The Bulletin

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15th May 2011

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!

Stall bookings/Details
For any enquiries, please contact:
Post: NVCF, 13 Warneford Road Oxford OX4 1LT, UK
(please enclose an SAE)
Email: info@nvcf.org.uk a downloadable booking form is available from www.nvcf.org.uk

Bulletin of the British Vintage Wireless Society
Incorporating 405 Alive
Volume 35 No.4 Winter 2010

www.bvws.org.uk

Separations and Printing by Hastings Print

Front: Regency TR1 in black.
Rear: Regency TR1 in red.
Photographed by Carl Glover

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Edited by Carl Glover. Sub-Edited by Ian Higginbottom
Proof-reading by Mike Barker,
Ian Higginbottom and Peter Merriman

Contents

From the festive Chair

Here with the Bulletin is this year's DVD and also a BVWS events Calendar which we thought would be a pleasing item to hang on your wall and have all the coming year's events ready printed on each page. The photographs by Carl Glover are masterpieces in their own rights and would make excellent pin-up pictures when each month has passed.

The DVD is very entertaining and you will need to watch it a good number of times to spot all of the wonderful period features of Broadcasting House. Two of the films are incomplete and finish abruptly. This is not a disc fault, but the content was felt to be significant enough for inclusion.

We would like to thank Gordon Bussey and Terry Martini for the DVD material and production.

You will see from the Calendar that we have reduced the number of Harpenden meetings to two each year. This is mainly due to the high cost of the hall hire and the significant increase we have been informed of for next year. There will be no major auction event with AGM. Instead the AGM will be held in March in the small hall whilst the main event is in progress in the large hall. Both events should also have a Vintage Wireless/Television related talk as well. Each event will have an auction which you are welcome to enter items into on the day or by reserving space by prior arrangement with myself either by letter, e-mail or phone. Catalogues of items will be posted on the BVWS website for free downloading and viewing usually in the week prior to the event.

2011 marks the 75th Anniversary of the British Electronic television service and we intend to celebrate this in each Bulletin and with a special event towards the end of the year. More on that in the next Bulletin in February 2011.

On behalf of myself and the Committee, I would like to wish everyone a very happy Christmas and the very best wishes for an exciting collecting year in 2011.

Mike...

Free Public Lecture at Bodleian Library
1 March 2011
The Douglas Byrne Marconi Lecture, Oxford
The first Douglas Byrne Marconi Lecture, to be delivered by Professor Peter Scott (University of Reading), will be held at the Museum of the History of Science, Broad Street, Oxford, on Tuesday 1st March 2011 at 5:30 to 6:30 pm. The subject of the lecture will be, 'The sources of competitive advantage and innovation in the interwar British radio industry'. Entrance is free to the lecture and the reception following in the Bodleian Library. Further information: e-mail: bookcentre@bodleian.ox.ac.uk

Research funding for radio history
Funding for research into any aspect of the history of radio communication is available for scholars to spend time with the Marconi Archive at the Bodleian Library, Oxford and with the collection of objects held at the Museum of Science, Oxford. The vast archive, occupying some 400 linear metres of shelving, includes personal papers of Guglielmo Marconi and business records relating to the radio industry up to the late twentieth century. Objects in the collection include devices from early experiments in transmission. Thanks to a grant from the Wireless Preservation Society in memory of its founder, Douglas Byrne, the Bodleian Library is able to offer a fellowship each year to support a scholar in residence consulting these collections. The first fellowship was awarded this year to Professor Peter Scott, of the Henley Business School, University of Reading, for research into competitive advantage and innovation in the interwar British radio industry. Professor Scott will deliver the first Douglas Byrne Marconi Lecture on 1 March, 2011. The Marconi Collection was donated to the University of Oxford by Marconi plc in December 2004. A catalogue of the archive, funded by the Wireless Preservation Society, is available online from the Bodleian Library. A catalogue of the objects can be found on the website of the Museum of the History of Science.

Of especial interest are records relating to the Titanic disaster in 1912. The role played by wireless telegraphy in saving lives during this tragic event is well documented in the archive, which features the logs of ships' radio operators recording the first and last distress signals from the Titanic as well as thousands of other messages exchanged before, during and after the emergency.

Besides documents relating to Marconi and his Wireless Telegraph Company, there are records of numerous other electronic and electrical engineering companies, all of which were ultimately absorbed into the General Electric Company (GEC) which in 1999 changed its own name to Marconi. For details of funding and how to apply for the Douglas Byrne Marconi Fellowship at the Bodleian Library, visit the library website at www.bodley.ox.ac.uk or write to: Fellowships, Centre for the Study of the Book, Bodleian Library, Oxford OX1 3BG. Applications for the 2011 fellowship must be submitted by December 31, 2010.

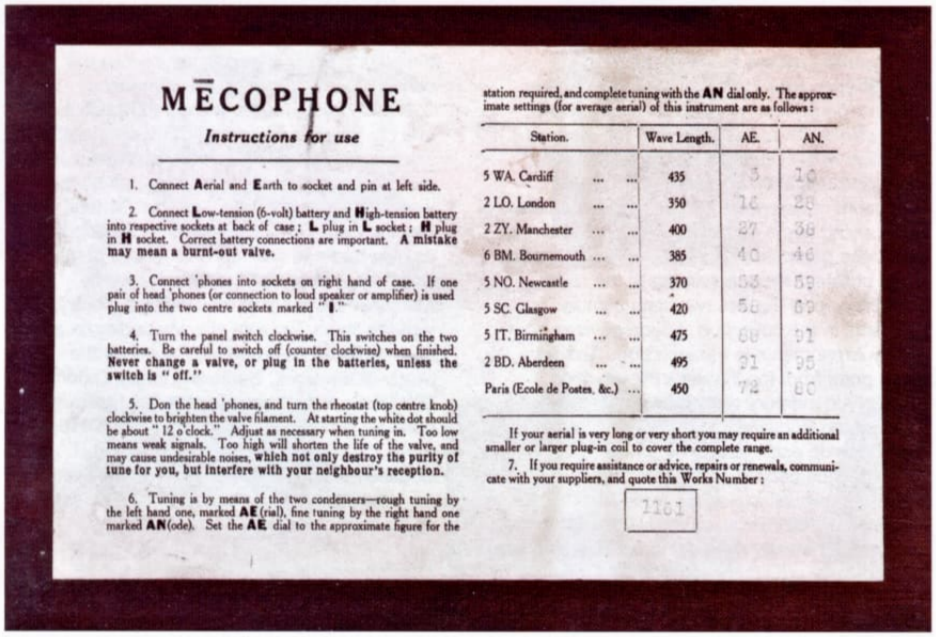
Bodleian Library website, Marconi Archive: www.bodley.ox.ac.uk/dept/scwmss/wmss/online/modern/marconi/marconi.html

Museum of the History of Science website, Marconi Collection: www.mhs.ox.ac.uk/marconi/collection/

Mann, Egerton & Company, Ltd. by Ian L. Sanders, Lorne Clark and Chris Simmonds

Mann, Egerton & Company Limited of Norwich[1] was founded in 1905 by Gerard Noel Cornwallis Mann, an electrical engineer and his business partner of five years, Hubert Wingfield Egerton, a motoring enthusiast. Mann, who had moved to Norwich in 1899 from his native Cornwall to take over an electrical installation business teamed up with Egerton and the pair operated as small-scale car dealers and coachbuilders in premises at 5, Prince of Wales Road, Norwich. On its formation, Mann, Egerton & Company combined the founders' already successful car interests with a growing general electrical installation business, supplying factories, large country estates and government buildings. By 1908 the company was selling many brands of motor car and supplying custom car bodies to prestigious manufacturers. Notably they added Rolls Royce to their customer base in 1909. By 1913, branches were opened in London and the South-East.

The *Mecophone* one-valve receiver used Mann, Egerton's patented circuit intended for improved volume and stability. The station list in the receiver's lid provides the wavelengths of the original eight BBC Main Stations. Bournemouth, 6BM was the last of these to open, on October 17th, 1923, so the model was likely introduced close to this date. The company produced a matching two-valve note magnifier.



MECOPHONE

Instructions for use

1. Connect **A**erial and **E**arth to socket and pin at left side.

2. Connect **L**ow-tension (6-volt) battery and **H**igh-tension battery into respective sockets at back of case; **L** plug in **L** socket; **H** plug in **H** socket. Correct battery connections are important. **A mistake may mean a burnt-out valve.**

3. Connect 'phones into sockets on right hand of case. If one pair of head 'phones (or connection to loud speaker or amplifier) is used plug into the two centre sockets marked "**I**."

4. Turn the panel switch clockwise. This switches on the two batteries. Be careful to switch off (counter clockwise) when finished. **Never change a valve, or plug in the batteries, unless the switch is "off."**

5. Don the head 'phones, and turn the rheostat (top centre knob) clockwise to brighten the valve filament. At starting the white dot should be about "12 o'clock." Adjust as necessary when tuning in. Too low means weak signals. Too high will shorten the life of the valve, and may cause undesirable noises, **which not only destroy the purity of tune for you, but interfere with your neighbour's reception.**

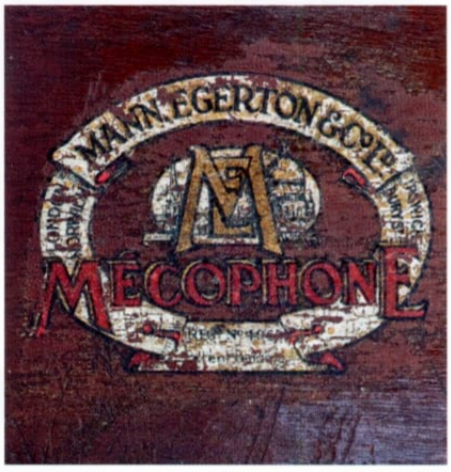
6. Tuning is by means of the two condensers—rough tuning by the left hand one, marked **AE** (rial), fine tuning by the right hand one marked **AN** (ode). Set the **AE** dial to the approximate figure for the station required, and complete tuning with the **AN** dial only. The approximate settings (for average aerial) of this instrument are as follows:

Station.	Wave Length.	AE.	AN.
5 WA. Cardiff	435	5	10
2 LO. London	350	16	28
2 ZY. Manchester	400	27	36
6 BM. Bournemouth	385	40	46
5 NO. Newcastle	370	53	59
5 SC. Glasgow	420	56	62
5 IT. Birmingham	475	80	91
2 BD. Aberdeen	495	91	95
Paris (Ecole de Postes, &c.) ...	450	72	80

If your aerial is very long or very short you may require an additional smaller or larger plug-in coil to cover the complete range.

7. If you require assistance or advice, repairs or renewals, communicate with your suppliers, and quote this Works Number:

1161



Mann, Egerton & Company manufactured wireless apparatus under the *Mecophone* trademark – derived from the company's initials – Mann Egerton Company.

During the Great War, the company built aircraft for the Royal Naval Air Service and the Royal Flying Corps under a government loan of £30,000. Aircraft were built both under licence – Sopwith Fighters, De Havilland Bombers, French Spad Scouts and Short Brothers' Torpedo Bomber Seaplanes – and models of their own design, including the Mann Egerton Type B, a maritime patrol aircraft of which ten saw service in the war. By the end of the war, the company's employees had grown to some 1,200 and Mann, Egerton turned their attention to the manufacture of classroom furniture for schools and other educational institutions and established an agricultural department to service tractors and farm machinery.

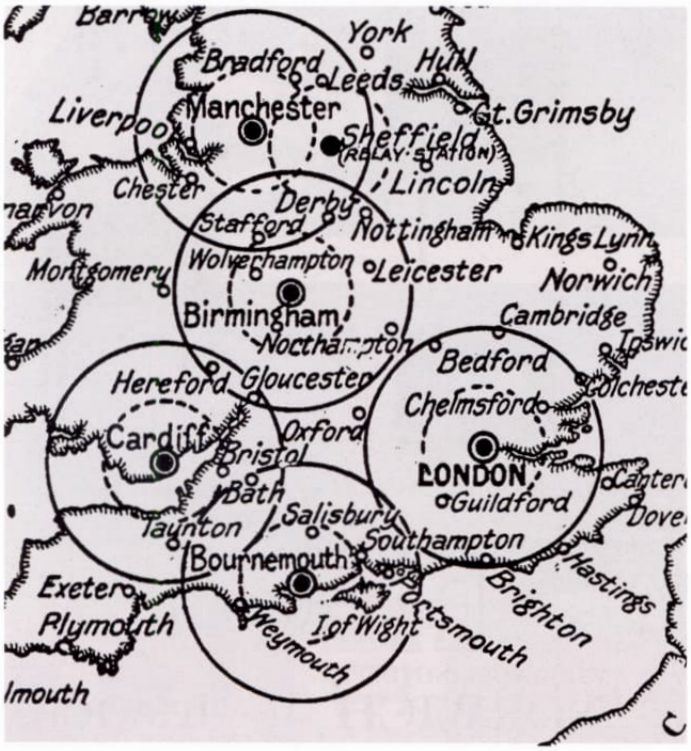
By 1922, Mann, Egerton & Company were operating an electrical engineering business at 21/23 King Street, Norwich and it was from these premises that the company launched its wireless enterprise under their *Mecophone* trademark. In 1923, Mann, Egerton manufactured a single-valve receiver employing a circuit of their own, patented design[2]. Intended to improve stability from oscillation and offer increased volume, the circuit provided reaction by connecting the aerial to the valve's anode through the tuned secondary winding of a high-frequency transformer, the primary of which was in series with the headphones. The receiver was iconically styled in a sloping mahogany cabinet with an internal valve whose filament could be viewed through an array of small holes in the front panel. Advertisements claimed performance *"better than the best two-valve B.B.C"*. models on the market, and equal to most three-valve models."

The receiver was priced at £8 15s. 0d., less valves and headphones. A matching two-valve note magnifier was available to drive a loudspeaker. Both the receiver and amplifier carried the BBC approval stamp. The receiver was given the Post Office registration number 4050; the registration number of the note magnifier is unknown.

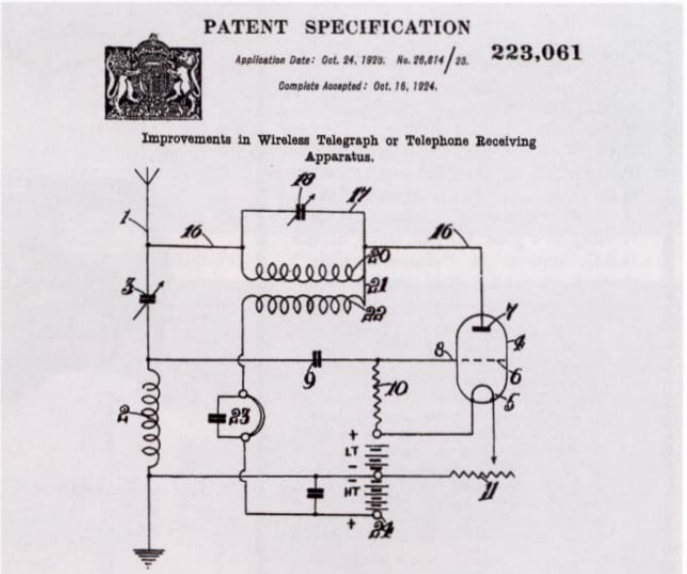
In 1923 and 1924, Norwich and much of East Anglia would not have been within crystal range of any of the BBC Main or Relay Stations then in operation on the broadcast (medium-wave) band. The opening in July 1924 of the BBC's 15kW experimental high-power, long-wave

Above: The *Mecophone 5XX* receiver was tuned for reception of 1,600 metres, long-wave only.

Below: In 1924 Norwich was outside of crystal range of any of the BBC medium-wave stations. (The dotted circles on this map represent a radius of 25 miles – the limit for crystal reception operating under favourable conditions). The high-power, 15kW station at Chelmsford, 5XX, which opened on July 9th, 1924 had a crystal range of over 100 miles. (The BBC high-power station moved to a permanent location at Daventry in July 1925 – Norwich would still have been within crystal range). *Pitman's Radio Year Book 1924*. Published by Isaac Pitman & Sons, Limited, London.



Below, right: British patent 223,061 dated October 16th, 1924 issued to Mann, Egerton and Company Limited and Harold Roby Taunton. The object of the invention was to improve the receiver's stability and obtain improved amplification using a single valve. Taunton's connection with the company is not known.



PATENT SPECIFICATION

223,061

Application Date: Oct. 24, 1923. No. 26,814/23.

Complete Accepted: Oct. 16, 1924.

Improvements in Wireless Telegraph or Telephone Receiving Apparatus.

Abstract: Thermionic amplifiers and detectors are provided with reaction by connecting the anode to the aerial through the tuned secondary 20 of a high frequency transformer the primary of which is in series with the telephones. The connection 21 of the primary to the secondary may be made at any point on the secondary. The Specification gives suitable dimensions for the transformer and the condensers. The circuit is stated to be very stable.

transmitter, 5XX at Chelmsford, with its planned 100 mile crystal reception range would, however, have brought the possibility of crystal reception to the area. It is likely that this state of affairs prompted Mann, Egerton to produce their *Mecophone 5XX* Crystal receiver. A compact, circular set measuring only 3½ inches in diameter, the Mecophone was pre-tuned for reception of Chelmsford on 1,600 metres. No provision was made for tuning or for broadcast band reception. Sales were most probably intended primarily for listeners in East Anglia, in the vicinity of the company's Norwich works.

As part of their business, Mann, Egerton apparently designed and supplied custom wireless cabinets to other manufacturers. An advertisement in The Wireless Trader for June 1923 provides examples of exceptionally ornate cabinet designs, clearly intended for high-end receivers.

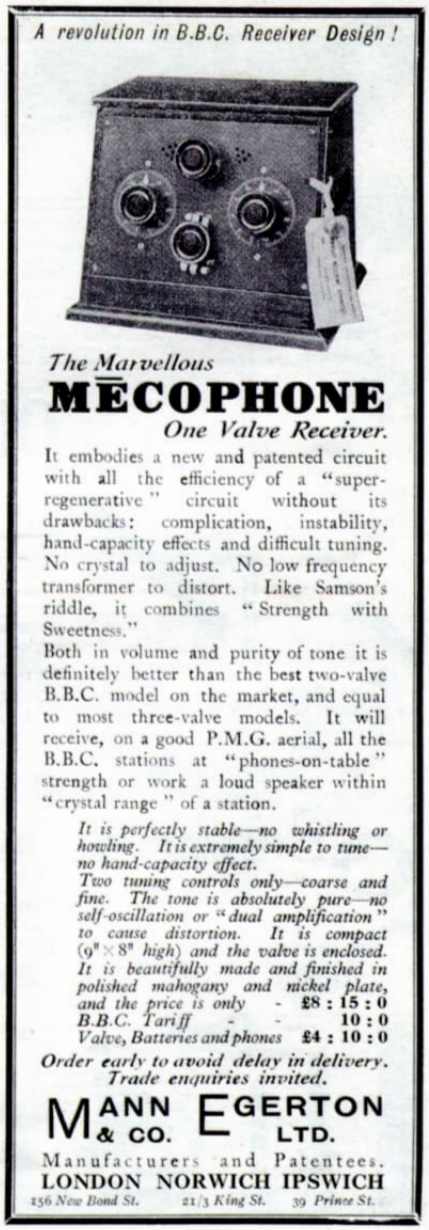
The company seems to have been engaged in the design and manufacture of wireless apparatus for only a few years at the start of formal broadcasting. In other segments of the company's business, coachbuilding continued throughout the 1920s and 1930s, although with the outbreak of the Second World War the company turned to the production of ambulances and troop carriers for the armed services and to the installation of radar stations. Construction of furniture for schools and businesses also expanded during the war years.

Gerard Mann died in 1941. After the war, the company grew steadily through a series of acquisitions, but in 1964 Mann, Egerton's electrical department was sold off to the Westinghouse Brake and Signal Company. The automotive interests were subsequently purchased by Inchcape plc in 1973. The Mann, Egerton name, however, has survived and is now associated with a car dealer group operating in East Anglia.

1. Norwich Heritage Economic and Regeneration Trust: www.heritagecity.org/research-centre/industrial-innovation/mann-egerton

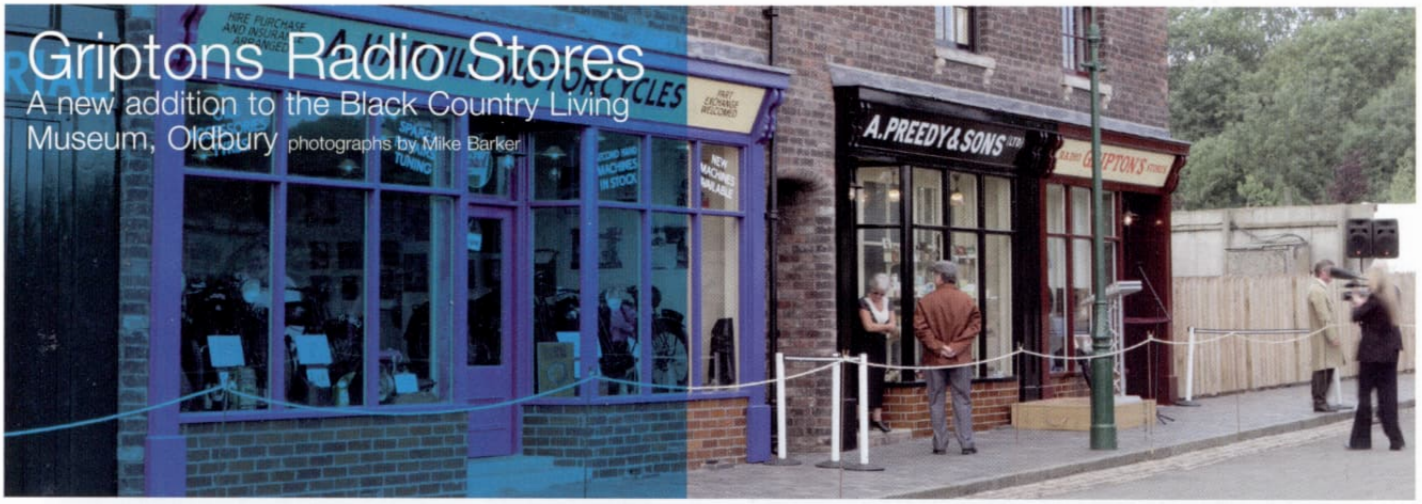
2. Mann, Egerton and Company Limited and Harold Roby Taunton: *Improvements in Wireless Telegraph or Telephone Receiving Apparatus*. British Patent 223, 061, October 16th, 1924.

Below left: *The Wireless World and Radio Review*, December 12th, 1923. Below right: *The Wireless Trader,* June 1923. Above: *The Radio Times*, March 28th, 1924.



Griptons Radio Stores

A new addition to the Black Country Living Museum, Oldbury photographs by Mike Barker



Opening speeches

The Griptons (portrayed by actors)

BVWS member Mike Butt doing a quick repair

Below: A view of the workshop

Recreating a Dinosaur by Peter Lankshear

I was most interested in and enjoyed L.L.Williams' excellent description in the Summer 2009 Bulletin of his experiences with the McMichael Super-heterodyne receiver. He motivated me to resurrect a project that had been on the "back burner" for more than 20 years.

First, a little history. The supersonic heterodyne receiver, which antedated the T.R.F. had its origins during the final period of WW1, in the work of France's Lucien Levy, America's Edwin Armstrong, and in Germany that of Walter Shottky. Each was intent on finding methods of achieving pre-detection amplification using the primitive triodes of the time, which were ineffective at even low radio frequencies. Although methods differed considerably in detail, their solutions were each based on utilising a supersonic heterodyne signal prior to detection. Most importantly, both Armstrong, who already held the regeneration patents and Levy were granted patents that were eventually to be of considerable commercial and technical importance. Progress was such that In 1922, America's General Electric and Western Electric each produced a limited number of successful super-heterodyne receivers for professional work, but these were far too expensive and complex for the emerging broadcasting and amateur markets. By then, the Armstrong patents were in the possession of the newly formed Radio Corporation of America, of which G.E. was a partner, the Levy patents were controlled by Western Electric and neither would license other American manufactures to produce super-heterodyne receivers. In 1924, British Western Electric introduced their 7 valve model 44002 and the next year a 6 valve kit set. Burndept and McMichael were also making super-heterodynes in Britain, probably licensed by Western Electric's subsidiary STC. (see note 1).

Most American receivers in the early 1920's used one to four valves, and regenerative grid leak detection. In Britain, regenerative receivers without an R.F. isolating stage were considered to be anti-social. Conditions there were somewhat different. There were fewer and more powerful stations, less demanding of sensitivity, thus making regeneration less important.

The greatest merits of the super-heterodyne were its sensitivity and selectivity, and in the early days of broadcasting, considerable importance was given to their ability to receive transmissions over long distances and to be able to separate them from local signals. For enthusiasts or DXers as they were called, quality and content of the programmes was probably secondary. For them, the super-heterodyne was the ultimate DX instrument, far more potent than any conventional receiver.

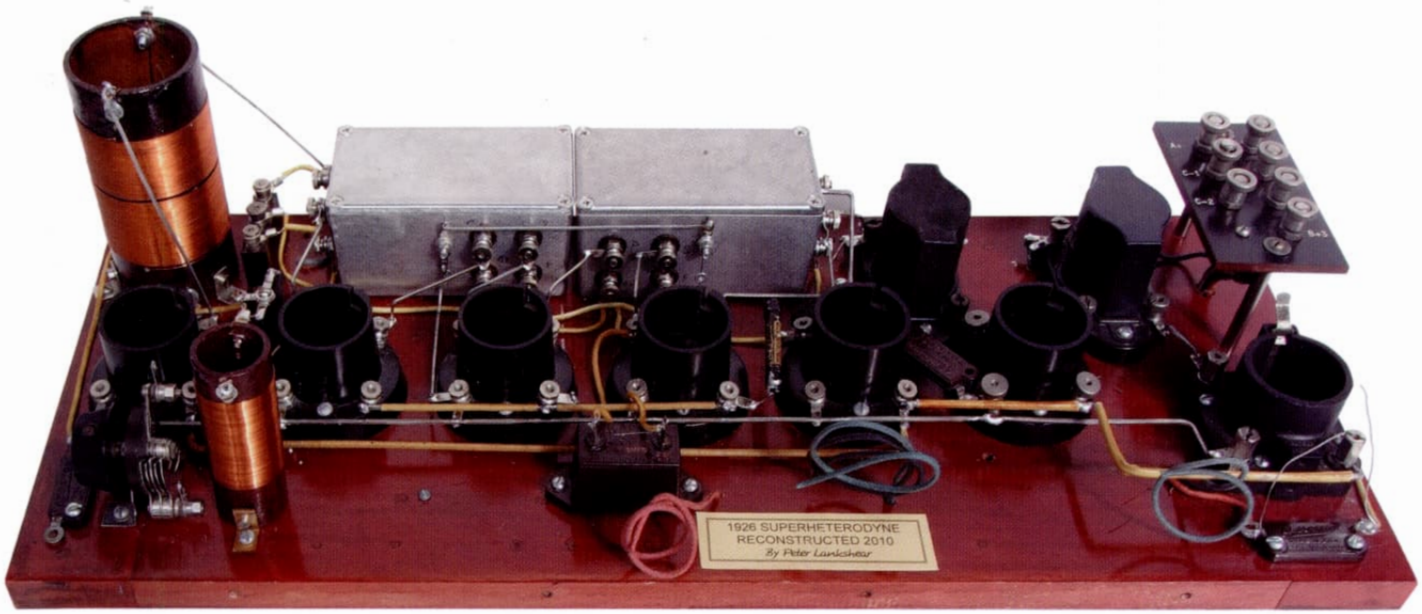
Independent Development

Some independent American engineers set about developing super-heterodyne receivers with varying degrees of success. The patent situation meant that they could not sell complete receivers but there seemed to be a loophole in that they could make and supply components individually or as kit sets. However, compared with conventional sets, these receivers were complex, and requiring 7 or more valves, were very expensive. Consequently only the well heeled and knowledgeable hobbyist could consider making one. Some of the parts suppliers tried to circumvent difficulties by making up part assemblies, but RCA stamped on that practice.

By the end of 1922, Charles Leutz, at one time an American Marconi and later a Mallory engineer, had come up with what can only be described as a heroic pioneering effort. His model L, probably the first super-heterodyne for public use, occupied two panels, each 40" by 8", with 4 meters, 24 knobs and 25 terminals! There were 6 I.F. stages and in all it used 10 valves. Later he produced designs for his model C with only one 40 inch panel and 8 controls. These receivers were definitely for the serious enthusiast. Initially Leutz supplied complete kits but RCA eventually sued him for patent infringement. Then Leutz, as Experimenters Information Service Inc., continued to make available blueprints and individual components. Soon others were publishing instructions and components for making super-heterodynes. Names such as Remler, Raven, Silver Marshall, Lecault, Tropodyne, Best and Branston became familiar to enthusiasts. In many aspects, the lineage of these various designs can be traced back to the Leutz model L.

RCA Enters

During 1923 RCA decided that it was time to look at producing a super-heterodyne themselves. A General Electric team which included Edwin Armstrong and his cohort Harry Houck, developed for RCA a successful 6 valve super-heterodyne; for its time, very complex and doubtless a mystery to many technicians. For economy, the first valve was reflexed as both a semi tuned R.F. amplifier and as the first I.F. stage. The frequency converter valve was self oscillating and to avoid "pulling" it utilized second harmonic mixing. The



Breadboard ready for the front panel

heart of these early RCA receivers was the "catacomb", a metal box containing the R.F, Oscillator and I.F. transformers plus their associated components, all sealed in wax. If a fault developed, the whole catacomb was replaced by RCA, but only as an exchange and then only if the seals were unbroken. The catacomb was an effective way of keeping vital parts of RCA super-heterodyne's secret.

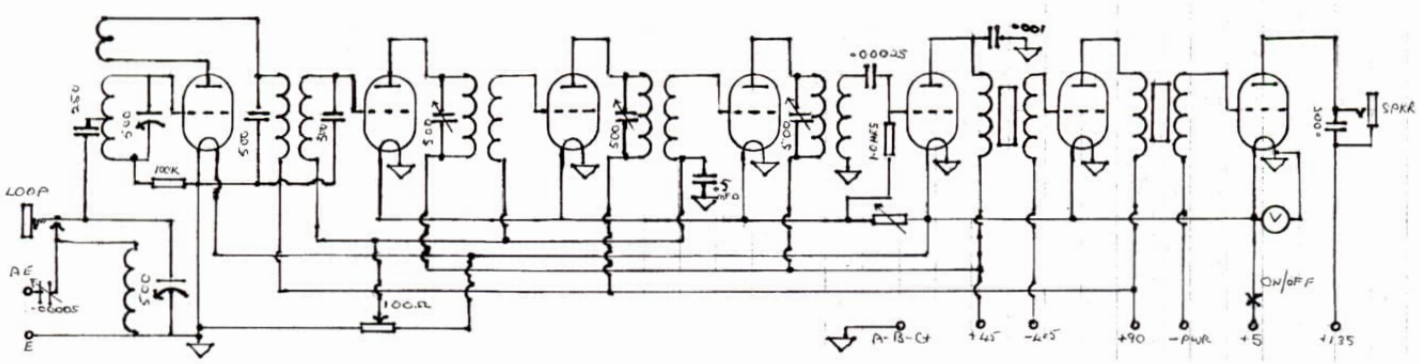
Westinghouse, as an RCA partner, was continuing the pursuit of copyright infringers. Included in the net was Branston who had, in their opinion, copied RCA's first superhet a bit too closely. As an example, attached is a copy of a 1926 legal document regarding a successful court case in which Westinghouse charged two manufacturers, Branston and Precise with infringements. Incidentally, this document is worth reading carefully as it gives clear descriptions of the operation of both the conventional super-heterodyne and RCA's reflexed second harmonic version. Note too that the claim includes Fessenden's heterodyne patents which the RCA group also owned. They certainly had the super-heterodyne patents well and truly tied up. The legal description is clearly written in relatively non–technical language, no doubt for the benefit of legal gentry without a good knowledge of the super-heterodyne.

Although less expensive than the RCA models, kit sets still cost much more than conventional receivers. As New Zealand in the early 1920's had only a small population and few people that had the means and ability to build complex receivers, early super-heterodynes there are rare. Naturally then, when, many years ago, I came across the battered remains of a receiver that had been built around one of Branston's kits, I secured it in the hope that something could be resurrected from it. However, it soon became apparent that most of the smaller components had long gone, leaving only the remnants of a rough home made oak cupboard style cabinet, some of the Branston transformers and seven skirted UV bayonet valve sockets. There were no audio components. The ebonite panel had reacted to atmospheric moisture and created sufficient sulphuric acid to corrode much of the square section bus bar wiring. The panel was distorted and broken, but it did have on it a couple of good dials, tuning capacitors and a filament control variable resistor. As a starting point, with the help of a cabinet maker friend I constructed a chest type cabinet from the original timber, and made a traditional non warping breadboard base to mount the components. (Breadboard construction got its name from the early experimenters who used actual breadboards as convenient bases to mount components).

RCA had three popular types of high vacuum receiving valves in the early '20's. These were the UV 201A, the UV 199 and Westinghouse's WD11/12. The UV prefix referred to the early skirted bayonet type of socket, which in 1925, was superseded by the familiar long pin UX base. The 201A was the standard workhorse, with a mu of 8 and a 5.0 Volt .25 Ampere thoriated tungsten filament. Preferred for super-heterodynes for its battery economy, was the smaller 3.3 volt .06 Ampere UV199, with an amplification factor of only 6. The Westinghouse valves had similar characteristics to the 199, but with 1.5 volt filaments. With a higher plate resistance and lower inter electrode capacitances these smaller types were easier to tame in high gain amplifiers. However, although Branston had specified the UV199 valves, the large sockets in my receiver indicated that the valves originally used had been 201A or perhaps some of the Dutch UV based type A609, its lower filament current equivalent. I had no UV199 valves or their sockets, so the bigger valves it would have to be.

My attention turned to the Branston components. Three I.F. transformers were sealed in a close fitting brass box and the 1st I.F., R.F oscillator and coupling coils were in smaller matching boxes. The circuit had obviously been based on the RCA system, although with an additional two I.F stages and regeneration in a loop aerial. The coil box terminal configurations, suited to UV 199 valves, made connections to the differently configured UV201A sockets complicated. More importantly, some of the I.F. windings were open circuit. As with the RCA catacombs, all the boxes were wax filled. This would first have to be melted out, so when the "cook" was safely out of the way for a couple of hours, the kitchen oven was set to100 degrees and the transformers set over a basin for the wax to melt out.

The Branston IF transformers proved to have conventional iron audio transformer cores but with wave wound pies for the windings. As was common at this time, there were no I.f. tuning capacitors and resonance depended on self capacitance. One detail that immediately concerned



The Circuit that resulted from the writer's researches. It is basically the same a many of the early super-heterodynes.

BRANSTON RADIO

Make 7 Dry Battery Tubes Do the Work of 10 in Super Heterodyne Set You Can Build

Panel Size 7 x 21 Inches—Only 2 Controls

This set was built using the Branston Kit shown below. It is a strictly loop set of coast-to-coast range. It has remarkably fine tonal qualities, great volume, wonderful selectivity. It amplifies distant stations to the volume of local ones.

8 MATCHED TRANSFORMERS $35

With our clear and complete instructions you can easily build a set to equal this—a better set than you could buy for a lot more money.

Send for Blueprints and Catalog

Send 25c in coin or stamps for complete blueprints and layout covering Super Heterodyne, Radio Frequency and Honeycomb Coil Circuits; also complete catalog of Branston Quality Radio products.

Your dealer has Branston Kits or can get them for you.

Branston Kit No. R-199

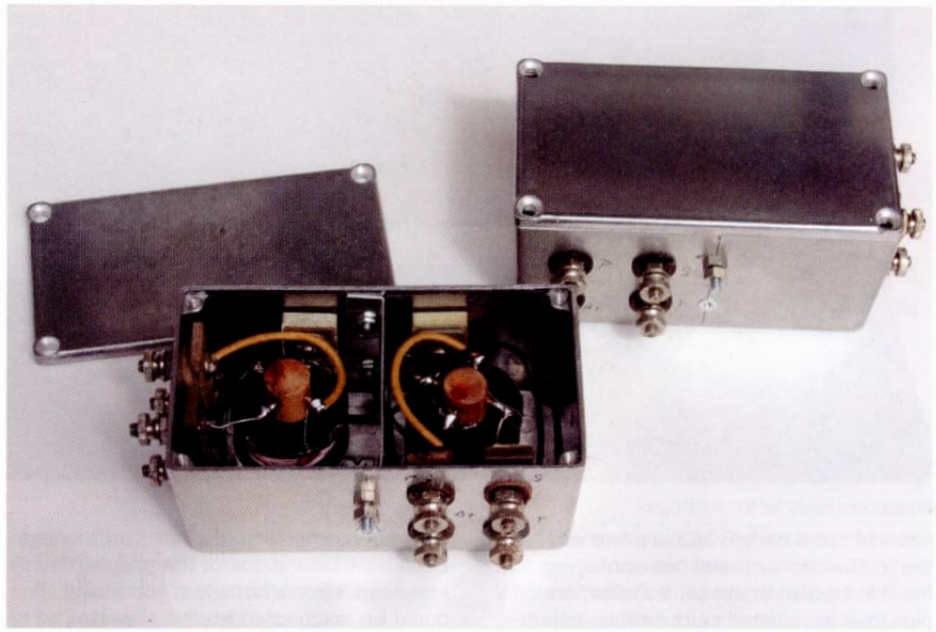
8-stage Long Wave R.F. Transformer $13.50, Twin A. F.'s $8.00, Single Stage Long Wave R. F. $4.50, Long Wave Tuned R. F. $4.50, Special Tuned Coupling Transformer $4.50, Short Wave R. F. $4.50. (Sold separately if desired.) All matched and given operation test.

CHAS. A. BRANSTON, Inc.
811 Main St., Buffalo, N. Y.

Manufacturers of Branston Violet Ray High Frequency Generators.

In Canada—Chas. A. Branston, Ltd.
Toronto, Ont.

This was the kit that Branston sold



The result of the I.F. building project

The companion loop aerial. Big loops like this deliver a surprisingly good signal

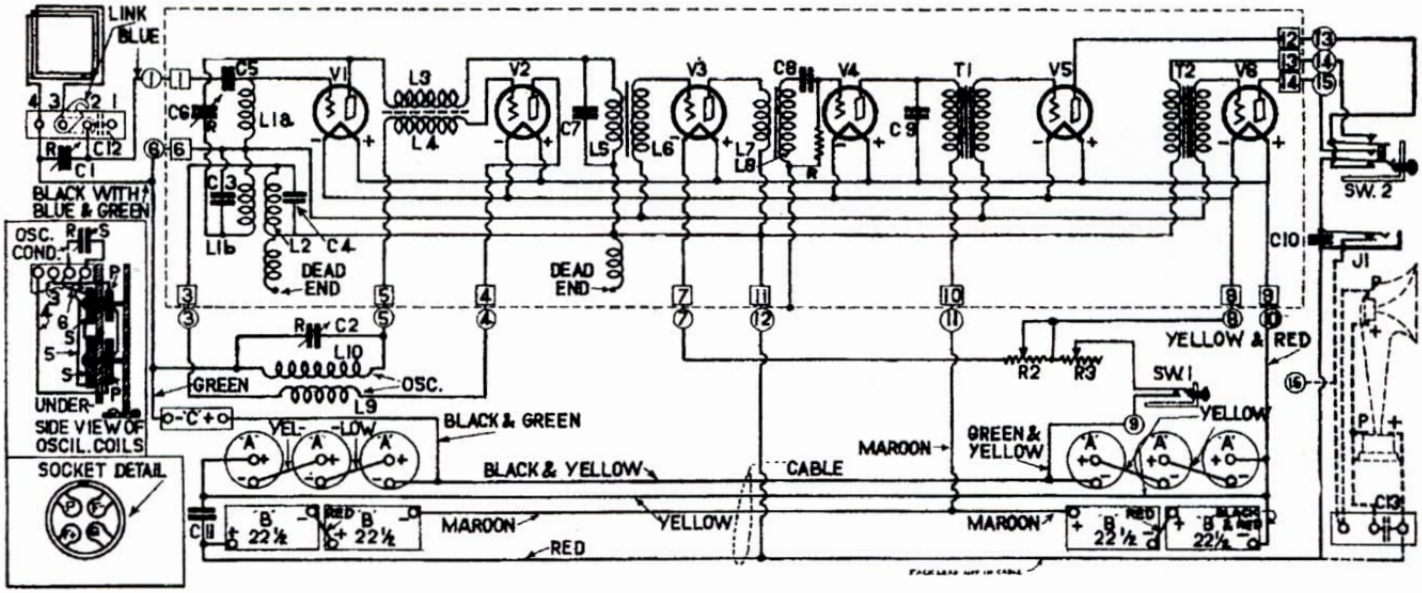
me was that the cores in the multiple group were virtually in contact with each other without any shielding. Consequently there must have been considerable coupling between them, a sure recipe for instability. Maybe there was some coupling between the coils and transformers to provide a bit of negative feedback in an attempt to compensate for some of the unavoidable positive feedback.

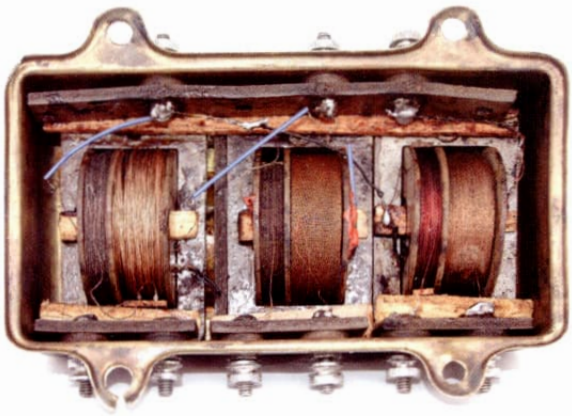
The more immediate problem was the open circuit windings. Repairs looked to be not very hopeful. Unfortunately I am not one of those mechanically gifted people who can whip up something like a workable wave coil winder from a few odds and ends. The best I could do would be to unwind the coils to their breaks and random wind them back again. This was done with the realization that any matching of the original transformers would now be impaired, and the self capacitance of the windings increased, but I had little alternative. I was not especially optimistic of success. It was impossible to trace out much from what was left of the original wiring and although Riders Manual volume 1 has a few early super heterodyne circuits, Branston was not represented. There are the RCA receivers and there seemed to be a correspondence between the Branston and the early RCA series.. RCA were very coy about providing too much information and their methods of drawing made their early circuits very hard to decipher. However, a bit of sleuthing revealed that some Brunswick brand receivers used the early RCA Radiola 24 model "chassis" and Brunswick had fewer inhibitions about publishing more information. Even so, there were few details such as values of components.

Expensive Valves

Early on valves were very expensive so every effort was made to reduce the count. The 1922 RCA catalogue lists the UV201 at $6.50 when at the time, a new Ford T car could be bought for less than $300! First generation RCA super-heterodynes and the Branston therefore used a self oscillating first detector stage combining the operation of mixer and oscillator in the one valve. The mixer was coupled to the aerial through an R.F. stage with its grid tuned, but broad band transformer coupled to the mixer. This same valve was also reflexed as the first I.F. stage. RCA used only one further I.F. amplifier, whereas Branston used a further two! I had increasing doubts that I was going to have a stable receiver.

My box of old bits and pieces held a pair of suitable audio transformers. These were the Philips 4003 type which can be relied on to have intact windings and a good frequency response. It is not always known that the reason for this is that they had corrosion proof silver wire for the primary and frequency flattening nichrome secondary windings! There





Above: The circuit of the first RCA super-heterodyne receivers. This simplified drawing was made by John Rider for the Gernsback "Official Radio Manual" No1

Left: The Branston I.F. transformers without the wax.

Right: Chest cabinet made from remains of the original cabinet

were few additional components to find as early receivers used a minimal number of resistors and capacitors. I made a new switchboard grade Formica front panel and had it engraved. Next the valve sockets were mounted in the classic straight line. I duly wired the receiver in accordance with the Brunswick circuit but with two more I.F. stages. As most items had terminals, wiring consisted mainly of the fitting of solder lugs to and bending busbar wire to shape.

The receiver worked – sort of - but I was not surprised to find that the I.F. section delivered little gain before it became hopelessly unstable. The oscillator was operated at its second harmonic which meant that over part of the tuning range it was possible to tune some transmissions in several places. The receiver was virtually useless and any in depth information about early supers was hard to locate. To make any progress, I needed more authentic information. My collection of old radio magazines and my textbook library, dating from the late 1920's was practically silent on the matter of early super-heterodynes, I now realize that most publications were too young, and others avoided the topic! Twenty five years ago there was no internet to search, available research material seemed virtually nil, so I put the receiver up on a shelf, but kept a watch for any information that might come my way.

Fast forward 25 years to the present and the *Bulletin* article.

In the intervening time, I had managed to get a reprint of Leutz' little Experimenters' Information book about his receivers but it was aimed at his customers and he was not giving away much detail as to how his components were made. The Bulletin article regenerated my interest as at last I had some real material to work on. My major problem was to produce a satisfactory I.F. amplifier in keeping with the early technology. I decided to get some "hands on" experience, starting with polishing up my rather rusty basics. Textbooks like Terman's and Ghiradi have plenty of fundamental theory, and it became apparent that although the old I.F. systems operated not far above audible frequencies, there was still enough grid/anode valve capacitance of 8.1mmf for the 201A to oscillate, even with quite low Q tuned input and output circuits. The 201A's relatively low anode impedance of about 10,000 ohms does provide quite a bit of damping to assist stabilisation by further lowering the Q but the low amplification factor of only 8 was discouraging. The 199 was somewhat better with 3.3mmf but with a mu of only 6.6.

It was time to do some calculations comparing different valves. The formula is:-

$$\text{Gain} = \frac{\text{Amplification Factor}}{1 + (\text{Anode Resistance/Load impedance})}$$

I assumed a unity ratio transformer e.g a pair of tightly coupled tuned windings and likely to have an impedance of about 50 Kohms.

The calculated stage gain with a type 199 valve proved to be 5. That of a 201A, was 6.6. A Philips A615 did better with a calculated stage gain of 12. No wonder sets with 3 IF stages were common! In my case, with three stages with 201A valves the total gain with unity coupling should be about 6.6 X 6.6 X 6.6 = 287 which looked hopeful. As a matter of interest, I calculated the gain using a type UX222, America's first screen grid valve, which became available in late 1927 and in some respects a partner to the 199, with the same filament voltage and similar mutual conductance of about 0.45 ma/v. Despite the modest performance of the 222, the gain using the same transformer would have been a healthier 25 for a single stage, one reason why the arrival of the screen grid valve rendered the triode obsolete as a tuned amplifier. By way of comparison, I calculated that the gain with critically coupled modern double tuned I.F. transformers and a more modern 2ma/v pentode would have a gain of about 100. High Q iron cored transformers would doubtless further improve on this figure.

More gain could be achieved with the triodes by providing a transformer step up ratio, using untuned tightly coupled primary windings. A study of the circuits of the kit set superheterodyne's seemed to indicate

The rear view of the completed receiver.

that this was used in some receivers. Unfortunately capacitance between windings tends to counteract the inductive coupling and in practice only modest ratios can be achieved, even with very low loss windings. Experiments with bifilar winding a small primary in with the tuned winding produced practically no signal transfer at all as did spacing the windings to minimize the capacitance. About the only way that I could expect any reasonable step up would be to use very narrow sectionalized windings In my case, with my primitive windings, any attempts to use other than bifilar in unity ratio were not satisfactory.

Discovering Old Technology

I was fortunate in having some test equipment that the ancients could only have dreamed of. As well as the usual oscilloscope, I have a Wayne Kerr precision audio oscillator that covers up to 120kHz and which has calibrated attenuators. Also there was a R.F. signal generator and capacitor bridge. These, together with a couple of FET meters enabled me to get some meaningful answers. About this time, Gary Tempest sent me some very useful photos he had found on the Internet of early I.F. transformers, and whilst there were some nicely made units with wave wound coils, some were jumble bifilar wound. This confirmed that this was the way forward for me although they would have only a unity turns ratio. Neutralisation of the IF amplifier stages would have to be considered, but a careful look at all the available circuits showed that the only receivers with neutralised I.F. amplifiers were RCA sets. In fact I later found that Leutz had a small comment that neutralization wasn't worth bothering with. He advocated having some residual regeneration in the I.F. amplifier to give increased gain. I noted that the Bulletin article on the McMichael receiver mentions showing signs of some regeneration. This I later found out was accepted by many designers as being useful when running at maximum sensitivity.

I set about developing a three stage I.F. amplifier using unity transformers with what was in effect, tuned choke coupling. First I had to decide on a suitable I.F. frequency. Branston used about 45kHz, but I had already found that only one R.F tuned circuit before the mixer was poor protection against 90 kHz images. Furthermore, oscillator pulling from a strong incoming signal altering (pulling) the oscillator frequency would be likely. I settled for 80 kHz, noting that the McMichael uses 85 kHz. I located some diecast boxes that would hold two bobbins each and made shielding partitions. Although using iron cores would have made for more compact windings the actual inductance would be hard to calculate. I settled on an empirical design using ½ inch wooden cores with ¾" wide windings of 1000 bifilar turns of 38 S.W.G. single silk enamel wire. Another factor that needed clarification was that of I.F. tuning. Many of the American receivers seemed to have no external tuning capacitors. Instead they relied on self capacitance, with coils matched up in sets. I decided to use 500pf trimmers.

A bread boarded amplifier was built up and when tuned to 80kHz the total gain was 300, with a slight degree of regeneration very close to the calculated 287. My I.F. strip looked promising. However, there was still a problem. Tuning was far too broad, with the responses at 20kHz and 120kHz only a few db down. This was, of course, the penalty for having a low Q from the high distributed self capacitance I.F. windings. The obvious answer was to treat the I.F. system as a broad band amplifier and use a band pass filter for the input tuning. I explored my supply of bits and pieces and came across a nicely made early 130 kHz Atwater Kent I.F. transformer which tuned nicely to 80 kHz with fixed 500pf capacitors. Luckily it fitted neatly into one of the coil box partitions. I later discovered that this method of tailoring the overall I.F. response had been common, using a sharp filter on one stage of an otherwise naturally broad band amplifier.

During development of the I.F. amplifier I had tried two types of volume control, both to be found on 1920's receivers. The first was the most common, a rheostat in the filament supply lead to adjust filament temperatures. Ideally, this was used only on amplifier stages so as not to cripple the mixer, detector and output stages, when backed off. The disadvantage of this method is brief thermal time lag when the control is altered. The second system can be alarming to those used to operating valves with negative bias. This method was used in the McMichael receiver and is, as L.L. Williams describes it, a potentiometer control connected across the filament supply. The moving arm is connected to the I.F. valve grid returns. With the wiper at the negative end of the control there is a negative voltage on the grids and the amplifier is working at maximum gain. As the wiper is advanced across the control, the voltage on the grids becomes less negative and the grids start drawing progressively more current. This has the effect of reducing the signal by seriously damping the grid windings. This does no damage as the anode voltage of the I.F. stages is only 45, and the maximum anode current for each valve is no more than 3mA.

Both methods worked, but I found later with the completed receiver, that both controls were necessary to cope with today's strong signals, and when used together, control of volume over a wide range of signals is quite acceptable.

Frequency Converter Research
With a suitable I.F. amplifier now available, the next project was a suitable frequency converter. Before the advent of multigrid valves, the choice was between self powered or "autodyne" mixers or separate oscillator and mixer valves. The virtue of the autodyne was that it saved an expensive valve, but it had problems. Injecting a strong incoming signal into an oscillator can create frequency pulling, which would have been made worse when the oscillator and incoming signal were only 40kHz or so apart. A further problem of close spaced oscillator and received frequencies was strong radiation from an external aerial. RCA minimized both problems by mixing the incoming signal with the second harmonic of the oscillator. This was reasonably effective, although it did create a noisier signal than using the fundamental frequency. Another problem, exacerbated by the absence of any tracking between the aerial and oscillator tuning, was in the Branston and probably with the RCA super-heterodynes, that there were five images possible of some transmissions.

The other type of single valve oscillator/ mixer was the "Tropodyne" used in the McMichael receiver. I was fortunate to have received some further information about it from Gary Tempest. The Tropodyne, was devised by Clyde J.Fitch, and as described in the Bulletin article, relied on the aerial being connected to form a bridge to the centre or neutral point of the oscillator coil. I reasoned that to be a true bridge the lower end of the oscillator coil should be connected to the filament via a capacitance equal to that of the grid-filament capacitance. However, as this is only 3.3pf it makes little difference in practice. I made up an experimental Tropodyne mixer and found the feedback winding needed far more turns of wire than is usual with conventional oscillators. Another problem is hand capacity causing detuning, as both ends of the tuned winding are above earth. It can be minimised of course by a shielded panel and using a tuning knob rather than a dial containing metal. These were minor problems and there seemed to be no reason why it would not do the job.

With the converter and I.F. stages working, it was a simple matter to wire up a grid leak detector and a two stage audio amplifier and apply suitable voltages. Although somewhat rough and "hay wired", the experimental receiver showed considerable promise. With no aerial tuning and with pickup from only a few inches of wire connected to the coil tap, local stations were able to overload the detector.

A Mine of Information
It was around this time that Gary and his American friend Chuck, who both had been following and encouraging my progress, introduced me to the wonderful book that could have saved me a lot of earlier grief . It is a 1926 reprint of the Radio News magazine collected articles on super-heterodynes. It contains a wealth of information and instructions on super-heterodyne construction, even to making I.F. transformers. It confirmed much that I had discovered in my "reinventing the wheel" which was reassuring, and I can recommend it to anyone who is wishing to study the early receivers further. It is available on the Internet and the address as at the end of this article (See note 2).

Everything was ready to come together. I assembled all the parts in a traditional layout and wired it in the style of the period. While I was about it, I built an aerial coil for use without a loop. Pleasingly, the completed receiver worked at first switch on. With a short aerial and as most people are today listening to the F.M. band, the risk of the oscillator interfering with the neighbours is very small. In operation a few feet of aerial wire provides plenty of listening signals with no complaints from the neighbours and is more convenient than using the loop that I had made.

Learning to Drive the Beast
Switching on an early super-heterodyne for the first time can be a disconcerting experience. Until one learns how to drive one it can be difficult to find much on the dials that makes sense. If the two tuning controls are out of step, the set can be quite silent. Leutz had something to say on the matter. In his book he says:

The actual operation of a super-heterodyne receiver cannot be fully understood unless practice is combined with instructions. It must be remembered that the operator cannot consider himself fully proficient with less than several weeks experience. It is, however, possible to secure very good results after three or four weeks' practice. However a thoroughly experienced operator can bring in signals to a high audibility that an inexperienced operator would not hear at all.

There we have it! I found it best to prepare a graph of the oscillator tuning using a calibrated signal generator. The oscillator frequency can be either above or below the received frequency but make sure that it is consistent as with an I.F. of less than 100kHz, it is easy to swap sides at the top of the band. To find a given station, tune the oscillator to the required frequency and then adjust the aerial tuning capacitor. It is likely that nothing will be heard until the aerial tuning is nearing resonance. It is helpful, but not essential, to also make graphs of the aerial tuning. The early RCA receivers had dial scales that the station names could be written on with a pencil. Loop and wire aerials are unlikely, of course, to have identical calibrations.

How well does it go? Subjective assessment shows that the performance is about the same as that of a more modern domestic super-heterodyne , with sensitivity considerably greater than its contemporary TRF sets. In a reasonably quiet suburban location, the limiting factor is background noise. As is to be expected, tuning is somewhat involved, and there is not the luxury of A.G.C. For all that, it provides a good listenable signal when connected to a modern speaker.

The Super-heterodyne Out of Favour.
By 1926, the super-het was in decline. The standard American receiver was now the TRF with one or more commonly two R.F. stages, a detector and two audio stages. It was far cheaper than any super-heterodyne, and regeneration was no longer needed. It would have been a rare housewife who could confidently tune an early super-heterodyne. Using a far cheaper TRF was much simpler although it was handy to have three hands! The novelty of tuning in transmissions from distant stations was wearing off and entertainment was coming more from the programmes themselves rather than DXing. The attraction of the super-heterodyne was wearing off.

Although in France where super-heterodynes seem to have been popular with amateurs, elsewhere in Europe, economic factors would have been important, and Jonathan Hill's "Radio Radio" indicates there were few models made prior to the 1930's. A check through McMahon's "Radio Collector's Guide" for 1929 and the years 1931/32 is revealing. In 1929 although there were literally hundreds of receivers available in America, there were just four super-heterodynes, all using the RCA model 60 chassis and one each that used Scott and the Silver Marshall chassis. The 1931/32 list identifies more than 700 super-heterodynes! What had happened?

In 1930 several important factors had changed the American situation. First there had been the advent in 1928 of the screen grid valve which made high gain selective and stable and simpler I.F. and R.F. amplifiers possible without neutralisation. Oscillator tracking and ganged tuning problems had been solved, making one knob tuning possible. However, the most important development was not technical! The RCA group had come under scrutiny of the American Government for their reluctance to licence other manufacturers to make receivers without paying massive royalties and for their monopolistic control of the super-heterodyne patents. The courts used Anti Trust laws to force RCA to give up its monopolies and issue licences including those for super-heterodynes. It is apparent that various manufacturers had been busy researching and developing super-heterodynes in anticipation. Now the lid was off and within a year the new generation receivers were flooding the market.

The 1920's receivers had gone the way of the dinosaurs and the modern super-heterodyne had arrived. We must remember though that for all their quirks and idiosyncrasies, the early super-heterodyne receivers represented the cutting edge of electronic technology, considerably in advance of other receivers and deserve an honoured place in the receiver hall of fame.

Notes:
Note 1:Correspondence some years ago from

Article continued on page 68

NVCF May 9th 2010

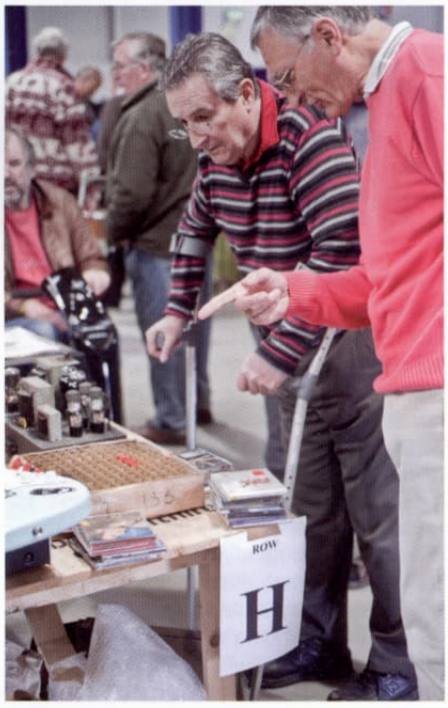
photographs by Carl Glover


WALL TABLE


RADIO
ANNUAL


EDISON
HOME
PHONOGRAPH
EDISON
STANDARD
PHONOGRAPH


ROW
K


ROW
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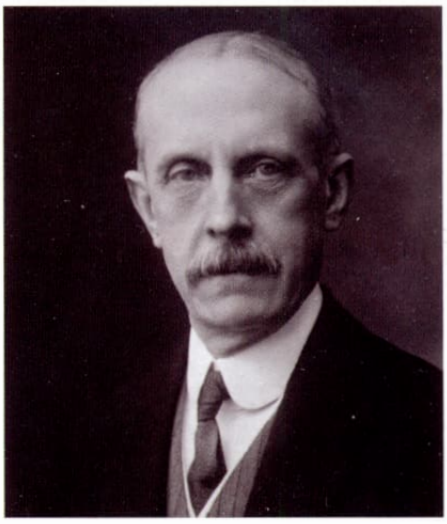
HW Sullivan Ltd - Electrical, Telegraph and Radio Engineers

by J Pactrick Wilson

I intended to write this article some years ago but had hoped to learn more about the radio side of Sullivan's activities first. This has not happened but perhaps publication of this story may elicit further information from other members.

1: Wheatstone bridge (pre-1922)



2: Herbert Watson Sullivan, 1856-1925

Briefly, the company was formed in about 1897 by HW Sullivan to manufacture submarine telegraphic instruments and test equipment. He ran the company until his death in 1925 when it was continued by DA Stevens until he retired in 1964 in favour of his sons, Brian and David. In 1967 it ceased to be a family business when taken over by Cambridge Instruments, and then by George Kent in 1968, becoming part of Thorn Instrument Division in 1970, moving to the AVO factory in Dover in 1972 and ultimately ending with management buy-outs. The last Sullivan catalogue was produced in 1982 although some products were available for a few more years.

My own interest in the company started when I saw a magnificent old Wheatstone bridge (Fig 1) looking distinctly out of place in one of the many ex-government surplus shops in Lisle St in the 1970s. Although probably overpriced for the time, I have never regretted buying it as it started my interest in old electrical instruments and submarine telegraphy. I was impressed not only by its appearance with ebonite, polished mahogany, and lacquered brass with bevelled glass covers, but by the solid and silky motion of its knobs and plugs and the precious metal contacts of the switches.

Since then I have managed to piece together this story from old catalogues, obituaries, patent specifications, articles in *The Electrician* and the *Journal of the IEE*, and most importantly, the reminiscences and memorabilia of former employees. The latter gave insights from widely differing perspectives on the rise and fall of the company, working practices in a bygone age, various "tricks of the trade", wartime experiences and the characters of men, some obsessional for accuracy and perfection and others sometimes bordering on the eccentric. Curiously, at least until the company was taken over, nobody seemed to put profits high on the agenda.

Origins of the company

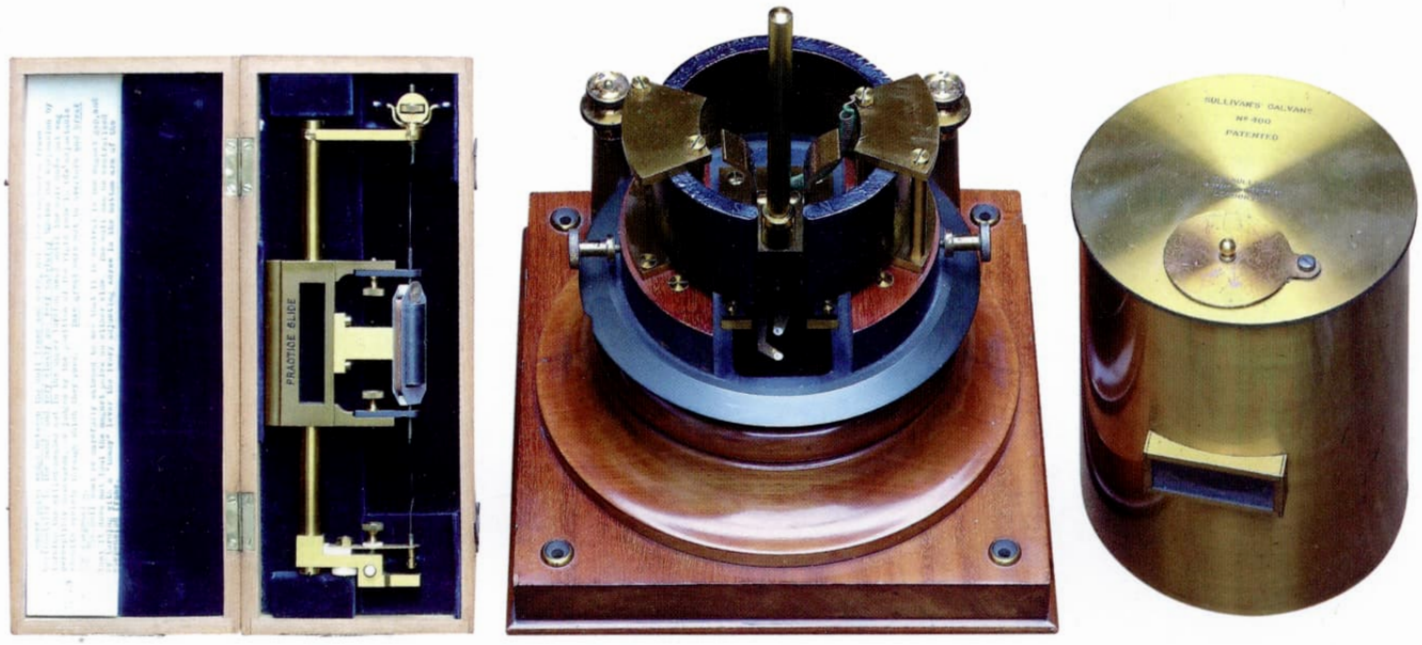
Herbert Watson Sullivan (Fig 2) was born in Malta in 1855, the son of John Jonathan Sullivan, Esq. The family owned a cigarette company, Sullivan, Powell & Co Ltd, of 24 Hanover Square, London W1 (Fig 3), in which two of HWS's sisters continued to be involved in later years. He was educated in Jersey and joined the Telegraph Construction and Maintenance Co Ltd in

3: Sullivan, Powell & Co Ltd, cigarette box (same family but not financially linked)

1870 as an apprentice. On completing this, he moved to the Eastern Telegraph Co. for six years, where he took charge of the electrical arrangements at their Gibraltar station. During this period he assisted CV de Sauty in the first successful duplex experiments on long submarine cables (i.e, sending signals simultaneously in opposite directions through a single wire and earth return). Later he was invalided home for a few months but then resumed and worked afloat for two further years. He suffered from poor health for the rest of his life.

In 1879 he rejoined the Telegraph Construction and Maintenance Co. and assisted in many important cable laying operations, including Ireland-Newfoundland, Singapore-Batavia, Lisbon-Madeira, Suez-Aden, the Straits of Sunda and Mozambique-Zanzibar. After this he worked for two French companies, for whom he installed and organised a number of cable stations in various parts of the world. He was Electrician-in-Chief for the manufacture and submersion of French Government cables between Marseilles and Tunis, and Consulting Engineer for the cable between Australia and New Caledonia.

At the time of his election to Associate Membership of the Society of Telegraph Engineers in 1878 his address was "Norfolk House, Westwick Gardens, W Kensington Park", and he became a full MIEE in 1892. The address for his first patent was "29 Ladbroke Square, Notting Hill". These were probably both those of his sister with whom he lived for much of his life, never marrying. In 1893 he took out a patent for "Improvements in and relating to the Deprez D'Arsonval Galvanometer" which contained several innovations to minimise the influence of motion at sea. These included mechanical balancing of the coil by adjustable projections, the use of ebonite collets (not normally in contact with the coil assembly) to limit motion and prevent damage to the suspension during shock or tilt, and a governor arrangement to tighten the suspension during disturbance. A marine galvanometer performed two important functions during cable-laying operations: firstly, as a conventional instrument for electrical testing and fault finding and, secondly, as a "speaking" instrument in an operation which must have seemed magical to sailors in those



4: Sullivan's Galvanometer (1903) with slide removed

pre-radio days, of communicating with the shore. In "cable code" the dots and dashes of Morse are represented by left and right deflections of the galvanometer spot.

The final product (Fig 4) used an aluminium coil former almost slit through to provide critical electromagnetic damping, a taut suspension which can be slackened for sensitive laboratory use, two lead wire projections (missing in Fig 4) which can each be bent outwards or sideways for balancing, an adjustable camel hair brush to damp motion further when used for "speaking", and interchangeable coil and suspension slides. Later, more sensitive free-hanging suspensions (which require levelling) became available and all slides from 1895 until about 1968 remained interchangeable, sliding between the vertical "skis"and connecting with the sprung contacts below. The patent was taken out with Elliott Bros as patent agents who illustrated it in their 1895 catalogue as *Sullivan's Form of d'Arsonval Galvanometer* at £18 plus £3-10-0d for a spare speaking or testing slide.

Until this time all marine galvanometers had been of the moving magnet type designed by Lord Kelvin even though moving coil units had been available for laboratory use from about 1881. Sullivan advertised his instrument in a booklet of 50 testimonials, dated between 1895 and 1902 including this one from G Marconi: "The Italian Embassy have enquired of me about your Galvanometer. I have told them that several leading Captains in the British Navy have told me that they consider it the best instrument of its kind". Its advantages are quoted as: immunity from ship's or earth's magnetism, roll, pitch or vibration of the vessel, its rapidity of response due to critical damping and short oscillation period, portability compared with the heavy iron-clad Kelvin, ease of setting up and about three times greater sensitivity. It gained recognition as the "Rolls-Royce" of galvanometers and established the reputation of Sullivan.

It was related many years later by Mr Mallinson, a galvanometer expert whom Sullivan had head-hunted from the Paul instrument company, that Sullivan had started by assembling galvanometer and resistance coils in his sister's kitchen and baking them in her gas oven. He had the parts for these manufactured to his specification by Elliott Bros, but at some stage became dissatisfied with Elliott's workmanship and switched to Robert W Paul, an electrical instrument manufacturer who was also producing some of the earliest ciné equipment. Apparently Elliotts then started assembling and selling Sullivan's galvanometer themselves so he sued them and with the proceeds was able to put his company on a sound financial footing. There are probably elements of truth in this story, but Elliott's was a reputable company and had legitimately produced and marketed the galvanometer for him in 1895. It is possible that the galvanometer (No 65) used in the Porthcurno test set (Fig 5) dates from this period as it is not labelled "19 Great Winchester St" as is No 400 (Fig 4).

The Sullivan Era

In 1897 (although a 1922 advert stated 1900) Sullivan founded his company at 19 Great Winchester St, off Old Broad St, where many of the submarine telegraphy companies also had offices. His works were first listed in the Commercial Directory in 1903 at Liverpool House, Middlesex St ("Petticoat Lane"). Presumably by this time the company had started producing many of its own parts. His employees would finish and assemble them but he would do the final calibrations himself. During 1913 the official address changed to "273 Winchester House, Old Broad St, EC", with works at "104-106 Middlesex St" (which was "Liverpool House").

Over the period from 1893 until his death in 1925 Sullivan had obtained at least 48 patents, most relating to telegraphy including further galvanometer improvements, moving coil relays, the use of a length of real cable at the beginning of an artificial line for a better balance in duplex telegraphy, improved loading coils for superimposed telegraph working (with Chas E Hays), improved telegraph cables using wax impregnated paper insulation and iron wire or tape loading. Others included winding of resistances to minimise reactance (with CE Hays), improvements to variable condensers, a cylindrical pancake variometer concentric with an air condenser to give a wide tuning range (with Joseph Joseph), an improved electric light switch (with Henry Joseph & Dean Osgood), and an improved heater element (with Chas B Gresham). The last is interesting because it represents an oddity in their output, a domestic radiant heater which they manufactured and sold over several years. Could it have been a stop-gap to keep the men occupied and cash flowing when orders were slack? In 1941 the metal working shop was still known as "Heaters".

By 1918 an additional works address had been added at "Harpenden Rd, W Norwood, SE27". This may have been the result of WW1 contracts in which they were developing wireless telegraphy for the government. This initial involvement laid

5: Porthcurno Cable Station Test Set (Wheatstone Bridge updated in 1947)

the foundation for many future contracts with our own and other governments and, of course, the early manufacture of wireless equipment for the general public.

In 1920 he advertised on the back of *Wireless World* (Fig 6) a "Standard Experimental Valve Amplifying Receiver Panel" for educational purposes at £45 and a book of working diagrams at 1/- and "List W" of wireless equipment. In the 1921 *Wireless World* Sullivan's were offering their own "R-valve" (probably those in Fig 8) which would presumably have been made for them by a valve company. In 1922, the advert included a "Crystal Receiver at £2-17-6, Combined Crystal and Valve Set at £9-5-0, Two-Valve at £14-15-0, Three-Valve at £19-0-0 and Four-Valve at £23-15-0" . The crystal and four valve receivers (Figs 7&8) were photographed at BVWS events and may still be in the hands of members. They did not stay long in the receiver field as mass production was never their forté, but did of course continue to produce radio frequency test equipment including the wavemeter seen in Fig 9 (calibrated 18/12/1925, valve not original). The latter was still listed in their 1946 catalogue, by then using a low filament current valve rather than the bright-emitter type "R5" which my wavemeter specifies.

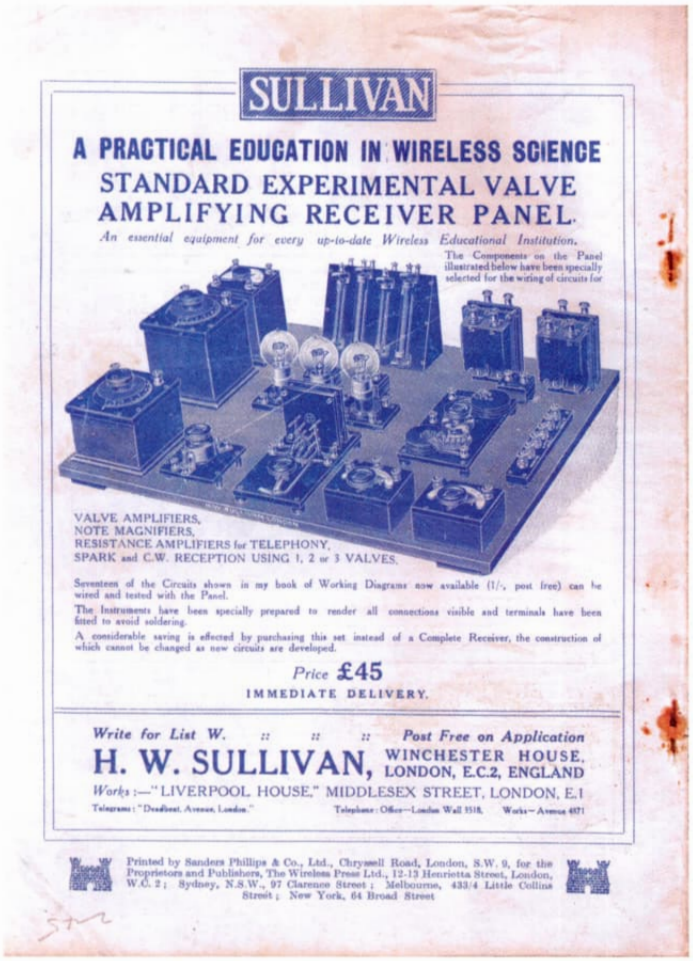
A 1921 catalogue, Section "T", "Principal Testing Instruments ... for use in ... Submarine Telegraphy, Telephony and General Laboratory Measurements in Cable Manufacturing Test Rooms, Colleges, etc", described some of their product range at the time. This included four models of universal galvanometer and accessories, eight models of universal shunt, five resistance boxes, four Wheatstone bridges, a Gott's substitution ratio arm, seventeen keys (Fig 10) and commutators, galvanometer scales and stands, four standard mica condensers and two condenser boxes, a portable cable testing and signalling set and a three-range milliammeter. They certainly produced other items, including a Lodge lightning guard (Fig 11), relays, Morse recorder (Fig 12), and probably most standard telegraphic devices.

The prices of Sullivan items were higher than other companies but because of their design and finish, would have been more expensive to manufacture. On the Wheatstone bridge mentioned above, the switch contact surfaces are precious metal and the glass covers are individually fitted and marked, and the adjusting screws are sealed in red with "HS". The manganin coils were always aged over many months and recent measurements show the ratio arms are still balanced to within 0.005% and, after correcting one rogue coil, measurement accuracy is 0.01%. It is clear that Sullivan with many years experience on the installation and testing side of submarine telegraphy and with first hand knowledge of the consequences of breakdown and the capital and income at stake, considered that only the best would be good enough for telegraphic test equipment.

By 1922 Sullivan felt that it was time to close the business down. His health, which had never been good, had deteriorated further, he had no family to take over, and the company was in a poor financial condition. Stories differ on how this was avoided, but he agreed to become a limited company to inject more capital from the issue of 20,000 £1 shares, he and his solicitor holding one each.

Sullivan's place of death was given as 202 Bedford Hill, Balham (Fig 13), which was a nursing home run by Mrs Stevens, with the Stevens' family home being next door at 204. One story is that when Sullivan realised he was dying, Mrs Stevens suggested that her son Donald might be able to take it over. The other version is that after Stevens became a director and secretary of the company he offered to try and turn it round. By all accounts Sullivan was a kindly man who may have been taken advantage of by some of the less conscientious workers whom Stevens either pulled into line or sacked. However, HWS continued to manage the company until his death on 28 Jan 1925, whereupon Lt Comdr Bishop held the fort. The revised Articles of Association list Lt Comdr Walter George Bishop, OBE, RN Ret'd, Mr Donald Arthur Stevens and Mr James Hayne Stephens as Directors. The letterhead (Fig 14) indicates that DA Stevens was a director before HWS died. Fig 15 shows a company dinner in about 1925 with Stevens to the left of the mirror, next to Bishop, in front of it, and on the nearest table, Littlemore at the end with Griffiths on his left and Speer on his right.

At some point Sullivan's workers



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6: Wireless World back cover (7 Aug 1920)

7: Sullivan Crystal Set (post 1922)

decided to make him a presentation of a grandfather clock, which with their various instrument and woodworking skills, they had made for him. How appreciative he was for a gift made from his own materials in the hours he paid for is not recorded! Little is known of his other interests and activities except for his involvement in the London & Provincial Anti-Vivisection Society, of which he was a life member, served on the Executive Committee from 1917, and was Chairman from 1918 until his death.

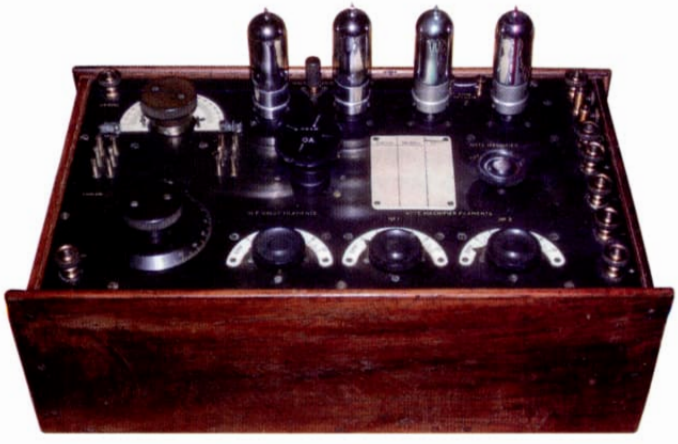
The Stevens Era

Donald Arthur Stevens (Fig 16) was born 18 Jan 1895 and educated at Southgate College and apprenticed to the British Construction Co. In 1914 at the declaration of war he and his brother Claude enlisted with the RNVR and were dispatched to defend Antwerp with a delaying action to allow the Allies time to escape. When the Germans marched into Antwerp, they crossed the border into then neutral Holland where they were captured and interned at Groningen until the end of the war. During this time he was involved with education among the other prisoners. On his release he enrolled at King's College London, where he was awarded an Hons BSc in Engineering, an AKC, and Diploma of Engineering in 1921. He became President of the Union Society and later, Honorary Life Member of both that and the King's College Engineering Society. He was elected Associate Member of both the Institution of Structural Engineers and the Institution of Civil Engineers. He had been initiated into Freemasonry during internment and continued to be extremely active within the movement, holding many offices and founding new Lodges.

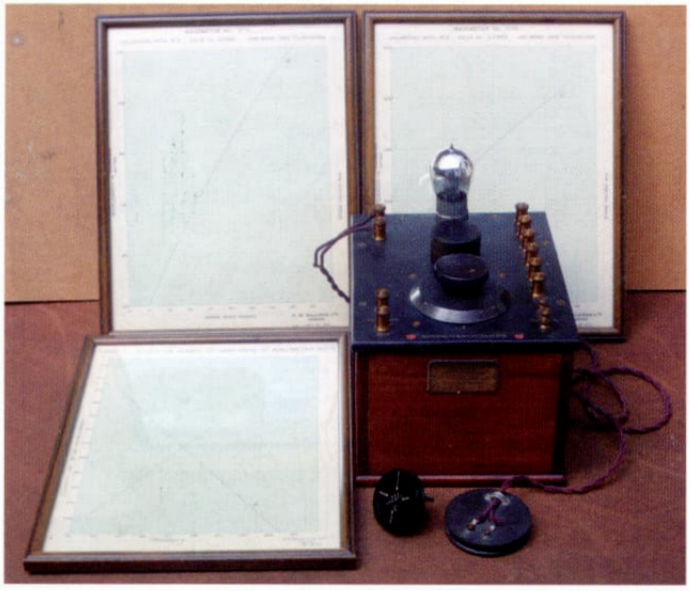
In 1921 he was surveying and constructing bridges in Nigeria, and became Executive Director of the Northern Provinces when his predecessor died of blackwater fever. He contracted blackwater fever himself and returned to England in 1924, being appointed Managing Director of HW Sullivan Ltd in 1927 at an annual salary of £1000 free of tax. He was given authority to restructure the company and on the death of the controlling Director [Bishop] assuming his place with financial control of the company. He probably bought Bishop's shares at this stage and, later on, bought out JH Stephens.

As a civil, not an electrical engineer, Donald Stevens was concerned with managing the company rather than technical developments, but did nevertheless oversee the extension of the work of the company from cable testing instruments into audio and radio frequency measurements and standards. The technical side of the company was very much governed by Mr Griffiths. Stevens was, however, actively involved in the many foreign sales to national physical laboratories, etc., and did much travelling on their behalf, frequently taking his wife, where they became friends with several families they visited. Where justified, he would establish a local agent to handle the business. Mrs Mabel Stevens related their trip to Russia in 1936 when, following a diplomatic incident, most trade was banned. Nothing worked in their hotel where they were advised against going first class because, although the choice was greater, everything was "off" except the same poor quality food that everyone got.

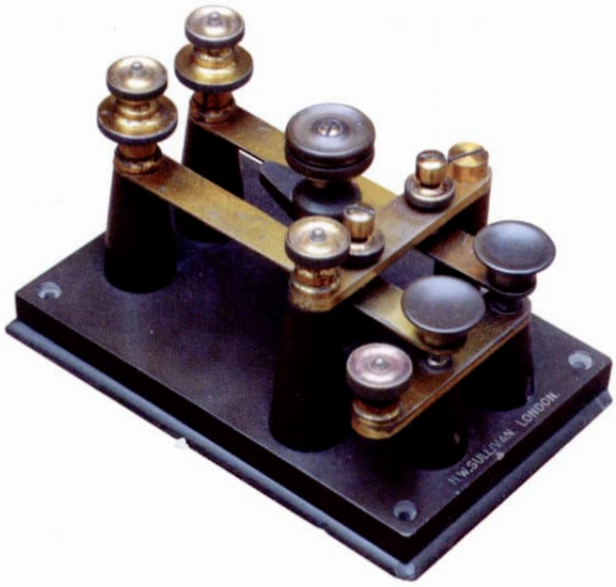
One of the first major changes that Stevens made in 1927 was to bring together offices and works in an old double-fronted



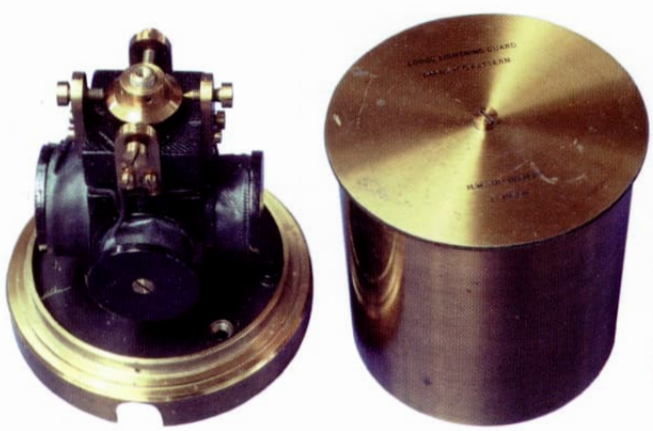
8: Sullivan 4-Valve Receiver (post 1922)

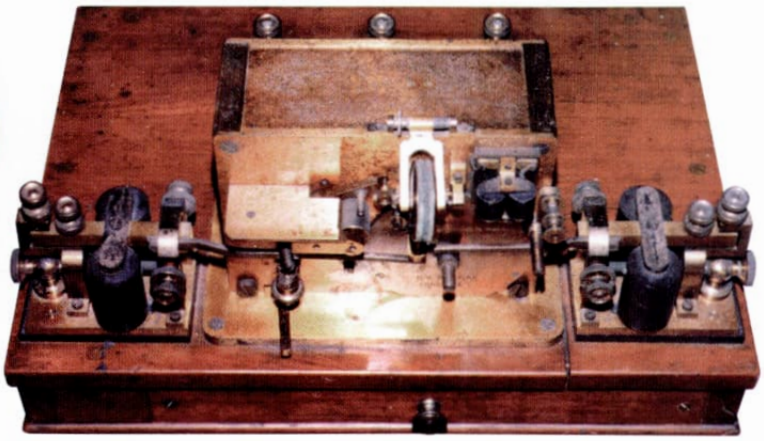


9: Wavemeter with calibration charts (50-100m & 190-510m, 1925, valve replaced)



10: Testing Key, Reversing (pre-1922, can be used as "speaking" key)





11: Lodge Lightning Guard (post-1922, more compact than original Muirhead version) 12 (right): Sullivan Morse Recorder (pre-1922) using standard sounders

Georgian manor house at "72 Leo St, Peckham, SE15", just off the Old Kent Rd, and surrounded by a pleasant walled garden (Fig 17). This had formerly been used as a naval laundry, a workhouse, and a bleach works. The move was made by horse and cart and by hand carts over the three miles across Tower Bridge . The panelled boardroom was to the left of the main door with offices situated in the other reception rooms of the old house with the works in the extension to the back, the upper floors, and the various outbuildings, which were added to over the years. One of these was a tall church-like building which had been used for drying sails.

The factory could have been out of Dickens with its cobbled yard, with the stores being in the old stable at the far end. The test room had been the tack room still with the old fastenings around the walls, and the original half doors to the stable. Apparently the second floor was a somewhat makeshift addition which gave considerable cause for concern during the air-raids as it contained the heaviest machinery. As 20°C had to be maintained for test purposes, the air conditioning consisted of opening a window if it was too hot and turning on a heater if too cold and real problems in a hot summer.

The war years were a source of many reminiscences. Apart from incendiaries, the premises never received a direct hit. There was sleeping accommodation and a nightly rota of 3 or 4 for fire duty on the roof, and several underground shelters in the grounds. Bayonet practice was given to the firm's Home Guard unit by Mr CJ Holbrook, Head of the Design Office and a major during WW1, who arranged sandbags in the trees for the men to charge. In typical "Dad's Army" fashion they were supplied with Ross rifles of 300 calibre and Enfield 303 ammunition, which of course did not fit!

Sullivans was always a happy place to work under a benign family regime. In 1941 there were 41 on the staff and 326 on the payroll rising to 500-600 by the end of the war, then a rapid decline staying at about 200 until take-over. Many of them had worked for Mr Sullivan and remembered him with affection. Stevens similarly felt personally responsible for his workforce but did not want outside influences like trade unions disturbing the family peace. He would continue paying staff when they went to war but could be arbitrary in his generosity. When he heard that Jock the plumber was ill he bought fish and personally drove out to his digs in his Humber to deliver it yet when a senior engineer was in hospital he appeared to take no notice. Workers would organise regular collections to support colleagues when ill. Later when unions did appear, he lost interest in personnel on the shopfloor whom he felt were served by the unions, but retained a fatherly interest in his salaried staff. It was not until after the war that a pension fund was established.

The company kept the Stevens' family in considerable comfort, and could be called upon for minor home repairs and improvements, but was never in danger of making them seriously rich. David Stevens related that when he and his brother Brian were at boarding school their letters with news from home were typed by Joyce, the office secretary, and their cheques were signed by Mr Douch, the Chief Accountant. When John Lewis got married, the Stevens' lent them their caravan for the honeymoon and drove them to it.

During the war the company continued to produce instruments for cable ships as well as Admiralty work for anti-submarine warfare, ASDIC, goniometers, the cumbersome transceivers that soldiers would carry on their backs, aircraft receivers and transmitters, transducers, the R209 wavemeter used for guiding planes by beacon, waveguides for radar, and of course, the standard products which were still required. They took over four shops (828-834, Fig 17) in the Old Kent Road to use as extra factory space, and also had part of Klingers factory on the Sidcup bypass. These were used to produce ammeters and valve holders and cans using female labour. Mr Griffiths moved his office to Reigate, which was considered

13: 204 (Stevens' house) & 202 (Nursing Home) Bedford Hill, Balham

15: Company Dinner (1925-7)

14: Letterhead (1922-5)

safer, staying with the Rev Alwyn and paying him £7/16/- per month rent.

At the end of the war these extramural sites were given up but the grounds now also contained four further brick buildings: an RF Lab, a Galvanometer Lab, a Drawing Office and Main Stores. At one stage Griffiths became dissatisfied with the level of pollution in the Old Kent Rd and its effect on the delicate galvanometers and so he asked Mr Stevens if he had any spare room in his house at Hayes in Bromley. With the agreement of Mrs Stevens, the spare bedroom was thus taken over by Mr Mallinson during working hours for galvanometer assembly. This continued until the birth of the first Stevens' child.

William Henry Frederick Griffiths (Fig 18) was a key figure in the company, starting as an apprentice in about 1915. Sullivan recognised a kindred spirit, someone who was interested in electrical measurements, getting to the frontiers of accuracy and stability, and producing equipment of the highest possible quality. He arranged for his technical education and eventually promoted him to Chief Engineer. It was his designs which kept the company at the forefront for many years although, as is common with others, he ultimately failed to keep up with modern developments and methods. He was, by his fastidious nature, both the mainstay and to some extent the bane of the company. He was awarded an MBE for his war work.

According to Mallinson he had obtained an agreement with Sullivan that, for any significant innovation that he introduced, his name would appear on the instrument concerned and he would receive a royalty on its sale (although his first patent and appearance of his name did not occur until after HWS's death). He would not countenance any instrument leaving the factory without being personally certain that it was absolutely perfect. Many a time an instrument already packed for dispatch would be unpacked, inspected and some slight blemish on the lacquer corrected or more costly still, submitted for further calibration.

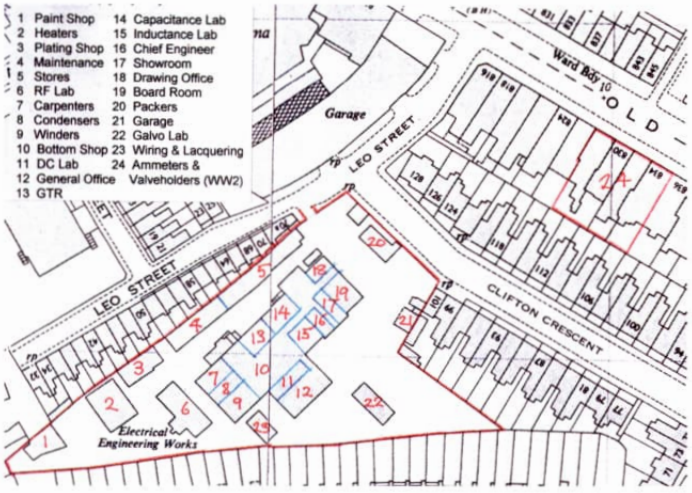
Griffiths took out at least 24 patents and published over 15 papers in technical journals. In addition he produced didactic introductions to the company catalogues on standards, stability, and measuring techniques and instruments, which were highly valued in their own right. One of his ingenious innovations was a dual decade switch for resistance boxes (Fig 19) which, with 21 positions per dial, could cover 8 decades with 4 dials to four-figure accuracy (Dial 1: ten thousands or units; Dial 2: thousands or tenths; Dial 3: hundreds or hundredths; Dial 4: tens or thousandths) thus halving the number of switch contacts in series and the size of the box.

Another idea was the production of a bridge giving direct reading in any two chosen systems of units. The first standard for resistance was the BAU of 1865 which was replaced by the Legal Ohm in 1881, then by the International Ohm in 1889, and finally by the Absolute Ohm in 1949. The last three do not differ greatly and are about 1.3% larger than the BAU. Submarine telegraph companies were, however, incredibly conservative so that even in 1955, nearly 75 years after the BAU had become obsolete, it was still the unit of resistance that they worked in! Griffiths' solution was to construct a bridge in which the ratio between the ratio arms was half the ratio between the two required units, and the variable arm values were set midway between the two units. By interchanging the ratio arms, it would thus read directly in either of the two chosen systems.

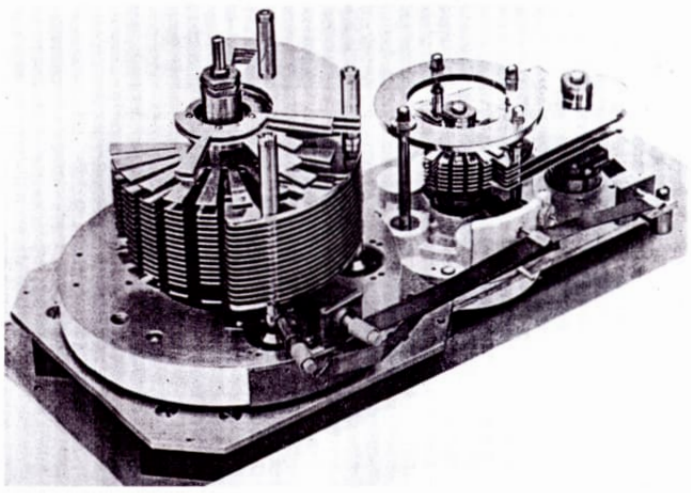
Whereas Sullivan had been primarily concerned with submarine telegraphy and low frequency and DC measurements and standards, Griffiths' expertise included capacitance and inductance standards and extended to radio frequencies measurements and covered the full period of thermionic valve technology. He was probably chiefly responsible for the company's pioneering position in radio production but may also have been responsible for its failure to move into mass production. It was said that he strongly opposed the introduction of transistors.

16: Donald Arthur Stevens, 1895-1966

18: William HF Griffiths, ~1900-74



17: Leo St site and 828-834 Old Kent Rd



20: Three-dial air condenser, two switched decades plus variable

Other Griffiths patents were concerned with AC bridges, oscillators and improvements to standard fixed and variable capacitors and inductors and it was in this area that the name of Sullivan was supreme. He devised a system of temperature compensation for condensers and for condensers that would compensate for changes in associated inductances; he devised an arrangement of slots in condensers vanes (Fig 20) so that around the detented positions, the gap in the vanes greatly reduced the change of capacitance with dial position, thus allowing accurate "switched" values without the losses associated with electrical switching. In the case of inductors he showed that the effects of expansion of copper wire can be compensated by utilising the different coefficients of expansion of ebonite for the ends and bakelite for the ribs on which the coil is wound giving a resultant coefficient below 5 ppm/°C. For his best air condensers the values were about 3 ppm/°C.

Move to Orpington

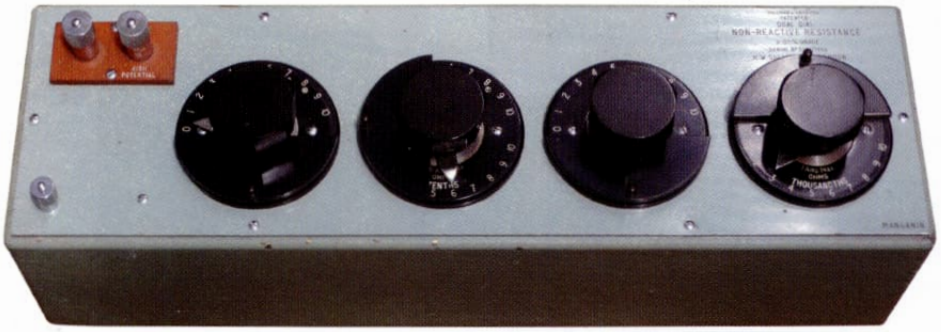
In 1963, owing to government policy on local redevelopment, the company was forced to move. They were offered sites at St Mary Cray (Orpington), Paignton, and somewhere in the north. As Mr Stevens lived in Kent and had no great desire to move, Murray Rd, St Mary Cray, was chosen. At this stage they had an overdraught of about £30,000 but with the new building funded by the government, it was hoped that after the move they would come out in the black.

At Leo St each labourer had his own little office with its own fire and cooker and boy, into which the foremen were frightened to go. It is related that one foreman, Arthur Harris, would always arrive in his dark suit, bowler hat and rolled up umbrella and change into working man's clothes on arrival, then sit reading the paper whilst his boy made him a cup of tea. Instead of making a clean start, they effectively recreated this set-up in the new purpose built factory so instead of coming out in the black, they ended up with a £70-100,000 overdraught. Even Mr Griffiths insisted on a wall right down the middle of the factory so that the people in the workshops could not see into his laboratories.

The new factory (Fig 21) had woodworking and stores to the right on the ground floor, with the remainder air-conditioned to 20°±1°C for the capacitance, inductance and resistance laboratories, and upstairs was the main general office, the managers' offices and the canteen. A great attraction for many of the workers was the provision of council houses, which were a great improvement on the terraced houses without bathrooms around the Old Kent Rd at that time, although others chose to commute on the bus provided. In spite of the enforced rush, however, the Leo St site was not cleared and turned into a park for another 15 years, by which time the company had moved again! By 1966 the overdraft had risen to at least £120,000, possibly nearer £200,000. Sometimes the bank would have to wait for a cheque to clear before releasing money to pay the wages.

Donald Stevens retired in 1964, in favour of his sons, Brian and David, and died in May 1966. Brian had worked previously at BTH and DeHavilands, and took over as Managing Director, whilst David (Fig 22) remained with sales. The company was in very poor shape financially and heavy death duties created a further burden for the company. There was also strong pressure from the government through the IRC for all electrical companies to be brought together under Weinstock of GEC. Thus when Brian and David with their relative inexperience were set an impossible task and an offer to combine with Cambridge Instruments came in 1967 it was accepted. This was the end as a family business but the name, premises and most of the workforce continued for a number of years longer.

With the retirement of Griffiths imminent, it was necessary to find a replacement. They decided to look round amongst their customers for a possible successor. The name of Alan Silcocks from STC was decided upon unanimously, and he agreed to take it on. He introduced the transformer ratio bridge, an idea of Blumlein from 1928 and used in the Wayne-Kerr Bridge, which was ideal for accurate high frequency work, and of course he also brought the company into the transistor



19: Dual Dial 8-decade Resistance Box (0.001-111,100 , 0.05%, 1956)

21: Murray Rd, St Mary Cray, Orpington

22: David Stevens in 1997

23: Chris Jones in 1996

and fully electronic era, albeit several years later than it should have been. Tragically he and the commercial director were killed in the late '70s in a light aircraft accident whilst flying on company business.

Other personalities from the Stevens era include Mr CH Burrows, who was a Works Manager of the old school, followed by Harry Taylor, who had previously been foreman of the middle shop; Mr Wm Frankton was Head of Test and rather eccentric with a droopy moustache, monocle, spats and a waistcoat onto which he allowed his cigarette ash to drop, and would smarten his bowler hat with pen and Indian ink. He was succeeded by Reg Parmenter, who was a leading light in resistance measurement and a great asset to the company. George Heskins was general foreman over the three main workshops, and his son Bill was an instrument maker. Gatling and Baldwin were also foremen. Mr EW Lewis was Company Secretary and was followed in this by Mr EG Douch who had started as a junior clerk and worked up to Chief Accountant. The Chief Salesman, Conway, had a resonant voice which he used for amateur dramatics. For many years he had to manage without a car and although a good salesman, he was not really up with the technology. One of the carpenters was "Eppy" Lee because in the "Petticoat Lane" days he won the annual race round the block and was named for a famous runner of the time, Epinard.

Much of the early information and anecdotes were gathered by Chris Jones (Fig 23) John Lewis, who started shortly after him in the office. Chris was into everything and knew all that was going on in the company. He started as an apprentice in 1941 and when he explained that he wasn't quite 14, was told "If you want the b***** job you start on Tuesday". His basic pay was 15/10d (79p) per week from 7.45am to 5.30 (compulsory overtime to 7.15pm) and 7.45 to 1.30 on Saturdays, with two days paid holiday over Christmas and one at Easter, and one week's unpaid holiday in the summer. He was made redundant at the end of the war, but returned when employment picked up and became head of the second class test room for 0.05 and 0.1% resistances, whilst Mr Parmenter did the 0.005% and better. He declined to move to Dover and with three others set up Algo Instruments which provided official repair and BCS calibration services for Sullivan, AVO and other makers. They set up with a roomful of equipment not required in Dover which they got for £10. Several of my instruments and photocopies of early catalogues came from them.

The Goldfinch Era

After take-over by Cambridge Instruments in 1967 it became apparent that drastic reorganisation at Sullivans was required and so WJ Goldfinch, BSc(Eng), FIEE, moved to Orpington as Managing Director in 1968. He created a new atmosphere by sweeping away the previous formality by going round in shirtsleeves and insisting that everyone called him Bill.

He started technical college in 1943 and did an engineering degree at Northampton Polytechnic (now City University) and joined Cambridge Instruments in Sydney Rd, Muswell Hill, in 1948 as a Technical Apprentice. This had been Robert Paul's factory from 1902 until they combined with the Cambridge Scientific Instrument Co in about 1920 to form The Cambridge & Paul Instrument Co Ltd, and becoming Cambridge Instrument Co Ltd, in 1924. They had other factories in Cambridge and from 1958 at Torrington Park, Finchley, with head office and sales in Grosvenor Place. Goldfinch rose rapidly in the company and by about 1960 was General Manager of the Muswell Hill factory which was predominantly manufacturing and product development. He eventually became Master of the Worshipful Company of Scientific Instrument Makers and was honoured with an OBE.

Cambridge Instruments were about ten years ahead in terms of technical innovation and manufacturing techniques and probably constituted about three quarters of the combined company. It was found that the beautiful but expensive Griffiths switches were electrically less consistent than the mass produced Cambridge switches costing only pence. Sullivans were able to offer a highly skilled workforce and a modern factory. It was immediately decided, however, that many of the parts which had

24: PO cable test desk from Taplow telephone repeater station (1925, Amberley Museum)

25: Decade Mica Condenser, 0.001-1uF (post-1922)

26: Universal Galvo (1951)

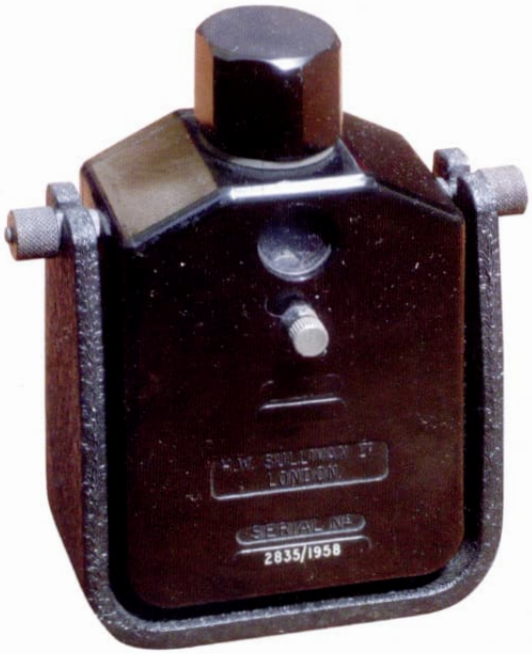
been hand made should be either bought in or mass produced, so most of the work became assembly rather than manufacture, and work from Muswell Hill was shifted to Murray Rd. Both brand names were to continue, with instruments retaining their parent identity, until redesign was required, when standards and AC instruments were to be marketed under the Sullivan name and DC potentiometers and bridges as Cambridge. EIL (Electronic Instruments Ltd) of Richmond had already been acquired by Cambridge in 1960 and would continue with EIL megohm meters. By 1978, however, all products were sold under the Sullivan name even though their origins could still be identified by style and model numbering.

The merger made good sense because a year later (14 June 1968) shares rose rapidly when, against a rival bid by Rank, they were bought by George Kent Ltd, and in about 1970 they became part of the Thorn Group. In 1972, Goldfinch also oversaw the closing of the Orpington factory and the move to Dover where they combined with AVO in their factory at Archcliffe Rd. AVO was a larger concern with a workforce of 900 with much more mass production than either Cambridge or Sullivan but, having produced the first DVM (digital voltmeter) they failed to market it properly, allowing Fluke to dominate the market. At this stage most of the workforce decided to take redundancy settlements rather than move, so that in the end only about twelve people went including John Lewis, who eventually moved from Dover to be Personnel Director for the whole of Thorns at Hayes, and Bill Goldfinch, who ran the Thorn Instrument Division and later led a management buy-out which included the Dover factory. John Lewis noted that until take-over Sullivans had only employed three graduates whereas later at Thorns, 4,000 of the 6,500 employees were graduates.

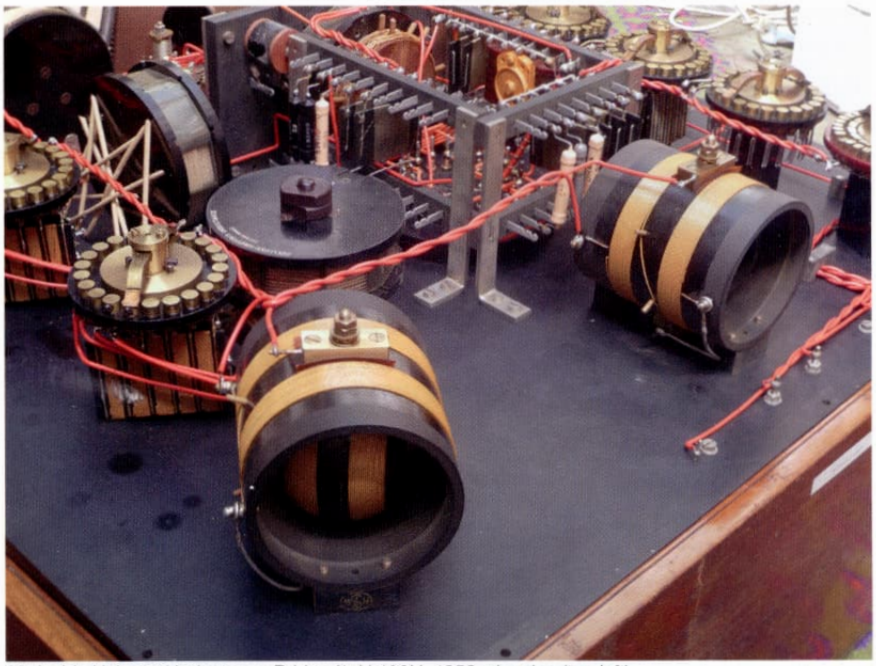
Working Practices

The company did not originally manufacture equipment ahead of orders but prided itself on personal service to the customer. For high precision standards this not only meant waiting for manufacture but for an extended period of ageing before testing to confirm stability as well as final calibration and perhaps certification by the NPL. Thus an eighteen month to two year wait was common. It was not unusual to invite the customer to see his instrument before the final calibration was complete and for the salesman (Conway or David Stevens, or in the case of foreign sales to an important customer, Donald Stevens) to deliver the instrument personally and supervise its setting up and installation. Several such deliveries were made to laboratories whose function was unknown at the time but later turned out to be secret atomic energy establishments.

A skilled instrument maker and his improver would work from raw material



27: Bakelite Galvo (1958)



28: Inside Universal Inductance Bridge (1uH-100H, 1956, showing (top left) three compensated inductors and (bottom & right) two variometers)

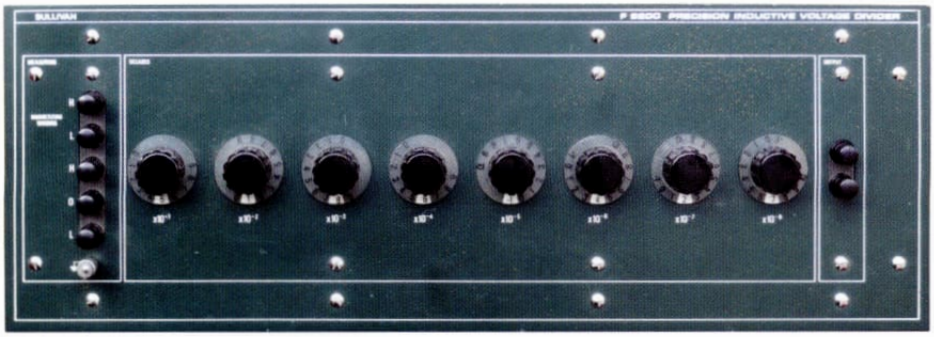
29: Wheatstone Bridge (1950)

until the final instrument was assembled. Upon an order he would obtain the necessary materials from stock, plan out and execute the various stages of construction, using whatever machinery was required. All shopfloor work was done by gangs on piecework. Jobs such as coil winding and lacquering were done by women skilled in such tasks, working all day at the same job for 11¾d per hr. The gold lacquer was applied by brush after the piece had been heated to the correct temperature by Bunsen burner. When complete, the instrument would go for test and calibration. With such a wide range of skills involved and such high standards of workmanship demanded, an apprentice at Sullivans could always find a good job elsewhere afterwards. Unfortunately this method of work did not lend itself to either a continuous process of modernisation or to mass production. Many processes were done manually, or on bigger machines, by overhead belt drives. The introduction of powered machinery was resisted as it did not allow the man to "feel" what he was doing. New machinery usually appeared only if it could be paid for out of a large government contract.

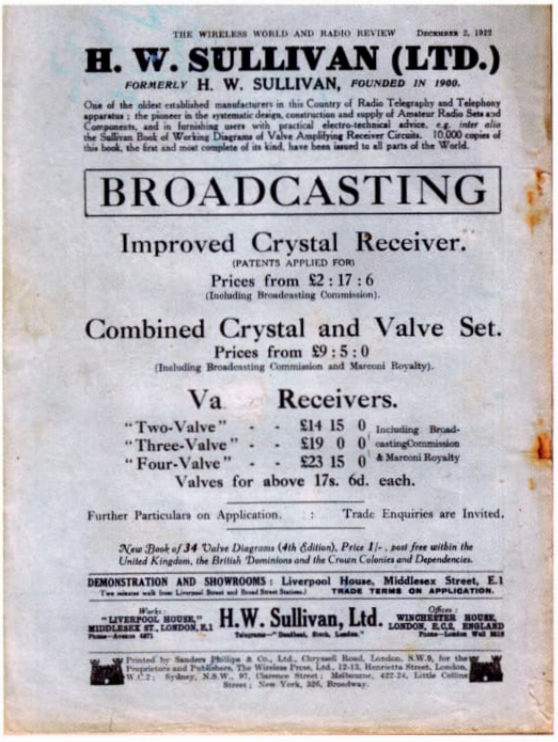
Although the company was involved with many innovations during the war it failed to take advantage of this later. There had always been a strong moral feeling that it would be wrong to make excessive profits out of the war, and this mentality seemed to extend afterwards to exploiting the expertise gathered through this experience. This was not, however, the only factor involved. Griffiths in particular wanted to get back to his beloved precision instruments and nobody was enthusiastic for mass production. Take, for example, waveguides and transducers, in which Sullivans were pioneers during the war. These were made in comparatively small batches by precision engineering methods on small and ancient machines. A change to mass production would involve heavy investment in complicated equipment to achieve low cost per item. This would have meant selling in a completely different market from the one in which they had experience. Thus they were just able to satisfy an order for 5,000 transducers, but when the next one came for 50,000, it had to go elsewhere.

One of the changes that had been introduced after the move was to build instruments in small batches so that the more popular items could be supplied from stock. This was particularly important for colleges and universities which were expanding and re-equipping at this time. With an annual grant that had to be spent within the year it was not possible to order something for two years hence.

Following take-over the company did become more efficient and profitable but it was very much a niche market and did not fit well with AVO. Unsuccessful attempts had been made in 1970 to combine with Tinsley which would have been a more natural partner. AVO's main reason for



30: Precision Inductive Voltage Divider (2 parts in 10^8, post-1972)



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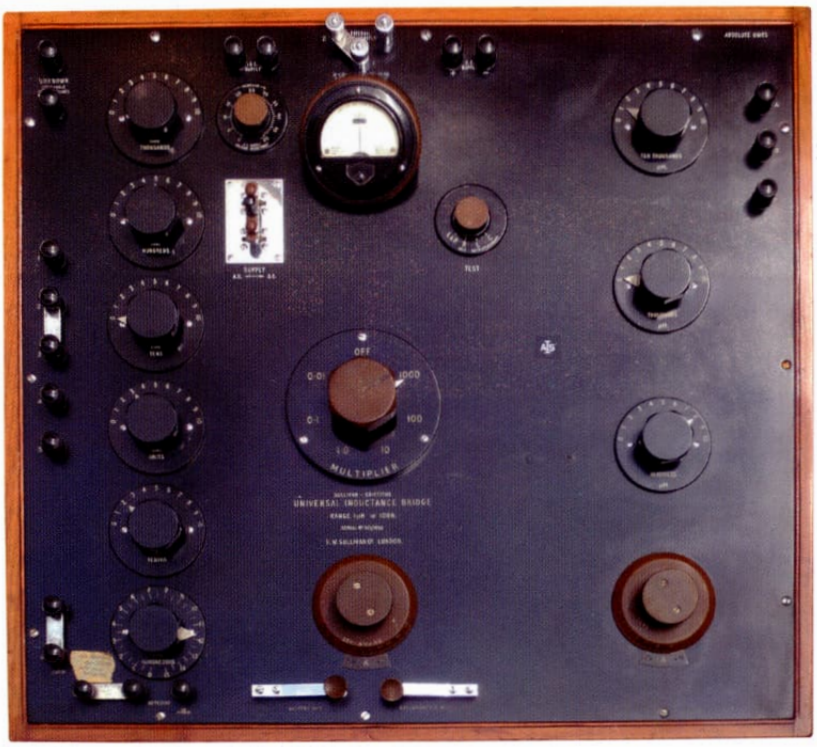
Wireless World back cover (2 Dec 1922)



Front of Universal Inductance Bridge (1956)

joining with Sullivan, apparently, had been to acquire Evershed & Vignoles (which had been part of Cambridge) for their Megger, but in the long run it was the key personnel from Sullivans which proved the greater asset. With the widespread introduction of fully electronic measurement methods the instrument side became obsolete, but standards would continue to be required.

It was not only during the wars that they did contract work. The Ministry of Defence, Admiralty work on Polaris, the AERE, the NPL, the Post Office at Dollis Hill and many other concerns would use Sullivans as their workshop to produce their own designs. Such contracts were normally priced on a cost plus 25% basis. In some cases these products were later marketed by the company. One example quoted by Arnold Lynch, who had worked at Dollis Hill on the optical tape reader used in *Colossus*, was a Schering capacitance bridge that he had designed. This was required for measuring both the properties of polythene for insulating the first transatlantic telephone cable (TAT-1) and the inter-electrode capacitances of the valves used in the repeater amplifiers, and was built for them by Sullivans. It was then listed in their 1955 catalogue at £283 for measuring capacitances up to 4pF at better than 0.001pF accuracy.

A very large and profitable contract with China, who were equipping about forty universities up to our National Physical Laboratory standard, also helped the cash flow situation for several years. David Stevens related the leg-crossing agony of trying to clinch this deal on his own, whilst being plied with numerous cups of tea, without daring to leave his papers on the table or insult his hosts by gathering them up. On another occasion, however, he had arranged for a colleague to phone him confidentially "If you can't settle for £xxxx by 4pm get the next flight home". Miraculously as the time approached the negotiations which had been getting nowhere suddenly got settled for £xxxx.

In many cases the customer would require NPL certification of accuracy even though this could cost half as much as the instrument. When re-calibration and certification was required, Sullivans would take it back and measure it themselves before submitting it to the NPL so if adjustment was necessary the expense of submitting it twice could be avoided. They then measured it again afterwards before returning it to the customer. In this way Sullivans were able to maintain their own standards probably better than anyone else.

Product Range

Over the years the range of instruments and the style of design and materials used for construction have gradually evolved. The turned polished mahogany base for the galvanometer had already disappeared by 1921. Other items from the early period not illustrated in any of my catalogues include: a desk fitted out as a test-set for the Bristol-London Post Office cable at Taplow (Fig 24, on display at Amberley Museum); a 1μF mica decade condenser box (Fig 25) in which double switching reduces the number of condensers required by adding the 5 (or 6 on the last range) to the lower values.

The 1946 catalogue illustrated many grey metal boxed instruments with bakelite rather than ebonite knobs (Fig 19), the galvanometer had a plain keramot (red/brown ebonite) base and black crackle-enamelled brass cover (Fig 26). In 1955 a small bakelite galvo was added (Fig 27). They did not, however, simply change for change's sake. Even the 1964 catalogue illustrated items from the earliest era alongside rack-mounted grey metal boxes.

The serial numbers used appear to be open and honest, apparently starting from No 1 for each type of instrument and by 1934 they were adding year of manufacture. Model or catalogue

numbers started to appear on instruments by the 1950s. After take-over Sullivan and Cambridge numbering occurred alongside each other in the catalogue. Items originating after take-over used long obscure serial numbers.

In 1946 a number of precision oscillators and wavemeters extending up to 60MHz and down to 0.01% accuracy were included, as well as components intended for radio work. The 1955 and 1964 catalogues included Griffiths informative introductions and fixed and variable inductance, capacitance and resistance standards with accuracies from 0.1 to 0.001%, six models of oscillator and wavemeter, three inductance bridges (Fig 28 shows two variometers and three compensated inductors inside the Universal Inductance Bridge), variable linear, log law and decade condensers, eight models of capacitance bridge, nine models of Wheatstone (Fig 29) and Kelvin bridges with accuracies from 0.1% to 0.003%, a potential divider to 0.001%, four models of galvanometer including the interchangeable slide model (Fig 26), universal shunts, keys, plug switches and other accessories.

By 1971 the company had been taken over by Cambridge so the Sullivan catalogue now illustrated a reduced product range for existing Sullivan items alongside and sometimes competing with items from Cambridge Instruments and EIL. The only electromechanical galvos were of Cambridge origin. The new Sullivan introductions were an electronic milliohmeter, AC and DC detectors, a transformer-ratio arm inductance bridge, a transformer-divided air capacitor, a transformer-ratio arm decade capacitance bridge for 10pF to 1μF at 0.01%, or 1ppm using an external standard, modernised versions of Wheatstone and Kelvin bridges, a DC potentiometer, an eight-decade precision inductive voltage divider (to 2 parts in 10^8) and a four-decade ratio transformer. These now sported a dark green panel with white lining although sometimes using a veneered wooden box (Fig 30). They also offered a BCS-approved calibration service for resistance, inductance, capacitance, DC voltage, potentiometers and bridges.

In 1978 after the company had moved to Dover the catalogue was issued in two parts: "Precision Instruments" and "Electrical Measurement Standards". New Sullivan instruments include a 2% capacitance bridge, 0.5pF-50μF, a telephone cable test set first introduced for STC in 1974 which had many teething problems with its non-destructive contacts, a portable megohmmeter, 100k to 100T , a precision potentiometer of 0.001%, further DC detectors, further transformers and other items of Cambridge origin. The Standards catalogue again offered the calibration service but has a further reduced range of standards: 13 inductance, 17 resistance, 3 capacitance, and 3 emf standards 2 decade capacitor boxes, and 8 decade resistance boxes. The last major new instrument to be introduced was in 1978, an automatic component analyser, a 14-range digital autoranging instrument giving the effective parallel capacitance and conductance or series inductance and resistance at 1kHz. The associated component comparator was released in 1979. In 1982 they withdrew from the British Calibration Service (BCS) saving an annual fee of £2028.

Conclusions

HW Sullivan is probably typical of many small companies over this period: a family business without ambitions of becoming too big for the owners to handle and without ever seriously planning for the future. The nature of its product range prevented it ever becoming really big. The company is notable for the high quality of its products and attention to detail rather than for any striking fundamental innovations. It should have led the way in electronic measurement, but that would have been inconceivable until it was too late. Nevertheless it managed to serve a niche market over a considerable number of years whilst being virtually always undercapitalised.

Acknowledgements

The author would like to thank Mrs Mabel Stevens, Mr David Stevens, Mr Bill Goldfinch, Mr John Lewis and Mr Chris Jones for agreeing to be interviewed and for the information that they provided, Porthcurno Telegraph Museum and BT Connected Earth at Amberley Museum for allowing photos of their exhibits. The tape recordings and transcripts will eventually be deposited in the IET (formerly IEE) Archives. The author would like to thank IET Archives for providing a grant under their Oral Archives programme.

New Radio Poster for British Vintage Wireless and Television Museum

Peter Nash – BVWS member and friend of the British Vintage Wireless and Television Museum, West Dulwich has followed in the footsteps of Norman Jackson, the artist responsible for a series of posters illustrating wireless between the 1920's and 1940's. Norman's original posters have been a popular item in the BVWS and Peter has seized the initiative in realising that it was time to capture the likenesses of British radios from the 1950's. Norman Jackson was responsible for skillfully illustrating countless BVWS Bulletins between the late 1970's and early 1980's.

Peter has painstakingly drawn the radios using a pencil to give them a near–photographic appearance, he has just commenced working on a poster comprehensively illustrating British televisions which is also for the museum.

The poster costs £5.00 and is available from The British Vintage Wireless and Television Museum, 23 Rosendale Road, West Dulwich, London SE21 8DS. Telephone 020 8670 3667

www.bvwm.org.uk

R1155: Give us the tools and we'll finish the job!

By Roger Grant

This project started with a sequence of events around the Harpenden swapmeet mini-auction in October 2009. In among the auction items there were two R1155 WWII aircraft receivers of Lancaster bomber fame. I remember modifying one of these for domestic use in my youth, the mod consisted of removing all of the direction finding circuitry and fitting an audio output stage and a mains power supply. The set was originally only capable of driving headphones and powered from a rotary transformer elsewhere in the aircraft.

I used this modified set to drive a large speaker in my father's shed while rebuilding my AJS motorbike in the summer of 1965. Happy memories of listening to the pirate radio ships anchored in the Thames estuary and North sea, Radio Caroline on 199m and Atlanta on 204m. These pirate stations started up in 1964 when having pop music on all day was a real revolution (I was 16 at the time), the BBC Light program only put out about one hour of pop music a week and Radio Luxembourg was only available in the evenings after 7:00 and faded in and out quite a lot.

A week or so before Harpenden, after watching a film about the pirate radio ships, (The Boat that Rocked) a colleague at work said he had found among some of his reel-to-reel tapes a recording of the last hour of Radio Caroline and I would be welcome to make a copy. Seeing the R1155's, I thought I might bid for one, as I hadn't played with an R1155 since my youth and listen to the tape on the same radio as I did in 1965 (this time through a 1 Mc/s modulated oscillator nearby).

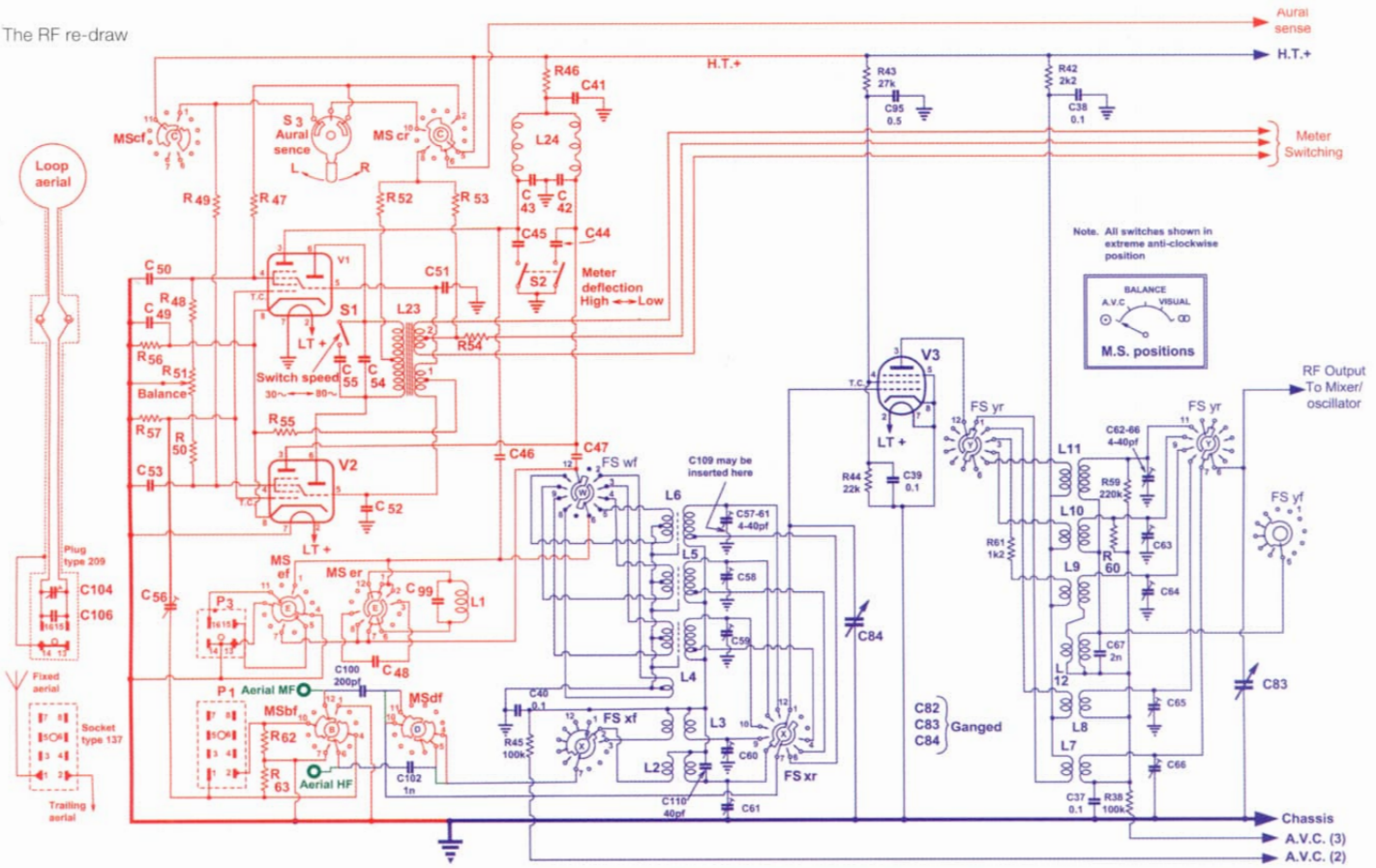
These R1155's at Harpenden were not the nicest I had seen and the first went for a bit more than I was prepared to pay. At this point a fellow member and long time friend Norman Purrott said he had a pair of these in his shed that he didn't want and I was quite welcome to them, he said they were very scruffy and would need a lot of work. I went to collect them a week or so later and found there were three and they came with a folder full of circuit diagrams and operating instructions, including the A.P.2548A. Air Ministry manual. A precursory look round showed them all to be in a bad way but I found myself instantly drawn to the challenge.

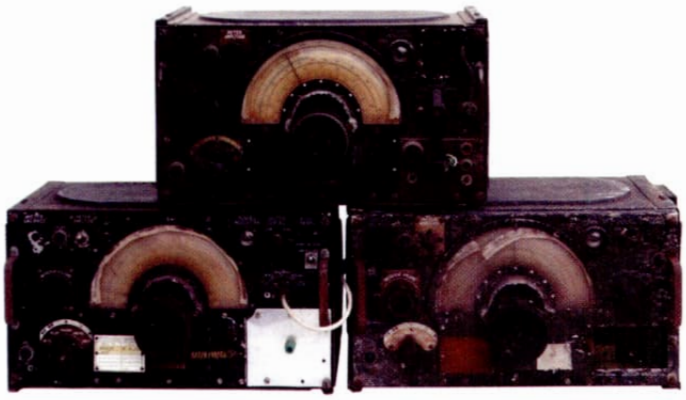
The first, an R1155B, Aluminium chassis type, the front panel a bit corroded and pock marked, all of the valves were missing, but the set appears unmodified. No evidence of any corrosion inside the set, the outer metal cabinet has protected it quite well. A lot of work outside though, I think I'll leave this one alone, keep it as a reference, I'll migrate any original valves back into this one and I might fully restore it as an original at a later date.

The second, another R1155B, Aluminium Chassis, Front panel a bit corroded with pock marks. All DF kit removed including the Master switch. A mains power supply has been fitted inside using a silicon diode rectifier, a top-hat type BY100, a piece of history in itself, and an output stage using a 6V6 output valve. There's an unsightly unpainted aluminium panel fitted where the Jones plugs used to be, the mains lead comes out of the master switch shaft hole, the set looks fully modified and might have actually worked sometime in the past. Very scruffy outside, with most of the interesting bits on the front panel missing, it's not very aesthetically pleasing to look at and needs a lot of tidying, although again no corrosion inside. The mod looks like it was done with speed in mind with no attention paid to what it might look like. I think I'll shelve this one while I think about it.

The Third, An R1155F, steel chassis type, has a paxolin panel fitted where the Jones plugs used to be, has two

The RF re-draw





The front panel ready for re-spray

aerial sockets, a wander socket for the MF bands and a coax socket for the HF, there's also a phones jack, an unconnected speaker socket and a dangling choc block for the input power, HT and LT.

All of the DF kit has been removed already, the DF valves and local components including tag boards, meter controls and switches. A 6V6 output valve is fitted in the socket of V9 but not wired in, no evidence of an output transformer. The other two DF valve sockets stripped of components. The front panel a bit weathered but salvageable, the heavily plated metalwork survived rust attack but all front panel screw heads very rusty, there's a hole cut in the top right of the front panel to accommodate a meter, there's a circuit diagram in among the paper work of an 'S' meter mod, I expect that's what it's for. (It refers to an article in Short Wave magazine dated February 1947).

The wiring inside is perished in places and several components have been badly replaced, wires just twisted together and left to dangle. This one's outside condition is the best of the three, and again no evidence of corrosion inside.

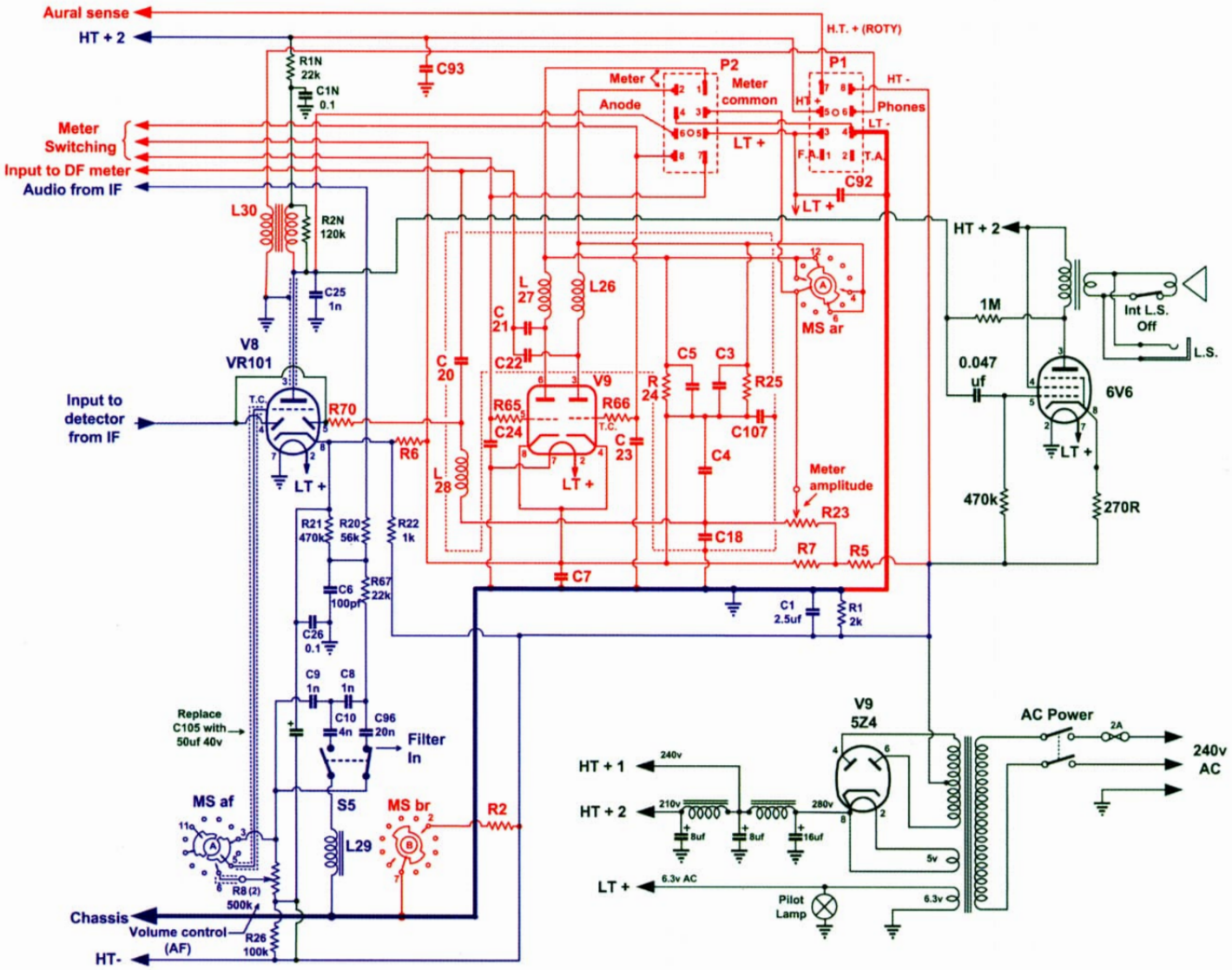
All three of these R1155's perspex tuning windows look very cloudy and may need reproduction, the tuning scale plate was very discoloured and the coloured tuning scales very faded, this set has the best looking tuning scale window so I removed this to see how salvageable it was going to be and it cleaned up very nicely, very easily, the cloudiness just dirt on the outside and with a light polish with some Brasso, came up like new. At this point I decided the half–started mod on this set should be finished as it would have been in the 1950's/60's, and this reminded me of the famous Winston Churchill quote I've used in the title, and when I found in my box of panel meters an Air Ministry moving coil meter dated 1941, that fitted the empty hole in the front panel, and with an FSD of 5m/A, exactly as the meter in the article, my fate was sealed and I'm on my way.

The slow motion drive removed with the tuning window sub-front panel was dismantled, the slow motion gears removed from the aluminium gearbox, The remainder of the original paint stripped off and the aluminium corrosion (white powder) was scrubbed off with a wire brush, the gearbox primed with grey primer and then sprayed satin black (Halfords), The slow motion drive is in two stages, the front part, the fine control, is sun and planet wheels with a gear ratio of 72:1 and the rear, a plain old friction drive, the coarse control, giving a ratio of 4:1.

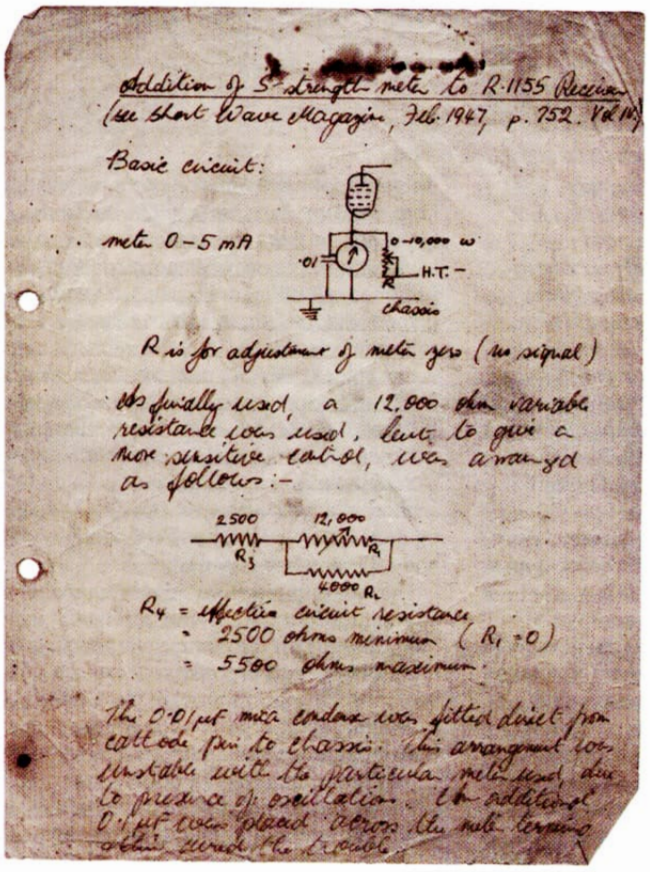
With the gearbox and tuning window removed, I cleaned, dusted off and re-sprayed this sub front panel and it all came out very well.

The fading of the coloured tuning scales seems to differ from set to set, on one the blue scale almost completely faded away and on another the blue ok but red very faded, the yellow on all of them faded to different degrees in different places, I have enough information from the three scales to reproduce a new scale.

I removed the tuning scale plate and scanned it into my PC. I imported this into



Above: The Audio and PSU re-draw, below: The pencil sketch of the S meter circuit



MS Visio, my preferred drawing software, and redrew the scales over the top of the scanned in image, this was quite easy, just lines and numerals, no fancy logo, the only slight difficulty was finding a similar font for the lettering, Gill Sans MT was very close, the original scan then deleted and the new scale printed off very nicely fitting on to A4 paper.

The rest of the front panel furniture was removed, the knobs all came off ok with no real problems with rusty grub screws.

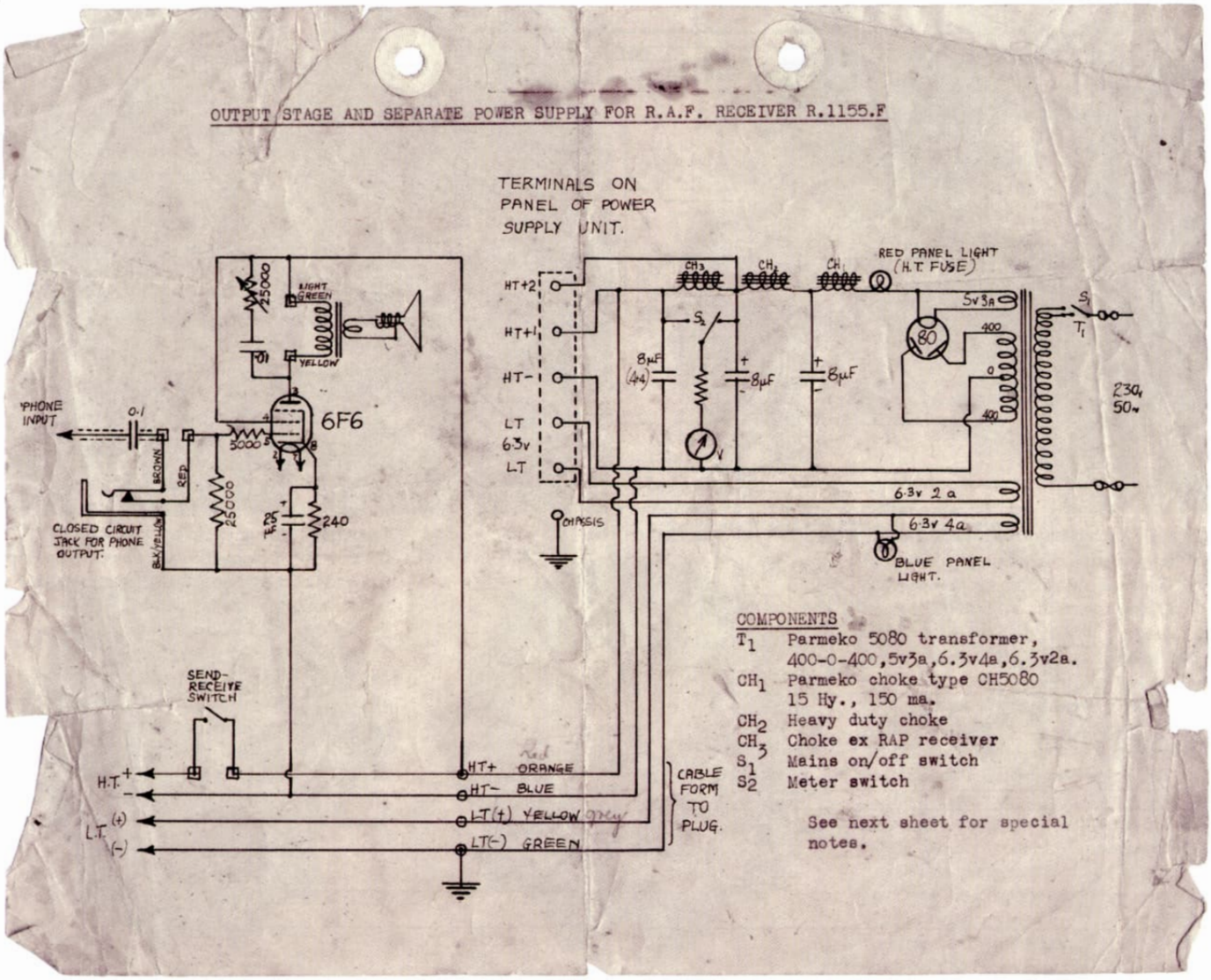
Some of the controls have brass plaques for decals and there's a brass model and serial number plaque, these are screwed to the front panel with small self tapping screws, the legend on these plaques is positive etched into the brass and back filled with paint, the exposed brass was heavily oxidised and corroded in places, this was bought back to life with a drop of Brasso, re-sprayed satin black, then re-rubbed with Brasso so the legend showed though, finally sprayed with clear gloss lacquer to protect the exposed brass as original.

All of the control and switch retaining nuts were removed along with any rusty screw heads that need replacing, the audio filter panel behind the front panel and the master switch rear bracket retaining screws were removed, this allowed the controls and switches to be pushed though inside the set. The front panel was then cleaned and prepared for a re-spray, the redundant holes filled with car filler and sanded flat, the permanent decals were masked off with masking tape and control holes masked off inside the set, the exposed sides of the set masked off with newspaper.

The spray job went well and the controls, switches and decals refitted replacing any rusty screws.

I installed the new tuning scale attached to the original plate and rebuilt the window and slow motion drives, the "S" meter installed in the hole already cut in the front panel where the "aural sense", "meter deflection" and "switch speed" controls were removed from.

It's my intention to keep as many of the rest of the original bells and whistles as practicable, and if possible fit an internal speaker. The het



The sketch of the power supply and output stage

tone controls (for CW Morse), the master switch even if it only switches the AVC on and off and volume controls between AF and RF. The "meter amplitude" pot will now be the "S" meter zero control, there's an extra switch fitted near the master switch, this will be the internal speaker on/off, in the vacant hole for the "meter balance" pot I'll fit a mains on/off toggle switch with a pilot lamp above it. I'll manufacture a new panel to fit the hole where the Jones plugs used to be, this will house the MF and HF aerial sockets, a jack socket for an external speaker and a three pin Bulgin socket for the mains input.

The outer case was next and was cleaned, rubbed down and holes cut for the speaker fret in the right hand end strengthening panel, finally primed and re-sprayed satin black, the whole set now looks good if nothing else, a real handsome beast, so on with the electric bit.

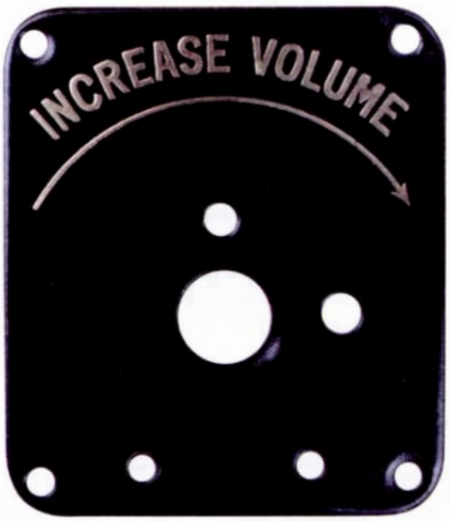
With ten valves and the pilot lamp it is going to require quite a hefty mains transformer, about three amps or more for the heater circuit alone, it will need a bit more than one would require for the average domestic set, I found one that nearly fitted the bill in my transformers box, unfortunately there was no 5v winding for the rectifier heaters, I fitted a separate 6.3v 2A heater transformer for this, with a few turns removed from the secondary to bring it down to 5v for the 5Z4 rectifier.

I removed the capacitor block C92, C94 and C1, this large block now mostly redundant with a new power supply. C1 and R1 were replaced and re-sited, the other large redundant block C93 also removed, hopefully this will make space for the mains transformer and an internal speaker.

The mains transformer was fitted in the place of the C92-C94-C1 capacitor block and the space in front of it already vacated of its DF components tag board, the rectifier valve fitted into the old V2 socket, I replaced this with a better quality type for better insulation than the paxolin original as it's the rectifier. There's space in front of the RF coil box under the tuning gang for the smoothing choke and capacitors.

The master switch consists of four double sided wafers, the rear three all controlling the DF gear now redundant, only the front wafer is required (Af and Ar) for controlling the volume controls and AVC. The switch was removed with its rear mounting bracket and the three rear wafers removed, the shaft was cut down and the wafer mounting rods replaced with 6BA nuts and bolts keeping the original front spacers.

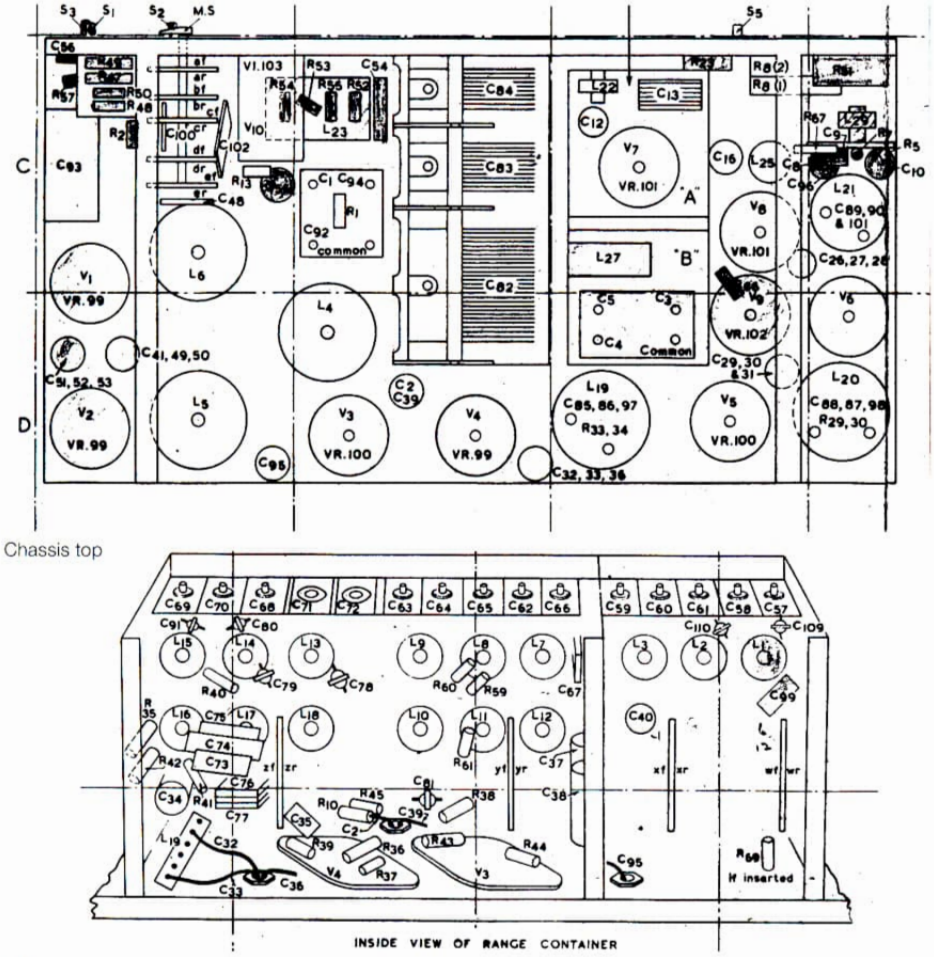
The now empty chassis area behind the cut down master switch and across to the end of the chassis was cut away using a metal nibbler, with this chunk of chassis removed should afford plenty of space for a speaker.



The Volume Decal

The mains on/off switch and pilot lamp were wired in and the integrity of the heater system checked out.

The old V9 socket is Ideal for the 6V6 output valve, and its output transformer in the now vacant box behind V7, again, the original components already removed. I selected a suitable output transformer, the valve book says it's 5k impedance for a 6V6, I found the best way to measure an output transformer's impedance is to connect the



Chassis top

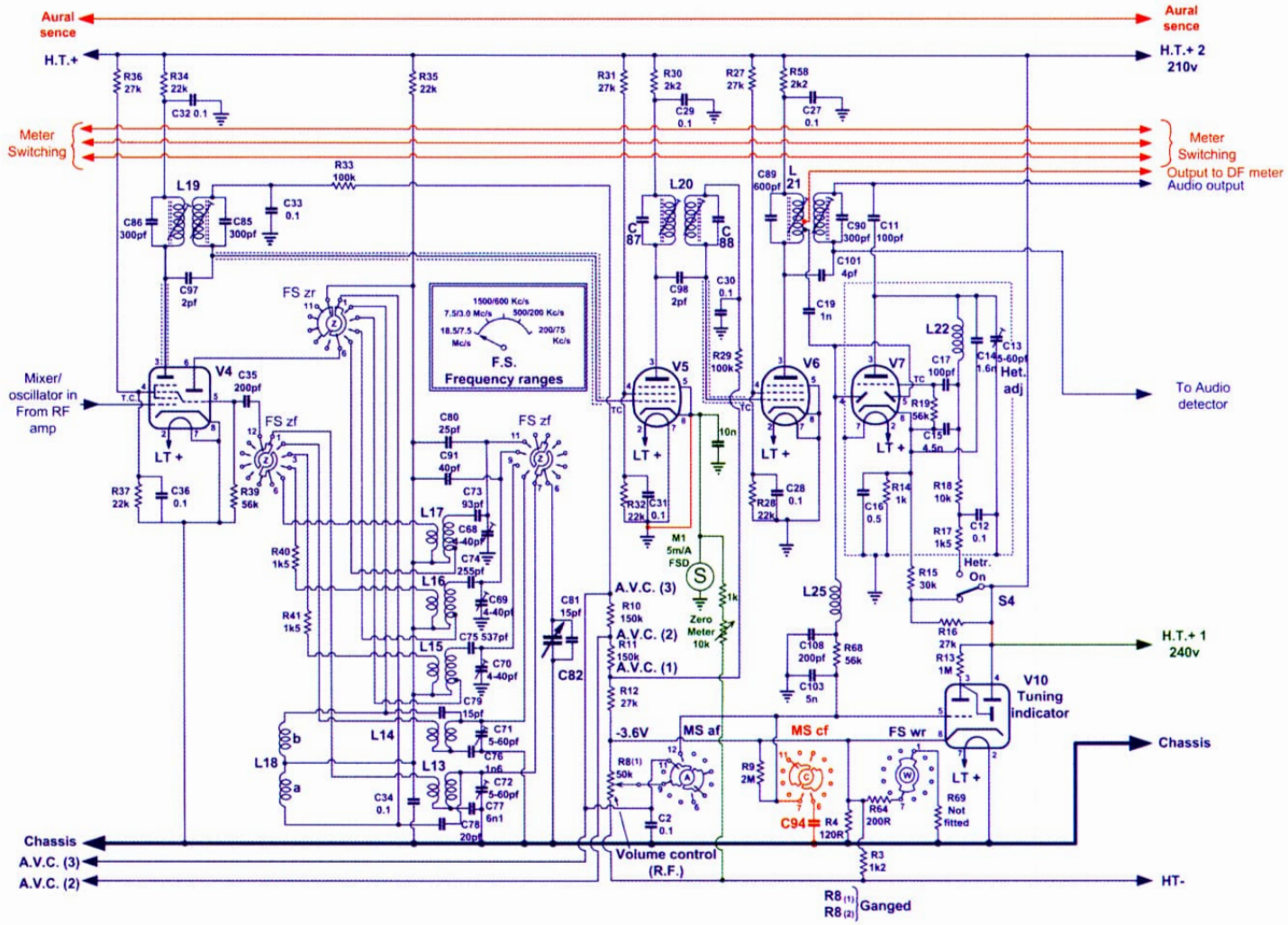
secondary to the speaker it's going to be used with, connect the primary in series with a 25k pot and apply 400c/s from an audio signal generator, set at say 20 volts, adjust the pot so that the junction of the primary and the pot reads half the input volts, disconnect and measure the pot, the resistance of the pot will be the same as the impedance of the transformer, (a practical approach avoiding the Chinese flute music).

The audio filter switch wiring had been clipped off from its components on a panel behind the switch, this wiring was replaced and the filter choke lowered on this metal panel to make room for the mains on/off switch and pilot lamp.

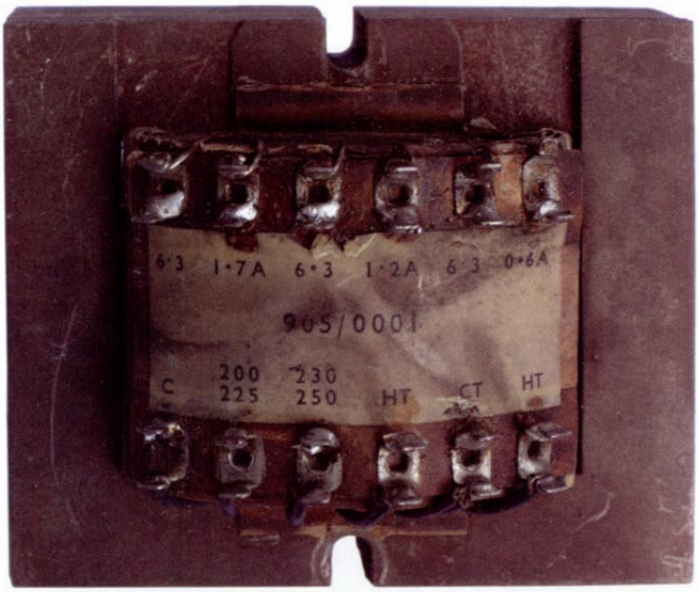
A lot of the cross chassis wiring insulation was perished and breaking up, this was replaced with a similar silicon rubber type (obtained from Harpenden), I pulled the middle out of the screened bits and pulled through the new wires, this operation was easier than I thought it was going to be, I just had to remove and replace the wire whipping around the ends of the screening, this included the wiring to master switch wafer "Af" the two sections for the AVC and volume controls.

There were dead wires dangling everywhere from components that had been removed, I dealt with these one at a time removing the redundant ones and replacing and completing those still required.Some of the dangling wires went into the coil box, the DF related ones were removed at source from the switch wafers and the others

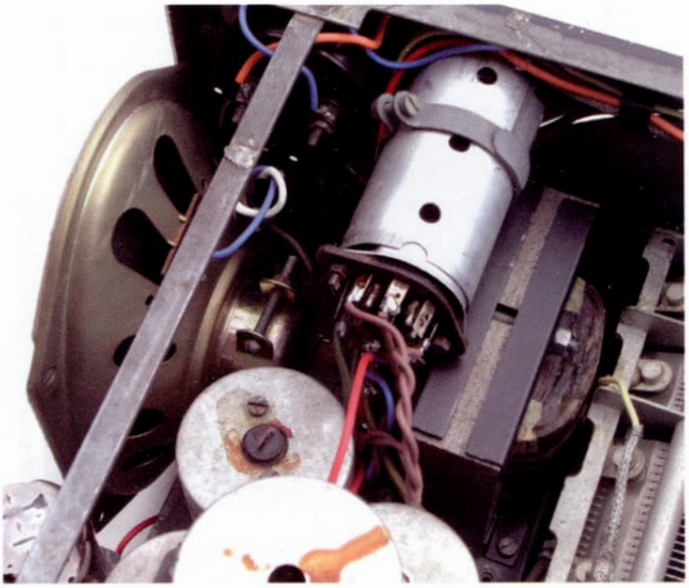
Coil box



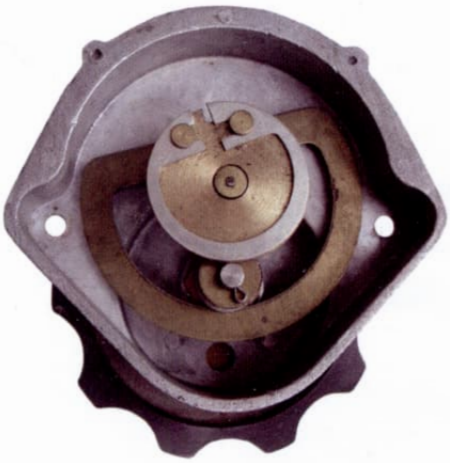
Mix oscillator



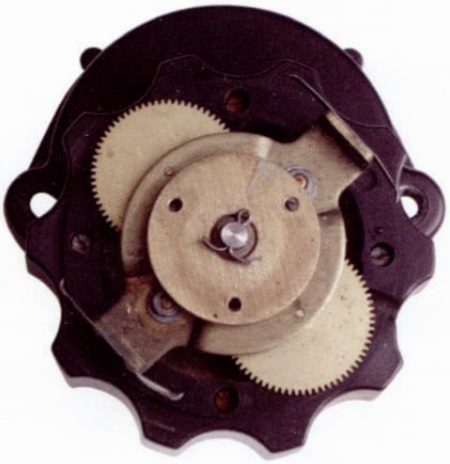
The Mains Transformer



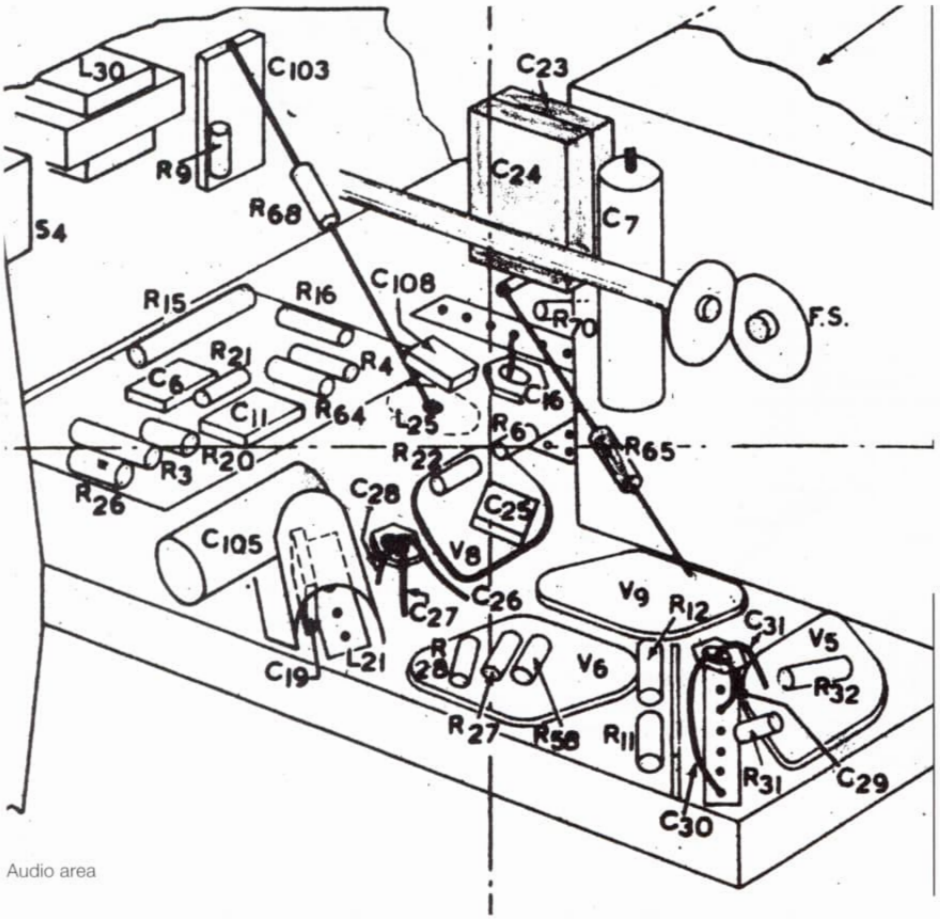
The mains Transformer fitted showing the speaker clamp



The friction slow motion drive



The geared slow motion drive



Audio area

replaced with new silicon rubber type.

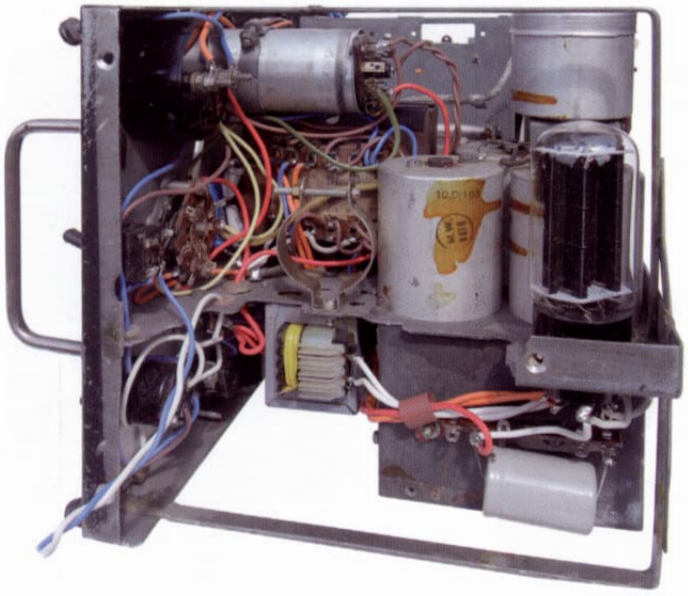
While removing a few dead wires I discovered that R4 120R and R64 200R were cooked to death and completely burnt out, these were replaced but I could find no obvious reason for this at this point in time. R3 was also looking the worst for ware and found to be completely open circuit, it looked like a lot of volts had ended up between chassis and the –HT rail.

The phones output transformer had already been removed and much of its wiring and components, the associated paxolin tag panel in the anode circuitry of V8 just dangling in space, housing a large 22k resistor not shown on the circuit diagram. I had removed the frequency switch control shaft with its bevel gear and "A" bracket, making access easier for replacing the burnt out resistors and a closer look at this circuitry, it needed making a bit clearer, I discovered there is hidden wiring under the chassis mounted tag panel; in fact a complete new set of drawings would be handy so I can more clearly see what's staying, what's going, and what's already been done.

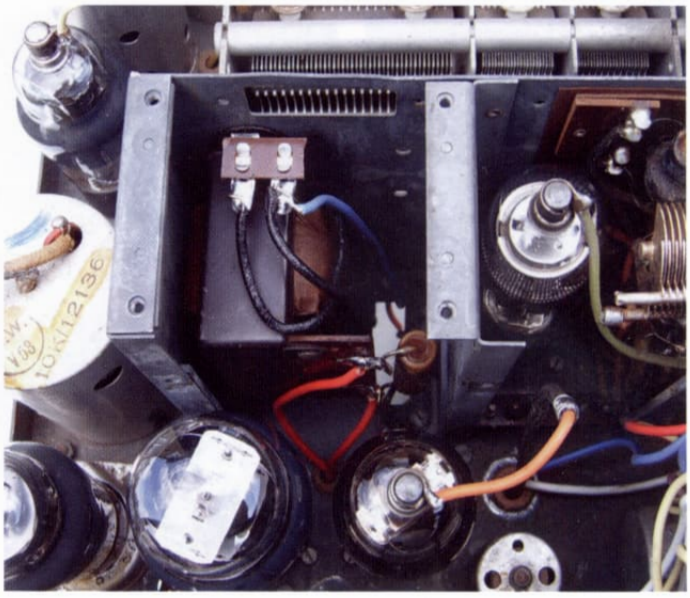
The original drawings, very old and very tired, were scanned into my PC the same as the tuning scale, redrawn over the top and then the scanned copy deleted. I can now print off a fresh copy whenever I like and scribble notes during progress. All the redundant bits drawn in red, all the original bits staying in blue and all the new stuff in green, this makes life a lot easier, adding the value of the components to the component numbers and pin numbers of the valves also helps with fault finding. Having now produced this set of master drawings, I made a second copy just for progress purposes where all finished bits were changed to black, including any components that were checked ok or replaced.

The rest of the new wiring finished, it's time to run a few checks. I've already replaced one or two decoupling capacitors mainly to relocate, I've checked most of the rest and they all read over twenty megs on the AVO, this is pretty good and plenty good enough for a preliminary run up.

First, check the HT rail to ground, it reads

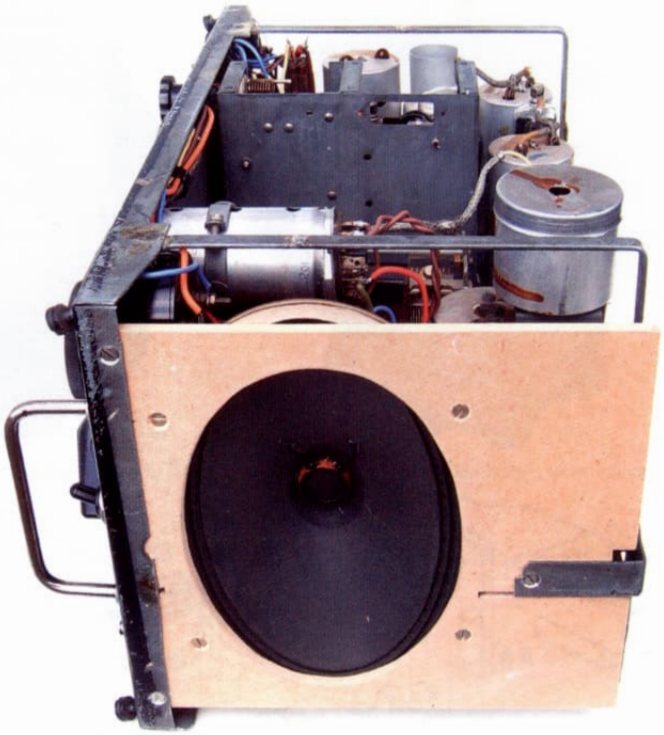


Mains transformer and speaker clamp



The Output Transformer fitted

The loudspeaker fitted



The speaker baffle

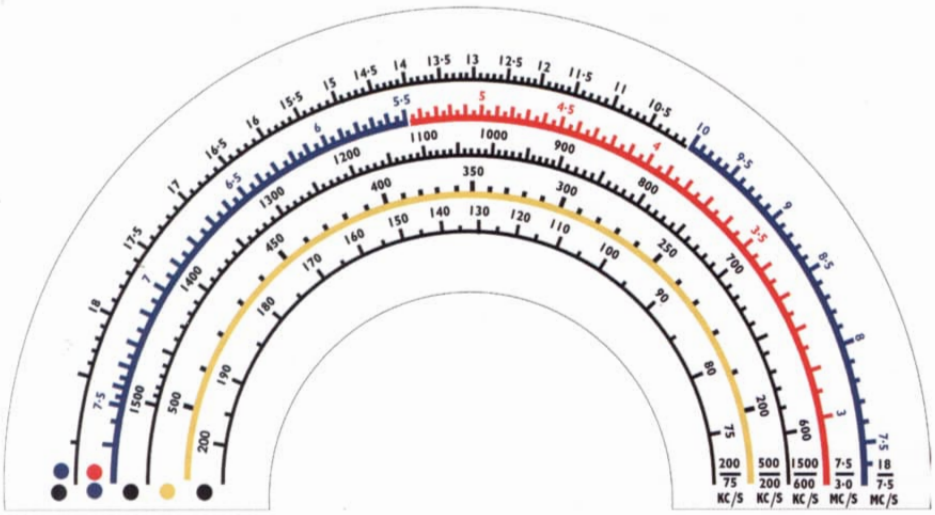
The Speaker fret

40k, looking for potential dividers on the HT rail I found four, all the screen grid feeds, these consist of 27k feeder resistors and a 22k in series to ground, four of these in parallel equates to 12.25k.

Checking these resistors individually I found two completely open circuit and a couple gone high resistance, this is unusual as it's more often the capacitors that cause the problems. The faulty resistors now changed and the HT rail reading 12.3k I felt confident enough for the first run, I re-fitted the valves and applied the power for a few minutes at a time carefully checking the HT current and for anything getting hot, the mains transformer HT output was measured at this time and read 300-0-300 volts (unloaded), after rectification and smoothing and the set's loading applied, I ended up with about 240v, a bit high, so I fitted a resistor in series with the rectifier cathode to drop it while I was working, 800 Ohms 20w wire wound did the trick, I'll revisit this when it's fully up and running.

Touching the output valve grid gave me the expected buzz but a bit low, touching the grid of the audio amp triode gave me a bit more but still a lot lower than expected, nothing from the rest of the set.

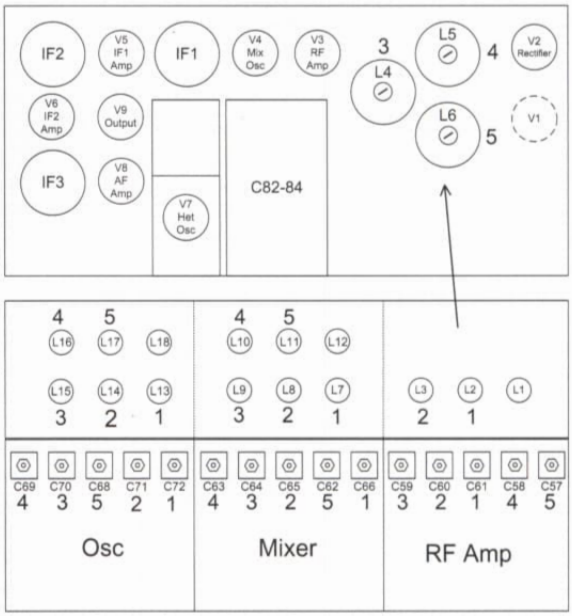
Running round the voltages, anode and screen grids (HT now around 210v), most appeared to be about right. The first exception was V5 the first IF, there were no volts on the anode, the feed resistor for this R30 2k2 is inside the IF can,



R1155F tuning scale.

The S meter close up

Above: Up and running.
Right: R1155 Alignment adjustment locator.
Band 1: 7.5 Mc/s – 18 Mc/s, Band 2: 3 Mc/s – 7.5 Mc/s, Band 3: 600 Kc/s – 1500 Kc/s, Band 4: 200 Kc/s – 600 Kc/s, Band 5: 75 Kc/s, IF 560 Kc/s



on removal I discovered this resistor very cooked and open circuit, the de-coupler capacitor C29 had already been replaced although retrieving the original from the removed parts box proved it was ok.

I don't think I've ever restored a radio with so many burnt out resistors. I then fired up the set again and now it's a bit more lively, I get a good crackle from the IF top caps (grids) and a lot of mush from the 200-600 kc/s band, (the IF band). It looks like the local oscillator isn't doing much, I did notice that the voltage on V4 triode anode, the local oscillator, was a lot higher than expected, indicating a lack of current being drawn, on re-measuring this voltage I noticed that pin 6 appeared to be missing, on removing the valve sure enough there was no pin 6, the label on this valve had crumbled, most of which was missing and unreadable, on the base was scratched "V4" and this was the reference I used on re-fitting the valves, it wasn't a VR99 at all, on replacing it with a 6K8 the local oscillator sprang to life and I was beginning to pull in a few stations among lot of noise and mains hum, at this point I discovered the volume control doesn't go down to zero output, according to the circuit diagram the audio volume control R8(2) has a 100k resistor (R26)

from its low end to ground (HT-), with the control pot at 500k, means the lowest it can go down to is 16 percent of max, this is still quite loud, obviously designed like this I wondered why this was, and the only answer I could come up with was that in a war time situation, a message could not be missed because the audio output was completely shut off. The remedy for now will be to put a shorting link across R26 the 100k.

Now controllable the set basically works, very noisy with occasional instability, deciding the decoupling capacitors may not be as innocent as they look I decided to change all of them, this was a long and laborious task, broken up only by a detailed surf of the internet for any useful information on mods I might incorporate at the same time, There were plenty of them, many from periodicals spanning across the years going back to the 50's and 60's, I incorporated some of these and recorded the changes on the master drawings.

The set is now much healthier and a tune round all of the bands proved them all basically working, a quick tweak of the IF's by ear much improved the performance, the white viscous slug retaining goo in the threads had stayed quite soft and most of the tuning slugs moved quite easily, but I did notice that the AVC wasn't working, no response from the tuning indicator or the S meter, I'll come back to this after sorting out the HT and a full alignment.

The 280 volts output from the rectifier is dropped to 240 volts by the smoothing choke, by adding another stage of smoothing I've lost another 30 volts bringing the main HT down to 210 volts, just about right, the power supply circuit did suggest two stages of smoothing and the 20 watt temporary resistor removed, the HT current measured at around 80 milliamps. The tuning indicator is a little dim so I've connected its HT supply to the mid smoothing stage, 240 volts giving it a little boost, the spec for the valve (VI103 or Y63) is 250 volts anode max.

At this time I also fitted the speaker, I had found an elliptical that fitted the bill nicely, and mounted a capacitor retaining clamp to hold it in place, this bolted directly to the chassis behind the master switch, there was even enough room for a 6mm MDF baffle, this made the speaker mounting a little more rigid which should improve the sound.

The next step the alignment, the IF frequency is 560kc/s, a bit of an unusual frequency, disconnecting the top cap of V4 the mixer oscillator and applying 560kc/s from my signal generator to the mixer grid, much to my surprise gave very little response, applying this signal to the grid of the first IF V5 and the set sprang back to life, re-measuring the voltages around V4 indicated no volts at all on the anode of the pentode, another open circuit resistor, I must have missed this one earlier. I was sure that the first IF transformer, in the anode circuit of V4 the mixer, peaked on the earlier tweak by ear and it still did, I put this down to tuneable stray pickup from IFT1, L19.

After replacing R34 2k2 all was now well and even the AVC was now working, with R34 o/c there wasn't enough gain for it to do anything, although the set seemed quite sensitive.

So on with the alignment, I had found an alignment procedure in among the info on the internet, very handy as there isn't one in the manual. Starting with the last IF, IFT3, L21, the lower slug was adjusted quite easily and peaked quite nicely, the top slug a completely different story, (I skipped this one on the earlier tweak) there appeared to be no slot for the trimming tool, I suspected that this had been broken away by a previous owner and a milling out would be required, being in at a very awkward angle in situ the only way to get at it is to remove the IF from the chassis, this done I discovered the slug had been glued up with some sort of heavy varnish filling the IF threaded tube and trimmer tool slot, it took several applications of Nitromores to dissolve this varnish and then I discovered the white viscous goo had hardened as well, at least I now had a trimmer tool slot, I filled the IF threaded tube with my favourite universal solvent, Ronson lighter fuel (Military spec SB4, lead free petroleum spirit), I left this to soak in over night and then gently and carefully worked the slug back and forth and eventually it re-vitalised the goo and became free, the IF returned to the chassis and the rest of the IF alignment continued uneventfully as all the other IF's were ok and just needed tweaking.

The re-alignment improved the performance considerably and as I switched to the 7.5 –18 Mc/s band the room was filled with Beijing Radio, China Radio International, China Drive, their news in English, on around 13.6 Mc/s, (Must be a European repeater).

Being eager to relive a memory while updating some notes, I swung the tuning to 1548 kc/s on the MF band for Capital Gold and some music, Capital Gold being very similar to Radio Caroline in the 1960's and playing constant 1960's music. Whoops! The R1155 Medium wave band only goes up to 1500 kc/s.

Back in the 1960's, all the domestic sets were calibrated in meters the lowest (figuratively) end of the band being 200m (1500 kc/s). With radio Caroline on 199m (1507 kc/s) just creeping in at the very end of the band, along with Radio Luxembourg 208m (1442 kc/s) and Radio Atlanta on 204m (1470 kc/s).

I remember some receivers at the time needing the local oscillator tweaking slightly to get down to Radio Caroline. The imported Japanese transistor sets, that flooded the market at that time were calibrated in megacycles, the top numbers on the tuning scale was 1.6 and .5 at the other end, I put this down to these sets being aimed at the American market as we were used to working in metres.

I assume that some time later Europe must have adopted the same band spread as the States, as Capital Gold is on 1548 kc/s (194m), out of the range of the 1960's British sets, (I must confess to a little scale mis-alignment on other sets in my collection to get this station) I also note that all of the AM stations these days are now quoted in Kc/s, something that I'd not thought about till now.

Having not yet done the RF alignment, I tweaked the local oscillator on this band up 100kc/s so that 1500 Kc/s was now 1600 Kc/s. This was achieved by tuning up the low frequency end of the band 600 Kc/s to 700 Kc/s with the local oscillator coil L15 and tuning the high frequency end of the band 1500 Kc/s to 1600 with the trimmer C70, just changing the frequencies in the alignment instructions. The white viscous goo in the tuning coils was also quite soft and the slugs moved quite easily.

As I had recently reproduced a new tuning scale saved in my PC, it would be very easy to change the numbers and print off a modified one, problem solved. I then tweaked the RF amp anode coil L9 for the low end of the band and trimmer C64 for the high end of the band.

The Grid (aerial) coil L4 is one of the large cans on top of the chassis, unfortunately the phantom with the varnish had struck again and the Bakelite adjusting screws on these coils would not budge, after removing the screening cans on L4, 5 and 6, I applied another large dollop of Nitromores on all three and left over night, the next day the residue cleaned off and as before I gently worked the tuning screw back and forth until it was fully free, aided by a drop of WD40, again L4 tweaked for max on the low end of the band and trimmer C59 on the high end, this improved the performance even more.

The calibration of the tuning scales on the other four bands was checked at both ends of the scale and was very close, so the local oscillator coils and trimmers were left alone, no point in tweaking if you don't have to. I tuned up the RF coils and trimmers using the same alignment procedure as the MF band, using the S meter signal strength as it was more easily seen than heard.

This R1155 is now up, running and back in its case, It's great fun to play with, you can tour the world on its short wave bands and I have spent many an hour doing just that, on my 75ft aerial running down the garden normally used for my crystal sets, with an RF amplifier and two stages of IF it doesn't miss much, it even sounds quite good with its 8"x 5" elliptical speaker.

I've very much enjoyed this restoration of a modification with plenty of interesting problems to solve and with lots of these sets originality already long gone, a real free hand to its modification.

I continued on with the tidy-up of the other modded set, this had fewer problems and also cleaned up and re-sprayed very well, I copied my mods from the first set into this one, I even found and fitted another 'S' meter and it now looks as good as the first, although all the tuning slugs in the two HF bands are chewed and jammed and requires the coil box removing to mill them out, a major task I haven't tackled yet, it just makes this set a little deaf on these two upper HF bands but otherwise works well on Medium and Long wave.

The unmodified set is still waiting for some original external direction finding accessories, before I start the restoration and build an external power supply and output stage, I suspect this may take some time.

The Acme Production Company
(From Bakers to Wireless Engineers)

by Ian L. Sanders, Lorne Clark and Chris Simmonds

"Manufacturers of wireless sets are turning their attention to receiving the long-wave transmissions from the new experimental high-power station at Chelmsford. Most of them are using plug-in coils, either for all tuning or for loading an existing coil or variometer, but this method has a way of taking up space. I saw a new crystal set yesterday, the "Acme", in which the difficulty has been ingeniously surmounted without the use of any coils other than the spherical variometer used for long waves also. The only adjustment necessary to change from the short to the long wave-lengths in this instance is the movement of a "plug-in" serial terminal from one socket to another. Nothing could be simpler, and the set remains small and neat." The Daily Graphic, 1924.

Acme No.1 crystal receiver

Popular Wireless Weekly, November 8th, 1924

The Wireless Trader, May 1924

The Acme Production Company Limited was formed by William James Allen and Wallace Devenport Vick on May 12th, 1922. Allen, born in 1875, was the son of a silversmith and Vick (1883-1953) the son of an heraldic engraver. The company was registered with a nominal capital of £3,000 divided into 3,000 shares of one pound each. At the time, Allen and Vick were established manufacturers and dealers in electrical and mechanical apparatus and scientific instruments with premises at 73½, Coleshill Street, Birmingham. In March 1921, Allen and Vick had filed a patent application for a device to switch on a set of lights in a predetermined sequence[1] and based on surviving company literature, the business seems to have been heavily involved in the development and manufacture of lighted advertising signs. (A patent issued to Vick 1915 relating to a display case[2], consisting of a light and mirror arrangement for exhibition purposes, reveals that he, at least, was already working as a lighting engineer at least seven years before the Acme Production Company was formed.)

All of the assets of Allen and Vick's existing business were transferred to the newly formed company. The Birmingham telephone directory for 1921 shows an entry for an Acme Electrical Company operating at 250, Stanley Road (only a few miles from Coleshill Street). The entry is absent in the 1922 edition, replaced by a listing for the Acme Production

Acme No.2 crystal receiver. The company's one-valve receiver used the same cabinet.

Unnamed crystal set by Acme Production Company with unusual front mounted tuning dial and carrying the Post Office registration number, 389.

A model of value and efficiency

The ACME 1-Valve receiver is the embodiment of compactness and simplicity of control and is complete in the one case, no accumulator being necessary. It is an ideal receiver for those requiring a head telephone equipment, having long-distance reception with minimum up-keep. It will also give Loud Speaker results at 10 to 15 miles on standard aerial.

Price with Valve, Batteries and Phones, **£8 . 8 . 0.**

Please write for the Acme Catalogue, which describes in detail this and other types of Acme Receivers.

The Acme Production Co., Ltd., Smethwick, Birmingham.

London Office and Showrooms: **102, Great Russell St., W.C.1.**

The ACME 1-valve Set £8 . 8 . 0

With all accessories.

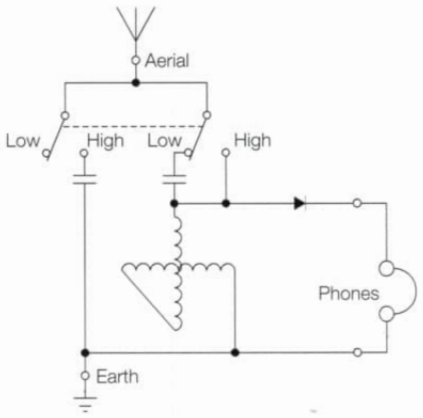
The Radio Times, September 12th, 1924.

Company and so it is probable that Allen and Vick were in business under the former name prior to forming their new enterprise in May 1922. It is fairly safe to assume that there was an ongoing business relationship between William Allen and Wallace Vick for several years – both are believed to have been employed as bakers in 1901, when Allen, then twenty-five, and Vick, eighteen, were living just a few streets away from one another.

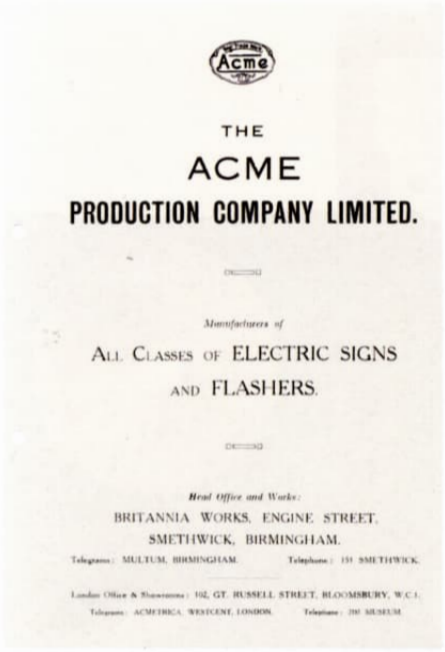
Shortly after its formation, a third director, William Henry Fulford (1862-1947) joined the Acme Production Company. Fulford with some sixteen patents to his name, mainly relating to cycles and motorcycles, was a partner in Mills-Fulford Limited of Coventry. The company was established in 1899 and in the years leading up to the First World War was a respected manufacturer of motorcycle sidecars and trailers. By 1909 Fulford had also ventured into aviation, producing the Fulford Monoplane No. 1, a chain driven machine. In his later years, Fulford clearly had an interest in wireless with at least one patent related to a frequency-hopping apparatus[3] intended to thwart eavesdropping.

Documents show that both Allen and Vick received an annual salary of £260 per annum plus a percentage of any dividend declared for any given year. Fulford received no remuneration. In July 1923, the operation moved to the Britannia Works, Engine Street, Smethwick and in December of that year a fourth director, William Keeling Coxon (1886-1937) joined the board. The original partners, however, maintained control of the company – shares being divided as follows: Allen, 501; Vick, 501; Fulford, 500; Coxon, 400. A London office at 102, Great Russell Street, Bloomsbury was also opened at about this time.

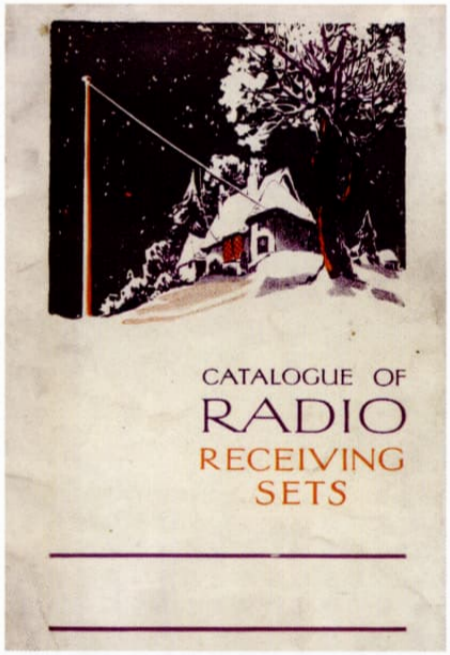
The company's products included illuminated advertising signs for retail firms and specialist electric flasher units for controlling lighting circuits. Although the precise date is not known, it seems that the



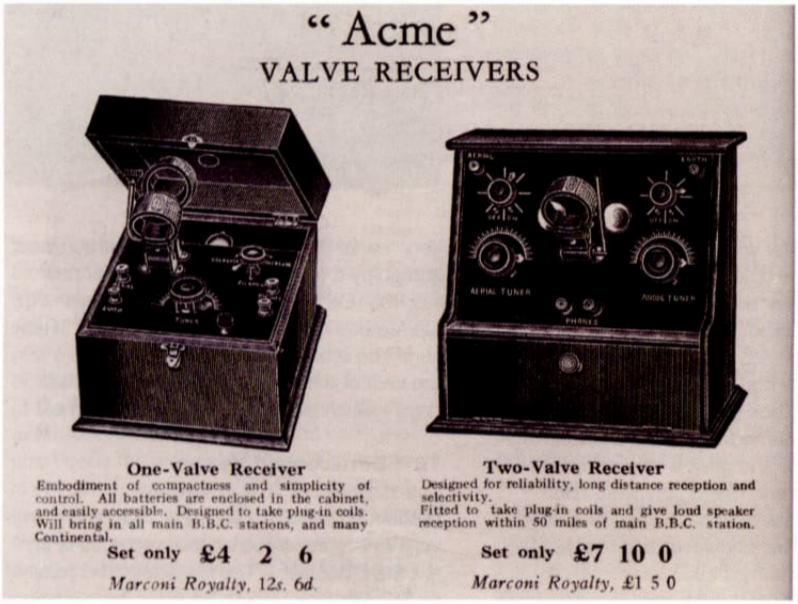
The Acme No.2 crystal set incorporated a high/low condenser switching arrangement to increase the coverage of the medium-wave broadcast band. Despite its simplicity, such "sophistication" was unusual in commercial receivers where price was a key factor. At the time, the incremental cost of the two condensers and the switch could be prohibitive for manufacturers.



Acme Production Company sales brochure for the company's lighting products probably dating to the early 1920s.



Acme valve receivers were not widely advertised. They do appear, however, in this unnamed catalogue probably dating to 1924.



Acme Production Company valve receivers.

Acme Production Company likely introduced its first wireless receivers sometime in late 1922 or early 1923, close to the start of BBC broadcasting. While the entry in the 1922 telephone directory describes the company's business as 'Scientific Appliances and Toys', that for 1923 states the business as 'Electrical Wireless Apparatus'. Certainly wireless products were being advertised by early 1924. In addition to receivers and amplifiers, Acme Production Company produced a limited number of wireless-related components focusing on variometers and inter-valve transformers. A patent issued in 1925 to the company[4] relates to an improved rheostat for controlling current in valve filaments.

The Company was a shareholder of the British Broadcasting Company[5], purchasing 100 shares in 1923. Within two years, however, the enterprise appears to have run into financial difficulties. In April 1924 Acme Production Company raised an additional £3,000 by means of a mortgage debenture from William Fulford's son, Francis Leo Fulford. Business must have continued to decline for the next two years and the company defaulted on the debenture. In early June 1926, F. Sharman & Company of 122, Shaftesbury Avenue, London, W.1. was appointed to oversee the winding up of the company and an official Receiver was duly appointed. Although the company was not formally dissolved until April 1929, it seems that the company ceased all operations at the time the Receiver was appointed – no mention of the company appears after 1926 in the Birmingham telephone directories. Interestingly, the company records indicate that a refund of £105 12s 6d. was received from the British Broadcasting Company, in respect for the 100 shares (plus interest) taken out by the Acme Production Company in 1924.

Acme produced three crystal set models, the *Acme No.1*, *Acme No.2* and an unnamed model with registration number, *389*. The former was a distinctive, compact design with a vertical panel housed in a neat mahogany cabinet. Originally designed for broadcast band (medium wave) reception, a long-wave model was offered in September 1924 for reception of Chelmsford, 5XX on 1,600 metres. The Acme No.2 was of more conventional design constructed in an enclosed cabinet with a headphone compartment at the rear. Also available in either broadcast band only or medium/long-wave versions, both versions featured an atypical double-pole 'low-high' switch to allow extended coverage of the broadcast band or permitting different length aerials to be used. In the 'low' position a condenser was connected in series with the aerial, while in the 'high' position a second condenser was connected in parallel with the variometer.

A one-valve receiver was advertised in September 1924 using the same cabinet as the No.2 crystal set. Employing a low-current, dull-emitter valve, both low-tension and high-tension batteries were contained in the cabinet (no accumulator was needed). A lower cost version in the same cabinet, designed to take plug-in coils, presumably with long-wave capability was offered sometime later. A larger two-valve receiver was produced at about the same time along with a matching three-valve amplifier. Both were housed in archetypical sloping panel type cabinets with batteries enclosed in the base.

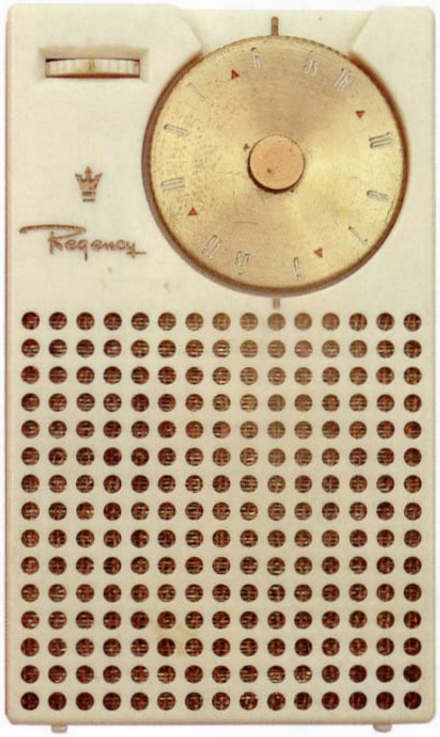
The Acme 3-Valve set was a high-performance receiver, also introduced in 1924. Built in an imposing vertical cabinet with horizontal top- and bottom-hinged doors, the design was a variation on the more common "smoker's cabinet" offered by competitors. At twenty-five pounds complete or nineteen guineas less valves and batteries, it was advertised to give loudspeaker output at a range of 100 miles.

Surviving examples of the Acme Production Company's valve receivers are extremely rare, leading to the supposition that limited numbers were actually sold and this would account for the company's financial difficulties after such a short period of operation. Certainly advertisements for the products do not seem to have been widely placed in the popular journals of the day. Little is known of the commercial acceptance of the company's other electrical products, but apparently these met with a similar fate as its wireless apparatus. In any case, the Acme Production Company's history mirrored that of so many of the early 1920s wireless firms whose rise and fall spanned just a few years at the start of broadcasting.

1. Allen, William and Vick, Wallace: Improvements in Automatic Electric Switches. British Patent No. 177,975, issued April 13th, 1922.
2. Vick, Wallace, Vick Arthur and Farmer, Thomas: A New or Improved Exhibition or Advertising Device. British Patent No. 8788, issued February 11th, 1915.
3. Fulford, Henry: Improvements in or Relating to Receivers for Electrical Transmission Particularly Wireless Transmission. British Patent No. 235,275, issued June 8 th, 1925.
4. Acme Production Company and Vick, Wallace. Improvements in Rheostats and Variable Resistances. British Patent No. 235,051, issued June 11th, 1925.
5. Lorne Clark: Shareholders of the British Broadcasting Company. BVWS Books, 2010. ISBN 0-9547043-6-3

Regency TR-1

Servicing the world's first Transistor Radio and building a battery for it. By Jim Duckworth

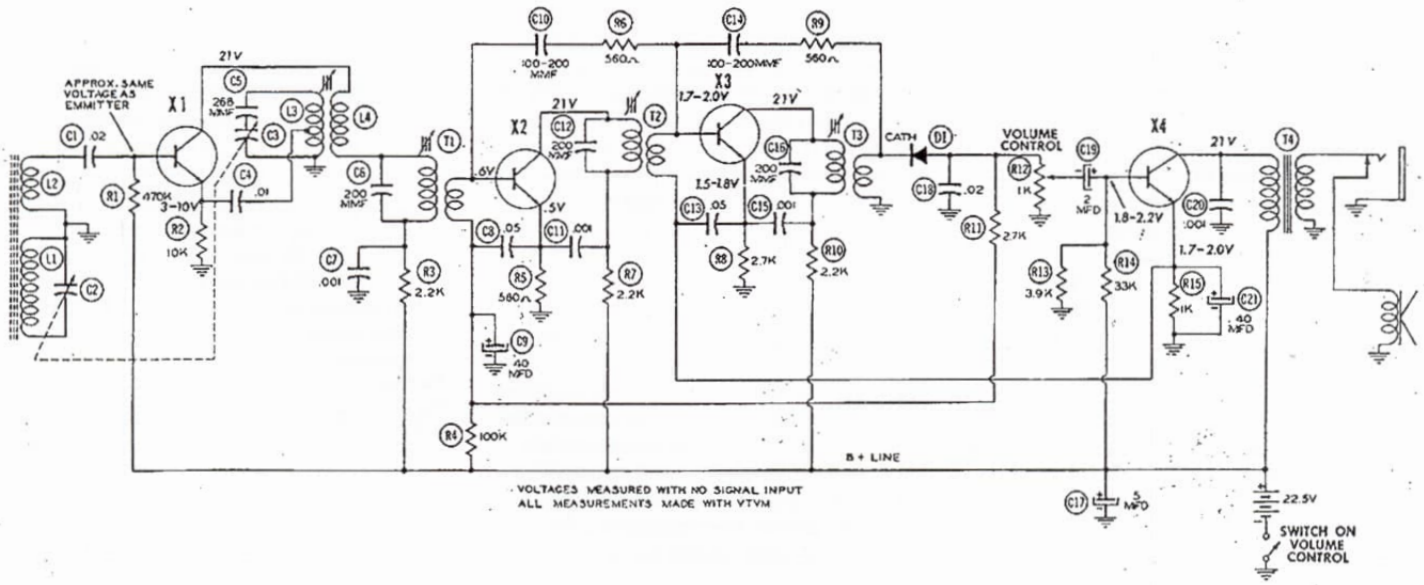


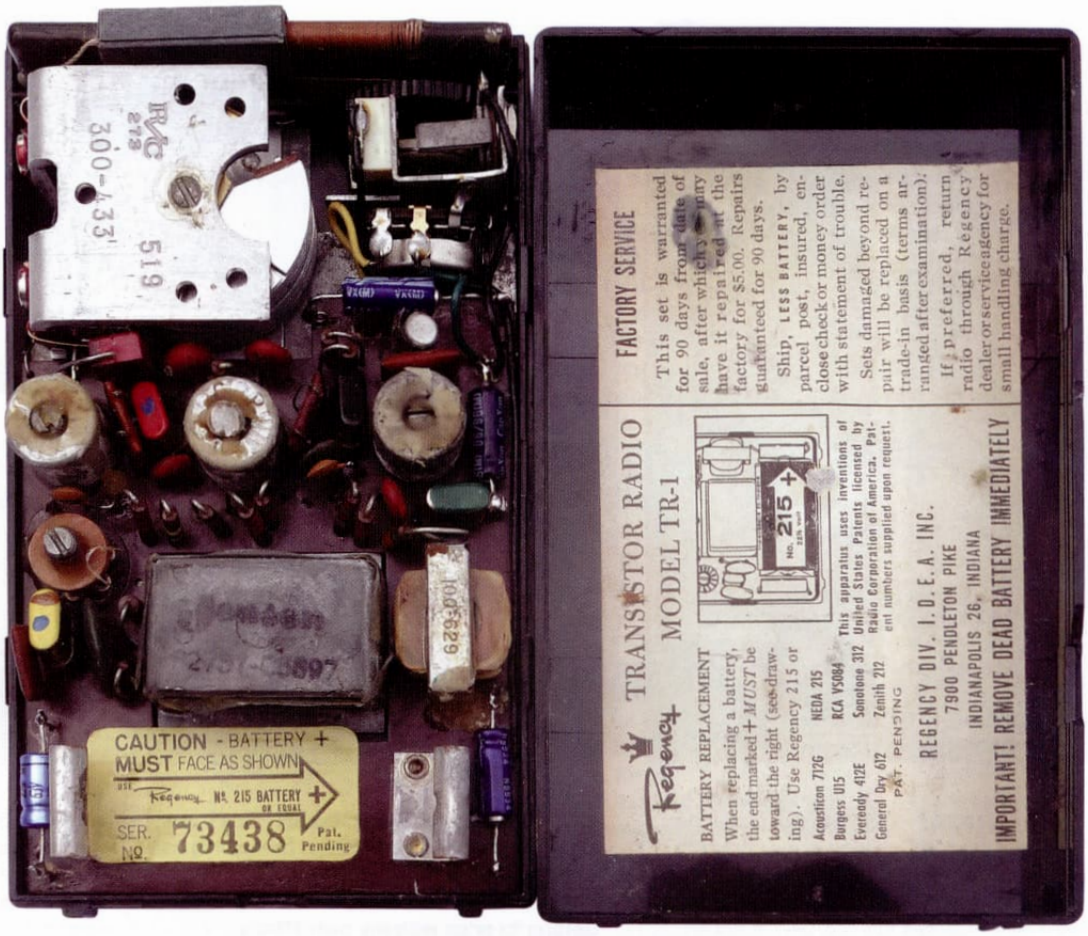
It is now almost 56 years since the Regency TR-1 was launched in November 1954 in New York and Los Angeles department stores, in time for the Christmas market. It was the world's first Transistor Radio and the first genuine pocket loudspeaker radio operating from a standard miniature battery – a 22.5v type, which normally provided HT for the valve hearing aids of the day or power for photoflash. Retailing at $49.95, the TR-1 was priced much higher than the '4 tube personal radios', which sold at between $20-30. However it was not compared to these, but rather to the wristwatch radio in the 'Dick Tracy' comic strip, and became an instant best seller with demand exceeding supply for some time. It was in production for just over one year with in excess of 100,000 units manufactured. The TR-1's cabinet was professionally styled by a Chicago design house and I like it a lot, seeming to be carved out of a solid block with tuning and volume knobs flush mounted. Originally available in red, black white and grey, a very attractive marbled green and mahogany were soon added. These seem to have been produced in smaller numbers however and rarely come up. For the Christmas 1955 season a very small quantity of exquisite pearlescent colours were offered in high end stores for $54.95.

Very few of these are known to have surfaced and enjoy a type of 'green' or should I now say 'red' Ekco status! Special editions include the famous Mike Todd 'TR-1 Book' – A TR-1 sunk into a false book and presented to the cast of the film 'Around the world in 80 days', which he was directing at that time.

TR-1 Development History

The story of the TR-1 development and production saga is now well known and very well represented on the web, also in an excellent booklet - 'The Regency TR-1 family', by Eric Wrobbel* which provides exhaustive information on and pictures of the whole





family including special edition sets and those retailed under other brand names (i.e. Bulova etc), and gives you a flavour of the way it was, over half a century ago. However one website in particular will tell you most of what you need to know from the history of the radio's development, to every detail of the sets themselves as well as servicing etc. This is the work of Dr Steve Reyer and is obligatory reading for TR-1 enthusiasts**, I recommend it very highly indeed. However, for the purpose of introducing this practical article dealing with servicing TR-1's from my collection and building batteries for them, I will provide my own summary from a wide mixture of sources. The Regency TR-1 was the result of an entrepreneurial partnership between Texas Instruments (TI), who were seeking high volume outlets for their transistors and IDEA – Industrial Development Engineering Associates of Indiana, who were in the business of designing and manufacturing (valve) TV signal boosters. They sold their products under the 'Regency' name and were keen to expand into other markets. Texas Instruments were driven on by the inspirational and visionary Pat Haggerty, who foresaw the possibility of high volume 'one per person', electronic equipment markets for the new transistor devices. (As an aside – when I worked for TI in their large Bedford facility in the early 1970's, this theme had moved on from pocket radios to calculators and was forever ringing in our ears, and Haggerty came over to talk to us about that as well!). Haggerty pulled a team together led by Paul Davis which developed an 8 transistor prototype radio in record time during May 1954. The transistors themselves were shipped to the development team almost hourly from TI's pioneering transistor facility in a huge effort to produce RF transistors with sufficient gain and low enough noise. But even then, an IF of 262 kHz had to be adopted (rather than the US standard 455 kHz), to boost the gain to the minimum necessary up to the detector. The breadboard prototype was eventually housed in the cabinet of an Emerson 'peanut tube' radio dimensions 6 x 4 x 1.25 inches utilising its gang condenser and loudspeaker. They tried to interest various Radio manufacturers in its production, but the big boys already had their own development programmes and did not respond. TI and IDEA finally got together and agreed the incredibly ambitious schedule of between June and October 1954, for redesigning and putting into production an even smaller version i.e. pocketable at 5 x 3 x 1.25 inches. IDEA appointed Richard Koch, an extremely able and determined senior engineer, in charge of the project. His design experience on 200mhz valve amplifiers for TV proved the ideal background as he observed that valve impedances at these frequencies were as low as transistor ones in the broadcast band area. Thus the business of interfacing high impedance tuned circuits etc to low impedance transistor inputs/outputs etc did not faze him at all and he immediately set about the task of reducing the number of transistors/components to fit in the smaller pocket radio cabinet and of course to reduce costs. He replaced the TI transistor detector with a diode on his first look at the circuit, then embarked on the much more difficult problem of combining the separate mixer/oscillator transistors into one circuit, eventually achieving a circuit design utilising just 3 transistors – Mix/osc + two IF + one germanium diode up to the audio amplifier. This configuration was to establish the basic transistor portable superhet circuit for all time and was a great achievement by Richard Koch. The TI three transistor 'push–pull' (class 'B'), audio amp was then reduced to just one transistor making a circuit total of four. This meant class 'A' audio operation with its consequent low efficiency and a power output limited to only 15 Mw, bearing in mind the low current drain necessary to achieve between 25 – 30 hours operation from the low capacity 22.5v battery. But space limitations - there was virtually no miniature component industry at that time (indeed the TR-1 project was a catalyst for its development), and the high cost of early transistors, dictated this final 4 transistor circuit. In the event, the project could only go ahead on the basis of a 100k price break of $10 for the kit of four transistors. So IDEA placed the 100k pcs order with TI, the die was cast and the rest as they say, is history.

Restoring the TR-1

How far do you want to go?

After all this time most TR-1's will not work yet most owners would love to hear them do so, albeit in some minimal fashion. Dr Steve Reyer (SR), relates his repair experiences on his website and asks the very pertinent question (vis a vis 'The world's first' etc), 'Do I really want to do this?' But as his particular TR-1 had already had a transistor changed, he in fact went ahead with his repairs and restored

Tuning knob removed revealing screws

it to very good working order. But made the point that once you change it, the originality is lost and you still might not get it working! He was probably trying to give a warning to radio repair novices that the TR-1 is not an ideal radio to start on if preserving originality is high on the agenda. Stating my own position however, my prime consideration has always been to get radios working again, to full spec if possible and using the latest good quality components to achieve this (but NOT to try to use modern transistors in place of the 1954/55 ones in the TR-1). For example I don't like to stuff one capacitor inside another etc, but I do like in general to maintain significant overall appearance and of course clean up any accumulated dirt and grime etc and give a set a good polish. SR has provided a solution for preserving the appearance of the electrolytics originally used on the TR-1 by providing scans of the original labels on his website – these can be sized and printed out to wrap around modern electrolytics, if that is what you wish. I finally tried this out on my white set.

Another consideration is that working on pocket radios is of course not the same as for standard valve sets. As a veteran who from the early 1950's cut his teeth experimenting with valve radios and designing 'homers' (including a 'packet of 20 earphone pocket portable', using Mullard hearing aid valves and the selfsame 22.5v battery!) and then doing the same with transistors from the 1960's onwards, I have now repaired over 100 transistor pocket radios from my own collection, and have learnt to proceed with great caution – it is possible to do a lot of damage in a small space in a short time! Early PC boards are notorious for the tracks lifting and breaking when attempting repairs. Fortunately In the case of the TR-1 it is possible to do a 'first echelon' (as the Services used to say) repair without removing the chassis i.e. to change the electrolytic capacitors from the top, they will almost certainly need it, and this usually brings the set back to some form of life.

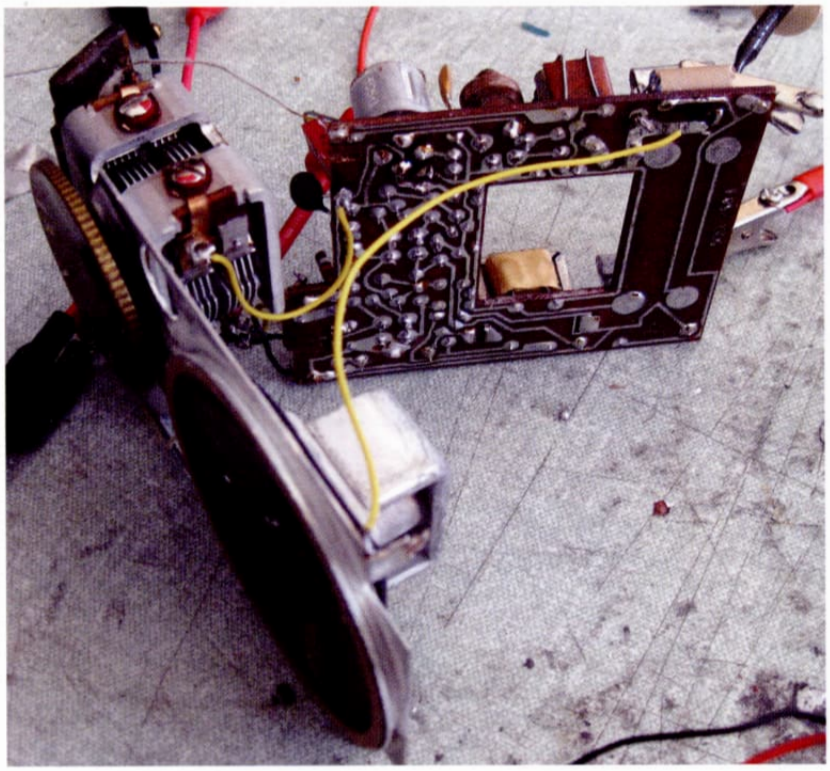
Getting to grips with my own TR-1's and checking the Electrolytics

I acquired the black set first, serial no 73438 putting it well into 1955 production. A three digit date code on the tuning cap gives a general clue, in this case 519 – week 19 1955. It was overall in good condition with no visible wear around the volume control slot – a point collectors look out for, but not working. Note the large white label in the lid back, talking about battery replacement on the LHS and Factory Service on the right. My earlier white set sn 39452 has a smaller label with Battery Info only. It also lacks a coin slot which the black set has, both items being two of the many idiosyncrasies of TR-1 production.

Doing a quick tour around the set to get your bearings, and starting at the bottom left hand side adjacent to the negative battery clip, the first component you see is C17 (see circuit on page 42), the main supply electrolytic. The mixer/oscillator transistor X1, colour coded yellow is directly above this along with its oscillator coil and then comes the first IF transformer T1, just below the gang condenser. The square red condenser between T1 and the gang is the oscillator padder. Transistor X2, the first IF amp is colour coded red with IFT2 immediately to the right of it and transistor X3, the second IF amp coded black has IFT3, the last in the line to its right. Heading upwards towards the volume control, the round metal can which looks as if it could be a modern TO 18 transistor, is in fact the germanium diode detector, with AGC electrolytic C9 immediately above it and below the volume control. Going down the RHS of the set and immediately right of IFT3 is C19, the electrolytic coupling the AF from the volume control to the base of the output transistor – colour coded green with the output transformer just below it. If C19 has gone open circuit, we are clearly not going to hear anything at all as it is in series with the AF signal. Finally, and to the right of the positive battery clip, we have C21, the electrolytic decoupling AF output Transistor X4 emitter. With this open circuit, we lose nearly all our AF gain.

In preparation for checking the electrolytics we first need to be able to power the set up. A 22.5v battery is still made in America – Ever Ready type 412 which comes as a carbon zinc (traditional) type for around $14 from RadioShack and others, or alkaline at around $30. Shipping to the UK will add another $6-$10. However I don't recommend doing that as we shall make a 'renewable' battery for much less! I used a home made 15v variable power supply in series with the standard 9v PP3 type battery and adjusted the variable supply to give 22.5 volts overall. To check the current consumption - it should be around 4 mA in total - I switched my PSU meter to milliamps, but a testmeter on the mA range in series will do the job. In the limit for this first 'check for life', you could simply string 2 brand new 9v batteries together (the TR-1 will work down to15–16v), but do not use this for an absolute current reading. Finally, I took three 47µF electrolytics, 25v working and attached a crocodile clip to each end.

After switching on and turning the volume up fully I tuned round the dial but found nothing. Holding the speaker close to my ear I could not even hear a breathing noise, yet the current consumption looked OK at just over 4 Ma. So observing polarity, I clipped one of the 47µF across C19, the electrolytic on the RHS of IFT3 taking the AF to X4 base. Bingo! A breathing sound came from the loudspeaker and tuning around I picked up Radio 5 – our strongest signal in North Norfolk by far – not very loud but quite clear (in the empty room!)



and the only one. The next 47µF was clipped across C21 – X4 emitter decoupler on the bottom RHS next to the positive battery clip. The sound increased strongly and I could get more stations; things were looking up, it was quite an emotional moment hearing the 'world's first', speaking again! Clipping another electrolytic across C17 on the bottom left hand side gained a small but useful improvement i.e giving the B+ rail a proper AC ground connection. Now the assumption in the above procedure – justified in this case – has been that the electrolytics are open circuit or very low on capacitance. The mechanism for this, which was an early blight on TR-1 production, was of the encapsulating material very quickly becoming porous (sometimes within the first 6 months!), and causing the electrolyte to dry out, open circuiting the capacitor. If in fact they had been short circuit or some kind of low 'dirty resistance', the above procedure would not have helped, but we would have been warned by unusual current readings – obviously so in the case of C17 which is connected accross the whole supply!

Changing the Electrolytics

So I set about changing all of the electrolytics by snipping the old ones out and soldering the new directly to the wire stubs. The process is greatly simplified for C17, C19 and C21 as they have extra long coiled up leads, permitting the condenser to be pulled to one side revealing the metal lugs which are used to attach the PC board to the metal chassis (and have to be 'straightened' for its removal). This runs the whole length of the set and supports the gang condenser, volume control assembly and loudspeaker. Sometimes the AGC capacitor has the extra lead length as well, but not in this case. Replacement values – C9 and C21 are 40µF so 47µF can be used. The actual applied voltage to these two does not exceed 2v but I used 25v ones anyway. For AF coupler C19 – originally 2µF I used the nearest axial type I had of 10µF, also 25v. Finally for C17 the supply decoupler, originally 5µF, I used 22µF, and this does need to be a minimum of 25v. After snipping I first made a good mechanical joint with the new component before applying a hot soldering iron briefly. The danger in not doing this is that the wire stub unsolders underneath, dropping through and thus committing you to a chassis removal. Switching on and tuning around gave pleasing results which I felt could be improved with alignment.

Aligning the TR-1

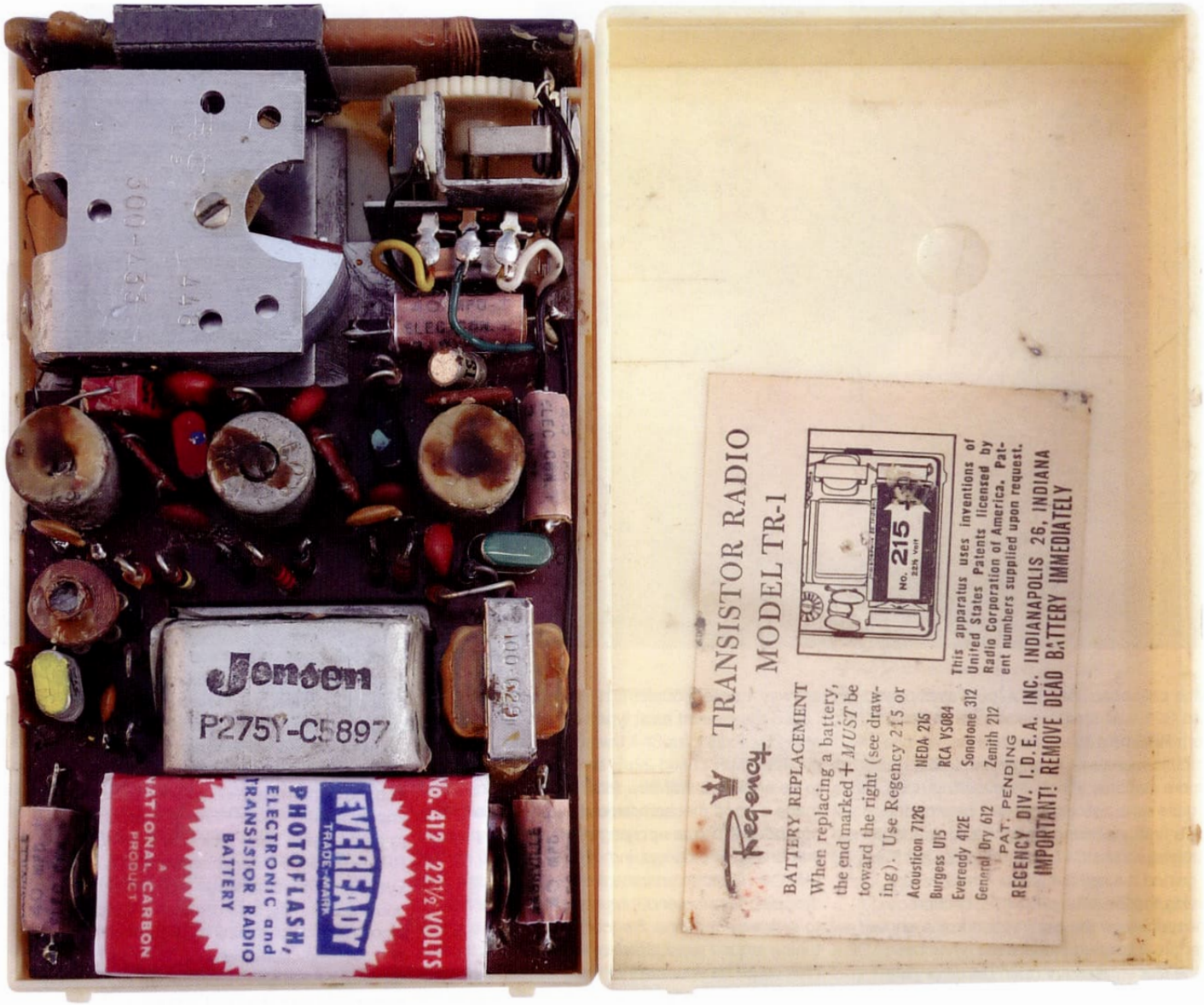
I have in my possession an original Howard Sams data sheet for the TR-1 with alignment instructions on the front page – in summary, the IF is 262 kHz, medium wave coverage is 535 – 1630 kHz, with a tracking point at 1500kHz. IF alignment involves radiating the signal from the generator via a loop, i.e a dummy aerial – do not try a direct connection to the mixer which may stop it operating correctly. An AC millivoltmeter can be conveniently clipped across the outer volume control tags as an output meter. Before starting I very carefully excavated the wax from the top of each transformer, setting it aside for reuse. I then found a plastic trimming tool which was an excellent fit for the cores – if you have to crack an IF slug – don't let it be any of these from the TR-1! The existing alignment was quite close to 262 khz but I watched with pleasure as each stage peaked up correctly, working from output back to input and reducing the generator output as I went along. When no more improvement could be obtained I put the wax back in.

For the RF alignment I initially followed the Sams/Regency procedure of first setting the LF end of the band to 535 khz with the oscillator coil core, then the HF end at 1630 kHz with the oscillator trimmer (inboard side of the gang – Sams gets this wrong!), in both cases peaking with the output meter. This has to be repeated two or three times, and then the aerial trimmer peaked at 1500 khz. I got improved results by following the procedure used by Zenith and other US manufacturers at the time and designed to achieve optimum tracking at the expense of dial accuracy if need be, which is to first set the HF end of the band i.e at 1630 kHz with the oscillator trimmer as above, then inject a signal at 600kHz and rock both the gang and oscillator coil core to find the optimum output. This must be repeated along with peaking up the aerial trimmer (outer side of gang) at around 1500 kHz.

I now had a set which performed well within the low AF output limitations, pulling in a host of continental stations after dark, though the sensitivity at the LF end of the band seemed poor compared with the HF end. Now usually this is due to a combination of lower local oscillator injection combined with the lower aerial tuned circuit dynamic impedance at the LF end of the band. (this is directly proportional to frequency and 'Q', so the HF end of the band at 1630 kHz is over 3x better off , for the same Q). In fact the local oscillator injection, measured with a scope at X1 emitter was pleasingly constant over most of the band at around 85 mv rms, dipping at the HF end, almost certainly due to these very early RF transistors running out of gain at this point. So the poor LF end of band performance could only really be improved with higher RF/IF gain which was to come a year or so later with much better RF transistors i.e. Zenith showed with its 'Owl Eyes' in 1955/56 how well a pocket radio could perform right across the MW band with a combination of a local oscillator giving a high and even injection of around 200mv rms and superior RF transistors producing significantly higher gain from the front end stages.

Restoring the Red set.

My red set serial no 78598 - was not quite as good cosmetically as the black having cracks in each top corner of the cabinet back, which I considered a minor matter and repaired with glueing and buffing up on a wheel. The front was better however with no wear at all on the volume control slot and a deep moulded rather than stamped Regency logo, which was a feature of earlier cabinets. The photograph on page 44 shows it with the back off and restored. Note from the label on the gang condenser on the same page that the set had been back to Regency for repair but evidently to no lasting effect, and at date unknown as the writing has worn off completely. The actual state of the chassis was poor and bore evidence of the set being stored for a long time in the cold and damp. The legend had also worn off the loudspeaker. At the time of repair it is possible that the cabinet was changed for an earlier one as there is no coin slot – as on the black set, a feature which appeared on cabinets from the early months of 1955 onwards, (way before my red set serial no). Eric Wrobbel reports in his excellent little book 'The Regency TR–1 family', (and on the basis of speaking to TR–1 original owners), that Regency adopted a somewhat pragmatic



White set with back removed and my home made battery installed

and eccentric policy with repairs, i.e. amongst other things, of late chassis being returned in earlier cabinets, and in extreme cases, in ones of different colour to the original!

The recapping and alignment of the black set proved to have been a mild 'limbering up' exercise compared with what awaited me with the red set. On switch–on there was no sound at all from the loudspeaker and in addition, I noted that the overall current drain was lower at around 3.2 Ma instead of 4. I established by emitter voltage measurements that the missing current came from X2 – the first IF transistor and furthermore, this arose from a missing base voltage. As this implied nasty things like an open circuit IFT secondary that would require chassis removal, I decided to first deal with the AF section as before by changing all the electrolytics. This produced a breathing sound but obviously no stations with the first IF amp out of action, I hooked up an audio generator across the volume control and was pleased to get full output from the loudspeaker, which for the record required some 30 mv input. This emphasised the 'local station' specification of the TR–1 with its single audio stage operation. The 6 transistor pocket radio circuit with driver + push pull output which was later to become standard around the world, required something less than 10 Mv input for 100Mw output. Having sorted the audio I decided to bite the bullet and remove the chassis. To do this you must first remove the cabinet which is very easily done by unscrewing the tuning knob central knurled screw and then the cross headed countersunk screw beneath it. Do not touch the other two round headed screws which attach the gang to the chassis (see the photograph on page 44). The chassis has 3 projecting lugs which push through corresponding slots in the PC board. Two of them are beneath C17 and C21 at each end of the battery respectively, and the third near C9, the AGC capacitor adjacent to the volume control. These must be straightened out from the PC board top to allow chassis removal. The fourth lug comes downwards from the gang condenser oscillator trimmer and is soldered to the PC board. A round hole in the metal chassis gives access to unsolder this. The final item which must be unsoldered is a short wire link beneath C17 which solders directly to the chassis, providing a ground link between PCB and chassis. Once all this has been done, the two can be separated with great care. Watch out where you put your thumbs and fingers otherwise you may push them through the loudspeaker cone!

The photograph on page 45 shows chassis and PC board separated. Leave alone the Litz wire connection between Ferrite aerial coil secondary and PCB, it is carrying the signal to X1 transistor base. My short yellow lead reconnects the oscillator trimmer to its square red padder cap on the PC board and the long one restores ground connection between chassis and PCB. I was now in a position to investigate the missing base volts. Referring to the circuit diagram – the most obvious candidate was an open circuit secondary on the first IF transformer. I finally located the two relevant pins but ohm meter tests showed all was OK – a relief, but where was the break? The track supplying the base bias came from right across the board. Inspection under a powerful magnifier showed this was also OK, then, the glass revealed that extensive unsoldering activity had taken place on the IFT pins – somebody had been there before me. A closer look revealed a hair line fracture between the bias track and IFT pin – I had found it! Continuity was restored by bridging with a wire strand and I switched back on expectantly. Result – as dead as the proverbial Dodo, but at least it now drew the correct overall current of 4 mA!

Referring to the circuit diagram IFT2 primary was clearly OK as the transistor was passing current, but how about the secondary? That checked out OK so I carried out these tests on the last IF transistor X3 and its IFT – all seemed OK but no sound. How about the local oscillator? I hooked a 'scope onto the frequency changer X1 emitter and as with the black set, got a nice sine wave around 80 Mv rms across the band. At this point I decided to stop taking measurements and see if I could find the signal somewhere with a homemade FET signal tracer with rectified output which I fed into a bench audio amp. Success! I picked the signal up at each transistor collector, increasing appropriately all the way, and also present on the last IFT secondary! So what was left Watson? – Answer, the germanium diode rectifier. Removing this from the board it checked out completely open circuit. I replaced it with new/old stock and the set burst into life through its own audio section! I had at last found the fault which had eluded the mystery serviceman and/or owner from the past, who had got stuck on the problem and broke X2 base feed in erroneously trying to excavate IFT1. So I aligned the set as previously described and found its resulting performance very pleasing and similar to the black one, but with the same caveat of relatively poor performance at the LF end of band. As a final measure I changed the three .001 IF decoupling capacitors, C7, C11 and C15, bringing about some small improvement and decided to leave it at that.

The white set

Fortunately it needed no more attention than the black, i.e. it was recapped and aligned. - note that this early chassis has simple battery contacts with non turned–over edges and cabinet with the smaller label in the lid, also that I have added the SR 'original' electrolytic labels! I now think this looks quite pleasing and may do this to the red and black sets!

Making up a 22.5v battery

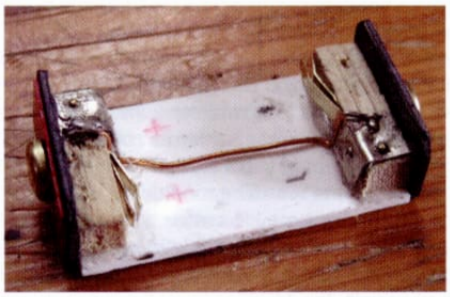
There is now a 22.5v battery available in the UK as well as the previously mentioned Eveready type 412 from USA. This is on the web from 'The small Battery Co', for around £10, though it is less iconic, in that it does not resemble the original Eveready product. However, if like me your formative years were spent in economising and 'make do and mend', the urge to continue doing so by using two type A23 12v alkaline bats in series at around £3.50 the pair – currently from Morrison's and Tesco supermarkets – is overwhelming and in fact it makes a nice little project on its own. It also looks good with a scan of an Eveready label from the TR-1 era around it (See the Battery assembly sheet images below). The pictures show the components and build up. The one really critical dimension of course is the overall distance across the battery studs as this has to fit between spring clips on the chassis and should be between 49-50mm. The chassis itself is in this instance made of 2mm styrene sheet, but could also be from 4mm mdf or ply with adjustment to the central hole drilling height. The basic construction is simple i.e two pieces of 'quarter square (6mm) strip, pinned and glued to each end of the chassis for strength and with two pairs of contacts for the batteries. The contacts to the outside are very conveniently made with 20mm paper fasteners, threaded through plastic outers, then through the central hole in the wood ends. They are then bent immediately at Rt angles and kinked in the middle to form a spring contact. The two internal brackets are wired in series and made from 6mmx11mm of thin tinplate or brass strip. Before cutting and bending at right–angles, drill two small holes at one end to take the smallest pins you can find which go right through the chassis. Then drill one hole for the battery contact making sure the drill 'exit' side will face the battery, as if this is not 'cleaned up', it will have a nice protruding 'nipple' for good battery contact. Once the main assembly is complete, as shown below, thin plastic or card sides can be fitted and glued in place to keep the batteries snug. The Eveready outer cover is a scan from a TR-1 era dud battery which came with the black set from America. I have shown it full size for colour copying but if it does not end up around 47x80 mm in the final article [it does – Editor] then this is the size you need to make it to after scanning. It is folded around the assembled battery and glued along one edge so that you can slide it on and off for battery renewal. The final photograph shows the completed battery ready for use.

Conclusions

I now have three restored and working radios which afford great occasional listening pleasure notwithstanding the limitations on audio output power etc. The Regency TR-1 is in any case a very satisfying set to own with a classically stylish design, standing the test of time and becoming ever more collectable. It also has as previously noted, the added attraction of an 'Industrial Mythology', surrounding special colours and editions. In Technological terms it was a landmark as the world's first transistor radio (at last that 'Holy Grail' from the 1920's - the crystal triode had come into its own!). And in marketing terms the precursor of the high volume 'one per person' radio and electronic markets, which Zenith then Sony were to exploit from 1955 onwards to great effect. In summary, it is an historic and very rewarding radio to restore and to 'get talking' again – I can recommend it.

References:
Eric Wrobbel ewrobbel@aol.com
author of 'The Regency TR-1 Family'.
Available by post for around $20.
**Dr Steve Reyer – author of key TR-1 Website
found at: http//myweb.msoe.edu/reyer/regency

22.5v Battery Assembly for the Regency TR-1



Key Dimensions and Data

Overall length across battery studs: 49–50mm
Chassis: 43 x 24 x 2 mm
Wood ends: 22x6.2mm square
Plastic ends: 23 x 13 x 1.2 mm
'EverReady' battery cover: 47 x 80 mm
Paper fasteners: 20mm
Metal brackets: Two 6x11mm bent at right angles
Batteries: A23 12v Alkaline

Variations on a theme: The Bush MB60 family

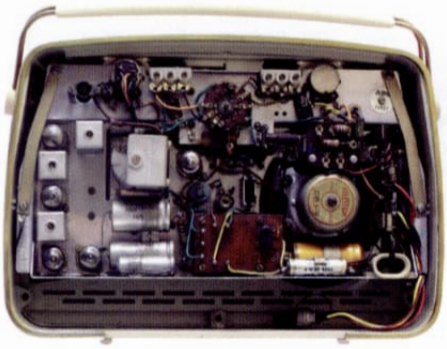
by Robert Darwent

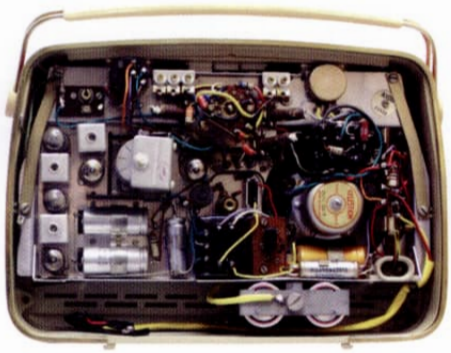
Like many, I found myself immediately drawn to the stylish appearance of these Bush portables that have become so evocative of the late 50's and early 60's period when they were released. Whether you share my enthusiasm for these sets or not, you will have not failed to notice just how popular they have become among vintage radio enthusiasts and the general public alike. The story of how the moulded plastic case for the first incarnation in the family, the MB60, was designed by David Ogle is well known, but how many are as familiar with all of the other related models that share this classic case design?

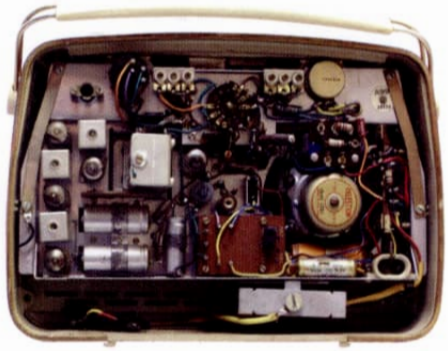
The MB60 (Early) model using the A99 chassis

The EBM60 export model using the A100 chassis

The MB60 (Later) model using the modified A99 chassis







Ogle's 'iconic' design proved so successful that Bush went on to release at least fifteen model variants that used it, several of which are scarce and a few quite rare by comparison to the better known sets. That success was not just down to the eye-catching good looks however but in equal part due to the simple well thought out ergonomics. The sets have a large tiltable carry handle and an attractive circular tuning dial which is both easy to read and a pleasure to use. Likewise the oversized thumbwheel controls and waveband push buttons make operation very simple. Definite plus points amongst prospective purchasers especially if you have poor eyesight and/or large fingers, factors which no doubt contributed greatly towards the design's overall popularity and longevity. So let's get acquainted in greater detail with the models in the family and begin with the set that started it all.

The MB60

Released in 1957 the MB60 is a two band portable designed for AC mains or battery operation, hence the model being designated 'MB' for Mains/Battery. The set is switched over from one power source to the other by the mains lead operating a simple switch arrangement when the plug is inserted or withdrawn from its socket. The set uses five Mullard Dx96 series battery valves, which was one more than typical four valve designs of the time, due to the circuit having an extra IF amplifier. This made the set a good deal more sensitive, a definite advantage over its rivals. It covers the reception of the long and medium wavebands using an internal ferrite rod with provision to plug in an external aerial via a socket at the rear. The moulded plastic case is light grey in colour with a red rexine band around the middle, brass being used for the 'B U S H' lettering and the trim. Initially the MB60 was designed to operate using an Ever Ready B147 battery or equivalent, which was a combined HT and LT unit; however the decision was made to modify the original chassis to allow the use of separate HT (Ever Ready B131) and LT (2 x U2 cells) batteries instead. Consequently all MB60's with serial numbers 12001 onwards have the modified chassis arrangement. The chassis remains electrically identical just some of the components, most noticeably the DL96 output valve and some large electrolytic capacitors, have been repositioned to accomodate the different battery types.

The TR82

Following on the success of the initial design Bush released in 1959 the TR82, a transistorised version of the MB60. Instead of battery valves this set uses seven Mullard OC-series transistors. Unlike the MB60 the set is battery powered only, using a 9 volt Ever Ready PP9 or equivalent. The initial models released were the TR82B and the TR82C, the difference only being in the colour scheme offered. The TR82B model has a cream case with a dark brown rexine band around the middle and as with the MB60 the metal trim on the set is brass. Whilst the colour of the TR82B case is best described as "coffee" or "mushroom" in shade, Bush described the colour themselves as "Regency Cream". The TR82C model has a light blue/green case with a dark blue rexine band around the middle, metal trim on these sets being chrome.

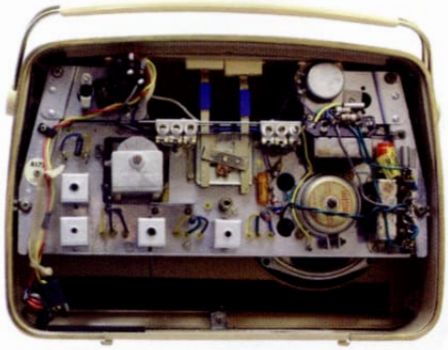
The VTR103

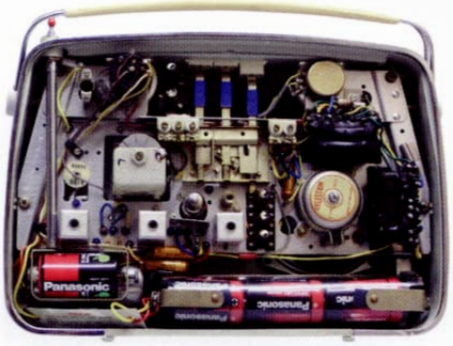
A further development of the MB60 theme came in 1961 with the release of a new set that had VHF coverage from 88 to 100 MC/s in addition to the existing long and medium wave ranges of the earlier models. Given the model designation of VTR103, it had a chassis design that

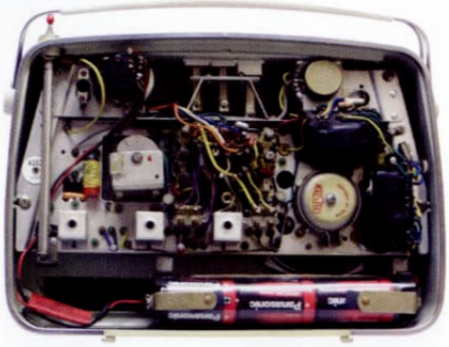
The TR82B & TR82C models using the A177 chassis

The ETR82 export model using the A190 chassis

The ETR92 export model using the A253 chassis







made use of the recently available Mullard AF11x series of alloy-diffusion transistors which offered improved HF performance over the earlier OC-series. The colour scheme for the set was new too, the case being light cream or ivory in colour with a tan rexine band around the middle. The metal trim is chrome and a telescopic aerial was provided for VHF reception, capped by a translucent red plastic 'pip'.

The TR82 modified

Shortly after the VTR103 release, Bush modified the existing chassis used in the TR82 slightly to include an headphone socket. Only the TR82C and apparently not the TR82B received this modification, examples of which all seem to have high serial numbers begining 15xxxx. In addition this same modified chassis was used for the release of a TR82 set having the same colour scheme as the VTR103, that is light cream case, tan rexine and chrome trim, designated the TR82D.

The TR82 Mk.II

In 1963 Bush released Mk.II versions of the TR82C and TR82D with a new chassis which also made use of the improved Mullard AF11x series transistors, the existing colour schemes of both models being retained. Presumably the earlier headphone modification for the TR82C and TR82D was either a way of using up existing stocks of the earlier chassis or used simply as a stop-gap measure until Bush was ready to release the Mk.II models. In any event, it made the sets with the modified chassis relatively short lived and they are fairly scarce in number. Again noticeably a Mk.II version of the TR82B set seems not to have been produced.

The VTR103C

Almost as an afterthought, in 1964 the VTR103 design was released in the alternate colour scheme of light blue/ green case, blue rexine and chrome trim as per the existing TR82C model and bearing the model designation VTR103C.

The TR82L

Released in 1964, the 'L' suffix denotes that the set had the addition of a preset '208' tuning button for Radio Luxembourg. As with the standard TR82 models the colour schemes offered were the same. So you could have the TR82CL with a blue/green case and blue rexine or the TR82DL with a light cream case and tan rexine, both models having chrome trim. But why bother to produce sets with a '208' button in the first place? Well Radio Luxembourg was immensely popular at the time and was the station of choice during this period for the younger generation, however receiving Radio Luxembourg was not without its problems. It suffered a great deal from fading after dark and could be quite difficult to tune in, so a preset button specifically for the station was very useful. No doubt it was a good selling point for the sets.

The Export sets

Intended for use overseas these models offer three wavebands. Dispensing with the long wave range, they instead offer the medium and two short wave bands. All three models were produced in much smaller numbers than their domestic counterparts and are quite rare by comparison.

The EBM60

The EBM60 was the first export set and as its model number suggests is the export version of the MB60, both models being released at around the same time in 1957. The EBM60 shares the same colour scheme as the MB60 too, that is light grey case, red rexine band and brass trim but the dial is clearly different having short-wave scales and legends. Interestingly the long strip of brass metal trim at the back of the set doubles as a sort of internal short wave aerial, however a separate plug-in telescopic aerial was also provided with the set which greatly improves reception. Like the MB60 the set uses five Mullard Dx96 series battery valves and is mains or battery powered, using HT (Ever Ready B131) and LT (2 x U2 cells) batteries.

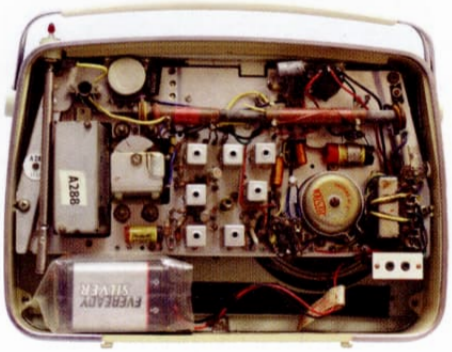
The ETR82

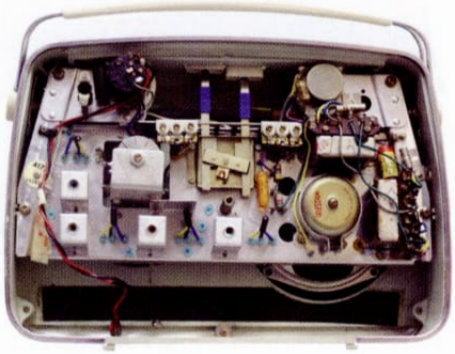
Now for the most unusual and possibly also the rarest set of the family. Released in 1959 the ETR82 was the second of the export sets and is interesting and unique for a couple of reasons. Firstly it is an hybrid (i.e. valve and transistor) and secondly I believe it is the only hybrid set that Bush ever made. The circuitry is basically the front end of the EBM60 spliced to a TR82. This was done because the short wave coverage of the ETR82 extended to 18MC/s (16m-band) and the Mullard OC4x series transistors available at the time could not be guaranteed to operate reliably at that high a frequency. Bush got around the problem by using a solitary DK96 valve to perform the task of frequency changer with transistors used throughout the rest of the circuit. The high voltage supply for the valve was produced from a miniature transistorised inverter (giving around 65 volts) fed from the main 9 volt supply (6 x U2 cells) used for the transistors. The LT for the valve was from another single U2 cell. Unlike the EBM60, the rear trim was not used as a sort of internal short wave aerial and the

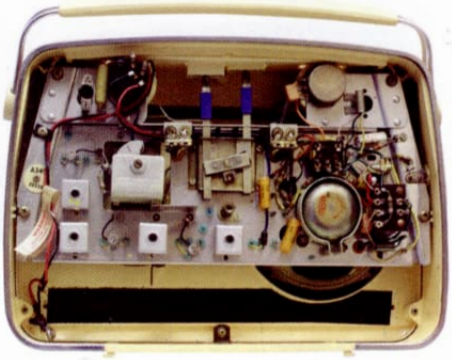
VTR103 & VTR103C models using the A287 chassis

TR82C (Later) & TR82D models using modified A177 chassis

TR82C (MkII) & TR82D (MkII) models using A349 chassis







ETR82 has a proper built-in telescopic aerial instead of a detachable one which is easily lost. The colour scheme of the set was light blue/green case, dark blue rexine band and chrome metal trim as per the TR82C model.

The ETR92

The following year in 1960 the final export set was released, the ETR92. By this time transistor technology had improved allowing an all-transistorised set to be produced, the new Mullard OC17x range of transistors taking the place of the frequency changer valve in the ETR82 model. Bush also took the opportunity to extend the upper range of the short wave coverage a little to 22MC/s (13m-band). Externally the ETR82 and ETR92 appear identical, they share the same colour scheme and both have built-in telescopic aerials. They only vary in the ETR92's dial having been modified slightly to include the increased short wave coverage and with the ETR92 having the addition of an headphone socket. Battery supply for the ETR92 was 9 volts made up again from 6 x U2 cells instead of the 9 volt PP9 battery used by the domestic sets. Presumably this was done because U2 cells were more readily available than the PP9 overseas.

Model, type and chassis tables

Fortunately Bush was very helpful in providing a type and serial number plate on the models it produced. On the MB60 family this metal plate is mounted underneath on the middle section of the case. Similarly the chassis number is given on a small plastic disk screwed to the chassis itself. Using this information I have created the following tables listing the 15 known model types and the 10 different chassis employed in them:

	Model	Type	Chassis	Wavebands	Case	Rexine	Trim	Released
1.	MB60 (Early)	237	A99	LW, MW	Light grey	Red	Brass*	c.1957
2.	EBM60	240	A100	MW, S1, S2	Light grey	Red	Brass*	c.1957
3.	MB60 (Later)	237	A99 (mod.)	LW, MW	Light grey	Red	Brass*	c.1958
4.	TR82B	345	A177	LW, MW	Cream*	Brown	Brass*	c.1959
5.	TR82C (Early)	346	A177	LW, MW	Blue/green	Blue	Chrome	c.1959
6.	ETR82	355	A190	MW, S1, S2	Blue/green	Blue	Chrome	c.1959
7.	ETR92	421	A253	MW, S1, S2	Blue/green	Blue	Chrome	c.1960
8.	VTR103	462	A287	LW, MW, VHF	Light cream	Tan	Chrome	c.1961
9.	TR82C (Later)	346	A177 (mod.)	LW, MW	Blue/green	Blue	Chrome	c.1962
10.	TR82D	508	A177 (mod.)	LW, MW	Light cream	Tan	Chrome	c.1962
11.	TR82C Mk.II	528	A349	LW, MW	Blue/green	Blue	Chrome	c.1963
12.	TR82D Mk.II	530	A349	LW, MW	Light cream	Tan	Chrome	c.1963
13.	VTR103C	622	A287	LW, MW, VHF	Blue/green	Blue	Chrome	c.1964
14.	TR82CL	653	A458	LW, MW, 208	Blue/green	Blue	Chrome	c.1964
15.	TR82DL	655	A458	LW, MW, 208	Light cream	Tan	Chrome	c.1964

(*Bush in their sales literature described the colour as "Regency cream" and the trim as "Florentine Bronze")

	Chassis	Valve and/or semiconductor line-up used									
1.	A99	DK96	DF96	DF96	DAF96	DL96					
2.	A99 (mod.)	DK96	DF96	DF96	DAF96	DL96					
3.	A100	DK96	DF96	DF96	DAF96	DL96					
4.	A177	OC44	OC45	OC45	OC72	OC72	OC72	OC72	OA70		
		OC44	OC45	OC45	OC71	OC78D	OC78	OC78	OA70		
		OC44	OC45	OC45	OC72	OC81D	OC81	OC81	OA70		
5.	A190	DK96	OC45	OC45	OC71	OC78D	OC78	OC78	OA70	OC72	OA81
6.	A253	OC170	OC170	OC45	OC45	OC71	OC81	OC81	OA70		
7.	A287	AF114	AF115	AF116	AF116	AF116	OC71	OC81D	OC81	OC81	OA90 OA71
8.	A177 (mod.)	OC44	OC45	OC45	OC72	OC81D	OC81	OC81	OA70		
9.	A349	AF117	AF117	AF117	OC71	OC81D	OC81	OC81	OA90		
10.	A458	AF117	AF117	AF117	OC71	OC81D	OC81	OC81	OA90		

Models using AF11x transistors

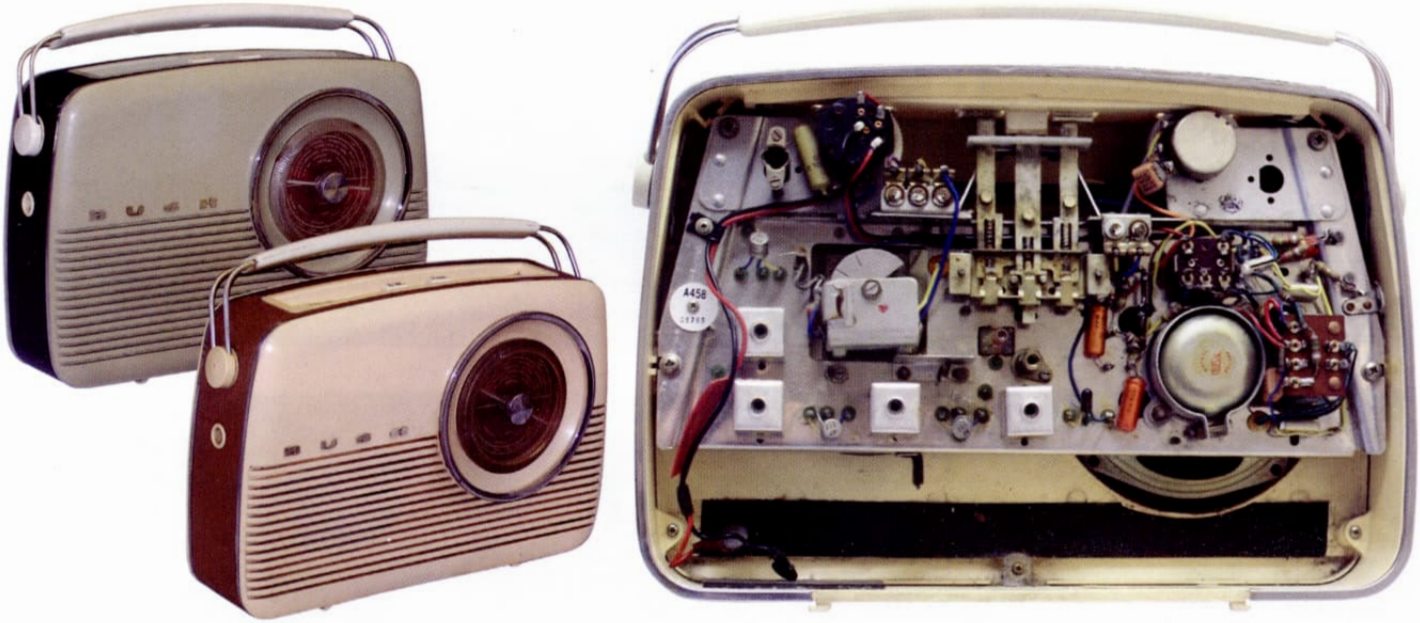
The models using the later Mullard alloy diffusion transistors of the AF11x series, the Mk.II sets and the VTR103, etc have a common fault of developing internal short-circuits, usually between the emitter and shield connections. It is sometimes possible to cut the shield lead and restore functionality but this can also lead to an increase in noise or cause instability. Replacement of the defective transistor is therefore the preferred option, and the AF12x series transistors are recommended.

Production differences

Different on the later models is the

"B U S H" lettering on the front of the sets. On earlier sets the letters are made of solid metal plated with brass or chrome, later models however have plastic lettering upon which a chrome coloured coating has been applied. Unfortunately this coating commonly wears thin revealing the bare plastic beneath.

Further model variants?
The list of 15 model types given here may not be exhaustive and there may be other little-known variants out there. It has been speculated that there may be a TR82B set with an headphone socket using the modified A177 chassis and even a TR82B Mk.II set with the A349 chassis, though this set seems far less likely to exist than the former. Any further information regarding such sets not already covered here would be most welcomed by the author: robert.g0uhf.2@gmail.com



The TR82CL and TR82DL models using the A458 chassis

About the new BVWS DVD by Terry Martini

I am delighted to be able to tell you a little bit more about this year's DVD content. Before I do however, I should explain that this will probably be the last DVD in the series unless any further material turns up. The last year or two has been a real challenge in terms of producing an interesting mix of material. With that said, I certainly never envisaged being in the very fortunate position of transferring and authoring five of the six members–only DVDs that the Society has issued which started back in 2004 with our two valve films.

For our DVD this time around we start off with a rarely seen film from 1934, entitled 'Death at Broadcasting House'. The film appeared in a collection of reels that formed some of the footage kindly handed to us by Gordon Bussey in 2008. The film was in the 9.5mm format and despite best efforts; we could not get it through the telecine as it was so fragile. Luckily, I had a much better video copy of it to hand and it is this version that has made it to DVD.

The film is ostensibly two stories in one. The first is the underlying plot of a murder during a live radio broadcast of a play. There are several plausible suspects who all had the opportunity and motive to commit the crime but the actual culprit seemingly has a cast iron alibi. His unmasking therefore comes as a genuine surprise. The second story is that of the daily routine in Broadcasting House where we meet two of the top stars of the day, Elisabeth Welch and Eve Becke, delightfully singing to the accompaniment of Ord Hamilton at the piano and Percival Mackey's dance orchestra respectively. Interweaved and connecting both stories is a gormless intruder who goes all over the building in search of the Variety studio, upsetting everyone in the process and also becoming a prime murder suspect. A gripping film, the only disappointment being that the police inspector never reveals his evidence until right at the end, thus depriving the viewer of accurately guessing the whodunit.

Our second film is Norman McLaren's 'Around is Around'. This was originally made for showing in 3D at the Festival of Britain. For it, he developed a technique based on filming oscilloscope patterns. The film used McLaren's trademark technique of direct drawing on to 35mm film. It was designed to introduce the viewer to the concept of 3-D and depicted patterns made by an oscilloscope set to specially composed music.

The film was first shown at The Telekinema Cinema, London, which was designed by Wells Coates. Funded by the Festival authorities, this 400-seat, state-of-the-art cinema was specially designed to screen both film (including 3-dimensional films) and large-screen television. Situated between Waterloo Station and the Royal Festival Hall, it proved one of the most popular attractions of the South Bank Exhibition between May and September 1951. 'Around is Around' garnered much praise at the time.

Our final two films are as a result of one of our members, Tony Dutton who kindly got in touch with me several months ago and to whom I would like to extend the societies thanks for submitting two short, but nevertheless interesting films. The first is a Mullard film on special quality valves. **Unfortunately it ends very abruptly suggesting part of it is missing.** The second film is a bit of a mystery so if any eagled eyed members can help here please get in touch through the usual channels. All we know about the footage is that the ship is the Electra 3, moored on Tyneside. There is no clue as to the company behind it or the equipment.

All film footage has been sourced from the best sources available, however due to the age of the material, the quality may be a little variable.

Audiojumble 10/10/2010

Photographs by Carl Glover


THE VORTEXION
TAPE RECORDER

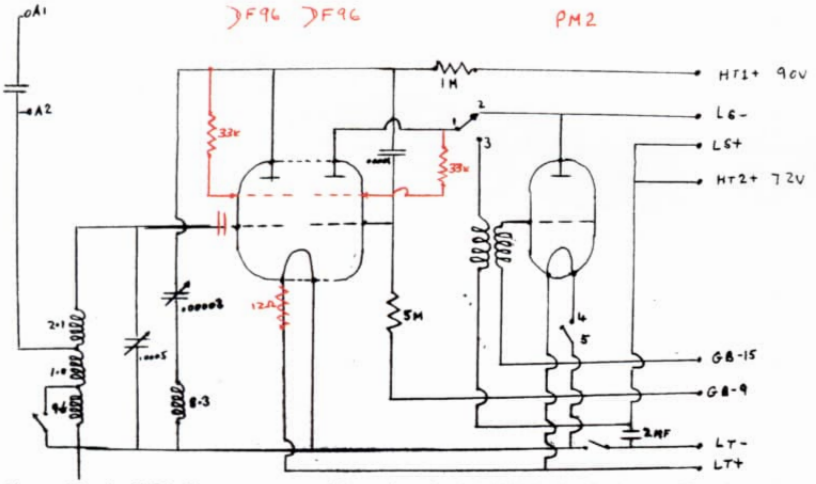

TAYLOR


FANTASTIC GARRARD 301
IN LOBICRAFT PLINTH
WITH SME 3009
£1500
QUAD ESL57 BLACK SPEAKERS

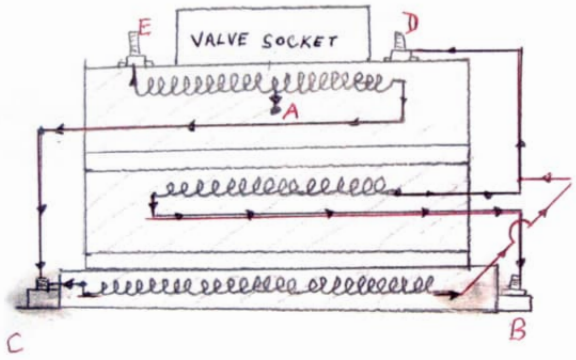
THE BTH VR3 Form CA Radio by Brian Stanfield

I won this BTH radio set at the Wootton Basset BVWS auction in 2008. When I got it home and put it on the test bench I noticed it had strange valves fitted. One had two extra connections in the shoulder of the B4 base.The markings on the valve read Mazda TS215 with a BVA and a BTH logo printed on the glass.

Above: The original TS215 and P227 (both O/C) as found in the radio.



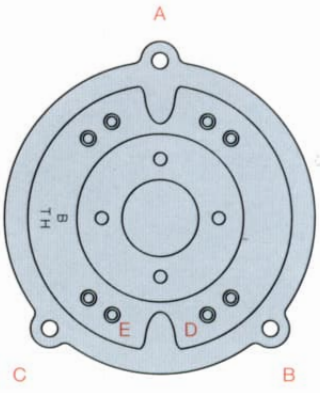
Above: Circuit of VR3. New components (shown in red) added hidden inside the new B4 valve base.



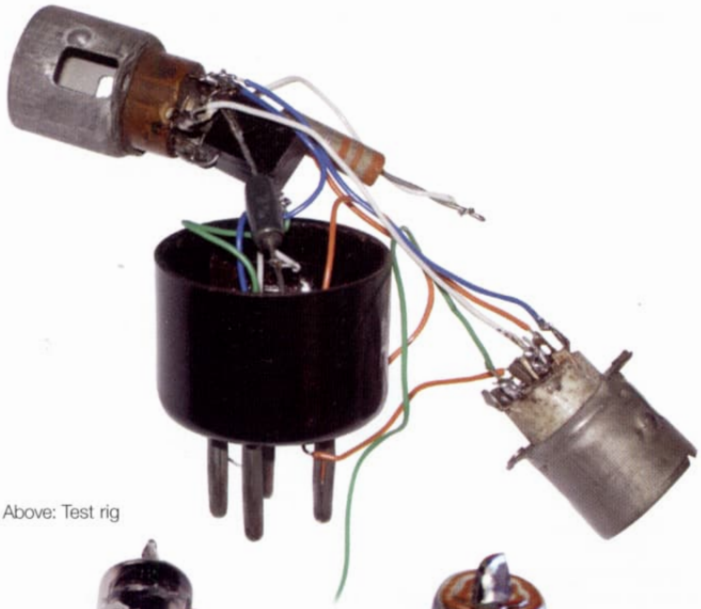
Side View: Contact A is terminated on Post A at rear of coil base

I traced out the wiring in the circuit paying particular attention to the aerial coil and the valve base connections. It turned out that the first valve was in fact a double triode with two grids and two anode connections with a common filament. Could a double triode valve have been designed to fit into a 1926/7 radio, was it the first valve of that type to have been installed in a radio set? Looking through my valve books and also on the Internet I found no records for the valve so I contacted the BVWS museum. A few days later I was contacted by someone who was willing to sell me a TS215 valve to fit in my set, but as the price was a little short of £100, I declined the offer. In any case if I had fitted a very rare valve into the set it may have blown the filament with the first switch–on, I decided to make a substitute. I looked at various options until I came across the DK 96, DF96, DAF 96 and the DL96 valves used in the Vidor range of radios. I had quite a few spare valves of this type and their small size would enable me to hide them inside a globe shaped envelope.

I found an old B4 base and fitted and wired two B7G valve holders to it. I tried various combinations of valves using different power connections until I found the best results for my set. The best combination I found was to use two DF96's in tandem. I had to use a 12 ohm resistor to lower the 2 volt LT supply down to 1.4 volts that the

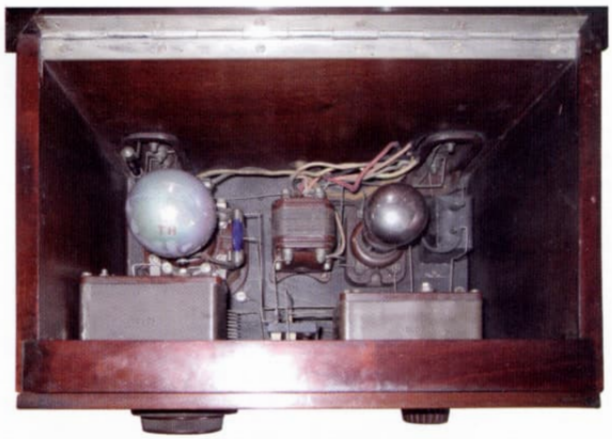


Front of set coil mount top view



Above: Test rig

Above: Final finished valve Above: Raw materials



new battery valves required. I also had to fit a 33k resistor between the anodes and the screen grids of both valves and a 50pf capacitor in the first grid circuit to make the valves work properly. I then used another B4 base and drilled and fitted the two extra connections to it after printing the 'pin out connections' onto the base as per the original valve. I bought a clear Christmas tree globe and made a hole in the base so that it would fit over the B4 valve adapter and accommodate the two DF96's. I then sprayed the inside to match an original BTH 'golf ball' pip–top valve, wired and fed the two new valves into the globe and they worked first time! The finished article can be seen alongside an original BTH pip top valve for comparison.

New tube for rare television at Museum

The picture on the right shows Gerry Wells holding a replacement Emiscope 6/6 12inch pre-war television tube. It was purchased last year by the BVWS using NVCF funds for the HMV 900 Receiver at the Museum as the original tube was useless.

This tube, which was tested before purchase gives an excellent bright picture and will allow the 'dual standard' HMV 900 to work again. The original tube is destined for re-build at RACS in France sometime in the near future.

Memories of a Pye 'Twintriple' by Henry Irwin

I remember visiting my Grandparents' house in the very early sixties when I was around ten years old. They had no television but my Grandfather was very proud of his large Pye Twintriple transportable mains wireless. It sat on a small cupboard which he had built, many years previously, specially for it and had pride of place in the room. Even as a child I sensed that this radio was a relic of a bygone era, a piece of obsolete technology. It was 1961 and I was just beginning to develop an interest in radio and of course at that time transistors were the new thing. Nonetheless that large solid cabinet and intriguing sunset motif grille held a strange fascination for me.

Of equal fascination was my Grandfather's approach to it. Only he was allowed to switch it on. He would don his reading glasses, unhook from the wall the special hook which he had fixed to its back to prevent unauthorized movement on its turntable and he would angle the cabinet in the direction of the BBC Northern Ireland Home Service station near Belfast. Then he would peer into the control aperture with its complement of bakelite knobs and its white celluloid drum graduated in metres like a scientific instrument and twiddle with tuning and aerial trim. I was aware, however, that at this stage in the venerable Pye's long career there was a problem. It had developed some sort of intermittent fault and this often required the insertion of half a matchstick into the gap beside the offending thumbwheel. If this didn't work he would apply a sharp thump to the top of the cabinet with the flat of his hand. I realize that this sort of scenario has become part of the comic folklore of valve radios but he really did, on occasions, resort to this drastic remedy.

My grandfather often fondly related how his beloved Pye was an "exhibition" set. That is to say it had apparently been on display as part of an exhibition of the latest developments in radio at the local Town Hall in the early nineteen thirties. Years later I learned that at its introduction in 1930 the Pye was an expensive top of the range piece of equipment, retailing at £23-2s-0d; well beyond the means of the average working man of the time. The precise story of exactly how it came to be in the possession of a precariously employed house painter was never elicited. I suspect that sales of such deluxe radios would have been slow in our small country town so it is possible that the dealer may have sold off this ex demo set cheaply after a few seasons had passed, possibly on hire purchase, using its "exhibition" pedigree as a piece of creative sales encouragement. Alternatively it may have been given as payment for work done. Such arrangements were common then and my Grandfather was always one for arranging "deals".

The Pye was invariably tuned to one of three stations. The BBC Home Service from Lisnagarvey, just south of Belfast, with its Northern Ireland "opt outs" for news and local programmes, Radio Eireann, which my Grandfather always referred to as Athlone, the location of its main transmitter and finally the BBC Scottish Home Service from Westerglen. He had a liking for the music of Jimmy Shand and of the Gallowglass Ceili Band and for this reason he would tune in on certain evenings of the week to BBC Scotland for broadcasts of traditional Scottish dance music which he perversely considered superior to the Irish variety. He would never willingly tune in to the BBC Light Programme. Rock and Roll and Jazz he referred to as "the music of the jungle".

During the war the Twintriple had a more varied and exciting career. My Grandmother told me how they sat around in the evening listening to the broadcasts of William Joyce (Lord Haw Haw) from Bremen. They also listened on the BBC to news of the strangely distant war which told of air raids in the south east of England and the tally of allied and enemy losses. Later on this detachment from the realities of the conflict was rudely shattered when they found themselves tuning in with horrified disbelief, mindful of their relatives, for news of the casualties and survivors after an unexpected air raid on Belfast.
On a lighter wartime note my mother related how, although expressly forbidden, she would, when her parents left her alone on a Saturday morning, tune in to the music of Edmundo Ross on the Forces Programme and perform a "rumba" around the floor with her school friend, taking it in turns to look out of the front door for signs of returning authority.

By the early sixties, although my Grandfather remained a wireless only man, all his neighbours had or were acquiring television sets. I well remember how in the evening the more distant stations such as Scotland became increasingly difficult to clearly receive in the presence of howls and modulated warbles from frame and line time bases. I do remember also the Pye's mellow resonant sound, not exactly muffled but giving prominence to the lower registers of announcers' voices and bass instruments.

It was around this time that my mother bought my Grandfather a compact radiogram, as I recollect, and the elderly Pye was pensioned off. For some reason it wasn't consigned to the bin and on one of my frequent visits, I came across it again in the spare bedroom. Thus began my intimate aquaintance with the construction of this radio. With a mixture of vandalism and curiosity appropriate to boys of a certain age, I remember systematically dismantling it over a period of several weeks. The initial disrespectful approach was soon tempered by a fascination for its almost architectural internal construction. Each screened compartment, with its individual valve or group of components became a little world of wonder to someone who was only just working out how the magic of radio was performed. Its mechanical complexity and exotic hardware, although from a time long past, were stranger than anything I had seen. Tall shouldered valves containing tantalizing glimpses of fine wire grids, metal boxes with screw terminals, devices with fins and complex coils. However the challenge to a youngster of removing the myriad nuts and screws in the Twin triple's "Meccano" like framework won the day. Eventually it was reduced to a pile of its individual bits. Even the valves were opened up. If I remember correctly, it was one of the later Twinptriples with a permanent magnet speaker and long after the other remnants had been cleared that magnet still provided me with hours of endless amusement.

So, that is why I have always had a secret regard for the construction of this radio. Many may argue that it was over engineered but I can testify to its undoubted build quality. Why then, you may ask, don't I have a Pye Twintriple in my collection today and why also have I spent the last ten years or so collecting transistor radios? Well, that is a complex question to answer. Transistors have their own different kind of fascination for me. However it may have something to do with the fact that the Phillips Superinductance set that I bought back in 1998 is still languishing untouched in a corner of the visitors' bedroom taunting me for my lack of confidence in taking on the restoration of its chassis and cabinet. Then again perhaps that is the curse put on me by my grandfather's old Pye for what I did to it all those years ago!

Dainty Dinah's Wireless Cards by Ian L. Sanders

When buying ¼ lb. Of "DAINTY DINAH", "BRAZIL DAINTY DINAH", or "MINT DAINTY DINAH" – the good Toffees by HORNER – ask your confectioner to give you one of these attractive Wireless cards. There are 24 different cards in the complete set, and together they enable even a child to understand the mysteries of Wireless and the construction of a Receiving-set.

These 1920s tins of *"Mixed"* and *"Brazil" Dainty Dinah Toffee* would have qualified the purchaser a free wireless card.

A 1920s advertisement for *Dainty Dinah* Toffee.

Dainty Dinah Wireless Cards

We shall be particularly glad if you will give one of the enclosed cards to each purchaser of ½ lb of DAINTY DINAH TOFFEE,

or

Dainty Dinah Nut Toffee, Brazil Dainty Dinah Toffee,
Mint Dainty Dinah Toffee, Dainty Dinah Buttermel, ::
Chocolate Dainty Dinah Toffee.

We feel sure that with few exceptions they will be appreciated by the buyers of our specialities named. In our newspaper advertisements we are referring to these Wireless Cards being given away with purchases of our Dainty Dinah Toffees.

GEORGE W. HORNER & Co. LTD.

Clearly George Horner & Company believed the free wireless cards were going to be an important incentive to buy their product and warranted featuring in their newspaper advertisements.

George William Horner established his confectionary business in Chester-le-Street, County Durham in 1911 by taking over the existing firm founded by John W. Luccock in 1878. Horner's original brand, *Mermaid Toffees*, was succeeded by the popular *Dainty Dinah* product line in 1914. The company grew briskly during the 1920s with large factories opening in East Ham, London and Edinburgh. At its zenith, George Horner's original factory employed almost 900 workers, mostly young women, easily recognizable dressed in their company's smart white uniforms.

Expansion continued through the 1930s until the war slowed down the output, from which the company never fully recovered. George William Horner died in 1947 and the business was taken over by his son George Kenneth Horner – an officer in the Life Guards. Under pressure from the larger manufacturers, Horner concentrated on the export market during the 1950s, but was unable to compete with the large chocolate manufacturers. The company ceased operations in 1961.

Although George Horner never admitted to Dinah's true identity, it was later revealed that the famous Edwardian lady in a bonnet was modelled on Alice Scott, George Horner's chauffeur. Her image appeared on tins and advertisements and a large bust was painted prominently on the factory's chimney. The factory was torn down in 1985, but the bust was preserved and is displayed at Chester-le-Street Civic Centre.

In 1926, the company introduced a series of twenty-four wireless-themed cards to be given away with the purchase of quarter-pound tins of *Dainty Dinah* toffees. The colourful cards, measuring 4¾ x 3¼ inches, were attractively designed and were highly detailed. Just about every aspect of the still new phenomenon of domestic wireless was covered, including basic theory, wireless components and the arrangement of simple crystal and valve receiver circuits. Special emphasis was given to the principles of tuning-in of stations.

Although given away with confectionery, the Horner wireless cards were apparently not targeted at the young enthusiast, but rather were designed to appeal to an adult audience, and were advertised in national newspapers. In any case, the series provides a fascinating insight into the significance of the embryonic technology of wireless broadcasting in the lives of ordinary people during the mid-1920s.

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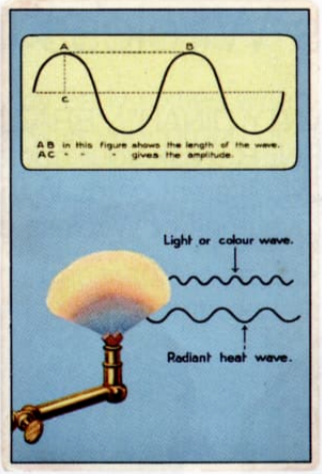

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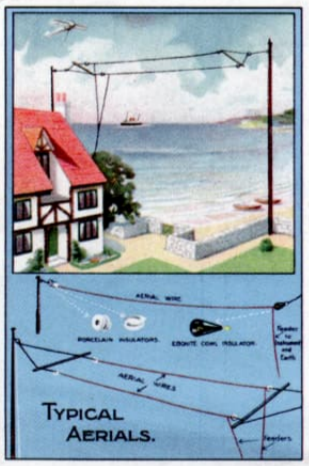

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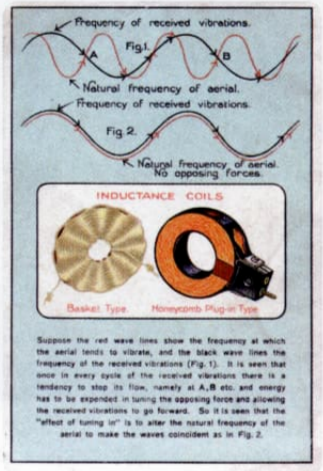

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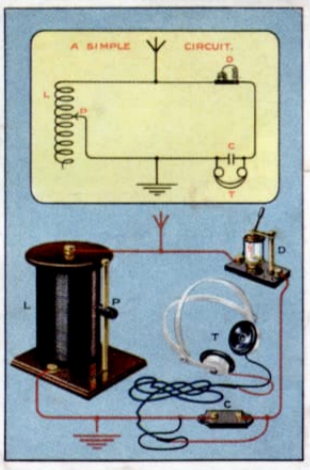

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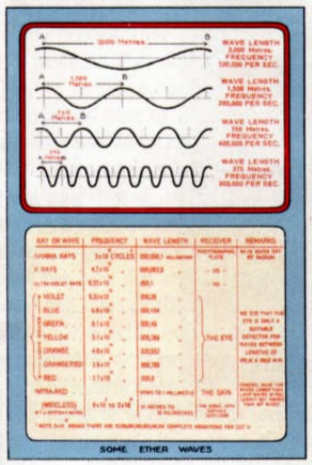

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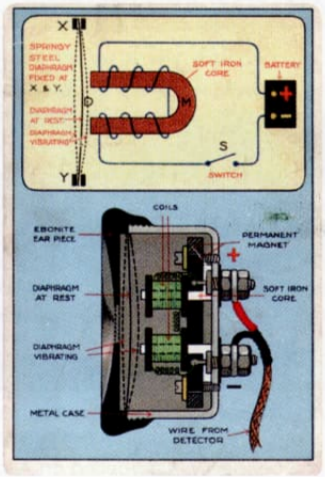

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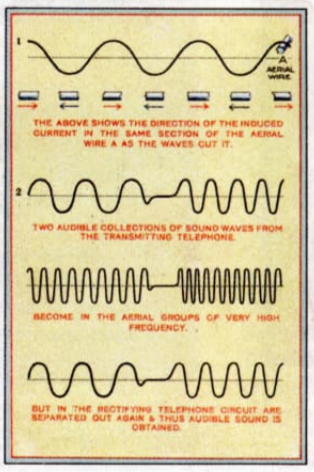

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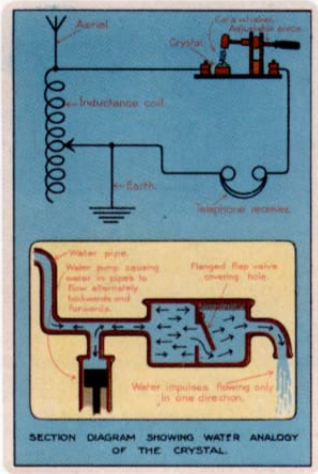

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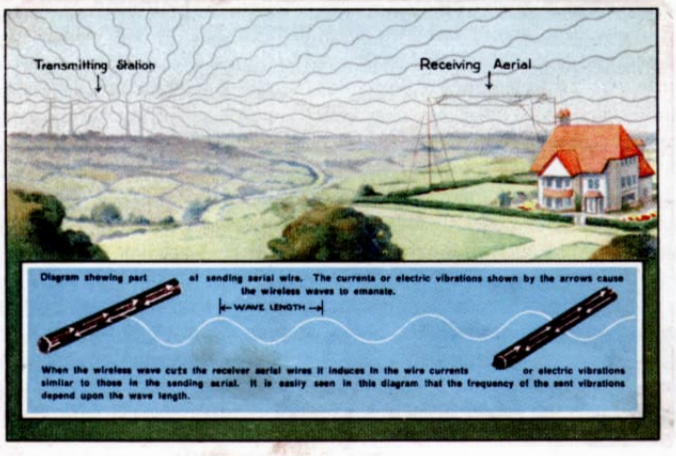

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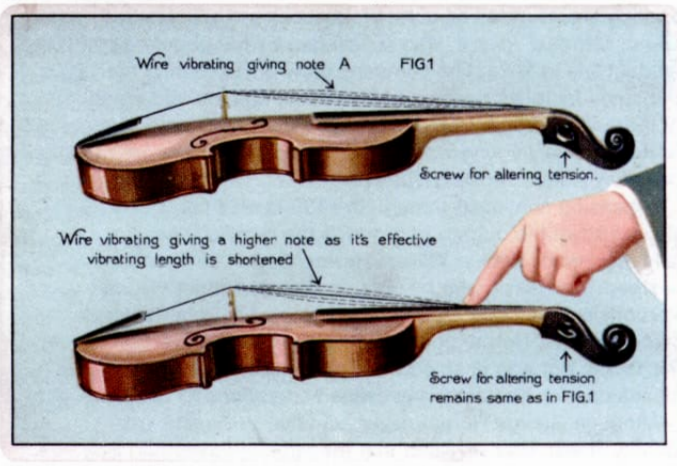

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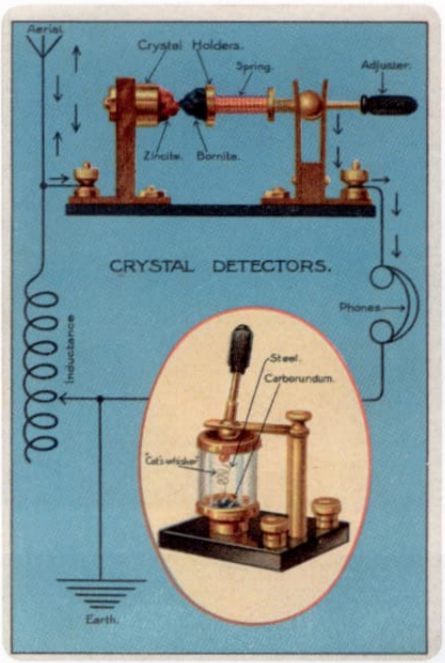

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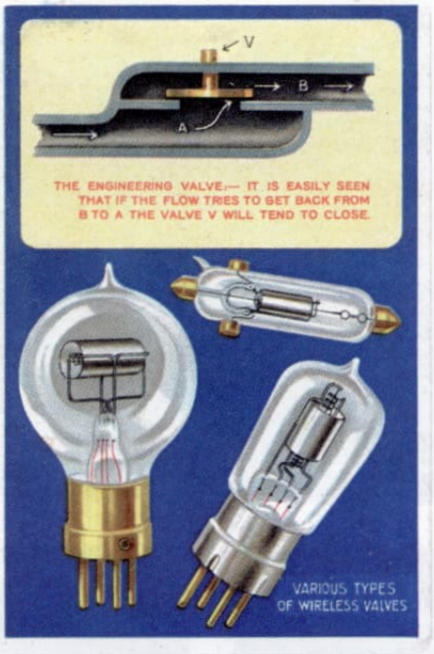

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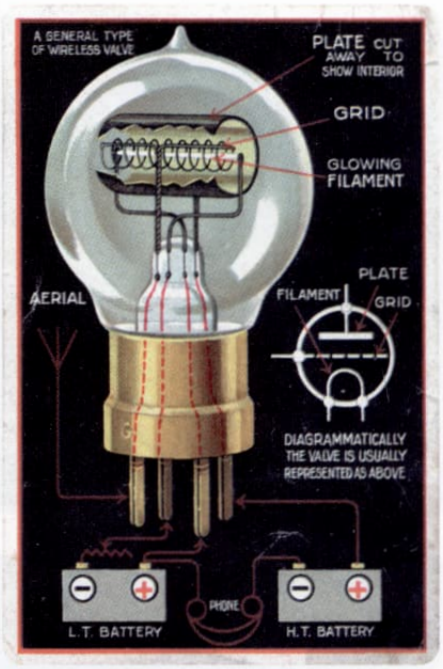

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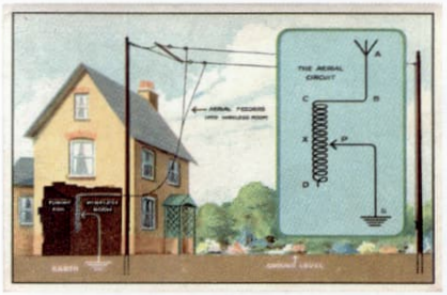

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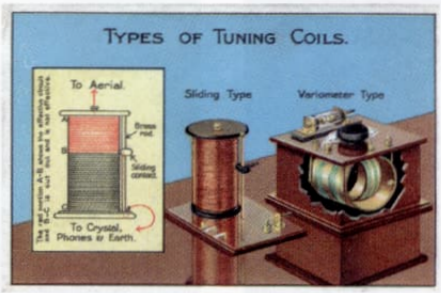

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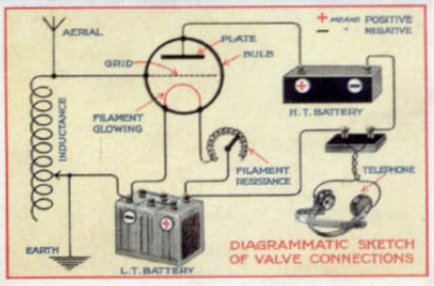

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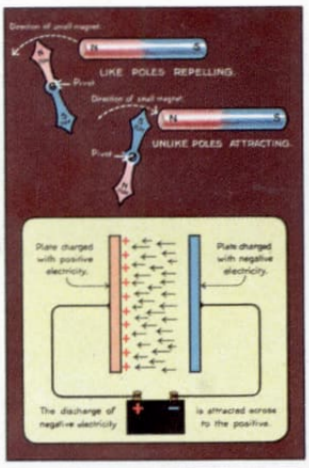

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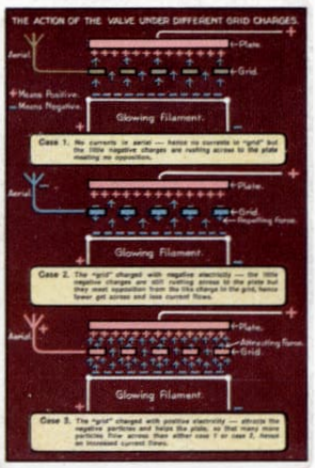

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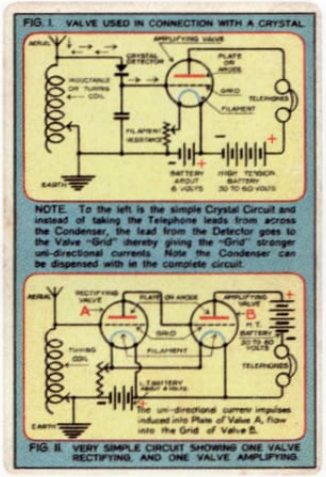

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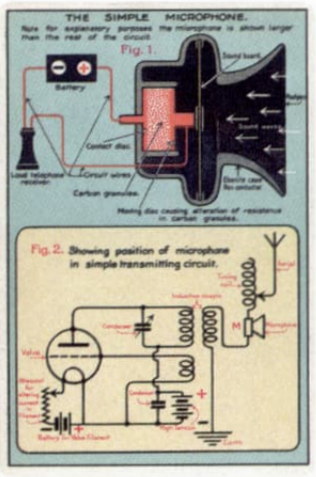

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1 General Theory
2 Air Waves and Ether Waves.
3 Heat, Light and Wireless Waves.
4 The function of the Aerial.
5 How an Aerial looks.
6 What is meant by "Tuning In" on a Receiving Set.
7 Tuning In.
8 The effect of Tuning In.
9 Tuning In by altering the Length of the Aerial.
10 The Tuning Coil.
11 Tuning In. By altering the Electric Tension in the Aerial.
12 The Simplest Wireless Receiving Circuit.
13 What is meant by Frequency.
14 The Telephone Receiver in Wireless.
15 Collecting the Aerial Vibrations.
16 The Crystal Detector. How a Crystal rectifies.
17 More about the Wireless Crystal.
18 The Wireless Valve.
19 Description of the Wireless Valve and its connection.
20 How a Wireless Valve acts.
21 How the Wireless Valve works.
22 How the Wireless Valve works, its rectifying property.
23 How a Wireless Valve amplifies.
24 The Microphone. How it works.

Dainty Dinah

The twenty-four *"Dainty Dinah"* wireless cards covered many aspects of the new technology likely to be of interest to the listener-in or to the would-be amateur constructor. Particular emphasis was given to the explanation of the tuning principle with six cards devoted to the topic.

Harpenden 17/10/2010

Photographs by Carl Glover


Edison


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MAGNAVOX


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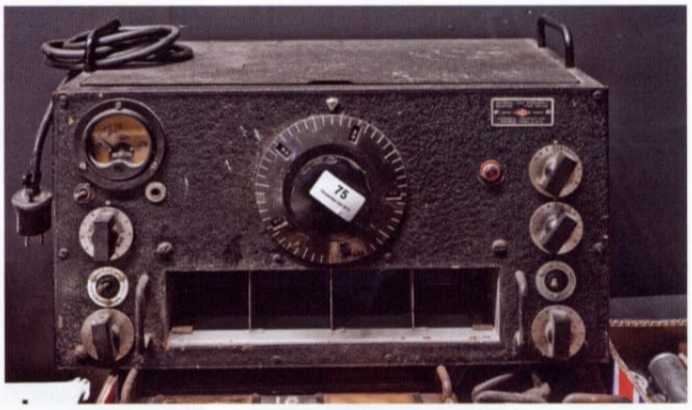
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Restoring a Philco 84B cabinet

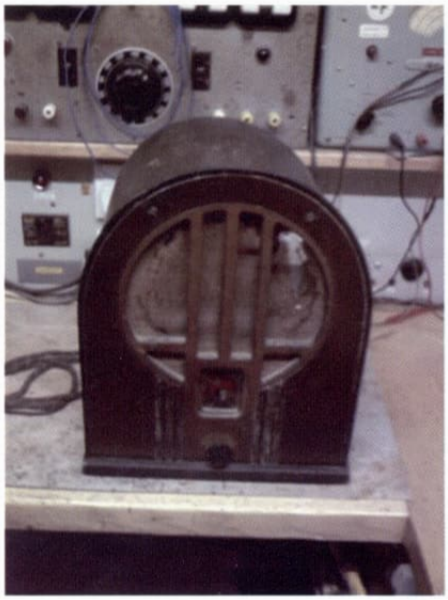
By Colin Wood

At the end of November 2007. I was browsing Ebay and was immediately attracted to this very sad looking Cathedral Philco 84B. It still had over two days to run before auction end and had two bids on it at $1.25 (62p). I was thinking what a wonderful restoration project this would make for the lucky winner. The set looked as though it had been shot as you could see right through the cabinet! The grille cloth was torn, the speaker cone was badly holed and this set was supplied originally without back cover.

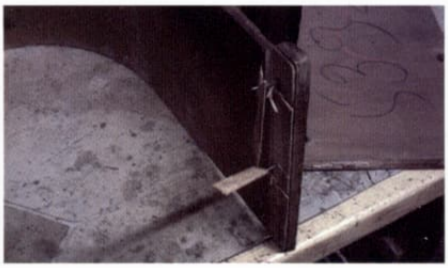
I wasn't going to bid on it as the set was in Oklahoma with a shipping cost of $69 to the UK. At this point my wife Bronwyn kindly asked of me what I would like for Christmas. Suddenly this set became a must have as I had fallen in love with it. The auction ended at 4am our time so a very large maximum bid was placed at 11pm allowing eBay to bid on my behalf and I retired for the night with fingers crossed. 6am the following morning I was logged on again to find the set had topped out at $61 with eleven bids, it was mine. I was absolutely delighted and paid for it via PayPal.

A large cardboard box was delivered quite quickly and I felt like a five year old child once again as I opened it. Sue Wolf, the seller had packed it very well so it arrived safely. With the packing materials out of the way the set was placed on the bench and given a visual inspection. Our neighbour, David, popped in to see us and as he looked at this wreck declared that it ought to be thrown in the dustbin which cheered me up immensely.

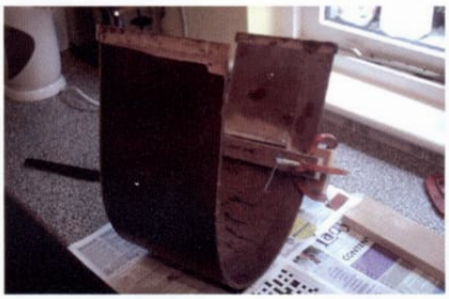
The chassis came out without problem, only one knob was fitted and this was not original. The cabinet was much worse than expected, it was falling apart with masses of de-lamination to the front and curved panels,



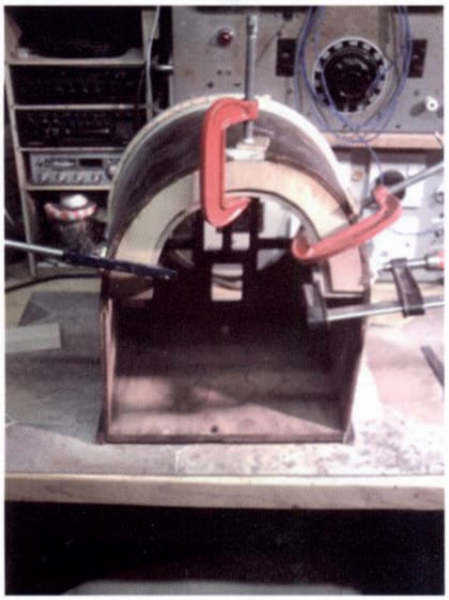
As purchased



Severe damage

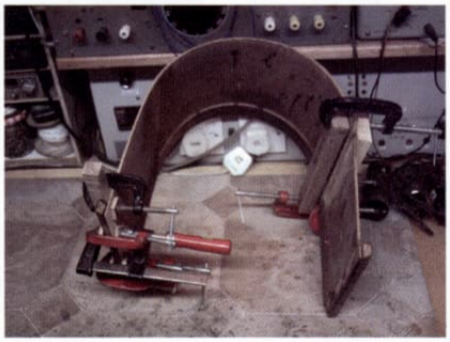


Repairs under way

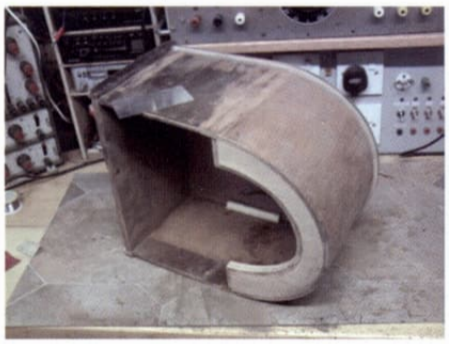


Additional strength added

Laminate coming apart



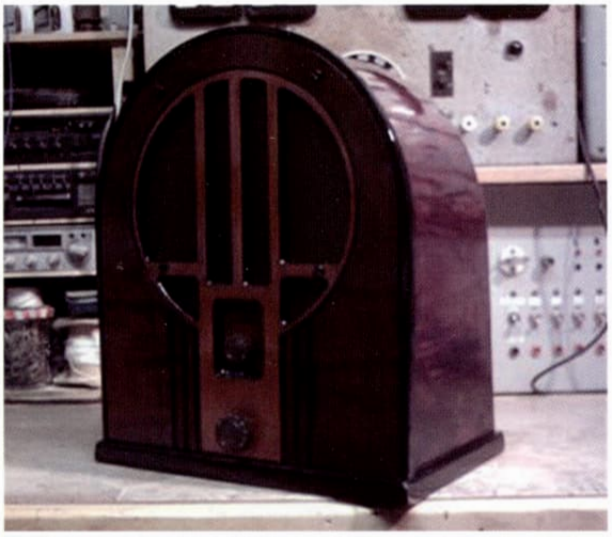
Glueing in progress



Stripping with scraper

Replacement strips glued in place

New back fitted



That's better!

Fully restored

only the base had survived. The curved panel was just a standard piece of 3 ply, only the centre ply was holding it together as it was pinned to the base. Using a hammer and block of wood the cabinet was soon in bits and looking like firewood! This set was bought with a full restoration in mind and at this point it could only get better.

Two full weeks followed with the glue pot on the hob every day as work was carried out re-gluing the veneers, hot hide glue was to be used throughout making this job so much harder, hide glue was chosen as it is perfect for this kind of cabinet work and hopefully in another seventy years someone will thank me for using it. Most of the time was taken allowing the glue to harden as the repairs could only be carried out in small sections at one time. Finally to my relief the cabinet was ready for putting back together which threw up the biggest problem of all, how to glue up a curved panel with a joint of almost three feet in length without the glue gelling? Initially the intention was to glue and pin both ends of the curved panel to the base as this appeared the obvious way to go. This was rejected after much thought, if the curved panel could be positioned to the front panel and glued quickly; there would be a better chance of getting the glue right into the housing, the two layers of veneer which originally formed most of the outer housing had long since gone and would be replaced later. Assembly was carried out in the kitchen, the sink was filled with water and an old towel was placed ready, the work surfaces were covered, everything was placed to hand and a number of dummy assembly runs were tried, two battens had been prepared together with 10mm threaded rods to be used for clamping, the rods were fitted with a hex nut at one end and a wing nut at the other end for speed. The glue pot was ready so there was no backing out now. Masking tape was applied around the joint to stop the veneer absorbing glue where it wasn't wanted. Working just the right side of panic, glue was very quickly brushed into the housing totally filling it, the joint was closed and the job clamped up, excess glue was removed with the wet towel and the job was left for a full day for the glue to set. The following day, all the worry and stress had been worth it, total success, it was then easy to secure the curved panel ends to the base with glue and longer panel pins using the original holes for alignment. Next job was to cut strips of 1/8"plywood to replace the missing two layers of veneer which formed the housing and glue them into place. The cabinet still looked very rough but at least it was now one piece. To add additional strength, glue blocks were added internally together with a new non standard arch to the rear. A back panel was designed and made for safety as the set would be converted to 240V volts. As work progressed I ordered new grille cloth and two new valves. A bit of luck was to be winning bidder on four genuine Philco rosette type knobs off eBay.

A cabinet scraper removed the old finish and brought all the repairs down level with ease. The light coloured section of the front panel was then masked off and the remainder was given a coat of water based Vandyke brown stain blending in the repaired veneers. The cabinet was left overnight to dry. The following morning started very badly indeed. The water stain had opened up not one split in the veneer on the curved panel but six splits; this was a low point and came very near to the cabinet being placed on the ground and me cheerfully jumping up and down on it. Fortunately the point passed by and a solution was called for, to play around now and mess up the new stain would have been disaster. In the end the stain was given two coats of button shellac to seal it then the splits were glued and clamped taking care to wipe away all excess glue. Once the glue had set two more brush coats of shellac were applied then the cabinet was flatted using 240 grit wet or dry abrasive paper used dry. Another four coats of shellac were applied and also two coats of shellac were applied to the inside of the cabinet.
A lot of time was spent flatting then the job was completed using a traditional French polishing rubber. The black trim was then painted using artists Mars black acrylic with the intention of giving it a couple of coats of shellac, this failed miserably, and the shellac turned the matt black brown! I then bought some special black paint off eBay at £8.50 for a spray can. This paint sets porcelain hard and looked very good as I applied it with a brush after first spraying a quantity into the plastic lid. Once it dried it looked a bit thin. As the second coat was applied it lifted the first coat making a mess of the job. Not to be beaten I drove to Hobbycraft in Sheffield, a 50 mile round trip to purchase some Humbrol enamel. I also wanted some paraffin wax. Humbrol black was sold out and paraffin wax was discontinued. Eventually I bought two small tins of Humbrol black from a local hobby shop and finally was able to complete this cabinet restoration. The cabinet had one last go at upsetting me as it took four attempts to fit the grille cloth due to the shape of the backing board.

During the restoration, I bought a new sheet of plywood and had been searching eBay for burr veneers just in case I messed up; a new cabinet was plan B. I have two compressors and two spray guns but living in England makes owning them a waste of time due to the climate. French polishing is inexpensive regarding materials and equipment, the smell and fumes are not overbearing and disperse quickly, the brush comes clean with a dip in methylated spirit and the polishing rubber can be stored in an air tight jam jar for months. French polishing can't be rushed; it involves 80% patience and 20% skill and can be carried out by anyone with the desire to give it a go. The chassis is very rough but appears original and the loudspeaker requires re-coning, both are next on the bench and if I can restore them to the same standard as the cabinet then I will be delighted.

Due to severe asthma as a child I didn't really start schooling until I grew out of it at the age of eleven. I left school with the distinction of being bottom of the class in woodwork and as I was in the top class this meant I was also bottom of the school. I now love woodworking and am very sincere when I say that if I can restore a wireless cabinet then anyone can.

As a bonus, Bronwyn has since paid for a second Christmas present for me, this time it's a Tombstone Philco 282, from North Somerset, UK. Another full restoration project; life is brilliant.

Miniature Wire Winder by Colin Wood

I came up with the idea of this handy little winder quite a while ago. When I first started tinkering around with radio I found I had a lot of difficulty trying to solder replacement components like resistors or capacitors into a chassis as I really needed three hands; one to hold the soldering iron; one to hold solder and one to hold the component in place. Around that time I repaired a vintage Philips radio and this was fitted with tiny coils like miniature springs holding wires together and I thought that's a brilliant idea. Going to bed with this on my mind I awoke in the middle of the night and spent ages thinking about how to produce these little coils and by the time I fell asleep had this winder figured out in my head.

The winder is made from offcuts of steel and the only cost was the needles. The original winder was made to be gripped in the vice but since then I've modified the design adding a base making it fully mobile. The only critical measurement is the drilled hole in the twister which slides over the needle but here are the measurements of the bits I used. Square base; black mild steel 2" square x 3/16" thick bored on center at 6.5mm and well countersunk on one side. Central post; 1/2" square bright mild steel 2.5" long; bored through 5/8" down from one end on centre tapping size for 6mm set screw; drilled axially at other end tapping size for 6mm socket countersunk screw; tap both holes at 6mm. Needle clamp; another bit of the 3/16" thick black mild steel; 1" long x 1/2" wide bored on center at 6.5mm. Twister; 3/4" dia bright mild steel 1" long bored 1.5mm axially taking care not to break the bit by frequently withdrawing and clearing the swarf.

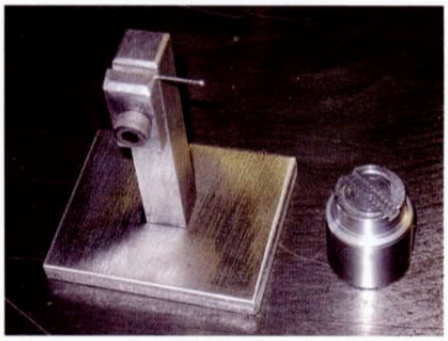
The twister was gripped in the vice and using a standard 12" hacksaw two parallel shallow cuts were made; these cuts were made with the hacksaw leaning over at about 30 degrees giving undercuts to the slot which help to locate the wire. One slot each side of the 1.5" dia drilled hole leaving a strip of metal with a hole in the center; this center strip was then gently removed with the hacksaw. I have an engineering lathe and reduced the end diameter of the twister but this isn't necessary as the twister will still work; I did it for appearances. The needle is a Milward Tapestry Size 18 bought for around £1 as a six pack from Hobbycraft. Using the side cutters of a pair of pliers both ends of the needle were cut off and the ends smoothed on the fine grinding wheel taking care not to draw the temper. Take care to cover the needle whilst cutting with a cloth as the needle is very tough and will fly also don't forget to keep fingers clear.

Assembly; secure the post tightly to the base using the 6mm socket countersunk screw; the next bit is fiddly but I nipped the post at about 45 degrees in the end of the vice jaws allowing spanner access and using the 6mm set screw the clamp and needle was nipped up tightly but not over tightened.

To use; locate the components wire across the front of the winder just above the needle with the loose end overhanging approximately 1" Hold the component with the left hand and push the wire away over the top of the needle to 45 degrees and whilst still holding the component with the left hand slide the twister on locating the hole onto the needle to engage the slot with the wire; push the twister fully onto the needle and slowly rotate clockwise viewed from the right allowing the twister to move away from the post as the coil is formed. With very little practice perfect coils will appear every time; if insulation is required then it can be slid on before winding commences. The tool can be set up for left hand use. All sharp edges were removed.

Remove the faulty component leaving 3/8" long tails attached to the chassis; scrape clean both tails and slide on the new component soldering it into place. This simple solution saves overheating with the soldering iron and as a bonus the 3/8" tails are good indicators as to where the new component fits; I've removed components in the past and lost their position. Bits of angle iron could be used to secure the post as a base and through drilled to accept a nut and bolt also the needle clamp and post could be through drilled to accept a nut and bolt; I used a 6mm tap for neatness as it was available.

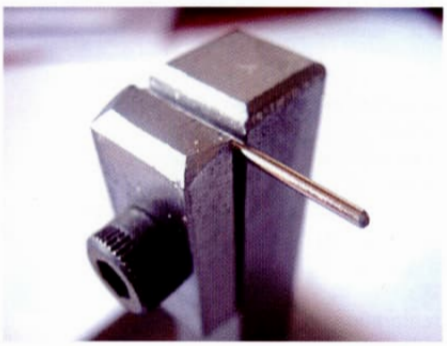
Using basic hand tools and electric drill this project can be completed in a couple of hours. Good luck!



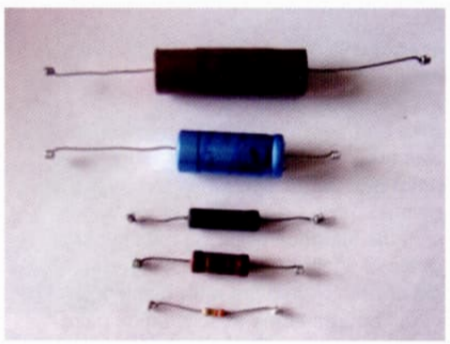
Wire winder

Sum of parts

The business end of the twister



Close-up of winder

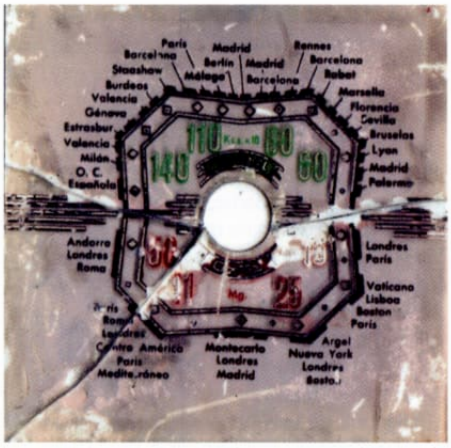


Examples of wound wire

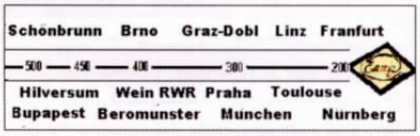
Sample windings close-up

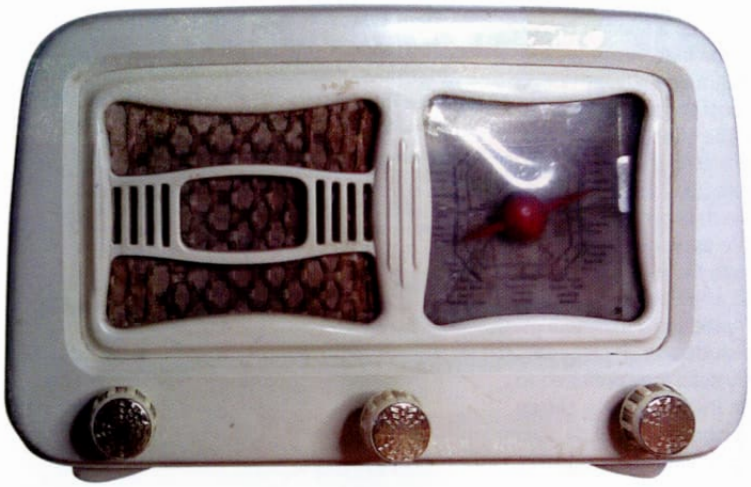
Making Dials – More possibilities

by Tony Jordan



Far left: Dial in original condition
Left: The restored dial
Below: Restored Eumig 323U 'thermometer' dial
Bottom left: Spanish set as bought
Bottom: Eumig 323U





I read Gary Tempest's article on dial making in the 2009 Autumn edition of The Bulletin with interest. I had just purchased a 1946 Eumig 323 MW radio with no dial and a broken dial cord. The radio should have a very simple glass strip dial with the medium wave frequencies shown along the centre. Station names are shown above and below the frequency band. From a picture of a Eumig on the net, I sketched out how the dial should look. I didn't have Adobe Illustrator or Coreldraw on my computer, so I used Microsoft Paint (which came with the computer). This method is very limited, but the dial was simple. I managed to get a Eumig logo from some documents found on the internet. The results weren't perfect, but looked really good on the set. The Perspex, I purchased on Ebay. It was A4 plastic menu covers (costing about £1 each +pp) these were the right thickness and easy to cut. I used Gary Tempest's technique of printing on DECadry, then sticking the DECadry to the plastic, to produce the scale. Getting the size exactly right took a bit of trial and error!

Then came a real challenge! I bought an old Spanish radio with a glass dial in 3 pieces. The dial had been taped together with clear sticky tape. This had yellowed with age (not to mention cigarette smoke). The dial was scratched and faded.

I carefully removed the sticky tape and cleaned the dial. I thought about buying Adobe or Coreldraw, but these don't come cheap! Also, reproducing the style would not be easy. My wife asked me to try to scan and enhance some 100 year old family photos. I have a copy of Adobe Photo DeLuxe 4 on my old laptop and used this to patch and enhance the pictures. "If it's good enough for a photo, it's good enough for a radio dial" I thought!

I then set about scanning the dial. Getting the glass pieces aligned took a good few scans, but finally I got a picture of the dial.

I then set about "painting" over the cracks and scratches. After some trial and error, I found the best way was to take a "swatch" of colour from a good area and then carefully paint over the cracks and scratches. A good quality mouse is essential ..and a wet Sunday! The red and green coloured frequency numbers took hours of careful painting as did the short and medium wave words (Corte and Normal). The black lines were re-drawn using the lining tool. Fortunately, some of the damaged station names were repeated (such as Londres, Paris). These were highlighted and copied from one part of the dial to another. The remaining broken names had to be done with a fine brush at max zoom.

The background colour was faded, this I "fixed" by adjusting the overall colour of the picture + adjusting brightness, contrast etc until it looked correct. I should have done this first; it changed the other colours a bit. I did try using the colour wand to change the background colour, but the background colour "washes" into the lettering.

I then exported the picture as jpeg and printed using the Windows Office Picture Manager. This required a lot of trial and error to get the size and the background shade right. I printed the scale on DECadry, but found the result was a bit too opaque. I eventually used good quality paper held in place by tape at the edges. The paper diffuses the dial light really well.

It is best to save the work as a,b,c etc at every major stage. A few times, I decided to go back a stage and try a different method or effect several times. As can be seen, this method made a fairly good job of the dial.

I still have two problems: who made the radio, and how do I get it to work!

Thanks to Gary Tempest for his article, I would never have attempted this if I hadn't read it.

Letters

Dear Editor

Many thanks to Stef Niewiadomski for his comprehensive and absorbing article on output transformers in the Spring issue of The Bulletin.

A few points, however: it's only OK to ignore a transformer primary's intrinsic shunt capacitance, (Cp), and hence, its self-resonant frequency, if we assume the receiver, or amplifier, does not incorporate a negative feedback loop encompassing that transformer. If, however, it does, you sometimes can't ignore these parameters, (though you may get away with it). As we go up in frequency, well above A.F's, the primary approaches self-resonance, and the phase shift through the transformer radically alters. This means that supposedly negative feedback may become positive, and the circuit oscillates, maybe at a supersonic frequency (Ref. 1). I would watch for this if substituting a transformer in "modern" valve receivers or small audio amplifiers incorporating an ECL86 (Ref. 2) or half-ECC83/EL84 cascade (e.g. many stereograms, some late Hacker or Philips products, some record players/ tape recorders). Why these in particular? Because these later tubes had a helluva lot of voltage gain in cascade, (especially the '86; this bids fair to be an operational amplifier in a glass bottle!) This high gain increases the chances of oscillation should mediocre external componentry, (or even unwise layout decisions) allow the feedback to go positive.

You may hence have to try a better quality transformer with a higher primary resonant frequency (or lighten the feedback), if your ears or oscilloscope tests reveal the AF amp. is oscillating when the feedback is applied (Ref. 3). A theoretically correct turns ratio may even have to take second place to just keeping things stable. Additionally, these receivers (often incorporating FM) were at last expected to have reasonable treble response, precluding the wholesale application of "tone-corrector" capacitors as a handy palliative to oscillation.

Sorry to go on, and I appreciate that Stef is mainly focussing on transformer replacement in earlier AM table radios and battery sets, often featuring low-gain DDT/ Output pentode combinations, and where there's often no (or very light) feedback anyway. But, I notice that Fig. 1 in his article lists the ECL86, and the EL84, which, as noted, is commonly partnered by the high-gain ECC83 triode. If not, it's fed from the only slightly less slopey EABC80, which has a u of 70. These cascades were commonly used with full two-stage feedback. Thus, my comments are certainly relevant when repairing say piano–key sets from the late valve period, and indeed the medium-power/ quality amplifiers which Stef mentions.

Moving to the EBL31 and its ilk, thanks to R.J. Grant and David Taylor for their recollections and excellent substitution idea for this long-scarce item. I just wanted to add, for general interest, that it can be quite a well-behaved valve, but it can also do some weird, unexpected things that have not so far been mentioned. These arise from having a big power pentode cohabiting with delicate little diodes. There's a real danger of internal leakage, or even a direct s/c, from the hot, hunky pentode's anode or screen, to the high-impedance diodes innocently sheltering beneath. Two examples: (i) Ekco U29 (nice little white-fronted bakelite transportable). Symptom: gradual loss of sensitivity over the first 20 minutes. This was due to slow leakage in the CBL31, between either anode or g2 of the pentode to the detector diode's anode, progressively shunting and damping its output. (ii) Pye Model 19A. (Multiband toneswitch table woody). Symptom: AF stages clearly alive, but no reception. This time, an EBL31 had developed a direct g2 to detector diode s/c, (yes!) destroying the latter, and hence muting the set.

In all these DDP "short" sets, it's interesting to contemplate what happens to the AGC delay if the pentode runs into grid emission and starts drawing oodles of current, (as R.J. recounts). This will show as a soaring cathode voltage, and here means that, even on local stations on a big aerial, the AGC may not even get out of bed until the set is already well RF-overloaded. The effect may depend on the user's volume setting, but will add to (or be indistinguishable from) the AF distortion already caused by the malfunctioning pentode. This general risk of the pentode interfering, possibly terminally, with the detector or AGC functioning, might be why European valve manufacturers didn't produce a miniature (B7G, B8A or B9A) double-diode output pentode for use in cheap AM-only sets; they preferred to put the diodes in with the IF pentode. Hence, there's no such thing as an E or UBL84....other than David's ingenious creation, of course!

Best Wishes
John Ounsted.

References and selected quotes:

Ref. 1: Mullard; Circuits for Audio Amplifiers. 1962 Edition. p. 27. (This is indeed a "Hi-Fi" reference, but the general principles are the same in less fancy kit). "The inductance and self-capacitance of the primary winding form a parallel tuned circuit in the output stage, and the resonant frequency must be as high as possible. It's usually between 50 and 100kHz on a good transformer." " The (primary self-) capacitance must be low to prevent an increase in the phase shift when feedback is used. A high capacitance can give rise to L.F. instability.."

Ref. 2: ibid. A new Audio Triode-Pentode type ECL86 (supplement). p.10. (A simple two-stage single-valve circuit is described, essentially similar to those used in mass-produced domestic products). " The (specified) frequency response will be achieved if the output transformer is free from resonances up to 50 kHz. If not, it may be necessary to cut the treble response to ensure H.F.stability."

Ref. 3: Gordon J. King; Servicing; an introduction to fault-finding. Practical Wireless. October 1971.p.514. Mr. King, an authority on domestic electronics servicing, analyses a typical ½ ECC83/EL84 stereogram AF stage. He comments:" Designs like this are geared to an output transformer of specific characteristics, so (when replacing) it might be necessary to alter the feedback capacitors to produce correct feedback conditions". He also notes that, with incorrect conditions, supersonic oscillation may be momentarily triggered by the music being reproduced. This may only be reliably detected using an oscilloscope.

Dear Editor

I would like to pay a tribute to BVWS member Neville Pearson.

Unfortunately I never met him but in June learned that he was disposing of various items. We exchanged a few brief messages when he eventually mentioned that his failing health prevented his lifting heavy items. I was particularly seeking some control knobs which he despatched with incredible rapidity and for which he refused any payment. The day following their arrival I received the sad message from Ann Pearson telling me of his having passed away.

He demonstrated total selflessness for which he must be admired and is a sad loss to his family and the community of vintage radio and TV.

Malcolm Burrell

Dear Editor

You might find the attached pictures a timely reminder of why old caps should be replaced. This 8uF/350VDC working(!!-in your dreams) blew itself out of an Ekco chassis and narrowly missed me-familiarity breeds contempt!

Ray Bown

Dear Editor

I wonder if any member or reader of the Bulletin has a circuit and experience of the Russian 8 band receiver "Selena Vega 215" ?

I was given one some time ago and decided to repair it. I wish I had not bothered as it has turned out to be one of those sets with lots of problems that never seem to end.

Should I eventually succeed in making it work on all frequencies I will write an article for the Bulletin outlining the problems and solutions as I do not remember seeing anything on these radios in the last few years. I have at last made it work on the AM bands, but FM is proving to be an even greater challenge, that I have yet to master, without a circuit with component values given.

I do have a circuit of an earlier model but this one is completely different in all respects and I am sure with the correct information I can finally make it work.

Graham Dawson.
johngrahamdawson@yahoo.co.uk

Dear Editor
Following the appeal in the Autumn BVWS Bulletin for us to write to our local MP to halt the proposed switch-off of analogue broadcasts by 2018 I received a reply which I hope will be of interest.

Best regards,
Del Burgess

HENRY SMITH MP

HOUSE OF COMMONS
LONDON SW1A 0AA

Mr Derek Burgess
Crawley
West Sussex

3rd September 2010

Dear Mr Burgess

Thank you for contacting me about the proposed 'digital radio switchover'.

As my colleague, the Rt Hon Jeremy Hunt MP, Secretary of State for Culture, Olympics, Media and Sport has stated, the Government is "*wholeheartedly behind a digital switchover of the radio industry.*" However, we believe it is very important that such a switchover is not rushed and that consumers are not inconvenienced or disenfranchised by the switchover.

In 2009, 66 per cent of all radio listening was in analogue, 21 per cent was in digital and a further 13 per cent was unspecified. This suggests that we have some way to go before radio listeners are ready for the switch to digital radio. If a successful switchover is to happen, then communication to consumers about the benefits of digital radio needs to be greatly enhanced – something that the new Government will be doing.

The Government believes that local radio stations should be consulted before any switchover date is taken into account. You will be pleased to know that, even following the digital switchover, local radio stations will be able to continue broadcasting on an analogue frequency. We will also bear the needs of analogue listeners very strongly in mind, as well as improving communication to radio listeners about the digital switchover.

I can assure you that I will make my colleagues in the Culture, Olympics, Media and Sport team aware of your comments.

Once again, thank you for taking the time to contact me

Yours sincerely

Henry Smith
Member of Parliament for Crawley

Crawley Constituency: 01293 934554 Westminster Office: 020 7219 7043
www.henrysmith.info henry.smith.mp@parliament.uk

Dear Editor
Two months ago the Prime Minister forwarded to the Department for Culture, Media and Sport a constituency letter from me dated 2nd June. Since then I have become increasingly concerned that a large scale waste of money, both public and private, affecting almost every adult in the UK, is going ahead by switching off FM and adopting an obsolete digital system of DAB radio.

In response to my earlier letter the Department for Culture, Media and Sport sent me a 'Digital Radio Action Plan – Fact Sheet' (enclosed) which is intended to answer any questions I might have. I have to say that most of it is flummery and increasingly I suspect politicians and civil servants have insufficient technical knowledge or understanding of the issues involved and advice to them may not be independent and unbiased. I attach a two page critique of the 'Fact Sheets' more obvious shortcomings. (The detailed information on the departmental website does not inspire me with confidence either.)

Having spent nearly 50 years in the radio industry and retired as a consultant to Philips Electronics Ltd and GEC Ltd (later Marconi plc) I am frustrated and concerned at the prospect of wasting so much money on an obsolete system instead of adopting a superior one such as DAB+ already launched in several continental nations. My contacts in the radio field, including those at the cutting edge of modern technology, can no more understand the push to adopt DAB and switch off FM than I.

By BVWS members writing to their local MP I hope they can influence proceedings and prevent the Government from digging itself into an expensive hole and wasting large scale public and private money on a change that does not appear to have been well thought through.

Yours Faithfully,
Gordon Bussey

Critique of 'The Digital Radio Action Plan – Fact Sheet
(italicized text is Gordon Bussey's replies)

1 When will a switchover to digital radio take place?
We support 2015 as a target date for digital radio switchover. Indeed the Action Plan we have published today is intended to support such a switchover timetable. However, it is a target date which Government, broadcasters, manufacturers and retailers should work towards, and not the date for digital radio switchover.

Quite simply the listener is at the heart of this process and a date cannot be set until the vast majority of listeners have adopted digital radio.

Is a criterion for switchover 50% of listening is to digital radio (the first bullet point) or when 'the vast majority of listeners have adopted digital radio' (the first FAQ)?

2 What will happen to FM?
FM will not be 'switched off', but will continue as a platform for local and community radio, and will continue for as long as it is needed and viable.

What will happen to Long Wave (LW)? FM is not synonymous with analogue but nowhere in any literature can I find any mention of LW. Long Wave is the nationally available waveband with a greater coverage than FM as it can go around and sometimes through obstacles such as mountains and buildings that can completely block FM and even more, DAB signals. Long Wave is critical in some areas of the country and could be vital if important information needs to be transmitted, for example, during disasters or national emergencies. An analogue system will remain intelligible at times when a digital platform has failed completely.

If LW is switched off what will happen to:
(a) those places in the UK that cannot receive a reliable FM signal and will not receive DAB?
(b) the shipping forecast – relied upon by countless small boats in British waters and beyond?
(c) the World Service on LW after closure of Radio 4 at night?
(d) Test Match Special (TMS) and othe sporting events capable of being enjoyed on pocket analogue sets by people out and about, including at sea and on the continent?

3 Why switch to digital radio?

We believe digital radio has the potential to offer far greater choice and content to listeners. Consumers are already opting to 'go digital', with around 11 million DAB sets already sold. Listening to digital radio is continuing to grow, and now accounts for around a quarter of all radio listening.

How is DAB usage measured? If it is based on the number of sets sold does it take into account the number of sets returned to suppliers or lying unused in cupboards (like mine) because the quality of reception is too unreliable?

4 Don't digital radios use more energy than analogue radios?
New independent research shows that the difference in energy consumption between digital and analogue radio sets is minimal, with the efficiency of digital radios continuing to improve.

I question the assertion that the difference in energy consumption between digital and analogue radios is minimal. The independent Intertek Report (March 2010) on the Research Study of Energy Consumption of Digital Radios Upgrade, Phase 1 Issue 2, page 5 of 25 indicates that

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Recreating a Dinosaur continued from page 13

Mr. Winston Muscio an Australian STC Engineer confirmed that STC used the Western Electric owned Levy Patents for making Super-heterodynes.

Note 2: "Radio News Super-Heterodyne Book" Is available on www.tuberadio.it/docs.htm .Requires WinDjView.(Free Download on Internet).

Useful References:

"Rider's Perpetual Troubleshooter's Manual" Volume 1.
"Radio! Radio!" by Jonathan Hill.
"Radiola, the Golden Age of RCA -1919-1929" by Eric P. Wenaas.
"Super-Heterodyne Receivers" Charles R. Leutz.
"RCA Radio Tube Manual R10" 1932
"Principles of Radio" Henny 1929
"Radio Physics" Ghirhardy 1930

United States 2nd Circuit Court of Appeals Reports - WESTINGHOUSE ELEC. & MFG. CO. v. PRECISE MFG., 11 F.2d 209 (2nd Cir. 1926)

United States 2nd Circuit Court of Appeals Reports

WESTINGHOUSE ELEC. & MFG. CO. v. PRECISE MFG., 11 F.2d 209 (2nd Cir. 1926)

WESTINGHOUSE ELECTRIC & MFG. CO. et al. v. PRECISE MFG. CORPORATION. SAME v. CHAS. A. BRANSTON, Inc. Nos. 234, 235. Circuit Court of Appeals, Second Circuit. March 8, 1926.

Appeals from the District Court of the United States for theWestern District of New York.

Patent infringement suits by the Westinghouse Electric &Manufacturing Company and another against the PreciseManufacturing Corporation and against Charles A. Branston, Inc. Judgements for plaintiffs (10 F.[2d] 517), and defendants appeal.Affirmed.

Darby & Darby, of New York City (Samuel E. Darby, Jr., of NewYork City, and John S. Powers, of Buffalo, N.Y., of counsel), forappellant Precise Mfg. Corporation.

Popp & Powers, of Buffalo, N.Y. (Samuel E. Darby, Jr., of NewYork City, and John S. Powers, of Buffalo, N.Y., of counsel), forappellant Chas. A. Branston, Inc.

Charles Neave and Stephen H. Philbin, both of New York City,for appellees.

Before ROGERS, HOUGH, and MANTON, Circuit Judges.

MANTON, Circuit Judge.

These cases will be disposed of in one opinion. Injunctionspendente lite were granted, after argument, supported by affidavits. The patents in suit are the Fessenden heterodyne, No. 1,050,441, No. 1,050,728, and Armstrong regenerative patent, No. 1,113,149. The Westinghouse Electric & Manufacturing Company is the owner of the patents, and the Radio Corporation of America is the licensee. All the patents have been held valid by this court, and no effort is put forth at this time to have them declared invalid for any reason. See International Signal Co. v. Vreeland Apparatus Co. (C.C.A.) 278 F. 468; Armstrong and Westinghouse Co. v. De Forest Radio Tel. & Tel. Co. (D.C.) 279 F. 445, affirmed (C.C.A.) 280 F. 584.

The appellant Precise Manufacturing Corporation manufactures and sells transformers and condensers. These instrumentalities may and are used in combination with other parts to make possible the patented circuits of Fessenden and Armstrong. As so used, they infringe all patents. The Precise supermultiformer is a unit comprising four transformers for use in a superheterodyne. They are tuned and matched together, then assembled in a metal box and sealed in wax. As such unit, they are designed and constructed for use in the intermediate frequency amplifying system of the superheterodyne. Matched transformers for operation at a fixed and predetermined frequency are to be found only in superheterodyne receivers. While transformers and condensers were known and used prior to the inventions, the patents here in suit and intermediate frequency amplifying systems were not known prior to these inventions, and therefore transformers constructed and designed for such use were unknown. Intermediate frequency transformers have no commercial utility, except in superheterodyne receivers. There is no show of construction of or use for them in other receiving sets. The efficiency of the system is due to the fact that the intermediate transformers are selected to operate at a predetermined frequency. This predetermined frequency is obtained by controlling the frequency of the oscillation.

Radio waves arriving from a broadcast station are intercepted by the antenna and radio frequency currents of the same frequency of alternation as that of the intercepted waves, and are set up in the antenna and transferred to the circuits of the first detector. The oscillator comprises a vacuum tube system which, by means of the regenerative invention of the Armstrong patent, may be so adjusted as to produce high-frequency alternating currents of any desired frequency. The frequency of the oscillations is so arranged that the difference between it and the frequency of the received oscillations will be a fixed or selected frequency, and it is this that gives rise to the term intermediate or beat frequency. The oscillator is so adjusted as to accommodate the intermediate frequency. The intermediate frequency amplifier system comprises three radio frequency amplifier tubes with other associate circuits. The system is designed so that it will amplify with the greatest efficiency alternating currents of a predetermined frequency. The second detector rectifies or detects the intermediate frequency currents, and separates from them the signal currents, which are termed audio currents. The audio frequency currents are then amplified in an audio frequency amplifier system, comprising one or more tubes. Such amplified audio currents then actuate a loud speaker or telephone receivers. The superheterodyne employs heterodyne amplification; that is, the weak currents produced by arriving waves are bound with stronger currents produced by the local oscillation. The resulting beat currents cause a stronger signal response than could be caused by the incoming wave currents alone.

The superheterodyne set has extremely high selectivity. In addition to the normal radio frequency tuning of the antenna circuit, by means of the variable condenser, the use of the heterodyne principle gives two supplementary means for excluding interfering signals. An undesired carrier wave of frequency differing greatly from the frequency of the oscillator will produce no effective beats. Beats can only be produced effectively by the interaction of vibrations having slightly differing frequencies. An undesired carrier wave of frequency differing slightly from the frequency of the desired wave will not produce signals, although beats may be formed. Beats produced between the currents from the undesired waves and those from the oscillator will not have the predetermined frequency. The intermediate amplifier system will pass only beat currents of a predetermined frequency value, and will exclude beat currents of different frequency values. Signals can only be produced by those beat currents where the intermediate amplifier system will pass to the second detector. The oscillator tube system, the intermediate frequency amplifying system, are characteristic of the superheterodyne receivers. In other receivers there is no oscillator tube system to generate radio frequency currents, or oscillations to beat with the currents set up by the received broadcast wave. There is no intermediate frequency, which is that found between the frequency of the broadcast waves and the frequency of the audio currents in other receivers.

On the carton in which the Precise supermultiformer is placed when sold, there are instructions which constitute directions or advice that it may be used in superheterodyne receivers, and in the advertising matter it is stated to be designed for perfect long-wave and superheterodyne reception, and that "Fig. 2 shows the underside of the layout and gives a clear idea of the `supermultiformer,' which really is the heart of the outfit, and is chiefly responsible for the sensitivity and stability of this set," and "the `supermultiformer' is a multiple transformer for superheterodynes developed by the Precise Manufacturing Corporation of Rochester, and takes the place of the four separate intermediate frequency transformers that otherwise would be used." There is little doubt of the intention of the seller to manufacture and sell to the public, with the intent that it be used in connection with and as an intermediate frequency transformer in superheterodyne receivers.

The Precise Filtoformer comprises a condenser and a coil, employed in the circuits of the oscillator tube system. The condenser completes a circuit from the plate oscillator coil to the tube, and the coil permits direct current from the B battery to reach the plate of the oscillator tube, while preventing the high-frequency currents generated by the tube from passing through the B battery. The only radio receiver on the market employing an oscillator tube to generate local high-frequency currents which beat or heterodyne with the receiver oscillation to cause an intermediate or beat frequency, is the superheterodyne. This oscillator system is characteristic of the superheterodyne. The appellant Precise Manufacturing Corporation, in its booklet, states in detail how to construct superheterodyne receivers, using both the supermultiformer and the filtoformer. What is there described, and what could be constructed under the directions given, would be a superheterodyne receiver. They show how the device called the Precise Supermultiformer and the Precise Filtoformer are to be used.

It is argued that the Precise audio frequency transformers cannot be complained of. It is established that the audio frequency currents range from 50 cycles per second frequency to about 16,000 cycles, and radio frequencies employed in broadcasting reception range from 560,000 to 1,500,000 cycles per second. Transformers designed and intended for use with audio frequency currents are used in types of radio receivers other than superheterodyne. An intermediate frequency amplifying system does not amplify radio frequency currents of the frequency corresponding to the waves used in the audio broadcasting. It is limited to use within a range of frequency very much lower than those of the broadcast waves to which intermediate frequencies, the radio currents derived from the broadcasting waves, are converted in the superheterodyne receiver. The appellees do not claim that the sales of the audio frequency transformers constitute infringement of the patents in suit. The order appealed from restrains the "making, using, or selling, or offering for sale, any superheterodyne radio receiving set or any superheterodyne kit, or superheterodyne parts, particularly oscillating coils with intermediate radio frequency transformers, infringing or contributing to the infringement of the Fessenden heterodyne letters patent, or the Armstrong regenerative patent."

There is a difference between the Branston type and the Precise type of superheterodyne receivers, in the use of "reflexing" in the Branston. In the operation, the loop antenna intercepts the broadcast waves. Currents of this frequency are amplified in the system, and are then transferred to the tube system, where they are caused to heterodyne or beat with the currents there locally generated. The currents of beat or intermediate frequency are then transferred back or reflexed to the system of the tube where

they are amplified. Currents for the wave frequency and currents of the intermediate frequency are both amplified in this system. Thence the currents of the intermediate frequency are further amplified in the system and are detected. The audio frequency amplifier system comprises the tubes of the Branston type, Branston's superheterodyne receiver is described in its booklet as a superheterodyne construction, and it accompanies it with a diagram calling it the "Branston reflex superheterodyne" in advertising in the daily newspapers; and it has placed its kit, constituting the parts, on sale in retail stores. The apparatus contained in these kits is useful only for the oscillator system and for the intermediate frequency system of the superheterodyne receiver. Its transformers are all specially designed and built for the superheterodyne. It is a complete set of parts for building the superheterodyne receiver. It contains an oscillator coupler, three intermediate frequency radio transformers, a special transfer coupler, and a special antenna coupler. These, excepting the antenna coupler, are characteristic of the superheterodyne, and the latter is not complained of.

This appellant sells a regenerative loop, which is specially designed and constructed with three terminals, so that it can be used in regenerative assembly of the Armstrong regenerative circuit. It can be used with receivers other than superheterodyne, but when used, as shown by Branston in the superheterodyne diagrams, the loop is connected so that radio frequency energy is fed back or regenerated from the plate circuit to the grid circuit of the first tube. Loops of three terminals were unknown prior to the Armstrong combination. The purpose of the three terminals is to effect generation in the circuits in which the loop is connected. The regeneration invention of the Armstrong patent is accomplished by the plate circuit coil, by the loop being inductively coupled to the grid circuit coil of the loop. This loop is capable of and intended for use as a receiving system, utilizing the regenerative system of the Armstrong patent in suit, and it infringes.

The claim of infringement here in each suit is contributory in character. It is the selling of parts designed and intended for use in an intermediate frequency amplifier system and in the oscillator tube system of the superheterodyne receiver. These two systems are characteristic of the superheterodyne receiver. The affidavits show that these parts are the most difficult to manufacture, as well as the most important in superheterodyne receivers. The remaining parts used in each invention may be said to be standard, and can be used in various types of receivers on the market, which are not involved here. The Precise set of transformers are tuned and matched for predetermined intermediate frequency of the Precise superheterodyne circuit. The Branston intermediate frequency transformers are likewise tuned and matched for the different predetermined intermediate frequency of the Branston superheterodyne circuit. The only use known to the trade of these, or that suggested by each of the appellants in their advertising matter or instructions to the users, is in the superheterodyne receiver.

Many valuable patents are combinations of unpatentable elements. By furnishing parts it makes it possible for others to assemble and use the combination, and when a manufacturer, by so manufacturing and advertising, points out the way in which this can be done, and thus, intentionally so acting, promote infringements of patentee's rights, he becomes a contributory infringer. Thomson-Houston El. Co. v. Ohio Brass Co., 80 F. 712, 26 C.C.A. 107. A device capable of an infringing use, and sold with the intent that it shall be so used, is an infringement of the patent, even though the same device is capable of a noninfringing use, and even though there may be a form of instructions that it shall be used in a noninfringing way. Sandusky Foundry & Machine Co. v. De Lavaud (C.C.A.) 274 F. 607. But where, as here, it appears that each of the appellants manufactured with knowledge of the contemplated infringement, contributory infringement is clear. Leeds & Catlin Co. v. Victor Talking Machine Co., 29 S. Ct. 503, 213 U.S. 325, 53 L. Ed. 816; Individual Drinking Cup Co. v. Errett (C.C.A.) 297 F. 733.

Judgments affirmed.

'Morch' Ado About... Phone Numbers!

by Tony Clayden

In their article on the REXOPHONE radios manufactured by Morch Bros. of London E.5., (The Bulletin Vol. 35 No. 2 Summer 2010), messrs. Clark, Sanders and Simmonds make mention of ".....the telephone directory entry for J.S. Morch ..... ".

One or two sharp-eyed readers may have noticed that the 'phone number appearing in some of the reproduced advertisements is Shown as 'Dalston 1100, but in the later ads. ,(from November 1924 onwards), it is given as 'Clissold 1100'. Why? A simple enough question, but the answer is a bit more complicated!

After the 1914 – 18 war, plans were implemented by Post Office Telephones to convert the entire London network to automatic operation. This had already been started in a number of smaller cities and towns in the UK, but the sheer size and potential complexity of an automatic system for London posed many problems, which required some very radical engineering solutions.

The scheme eventually adopted became known as the 'Director System', named after a newly-designed and very ingenious piece of exchange routing apparatus, which "directed" calls to their required destination. This was essentially a 'bolt-on' addition to the established STROWGER electro-mechanical switching equipment, which had already been standardised by the Post Office.

Telephone dials with letters as well as numbers were to be utilised. To place a call, the user "dialled" the first three letters of the wanted exchange name, followed by the four digits of the subscriber's number. Most of the letters were grouped in "threes", each group corresponding to a single digit; a not-dissimilar arrangement may be found on all current mobile phones.

This resulted in a number of clashes – e.g. Bromley and Croydon, Hampstead and Hammersmith, Lewisham and Leytonstone, etc. – and therefore not all existing exchange names could remain in use. Thus it was that Dalston clashed with Ealing; as a decision had been made to retain the latter name, Dalston would have to be changed! After searching about for an appropriate name, 'Clissold' was adopted, after the Rev. Augustus Clissold, a prominent local landowner and church curate; he had already lent his name to a local park and a street in nearby Stoke Newington.

Although the actual upgrade of Clissold to automatic working was still some years away, all exchanges which required a name-change –(there were several) – received their new identities at the outset of the programme, in readiness for the conversions, which could then be "rolled- out" across the Capital in any order convenient to the Post Office.

To accommodate the ever-increasing demand for telephone lines and to facilitate the introduction of International Dialling, all-figure numbering (AFN) was introduced in 1966, and overnight all London exchange names disappeared. CLIssold became 01-254, in this instance retaining its numerical equivalent, although more generally that was not the case. With a change of London numbers to a 4+4 format in 2000, it once again changed to 020-7254, and it's still going strong, although no longer serving the locality (Tresham Avenue E.5.) in which the Morchs' business was situated.

This is because as telephone usage expanded, exchange "serving areas" correspondingly contracted, and by the late 1920s a new exchange (AMHerst, sometimes spelt AMHurst and named after another "notable"), was brought into use to serve the Hackney E.8., Clapton E.5. and Homerton, E.9 districts; this lives on as 020- 8985. Meanwhile, CLIssold was mainly left to serve the Dalston/Kingsland and Haggerston E.8 and Stoke Newington N16 areas, and is officially known by BT as 'Kingsland Green' exchange.

Due to severe financial strictures after WW11, the last telephone exchanges in the London Director area were not converted to automatic working until the l960s, the final two actually some time after the introduction of AFN

It should be mentioned that, at the time of its inception, the Director System was at the "cutting-edge" of telephone switching technology. It was a British invention, born of a collaboration between a couple of the large telephone equipment manufacturers, (who employed some brilliant design engineers), and the British Post Office; it was subsequently adopted in Birmingham, Manchester, Liverpool, Glasgow and Edinburgh. It won the day against stiff competition from its major rival, the American Western Electric "Panel/Rotary" system, which was employed in New York and other major U.S. cities also in Paris.

The system remained in operation, with continual improvements, until the 1980s. The advent of electronic telephone switching equipment, first analogue, then digital, had rendered all electro-mechanical apparatus totally obsolete; Strowger finally bowed-out after having served the telephone-using public with distinction for over seventy years.

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measuring average consumtion DAB tabletop radios used 79% more energy than FM sets, whilst DAB portables used 138% more than FM sets. Mini/micro/audio units showed 84% difference between FM and DAB. Whilst it is true that current DAB tabletops and portables are much more energy efficient than older models, many of 11 million DAB sets already sold will be these older models.

5 Won't a switchover to digital result in huge amounts of waste analogue radios?
Any disposal of analogue radios will need to comply with the WEEE (Waste Electrical and Electronic Equipment) Directive. In addition to committing to an environmental impact assessment, the Action Plan will look at how we can work with manufacturers and retailers to ensure that unwanted analogue equipment is disposed of responsibly.

Leaving aside the question of whether analogue radios will be redundant in view of the continuation of local radio on FM, is it right to expect the genearl public – especially those on low incomes – to scrap over 100 million working analogue radios and pay out £2 billion (conservative estimate) on new DAB models when a switchover is not only unnecessary but the digital system chosen is already obsolete?

6 What will you do to improve the coverage of digital radio?
We acknowledge that some parts of the country are not served well by DAB, and we are working with industry to accelerate the build–out of DAB coverage. However, we are clear that a switchover can only occur when DAB coverage matches FM.

Who will pay for the hundreds of DAB transmitters needed to match FM coverage? The BBC does not appear enthusiastic and the commercial sector will invest only as far as DAB broadcasting is commercially viable.

7 What will you do to make sure people can receive digital radio in their car?
Car manufacturers have committed to fit DAB as standard in all new cars by 2013. In addition, there are already devices on the market which can convert a car radio to digital. This is an area where we expect the market to grow considerably, and prices to fall.

If the numbers of in–car DABS and their reception quality are lagging far behind home DAB radio usage will this delay any switchover?

From the detailed action plan on the government website it is doubtful whether technical and practical problems involved in DAB for cars have fully been thought through, particularly with regard to converters.

8 Isn't the sound quality of digital radio of a lower standard than FM?
A recent survey suggested that 75% of listeners found the sound quality of digital to be as good as, or better than FM.

How big a sample was in the survey you quote and what geographical locations did it cover? What were the questions asked.

To write in the Government fact sheet 'a recent survey says', is meaningless. The Radio Listeners Guide 2010 states that the quality of sound is not as good as FM because too many DAB stations are broadcasting at low bit–rates. The poor sound quality is very apparent on a good quality radio. (My DAB set gave good quality sound when I lived in Purley within a few miles of the transmitter. At my present address it is poor. Friends elsewhere report similar experiences).

9 Is there potential for another technology change, for example to DAB+
We believe that DAB remains the right technology for radio. With 11 million DAB sets sold, the vast majority of which are not DAB+ compatible, the benefits of adopting DAB+ are considerably outweighed by the detrimental effect this move would have on listeners whose DAB sets would become obsolete. However, although we are not committing to a change to DAB+ in the future, we must protect consumers from any potential future change. For that reason, a multi–standard chip which can receive both DAB and DAB+ must be included in future digital radio receivers.

The decision has been made to pursue a switchover from FM to DAB, but not DAB+ because 'the benefits of adopting DAB+ are considerably outweighed by the detrimental effect... on listeners' of making the existing 11 million DAB sets obsolete. Why then has the decision been made to switch from FM? Does the detrimental effect on listeners of making 100 million analogue radios unnecessarily obsolete count as nothing compared with making 11 million DAB sets obsolete? The logic of your argument is glaringly unsound.

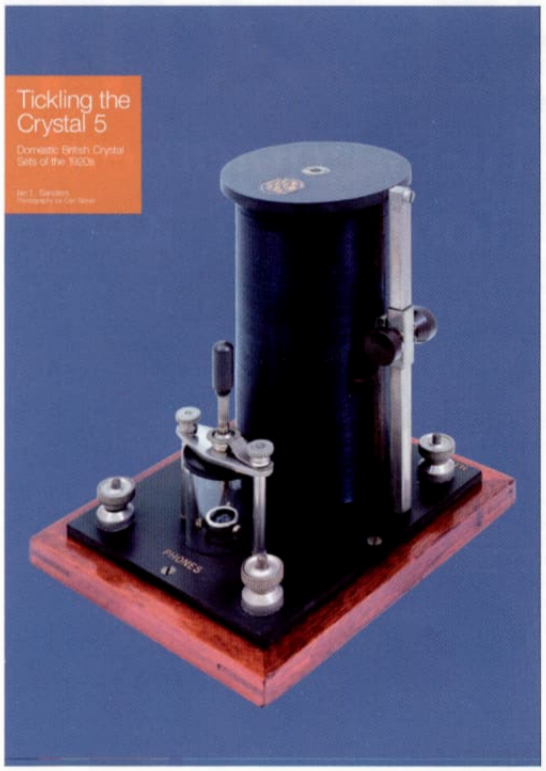
Gordon Bussey

General Radio Company Ltd. Sets Appeal
Dear BVWS members
Do you have any 1920s valve receivers, amplifiers or speakers manufactured by General Radio Company Ltd.? In the next column are some examples to help with identification, along with the GRC logo:

If you have any of these sets, amplifiers or speakers in your collection, or you know the whereabouts of any, then I would very much like to hear from you with a view to photographing them. Thank you for your help.

Yours sincerely,
Lorne Clark
(email: mailto:earlywireless@ntlworld.com
or phone 0118 9345606)

BVWS Books



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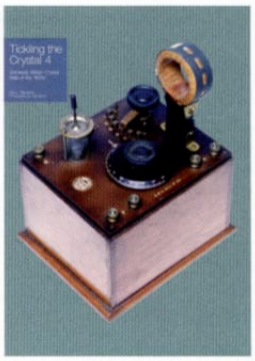

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Vol 11 Numbers 1, 2, 3, 4 Inc. BTH VR3 (1924) receiver, Marconi's 1897 tests, Origin of the term 'Radio', Baird or Jenkins first with TV?

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Supplements:

1 'The story of Burndept'.
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3 'Seeing by wireless' the story of Baird Television
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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

November 21st Lowton
November 26th Festive Music Night at The British Vintage Wireless and Television Museum
December 5th Wootton Bassett

2011 Meetings
February 13th Audiojumble
March 6th Harpenden
April 10th Golborne
May 15th NVCF
June 4th BVWS Garden Party
July 3rd Wootton Bassett
August 12th Museum Music Night
September 11th Table Top Sale at The British Vintage Wireless and Television Museum
September 18th Murphy Day
September 25th Harpenden
October 9th Audiojumble
November 20th Golborne
November 25th Festive Music Night at The British Vintage Wireless and Television Museum
December 4th Wootton Bassett

Workshops, Vintage Wireless and Television Museum:
For location and phone see advert in Bulletin. 11:00 start.
Harpenden: Harpenden Public Halls, Southdown Rd. Harpenden. Doors open at 10:00, tickets for sale from 09:30, Auction at 13:30. Contact Vic Williamson, 01582 593102
Audiojumble: The Angel Leisure Centre, Tonbridge, Kent. Enquiries, 01892 540022
NVCF: National Vintage Communications Fair
See advert in Bulletin. www.nvcf.co.uk
Wootton Bassett: The Memorial Hall, Station Rd. Wootton Bassett. Nr. Swindon (J16/M4). Doors open 10:30.
Contact Mike Barker, 01380 860787
Golburne: Golborne: Golborne Parkside Sports & Community Club. Rivington Avenue, Golborne, Warrington. WA3 3HG
contact Mark Ryding 01942 729005
For more details with maps to locations see the BVWS Website:
www.bvws.org.uk/events/locations.htm

Disappointing Audio Broadcast

This is a call for all members to put pen to paper and send the UK Government a *Strong Clear Signal!*

I am asking you to write a letter to your local MP and lobby them to halt the plans for the Analogue radio switch off which is targeted for 2015. This is a totally unnecessary move to force the change to digital radio without any real benefit to anyone other than the failing DAB radio industry and profitless commercial broadcasters. We cannot prevent the eventual switchover, but we can make it clear that this is neither the time to do it, nor the correct system to use. Below are the most salient points that you should make very clear in your letter.

Ofcom research shows that 4 out of 5 listeners are happy with current choice of analogue stations and audio quality.

Power consumption of DAB receivers is much higher. Typically an AM/FM radio will give 375 hours of listening on batteries costing £6 where a similar quality DAB radio only gives 32 hours at a cost of £9. This is an unacceptable increase in listening cost for everyone and especially those on low incomes and pensions and increases the cost of responsible battery disposal. It is also true to say that mains powered DAB receivers are more power hungry.

The DAB system used in the UK is now obsolescent with only two other European countries using it. Any digital broadcasting should be using DAB+ with the more efficient AAC codec instead of MP2 of the 1980's. FM on good equipment will always beat DAB for sound quality without annoying "drop-outs" and background "bubbling mud" noises. FM works well in large built-up areas and when in vehicles. DAB requires many extra smaller relay transmitters to give the same coverage as FM or AM.

Massive cost to consumers to replace the approx 150 Million perfectly good working receivers with inferior sound quality DAB receivers that suffer from a multitude of reception problems.

Recycling of analogue receivers will only cover modern portables, the rest will be confined to land-fill.

The Government are actively looking for ways to reduce spending so halt the building of new transmitters which will cost a huge amount of money to get full nationwide coverage, when the house of Lords report on digital broadcasting in the UK states that FM transmitters can be maintained fully for the next 20 years for £200 Million which is less than 20 pence per person each year saving listeners millions not having to buy new equipment.

Millions of listeners using built in vehicle receivers will be lost because of inadequate mobile DAB reception and no mass-produced cars yet include DAB receivers fitted as standard, and are not likely to for years to come.

You should write as a personal protest in respect to your own personal situation and how it will affect you and not as a vintage wireless collector, nor as a BVWS protest. The BVWS Committee will be sending a letter directly to the Prime Minister with these points and many more.


Regency