.

Moulds are strange and wonderful things. I read somewhere that they might be the only things to survive nuclear devastation. To me they should be handled with care and I cleaned outside with foam cleaner, followed by White Spirit, wearing a good facemask.

**The Motor Type 26200 (various suffixes)**

Now I could get on with the electronics and I decided to tackle the motor first. Fortunately, friend and fellow member Paul Barneveld sent me a lot of service information and gave me much useful advice. It's always best to start from other's experience if you can.

**Dismantling and repairs to the motor.** Pictures 1-3

The order of disassembly is fairly obvious: the turntable, the easily damaged pickup and its rest and then the end of record brake. Now it's just three screws to remove the motor via the bottom access hole.

Again it's easy to see how the motor comes apart and the pictures should help in visualising this. I'm told there are several variants, as no doubt, with the huge quantities needed then several manufacturers would have been used. On mine there were no loose ball bearings to lose.

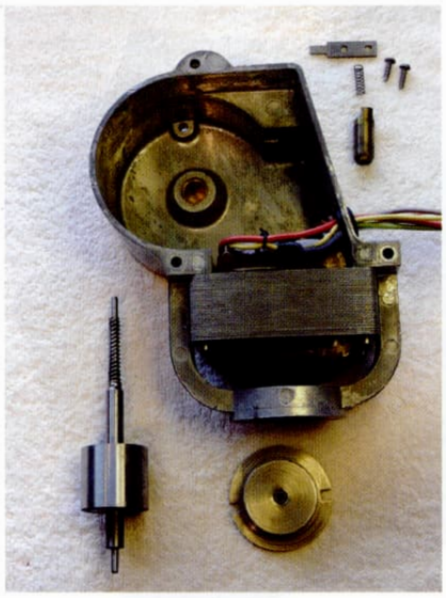
Once it was in pieces I cleaned all the parts ready for re-assembly. There is a worm reduction drive, with a fibre gear wheel, that reduces the motor speed to that required. After cleaning it should only be lubricated with grease as oil will soak into the fibre and soften it. I used Molyslip graphite grease and sewing machine oil for the bearings.

All rubber wiring carrying mains voltage was no longer safe. The insulation on that inside the motor had turned to goo from oil contamination, probably from over zealous lubrication via the holes provided.

It was replaced with siliconee rubber insulation. It was very tempting to unsolder the wire from the eyelets, in the stator coil cheeks, but this was not a good idea. The method of manufacture was to fit the wires first and then use the wire stubs, on the other side, to wind the coil wire around before soldering. It was far better to cut the wire off about an 1/8" from the eyelet, very quickly tin, and then wrap a single turn of the new wire around before again quickly soldering. Paul uses a method that may appeal to some; he strips off the old wire insulation and then slides on silicone rubber sleeving.

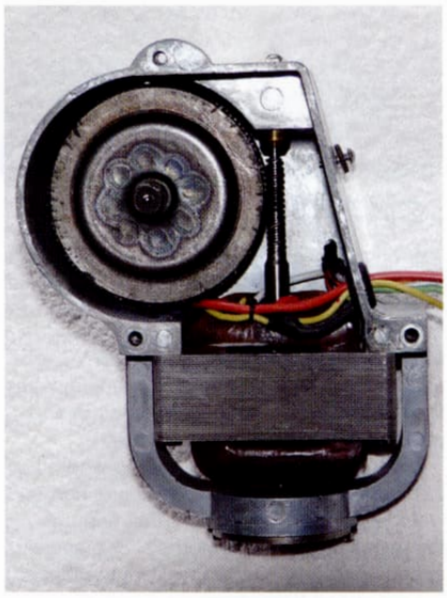
I was lucky with the incoming mains lead as the cloth outer was in good condition and I was able to pull new silicone rubber insulated wires through it. The originals had a slight twist and were built up with string fillers to make the cable circular. My replacement wires just ran straight and so the cable may tend to 'coil' in use but I can accept that.

There are two capacitors that create extra magnetic phases (more on this below)



1: Motor ready for rebuild

2: Fibre gear wheel



3: Back together

that needed changing. According to the service data the insulation should not be less than 50M Ohms at 500V, mine were down to 500K Ohms at 10V. They are in a box, that is not present in Picture 3, but it is mounted top right and one fixing screw can be seen. The 'caps' are sealed with pitch but because of the small size it's easy to remove them with a hot air gun. I was happy about this, as I didn't want to upset the Lady of the House again by using the oven.

Type X Suppression capacitors are ideal replacements as they are designed for use across the mains supply. Farnell Electronics had some low cost 0.68 micro-Farad rated at 300V AC. Testing the motor with the capacitors outside the box gave the highest voltage measured across one of them, as 212V AC. Note: Normal, 630V DC, 'poly' decoupling capacitors may be marginal as typically they are only rated at 220V AC.

After the motor is reassembled it's necessary to adjust the position of the stator assembly to minimise noise. Presumably unless the rotor sits central to the magnetic fields then vibration and noise occur. There is not much movement, with machined screws, but the rotor end- bearing cap is also slotted so there is some adjustment there as well.

**How the motor works.** Figure 1
It is a so–called Hysteresis Motor and I couldn't remember, if I ever knew, how these worked. As always there's lots of information on the Internet.

My simple explanation of the operation, after browsing the Web, is as follows. It has a four-pole stator and a rotor comprising a smooth cylindrical steel tube having special magnetic properties.

The stator has the four pole pieces magnetically separated from each other by brass inserts. Around each pole piece is a coil. Looking at the diagram, Figure 1, it is seen that the left and right ones are relatively low resistance and are connected in series across the supply. They are connected so that they produce fields, in their respective pole pieces, that are shifted by180 degrees. Now across

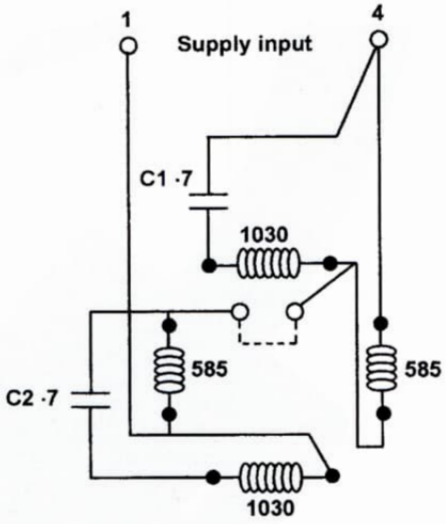



Figure 1

each of the left and right coils, are ones of higher resistance, in series with capacitors. The capacitors make the current lead the voltage by 90 degrees. This creates fields, in the top and bottom pole pieces, shifted by the same amount from their relevant left and right coil. So the net result is the motor has four rotating fields nominally spaced 90 degrees apart.

Now to the rotor and this requires a little more imagination. "The steel used is said to have a high Hysteresis meaning a lag or delay effect. Thus the flux induced into it lags that which produces it so it has something to chase and rotates. Once it gets up to synchronous speed the Hysteresis material is in a constant state of magnetisation and acts as a permanent two-pole magnet. Full-speed performance is therefore exactly the same as in a permanent-magnet synchronous motor."

More: "The outstanding special feature of a Hysteresis motor is the production of nearly constant torque during starting. This is ideal for record player turntables, where smooth starting torque reduces record slippage."

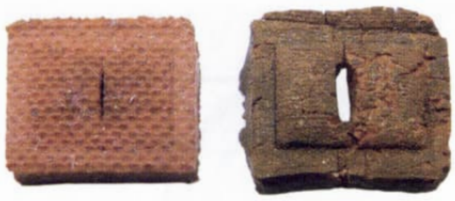
But why use such a motor? Remembering that this unit was being sold at a very low price then this must be the answer. There is another of these add on turntable units, Model 119 from 1937, costing almost twice as much. It's in a square box with a lid, that uses an induction motor requiring only one capacitor but it doesn't run synchronously and so needs an expensive governor mechanism. This consists of the familiar brass weights that throw outwards as the speed increases to operate a brake. The extra friction provides control to set the speed according to a top panel lever.

**The pickup (affectionately called the "Blunderbuss pickup"). Pictures 4-8**
This is of the moving iron type. The ferromagnetic armature is pivoted between pole pieces magnetised by a horseshoe magnet. Surrounding the armature is the pick up coil. When the needle moves, and being mounted within the tube of the armature, it disturbs the flux lines between the pole pieces and a voltage is induced into the pickup coil. In series opposition with the coil is a 'hum-bucking' coil that's there to cancel any hum voltages induced into the former. I'm told sometimes this second coil is missing, presumably removed by a previous repairer, but apparently hum is still not objectionable without it.

I have read of others, making gramophones play again, who have left the pickup untouched, "... it made a loud sound, so I left it alone". But really it won't play as the makers intended if the armature rubbers are too hard. In some rare cases the rubbers may still be useable but it's best to check at least. Picture 4 shows two top armature rubbers, one soft and still useable and the other that's solid. It's possible that later items used a different rubber.

The pickup was not open circuit, measured from the twin-screened leads, and was acceptably close to the given figure of 7.5K Ohms.

The pickup hadn't been worked on before as the wax, covering the head shell centre fixing screw, still looked original. The four screws at the front securing the pole pieces needn't be disturbed at this stage. Of course you need to remember to remove the screw that holds the needle in place.



4: Hard and soft rubbers

Once inside the first thing to be done (excellent tip this one) was to apply beads of epoxy, for reinforcement, around the coil lead out wires where they exit from the bobbins. They are wound with 47 SWG wire and have up to 8500 turns. Rewinding, with the by now fragile bobbins, is of course possible but naturally best avoided.

Mine was one of the rare cases where the armature rubbers still had resilience and so were left alone. The rubbers that support the assembly in the head shell were equally spongy and only needed re-gluing in place.

I did spend time checking that the armature was central in the gap in the pole pieces. A good light and a magnifying eyepiece helps. If the armature cannot be seen clearly then this may be due to corrosion and the source of another problem if rust particles are bridging the gaps (more on this later).

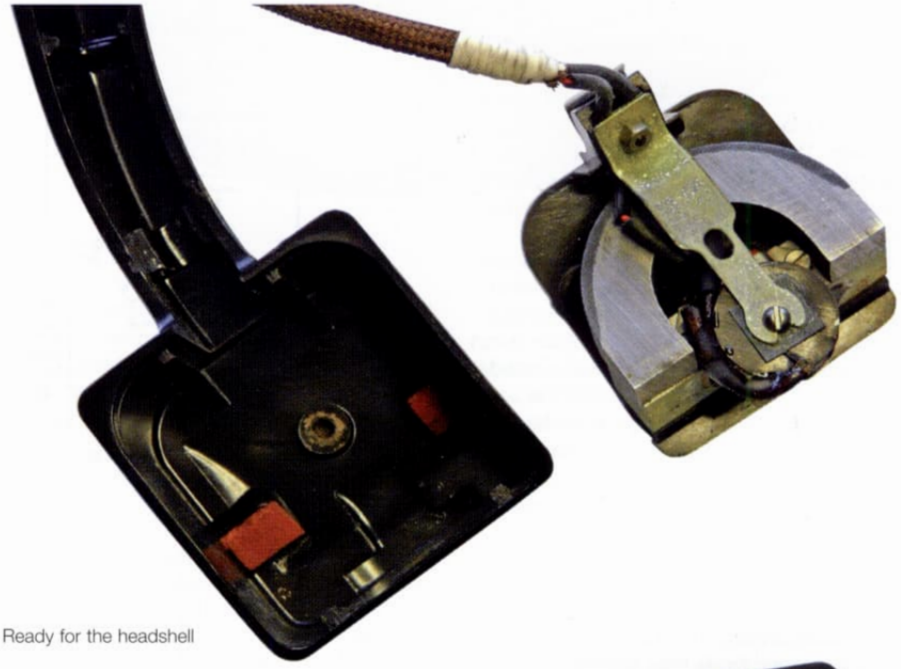
The rubber insulation, on the lead wiring, was perished at both ends where it was not covered by the cotton braiding. Maplin Electronics do a small diameter (2 mm) single-screened cable and a pair of these fitted comfortably inside the original braiding. The tiny, PVC insulated, inner wires were covered with silicone rubber sleeving where they are clamped at the head end. Before tackling these it helped to gain better access by removing the horseshoe magnet. This can simply be done by rotating it but it's a good idea to mark the top with a marker pen first. This saves trying to determine which is the best milled face that should be in contact with the pole pieces. Once removed a 'keeper' (a steel rule) was placed across it.

It was easy to use a sharp scalpel and cut off the old fabric sleeves and I simply laid the tiny new wires alongside the old connections and soldered them in place. The joints were insulated with heat shrink sleeving.

A lot of dust and magnetised particles had built up around the needle hole. These were sucked out with an old vacuum cleaner with a piece of small-bore tubing taped inside the smallest hose connection. It's not a good idea to run the machine like this for long of course.

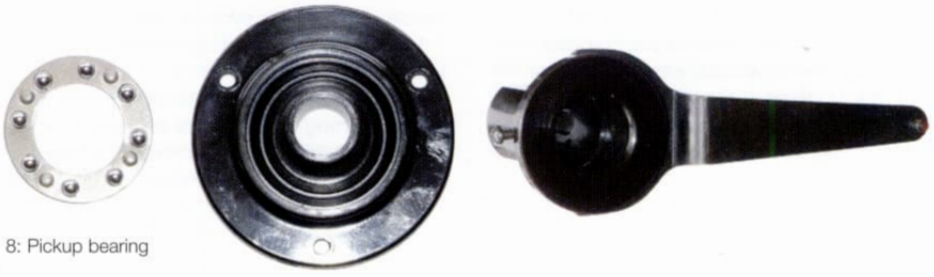
I disassembled the pickup bearing, Picture 8. As can be seen there are ball bearings that can get lost. Mine had roughness when rotating the Bakelite halves by hand. This needed correcting as it could definitely be felt when the assembly was rebuilt. The remedy was to rub down the inner part of the bearing with 1000 grit wet and dry used dry. Most of the resistance occurred where the stop screw, running in a slot, had distorted this over the years. The ball bearings were put back with a little Lithium grease.

5: The pickup internals



6: Ready for the headshell

7: Completed pickup head



8: Pickup bearing

**Putting the unit back together for a first try**
Cleverly the drive to the turntable is cushioned by the use of a rubber washer that also acts as a safety feature if the turntable is jammed. The turntable should rotate freely on the motor spindle and some corrosion and dirt was cleaned to allow this. The washer was rock hard and no further use so a replacement was used that had been cut, with metal punches, from rubber sheet. An alternative would be a 1/8" thick chassis mount washer, see below.

The motor is mounted on rubber bushes; almost certainly pure rubber, that appeared good but after several frustrating assemblies I decided that they weren't. I was advised, from one source, to lubricate the rubber parts only with liquid soap or water based lubricants. The soap works fine at first but once dry makes disassembly very difficult; it pretty well glues the rubber to the plain shanks of the motor screws. The best thing to use is French Chalk or talcum powder.

The main problem was that the turntable was not level with the motor board and also was low. I experimented with extra metal washers on top, on the 'heavy end' to compress these rubbers further. But although I could get the turntable level it was still low. If this is the case then the automatic brake lever L1 (see Brake diagram) will scrape on the turntable.

Eventually I ditched the original rubbers and used gum rubber chassis mounts from AES (Antique Electronic Supply, Arizona, USA). I used 1/8" thick washers underneath and 1/4" thick washers on top with pieces of Hellermann sleeve between the two. The holes in the underside washers were enlarged to 3/8" using a 'hit with a hammer' metal punch. This allowed the sleeves to be super-glued into the washers. The sleeves, which are a wedge fit in the holes, were just butted up to the top washers, which sit in counter-bores in the motor board and are a tight fit. The parts I used were:

AES Washer 7/8" x 1/8", P-H186
AES Washer 7/8" x 1/4", P-H185
10mm OD. Hellermann sleeve

It worked very well, and seemed to make the motor quieter, with ample clearance of L1 under a perfectly level turntable. It was level within 1mm to the motor board on all 4 sides.

Some useful measurements that worked for me:

Note: the replacement rubber drive washer under the turntable was 1/8" thick.

L1 pin, above the motor board approximately 3mm. L1 clearance under the turntable rim 3-4mm. Height of the bottom edge of the turntable above the motor board 13mm.

The felt pad, on the manual stop and brake lever, was low and may have been bent downwards during its life. I 'adjusted' this but still about 1/16 of an inch of the pad was visible below the turntable rim but I'm told this is normal.

**A look at another pickup.** Pictures 9-11.
I still wanted to know how the rest of the pickup came apart, what the armature looked like in detail and how new rubber could be fitted. Fortunately Paul found me an old item to play with.

Assuming that the pickup assembly has been removed from the head shell it's a good idea to temporarily replace it. This provides protection and something more substantial to hold whilst removing the wax and loosening the four screws that secure the pole pieces. Once I had them loosened they were lightly locked up once more and the assembly again removed from the head shell.

Next the hum-bucking coil was unscrewed, complete with its mounting bracket and carefully swung clear, Picture 9. This gives access to the frame screws, for the armature top rubber, which can now be removed, Picture 10. Note the slit in the rubber that the tip of the armature locates in. The fixings in the frame are slotted to allow lateral adjustment of the armature within the poles pieces upon re-assembly.

Now the screws holding the pole pieces were removed and the assembly gently eased apart as a little wax had been used in manufacture to hold the pickup coil firm. In Picture 11 is shown the badly corroded armature and below it a good example.

I didn't actually do it but putting in new rubber calls for a search for something suitable. For the ends of the armature, rings can be cut from an appropriate sized Hellermann sleeve or possibly bicycle valve rubber. The top mounting is more difficult and needs something that feels spongy when lightly pressed between thumb and forefinger. Paul has thinned down, using a craft knife, AES chassis washers with good results.

When re-assembling you have to remember to put the armature in with the screw thread, for the needle, facing forwards.

**The "Automatic Brake" mechanism. Figure 2 and Pictures 12-14**
I'm told that this is courtesy of Columbia and was adopted by HMV as it was superior to their own. Their mechanism was not able to cope reliably with differences in 'run out' grooves of other makes of record.

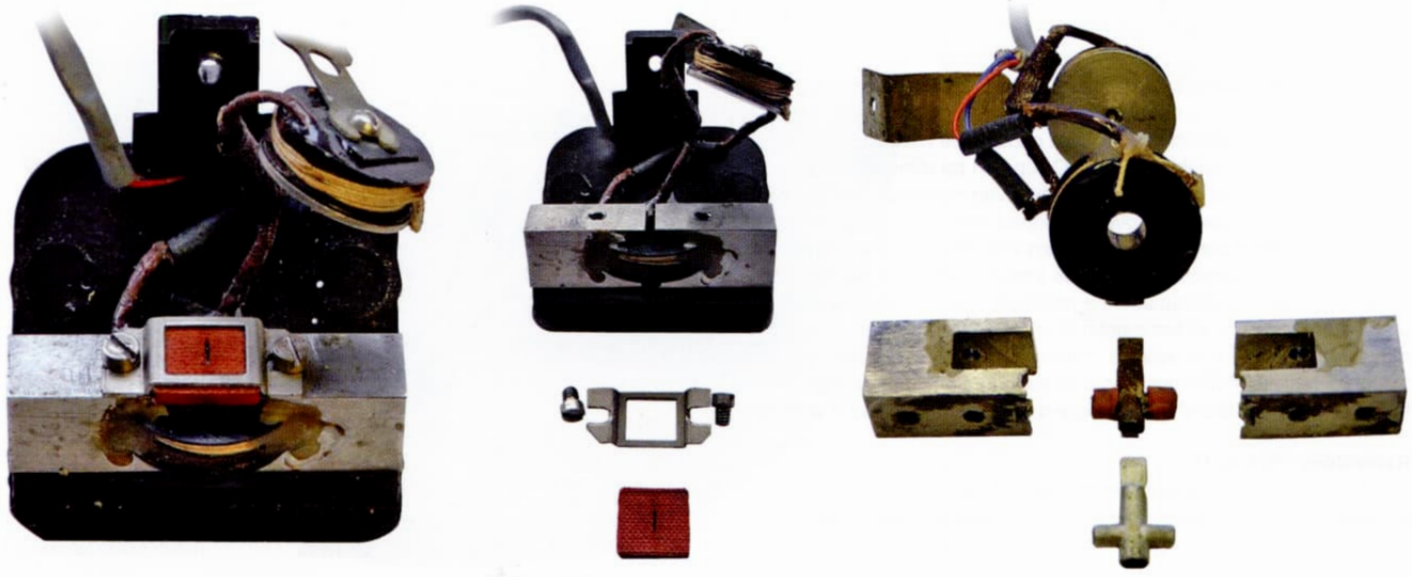
This is really very clever and works well after servicing. The pictures show the disassembled parts. Mine was rusty around the clutch that uses paper washers and as no oil could be used they absorb moisture if left anywhere damp. The bottom bearing surface is plated and had some rust pits. All I could do was to treat them and then fill with a little shellac. New washers were punched out from good quality thin card.

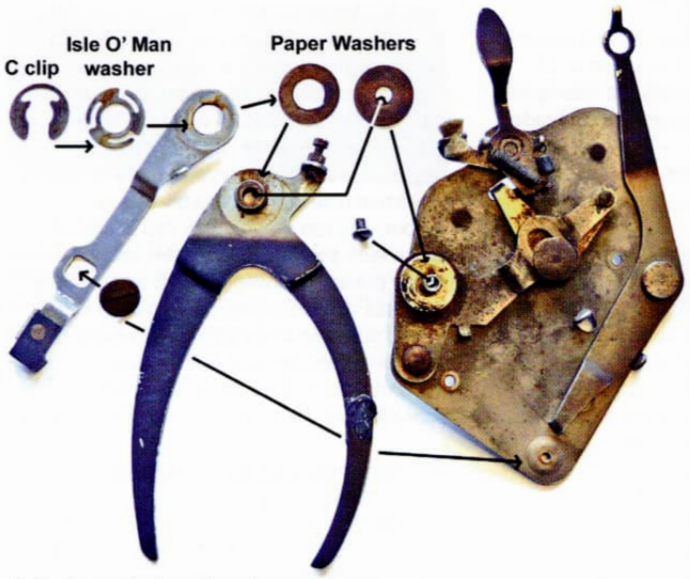
From the picture it works as follows:

**No "Automatic Brake" operation**
(lever in the OFF position)

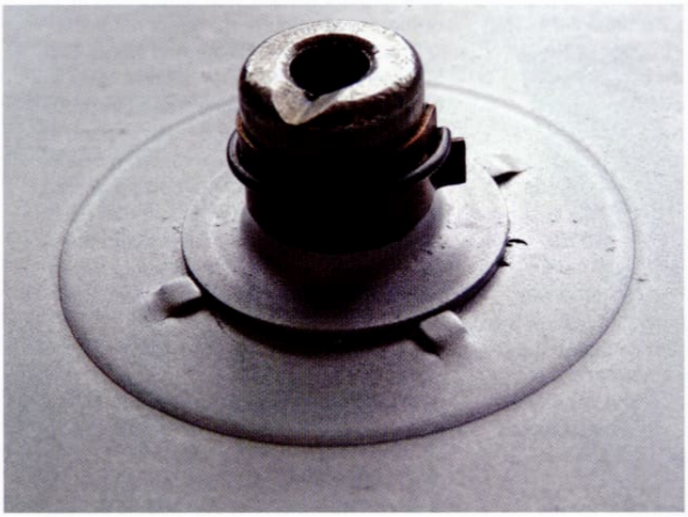
Assuming that the turntable motor switch is also in the OFF position, then at the end of the record lever L3 will be locked. When the pickup is drawn to the right, the pin on pickup lever L1, acting on lever L2, causes L4 (shown in the switched off position) and L5 to move to the right and operate the motor switch to the ON position. At the end of the record, when lever HB is pushed downwards by the user, this will reset L5 and L4 and switch the motor OFF.

9, 10, 11: Disassembled pickup






12: Brake mechanism stripped



14: Turntable cam

13: Brake mechanism finished

**"Automatic Brake" operation**
(lever in the position shown in the drawing)

When the pickup is drawn to the right the motor will start as before. The needle now traverses the record and the pin on pickup lever L1 engages with the left-hand arm of L2. This is loosely coupled to lever L3 by the clutch, comprising the paper washers and the Isle O' Man (IOM) tensioning washer (see Note: below). L3 moves to a position where the turntable cam, tooth D (see Picture 14), is bearing on surface A of the pawl CW, for each revolution of the turntable. This pushes the pawl out of the way and a quite audible tick can be heard. When the needle gets to the fast "run in" groove the rapid extra movement is sufficient to cause the pawl CW to move far enough towards the turntable spindle for tooth D to strike the face B. This causes L3, the clutch, L2 and L4/L5 to all move to the right such that L5 trips the switch and causes the motor to stop.

If switch off is unreliable then the C clip can be removed and more tension applied to the clutch by bending outwards the legs on the IOM washer. However, if over tensioned then, according to the Service Data, the quiet audible tick from CW pawl can become a hollow knocking sound, which maybe transmitted to the pickup.

I was advised not to replace the perished rubber sleeve, shown on L2 left-hand arm, as the mechanism works fine without it. It may have been there to assist in coping with warped records.

Note: The Isle O' Man washer is so called as it has three legs like the flag symbol of the Island's three legged running man called a Triskelion.

**Refinishing**. Picture 15
The turntable underside was treated for rust, masked off and sprayed with silver Smooth Right. The edge and all the operating arms and levers were sprayed with Halfords Ford Rio Brown that's a

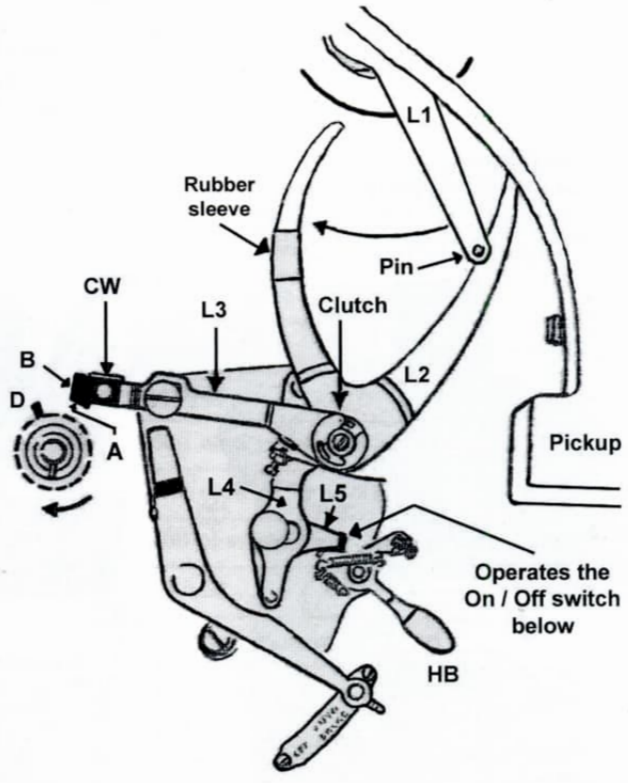



Fig 2: Brake mechanism from HMV service data

close match to the original paint colour.

**Removing the Model Number label**

These are made from celluloid and held in place with two tacks having flat heads. The tacks are very difficult to remove and if the label is levered from underneath it will split. The needed tool is an old pair of wire cutters ground completely flat on the reverse side that will allow the head of the tacks to be gripped and pulled out. In this instance one that was rusted broke off but I could easily move the label a little when refitting. HMV would have just hammered the tacks in but I opted to drill undersized holes first.

**Stripping and refinishing**

The finish on the cabinet was removed with cellulose thinners. The wounds were attended to, the plywood grain filled a couple of times and then the cabinet stained. This wasn't going to provide enough colour as the veneer was probably a cheap birch that was not very absorbent and of various shades.

I also had to deal with some stains to the top that looked a bit like Indian Ink: how did they penetrate the original lacquer? I did look into bleaching but the neutralising methods needed afterwards sounded questionable. I didn't want surprises after I had refinished the cabinet so it was safer to touch these in with paints.

First the cabinet needed spraying with a light coat of lacquer (Mohawk spray can) as the wood changes shade after this. I have tried car acrylic paints but you have to get it right first time so now I prefer oil based model paints. If it's wrong then a wipe over with White Spirit is all that's needed to start over. A few browns and some white achieve a mix close to the base colour. An artist's fan brush or a rub with a finger is useful to blur the paint edges when nearly dry. If lacquer is sprayed directly over the oil paint then a violent reaction will occur so it needs to be sealed with shellac first. There are two ways of doing this: either spray the shellac (Zinser Spray Shellac) or apply it with a small artist's brush. Neither is ideal as the Zinser has awful orange peel if sprayed. On balance application by brush may be best with a light rubbing down of the brush edges. Final 'flatting out' does take care of minor roughness at this stage. After the shellac I faked some grain using a very fine sepia-marking pen. Now it's time to find out if you have enough shellac cover by applying a lacquer coat. If done heavily then the answer will almost certainly be no. What's needed is a couple of mist coats with time left between and after them.

Progressing and now time to tone the cabinet darker. I could have used dye toner (dye suspended in lacquer) but I find it very difficult to get a uniform shading with spray cans and it would have been almost impossible with the complex shaped cabinet of this turntable. Also, I wanted to try a method told to me by an artist, Ben alias "Noisebox", on the Antique Radio Forum (USA).

*"Use artist grade pigment (Windsor and Newton or Rowney in the UK), which is basically a pure mineral-based pigment suspended in a minimal amount of cold pressed linseed oil. This differs from the "student grade" paints that have fillers and extenders as well as drying agents. Oil paints don't dry, they polymerise, which means they chemically react with the air and become a natural plastic; the short story. They have been around for more than 700 years so the science is far from new. I use mainly Burnt Umber (dark brown like walnut) and Burnt Sienna (more red like mahogany) but the colors can be mixed as needed.*

*First seal the wood with a coat or two of lacquer then squeeze a small amount of the pigment onto a soft cloth and rub it in, knowing that it's better to under tone because it can be darkened in the next layer. After getting the desired tone, "set" the pigment with a thin layer of spray lacquer. The solvent within the lacquer flows around the particles of pigment and essentially makes it part of the lacquer. The amount of linseed oil is negligible and is dispersed within the layer as well. From 30 plus years of experience I see no bad long-term effects from the oil. Linseed oil has also been used in furniture finishes for hundreds of years. The cold pressed oil does not darken.*

*Repeat the above until the level of tone you are looking for is achieved.*

*When tone is built up in thin even layers it increases the refractive index and frankly, has a stunning luminous effect. This is the essence of the Old Master oil painting technique as well".*

My first toning layer was a mix of two parts Burnt Umber with one part of Lemon Yellow and was close colour match first time. But it still needed to be darker so I repeated it for the second toning layer. I had been toning the sides at the same time as the top but decided to try to get this right first and match in the easier sides later.


15: Cabinet colour match

The problem was the top had quite large variations of colour plus the stains and other minor wounds. The toning method does give excellent control but needs experience: I found myself wiping on tone and then wiping off too much so that I wasn't getting anywhere fast. Eventually I started to make progress and was getting a uniform result.

Once I had decided that the top was satisfactory I did another two toning layers to the sides. Now I needed to apply a few coats of clear lacquer to give myself something to rub out. Obviously you can't rub out the toning layers as you would remove colour.

Before the final coats I added a new HMV transfer (decal in the USA), leaving plenty of time for all moisture to evaporate before spraying with just mist coats at first. After this some heavier coats were added and, after a couple of weeks, the cabinet was 'rubbed out' using wet abrasive paper and a final buff with #0000 wire wool and wax.

Picture 15 shows the result with a sample of the cabinet before, the area under the automatic brake, giving a fair example of the original colour.

**Equalisation and Bass Boost.** Figure 3 I'm sure that we all know that discs were cut with reduced low frequency amplitude and normally tailed off at the high frequency end as well. Reducing the low end made the excursions of the cutter and the pickup needle less and it made the 'bass' grooves smaller so that more recording could be put in the same space.

To quote from a copy of the highly respected Gramophone magazine (July 1931): "It is generally considered that the ideal pickup curve should show a rising characteristic at both ends of the scale from 250 cycles to at least 50 cycles in the bass and from 4500 cycles upwards in the treble to compensate for the falling response."

In 1938 EMI developed and detailed in Wireless World October 27th, a low-mass pickup, the "Hyper-Sensitive", made to have as flat a response as possible leaving the equalisation to be done electronically. I was amazed when I first examined this pickup, it's so tiny and elegant; it was years ahead of its time. But back to the Blunderbuss and other early types, where the tone arm had resonances, which boosted the bass and similar resonances in the armature and the needle did the same for the top end.

A later, 1937 article, from The Gramophone shows that the output for this pickup, on constant frequency discs (recorded with bands of constant frequency) does have a rising bass characteristic. There is about a 6dB rise from 500 c/s to 100 c/s and below. So almost certainly, with this economy turntable, HMV would have thought this adequate equalisation. However, it's a little more complicated than this and the article goes on to say that the use of constant frequency recordings is most likely misleading. Apparently two needles, from the same box, don't necessarily give the same result and even burrs where the needle is clamped alter the result. Further, their output is much higher than normal recordings and with these, the pickup would be attempting to find its way through complex waveforms; "harmonics and clang notes" to quote the article. The conclusion was that it was best to rely on the experienced ear.

Moving on, I decided to ignore the results of the constant frequency recordings and use my inexperienced and well worn ear to experiment with some low frequency electronic equalisation.

Looking at the Blumlein (see Note below) suggested response, from an Internet source, then the turnover frequency (where boost commences and is nominally +3 dB) is 250 Hz with a rise at 50 Hz of 12 dB. We can be pretty sure that Blumlein was giving figures suitable for the later Hyper-Sensitive Pickup, but it's a start.

A simple way to hear what different equalisations sound like is try the networks given in F. Langford Smith's Radio Designers Handbook and redrawn in Figure 3. At high and mid-band frequencies then the reactance of C1 will be low and the gain determined by the potential divider of R1 and R2. As the frequency falls then the impedance of the shunt branch increases and the signal passed through rises accordingly. So in use you turn up the volume to make up for the gain loss at mid-band and consequently have bass boost. The network shown for 6 dB/

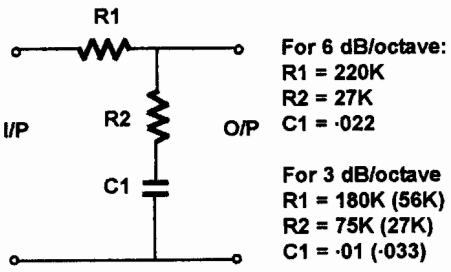



Fig 3: Bass boosing (Radio Designers Handbook)

octave boost has a mid-band loss of 20 dB, which is too much for most radios. The volume will be at or near maximum with a high hum level. I did build an operational amplifier circuit, without the gain loss but similar boost, but found myself turning down the bass control on many records. What does sound good and is more subtle is the Figure 3 network quoted as "partial compensation" (3 dB/octave) and having a mid-band loss of only 10 dB maybe acceptable for many radios. It could increase the hum level a little but this can be improved by using lower value resistors and a consequently larger capacitor.

Using lower value resistors can affect the high frequency response though. Remove the turntable, on this unit, and a plug can be inserted that connects a 7.5K Ohm resistor across the 100K normally there. For use with most EMI radios it's recommended that the plug be left out. Using it loads the pickup, reduces output and resonant peaks (the "alpine response" so called by the Gramophone) but also reduces the high frequencies. It would do this by electromagnetic damping, rather in the manner of shaking a moving coil meter from side to side, with a low value resistor across the movement.

Using the lower value resistors given I could hear no difference in the high frequency response of the radio I was using. It did reduce hum though, by the lower value termination on the 'gram socket. If the radio has an earth, in some manner, a hum loop can be set up as the gramophone has an earth fitted as standard. Breaking this loop may reduce hum further.

The network was built into a small die-cast box with Phono connectors that hide neatly behind the radio.

Note: Alan Dower Blumlein (29 June 1903 – 7 June 1942) who worked for EMI on sound recording, including inventing stereo, contributed advances to telecommunications, television and radar. He amassed 128 patents in his short life, tragically cut short by a wartime plane crash.

**Conclusions**

A small and insignificant item it may be but it was a long and interesting restoration. That understates it a lot actually as I got quite a thrill from it. It was different to just working on another radio and it was nostalgic to play 78's again after many years. They do have something; maybe it's just because they are as original as it gets with no electronic tinkering, grandly called re-mastering, to other media. Also, certainly for this single player, there is an involvement of putting the records on. So easy with CD's to play one and then 'drift off' such that they become background music. With the 78's you know you'll be getting out of the chair in a few minutes so you might as well really listen. On good condition discs (and I was lucky enough to buy and be given several) surface noise is not that obtrusive.

So depending upon what radio you connect it to it sounds surprisingly good. The fact that you can hear surface noise, particularly on worn discs, directly from the needle is in favour of Model 119 where the lid can be closed. However, I think this model is much more pleasing to look at.

Is it worth adding the bass equalisation circuit? Connected to most economy 30's radios the answer has to be no. But connected to something of good quality, with excellent bass response and a large speaker (I was using a recently restored HMV 650), then it does make a worthwhile improvement in my opinion. A non-old radio friend but a jazz enthusiast, who gave me many records said, "I have never heard 78's sound better". Well he might revise that if he heard them played on an HMV 801 radiogram for example, but it was still a much appreciated compliment.

Of course connecting such a working class device, to a top of the range radio, is a cheat and just for personal amusement. In the late 30's anyone who could afford such a radio would have certainly retired to the lounge, poured a large brandy, and switched on his equally impressive and expensive radiogram.

The artist's toning method has really impressed me, used as an addition to stain, and doubt I shall use toner spray cans again except of the obliteration type used for feet and some trim.

Sadly, Paul Barneveld pased away without seeing the finished article

# Brief Encounters with the EBL31

by R.J.Grant


Under the bench in my Dads shed lurked a large bakelite Ekco radio, an A21. It had been there for some time and as it didn't work no attention was paid to it. It had a valve missing.
It was late 1962 and as a schoolboy I had just finished building a two valve short wave set, a project in Practical Wireless, The Atlantic Short Wave Two. This lively little set using one 6AM6 and one 6BA7 B7G valves, whetted an interest in short waves. I vaguely remembered that this old Ekco under the bench had a short wave band so it was dragged out for a closer look, perhaps with my recently increased knowledge of things radio I might be able to get it going. The missing valve was the output valve, an EBL31. A good rummage through my then meagre box of valves produced no results as expected; it was definitely worth a look as this box of valves was always being added to by friends and relatives passing on all their unwanted radio junk and I never missed an opportunity to scrounge an old wireless from anyone who might have one going spare.

A look through the adverts in Practical Wireless had several firms offering EBL31's for around 23/6d (£1.17p), this was over a month's pocket money and I wouldn't be spending that much on one valve. (Most of my radio projects were built using salvaged parts, a trend that was continued for many years), trust my luck to need the most expensive valve in the book and there were no equivalents. Approaching dad wasn't an option as radios of this age were being thrown away all the time, just a case of waiting for the right valve to turn up, that's why the set was shoved under the bench in the first place.

I was determined to get this interesting set going, not only did it have a short wave band but also a "magic eye" tuning indicator, a large speaker and a tone control, great things were expected of it.

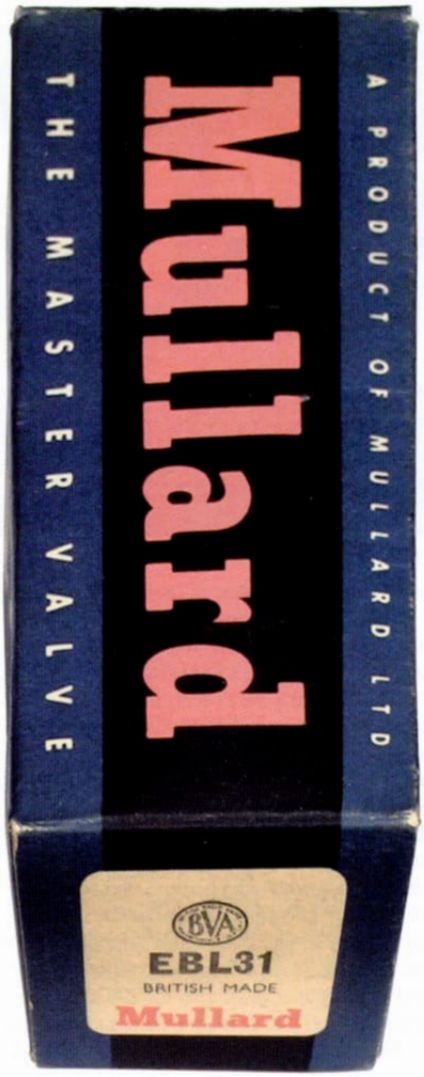
One of my school friends, Barry, also interested in radio, said they had a radio in their shed and he thought this had an EBL31 but he wasn't sure so after school we went for a look.
This set was a smaller bakelite set with a smashed cabinet, possibly an Invicta Model 10, in fact most of the top of the set was missing. Without needing to remove the back of the set I could see the now elusive EBL31, up till now I had no idea what one looked like. Just when I thought I had fulfilled my quest, Barry told me that his dad still used this set even though the cabinet was smashed and he (Barry) was forbidden to touch it, but at least I now knew what an EBL31 looked like.

The back entrance to my school was a narrow footpath between two houses, the rear garden fence on one side was the chain link type, up against which was a greenhouse, in this greenhouse there was a table covered in all kinds of junk, among this was a small tea tray with four valves on it, one being the now instantly recognisable EBL31 with its metalised red skirt around the bottom of the bulb and the top cap. I had seen these valves every day on my way to school for months with only passing interest, they were just old radio valves, but now they were important. It took several days to pluck up enough courage to knock on the door and ask if these valves were up for grabs and when I did I got short shrift as this chap, living next to a school, hated school kids and wouldn't give you the time of day. The A21 was put back under the bench and the waiting continued.

Time passed and on leaving school I trained as a Radio and TV service engineer and worked for a small family business with three shops. One of these shops, in Victorian times had been a dairy with stables at the rear. This area was now piled high with obsolete radios and TV's of the late forties and early fifties and I spent many a warm summer's afternoon hunting through these what seemed like hundreds of radios and televisions for anything interesting including of course an EBL31, with no luck at all. Lots of these sets were of the same period as the A21 but didn't have the same features and getting it going was becoming an obsession.

Occasionally old valve radios were brought into the shop for repair and I remember an occasion when an EBL31 was required to effect a repair, but by now valves of this vintage were no longer stocked by the usual suppliers and only available from specialists. I was half hoping we may order one, and I might borrow it and if this A21 worked, I might even purchase one myself now that I was earning a modest wage, but the customer instantly rejected the estimate for this repair when presented with the now even higher cost of this valve.

More time passed and through the 1960's I had gained an interest in wireless history with a small but increasing collection of vintage radios and parts, many radios and boxes of junk passed though my hands and still no EBL31. By now the requirement for one was fading as I considered the A21 being a post war radio and only around twenty years old; a bit young for my collection



Ekco A21

Ekco A22


EBL31 in the A21


EBL31 in the A22

which mainly consisted of pre-war radios.

A couple of decades whizzed by and the A21 and its output valve were long forgotten until in the late 1990's I obtained an Ekco A22. This was a major restoration project as the chassis was very rusty and the wiring loom rubber fell away as dust. While dismantling this set I noticed one or two repair bodge-ups, one being a couple of OA91 germanium diodes dangling in space around the base of the 6AG6 output valve. Reaching for the Trader sheet to see what was going on I discovered that this set should have the dreaded EBL31 and the 6AG6 had been fitted in its place with the germanium diodes providing the detector and AVC rectifier, lacking in the 6AG6. Not surprised that someone else had had problems obtaining an EBL31 I continued with the restoration, a little dismayed that an old problem had returned.

The chassis required the rust removing, priming and re-spraying. The perished disintegrating rubber wiring loom needed replacing so the set was completely stripped out and rebuilt, I returned the output valve wiring back to original from the circuit diagram and photographs in the Trader sheet and I found myself once again waiting for an EBL31. In order to complete the restoration of this set I robbed an EBL31 from another set in my collection but this still left a hole.

I had by now been collecting radios and gathering spares parts for many years, so a re-visit to some of my accumulated stock was the first place to look. There was a large pile of boxes full of valves and other spares dumped in the shed and only partially sorted before being stored in the loft. These were purchased from my local antique dealer, who would occasionally turn up in his Volvo estate car full to the gunwales with radio junk he had obtained from house clearances, ninety percent of which I would take down the local tip the next day. The ten percent that was left was a real treasure trove of valves, knobs and other spares and the occasional restorable vintage radio. He only ever wanted a tenner for the whole car load so the sorting and dumping exercise was well worth while. (He would leave with a big grin on his face as he'd pulled a stroke and found someone to buy the junk he was going to take to the skip anyway, not only was I hooked on this junk, I was open all hours).

Practical Wireless Valve price list

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DL93 | (P) | 1.4* | 0.21 | 150 | 90 | −8.4 | 13.3 | 2.2 | 100, 000 | 1.9 | — | 8,000 | 0.7 | 6 | B7G | 7 |
| Pen4DD(P, DD) | | 4.0 | 2.25 | 250 | 250 | −6.0 | 36.0 | 5.0 | 50, 000 | 9.5 | 146 | 7,000 | 4.3 | 10 | B7 | 22 |
| PenA4 | (P) | 4.0* | 1.95 | 250 | 250 | −5.8 | 36.0 | 5.0 | 50, 000 | 9.5 | 145 | 8,000 | 3.8 | 10 | B7 | 24 |
| EBL21 | (P, DD) | 6.3 | 0.8 | 250 | 275 | −6.2 | 44.0 | 5.8 | 50, 000 | 9.5 | 125 | 5,700 | 5.5 | 10 | B8B | 6 |
| EBL31 | (P, DD) | 6.3 | 1.2 | 250 | 250 | −6.0 | 36.0 | 5.0 | 55, 000 | 9.5 | 146 | 7,000 | 4.3 | 10 | IO | 15 |
| EL32 | (P) | 6.3 | 0.2 | 250 | 250 | −18.0 | 32.0 | 5.0 | 70, 000 | 2.8 | 485 | 8,000 | 3.6 | 10 | IO | 9 |
| EL33 | (P) | 6.3 | 0.9 | 250 | 250 | −6.0 | 36.0 | 4.0 | 50, 000 | 9.0 | 150 | 7,000 | 4.0 | 10 | IO | 36 |
| | (T) | 6.3 | 0.9 | 250 | — | −8.5 | 20.0 | — | 3, 000 | 6.5 | 425 | 7,000 | 1.1 | 5 | | |
| EL71 | (P) | 6.3 | 0.45 | 110 | 110 | −8.3 | 30.0 | 2.0 | 15, 000 | 4.2 | 270 | 3,000 | 1.0 | 10 | B8D1 | 14 |

Line of characteristics from the valve data book.

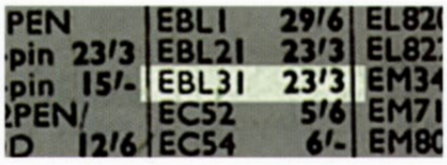
I sorted through and stored this latest acquisition and my efforts were not fruitless as I found, much to my surprise, a total of three EBL31's, all in varying states of decay, the best looking one had an open circuit heater, the middle one had about fifty percent emission and the third, the scruffiest, had heat stains on the side, most of the metalising missing and about 75% emission on the valve tester.

This one I fitted in the vacant hole. It worked ok to start with but after about half an hour it would gradually get quite hot and the output slightly distorted, the control grid would hover around zero volts almost going positive despite the new coupling capacitor and checking that the cathode bias components were correct and still the specified values. The original valve from this set now fitted in the A22 behaved in a similar way but was cosmetically better looking and lasted a bit longer before getting too hot. The middle one of these three valves was tried and was too low volume to be of any use. So I had one partially working. It was ok for half an hour or so and ok for the occasional demonstration.

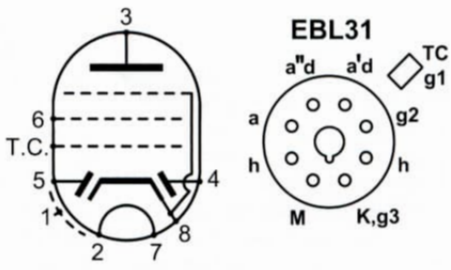
Since then I have purchased three more EBL31's from various sources, one was brand new in its box but when tried was found to be down to air (vacuum gone), the other two were in reasonably good condition and worked fine but both have a tendency to run a bit warm with slight distortion after a couple of hours use and just for good measure, the occasional flash-over, perhaps this may be a design fault and a reason why these valves are relatively rare. There are now a total of three other sets in my collection using an EBL31 and the valves were rotated so that the one fully serviceable valve from one of these sets ended up in the Ekco A22. It's sister valve the CBL31 with a 44 volt heater for the AC/DC sets appears to be less scarce, I seem to come across these all the time but I've never needed one, perhaps the AC/DC sets died of other ailments or just caught fire due to an over heating mains dropper leaving lots of unused spare output valves.

The EBL31 was one of the "Red" series of metallised valves first introduced in 1938, although in my experience I've never seen one in a pre-war set, I've only found them in sets made just after WW2 until the late forties when they were superseded by the Loctal EBL21 and the B8B series of miniature valves so the production run was relatively short, another possible reason for their rarity. All the data and equivalents books I have show them solely manufactured by Mullard with no equivalents. While hunting down one of these valves I did consider fitting an octal base to the side contact type EBL1 as it's the same valve with a Ct8 base but I found these just as rare and in a similar condition.

I never did get the A21 going, I seemed to have lost track of it, probably around the time in my late teenage years when my interest turned to motorbikes, and the shed was cleared out to make room. I vaguely remember removing its mains transformer to fix something else and it wasn't there when I left home and took my then relatively small radio collection with me. The Photographs of the A21 in this article are of one recently acquired at Harpenden in a Rupert style horse-trade. When I saw it there the memories of my youth came flooding back and I couldn't leave it there, so nearly fifty years later I got to play with an Ekco A21 and it well lived up to its expectations including an output valve that runs hot!




Price of EBL31




EBL31
Double Diode output valve and base connections

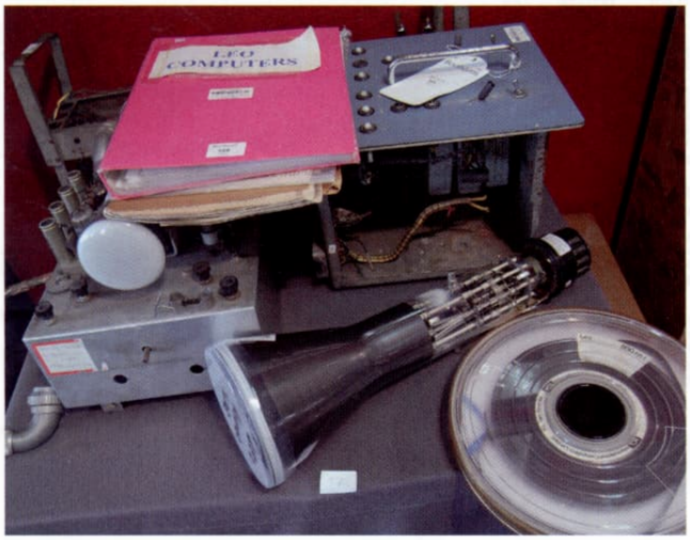
# SALE OF THE TV CENTURY?

A photo report by DICKY HOWETT of the Bonhams 'Michael Bennett-Levy Early Technology Sale' 30th Sept 2009.

Trundling down to friendly Bonhams in Knightsbridge to view (but not to buy) the Michael Bennett–Levy sale of tv-related items (and other audio and optical items) proved a fascinating experience. According to the sales brochure (£20) the Bennett-Levy's are decamping to France and so 'everything had to go'. The 'everything' amounted to everything from a '30k volt induction coil' to a Pye Mk3 tv camera channel circa 1956 (incorrectly referred to in the catalogue as an 'orthicon') Never mind, we can't all be experts.

A Plessey-built Baird Televisor. Sold for £18,000

Clunky projection tv. Several on offer. Hardly any sold




LEO11/3. Lyons Electronic Office. 1958. £8,400


Above: Part of the Donald Hunter Munroe Television Archive. Early BBC tv at Alexandra Palace documented by Studio Manager D H Munroe. Sold as one lot. Asking price at least £30,000

On pre-sale display were many examples of rare (the adjective 'rare' appeared a lot) pre-war television receivers. All pre-war items sold subsequently at the asking and in some cases twice the asking price. The Plessey-built 1930 Baird Televisor listed at £9,000 achieved a 'hammer' price of £18,000 and a similar-design window display model listed at £2,000 made just over £5,000.

In 1934 DIY Daily Express readers could purchase a Televisor kit for £6. The same kit at the Bonhams sale realised a selling price, slightly more expensive at £1,800. Novelty items under the hammer included a Green Ray 'Have Your Mind Read By Television' machine. This fairground attraction from the 1930s pre-supposed that televiewers had minds to read. For the insertion of a whole penny the end results were dished out, your tele-fortune printed on cards to keep and savour. The Green Ray sale asking price was £1,000 but it beamed in at £6,000. Yes, as we have always suspected, there's money to be earned from tv.

Of military interest was the very, very rare 'Block 3' 'aeroplane missile guiding television monitoring system' made by RCA. This iconoscope camera assemblage was installed in B17 bombers at the end of WW2. Two bombers were used. One had the camera and was filled with explosives, (the pilot bailed out after take off) and the other B17 acted as the guider. Unfortunately several of the 'guider' craft blew up when the system was switched on (high voltage sparking) killing, on one occasion, Joe Kennedy, elder brother of the President. The sale item Block 3 was obviously never used having a date of 1945. Asking price was £50/70,000 but the hammer came down at £36,000. Some bidders of other items had clearly lost their heads. A Bush TV22 listed at £300 raised £1,600! Whereas a Bush TV12 listed at £200 made £60. I have it on good authority that an individual bid for and won several Band One aerials. Pristine, 'never used' examples. Chocolate tea pots perhaps but the purchaser acquired roof top telly icons that now are all but vanished from the skyline. A collectable of the future? Who knows? Time to ask the Green Ray...

PS. The Pye Mk 3 camera channel failed to sell at an asking price of £4,000. Note: All prices quoted are the 'hammer' price and do not include VAT or any other commissions attached.

The Block 3 RCA tele- bomber kit

The GREEN RAY machine. Margaret has a go

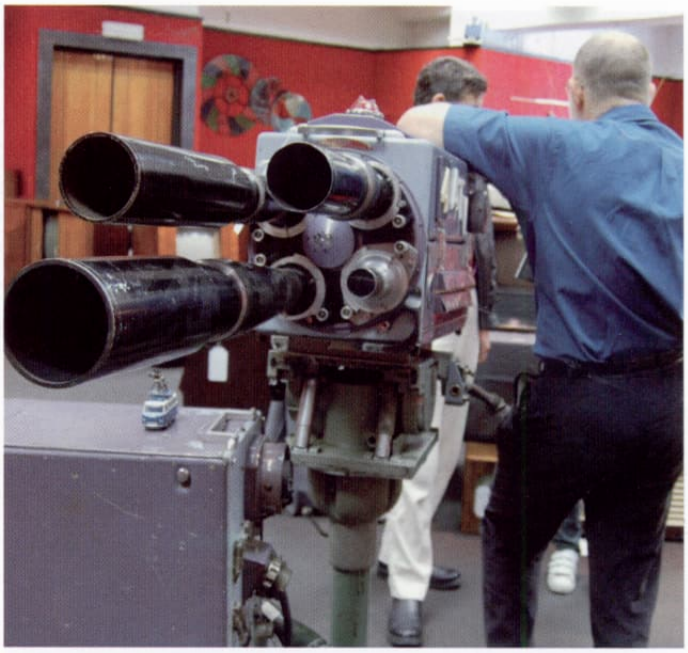
You just can't leave it be! The insides out.

Keracolour Sphere 1968. £240

JVC VIDEOSPHERE. 1966. Sold for £600


The Pye Mk3 Camera Channel. Unrealistically priced at £4,000. Repro 'ATV' badging

Swedish AGAPHONE wire recorder. A snip at £24



Michael Bennett-Levy with Pye Mk 3


Thomson early CRT 1910. £60

Trade Mark Gramophone Co player. 1899. £3,840


Daily Express Televisor Kit 1934

Rare Weiler mirror drum 1932. £1,500


Philips Laser Disk Player VLP 600. Discs thrown in. £24


Above, right: Baird mirror lid with radio, record player and drinks cabinet. Tv in the 1930s had the rich in mind. Same today. Sale hammer price £18,000

# Transistor History at Philips/Mullard

by Arnaud Cramwinckel, translated by Mark P D Burgess

Fig 1 Joost van der Spek, the first director of Philips Nijmegen

Fig 2 Jan van Vessem, head of development

Fig 3 Head office Philips Nijmegen

**The Invention of the Transistor**

Long before the discovery of the transistor, radio amateurs were familiar with semiconductors through the use of crystal detectors in their receivers.

In December 1947 Bell Telephone Laboratories United States researchers J Bardeen and W H Brattain discovered that a third electrode on a crystal of germanium semiconductor could influence the current between its two other electrodes. This discovery led to a revolution in electronics. Then W Shockley developed the theory and described the principles for the junction transistor (1948/49).

**The development at Philips**

These developments led the Philips Research Laboratories at Eindhoven into semiconductor research in germanium and silicon. In 1949 the Research Lab succeeded in making their first point contact transistor. At the end of 1951 the head of the Electron Tubes product group set up a separate section for the development and production of semiconductors. Production started in a new semiconductor factory in Eindhoven. The group was led by Dr J J van der Spek. In September 1952 Dr J C van Vessem, head of semiconductors development, reported that the production of diodes in that year would be about one million units.

In April 1952 Bell Labs organized a transistor technology symposium in order to share its know-how with others. Philips took part in this paying a fixed fee of $25,000 in return for a licence. During this symposium transistor industrial production processes were demonstrated. The insights gained and the documentation provided by Bell in "Ma Bell's Cook Book", introduced Philips and many other companies into the semiconductor industry.

**Philips at Nijmegen and Lent**

On 25 June 1953 the Philips Board agreed to build a large semiconductors factory in Nijmegen. The plant would include a development laboratory. Dr J J van der Spek (Fig 1) was the first director and Dr J C van Vessem (Fig 2) the head of development.

The choice of Nijmegen was influenced by the local availability of highly qualified staff and lack of such personnel and premises in Eindhoven. Production at Nijmegen began on October 26, 1953 initially in a former bank building in the centre of the city. The construction of the new factory was started and with the active cooperation of the Nijmegen municipality was ready in August 1954. The official opening took place on July 12, 1955. Philips now had a modern well-equipped factory for transistors, the largest in Europe (Fig 3). In less than 5 years the plant had over one thousand employees.

Strong demand exceeded the production capacity of germanium and silicon raw material for diodes and transistors at Nijmegen. In Lent, near Nijmegen, Thermion was put up for sale in 1956. This company made electrical appliances. In 1957, Philips took over the company and its 170 employees and used it to produce germanium and silicon raw materials as they were known. But economic recession and cutbacks saw the raw material production revert to Philips at Nijmegen. The Lent factory closed in 1984.

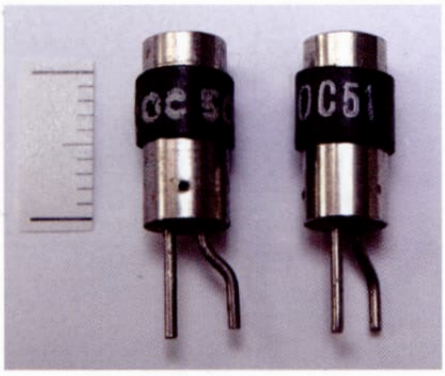



Fig 4 The first commercial Philips Point Contact Transistor OC50/51 c. 1953

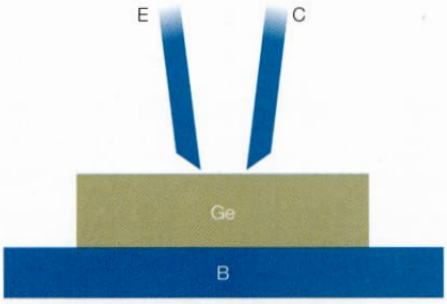



Fig 5 Point Contact Transistor. Ge Germanium Crystal. E emitter. C collector. B base. Thin wires of phosphor bronze or tungsten form contacts with the germanium. A current pulse melted and re-crystallized the germanium, forming the p-n junction.

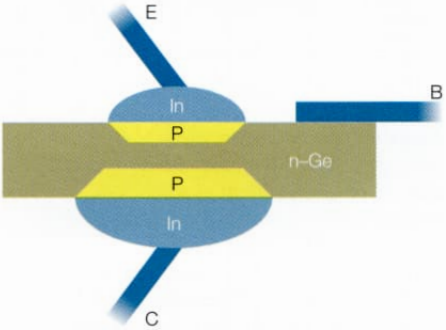
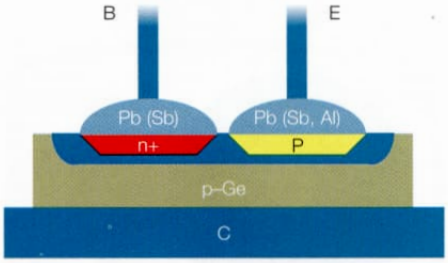



Fig 7 Germanium junction transistor made by alloying. Each p-n junction was made from melting a dot of indium on the germanium which gave p-type on cooling and recrystallising. The problem with this pnp junction transistor was poor control of the distance between the two p-regions (base thickness).



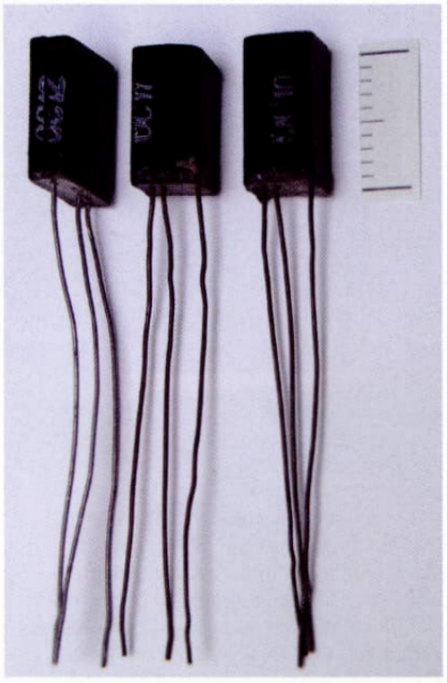



Fig 6 The first commercial Philips Ge junction transistors OC10/11/12. The housing is plastic. c. 1953-54

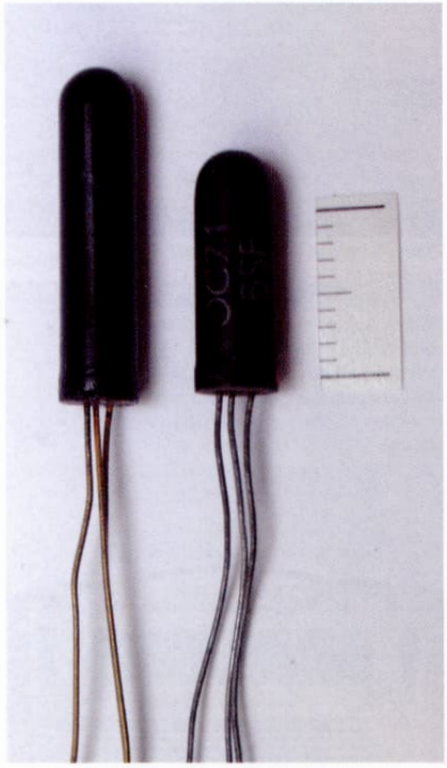


Fig 8 Germanium Junction Transistor. Types of OC70, OC72 in glass encapsulation. Later, c. 1954, the OC72 had metal encapsulation.

Left: Fig 9 "Pushed out Base" or POB transistor. Two lead balls containing a little antimony heated at 780C on a wafer of p-type germanium. At this temperature the antimony diffuses into the germanium creating an n-type layer, which serves as the base. Because one of the balls also contains aluminium, a p-type layer recrystallises under the ball on cooling forming the emitter. The wafer, which acts as the collector contact, serves as a heat sink.

**Development of Production Techniques**

When in 1953, the first transistors came on the market, their high frequency performance and ratings fell far short of vacuum tubes. Moreover, they were very expensive. The early methods for making p-n junctions were non-reproducible. See fig 4 and 5 for the methods of forming point contact transistor junctions.

The junction transistor or alloy transistor brought an improvement (fig 6,7 and 8). The p-n junctions were made by alloying but poor reproducibility remained.

Production was very labour intensive. Hundreds of girls in long rows assembled germanium crystals on jigs using tweezers under magnifying glasses or connected fine wires to the transistor's indium dots.

Replacing alloying by diffusion gave a major improvement. Initially Philips Research used a combination approach in what led to the pushed out base (POB) transistor or alloy diffused transistor (fig 9 and 10). The technology was developed by J R A Beale (Mullard/Philips Research UK) in 1957 and P J W Jochems (Philips Research Eindhoven) in 1958. This made it finally possible to produce high-frequency transistors (above 100 MHz).

Diffusion from the gas phase became more important. Etching made the collector-base junction the correct size. This constituted a kind of table structure leading to the "mesa" transistor.

**Planar technology**

An important step in quality control and improved commercial outlook was the introduction of planar technology. Because Philips had so much success with the development and production of germanium transistors they were slow to recognize the advantages of silicon technology. As a result Philips entered the silicon planar era behind its competitors, unlike the germanium era.

**Organisational Structure**

Philips organisational structure gave national country organizations (NO's) significant autonomy. Besides the central Semiconductors Product Division in Eindhoven there were also PDs in other key countries. For example, Philips had PDs operating in Germany (Valvo), in France (RTC), in England (Mullard) and in the USA (Amperex). By 1957 there was production and research in The Netherlands, England and France and research groups were active in Germany, Belgium and Switzerland. Thus while it could be responsive to local needs it also often led to duplication, ultimately not in the best interests of the company.

**Transistor Type Numbering**

The use of OA for diodes and OC for transistors is closely related to the European system for type numbering vacuum tubes. The first letter indicates the filament power supply and the following letter the structure. A transistor does not have a filament so the first number is zero. In practise this has become the letter "O." The second letter is also taken from tube typing. The letter "A" indicates a diode and the letter "C" a triode. This follows because the transistor is comparable to a triode given the number of electrodes. In Europe Siemens followed Philips in typing this way. For example, the OC71 transistor is

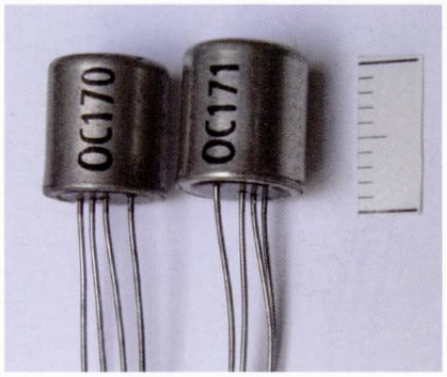



Fig 10. Germanium "pushed out base transistor. Types OC170, OC171. Suitable for high frequencies. c. 1958

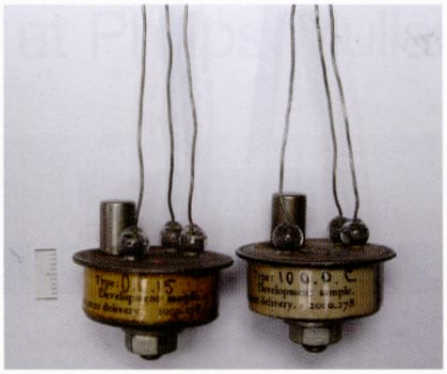


Fig 11. Germanium high power transistor. Prototypes OC15, 100 OC c. 1955

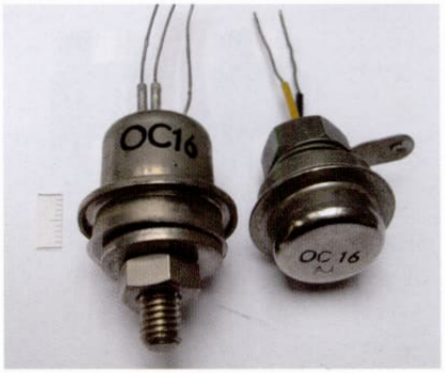



Fig 12. Germanium high power transistor type OC16. The first commercial power transistor in Europe. c. 1956

a low-power type with serial number 71.

Later the increase in semiconductor types required a more elaborate system, which was introduced around 1960. The Pro Electron code consists of two or three letters followed by 2 or more numbers. The first letter is A for germanium and B for silicon. The second letter is an A for a diode, C for a small signal LF transistor, D for an audio frequency power transistor, F for a small signal RF transistor, S for a switching transistor, Y for a power diode and Z for a zener diode. The third letter, Y or Z, indicates industrial applications. For example, AD149 is a germanium power transistor; BC107 is a small signal audio silicon transistor.

**Quality after 50 years.**

It is interesting to assess the quality after about 50 years in storage. We found some old batches of unused transistors still in their original packaging. They were measured with the PM6501 Philips transistor tester for short-circuit and current amplification.

Of 42 alloy junction types (26xOC45, 6xOC72, 11xOC74) all appear to be in a working condition. Of 74 alloy diffused high frequency OC169 transistors 33 (44%) were working, 27 (36%) had a short-circuit and 14 (19%) were open-circuit.

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Collection "Philips Historical Products" www.philipsmuseumeindhoven.nl

More about Transistor History on the website of Mark P D Burgess: http://sites.google.com/site/transistorhistory/Home


Fig. 13. Germanium high power transistor type OC36. In the standard TO-3 case. c. 1959


Fig 15. AG9104 Gramophone 1955. First battery turntable with a transistor amplifier.

Fig 17. The first Philips portable transistor radio. Type L3X71T, 1957


Fig 14. Philips first transistor hearing aid. Type KL5400, c. 1954

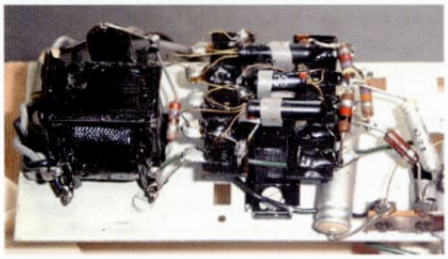


Fig 16. The amplifier in the AG9104 gramophone with 1xOC71, 2xOC72 transistors

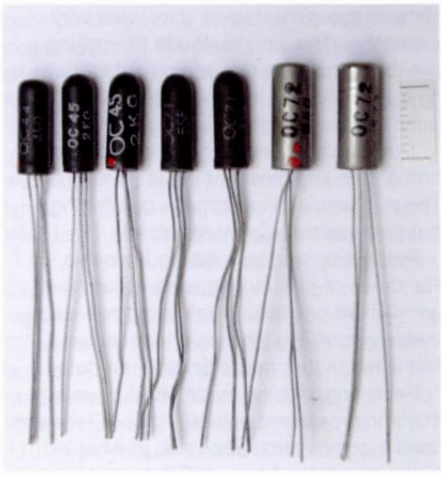
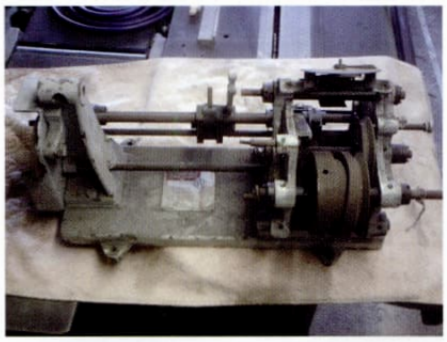



Fig 18. Transistor line up for the L3X71T radio: 1xOC44 2xOC45 2xOC71 2xOC72

# AVO Wave winder restoration

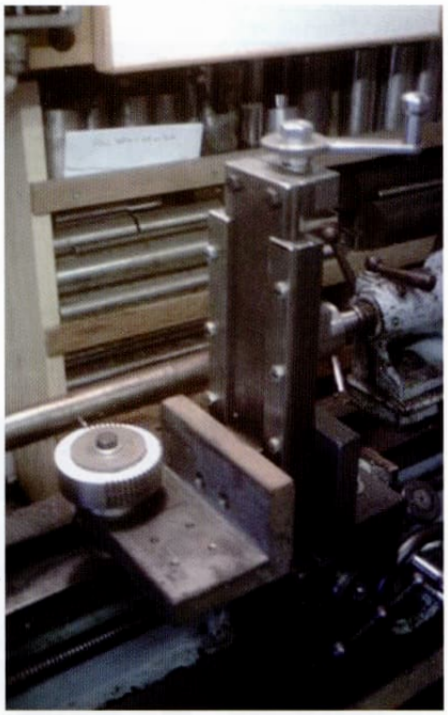
By Colin Wood.

With an asking price of £200 for this AVO Douglas Progressive Wave Winder in April 2009 I thought it appeared to be a lump of expensive scrap iron. It was seized solid with rust; had parts missing or broken and didn't have a single change gear wheel. I politely walked away. As the morning passed this winder remained on my mind and kept niggling at me as it would make a very interesting project. After dinner I phoned with an offer of £150 which was accepted and I collected the machine.



Expensive scrap

Paint stripping



Vertical slide

Fully dismantled

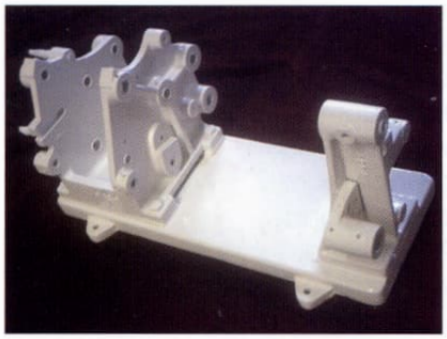
Free at last!

Given the dreadful condition a full restoration was the only option. The first problem was how to free the seized shafts as they would not turn and ran in plain bearings machined directly into the cast iron frame. The cast iron frame would easily break if too much force was applied and to grip the shafts using a pipe wrench would damage the shafts. The bearings were then soaked in a mixture of WD40/ Oil for a few days but made no difference whatsoever; the lot was seized solid. This was a bad start and the shafts could not be drawn out using a puller either. With a pair of heavy rigger gloves to protect my hands a blowlamp was used to apply heat; this was done very gently as heating in one spot could also fracture the frame so care was taken to apply heat all around the bearing. With many heating/cooling sessions all the shafts but one gave in and were removed; this work took another week. The last shaft refused point blank to be released; this was the main shaft which drives the bobbin. A new gas canister was fitted to the blow lamp and a great deal of heat was applied to both bearings but the shaft still refused to move. At this point I made up a special lever with a reamed hole and this was clamped very tightly to the shaft; again heat was applied and with a great deal of pressure applied to the lever the shaft finally moved; what a relief this was. All the shafts were then spun in the lathe and using fine abrasive paper they were polished. Abrasive paper was wrapped around a rod and each bearing was also cleaned allowing the shafts to rotate freely.

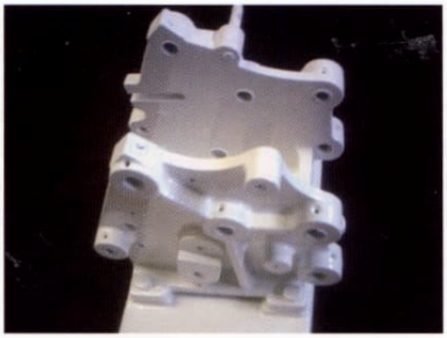
By using heat the paintwork looked terrible so the lot was removed using paint stripper; removing the paint was an unpleasant job and took ages to accomplish due to the shape of the castings. In order to make a decent job of the repaint the winder was totally dismantled and washed off. A litre of special one pack etching primer was purchased and whilst at the paint suppliers I enquired if it was possible to use a HVLP (high volume low pressure) spray gun with a standard compressor. £50 lighter I had a new spray gun but decided against purchasing the large bore hose for another £30. I have three other spray guns all high pressure types which put the paint everywhere with most going into overspray or as a cloud into the atmosphere wasting a great deal of expensive paint. The new gun was soon attached to the compressor and what a joy it was to put paint onto the winder with very little waste; it was a revelation and I should have bought it years ago; it worked fine with the standard hose. I had some undercoat and gloss left over from a previous job and used these to finish the paint job; the winder was now looking absolutely superb; the paint had gone on without problem and the cream white made a tremendous difference to the look of the winder. Assembly was slow as each component was checked and cleaned before fitting. A new wire guide arm was made because the original was broken; this small job alone took two days to complete.

At last the winder was sitting on the bench and could be turned by grasping the large drive drum by hand; a new winding handle still needed to be made. I was well pleased at this result but what now followed was the really hard part.

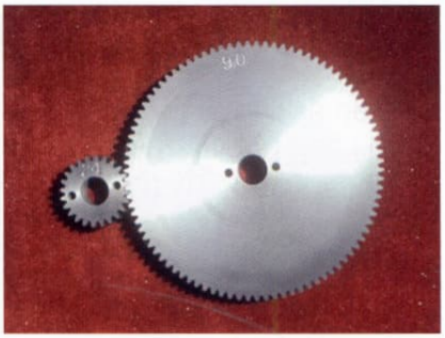
The winder obviously required change wheels but gaining information about these wheels proved nigh on impossible at first. I contacted the BVWS and got as far as being asked to be specific as to my needs; I asked for a gearwheel to be measured giving the maximum diameter and what the number of teeth were also the width of the gear and if possible a picture would be a great help as to the design of the



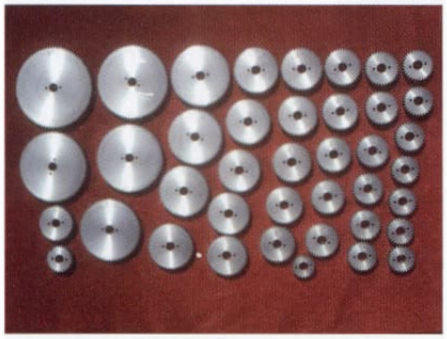
Nice paint job



Top coated

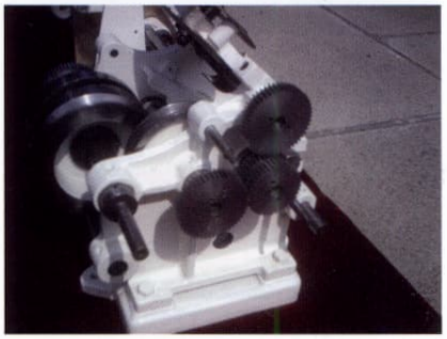


Little and large

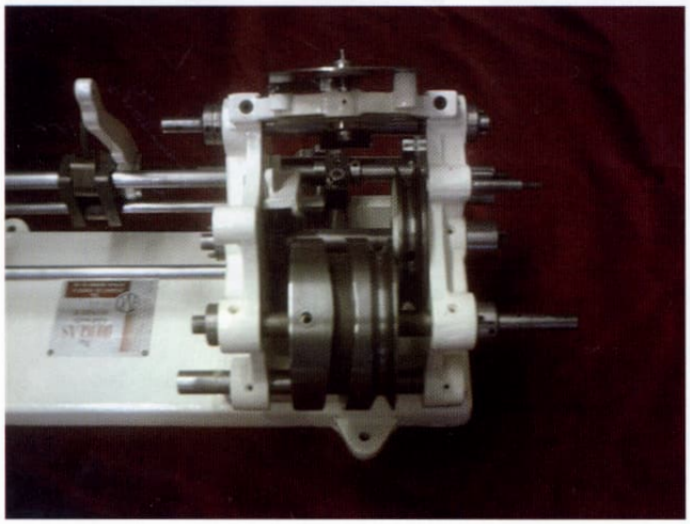


New gears

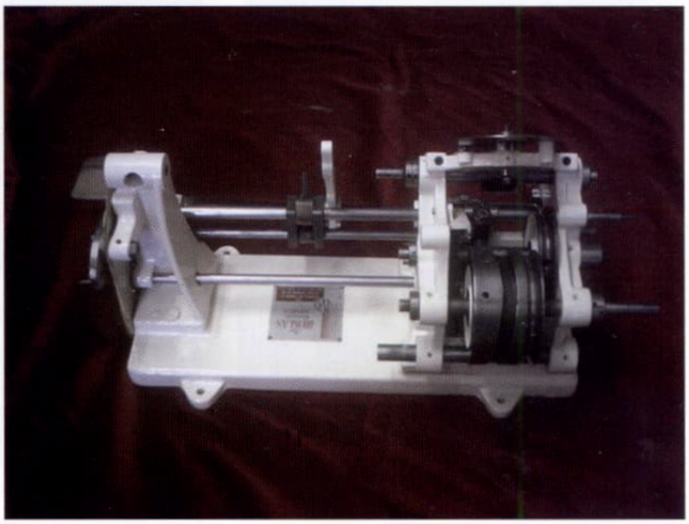
Wow!



Compound gears



Looks good



Rear view

gear; I waited well over a week for a reply which never arrived so joined a radio forum to ask for assistance. What a wonderful group of people these are on the forum. Within a couple of days I had received lots of help and information; Harold very kindly sent me a full workshop manual free of charge; others suggested very useful websites and John in particular didn't only go the extra yard: he did the marathon for me by taking pictures of gears fitted to his own identical wave winder and supplying dimensions of six of the gear wheels. This winder was originally supplied with a set of 45 gear wheels. These are; nineteen Wave Compound Gears; eight Wave Form Gears and eighteen Traverse gears. This was going to be a huge headache for me as I had never cut a gear before.

The plan was to make the new gears using my very rare Myford MF36 lathe. I had sold my large Colchester Triumph lathe at the start of the year and bought this Myford to save space. The Myford was advertised as in good condition but in reality it was badly abused and at 67 years old was worn out. I surfed the Internet and studied how others cut gears but all had proper vertical slides and expensive dividing heads; one site showed how to use a spare gear with the same number of teeth required as a direct index but this would mean finding a lot of gears so was rejected. I wanted to find a method of cutting gears which cost very little and didn't need all the expensive attachments. I started a new post on the forum asking how to accurately divide a circle and almost immediately received links to lots of free download CAD sites. By this time I was becoming overwhelmed with all the technical information I had received and was having many restless nights with gears running through my head. Time was passing rapidly and in order to use one of the CAD sites I would need to learn how to use it? I then had a look at a site I had previously used called 'emachineshop'. This site is just brilliant and is totally free. After playing around with the site for a while I noticed a reference to a 'spur gear wizard' but spent ages and could not open the wizard although I could access it! I checked the site's forum to find others with the same problem but still could not open the wizard. In desperation I submitted my personal details and suddenly the whole site opened up allowing full access to the wizard; this wizard proved to be a tremendous help; it cut through all the technical stuff which I had got bogged down with and by adding four pieces of data down the left hand column; Pressure angle; Number of teeth; Diametrical pitch and bore diameter I just sat back a few minutes and the full size gear drawing would appear in front of me on the screen; this was out of this world and forms the basis of my gear cutting

Having lots of offcuts of metal in the workshop I fabricated a vertical slide to attach to the compound rest on the lathe. This was made in such a way that the gear blank was fitted horizontally.

method. I tried printing the drawing but ended up with an eight inch diameter gear! More time was lost until I found that the printer needed setting to "actual size" then the drawing printed correctly and for good measure the printer was set to its finest line.

Having lots of offcuts of metal in the workshop I fabricated a vertical slide to attach to the compound rest on the lathe. This was made in such a way that the gear blank was fitted horizontally. A large sheet of Whale Tufnol was bought from Direct Plastics, collecting it from Sheffield, and this would be used to make the gears. A scrap 1" diameter bar was drilled to accept a 3/16" diameter piece of tool steel as I intended to use a single point fly cutter mounted between lathe centres. A piece of tool steel ready hardened and tempered was bought costing £3 and this was cut in half.

Gear blanks were initially cut out of the Tufnol using the large bandsaw then turned to size in the lathe. The drawings were downloaded, printed then cut out and in turn were attached to the gear blanks using double sided self adhesive tape. The blank was then mounted onto the vertical slide and the fly cutter set up between centers. The cutter presented a lot of trouble as it needed to be ground to the correct profile! I had bought a book called Gears and Gear Cutting by Ivan Law and this book contained information on how to produce an Involute curve. Involute cutters are readily available at a cost of about £20 each, there being eight cutters to each set. The book showed how to make a cutter then harden and temper it. This didn't appeal to me as I had the cutter in my hand already tempered so needed a way to grind it. After another restless night I came up with the idea of dressing a small grinding wheel to the correct radius then when the cutter was presented to the wheel it would impart the correct profile onto the cutter. This worked very well indeed; I bought a 3" x ½" plain grinding wheel costing £2 and mounted it in my woodturning lathe adding a grinding rest. A strip of metal was filed to the correct radius to suit the gear and this was used to size the grinding wheel; a devil stone made short work of this but caused a lot of abrasive dust.

With everything set up in the lathe the first pair of gears was made but would not fit the winder as they were too big. I had spent many sleepless nights with gear formulae; PA; DP; PCD; Module and base circles etc all running around in my head. More experimental gears were cut until I realized that I was using the PCD (pitch circle diameter) for my calculations when in fact I should be using the DP (diametrical pitch); I had tried overlapping drawings and measuring the centres and nothing appeared to work. Once I found the DP to be 24 everything suddenly clicked into place; I printed more drawings but this time the centres of the two 60T wave gears looked perfect and with the gears cut they fitted. This was a real breakthrough but I wasn't impressed by the look of the Tufnol gears on this winder so wondered if the method would hold up cutting cast iron.

I visited Blackgates Engineering and ordered eight cast iron rounds; I was there for over two hours whilst Duncan cut the pieces and to pass the time chatted to customers who came and went. At one point Duncan said he thought I looked very much like the professor in "Back to the future" to which another customer remarked that its not bad enough leaving these premises with empty pockets but we get insulted into the bargain. It's these little things that make our hobby so much worthwhile and now when I e-mail Blackgates I sign myself "the mad professor".

Six cast iron gears were successfully cut and the winder was working so I ordered the remaining gear blanks and collected them. I had fitted a 2HP motor to the lathe as the 1/4 HP motor supplied was far too small. These cast iron rounds needed facing so I faced six before finding out I was making shallow cones as the lathe was at least 15 thou out. I hadn't noticed this with the first few cast iron gears. The compound slide would not swivel around enough and as I grasped the chuck in both hands giving it a good tug found there was considerable play in the bronze bearings plus there was also plenty of end float. The end float was easy to adjust but I knew these lathes to be prone to breaking their headstock casting if the bearing adjustment was nipped down too tightly so bit by bit the adjuster was tightened until slight drag could be felt but even with this done there was still to and fro movement making me believe the bearing had worn oval! The adjuster was backed off slightly and to compensate for the run out the headstock was rotated aligning it with the cross slide allowing the blanks to be faced; whilst facing the very last large blank the lathe started to chatter; I had been nursing the lathe along as sometimes it would take a heavy cut other times it would struggle with 10 thou and it was now really starting to annoy me because I wanted to get this project completed before I fell off my perch. Wiping the headstock down with a cloth the casting had completely broken right across the main bearing. The following morning was spent running around local firms as I tried to obtain some cast iron welding rods but to no avail; it was Saturday morning and English industry doesn't work weekends so I returned home and welded up a steel clamp as a temporary repair. The repair held and 44 cast iron gears were finally cut; a small jig was then made and the two small holes in each gear was drilled these mate with the driving pins in the dogs at the end of the shafts then the numbers were stamped on the gears; the last job was to soak the gears in turps to remove the remains of the drawings. The vertical slide worked perfectly and as the blank was raised to commence the cut it was wonderful to see the"V" notch appear; at this point it was so easy to see if the cutter was centered and if not a slight adjustment could be quickly made, watching the cutter take out the waste between the lines just has to be seen to be believed and really made all the effort worthwhile. The cutter scooped out the waste in the form of small chips rather than dust and went through the cast iron as though it was going through butter; the cutter withstood a tremendous amount of punishment and didn't require re-sharpening for each batch.

With my new found experience I can cut a 60T cast iron gear in less than one hour; this is putting the teeth on and doesn't include facing or boring.

For gears not requiring great accuracy this method produces gears using very little equipment and costing peanuts. I spent £10 and bought a car load of steel offcuts from a local sheet metal firm; I had already made a 4" belt sander with some of them and others were used to make the vertical slide; the tool steel at £3 was cut in half and the one half cut all 44 gears with no trouble at all; the gear drawings only cost the paper they were printed upon. The double sided tape cost £1 for three rolls from Poundland. The grinding wheel cost £2. Indexing was done directly from the drawing attached to the gear blank and was rapid. A dividing head wasn't needed. Using cast iron the blanks cost £86 which included a £10 surcharge to offset the cost of the cutting which I thought reasonable.

The finish on each tooth is very shiny without any tooling marks. The blanks were assembled into groups and each group completed before the cutter profile was changed. With my new found experience I can cut a 60T cast iron gear in less than one hour; this is putting the teeth on and doesn't included facing or boring.

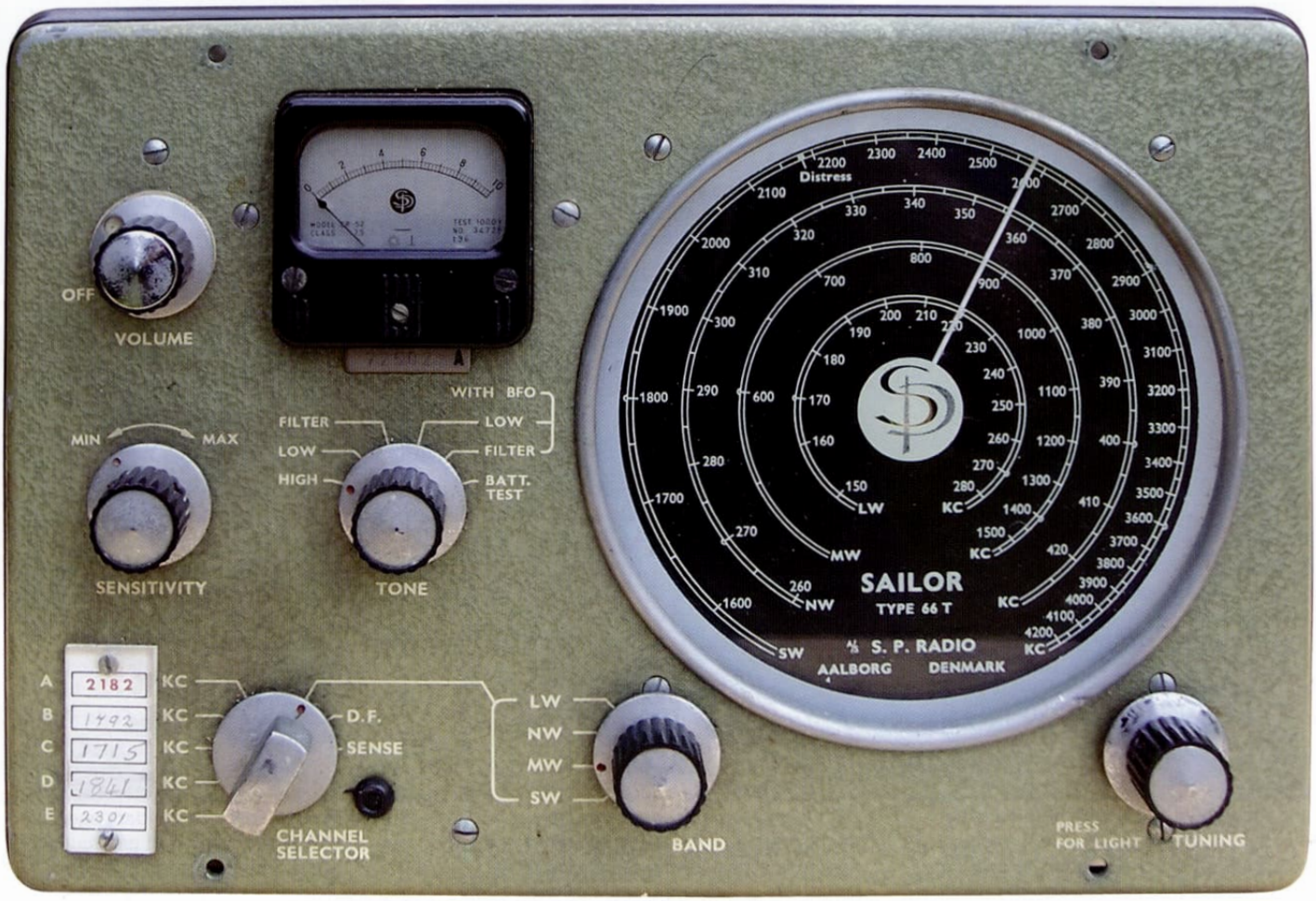
Right from the outset this project has been difficult and these notes are only an insight as to the amount of work that has been carried out over the last few weeks and the steep learning curves involved. Fly cutting goes back to the dark ages but in general this method of gear cutting is my own as I have never seen anything like it before in books or on the web. One more gear remains outstanding and the blank will have to ordered specially as Blackgates don't stock the bar size; it's the daddy of them all at 96T but will present little difficulty as gears from 24T to 90T have already been made. A number of small jobs need to be completed before the winder is in full working order but priority will now be given to totally rebuilding the lathe whilst the weather is warm allowing me to spray paint. For those with Internet access more information on this project can be found on the forum. (Vintage radio). This has been a unique and very enjoyable project and I can only offer my most sincere thanks to everyone who has helped me along the way.

www.vintage-radio.net/forum/
www.directplasticsonline.co.uk/
www.emachineshop.com/
www.blackgates.co.uk/

# Sailor 66T Receiver Power Supply and Speaker Unit

by Stef Niewiadomski

I recently bought a Sailor 66T marine receiver and thought it would make a great "garage radio", mounted on a wall, in a similar way to how it would have operated during its working life. The receiver is VFO controlled over four bands (LW, NW, MW and SW) with the ability to also select up to five crystal-controlled frequencies. Construction of the receiver is very robust and of high quality, reflecting the tough environment in which it was expected to operate reliably. This is a professional receiver and would have had a correspondingly high price tag when new.




The receiver allows for five crystal-controlled frequencies, selectable from the front panel. My receiver was equipped with 2652kHz, 2262kHz, 2185kHz, 2311kHz and 2771kHz crystals, giving reception frequencies of 2182kHz, 1792kHz, 1715kHz, 1841kHz and 2301kHz respectively. With an associated transmitter, no doubt the boats these receivers were fitted to contributed to the "fish phone" annoyances in the 160m band.

Clearly marked inside the receiver is the statement "Xtal freq = Signal Freq + 470kc/s" showing us the receiver's intermediate frequency of 470kHz, very conventional at the time. The IF amplifier has a series of tuned circuits to set its selectivity, with no crystal or mechanical filters as far as I can see.

The 66T was made by S.P. Radio in Aalborg, Denmark. Nowhere in Denmark is too far from the sea (the Baltic to be exact) and the city of Aalborg (said to have been founded by the Vikings) is conveniently situated for marine-based trade and fishing. The company has a history of building and supplying high-quality radios (receivers, transmitters and transceivers) for the marine industry, including pleasure craft and serious ocean-going trawlers and cargo boats. Occasionally Sailor sets come up for auction at BVWS events, and they are easily recognisable by their bright green cabinets. You may also have seen some Sailor equipment on the bulkheads of the trawlers in the TV series Trawlermen, presumably of rather later vintage than my 66T.

**No Manual**

Unfortunately my 66T did not come with a manual or schematic (if anyone would allow me to copy theirs, I would much appreciate this and pay costs of course) but looking inside the receiver it has a 3-gang tuning capacitor which indicates it has an RF amplifier stage, which is further re-inforced by its superior sensitivity and selectivity. I believe this model was introduced in 1966 and the vintage of the transistors seems to indicate this. The transistors I can see show metal-cased silicon BC108s used in the AGC/BFO board and germanium AF127s in the IF strip, so the design of the receiver is definitely on the "cusp" between germanium and silicon transistor design practice.

The receiver does not have an internal loudspeaker or mains power supply so I thought it would make a pleasant project to build these and mount the 66T and the power supply and speaker unit on a wall–mounted wooden panel as they would have been mounted on a ship. The receiver has a battery compartment, accommodating 6–off D–size batteries, for operation independent of the mains.

The receiver also has an S–meter, calibrated simply with the meter's original linear 0–10 scale which is also used to measure

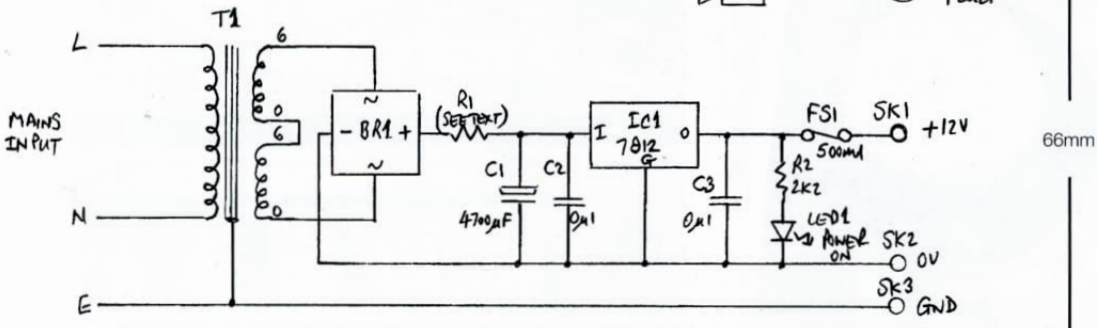



Figure 1. SCHEMATIC OF THE SAILOR 66T POWER SUPPLY & SPEAKER UNIT

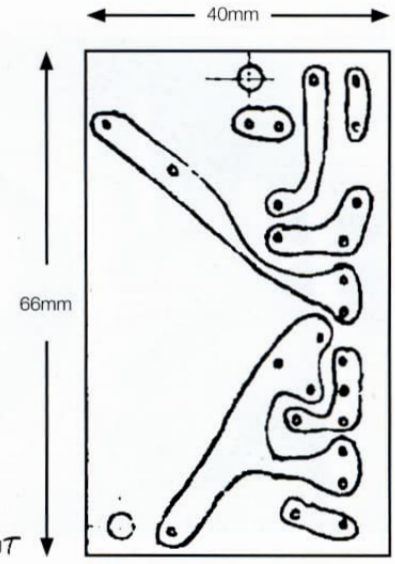
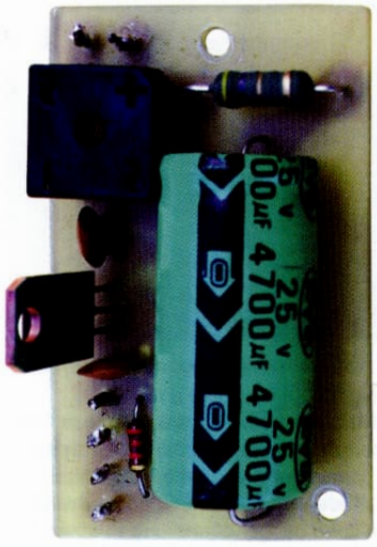



Figure 2a: PCB tracking



The assembled power supply board

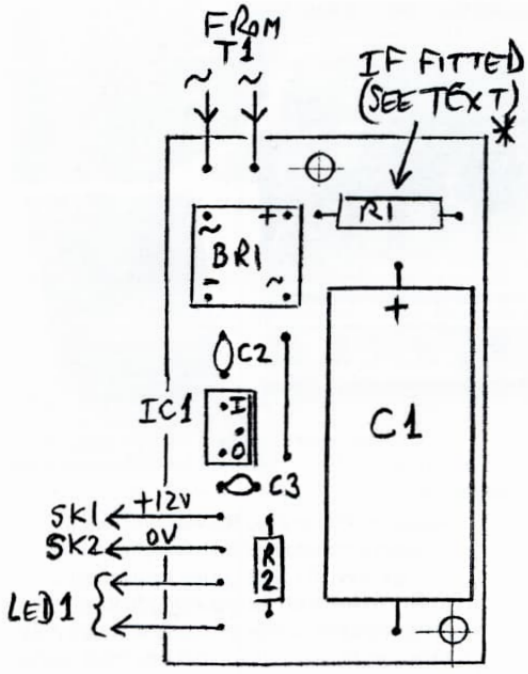
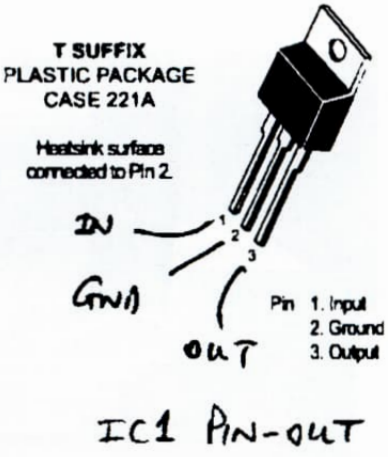



Figure 2b: PCB component layout




the supply voltage to check the state of the batteries. It also has a front panel switch with high, low and filter positions, with and without the BFO, to set the audio response.

The unit described here generates a current limited and fused supply at +12V at up to about 400mA (limited by the transformer used), to power the 66T, and also contains a loudspeaker. I used components available from various suppliers to build the unit completely from new, to be sure constructors would have no problems sourcing the "bits". The experienced constructor with a decent junk box should have many of the components to hand.

**The 66T's Frequency Range**

The receiver has a large circular black dial with white markings, giving about 330° of tuning range, tuned by a small-ish chrome-plated knob. The mechanism produces very positive, backlash-free tuning. Four wavebands are provided, namely:

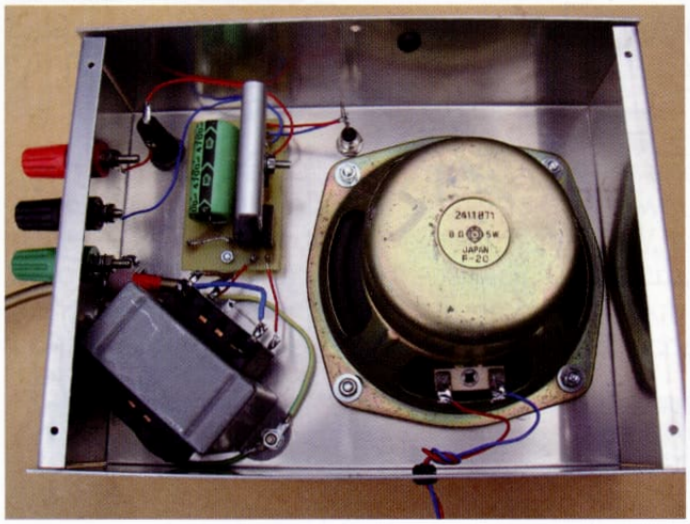
| | |
|---|---|
| SW | 1550 – 4200kHz |
| NW | 260 – 425kHz |
| MW | 500 – 1550kHz |
| LW | 150 – 280kHz |

The MW and LW bands are self-explanatory, but the SW and NW ranges need some explanation.

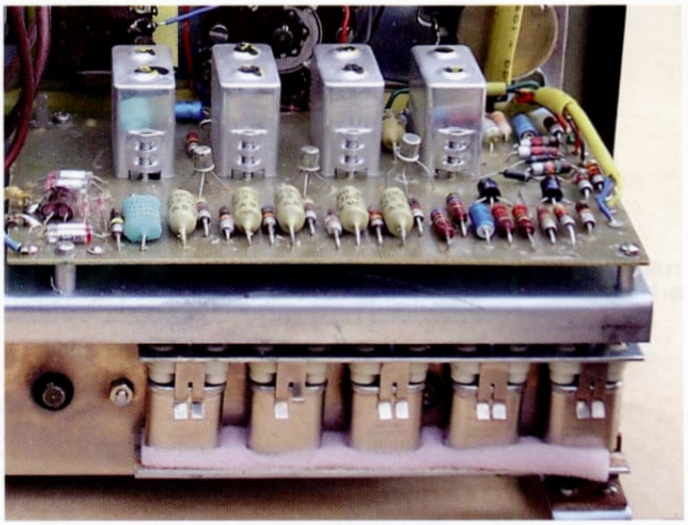
From a radio amateur's point of the view the SW range covers the 160m and 80m bands. The band spread on 160m is reasonable and I've had no problems resolving AM and SSB on this band. 80m was a little more problematic since the portion of the dial covering this range is very small. However I did just about manage to resolve SSB in this band, though I would not recommend the receiver for this purpose.

The United Kingdom Frequency Allocation Table at: www.ofcom.org.uk/static/archive/ra/topics/spectrum-strat/uk-fat/uk-fat2002.htm shows portions of the range 1600kHz – 2650kHz to be still allocated to maritime mobile. The maritime distress frequency of 2182kHz is marked prominently on the 66T's scale. A comprehensive list of world-wide Coastal Radio stations in the range 1609kHz – 4000kHz can be found at: www.coastalradio.org.uk/.

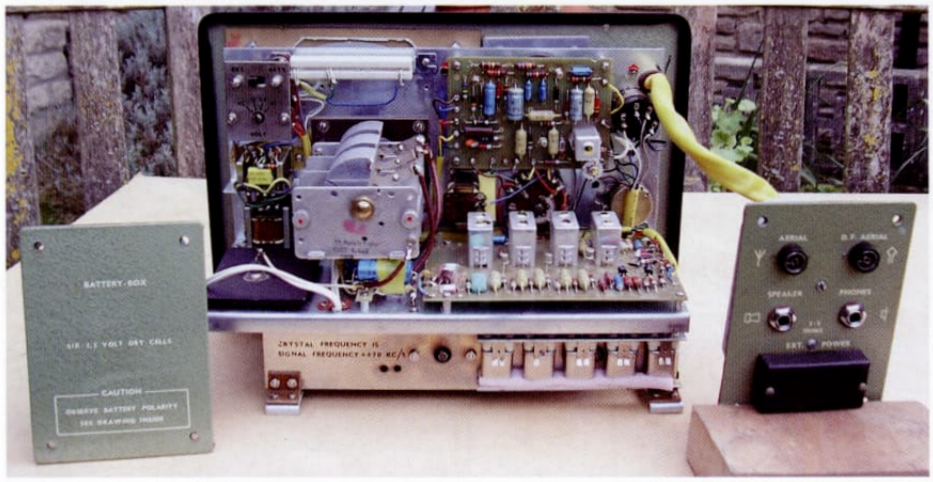
According to: www.classaxe.com/dx/ndb/reu/index.php the NW band is now populated with Non-Directional Beacons (NDBs), which are low power (25W and 50W) aeronautical beacons used for aircraft navigation. These made an interesting few days' listening, seeing how many I could hear. From my location in Oxfordshire, on a fairly basic long wire antenna, I managed to hear 14 NDBs,



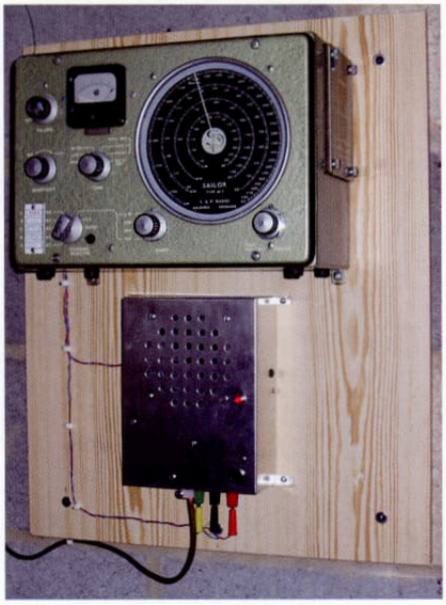
View inside the chassis before the back is added



IF board and crystals below



The 66T with its back removed and the side panels opened out



The 66T and power supply mounted on the wall

as shown in Table 1. I think I can just about hear EPM on 316kHz, but I don't have this as a "definite" yet. The stations transmit their call sign in slow (or in the case of Oxford, very slow) Morse code on an audio carrier (ie not pure CW) with a precise repetition period. The link above accesses a searchable database of these transmissions and makes it easy to identify any you hear from their call sign and frequency.

A BFO is fitted to the receiver, set to LSB for SSB reception, which is the conventional sideband used for transmissions below 10MHz.

**Circuit Description**

Figure 1 shows the schematic for the DC power supply. The mains input to the unit feeds the primary of the mains transformer T1. In my prototype unit I did not fit a mains switch, relying on the mains socket on/off switch, which is perfectly acceptable. The secondary of T1 feeds bridge rectifier BR1 whose output is smoothed by C1. R1 limits the switch-on surge into C1 and also drops a little DC voltage during normal operation, saving a little dissipation in the regulator. I found that the secondary output voltage of my mains transformer was only just adequate to provide about 14V to the regulator, IC1, and so R1 was omitted. If you use a transformer with a higher output voltage (say 15V RMS), then by all means fit R1. To maintain its regulating function the 7812 regulator needs a minimum of about 2V between its input and output terminals at the 300mA output current needed by the 66T.

The regulator output feeds a panel mounted LED via current limiting resistor R2, and the +12V output socket SK1 via a 500mA fuse. SK2 is the 0V output, and SK3 provides a mains earth (GND) to the receiver.

**Construction**

The prototype unit was built in an aluminium case 200mm x 150mm x 65mm, or similar, with 10mm x 10mm angle runners along the top and bottom sides to mount the unit on a wooden wall panel along with the 66T (see photos).

Figures 2(a) and 2(b) show the PCB tracking (at life size) and component layout for the board. Take care to correctly orientate the electrolytic capacitor C1 and IC1. The pin-out for the 7812 is also shown for reference. A short length of aluminium angle was bolted to IC1 as a heat sink, though this is hardly justified by the heat generated.

The PCB has been designed to accommodate an axial version of the electrolytic C1: if you have a radial electrolytic of the correct value, you can drill a couple of extra mounting holes in the PCB. There is one link on the PCB which can be made with bare tinned copper wire as there is no danger of shorting to other components. I always use 1mm terminal pins soldered into the holes for the inputs and outputs to the board to facilitate the wiring to and from the board, rather than trying to insert wires into the board itself.

The photos show the general arrangement of the major components mounted in the case. The placement is not critical and so tag board construction, ugly construction or even veroboard could be used if you don't want to invest in a PCB.

You can work out the drilling details of the panel from the photos of the prototype unit. Make sure you have all the panel-mounted components before you start drilling because the exact dimensions of the transformer, the LED, the fuse holder and the loudspeaker from different suppliers may vary. Drill a series of holes in the front panel to let the audio out.

A rubber grommet should be used in the hole where the mains cable passes though the aluminium panel, and the cable clamped to the chassis inside the

**Table 1. Non-Directional Beacons (NDB) heard**
Reference for IDs, etc: http://www.classaxe.com/dx/ndb/reu/index.php

| Beacon frequency | Morse | Beacon ID | Period | Location | GSQ | Power | Comment |
|---|---|---|---|---|---|---|---|
| 277kHz | -.-. / .... / - | CHT | 5.6sec | Chiltern. | IO91ro | 25W | Slow morse. Weak signal. |
| 282kHz | .-.. / .- | LA | 10.0sec | Lyneham, Wilts. | IO81xm | 25W | Slow morse. |
| 316kHz | Not heard yet | EPM | 5.5sec | Epson for Heathrow | | 25W | Not definitely heard yet. |
| 325kHz | --- / ..-. | OF | 8.3sec | Filton, Bristol | IO81qm | ? | Slow morse. Weak signal. |
| 331kHz | -- / ... / - | GST | 5.2sec | Gloucester. | IO81vv | 50W | Fast morse. Weak signal. |
| 335kHz | .-- / -.-. / --- | WCO | 6.9sec | Westcott. | IO91mu | ? | Slow morse. |
| 352kHz | .-- / --- / -.. | WOD | 6.2sec | Woodley, | IO91nk | ? | Slow morse. Strong signal. |
| 367.5kHz | --- / -..- | OX | 10.4sec | Oxford/Kidlington. | IO91it | ? | Very slow morse. Strong signal. |
| 386kHz | -... / --.. | BZ | 10.0sec | Brize Norton, Oxon. | IN91er | 50W | Slow morse. Strong signal. |
| 388.5kHz | -.-. / -.. / ..-. | CDF | 7.9sec | Cardiff. | IO81hj | ? | Slow morse. Very weak signal. |
| 391.5kHz | . / .- / ... | EAS | 4.5sec | Southampton/Eastleigh. | IO90hw | ? | Slow morse. Weak signal. |
| 406kHz | -... / .... / -..- | BHX | 8.2sec | Birmingham. | IO99ck | 25W | Slow morse. Weak signal. |
| 414kHz | -... / .-. / .. | BRI | 10.5sec | Bristol/Filton. | IO81pj | ? | Slow morse. Weak signal. |
| 421kHz | -... / ..- / .-. | BUR | 6sec | Burnham. | IO91pm | ? | Slow morse. Weak signal. |
| 433.5kHz | .... / . / -. | HEN | 4.5sec | Henton. | IO91os | 25W | Slow morse. |

unit so that it can't be accidentally pulled from the outside. The earth wire from the mains cable is connected to the metal chassis via an earth tag on one of the transformer mounting screws.

**Wiring up the Unit**

The unit is very simple to wire up. Thoroughly check the locations and polarity of the component on the PCB and check that all the solder joints are good, with no solder bridges or shorts on the underside of the board. Start by wiring the mains cable to T1 primary, and then wire T1 secondary leads to the PCB, solder the LED leads to the correct pins on the PCB and the +12V output from the PCB to SK1 via FS1. The transformer I used for T1 had two 0-6V secondaries which I wired in series: if your transformer has a single 12V or 15V secondary, then this will not be needed. Then wire the 0V output from the PCB to SK2, and the ground connection from the metal case to SK3.

The loudspeaker was wired with a twisted pair of wires to PL1, the wires passing through the side of the case via a small grommeted hole.

**Testing the Power Supply and Speaker Unit**

Before switching on, double-check the internal wiring of the unit, especially the mains wiring. Don't forget to insert a 500mA fuse into the fuse holder.

Now plug the unit into the mains and check that LED1 lights. If it doesn't light, chances are that it's wired the wrong way round, so turn it round. Once this initial stage has been passed successfully, check that about +12V is present between SK1 and SK2.

If required the supply can now be loaded to check its regulation under different loads. The DC output can be loaded up to 300mA, by using a resistor of about 40ohm. The output voltage should change very little, as this current is well within the capability of the 7812 regulator. You can let the power supply "cook" for an hour or two, and the transformer and IC1 should get slightly warm, but definitely not hot.

The unit can now be screwed into the wooden wall panel, below the 66T receiver, as shown in the photos. The receiver itself is fitted with four lugs, making it easy to fit to a vertical panel, as would be typical in its working environment. These lugs can be unscrewed from the case if table mounting is preferred.

You should open up the receiver by unscrewing four screws on the front panel, and check that the External power input (as opposed to the internal battery pack) is selected and the external voltage is set to 12V, on the small switch panel at the top left hand corner of the receiver, as viewed from the rear. The power connections to the 66T are via a screw terminal panel on the left hand side of the case, when viewed from the front. The terminals are clearly marked Pos (+), Neg (-) and Earth (with an earth symbol).

Once the power connections have been made the power supply can be switched on, the loudspeaker plugged into the receiver and an antenna connected. The receiver should now work with plenty of available loudspeaker output.

**Conclusion**

This article has described a mains power supply and loud speaker unit for use with the Sailor 66T receiver. Today most navigation is done using GPS, and ship-to-ship and ship-to-shore communications is on VHF and so the 66T is redundant from its original professional purpose. Of course it uses almost antiquated technology by today's standards. However it's a good looking radio and a good performer and so deserves a new lease of life. I think it now has a fitting retirement belting out 1960s classic hits and the such-like, with the occasional wander around its other bands, in my garage.

**Component List**

R1 4.7ohm 1W carbon film (see text)
R2 2k2 0.25W carbon film

C1 4700uF 25V axial or radial electrolytic
C2,3 0u1 50V ceramic decoupler

T1 Transformer, mains input, 20VA 0-12V output at 500mA (Maplin N05CF or similar)

IC1 7812 positive 12V fixed voltage regulator
BR1 200V 3A bridge rectifier
LED1 Panel-mounting LED and mounting clip

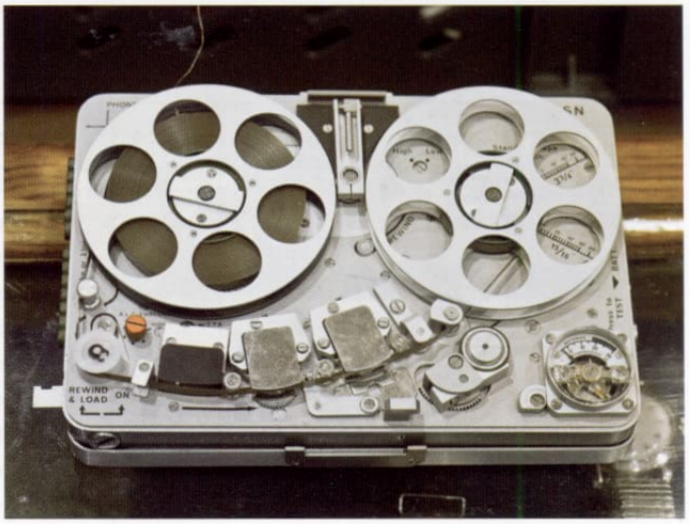
LS1 8ohm loudspeaker

SK1 Banana socket (red) +12V
SK2 Banana socket (black) 0V
SK3 Banana socket (yellow) GND

PL1 ¼" jack plug.

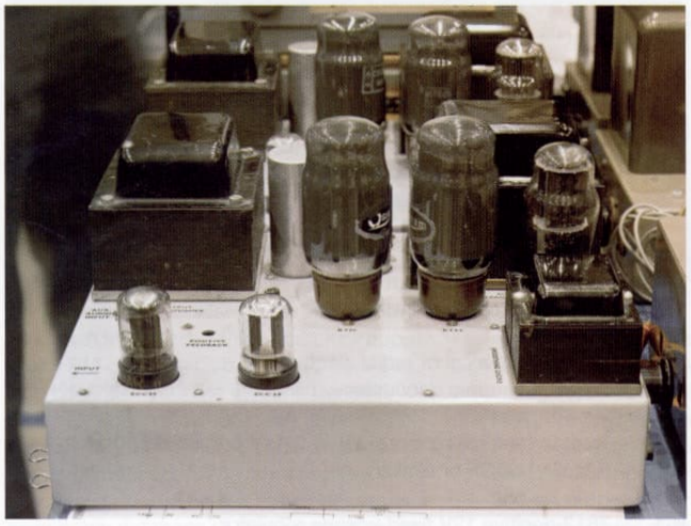
FS1 Fuse holder (20mm) plus 500mA fast-blow fuse.

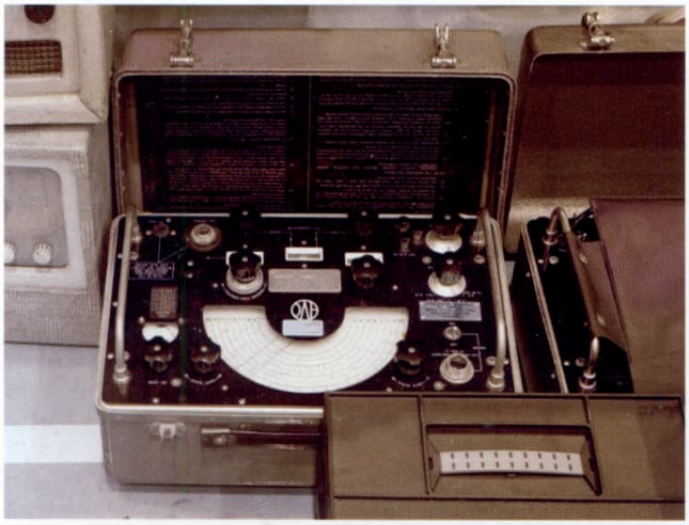
Printed circuit board.
1mm terminal pins.
Aluminium case 200mm x 150mm x 65mm, or similar.
10mm x 10mm aluminium angle.
Insulated connecting wire.
Mains cable, grommet and cable clamp.
Small grommet for LS1/PL1 lead.
Screws and nuts for PCB and T1 mounting.
Earth tag, screws and nuts.

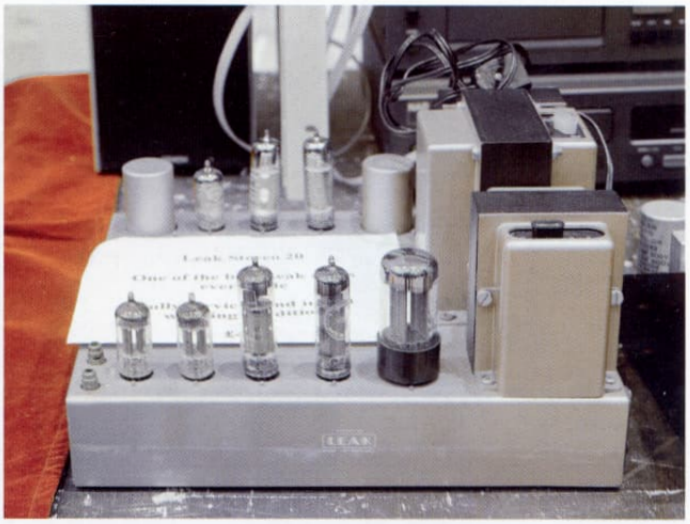



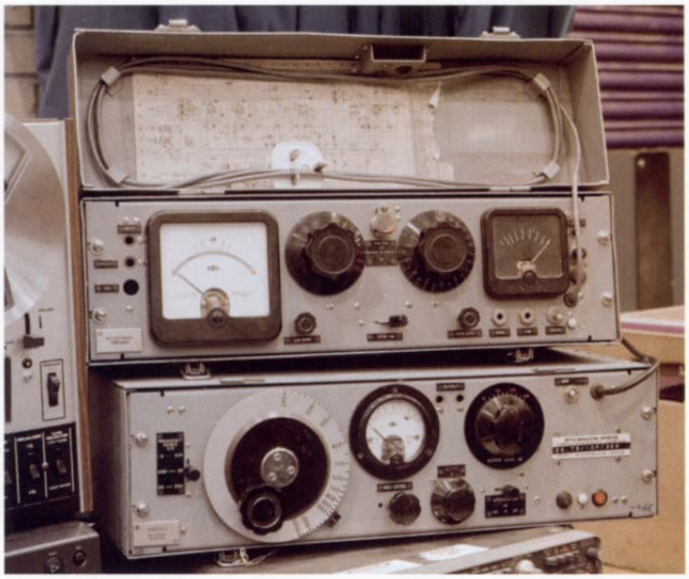

# Audiojumble!

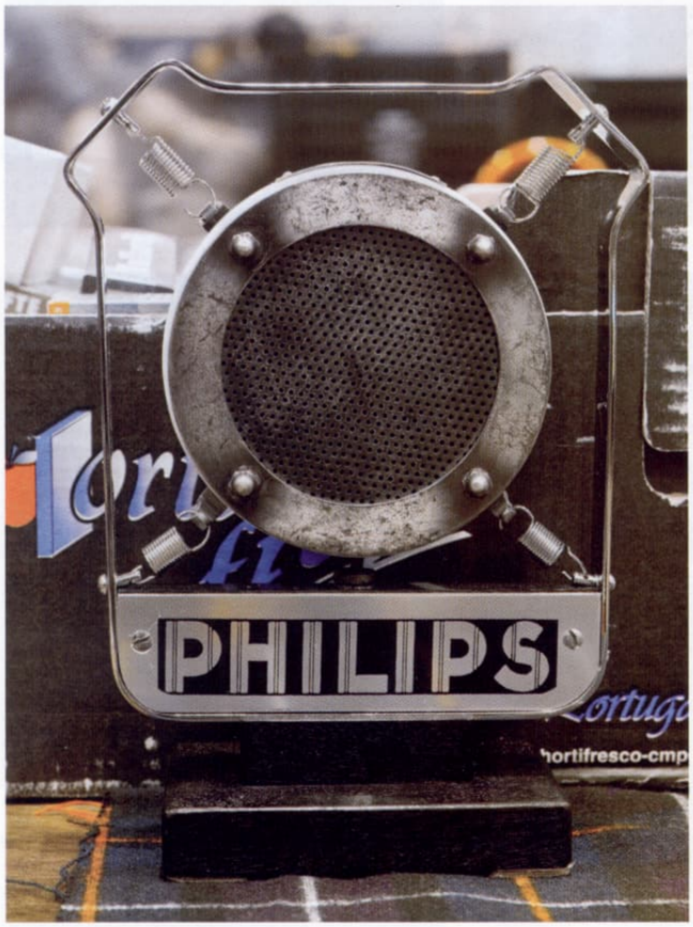
Photographs by Carl Glover

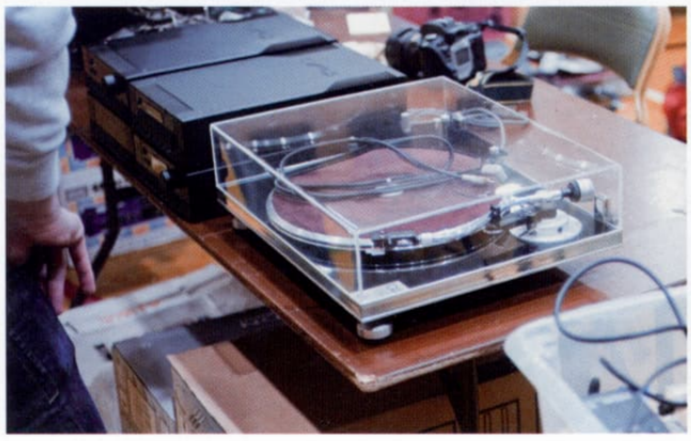


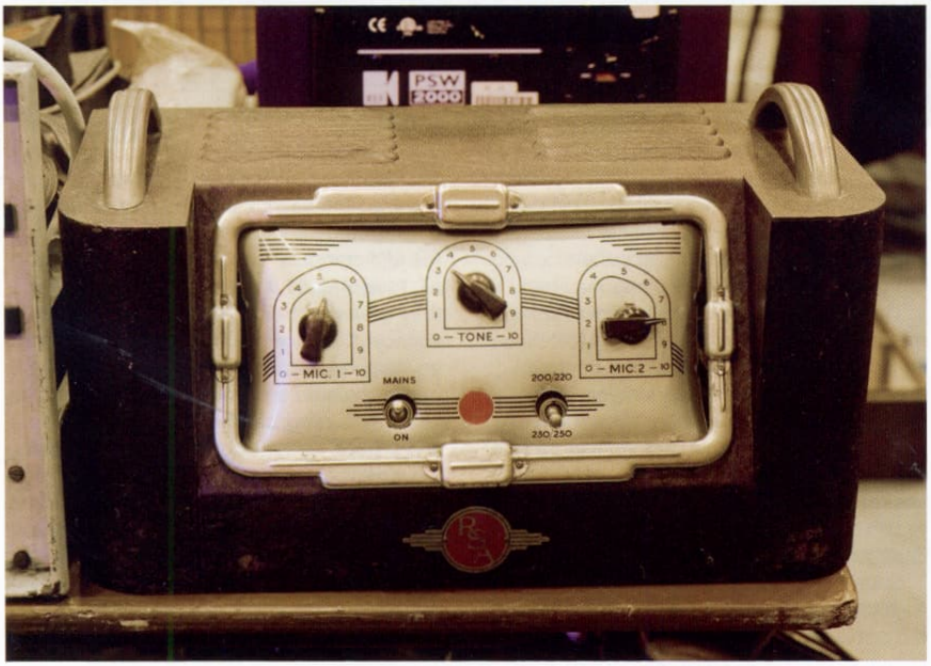







PHILIPS




PSW
2000
MIC. 1
TONE
MIC. 2
MAINS
ON
200/220
230/250

# Battle survivors

In Memory of Howard Baynton, by Richard Shanahan

I use the plural because the article is about two survivors, a Japanese bomber radio A99 type 3 and my old college tutor, Howard. Howard passed away in 2007.

Both saw action in Burma, during World War II, both survived. Howard was with No.53 regiment, Radar Signals Section. Their 3.7 inch AA guns brought down a Japanese twin–engined light bomber, sometime in 1944, he was not sure of the date. He was not allowed to keep the valves that came with the set in the downed bomber; he and I assumed that they might be of use in Allied equipment.


An early reference[1] gives the valves as being 'identical' with the American 6P7. It also records a frequency coverage, using two plug–in coils, of 1.5 to 6.7 mHz, the IF being 450 kHZ. A later Article[2] gives more illustrations. Both articles give good general details. Howard's radio has a No.2 coil pack, 3.2 to 6.7 mHz. He thought he had the other in his garage but I have never found it.

Howard gave me the radio in early 1999. Condition (remember this radio came out of a crashed plane) is very good. The case is light matt brown, the front panel was possibly semi–gloss black. The case has two sets of runners, top and bottom, which confirm its slotting into other equipment (see ref 2). There is no blast damage but slight 'G–force' damage. Both IF transformers and a dividing panel show a rear 'tilt', indicating that the radio faced the rear of the plane.

The photographs of the set show some missing items. The front panel has lost its panel light cover and half of a control knob (later identified as the volume control). The rear of the case shows a missing cover; I am unsure of its use. The rear of the radio shows a 7–way socket. Helpfully, five are identified with a +, two – signs, a +250 and +600 (volts?) Japanese symbols are also evident.

Soon after Howard gave me the radio, he told me that a resistor was missing, but did not indicate that he had tried to get it going. The search led me into a rather bizarre correspondence, the first via a friend's computer did not raise anything at all. I telephoned the Japanese Embassy; they gave me the address of their defence agency. A couple of weeks later an envelope arrived containing a drawing of a mid 19th century pistol with the name LR Littleton, a copy of a possible certificate and a pack of little stick–on posters with the words 'Japan self–defence Forces'.

At the same time I contacted the American Embassy, they gave me a contact at their national archives. They replied, giving me a different address in Japan – the War History Office. The Americans had no further information. My letter to Japan

was returned unopened a few days later.

I ended up looking carefully at the set. It comes easily out of the case and the insides are in good condition. Problems became immediately evident upon closer inspection. Bearing in mind that Howard had mentioned a missing resistor I noticed two other vacant places, plus a mounted resistor with short, broken leads. There was also one loose resistor. The sides of the IF transformers are open, in one there were two disconnected leads. A short lead coming from a small rectangular box was near one of the vacant places. Three valve caps were in place, they are the small type, but not a fourth. At this stage I couldn't work out where it would be connected.

It was time to decide what to do with the set: unless I'm working on someone else's radio, there are only four possibilities:

Tidy up and keep for interest
Tidy up and sell
Restore to a working condition and keep
Restore to a working condition and sell

I chose to restore and keep, I know Howard's family wanted me to.

Two things stood out for attention - a very wobbly tuning knob and the handle on the coil pack, which was about to fall off. Some gentle persuasion at the other end of the pack resulted in its removal. Once out, it was obvious that the handle operated catches, I removed the cover to access the mechanism. The handle had a missing screw, like others in the set, was close to BA sizes. I retapped to 8BA. I also investigated the three coils, which are wound on ceramic formers. Connections are taken to 15 'button' contacts, which engage a similar number of springy plated strips above the tuning gang.

The coil nearest the front had a compression trimmer accessible via a hole. The rear coil had a tubular ceramic component with a paint–sealed screw, it was adjacent to a paxolin structure with two internal contacts. I suspect that this would contain a crystal for a 'spot' frequency[2]. There was a small capacitor under this coil, I couldn't see any markings.

**The tuning knob**

The grub screw had lost half its slot, Howard may have tried to remove it but I didn't think so. I undid it with surgical forceps gripping the remaining side, the shaft end was not square – at some time it had been filed, it was also slightly bent. I re–drilled the hole for a 4BA grub screw, but the tuning knob would not run true. I decided to make a sleeve to couple shaft and knob. Drilled out the brass insert as far as I dared as the knob is solid. The sleeve on my lathe and the shaft end was bored to be a close fit – approximately 6mm. The knob end was 10mm to match the new insert hole. To 'even' the grip on the shaft end I drilled three 6BA threaded holes 120 degrees apart. I could not get to the good section of the shaft because of the adjacent tuning dial bezel.

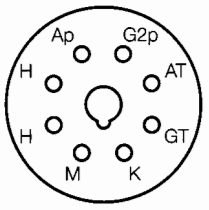
**Restoration**

Apart from the obvious problems mentioned, there are four major ones – the valves. I made a telephone call to Rod Burman who informed me that they were available in the USA for £50 pounds each (this was in 1999). I assume that they are even more expensive these days. Shipping, insurance and import duties would put these valves into the 'arm and leg' area of cost.

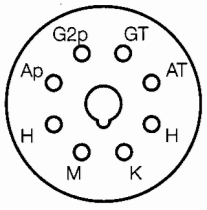
There is a light at the end of this particular tunnel in the shape of a 6F7, though it has a different base. The 6P7 in the set is an international octal, the 6F7 a UX7. They are listed as electrical equivalents in WW valve data sheets. As I'm certainly not changing valve holders I shall make adaptors. This will mean that the height will be greater but I will have a working radio in its original state.

Looking at the references, it appears that the valve sections (they are triode pentodes) 'dive about a bit' they are:

| | |
|---|---|
| RF Amp | V1 Pentode section |
| Mixer | V2 Triode section |
| OSC | V2n Pentode section |
| 1st IF Amp | V3 Pentode Section |
| 2nd IF Amp | V4 Pentode section |
| DET/BFO V4 | Triode section |
| 1st AF Amp | V1 Triode section |
| 2nd AF Amp V3 Triode section | |



Wireless World



As found

I'm no expert on circuits, but I know enough to be able to spot circuit stages so I decided to trace out the circuit by point–to–point checks. By following the 6P7 base data, I began to identify the circuit. I started with what I hoped would be two 'easy to spot' stages – RF amp and AF output. In the case of the RF amp, the aerial circuit would point to tuning–gang section and coils. The AF output stage would have the output transformer and phone jack. My first check drew a puzzling circuit, nothing made sense using the 6P7 base data.

It was sometime before I realised that the connections were not as expected. The 'fitted' holders did not match the WW data. The index gives IO76, the characteristic page, 105. It would seem that if I had used the 6P7's I would still have base problems. Maybe the term 'identical' needs to be taken with a pinch of salt!

I cleaned up the case and front panel with my 'magic mixture', a four to one of linseed oil and white spirit. I've used it on almost everything, from rexine–covered portables to metal; it removes surface dirt with ease and leaves a slight sheen. Of course, you don't use this if a finish has to be painted. It is a source of amazement to me that items for sale are often presented in a filthy state, very often, all that is needed is a light wipe with a damp cloth.

Around this time I discovered a possible danger. I had enlisted dave Warners' help in sourcing information, he located a group who yielded quite a lot of information regarding checking the dial for radium! I've come across this problem before with 'hot' dials from aircraft – I keep them well out of the way! Luckily an inspection of the radio dials with a Geiger counter gave it the all–clear.

I returned to the radio. The partly damaged volume control knob was not as easy to remove as the tuning knob. I had to 'spot' the broken grub screw slot with a fine cutter in my dremel type drill. I followed with a 1/16 inch twist drill, and followed with the smallest size in my 'broken stud' removing toolset, and out it came. Once more I redrilled for a 4BA size grub–screw. My first circuit to be traced was the AF output stage. As hoped, this now yielded the triode connections, and some pointers to its pentode section (1st IF Amp).

A little more of the radio's construction might be of interest at this point. On the rear of the set is a small paxolin panel with small protruding metal contacts with voltage indents. Behind it is a similar sized panel with four similar contacts. These were unmarked. The panels were joined back to back by four thin, long screws and spacers. One was missing its nut and the other three were loose, perhaps Howard had worked on a similar exercise, but had never mentioned it.

My initial tracing had identified the heater wiring easily, I had to repair the seized–up pilot light holder. One side, at each valve was grounded. Also grounded on the rear socket, was a pin marked + which shared an adjacent pin with a Japanese symbol meaning -, this was the 6.3V LT. But there was no continuity for the other side of the heater circuit. Careful inspection revealed a connection to one of the contacts on the inner panel. Also, its neighbour was connected to the minus pin and to the 6.3V identified contact. More careful inspection showed two, almost flush, cut 'ends' on the two contacts. I linked the two, and I had LT continuity.

I was close to applying power to something that fell out of the sky in World War II!

By this time I had acquired four 6F7's from Gerry and made four adapters. These were IO to UX7. Also, with the help of a fellow BVWS member[4], I had identified most of the Japanese symbols, he is also trying to find me an original circuit for the set.

HT tracing was another problem. HT –was open circuit to everything! But the positive rail was a puzzle. I had assumed that the +250 pin on the socket was HT+ to the receiver. The 600V pin I again assumed might be associated with the transmitter unit. But I could not find continuity from the +250 to any anode circuit. To return to the front panel. I had again assumed that the 'momentary make' push–button switch was a VFO switch. Prior to having help with the symbols, I had pushed this button whilst tracing HT+. I had continuity! I wondered whether this could have been a push–to–make/ push–to–break type that had somehow lost correct operation, so I 'linked' it out.

I now felt that I had enough evidence

to try the output stage. I decided to use the +250 pin and chassis as HT-, LT (+ and -) being identified earlier.

I plugged in a 6F7 with adaptor, put a 6V bayonet panel lamp in, and applied 6V from a rechargeable battery. The moment had arrived! I was only appying a heater supply, but was aware that the last time this radio had *any* supply at all was in 1944, just before a 3.7 inch shell arrived.

The dial lamp lit up and the valve took about 200mA. Next comes HT.

I had traced V3, triode section and was fairly confident I could get enough AF through it. I used the +250 pin and chassis as HT- and my advance sig gen on AF to V3's pin 5. My old Brown Brothers crystal set headphones were connected to a jack plug and plugged in. I cautiously applied a low value of HT and gradually 'wound' it up whilst listening. Reaching about 200 volts I could just make out a very faint signal. The valve was taking about 5MA HT.

I switched off and checked again, testing valve and continuity. had I missed something? With a signal gen straight on Pin 5 (via a 0.1µf) I should have got a decent note. I switched on and tried again. I happened to move the jack plug slightly out. I was immediately given an ear–blast of 400 Hz (MOD), the plug was in too far, I was using one with a funny shaped end – ah well, one stage working!

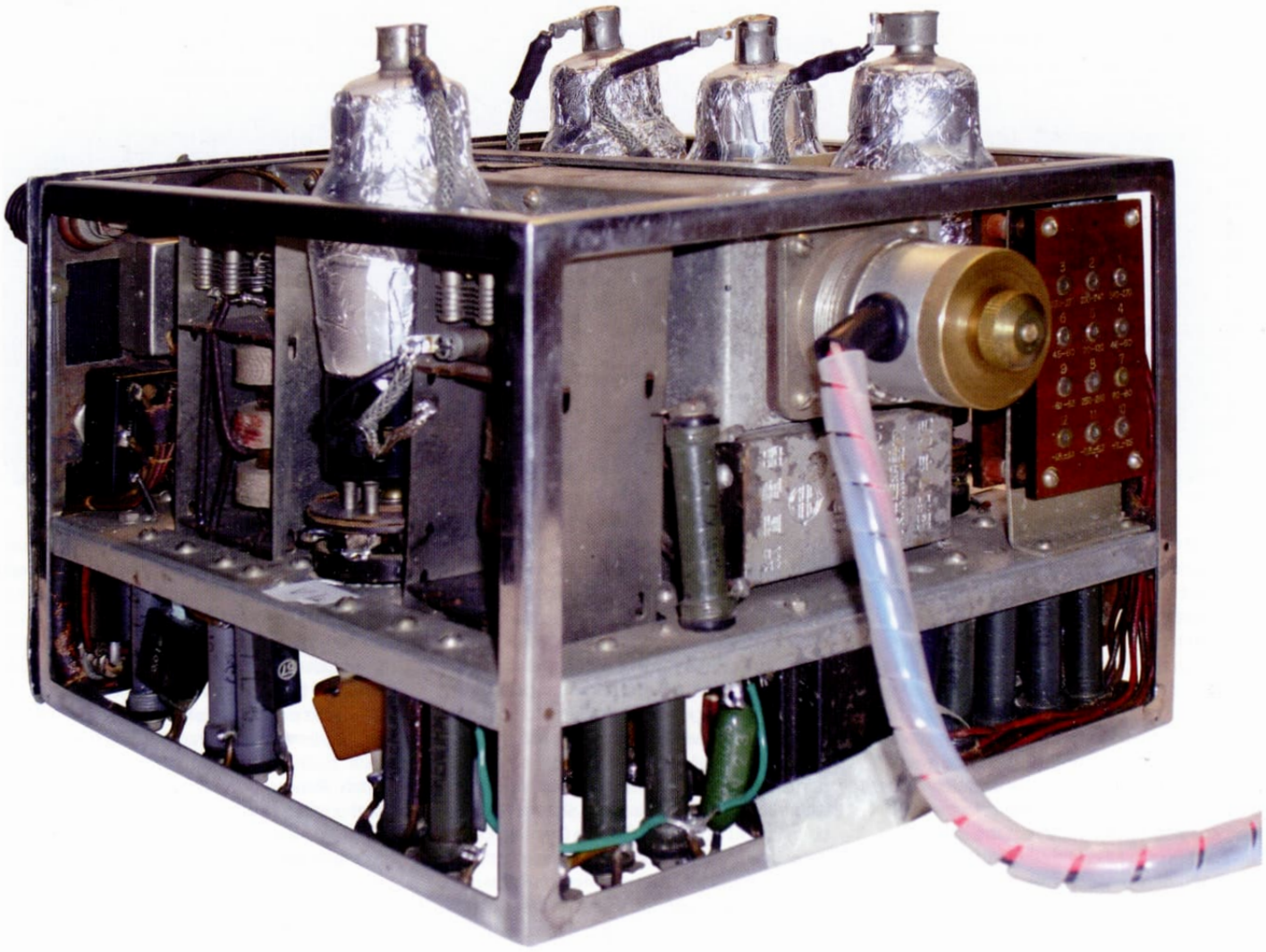
About this time I began to doubt my identification of the locations of V1 and V2, As it turned out they were different to my original impressions. As soon as I retraced the circuits, the RF and frequency changer circuits began to make sense. The coupling from the frequency changer (V2) appeared to be capacity coupled. One of the disconnected leads, near V3 top cap also made sense. Earlier, I had found a loose resistor with a capacitor attached. It matched the top cap connection to

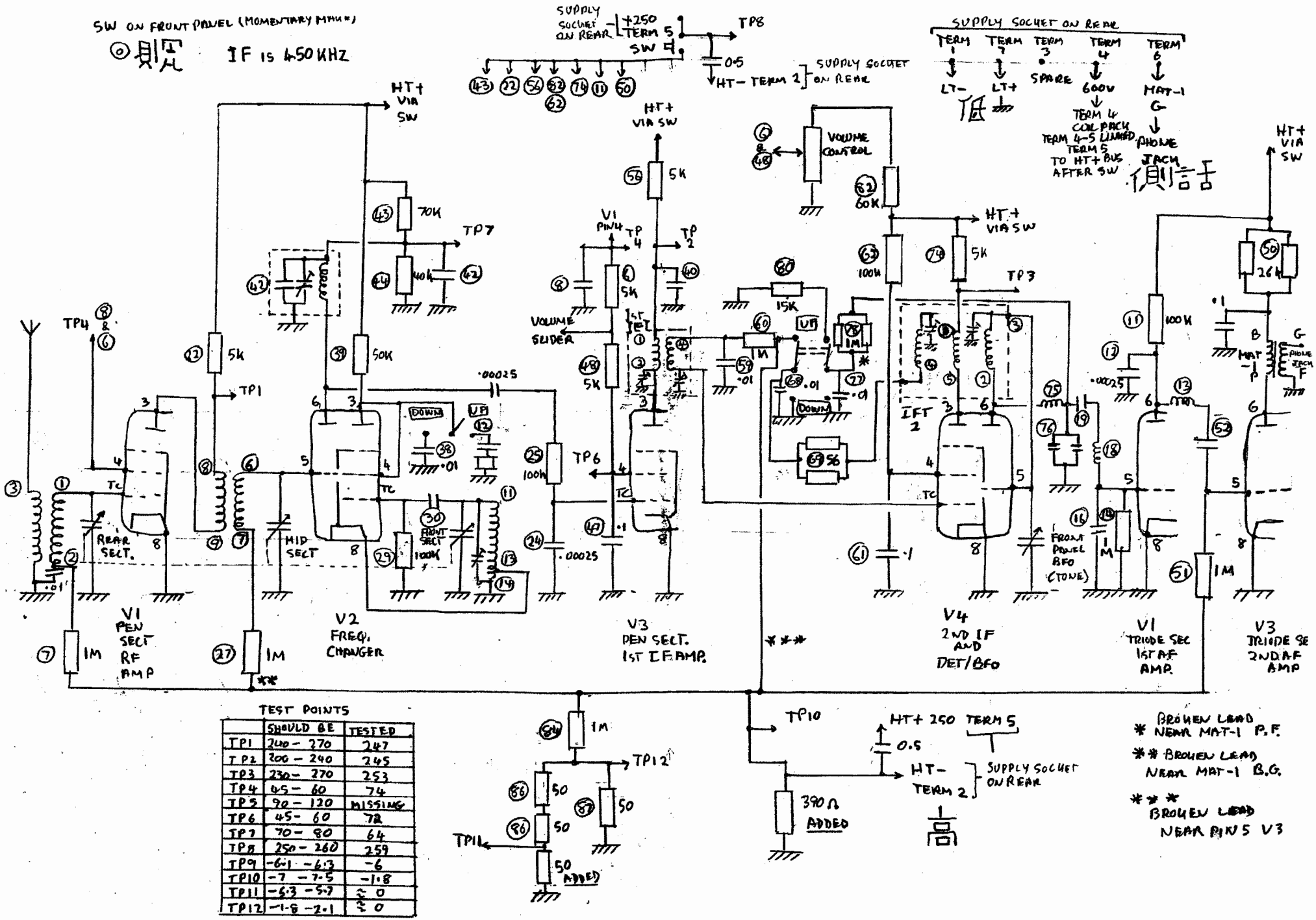
On paper, this may sound like a lot of things were falling into place fairly quickly. They weren't! The tracing took a *lot* of time.

V3 and the broken lead, coming out of the small rectangular box, was the other end. I think this box is an IF filter.

On paper, this may sound like a lot of things were falling into place fairly quickly. They weren't! The tracing took a *lot* of time. The radio is well built, but not designed to be serviced easily. Nearly all the leads from the coil pack connections are out of sight above the tuning gang. I had to check each possible link. An example of this was the coupling between the aerial coil, connections 1 and 2, and V1 connection grid – it didn't appear to exist! Luckily the connection , No.1 was just visible behind the 'rear gang' with a dentists mirror and a 'pea' bulb. I could see no obvious connection. For ages I studied three wires which I thought all went through to the next gang section, one didn't, it was the missing link. With the gang fully open there was just enough room to get my Adcola soldering iron straight down onto the tag to splice a short piece of new wire. Whether this was a poor joint or caused by the crash was not obvious.

I was now ready for trying the RF amp (V1 pentode sect). I unplugged V3 and replaced it in V1's socket. With HT, LT and my advance signal generator and Hitachi 'scope, I tried RF. With channel two on the frequency changer (V2 triode pins) I had a fuzzy trace. At this point I happened to twiddle the volume control and the picture cleared momentarily. I now suspected this control was not in the AF, but via a complicated chain controlled the gain. I took it apart. It only partially responded to re–tensioning (it was wire–wound), so I replaced it. I was now getting a nice clear trace with a gain of about 200. Even better, I was putting in 5 mHz (mid–band) and calibration was almost spot–on. Operating the aerial coil trimmer peaked the signal. At this stage I realised that I was using unscreened valves – the originals were metal.






TEST POINTS

| | SHOULD BE | TESTED |
|---|---|---|
| TP1 | 240 – 270 | 247 |
| TP2 | 200 – 240 | 245 |
| TP3 | 230 – 270 | 253 |
| TP4 | 45 – 60 | 74 |
| TP5 | 90 – 120 | MISSING |
| TP6 | 45 – 60 | 72 |
| TP7 | 70 – 80 | 64 |
| TP8 | 250 – 260 | 259 |
| TP9 | −6·1 – −6·3 | −6 |
| TP10 | −7 – −7·5 | −1·8 |
| TP11 | −5·3 – −5·7 | ≈ 0 |
| TP12 | −1·8 – −2·1 | ≈ 0 |

Using double sided tape and silver foil I screened my four 6F7's. I trapped a short piece of wire under the foil, taking it down to the metalling pin on the IO/UX7 adaptor.

It was now time to fire–up the RF/ frequency changer sections together (I had now construted four adaptors). With HT and LT I was running on 6.3 volts AC. I applied 5 mHz modulated to aerial input. I monitored the anode of the mixer selection of V2. After the 0.00025µF capacitor going to the 1st IF I was rewarded with 400 Hz and swinging the gang showed that I had tuning control. I now had four stages working.

I found that following my line of tracing was paying dividends, I was beginning to get a clear picture of this radio. For instance I was puzzled by seemingly duplicated resistors. It turns out after talking to an ex–RAF colleague that this was common in cutting down the number of stores items. This shows on my circuit e.g two 69's in parallel measured 56 ohms. This was also applicable to capacitors The values indicated are all measured in situ. With V1 pentode section working, its triode section was proved in V3's position. I now moved the signal generator to capacitor No 19 feeding D1 triode. I was again rewarded with a clear 400Hz tone. Five stages working.

By this time I had traced most of the HT- chain. I experimented with a decade resistor box in a location that appeared to be a missing bias resistor. A value of 390 ohms gave a bias of 7 volts. There were a couple of breaks, shown by ** and *** on the circuit diagram. Once I began to see the circuit unfolding, I remade the connections based on experience.

With the information from the BVWS colleague, some of the IF and detector stages started to make sense. The two double–pole change–over switches now fell into place. One in the anode circuit of the oscillator would have brought in the xtal, the other, the BFO IFs and detector circuits. The BFO trimmer was on the front panel. IFT 1 was easiest to trace, the circuit followed a familiar layout, the trimmers have a chassis connection. The circuits which gave me the most problems were IFT2 and the circuits around the second change–over switch. The colleague identified the positions as up, telephone, down, telegraph. IFT2's two disconnected leads were carefully studied. The leads were in the upper section of the set, just above a paxolin panel. The missing top cap connection was also discovered, it was in IFT1.

With all four valves in I applied HT and LT. With 450 kHz modulated at TC of V3 pentode and a small amplifier to the phone jack, I had a 450 Hz note. Three more stages working! I trimmed the IFT's, only IFT1's peaked, IFT2's did not seem to have any effect.

Now the big one! With 5mHz on the aerial, I swung the signal generator around 5 mHz, the 400Hz was at about 4.9 mHz. I had earlier guessed that a compression trimmer on the coil pack and accessible from the outside was the oscillator trimmer. I was right, I slowly 'walked' the trimmer and the sig sen 'up' frequency until 5 mHz was reached on the dial. I followed this by peaking the RF and mixer section trimmers. I was experiencing a 50Hz hum and realised that although the valves were indirectly heated, the LT supply was essentially one wire linking the bases. I reverted to a 6 volt rechargeable. With a clear background and after peaking the trimmers again, the 5mHz signal was slightly better. Time to try an aerial.

From end to end of the band – nothing! I checked reception with a contemporary of the 99, my R109 bought from my science master for £3.00 in 1957. It showed strong signal across the band. I rechecked my circuits. After much careful checking I found the first of two major errors. I had inadvertently connected the triode section of V4's anode to HT+! I was beginning to doubt my connections around IFT2. After much checking I found that one of the coils was earthed! I re–drew the IF circuits in isolation to study. I had to assume that the original untouched connections were correct in 1944.

IFT2 had the two broken ends mentioned earlier and were reconnected to what I thought were possible locations. In IFT2 the base connections of 1, 2, 3, 4 and 5 were original. The ends associated with two of the coils with connections to 4 and 2 were the problem. I reconnected these ends as shown in my final 'circuit'. I think that this looks quite close to what might have been. At about 2.30pm on the 17th November 2007 the 99 produced its first intelligible reception for about 63 years! The frequency was about 6.5mHz (the 41 metre band). I think it picked up a Dutch station, the tuning was quite sharp with a very reasonable sound.

It was only after I had got reasonable results that I found out the function of the 'push' switch. The BVWS colleague had identified it as being for measurement. I wondered whether the 600V pin on the rear socket was the HT+ input? The +250 pin is linked via the push switch to the HT bus, the 600V pin via coil pack connections 4 and 5 is connected to the HT bus.

There are two problems which are still out standing, the BFO and Bias. The BFO operation eludes me. I think it may have centred around a broken wire (marked * on circuit diagram). Regarding the Bias, I have experimented with alternative circuits and seem happy with the one shown in the circuit diagram. The test points, especially the HT and LT, are close to those in practice. The bias levels with the exception of one are miles out. For example, TP11 should be -5.3 – 5.7, 12 -1.8 – 2.1 (according to the small rear panel), both measure zero! Other anomalies appeared; TP5 should be 90 – 120, it's not connected to anything! In general, the HT test points are within, or close to the marked values eg TP3 230 – 270, measured at 253.

A couple of things were done to improve operation and appearance. I made a panel lamp cover out of thin sheet brass. Two tapped holes took a re–tapped 6BA bolt, I painted the cover black, with the inside white. It works quite well! The other item was a plug for the rear socket. Up to this time I had used small crocodile clips. The main problem was the physical dimensions of nuts, bolts, connection pins etc. The socket pins measured 2.9mm. I used 2mm sockets carefully bored out. I made a paxolin panel to match a piece of aluminium tube from a piece of vacuum cleaner hose. The tube fitted nicely into the socket. With the seven modified 2mm sockets pushed into the pins I used a small amount of araldite to bond tube, panel and sockets together. Then whilst unplugged, I applied resin/hardener to reinforce the whole thing. My first attempt ended in near disaster. The resin leaked between the tube and socket, I had to cut it out!

I am now at the position of having a working World War II Japanese military radio. It is still close to its original condition. If I ever come across the original valves they will plug in with the small top caps reintroduced and it should continue working.

Regarding my circuit diagram; the circled numbers near components are their idents. Some components have no value. This is because it was out of view. The inductors, eg 17 and 75 have no values. They are wound on insulated cores. I have included Japanese symbols where possible. The circled numbers near the RF and IF coils are the numbers at the mounts. TP are the test points. An original circuit diagram would clear up the mystery connections, especially around the Bias and BFO circuits.

At the end of the day, I think I am lucky to have it going as well as it does. It has been an enjoyable restoration project; I have literally crossed oceans for information, met pleasant, helpful people with similar interests. I know Howard would approve.

References

1 WW December 1944
2 Radio Bygones No. 57 page 14
3 Army Radio Spares Co. (sales@armyradio.com)
4 For personal reasons the BVWS member wishes to remain anonymous

# Rectification by Bill Williams

The radio books I read when I was young often contained a phrase like 'AC must be rectified before it can be used.' This deserves the riposte, 'Why, what's wrong with it?' The earliest electrical machines and appliances usually ran from a DC supply from steam driven dynamos. DC power at a potential suitable for domestic use could only be economically distributed over a very short distance, requiring a power station for each small town or city block.

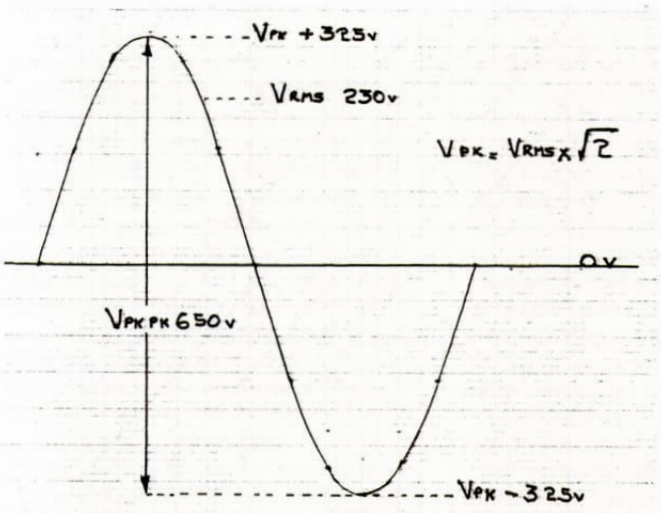



Fig 1a Voltages in a 230v RMS Sine Wave

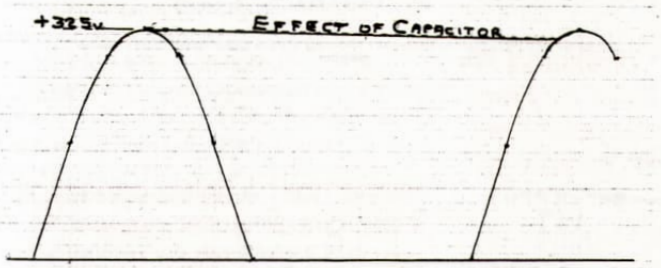



Fig 1b The above waveform ½ wave rectified by a perfect rectifier

AC which could readily be 'stepped up' to very high voltages to transmit enough energy for a whole city hundreds of miles from where the hydro–electric power or coal was and then 'step' it back down again for household use, had to be the only viable system. Many of the early power companies had a huge investment in DC power and naturally resisted any change to AC. Their line was that there WAS something seriously wrong with AC. It couldn't power some devices made for DC and it was very dangerous because it could produce high voltages. It was no contest. The AC power companies supplied converters for industrial users who needed DC and in my native city of Birmingham, householders with DC mains radios were given free adaptors to enable their sets to run off AC. Thus a word meaning to put right came to also mean a device to convert AC into DC.

Most readers will immediately associate rectification with radio HT supplies but in radios it also plays a very important role in recovering audio from the signal AVC frequency changers and measuring instruments like multimeters and valve testers.

In this article I am going to concentrate upon the types of HT supply we see in vintage radios. The device we call a rectifier does not convert AC to DC. It changes a current which flows in alternate directions into a stream of unidirectional pulses. To turn this into smooth DC we must add a smoothing circuit and in accord with the definition 'AC to DC converter' the rectifier and smoothing circuit must be considered together.

I think anyone from the service trade of forty years ago and a lot of BVWS members will agree that the part of old radios most likely to fail is the HT supply. Power supplies tended to be a bit of a 'Cinderella' subject even among circuit designers. They were too simple to merit serious thought. Often a little thought applied to selecting a component with an adequate margin of safety or a two–penny resistor in the right place would have made a whole world of difference and six–penny worth of protection would have reduced a major repair job to a simple component change. Some sets were quite notorious; an experienced service engineer given the model number would tell you the fault with 95% accuracy. One maker produced a rentals version of a popular model because the rentals trade demands high reliability. The rentals set differed in the specification of only two parts. If inadequate design was one factor, the fitting of unsuitable parts by the service trade was sometimes another. I think it's time that Cinderella went to the ball!

Elementary texts on rectification usually deal with idealised components, for instance diodes, which behave like switches which turn on when the anode is positive and off when it is negative. I have no problems with this approach to understanding how a circuit works. All understanding has to start somewhere but real circuits use real components and the next step is recognising all the imperfections of real parts and using this knowledge to design circuitry which achieves the design objectives exactly and with high reliability. Most valve makers at one time produced valve data books of popular receiving valves which included some circuits which were guaranteed to work if exactly the specified parts were used, but also provided tables of parameters and limiting values sufficient for basic design work. Very full data often running to twenty pages per valve was available to professional designers but the data from the popular books is more than adequate for power supplies.

Let us look at some real components with imperfections and limitations and see what they do in real circuits – I will only consider types in common use in vintage sets. First, the rectifier. This would be a finned copper oxide rectifier in some early mains sets; finned selenium circa 1950 and contact cooled selenium circa 1955. Valves would be half wave (single diode) indirectly heated with high voltage heater cathode insulation for AC/DC sets. Double diodes with a common cathode are often called full wave but more correctly bi–phase rectifiers. These may be directly heated or indirectly heated with the cathode connected to one end of the heater. These need a separate highly insulated heater supply. After world War II bi–phase rectifiers with 6.3v heaters and high voltage cathode insulation for sharing a heater supply with other valves became quite popular. What follows applies only to the foregoing devices. Modern silicon power rectifiers behave in very significant different way.

Before discussing the practical operation of rectifiers, a word about AC voltages. If you connect your multimeter to your domestic mains it will read about 230v. That is 230v RMS. AC power voltages are always RMS unless otherwise stated. Hence the mains voltage is just 230v. When AC mains first came into use there was a problem of how to specify the supply voltage to the user. The chosen form was a means to specify AC voltage in a way which it would enable say 230v AC to light a filament lamp to the same brightness or make an electric kettle boil in the same time as 230v DC. Some early texts refer to effective voltage but RMS (Root Mean Square) became so standard that we take it as read, RMS means what it says. If we measure the amplitude of an AC voltage at regular intervals and square the measured values, the square root of the mean of all these squares is the effective value. In basic power engineering the AC waveform is assumed to be sinusoidal. RMS is true for any wave shape but a sine wave gives nice simple relationships – shown in Fig 1a.

If this waveform of 230v RMS were applied to an ideal rectifier which passed the positive half of the wave only – Fig.1b – it is apparent

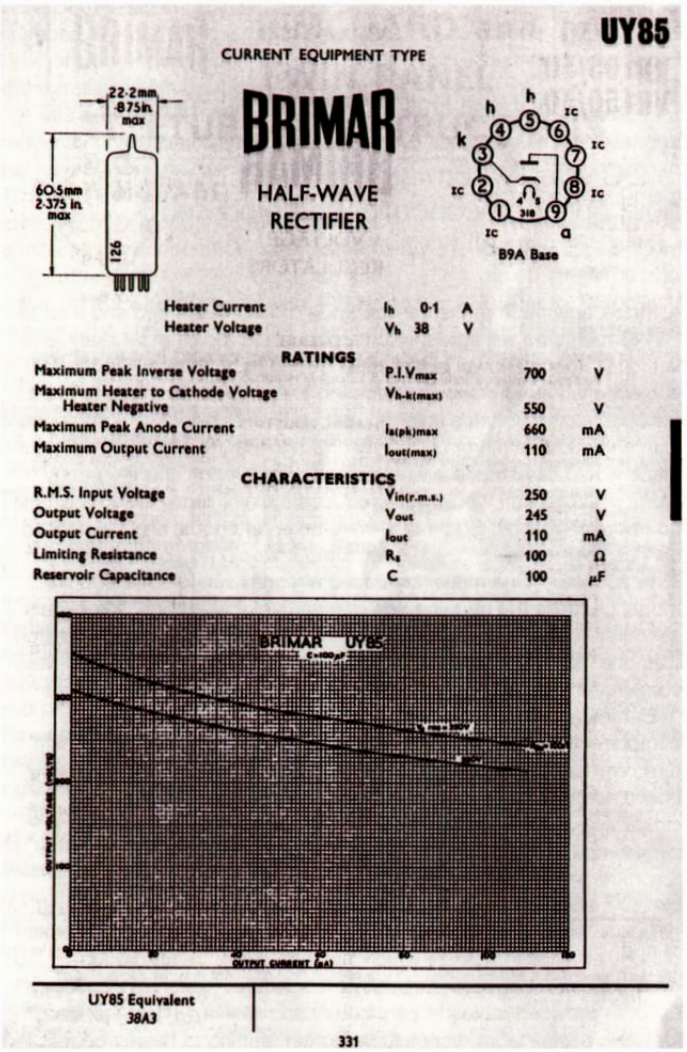



Fig 2

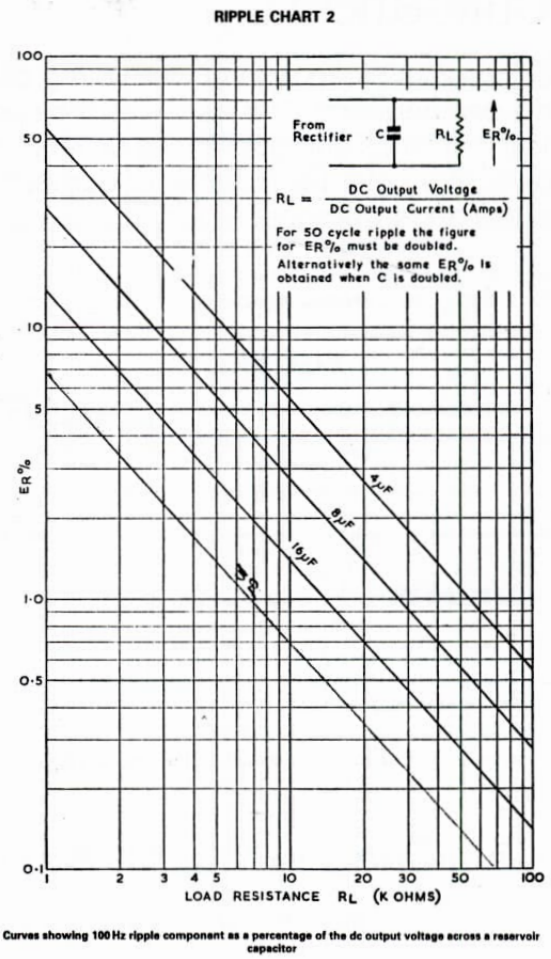



Fig 3

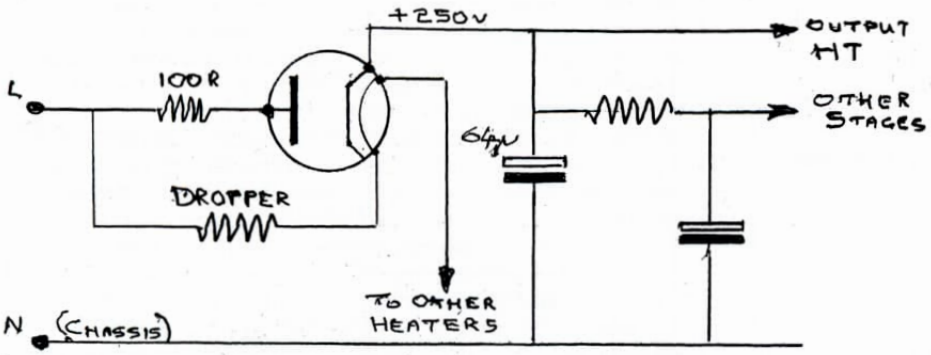



Fig 4

Remember a failed capacitor, if the circuit is not protected, can lead to a failed rectifier and a transformer burn out.

that the cathode of the rectifier will reach a peak potential of about 325v and were the device a valve, the heater to cathode insulation must withstand at least this value and as we shall see when we come to real circuits it may need to be much higher. If we connected a capacitor to the rectifier cathode it would charge to 325v and realistically have to be 350v working. With the capacitor charged to 325v the anode can swing down to -325v. The valve must therefore be able to withstand 650v to rectify 230v AC. Realistically a half wave rectifier for a 230v AC/DC set will have a peak inverse voltage rating (PIV)of at least 700v.

Now we have to consider a real rectifier which has inconvenient facts like internal voltage drop, maximum permitted reservoir capacity, minimum supply impedance and maximum peak cathode current. All this is specified on any basic data sheet. Exceeding any of these limits will reduce rectifier life and failed rectifiers can damage smoothing capacitors or burn out a mains transformer if it is inadequately protected.

We will construct a simple half–wave circuit for an AC/DC set operating from 230v 50Hz mains to supply an HT of about 250v at 60mA most of which is consumed by the output stage. I have chosen a UY85 rectifier because I have data for that. I haven't designed a valve rectifier circuit since the late 1950's when silicon rectifiers became available and revolutionised power supplies. Referring to Fig. 2 and Fig. 3 we choose a value for the reservoir capacitor. How big it needs to be depends upon how much HT ripple can be tolerated. In AC/DC sets it was common practice to feed the output stage direct from the rectifier cathode. Because there is no following amplification and the speakers in small sets have poor bass response, considerable 50Hz hum voltage can be tolerated in the output stage anode supply; usually up to 2% will be unnoticeable. A second RC low current filter reduces the ripple for the other stages to a fraction of 1%. Some AC/DC sets have choke filter circuits and these may only require quite small reservoir capacitors. Calculate RL for Fig 3

$$RL = \frac{250}{0.06} = 4.17K \text{ for } 60mA \text{ at } 250v$$

Run up to the 4K line to intercept the 32µF line below 2%; for 50Hz we must double this to 64µF. 64µF 400v electrolytics of

ripple current ratings 300 to 400 mA are available of current manufacture and are comfortably inside the valve limit of 100µF max. Which brings me to ripple current. This is approximately the ripple voltage which in this case 2% of 250v or 5v peak to peak or very roughly 2v RMS $\frac{1}{wc}$. Therefore the current in 64µF at 50Hz will be

$$\frac{1}{100\pi \times 64 \times 10}$$

which is near 40mA which makes my capacitor selection provide a large margin in both voltage and current. This is the recipe for high reliability. Never dismiss ripple current rating as unimportant. Some of the early rectifier types in AC mains sets have a maximum reservoir capacity rating of only 8 or 16µF. If it's a large radiogram with an HT requirement of 150 mA or more you may need a capacitor rated of a 1/4 amp or more. Rectifiers in these sets may have a ripple voltage at the cathode of 20v RMS which the following choke removes, but the reservoir capacitor has to pass the ripple current. Some of the current 10 and 15µF 450v axial capacitors you may be tempted to fit have a current rating less than 100 mA. Remember a failed capacitor, if the circuit is not protected, can lead to a failed rectifier and a transformer burn out.

Two more parameters have to be attended to; maximum peak cathode current and minimum series resistance. Fit a 100Ω resistor and we have complied with both. In the case of the resistor I would use a wattage barely adequate with the intention that it would burn out if the HT supply is shorted and protect the circuit. Resistors with a non–flammable coating must be used. We are using a real valve with considerable internal voltage drop which added to the effect of the resistor means we shall get a lot bless than 325v. The graph on Fig. 3 shows that interpolating between the 220v and 250v curves we should have near 250v DC at 60 mA load. However the same graph indicates that if the output transformer went open circuit the voltage would rise to about 320v. Therefore all capacitors connected to HT should be 350v working or much more than an output transformer may have to be replaced.

The final circuit is in Fig. 4. It was arrived at using only rough approximations. There is no point in using precise circuit theory to compute circuit constants to three significant figures when we finally have to make a selection from available components like 47 or 68µF at 250 or 400v. Just work with a good margin on the right side.

The design I produced was obsolete fifty years ago. The design methods by which it was arrived at will enable BVWS members faced with the need to repair a set using alternate parts or components of recent manufacture to make choices which will result in satisfactory and reliable operation.

There was a period when electrolytic capacitors evolved to pack more microFarads into smaller cans when some service engineers replaced failed capacitors with higher values. They said it improved smoothing. It certainly didn't enhance rectifier life but then that was good for trade. If you have a set which has had smoothing capacitors replaced, check that the value, ripple current rating and working voltage are correct and if necessary select a suitable replacement.

The bi–phase rectifiers used in AC mains sets are essentially two half–wave circuits with the added complexity of a transformer. The essentials are exactly the same except the ripple frequency is 100 Hz instead 50 Hz. In this case the minimum series resistance may be supplied in part or totally by the resistance of the transformer windings. As is always the case there is a contribution to the effective secondary resistance from the primary. To find the effective series resistance per anode, measure the primary and half secondary resistances then add the primary resitance times the square of the turns ratio to the half secondary resistance – e.g for a 230v primary 460–0–460v secondary that is 4 x primary + 460v winding per anode. If the result is not high enough, resistance must be added to the anode circuit. It is often assumed that the transformer effective resistance will be sufficient. If it is necessary to substitute another rectifier type, it may not be.

Bi–phase rectifiers often have similar ratings in both directly and indirectly heated types. Generally, providing all the ratings

A possibility which I have never tried is to fit silicon rectifiers with suitable resistors and clamp the capacitor voltage to a value well below its voltage rating but with the valves warmed up with series connected zener diodes.

are compatible, indirectly heated types may be substituted for directly heated types with some advantage. The converse is not advisable. Indirectly heated rectifiers take much longer to get their cathodes to operating temperature so that by the time they pass current the other valves are ready to sink current. The load from the rest of the set prevents the voltage at the reservoir capacitor from surging to near the transformer peak voltage. Some old sets with directly heated rectifiers have a reservoir with a high surge rating to withstand this surge. Designs specifying indirectly heated types may not.

The most modern set in my collection is an HMV model 482 (1935). I purchased this in good working order. In the U14 rectifier socket was a B4 valve base with two 1A 1200 PIV silicon rectifiers each in series with a large wire wound resister. Someone had done a good job. The series resistors had been selected to bring the HT down to the design value when the valves were heated, but before that there was a surge to over 500v. The reservoir capacitor being intended for use with a directly heated rectifier was rated 500v working, 550 surge, 250 mA ripple 16µF. I give whoever did it 9 out of 10 but I couldn't leave it like that. Capacitors rated at over 500v don't appear to be made any more and I always replace old capacitors. I fitted 500v 16µF plain foil and put an MU14 which is an indirectly heated replacement for the U14 into the socket. With this rectifier the surge is no more than 400v. Over twenty five years on, all is still well and may continue to do so unless some future owner finds a new U14 or fits silicon rectifiers.

I have pondered upon what I could do if it became impossible to replace the valve rectifier in one of my old sets with a suitable alternative even by changing the valve holder or making an adaptor. A possibility which I have never tried is to fit silicon rectifiers with suitable resistors and clamp the capacitor voltage to a value well below its voltage rating but with the valves warmed up with series connected zener diodes. When the voltage drops to normal the zeners of course cease to conduct. The zener voltage and current rating can be read directly from the rectifier characteristic and if the zener power rating is adequate, failure of the valves in the set to draw current for any reason does no harm. Zener diodes may fail short circuit if overloaded. Fit a protective fuse. Capacitors fail short if over–voltaged so fit a fuse anyway; which brings us to protection. A fuse of suitable rating is very cheap, very reliable and totally effective. It cannot prevent a fault condition but when a fault occurs it may prevent a transformer burn–out or even a fire. A fuse to carry normal HT current in the transformer centre tap return covers all common HT faults. The very rare anode to anode short in a bi–phase rectifier may need a primary fuse. 1 amp fuses for 13A mains plugs are available.Prolonged overloads insufficient to blow a fuse need a thermal trip best clamped to the transformer core at a point remote from the chassis. I expect I will get some mail if I don't treat you like children and warn you that HT voltages may harm you. If HSE find out what is inside old radios they will probably ban them.

My objective in this article is to help readers with average skills and old radios with rectifier problems without going into the field of power supplies other than in this very narrow context. I hope it may help you to put it right.

# Radio and Moving Pictures on You Tube

By now most of us are probably using the internet as a fantastic source of data and project ideas. In fact I can't remember the last time I looked up data in a 'real' paper data book, and of course eBay has become a significant site for radio restorers and constructors to buy and sell equipment and components. I particularly enjoy looking at 'Virtual Museum' websites where you can view high quality pictures of various vintage equipment and components, along with notes on the gear explaining its origin.


Hallicrafters Super Defiant SX-28 radio, tuning to SSB signals on 20m. Note the Related Videos section on the right hand side showing other classic receivers.


AR88


Result of the Marconi Radio search

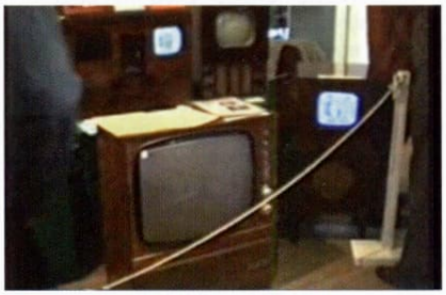

Tuning the Heathkit DX–40 transmitter

The EM11 magic eye valve


Making a triode on You Tube from scratch


The 'Duck and Cover' cartoon with Bert the turtle

Result of BVWS search on You Tube



Television display at Harpenden

Possibly less well known to vintage radio enthusiasts are the video clip sharing sites, such as You Tube. You might think that You Tube is only for 'youngsters' looking for music performance clips, but I was pleasantly surprised when I took a real ferret around on the site just how much radio and electronics 'stuff' it also holds. Maybe we tend to think our hobby doesn't 'move' very much, in a literal sense, and so moving images aren't really relevant. I think I've now convinced myself that this simply isn't true!

To view You Tube content, you'll need a reasonable speed internet connection. I get about 3Mbps from BT, and this gives pretty good results, although at busy times of the day, the clips sometimes pause a little. Also make sure the audio is working on your PC so you can enjoy the noise the featured radios make.

**Where to Start?**

One great example of how moving images represent our hobby is the demonstration of a good old Hallicrafters Super Defiant SX-28 radio, tuning to SSB signals on 20m. Go to: http://uk.youtube.com/ and search for 'super defiant' to get to the demo. The commentary is obviously given by an experienced US-based 'ham', though he doesn't give his callsign. There's a similar demo of the AR88D, being tuned across the broadcast bands. Again just search for 'ar88'. Don't worry about upper and lower case letters, You Tube is insensitive to the case in searches.

As you'll discover as you use the site, whenever you make a search and find a clip on You Tube, its search engine also generates a Related Videos list. If you click on these thumbnails, you will often be taken in unexpected directions. I recommend you try this and let serendipity take its course. In the case of the 'ar88' search you'll see clips of other new and vintage receivers, including the Drake R-4C, which you may never have thought of looking for, being tuned across the amateur bands.

> The full range of Heathkit products is represented, not just radio-related ones. Just enter 'heathkit' and see the many 'hits'. Take a look at the Heathkit Hero robot: there are lots of clips of this fascinating machine.

Like any internet-based search, you can be as exact or as vague as you like. An example of an exact search was when I typed 'valve radio restoration' into You Tube. Many interesting and informative videos came up.

I tried a search for some classic domestic radios by first of all entering 'ekco' and found a clip on the A22, in fine condition and working. 'Murphy radio' didn't produce the effect I expected: I got some wrapper DJ singing something about Rhodes-Murphy, whatever that is! 'Marconi radio' proved to be a good

starting point for many vintage radio related items. An interesting related item was 'world's largest radio', a clip showing the commissioning and operation of a massive 1MW RCA-built transmitter for the US Navy.

'Transistor radio' does produce some clips of what I expected, ie vintage transistor radios, along with some songs with this phrase in the title, including Connie Smith's 'Tiny Blue Transistor Radio', which was a hit in 1965. Interesting to see how this new technology made it into the pop songs of the time.

Choose Your Favourite Modulation
Select your modulation type of interest by searching for 'amplitude modulation', 'frequency modulation' or 'single sideband'. All produce illustrations of the theory and practice of the mode.

AM transmitters, both professional and amateur-built, are well covered on You Tube. For example, there's an interesting video of the Heathkit DX-40 being tuned. The video starts with a slow 'tour' around a very well preserved example of this well known AM/CW transmitter and then proceeds to a sequence of peaking the grid and dipping the final current on 80m, with 50W output power: no doubt very evocative of many amateurs' early days in radio. A good-looking Heathkit SB-102 transceiver is shown 'covers off' and operating. A complete Heathkit station line up of HR-10 receiver, transmitter (DX-60) and VFO can be found by searching for 'heathkit ham radio station'.

The full range of Heathkit products is represented, not just radio-related ones. Just enter 'heathkit' and see the many 'hits'. Take a look at the Heathkit Hero robot: there are lots of clips of this fascinating machine.

British equipment doesn't seem to be very well represented, although a search for 'codar' produced a very interesting clip of a CR66 receiver in action. 'Eddystone' produces a few radios (it would be nice to see more), a demonstration of the bug key producing live CW, the steam locomotive 34028, the lighthouse and a brand of air rifle. Related videos shows a list of many bugkeys, professional and home made, I'm sure of interest to CW fans.

**Valves and Tubes**
Although valves glow and therefore are more photogenic than transistors, they generally don't move. However, one type of valve that shows well in a movie format is the magic eye. 'Magic eye valve' or 'magic eye tube' returns videos of the EM11, EM34, EM80, EM84, 6AF6 and 6E5 in action. The EM11 is particularly interesting since it has the 'Maltese Cross' (or clover leaf) display format.

One very movie-genic type of valve is the mercury arc rectifier, with its eerie moving strings of arcs. A search for 'mercury arc' will return several clips of these rectifiers in action. A particularly interesting one was shot at Laxey substation, on the Isle of Man, in June 2004.

Both professional and amateur valve (or tube) making activities are represented on You Tube. If you search for 'making valves', an old three part Philips-Mullard series showing the manufacturing process of valves, in particular a pentode, is revealed. The video starts by showing the individual components, such as the cathode, heater, grids, and so on, and then shows how they are assembled, largely by hand, into a working valve. 'Mullard blackburn' reveals a series of clips of valve manufacture in the Mullard works in that town.

On a similar vein, if you search for 'making tubes' you'll get a fascinating video of an amateur making his own triodes. A related video shows the 'The Making of a Triode' based on the original 1906 patent descriptions by Lee De Forest.

There's an interesting series beginning with 'how to spot a nos ...'. For example searching for 'how to spot a nos 6v6gt' gives a clip about the various types of 6V6 valves. The term 'NOS' stands for New Old Stock, that is obsolete equipment or components that have never been used. Its use in our hobby is just a sub-set of similar use in car restoration and other hobbies where old but unused components are needed.

The construction of valve equipment is a popular pastime. A search for 'valve amplifier', 'valve radio' or 'valve transmitter' produces many pieces of 'new' valve design and construction. Don't forget also to try the word 'tube' in this sort of search, to make sure you pick up the US content.

**Transistor Theory and Practice**
If you want to refresh yourself on electronics theory, there are many videos to choose from. 'Transistor biasing' reveals many videos on the subject, including a series of lectures from the Indian Institute of Technology in Madras. An interesting related video is 'Comparing the function of transistors and valves', with a very mellow commentary.

A search for 'transistor amplifier' returns videos of many home-built amplifiers, as expected. The history of transistors (invented in 1947, so they already have a fairly long history) is also well represented.

**Hamfests and Rallies**
You may have seen reports and pictures of the famous annual hamfest at Dayton, Ohio. Search for 'hamfest' and you'll see clips of many of these events in the US, as well as Dayton itself. A search for 'friedrichshafen 2009' shows this popular German Ham Fest, accompanied by a very dynamic pop soundtrack (if it's not to your taste, you can always turn the sound off). A search for 'radio rally' will produce many UK events.

I'm pleased to say that a search for 'bvws' returns a video of the Wootton Bassett event in December 2008, and Harpenden is also represented. Can you see yourself there? 'British vintage wireless' produces clips of many more events, including the National Vintage Communications Fair.

**Restoration**
The restoration of old equipment is well represented. For example, a series of five videos on the detailed restoration of an RCA radio model 280 can be found.

If your interest lies in old TV sets, search for 'my tv set collection' (not mine) to see and drool over a vast collection of old TVs. Many tv-related videos can then be selected via the Related Videos, including demonstrations of mechanical TV sets.

The many different styles of receiver can be explored by searching for 'crystal set', 'regenerative radio', 'superhet receiver' (though believe it or not, there's actually a band with this name ... enjoy!) or 'trf radio'. You'll see lots of examples of each type. 'Shortwave receiver' brings up many examples of all types.

**Duck and Cover**
In 2007 I wrote about the Conelrad alert system (see Radio Bygones February / March 2007: issue number 105) and referred to the US Civil Defence cartoon film Duck and Cover, which features the character Bert the Turtle warning children of what to do in the event of an unexpected atomic strike. At the time the cartoon was somewhat difficult to track down on the internet, but now several versions are viewable on You Tube. I recommend you take a look and wonder at the matter-of-fact approach to surviving atomic war. I quote: 'We all know the atomic bomb is very dangerous ... '.

A later development from Conelrad was the EAS Emergency Alert System: a clip showing a test transmission of the system has the warning spoken by a Steve Hawking-like synthesised voice. The system is still used for other emergencies, including Tornados, and various examples from different regions of the US can be seen.

**What Else?**
As well as indulging your radio habit, don't forget to view some of those old Elvis, Beatles and Rolling Stones videos! If you're interested generally in science and engineering, take a look at the model and full-size engines, all the way from steam to jet technology. There's also an impressive collection of clips of model rockets, including how to make them if you're so inclined.

If you want to re-live your youth (or the youth you wish you'd had), search for 'model steam', 'model rocket' or 'model aircraft'. I was just enjoying watching a massive B-29 model aircraft flying around ... most impressive!

I hope you've found this article interesting and are going to give You Tube a try. I've only scratched the surface of what's on the website relevant to our hobby. I can't guarantee that all the videos I've referred to here will be available when you take a look: the site is ever-changing and no doubt you will find much more of interest than I can even hint at. Take a look around the website and search for what interests you in radio. If you can't find anything that's down your street, maybe you should consider shooting a clip and uploading it for others to see.

# Murphy Day 2009

This years Exposition at Mill Green Museum centred around smaller household sets of the 1950's and the specific export receivers made by Allied Industries under licence from Murphy Radio for the New Zealand market.

A good number of ex-employees and BVWS members enjoyed the afternoon of radio and TV entertainment.

A fully restored and working Murphy V114 was presented to the Museum for their on site collection.



# ‘Wireless Waves’ Weekend at Bletchley Park

The BVWS were invited to one of the many open weekends held at Bletchley throughout the year. The theme being ‘wireless in war time’. John Pether, a prominent member of the Bletchley team arranged for us to set up a display of vintage radio and TV in the mansion.

A large number of VMARS members set up radio tents in the grounds and operated mobile and fixed amateur stations. There was even an amateur TV station broadcasting images from our display to other buildings on the site. With a good number of people in period uniform it was quite off putting to meet up with a German storm trooper, but most entertaining.

Most of the TV’s ran for over seven hours a day on both days without the slightest glitch. Only the pre-war Cossor 54 protested late on the second day.

We were amazed at the interest people had for the display with many spending up to an hour just watching the early post war material and listening to war time music and radio broadcasts.

Peter Merriman, although not pictured here also spent a great deal of the two days with us and helped with arrangements and set up. This was a fine day that we look forward to repeating in the future.



# Bonhams TV Auction

## Michael Bennet-Levy Early Technology Collection Sale, Knightsbridge by Ken Brooks

Anyone with an interest in early television would have enjoyed this extensive collection on public display prior to the sale. Upon entering the subtly lit sale room, here was laid out what may be the largest private collection of pre-war televisions ever seen. Passing the impressive Pye MK III camera, famous for its appearance in the opening shots of Grandstand, was a mouth watering selection of both pre and post war televisions, accessories, and literature.

This was a chance to see some sets featured in the television enthusiast's bible, TV is King, and much more besides in all their glory. A large number of post war sets, mostly 405 line monochrome, occupied one side of the sale room. These were the sets that defined living rooms from the late 1940's to the 1960's, ranging from the modest kit set based upon a surplus radar tube, console and table sets, through to monster combination radio, gramophone and television units. There was also some early colour equipment.

A separate area housed an important archive of early television material, and prominently displayed was the original printed running schedule for the service opening in 1936, a truly historic

Below: Rosemary Brooks wonders how the Baird T14 with cellarette will fit in the lounge

document. Nearby were early cathode ray tubes, a mirror drum and a Baird mechanical Televisor. Cleverly suspended from the walls were some examples of X and H aerials, at one time part of the built environment but rarely seen today.

Another area displayed twenty six pre-war television receivers. When one considers that surviving pre-war televisions are rarer than Stradivarius violins the significance of such a collection becomes immediately apparent and the display represents a good portion of surviving pre-war sets. These receivers were first bought at considerable expense to enjoy just a few hours of the single broadcast channel and represented an act of faith on the part of pioneer owners. Sets ranged from tiny 5" tubes through to the grandeur of enormous mirror lid receivers with radio and gramophone, housed in distinctively crafted cabinets. Visitors were even able to enjoy a rare sight of a restored pre-war set working. Several BVWS members were spotted at the viewing and so inspiring was the display that a decision was taken to attend the sale day, with perhaps the possibility of carrying away a small part of this magnificent collection. Thanks are due to Laurence Fisher and the Bonhams team for their hospitality and for mounting such a superb display.

# Marconi Monument, Alum Bay

John Elgar Whinney pays this historic memorial a brief visit

At the Needles holiday park in Alum Bay, Isle of Wight, almost hidden away amongst various tourist 'attractions' is a small four–sided granite monument. The bronze plaques attached onto the four sides gives some dates of Marconi's successful experiments from this location.

In December 1897 Gugielmo Marconi set up his wireless equipment in the Royal Needles Hotel, above Alum Bay where he sent the very first wireless radio transmission across the Solent using a huge 168 feet high mast.

There is no admission charge to the park and all–day parking is only £3 per car.


# Letters

**Dear Editor,**
I've recently returned from a holiday at Lake Garda in Italy. On a particularly wet day, rather than lounge around the hotel all day, my wife & I took buses and trains to Verona. We were surprised to find out about a radio museum hidden away in the Technical Institute. It's a large collection, founded in 1999 and subsequently updated in 2001.

Most of the radios are from a private collection and cover from the 20's through to the late 70's. They are organised over 3 rooms, mainly in show cases, in 15 main sections as follows:
1 Philips Receivers, 2. Example of a Radio Test Bench, 3 Scientific Devices & Receivers with external Valves, 4. 20's Receivers, 5. 30's Receivers, 6. Crystal Sets, 7. Valves, 8. Laboratory Equipment, 9, 10, 11. 40's Receivers, 12. Speakers from 20's, 13, 14. 50's Receivers, 15. Car Radios

Naturally there are many Radiomarelli receivers, but there is a good selection of European and American sets too. They don't have any round EKCO's though!

The museum is located in the Instituto Tecnico Industriale Statale on Via del Pontiere, Verona, Italy.

There are several hundred receivers on display plus some televisions and other radio related items. It's well worth a visit.

Their website is www.museodellaradio.com and it gives a lot of detail regarding the displays.

There is a comprehensive catalogue available, but as far as I can tell, it's free if you are visiting and have paid to enter - mine was anyway (at least I hope it was supposed to be - I just picked it up off a pile by the entrance!) If any members do go to Verona, buy a special attraction entry card at the Tourist Bureau in the train station - it gives entry to 10 different places of interest, including this radio museum and major tourist spots such as the Arena, Romeo & Julliets houses, Julliet's Tomb etc. and saves a great deal of money.

Colin Boggis

**Dear Editor,**
BBC OBA/8 Amplifier.
Not long before WWII, the BBC developed a very useful Outside Broadcast Amplifier, the OBA/8 that was technically advanced, for example, using negative feedback for gain control . The main amplification was achieved by a pair of AC/SP3 valves.

Considerable use was made of the OBA/8 for other purposes such as control rooms, continuity suites etc.

Although it was followed by the OBA/9 in the 1950's I understand that the OBA/8 remained in service in some cases until the 1960's

I would be grateful if any BVWS member who has circuit details of the OBA/8 would be so kind as to let me have a copy.

Peter Lankshear
peemel@clear.net.nz

**Dear Editor,**
I'm sorry to feel compelled to write this note to you, and I hope that you will publish it!

Over the past year I've responded many times by email to member's requests for information and parts, whenever I've been able to help. Whilst some members have come back to me to say thank you, I have to say they are in the minority! Many members don't reply, and I'm at a loss as to why this is. It might be that the email addresses given are no longer functional or for some obscure reason my mails don't get through, although I never experience this problem with other contacts. Can I just ask members, in future if someone offers help or sends data, please let them know you've got it! Lack of replies is likely to lead to no responses and this doesn't help us keep the old radios going!

Colin Boggis

**Dear Editor,**
In many articles on set restoration, there is a description of the set as found prior to work starting. Fair enough. But I have noticed that when it comes to describing previous repairs, it is often done in disparaging terms regarding the workmanship and methods used. These repairs are all part of the history of the set, and were probably done many years ago, maybe during wartime conditions when parts were in short supply. The repair may have been done to a set that had worked for many years without a fault, with the intention of giving the customer a bit more service from the receiver at minimum cost. It certainly wasn't done with the thought of preserving the original appearance, or that some fifty years or so later, some critical inspector would be picking holes in their work. The chances are that the repair did its job, and the customer was satisfied. The choice of restoring the set to original is that of the present owner, so don't be too hard on the old service repair man, his job was to get the set going again, and make a living.

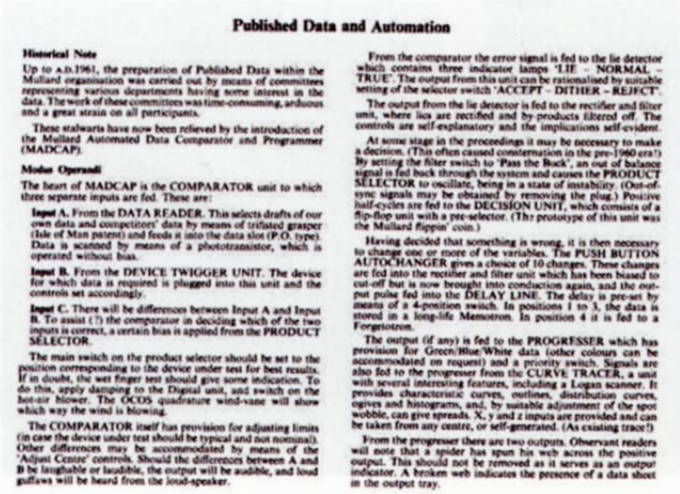
David Rudram

**Dear Editor**
Going through my old documents from when I was working for Mullards at Mullard house Torrington Place 1959-1961, I came across a couple of Technical Service Department Christmas entertainment pieces in which I had involvement one way or another. I actually started work for Mullards at their Magnet division in Shaftsbury Ave in 1954 then I moved to Mullard House around 1955 or 56 then I had two years in the Royal Sigs 1957-1959. TSD amongst other things was responsible for assessing the differences in competitor's valves in order to push Mullard Valves to the public. we also dealt with public enquiries on the 5-10 Amplifier which was being sold as a DIY Kit, this also meant attending Earls Court Exhibitions.

Peter Logan

**Dear Editor,**
**Ref: The Bulletin Vol 34 page 38 Autumn 2009.**
In reference to Steve Stares letter in the Bulletin. I believe the location for the Ekco advertisement is Bitterne Triangle in Southampton. The advert is on side of a building which is now a Fish and Chip shop (one of the best F&C shops in Southampton).

Best regards,
David Dawkins - Southampton



**Published Data and Automation**

**Historical Note**

Up to A.D.1961, the preparation of Published Data within the Mullard organisation was carried out by means of committees representing various departments having some interest in the data. The work of these committees was time-consuming, arduous and a great strain on all participants.

These stalwarts have now been relieved by the introduction of the Mullard Automated Data Comparator and Programmer (MADCAP).

**Modus Operandi**

The heart of MADCAP is the COMPARATOR unit to which three separate inputs are fed. These are:

**Input A.** From the DATA READER. This selects drafts of our own data and competitors' data by means of trifated grasper (Isle of Man patent) and feeds it into the data slot (P.O. type). Data is scanned by means of a phototransistor, which is operated without bias.

**Input B.** From the DEVICE TWIGGER UNIT. The device for which data is required is plugged into this unit and the controls set accordingly.

**Input C.** There will be differences between Input A and Input B. To assist (?) the comparator in deciding which of the two inputs is correct, a certain bias is applied from the PRODUCT SELECTOR.

The main switch on the product selector should be set to the position corresponding to the device under test for best results. If in doubt, the wet finger test should give some indication. To do this, apply damping to the Digital unit, and switch on the hot-air blower. The OCOS quadrature wind-vane will show which way the wind is blowing.

The COMPARATOR itself has provision for adjusting limits (in case the device under test should be typical and not nominal). Other differences may be accommodated by means of the 'Adjust Centre' controls. Should the differences between A and B be laughable or laudible, the output will be audible, and loud guffaws will be heard from the loud-speaker.

From the comparator the error signal is fed to the lie detector which contains three indicator lamps 'LIE – NORMAL – TRUE'. The output from this unit can be rationalised by suitable setting of the selector switch 'ACCEPT – DITHER – REJECT'.

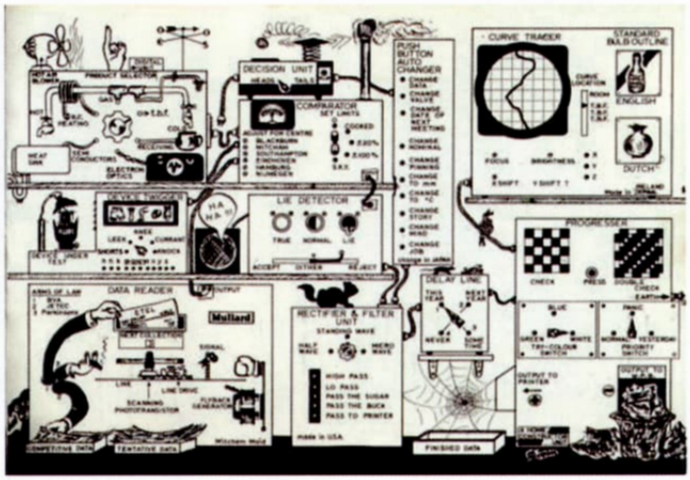
The output from the lie detector is fed to the rectifier and filter unit, where lies are rectified and by-products filtered off. The controls are self-explanatory and the implications self-evident.

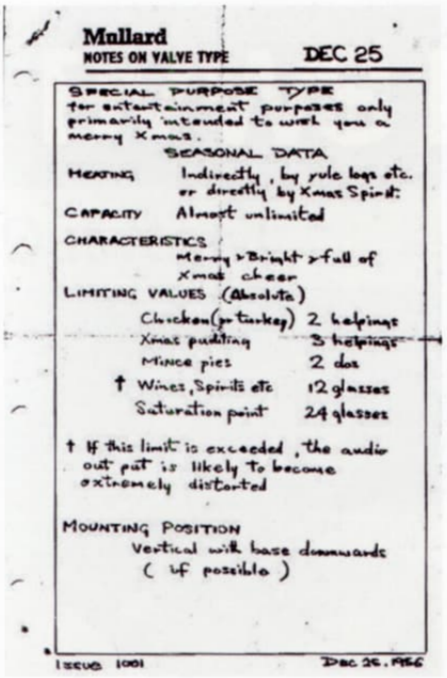
At some stage in the proceedings it may be necessary to make a decision. (This often caused consternation in the pre-1960 era!) By setting the filter switch to 'Pass the Buck', an out of balance signal is fed back through the system and causes the PRODUCT SELECTOR to oscillate, being in a state of instability. (Out-of-sync signals may be obtained by removing the plug.) Positive half-cycles are fed to the DECISION UNIT, which consists of a flip-flop unit with a pre-selector. (The prototype of this unit was the Mullard flippin' coin.)

Having decided that something is wrong, it is then necessary to change one or more of the variables. The PUSH BUTTON AUTOCHANGER gives a choice of 10 changes. These changes are fed into the rectifier and filter unit which has been biased to cut-off but is now brought into conduction again, and the output pulse fed into the DELAY LINE. The delay is pre-set by means of a 4-position switch. In positions 1 to 3, the data is stored in a long-life Memotron. In position 4 it is fed to a Forgiotron.

The output (if any) is fed to the PROGRESSER which has provision for Green/Blue/White data (other colours can be accommodated on request) and a priority switch. Signals are also fed to the progresser from the CURVE TRACER, a unit with several interesting features, including a Logan scanner. It provides characteristic curves, outlines, distribution curves, ogives and histograms, and, by suitable adjustment of the spot wobble, can give spreads. X, y and z inputs are provided and can be taken from any centre, or self-generated. (As existing trace!)

From the progresser there are two outputs. Observant readers will note that a spider has spun his web across the positive output. This should not be removed as it serves as an output indicator. A broken web indicates the presence of a data sheet in the output tray.





**Mullard**
NOTES ON VALVE TYPE DEC 25

SPECIAL PURPOSE TYPE
for entertainment purposes only primarily intended to work you a merry Xmas.

SEASONAL DATA

HEATING: Indirectly, by yule logs etc. or directly by Xmas Spirit.

CAPACITY: Almost unlimited

CHARACTERISTICS
Merry > Bright > full of Xmas cheer

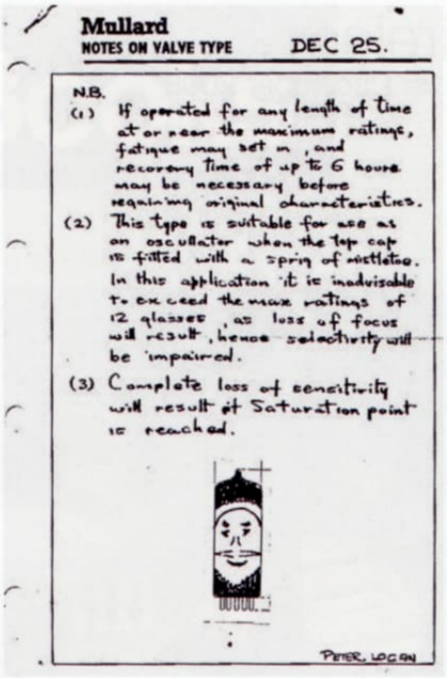
LIMITING VALUES (Absolute)

| | |
|---|---|
| Chicken (or turkey) | 2 helpings |
| Xmas pudding | 3 helpings |
| Mince pies | 2 doz |
| † Wines, Spirits etc | 12 glasses |
| Saturation point | 24 glasses |

† If this limit is exceeded, the audio out put is likely to become extremely distorted

MOUNTING POSITION
Vertical with base downwards (if possible)

ISSUE 1001 Dec 25. 1956



**Mullard**
NOTES ON VALVE TYPE DEC 25.

N.B.
(1) If operated for any length of time at or near the maximum ratings, fatigue may set in, and recovery time of up to 6 hours may be necessary before regaining original characteristics.
(2) This type is suitable for use as an oscillator when the top cap is fitted with a spring of mistletoe. In this application it is inadvisable to exceed the max ratings of 12 glasses, as loss of focus will result, hence selectivity will be impaired.
(3) Complete loss of sensitivity will result if Saturation point is reached.

PETER LOGAN



**Dear Editor,**
Here's a valve oddity for Bulletin readers to consider. It's faintly marked LS5D and the base only ever had three pins as the grid connection is on the side of the envelope. This variant does not appear in any of my reference books. Any ideas?

Tony Hopwood



# The haunted Wireless

Spotted by the Editor whilst exploring the Ghost Town of Bodie, California – An American Bosch Model 16 Amborola six valve TRF battery radio from 1925 and made by American Bosch of Springfield, Massachusetts (note healthy layer of dust on set).

If you happen to be in the vicinity of Yosemite in the Californian High Sierras, Bodie is a very interesting place to visit as many of the buildings from this abandoned mining town remain intact right down to the furniture within. Bodie was established in 1861 with an initial populace of about 20 miners and grew to an estimated 10,000 people by 1880. Today it is kept in a state of 'arrested decay' so that it hopefully can be appreciated by visitors for many generations to come.

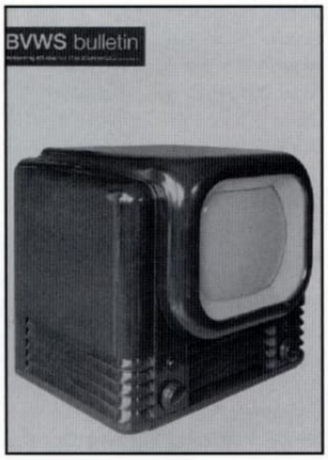
# British Vintage Wireless Society
## Statement of Accounts - Year to 31st December 2008

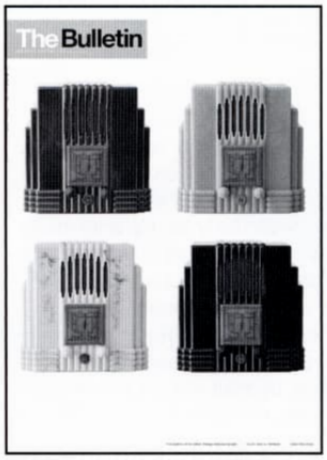
| | | Year ended 31st December 2008 | | Period ended 31st December 2007 |
|---|---|---|---|---|
| Receipts | | £ | | £ |
| Subscriptions | | 34,200 | | 31,580 |
| Sale of publications | | 2,534 | | 931 |
| Capacitor Sales | | 2,132 | | 1,675 |
| Meetings | | 2,819 | | 2,759 |
| Estate sales receipts | | 54,493 | | 26,953 |
| Valveman DVD sales | | 659 | | 668 |
| Donations | | 224 | | 326 |
| Bank Interest | | 728 | | 738 |
| Advertising | | 943 | | 513 |
| Miscellaneous | | 68 | | 25 |
| NVCF Profit | | 3,561 | | 818 |
| Total receipts | | 102,361 | | 66,986 |
| Payments | | | | |
| General expenses | 12,108 | | 8,848 | |
| Meetings | 2,633 | | 1,862 | |
| Bulletin costs | 28,793 | | 22,311 | |
| Estate sales payments | 47,692 | | 26,393 | |
| Capacitor costs | 3,480 | | 2,416 | |
| Donation to BVWATM | 166 | | - | |
| Valveman DVD sales proceeds transferred to BVWATM | 938 | | - | |
| Other publication costs | 972 | | 1,925 | |
| Corporation tax | 146 | | - | |
| Total Payments | | 96,928 | | 63,755 |
| Surplus for the period | | 5,433 | | 3,231 |
| Total assets at beginning of period | | 42,495 | | 39,264 |
| Total assets at end of period | | 47,928 | | 42,495 |
| Assets | | | | |
| HSBC current account | | 7,328 | | 13,183 |
| HSBC deposit account | | 32,142 | | 24,415 |
| NVCF assets (held for the benefit of the BVWATM) | | 8,458 | | 4,897 |
| Total assets | | 47,928 | | 42,495 |

KEENS SHAY KEENS LIMITED
Chartered Accountants

# National Vintage Communications Fair
## Statement Of Accounts - Year To 31st December 2008

| | | Year ended 31st December 2008 | | Period ended 31st December 2007 | |
|---|---|---|---|---|---|
| Receipts | | | £ | | £ |
| Table bookings | | | | | |
| | Members | | 6,261 | | 3,144 |
| | Non-Members | | 7,364 | | 9,491 |
| Bank Interest | | | 1 | | - |
| Total receipts | | | 13,626 | | 12,635 |
| Payments | | | | | |
| Event management | | 9,291 | | 8,796 | |
| Miscellaneous | | 774 | | 1,056 | |
| DVD Purchases | | - | | 1,944 | |
| Interest and Charges | | - | | 21 | |
| Total Payments | | | 10,065 | | 11,817 |
| Surplus for the period | | | 3,561 | | 818 |
| Total assets at beginning of period | | | 4,897 | | 4,079 |
| Total assets at end of period | | | 8,458 | | 4,897 |
| Assets | | | | | |
| HSBC current account | | | 8,458 | | 4,897 |
| Total assets | | | 8,458 | | 4,897 |



# 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, 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 British Vintage Wireless and Television 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

**2009 meetings**
**6th December** Wootton Bassett

**2010 meetings**
**February 14th** Audiojumble
**March 7th** Harpenden
**May 9th** NVCF
**June 5th** BVWS Garden Party
**June 6th** Harpenden AGM & Auction
**July 11th** Wootton Bassett
**October 10th** Audiojumble
**October 17th** Harpenden
**December 5th** Wootton Bassett

**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!

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Bonhams 1793


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**Illustrated**
A Kolster-Brandes neon shop sign, circa 1950, with stepped top, large company letters in shaped red neon tube, miniature lightbox below with TV and Radio backlit in green.
Estimate £200 - 300
To be offered 10 November, Knightsbridge

Bonhams would like to thank all BVWS members who attended the recent Michael Bennett-Levy early Technology sale at Knightsbridge, for which three new world records were broken in the television section alone.

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