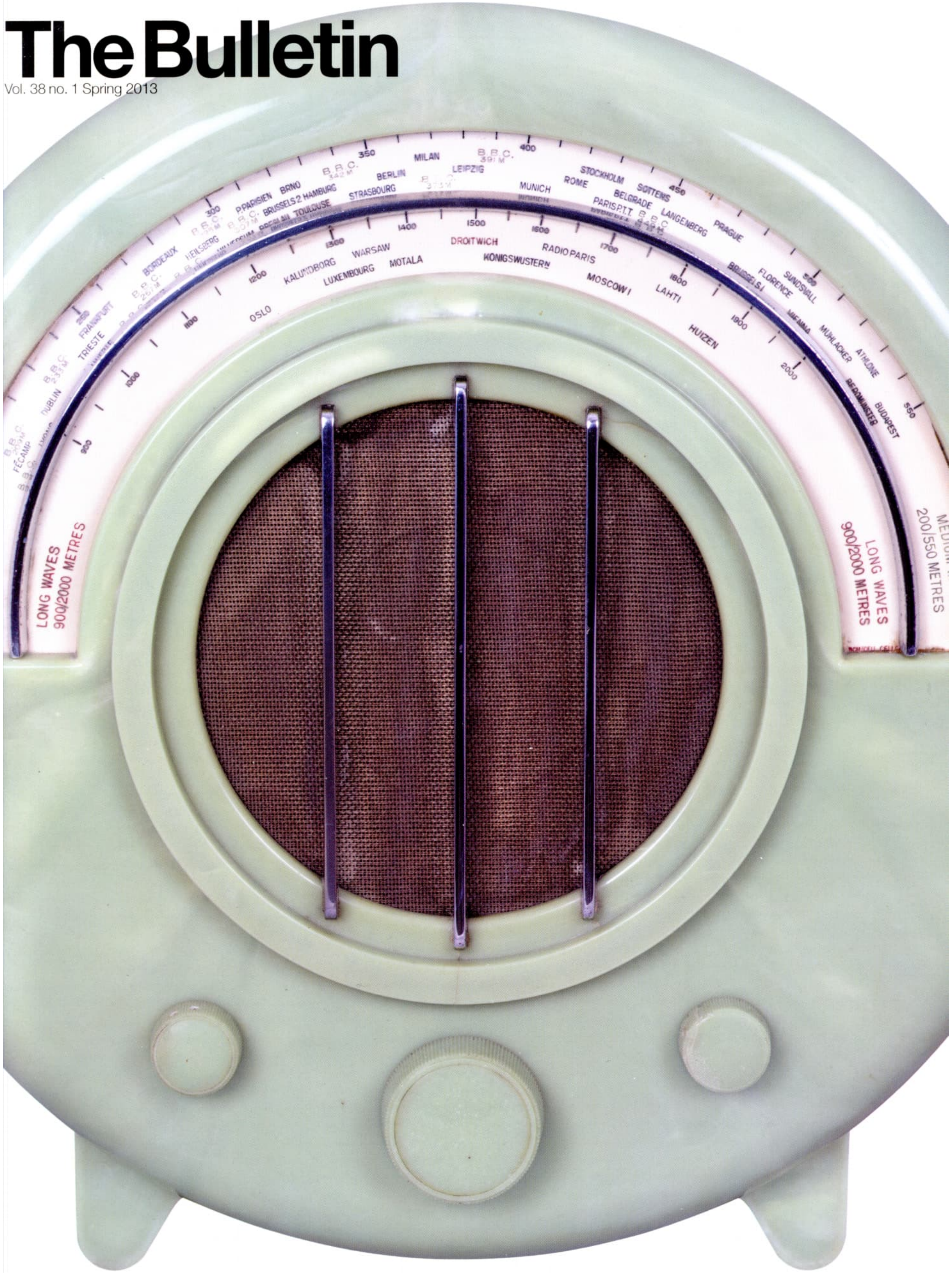
The Bulletin

Vol. 38 no. 1 Spring 2013



 £5.00 | free to members ISSN 0955-9345


Sunday 12th May 2013
National Vintage Communications Fair
Now in our 18th year!
10.30 to 4.00 £8 admission (under-14s Free),
early entry 9.00 at £25
Up to 250 Stallholders
Free car parking!
Event details plus downloadable stall booking form available at: www.nvcf.org.uk
Any enquiries: info@nvcf.org.uk or post:
NVCF, 13 Warneford Road Oxford OX4 1LT, UK (enclose an SAE)

BVWS team

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

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

Sub Editor:
Ian Higginbottom

Treasurer:
Jeremy Day
62 Sherbourne Drive,
Old Sarum, Salisbury
Wiltshire SP4 6GA
treasurer@bvws.org.uk

Ordinary Committee Members:
Jon Evans
Tel: 0121 5447006

Terry Martini
terrym@ferrographworld.com

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

Harpenden Organiser:
Vic Williamson,
Tel: 07805 213369

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

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

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

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

Bulletin of the British Vintage Wireless Society
Incorporating 405 Alive
Volume 38 No.1 Spring 2013

www.bvws.org.uk

Separations and Printing by Hastings Print

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

Front and rear cover: Green Ekco AD65.

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

Contents

From the Chair

Well here we are 2013! The door opens and the light streams in on another year with many events to attend and opportunities to find those rare items just waiting for a new home.

I hope you all had a relaxing Christmas break with lots of time to spend in the workshop.
I wish I could say that I had. Unfortunately whilst out for a walk on Boxing Day, I slipped over on wet grass and broke my right wrist. The consequences of this catastrophic act being a day in hospital for surgery and I now have three metal plates and three Frankenstein like scars. I am now slowly getting back to some sort of normality, but cannot lift anything much and cannot do a lot of things in the workshop which is most frustrating. However I will not let this affect the BVWS auction activities and events. I have drafted in extra help and it will be 'Business as usual'. In fact we have already been out twice this year to gather van loads of radios for forthcoming auctions.

I would like to thank everyone reading this for getting your 2013 membership back to Martyn Bennett in good time. My thanks also go to Martyn (and his wife Ann) for getting everything entered and sorted in such a speedy and organised manner, especially as it is their first time dealing with renewals etc.

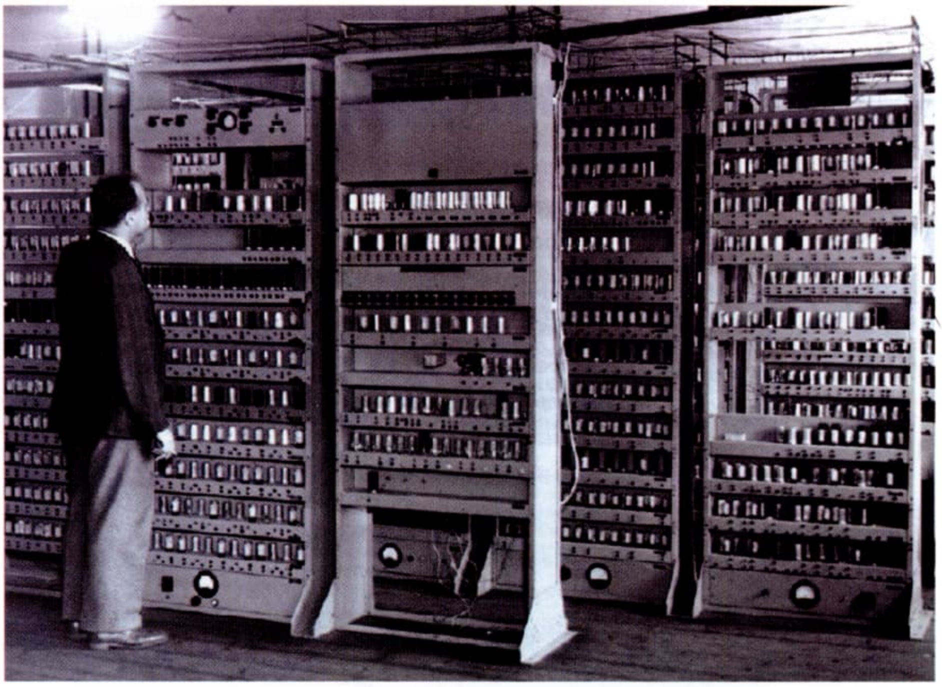
The time has come around once more to issue the 'Members Handbook' but to spread the work load this will now go out with the Summer Bulletin.

With a good wind behind us, we hope to make more of the BVWS website in the coming year in the area of our Archive material and making it available. Also online purchasing will appear for books and Capacitor sales etc.

Take a look at the new BVWS 'Parts Dept.' advert at the back of the Bulletin. It now gives more information on the items and more importantly allows for a 'pick & Mix' approach to buying the capacitors where people do not require quantities of fifty of one type.

I hope to see everyone at Harpenden on the 24th of February. Don't be shy, Do come and help unload the van as I will not be able to do much lifting and moving on the morning.

Mike...



EDSAC (Electronic Delay Storage Automatic Calculator) Appeal for Valves etc.
The National Museum of Computing based at Bletchley Park are seeking the help of BVWS members to source needed valves and components to enable them to rebuild the EDSAC Computer originally designed and used at Cambridge University in 1949 as a fully authentic working replica.

Evershed and Vignoles by Christopher Deavin

I have been collecting early laboratory and test instruments for many years and have recently added an early Bridge Megger to my extended collection of Evershed and Vignoles instruments. This prompted me to produce this article as I believe it is helpful to understand the history of the Company so that one can appreciate how such technical innovations evolve. It describes the activities of Evershed and Vignoles from their inception until they became part of the George Kent Group in 1965.

Much of the following information has been reproduced from documents in the archives of the Megger Company, copies of which were kindly lent to me in 2003 by their Publicity Assistant Marion Heard to whom I am greatly indebted.

I was alerted to the rate at which equipment becomes of historical interest when I realised that the AVO 8 - a 'state-of-the-art' instrument given to me for my 18th birthday - had become an item in my own collection!

For further images and information on Megger and other instruments I recommend readers visit Richard Allan's website www.richardsradio.co.uk.

Origins of the Company

Electrical engineering dates from Faraday's discovery of electro-magnetic induction in 1831, but the supply and distribution of electricity did not commence until nearly fifty years later when Brush produced the first practical arc lamp, followed shortly after by the incandescent lamp perfected by Swan and Edison.

With the development of electrical engineering the need soon arose for measuring instruments giving direct readings in volts and amps. Beginning in 1881, Professors Ayrton and Perry devised numerous instruments of the kind to which they gave the names Voltmeter and Ammeter, words which have become part of the English language. In 1884, a hot-wire voltmeter was invented by Captain Phillip Cardew, R.E., and was for some time used more extensively than any other form of voltmeter.
The Cardew voltmeter was manufactured by Messrs. Goolden and Trotter in a small workshop in Westminster, Mr. Sidney Evershed entered the service of that firm and was appointed manager in 1886.

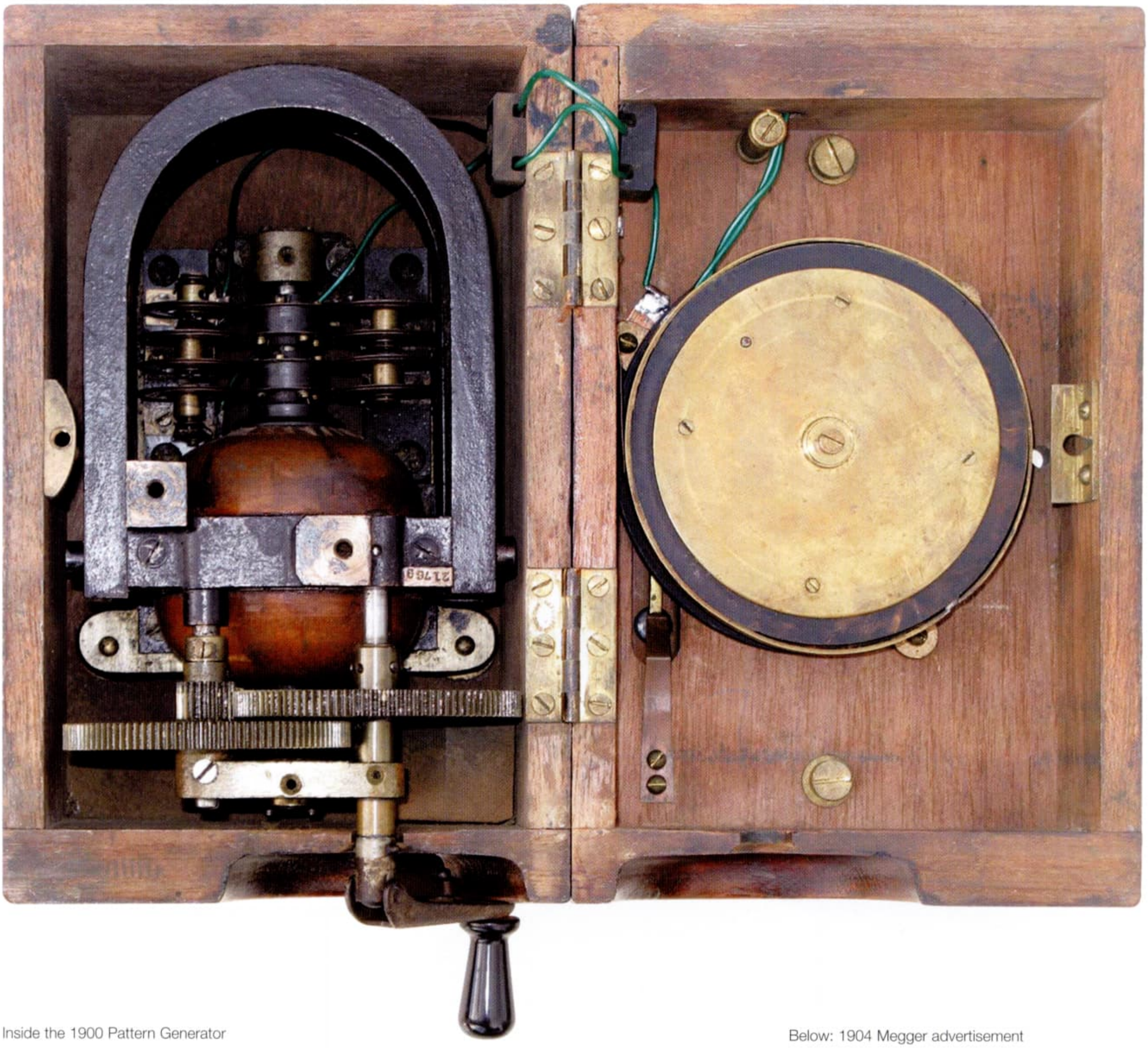
In the previous year Mr. Evershed had designed a convenient form of measuring instrument of the moving-iron type, constructing the first model himself, and winding it as a voltmeter. In 1887 the manufacture of this instrument was undertaken by Goolden and Trotter and the first instruments bearing the name Evershed were supplied to the Ordnance Survey at Southampton. This small factory, which at the time of Mr. Evershed's advent employed six workmen and a technical staff of two persons, was the cradle of the firm of Evershed and Vignoles.

1900 Pattern Generator

In about 1888 Mr. A.P.Trotter, who later was electrical adviser to the Board of Trade, retired from the partnership and a Mr. Ll.B. Atkinson, who later became the director of the Cable Maker's Association, took his place and the firm became known as W.T. Goolden & Co.

W.T.Goolden and Co. were succeeded by Easton, Anderson & Goolden, and in 1894 the instrument department was purchased by Mr. Evershed and Mr. Vignoles, together with some of their friends, and Evershed and Vignoles came into existence. Among those associated with this new development were Professor W. E. Ayrton. F.R.S., the first Chairman of Directors, and Mr. H. M.Gregory who was still the Director in 1932.

The business was first carried on at Woodfield Works, Harrow Road, but in 1903 land was purchased and a factory erected in Acton Lane, Chiswick; the works were extended from time to time and in 1932 had a floor area of 111,000 square feet. For many years the business was conducted by Mr. Sydney Evershed, Mr. E.B.Vignoles and Mr. A.Vines as joint Managing Director, but by 1932 the two former had retired from active management and Lt. Col. W.A.Vignoles DSO had joined the Company as Joint Managing Director with Mr. Vines.



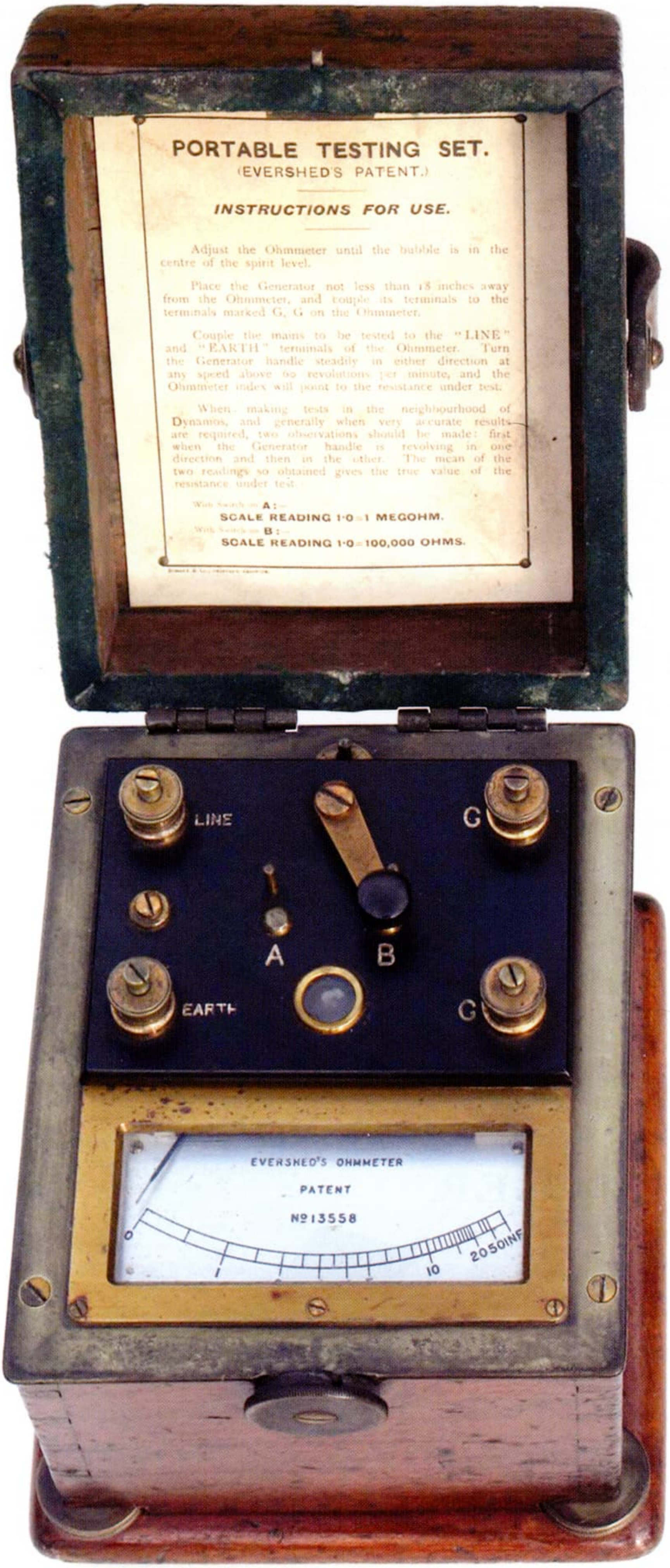
Inside the 1900 Pattern Generator

Below: 1904 Megger advertisement

Original Board of Directors and Staff

Mr. Evershed began the study of electricity and magnetism before the advent of the technical college. Arriving at the student age he set out to train himself, reading physics and elementary mathematics, and repeating all the necessary experiments with the aid of home-made apparatus. It was an informal but thorough training, and when the introduction of electric lighting gave a great impetus to electrical engineering, he was well able to take part in the work waiting to be done.

In 1886 he was elected an Associate of the Society of Telegraph Engineers, subsequently called the Institute of Electrical Engineers (IEE), and was elected a full Member in 1903. He was an active member of the Institute and occasionally presented papers on his own research. One of his more important papers, on insulation resistance, was the outcome of investigations carried out at the Acton Lane Works; this was presented in 1913. He also presented two papers on permanent



Inside the 1900 Pattern Ohmmeter

magnets, the first being the scientific basis of their design and performance; the second dealt with the properties of magnet steels and the methods to be employed in steelworks to avoid their defects.

Mr. E. B. Vignoles was educated at Malvern College and the Central Technical College, Exhibition Road, and in 1889 became a pupil in the firm of W.T.Goolden & Co. He was one of the founder members of Evershed and Vignoles and one of the first Joint Managing Directors. In 1931 he resigned his posts to undertake a world tour but retained his interest in the Company as a Director with a seat on the Board.

Mr. A. Vines was educated at Emmanuel College, Cambridge, and joined the firm of W. T. Goolden & Co. as an assistant in the instrument department in January 1891. He was appointed Works Manager when Evershed & Vignoles was formed and was made Joint Managing Director in 1909. He was a member of the IEE and at one time President of the Engineering and Allied Employers' London and District Association, and a vice president of the British Engineers' Association.

Mr. H. M. Gregory was educated at University College School, London, and articled to Messers. Humphries and Tennant, Marine Engineers of Deptford. In 1884 he became Manager of the Ruabon Collieries and Ironworks of the New British Iron Co. Ltd., and six years later joined the firm of Brown Lennox & Co., chain and anchor makers of London and Pontypridd. He joined the Board of Evershed & Vignoles in 1894 and was a member of the Institute of Mechanical Engineers.

Lieut-Colonel W. A. Vignoles received his education abroad and at Finsbury Technical College, joining the firm of W. T. Goolden in 1891 as a pupil. Later, after serving five years with Crompton & Co. Ltd., he was engaged with Messers. Kennedy and Jenkin on schemes for public electric supply, and was appointed Borough Electrical Engineer at Grimsby in 1901.

During the 1914-1918 War he served in France with the Lincolnshire Regiment and later commanded the 9th Batallion of the Northumberland Fusiliers, being awarded a D.S.O and Bar. He joined Evershed & Vignoles in 1931 as Secretary and Joint Managing Director.

Other members of the Staff who rendered valuable service to the Company were:
Mr. T. M. Tuley, the Accountant.
Mr. J. C. Needham, Manager of the Naval Department.
Mr. F. C. Knowles, MIEE Sales Manager (Chairman of the Meter and Instrument section of the IEE).
Mr. G. B. Rolfe, BSC, AMIEE, Development Manager.
Mr. F. R. Martin, Works Manager.
Mr. C. Midworth, AMIEE, Instrument Department.
Mr. C. E. Perry, Megger Testing Set Department.
Mr. S. Finnis, AMIEE, ACGI, Research Department.
Mr. A. G. Moore, AMIEE, Naval Test Room.

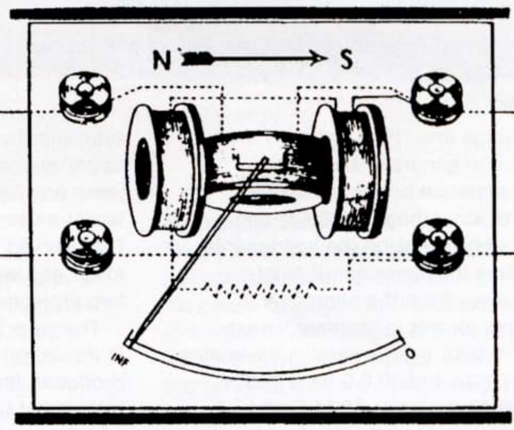
1919 Bridge Megger

Development of the Megger
(A précis from 'Instrument Practice' April 1948)

The development of electric lighting in its early stages emphasised the importance of effective insulation, and Evershed's testers date back to 1888 when Goolden & Trotter established their department specialising in domestic installations. The firm required an instrument with which to test the safety of their installations, and Mr.Evershed was commissioned to build it.

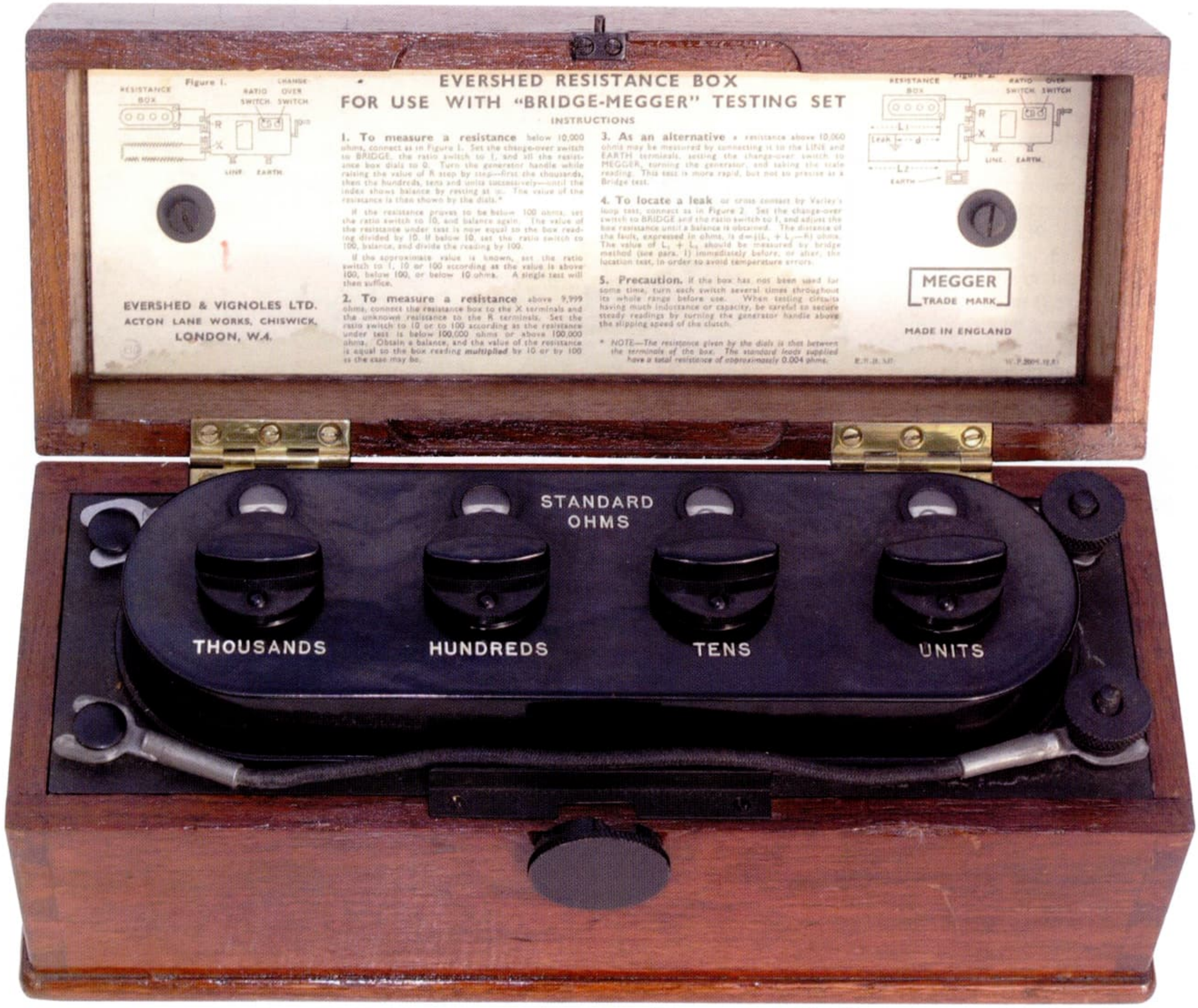
Hitherto measurements of insulation resistance, when undertaken at all, had been a laboratory operation. Tests were made either with a Wheatstone bridge or by coupling the system under examination in series with two cells and a high resistance galvanometer, the deflection of which was compared to that produced when a known resistance was inserted. However, such low voltage tests failed to reveal defects liable to cause breakdown when higher voltages were applied, and Evershed knew that the only sure way was to test at not less than the working pressure. His aim was to produce a portable tester that could provide a high testing voltage, was direct reading and easy to operate - an instrument suitable for industrial rather than laboratory use.

In 1882 Professor W. E. Ayrton had constructed an ohmmeter comprising a small permanent magnet suspended at the centre of and controlled by two coils at right angles to each other. One coil was connected across the battery terminals, the other in series with the resistance under test across the same terminals. Ayrton had achieved one of Evershed's requirements in that the resistance measurement was independent of the voltage, although the range of his instrument was limited to comparatively low resistances. Evershed modified this early instrument, introducing a separate high-voltage portable generator unit of the magneto type used at the time for ringing telephone bells, and adding in the ohmmeter unit a permanent magnet pivoted directly under the axis of the moving magnet, thus compensating for errors due to the earth's field and stray fields produced by the generator. So advantageous did this instrument prove that Evershed patented its design and Goolden & Trotter commenced production, the first models being marketed in 1889.



Evershed's original Ohmmeter.

In 1890 the forerunner of the later generator was introduced that had a smoother voltage curve than the magneto previously used. The armature had a cast iron core, the winding comprising four coils placed at right angles around the core, each connected to its own two-part commutator. The brushes were so connected as to add the electromotive forces of the four coils, thus producing twice the voltage obtained from an ordinary drum winding. Horseshoe permanent magnets embraced the pole pieces and gave the necessary excitation, the armature being driven through ordinary speed gearing by a small detachable handle. Further improvements followed in 1899 to minimise electrical and friction losses: transformer iron stampings were adopted for the armature core, involute teeth and roller bearings for the gears, and rotating discs were used to collect the current from the commutator.



Resistance box for 1919 Bridge Megger

At this stage (the '1900 Pattern') the ohmmeter and generator had to be housed in separate boxes to minimise the effect of stray magnetic fields and the instructions for using the instruments were to place the generator at least 18 inches away from the ohmmeter.

The prices for this instrument varied from £18.10.0 for a 100v version measuring up to 5 M Ohms to £30.0.0 for a 1000v version measuring up to 50 M Ohms.

It was soon realised that a steady voltage was necessary if accurate readings were to be taken when testing circuits having large electrostatic capacity. As it was difficult to turn the handle at an absolutely constant speed terminal voltages inevitably fluctuated and in 1903 Evershed devised the constant speed, centrifugally controlled clutch that became a feature of 'Megger' testers.

Alongside improvements in the generator came parallel changes in the ohmmeter itself. In 1890 the single magnetic needle was replaced by an astatic combination of two sets of exactly similar needles fixed to the same axle, but magnetised in opposite directions. Four years later a soft iron needle magnetised by an exciting coil was substituted: a soft iron tube with two projecting arms at the upper end was fitted with an inverted cup jewel and formed the moving system, whilst an exciting coil surrounding the tube served to magnetise it so that the lower end was the south pole and the two projecting arms were north poles.

The year 1904 marked a great advantage in insulation testing as Sydney Evershed produced the prototype of a new instrument having both ohmmeter and generator units housed in the same case for which his co-director Mr. Vignoles coined the term 'Megger'. The ohmmeter unit had been completely re-designed and a moving coil system adopted, arranged so that the two coils, for voltage and current respectively, were mounted together. The ohmmeter movement contains no control spring, this being replaced by a control or voltage coil connected across the generator in series with a fixed control circuit resistance. The pointer therefore only takes up a definite position when the generator handle is turned. The deflecting or current coil is also connected across the generator, and is in series with the resistance under test; the instrument measures the ratio of the currents in the two coils that depend only on the value of the resistance under test.

The prices for this instrument varied from £18.10.0 for a 100v version measuring up to 10 M Ohms to £37.0.0 for a 1000v version measuring up to 2000 M Ohms

During subsequent years the design was modified from time to time, such modifications frequently being initiated by the introduction of new materials. For instance the magnets that were originally made of Tungsten steel were replaced by Cobalt and later by Alcomax.

In 1948 a complete re-design of the Megger Testing Set took place with the object of increasing sensitivity and scale length. At the same time a series of mains operated instruments were devised in which the generator was replaced by a mains driven power pack; such sets were supplied with testing voltages up to 10,000 volts.

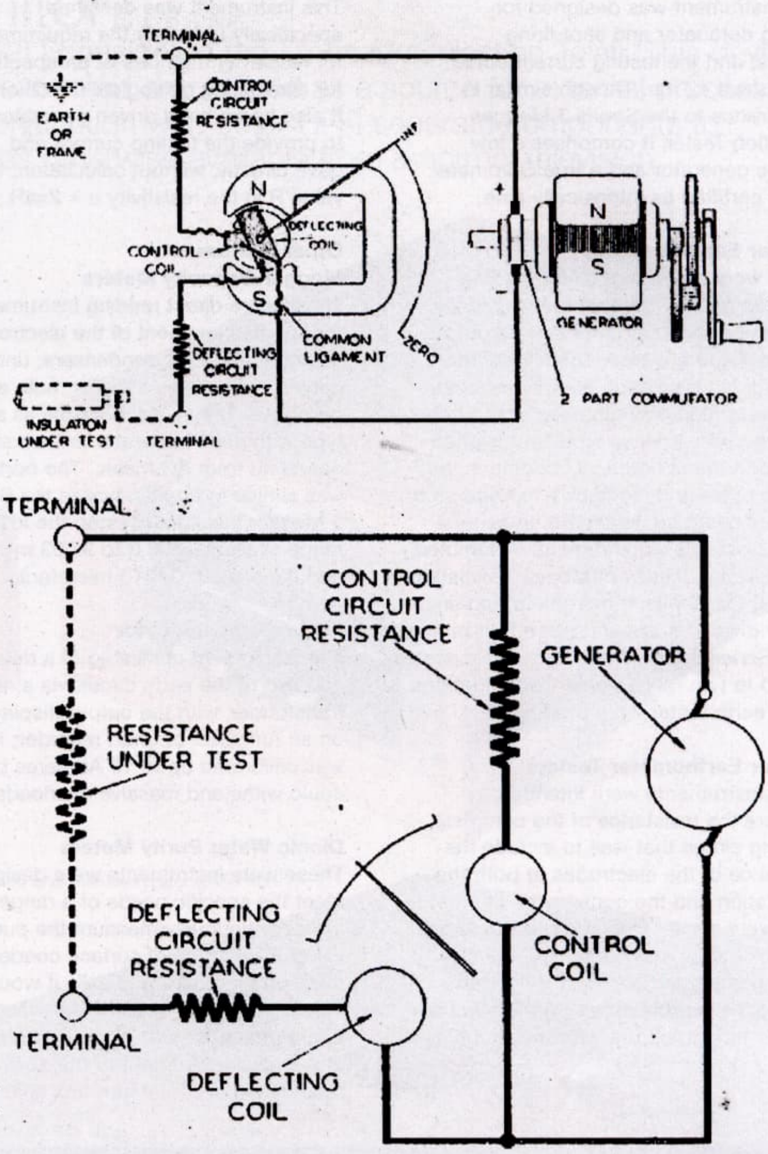
Originally all the instruments had conventional generators with a wound armature and a permanent magnet stator field, but the development of permanent magnet materials made it possible to produce small generators in which the rotor is a permanent magnet with a stator field coil.

In 1959 the Series 3 instrument was re-designed using an a.c. generator with a static rectifier, and from then on the use of a.c. generators was always considered for any new designs.
In 1966 the advent of transistor converters made it possible to produce small battery operated instruments for general testing purposes, yet they needed to be convinced that they could be as robust and reliable as "the hand generator type which has stood the test of many years".

Range of instruments
The following instrument ranges are based on Evershed & Vignoles' list in their 1932 publication, but the list has been extended to include information on some of the types of instruments produced after 1932.

Megger Insulation Testers
There were four series of Megger insulation testers that evolved from the original design:
Series 1 – For testing high-tension equipment with pressures up to 2500v and ranges of up to 50,000 M Ohms; a special 5000v tester was also available.
Series 2 – For testing power circuits, apparatus operating on 500v, and for mains having moderate electrostatic capacity. Range up to 2000 M Ohms.
This version was originally called the Meg Insulation Tester.
Series 3 – Known as the Wee-Megger Tester. For testing house wiring at pressures up to 250v. Testing pressures up to 500v and ranges up to 50 M Ohms.
Series 4 – An intermediate instrument with the voltage and resistance ranges of the Series 3 but having a constant pressure generator. It could be fitted with a divide by 100 switch or a continuity range.

Bridge-Megger Testing Sets
The success of the Megger led to demands for an instrument of a similar type that would deal with the measurement of conductor resistance down to a small value. Again two series were produced. Each comprised a hand driven generator of the constant pressure type to produce the testing voltage, a change-over switch to change from insulation to Wheatstone bridge tests, and a moving coil ohmmeter which measures directly the value of insulation resistance and which acts as the galvanometer for the bridge tests. A ratio switch and a direct reading resistance read on four dials completed the bridge
Series 1 – Consisted of two units in wooden cases, the adjustable resistance being contained in a separate case from the instrument to which it is attached by two short leads. On the side of the instrument there were two terminals marked "Line" and "Earth", which were used for insulation tests, and at the end of the case were two pairs of terminals marked "R" and "X" for connection to the resistance box and resistance under test when making bridge tests. Testing voltages of up to 1000v were provided and the resistance range covered was from 0.01 Ohm to 2000 M Ohms.



The "Wee-Megger" Tester—principle of operation.

Within the main unit is a test certificate dated 1919
Series 2 – Testing Set was contained in a single aluminium alloy case. The instrument had only two terminals - marked "Line" and "Earth" which were used for both insulation and bridge tests. Testing voltages of up to 1000v were provided and the resistance range covered was from 0.01 Ohm to 200 M Ohms.

Ohmmeters
Evershed's range of Ohmmeters were direct reading true Ohmmeters based on movements similar to those used in their insulation testers; they marketed five different models:

Megger circuit testers
Portable instruments operating from self-contained 4.5v dry batteries intended for the measurement of motor windings and other conductor resistances. Four instruments were available with ranges up to 30, 300, 50.000, and 300.000 Ohms respectively.

Workshop Ohmmeters
These were also direct reading Ohmmeters but operated from an external supply, they were employed by manufacturers of telephone and telegraph apparatus, wireless sets, electric lamps, etc. It appears that they were tailor-made to meet specific needs and were available for wall mounting or bench use.

Ductor Low Resistance Tester
A portable direct reading Ohmmeter for the measurement of low resistances from a few Ohms down to 1 micrOhm. Each instrument had four or five different ranges and was intended for testing of switch contacts, rail bonds, windings of series motors, etc. It operated from an external alkaline battery supplied with the set.

Evershed Bond Tester
This was a low range true Ohmmeter for testing the bonding of aeroplane structures, metallic sheathing, etc. It had a range of 0 – 0.1 Ohm and operated from a self-contained alkaline cell.

Safety Ohmmeter
This instrument was designed for testing detonator and shot firing circuits, and the testing current could not exceed 12 ma. Though similar in appearance to the Series 3 Megger Insulation Tester, it comprises a low voltage generator and a true Ohmmeter. It was certified as intrinsically safe.

Megger Earth Testers
These were a range of direct reading instruments that enabled the resistance to earth of earth electrodes to be quickly and easily determined. There were three patterns of instrument, each consisting of a direct reading Ohmmeter and a hand generator of a special type so designed that under most practical conditions the effects of electrolytic back e.m.f and stray currents could be neglected. In general appearance these instruments resembled the equivalent series of Megger Insulation Testers; the Series 1 instrument had an evenly divided scale and up to four ranges, while Series 2 and 4 had logarithmic scales and up to two ranges only. Two variations of the earth tester were produced:

Megger Earthometer Testers
These instruments were intended to measure the resistance of the complete earthing circuit that was to include the resistance of the electrodes at both the sub-station and the consumer's premises. They were similar to the Series 2 and 4 Earth Testers, but contained a neon warning lamp and a special switch to protect the instrument as Earthometer tests were to be carried out with the circuit live.

Geophysical Earth Tester
This instrument was designed specifically to satisfy the requirements for resistivity methods of prospecting for elucidating geological conditions. It also had a hand driven generator to provide the testing current and gave directly, without calculation, the value R in the resistivity $\sigma = 2\pi aR$.

Other instruments
Megger Capacity Meters
These were direct reading instruments for the measurement of the electrostatic capacity of power condensers, underground cables, and condensers for radio and other purposes. They were available as a portable type with hand generator or workshop type operating from AC mains. The portable type was similar in appearance to the Series 1 Megger Insulation Tester; the lowest range available was 0 to 3.003 microfarad, and the highest 0 to10 microfarad.

AC Leakage Indicator
This equipment consisted of a detector coupled to the earth circuit via a ring transformer, with the output displayed on an Ammeter or chart recorder; it was calibrated up to 10 Amperes but could withstand massive overloads.

Dionic Water Purity Meters
These were instruments were designed to meet the specific needs of a range of users.
a) To continuously measure the purity of water flowing out of surface condensers, distilling plant, etc. Typically it would be incorporated in a cubicle that would include a chart recorder and alarm indicator.
b) A similar instrument to the above but housed in a cast iron box suitable for marine installations; this would usually be called a salinometer.
c) A portable, direct reading, laboratory type instrument with its electrical supply provided by an Evershed hand-driven generator.

Switchboard and Portable Instruments
Evershed and Vignoles made a wide range of moving iron, moving coil, and dynamometer instruments built, when required, to sub-standard accuracy; the maximum error allowed being 0.2%.

Instrumentation and Control
They also manufactured a wide range of control equipment for both plant and marine systems:
Electrical tachometers
Rudder indicators
Flowmeters
Process controllers
Tank gauges
Position controllers
Remote indicators
Revolution counters

Recording Instruments
Evershed manufactured both fixed and portable recorders for general use as well as those specifically designed to work with their instrumentation; the portable recorders were housed in hardwood cases, and the fixed in an iron case designed for wall or switchboard mounting. Recorders could be supplied with either continuous (roll) or daily (disc) charts. Single or multiple movement instruments were available with chart speeds from ½ inch per hour to 12 inches per minute. Their earliest recorder was the Holden Hot Wire Recording Voltmeter, some of which survived for over 30 years.

Television Sound Monitor by John R. Sully.

In the last issue of the Bulletin (Winter 2012) I considered the Dinosaur/Celestion Telefi. This device enabled a high quality sound signal to be extracted and utilised as a source for external processing and amplification. The device is used in conjunction with other Hi-Fi separate components to achieve better sound reproduction than was otherwise available from a normal television.

Fig 1 Telefi (left) and Television Sound Monitor

Fig 2 Television Sound Monitor in metal finish

Although equipment to provide a high quality source of television sound was a very narrow market, there were several companies that developed devices to provide the aforementioned function in the early 1970s in addition to Dinosaur/Celestion and their Telefi device. The Telefi was certainly the only device which seemed to have big name backing, but during research I found other companies who appeared to be operating in this market both before and after the heyday of the Telefi. For example Jason offered a device in the 1960s designated JTV/2, which was designed to provide high quality television sound. This device was valve based and utilised a "Fireball" turret tuner operating on the VHF bands I & III, and also provided three switched FM radio stations (Home, Light & Third). Lowther also developed a device to provide high quality television sound in the 1970s.

Going even further back to before WWII, it should also be remembered that some domestic radios also offered television sound. These tended to be the up-market receivers, for instance the better quality radios and radiograms from manufacturers such as R.G.D. (e.g. model 1015). Additionally, some less expensive 1930s radio manufacturer's such as Defiant (e.g. model MSH938) also offered television sound in the 1930s. It should be noted that some of these receivers may have been used in conjunction with vision-only pre-war television sets such as the Ekco TA701 in order to keep the purchase price of the television itself down, rather than as a means of improving the audio content of the television, which generally was already well catered for in television receivers of that time.

Moving forward to the 1980s, high quality television sound Hi-Fi component units were still being manufactured, for example the National TR-565EU, and the Arcam Delta 150. A further need for a television sound tuner is in the provision of receivers for blind people and those with severe sight impairment. The British Wireless for the Blind Fund provided portable sets capable of receiving television sound, for example the TVS1 made by Roberts Radio in the 1980s.

However, the previous article on the Telefi and this article are concerned solely with the devices from the early 1970s, which were primarily intended for improving the television sound available from ordinary domestic television receivers at that time. As discussed in the previous article, the quality of early 1970s sound reproduction available from most television receivers had deteriorated in spite of the fact that the same high quality signal continued to be transmitted. Therefore this article will take a brief look at perhaps the main competitor to the Telefi, from a company named Motion Electronics. This follow up to the earlier Telefi article also provides an opportunity to compare the two devices. The name given by Motion Electronics to their device is the "Television Sound Monitor", which is rather less snappy than "Telefi". The two devices can be seen alongside each other in fig 1, where the

Fig 3 Television Sound Monitor in wood sleeve

Fig 4 Television Sound Monitor front view

Fig 5 Television Sound Monitor rear view

Television Sound Monitor" is on the right, and the Telefi on the left.

I suspect the Television Sound Monitor was developed first, but there is rather less information available for research to confirm this. Unlike the Telefi, the developers of the Television Sound Monitor apparently did not seek to obtain Patent protection for their unit.

Firstly, a brief recap of the Telefi: A wand containing a ferrite cored inductance is positioned close to the IF strip of a standard 625line television, where it picks up stray electromagnetic emissions. This signal, largely free of distortion, is amplified and demodulated, and presented as an output of variable level suitable for further amplification or processing in a Hi-Fi system. This unit has the main advantage that no electrical connections need be made to the television receiver itself, and an external aerial feed is not required.

Motion Electronics have taken a different approach with their Television Sound Monitor. On the face of it their approach is rather simpler, in essence they are simply incorporating the essential elements of a television receiver necessary to generate the sound signal, but with obvious cost and signal availability disadvantages.

The Television Sound Monitor unit is constructed within a metal frame chassis. The chassis incorporates a printed circuit board at the base which accomodates the discrete components, and the metal framework provides stability for the larger components. The framework chassis is fully encased in a sheet metal cover to all sides. The metal cover is finished in good quality hammered grey paint finish, and is held in place by four screws (fig 2). The front panel is silver and the unit looks quite acceptable in this format. For those customers who required a rather less utilitarian finish to the unit, a wooden sleeve could also be supplied. The whole unit then slides into the wood-effect sleeve, apparently aiming to give the impression of straight grained walnut. Unlike the Telefi which has a solid teak sleeve, the Television Sound Monitor wooden sleeve is made of chipboard with a vinyl finish, and does not look as stylish. The sleeve is held in position by a piece of plywood at the back of the cabinet that turns about a central pivot and the ends of the plywood locking piece engage in a groove around the inside of the wood sleeve. It does work effectively, though is rather "Heath Robinson" in concept. (See fig 5). Measuring 11" x 6 ¾" x 4 ½" the Television Sound Monitor is rather larger than the Telefi.

The Television Sound Monitor was available for reception of either UHF or VHF transmissions. The UHF version covered bands IV and V, channels 21-69, and cost £43.37 in chassis form, and £47.63 with walnut-effect sleeve. It was also available as a combined UHF/VHF version covering bands I, III, IV, V costing £48.66 or £52.92 enclosed in the walnut-effect sleeve. Having noted the rather indifferent quality of the chipboard-based walnut sleeve I am rather surprised it apparently cost an extra £4 or so to include this option. As can be seen in the photos (fig 3), the example pictured in this article is the UHF-only version in walnut sleeve.

The front panel (fig 4) includes a pilot light, on/off switch, AM/FM switch, six tuner pushbuttons and tuning meter mounted onto a plastic coated panel, suggestive of the then popular brushed aluminium finish. The rear panel (fig 5) is punched and screen printed so that it can be used for both UHF and VHF versions of the device. The mains input cable feeds through the rear panel, a UHF aerial socket is present together with an associated R.F. sensitivity control. The panel could also support similar VHF elements, but the holes are plugged with rubber bungs in the example pictured. Output from the device is via a 5 pin 180° DIN socket. The output level can be varied with a variable volume control, consisting solely of a plastic shaft with no knob. The level could be varied up to 0.5v.

Internally, a small mains transformer is positioned at the rear of the unit, together with 100mA fuse. All the discrete components are mounted on a good quality printed circuit board (pcb). The pcb is punched to support both UHF and VHF, obviously in the example pictured (fig 6) only the UHF components are provisioned. Tuning is effected using a vari-cap tuner. The unit is tuned in conjunction with the small edgewise panel meter. With the AM/FM pushbutton in the FM position the chosen station is approximately tuned in. The AM/FM pushbutton is then put in the AM position where use is made of the meter as a signal strength indicator. One now tunes to maximum leftwise deflection. The AM/FM pushbutton is then switched back to FM where the meter returns to about centre zero, and a minor final adjustment of the tuning control results in precise tuning. The tuning method sounds complicated as described, but

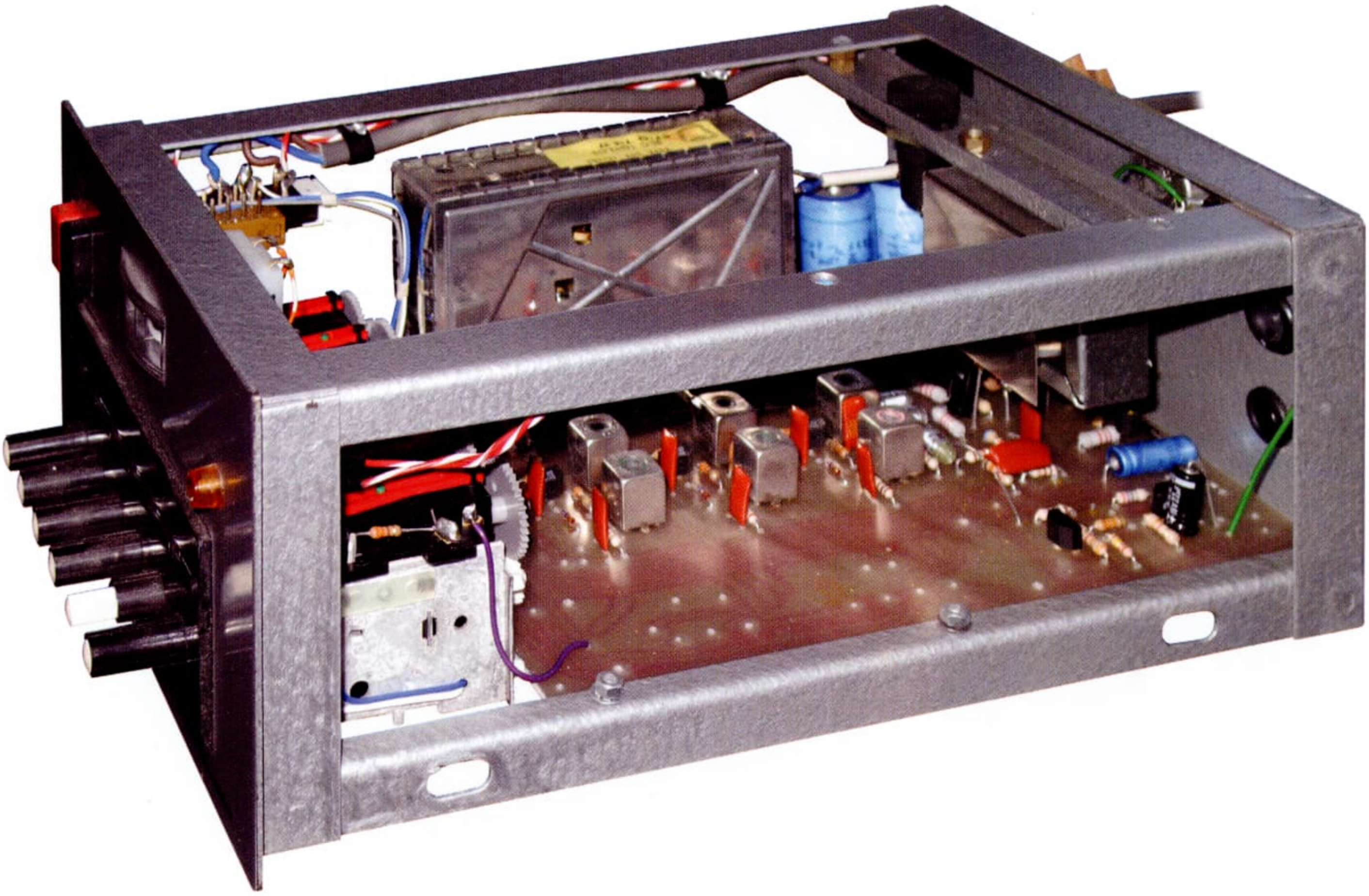


Fig 6 Television Sound Monitor internal view

is rather easier in practice, and indeed a good result is achieved by simply turning the tuner control shaft and monitoring by ear alone (which after all, is the way this particular tuner would have been used on most televisions it was fitted in to). However, at nearly £50, it was a rather expensive solution to the challenge of extracting a television sound signal. It must also be remembered that the Television Sound Monitor needed its own aerial feed, unless the user resided in an area of sufficient signal strength which could tolerate a signal splitter in the aerial circuit without degradation of quality.

The previous article solely on the Telefi noted that I had been unable to pick up an acceptable signal using the device. For the comparison testing it was clearly necessary to ensure the Telefi was working to the best of its ability. I found that a good signal could be picked up by the Telefi using the wand, but the area space where it works well is very limited; say a cubic volume of about eight cubic inches (in the test tv receiver). Other components positioned near the effective area cause the signal to degenerate into noise and mush as soon as the wand enters their proximity. Eight cubic inches may not sound so small, but it must be remembered that the wand has to be secured against something, (which generally cannot be another component or noise tends to be introduced), or suspended in the area. Additionally, the plane of the wand can also affect the signal which is picked up, though the field where it is blind is comparatively narrow and is presumably due to the construction of the ferrite elements within the wand pick-up head. Once the Telefi wand was correctly positioned and secured, it did work very well with minimal noise and/or hum. The range of the wand is so small though I find it difficult to believe it could ever pick up the signal when positioned outside of the host television cabinet. It must have been necessary to place the wand head right next to the IF strip in every situation it was used in. The instructions indicate that in the case where the wand needs to be placed inside the television set, the positioning should be done by a qualified and skilled person. I suspect a lot of owners decided against employing someone to place the wand, instead positioning it themselves at very real risk of exposure to high voltages. I also wonder about the reliability of the positioning. In the early 1970s a significant proportion of television receivers were still utilising hybrid valve/ transistor technology, with consequent heat issues. Excessive heat and temperature fluctuations could well cause the wand fixing material to dry out or drop off.

In the Telefi's favour, the sound output presentation is much more reliable from a phono socket than a DIN socket, and also gives an air of quality and professionalism in this format. The Telefi also looks better in its real wood sleeve and genuine brushed aluminium front panel. For those owners without an available AUX input to their amplifier, the Telefi also takes care of the switching via the Tuner input of the owner's amplifier. Also, it doesn't need a separate aerial input. The output level from the device also seems to be more realistic at anything up to 1v. The sound output will always be appropriate to the picture on screen at any given time, without the need to change channels on the sound equipment. It may be an advantage that it is much smaller than the Television Sound Monitor. It is also well on the way to being half the price of the device from Motion Electronics.

In the Television Sound Monitor's favour, it does not need to rely on picking up the sound source via a wand. This is of course a very significant advantage, and in fact constitutes the only real main advantage, as far as I am able to determine. Both the Television Sound Monitor and the Telefi were on the market at the same time in 1972, the former costing almost £50, and the Telefi costing about £30. The side by side test was conducted without specialist measuring equipment but instead simply listening to the resultant output. In my opinion the Television Sound Monitor was the best performing unit, but not by a significant margin. Having connected the unit to a reasonable quality Hi-Fi separates system from the 1980s I can report that it would definitely fulfil its function of providing a television sound source suitable for further amplification and processing.

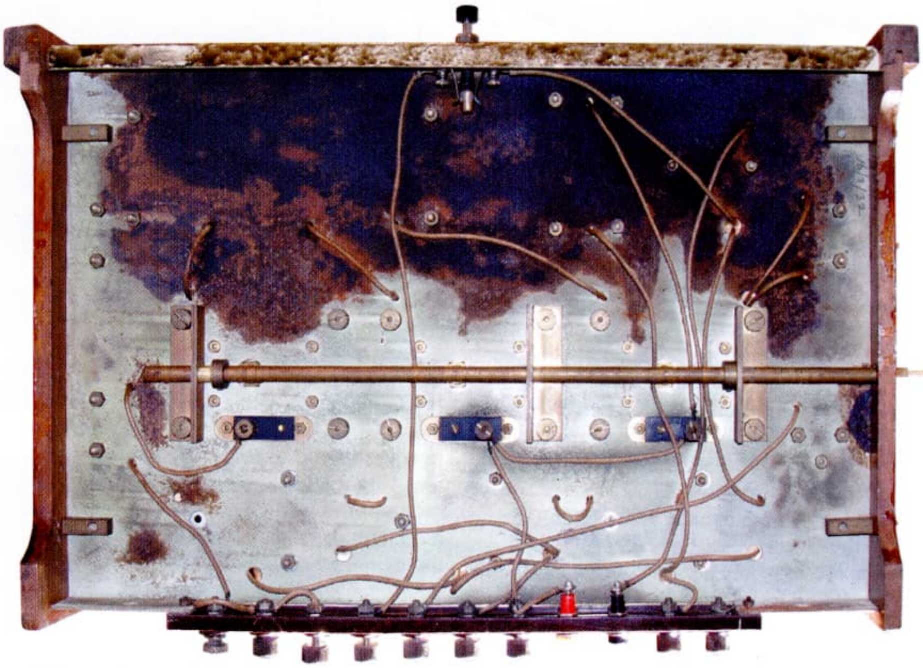
It occurs to me that any potential purchaser who cared enough about television sound quality to spend this kind of money forty years ago, could probably afford and justify the more expensive device anyway. However, I don't have any idea of sales figures, so unless any reader happened to be involved in retailing these devices, we are left with only conjecture.

Restoring an Osram 'Four' New Music Magnet

by Gwyn Griffiths

This set caught my attention at the July 2009 BVWS Swapmeet at Wooton Bassett. Having previously worked on a Scott-Taggart ST300 of about the same vintage, and been impressed with its performance, I was intrigued to find out how this four-valve set from a commercial kit would compare. The generally tidy cabinet and upper part of the chassis, and the evocative transfers for the set's logo and the supplier, 'W.M Hardwick, The Garage, Shuttlewood Road, Bolsover' clinched it - the Osram 'Four' New Music Magnet would become my autumn project.

The front half of the underside of the chassis was corroded, and would need attention, but I wanted to see if it was working before dismantling the set entirely, which was my intention. In this regard, working with what was originally a kit had several advantages. As the receiver was meant to be assembled with few tools, disassembly would be very easy; almost all connections were by screw terminals.



Despite the straightforward nature of the set, and the ease of tracing out the circuit, I first tried finding a circuit on the Internet. Success, but only one useful article, and that with text in German (footnote 1). However, thanks to Nigel Squibb, the key information was soon extracted. There were some differences between the circuit and the set - surely the output valve that was present, a KT2 critical distance tetrode, was not right? Was the use of B5 bases when valves with B4 bases were fitted common, I wondered? Of course, the KT2 could have been a later modification, but there was no evidence that there had ever been a wire from the screen grid terminal of the valve base. Furthermore, the LP220 in the detector position also seemed wrong. Consulting the entry for the Osram 'Four' New Music Magnet in 'The Saga of the Marconi Osram Valve', page 107, elicited the line up as two S215 RF amplifiers, a H210 detector and a P2 output valve. At least the two S215s were present and correct. The LP220 that was present in the detector position could be used as the output triode, and a 210HL was found for the detector. All of these valves were checked on a simple home-built valve tester that doubles as a metered battery eliminator and found to have acceptable emission and mutual conductance.

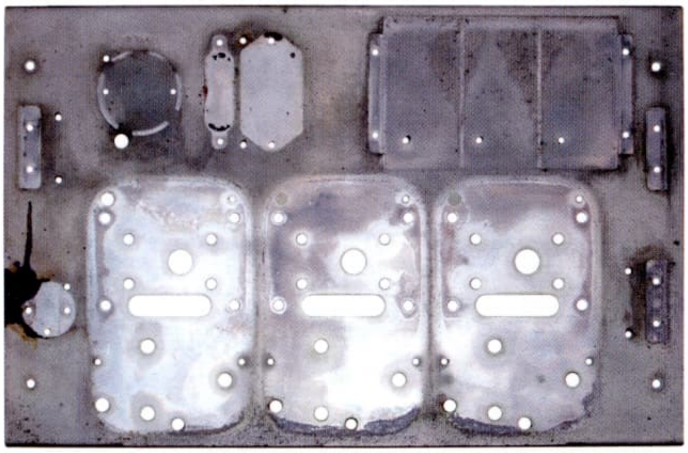
With an Amplion moving magnet loudspeaker connected, long wave reception was quite reasonable, but medium wave was poor and intermittent. I made a note to look at, and clean carefully, the wonderful mechanism of the six-pole wave-change switch. The strip-down started.

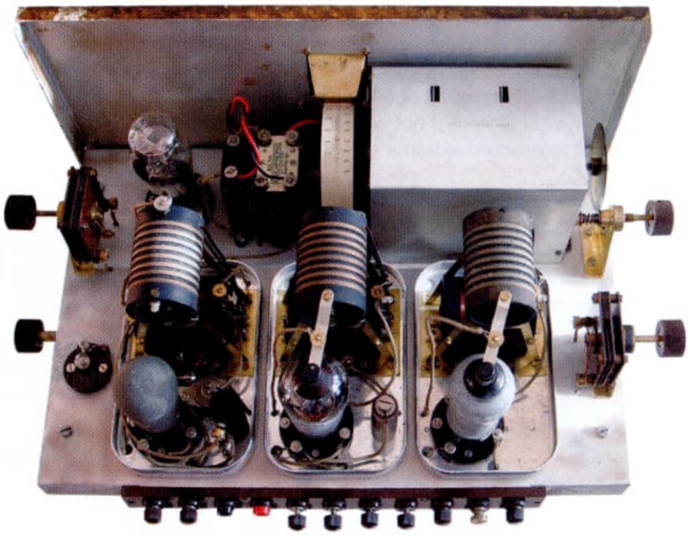
The wooden lid was hinged to the side cheeks using simple brass pins in a strip of hardwood. Without a retaining chain, it is not surprising that at some time the lid had been forced back and the hardwood strip split. The strip had been glued at least once before. It needed repair again, but this time a restraining chain was added, after weighing up originality against the risk of, one day, worse damage to the case.

The set-screws and nuts securing the plywood back to the aluminium angle corner pieces were removed and set aside for cleaning in an ultrasonic bath (as were all of the knurled terminals, the brasswork of the wavechange switch and all the other nuts and bolts). Systematic disassembly then commenced. A notebook with step-by-step notes was kept, and each (cotton-covered?) wire labelled with its step number. The original GECoPhone BC542 1 μF and BC342 0.25 μF capacitors tested good, and were kept. As the solid dielectric reaction differential variable capacitor was removed, a small pencilled date became visible: 16/3/32. The GECoPhone BC710 3:1 interstage transformer was removed and cleaned. A modern, tape-wrapped 1.5Mohm resistor had been added across the original glass-tube encased grid leak resistor, which read 3.8MOhm.

All the bare ends of the connecting wires were abraded with 160 grit aluminium oxide paper. The chassis was bead-blasted clean (thanks to Andy Webb), and to my amazement, the only area of pitting was not on the underside, but on the upper side by the bulb-holder. Several coats of a silver enamel paint rubbed down between each coat made for a neat and very similar finish.

A close look had shown that the wave-change mechanism was actuated with three ball bearings, one for each of the two





RF stages, and one at the detector. Care was taken not to let them escape! Each of the three coil assemblies was then dismantled. This gave access to the three sets of switch contact pairs for the wave-change mechanism. Crocus paper and a switch cleaner restored the contacts to reliable operation.

Reassembly was the reverse of disassembly and was straightforward. The date, 27/12/09 was added in pencil next to the original (hopefully the set will survive another 77 years). After a final check of the wiring, the heater voltage was applied and the current checked, followed by the grid bias (-3V), HT+ (105V) and the SG+ (70V) from the power supply. With the set now receiving stations on medium wave and long wave, using a 60' long wire aerial in the loft, how did it compare with the ST300? First, reaction was rather fierce; it was easier to control on the ST300, no doubt aided by the low HT voltage on the detector as suggested by Scott-Taggart and implemented through a separate HT line. Nevertheless, over a few winter days and evenings, a good number of stations from across Europe were received on medium wave. A creditable performance, and a fitting close to an enjoyable restoration.

A postscript to these notes is appropriate. Thanks to Bill Hewitt (footnote 2), I now have a reprint of the original booklet for the construction and operation of the set, including the circuit diagram. This has settled a number of misconceptions I'd had. First, the use of four B5 valve holders was standard in this kit. Second, the recommended output valve for dry battery operation was an LP2, with a grid bias of -3 to -4.5V, whereas the Osram P2 'Super Power' valve was suggested 'when it is desired to handle more volume without distortion', although at the cost of an additional 4-6mA of current from the HT battery.

The advertisement for the kit proclaimed in a banner headline, 'There's no drilling and no soldering - no carpentering - the cabinet and components almost fall into place'. Ten special features were

1 The two Screen Grid high frequency stages give extreme selectivity and sensitivity with an unrivalled range.

2 Enormous amplification with perfect stability is given by the complete shielding of the H.F. circuits

3 Equal efficiency guaranteed on both wavelength bands.

4 Change of wavelength is effected by an external switch and the set need not therefore be opened.

5 Maximum ease in tuning by single knob controlling triple gang condenser.

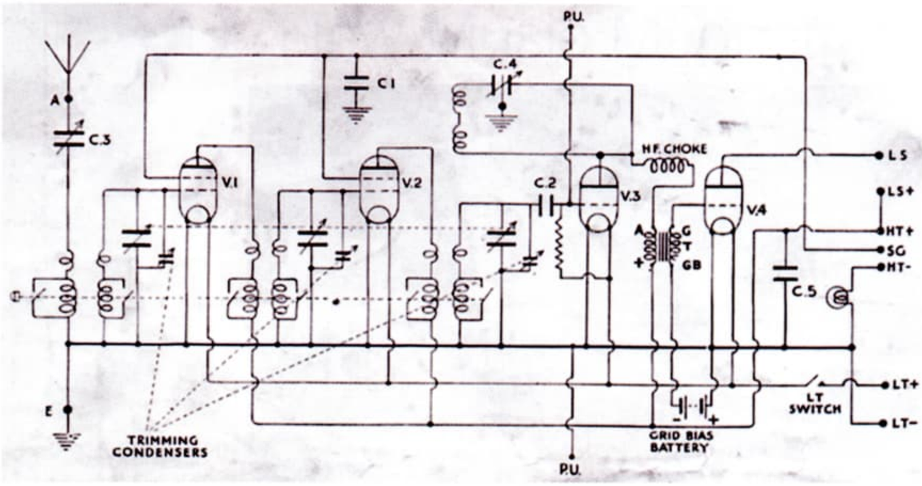
6. Assembly is the essence of simplicity. Volume control is provided not only to act as such but to procure extreme selectivity.

7. Two terminals provide connection for gramophone pickup.

8. May be built for all A.C. Mains operation at small additional cost.

10. Attractive Walnut Constructors Cabinet of modern design with front panel to match.

Items for the kit were packed in separate packets, with all of the components with the exception of screws, nuts, etc. given GECoPHONE BC part numbers. A list of wires, with their lengths to 1/2" was provided with brief descriptions of each end termination. After the baseplate assembly, the next step was to wire the baseplate, guided by diagrams showing numbered wires and lettered holes, and the length to be cut; 33 wires were to be connected at this stage. The panel was assembled to the baseplate, a key fixture being the L.T. switch. The wiring was completed for the final 7 wires. A note explained that when wired for battery operation, each of the valve holders would have one unconnected terminal. This was to allow for the use of the set with AC valves, 'when the GECoPHONE A.C. All Power Unit is employed'.



The wooden cabinet comprised two sides, a back, and a hinged lid. Aluminium angle brackets facilitated the joining of the side plates to the back. Brass support blocks under the baseplate with tapped set-screw holes enabled the baseplate to be fixed to the side plates. The next part to assemble was the wave-change switch, with its three small steel balls, and the warning in italics, 'taking great care not to lose the small balls'. The knob with no indicating dot was to be used for the slow motion tuning drive. The spindles of the aerial coupling capacitor (volume control) and the reaction variable capacitor were to be set as far anti-clockwise as they would go, and their knobs fitted with their spots at '6 o'clock'. Connecting the batteries, fitting the valves and screening boxes, a final check of the wiring, and screwing in the fuse lamp in its holder saw the assembly complete, and the set ready for use.

1 "Wirshilen nach England" originally by F. Strobel made available as a pdf by Thomas Günzel at http://www.radiomuseum.org/forumdata/users/5100/Osram_Music_Magnet_Four_v20.pdf . A circuit for a later variant is available at www.electrojumble.org/DATA/Music_Magnet_4_with_AC.pdf
2 At http://tinyurl.com/3ynuynt

MURPHY TELEVISION

The blank screens of 1939

by Mike Barker

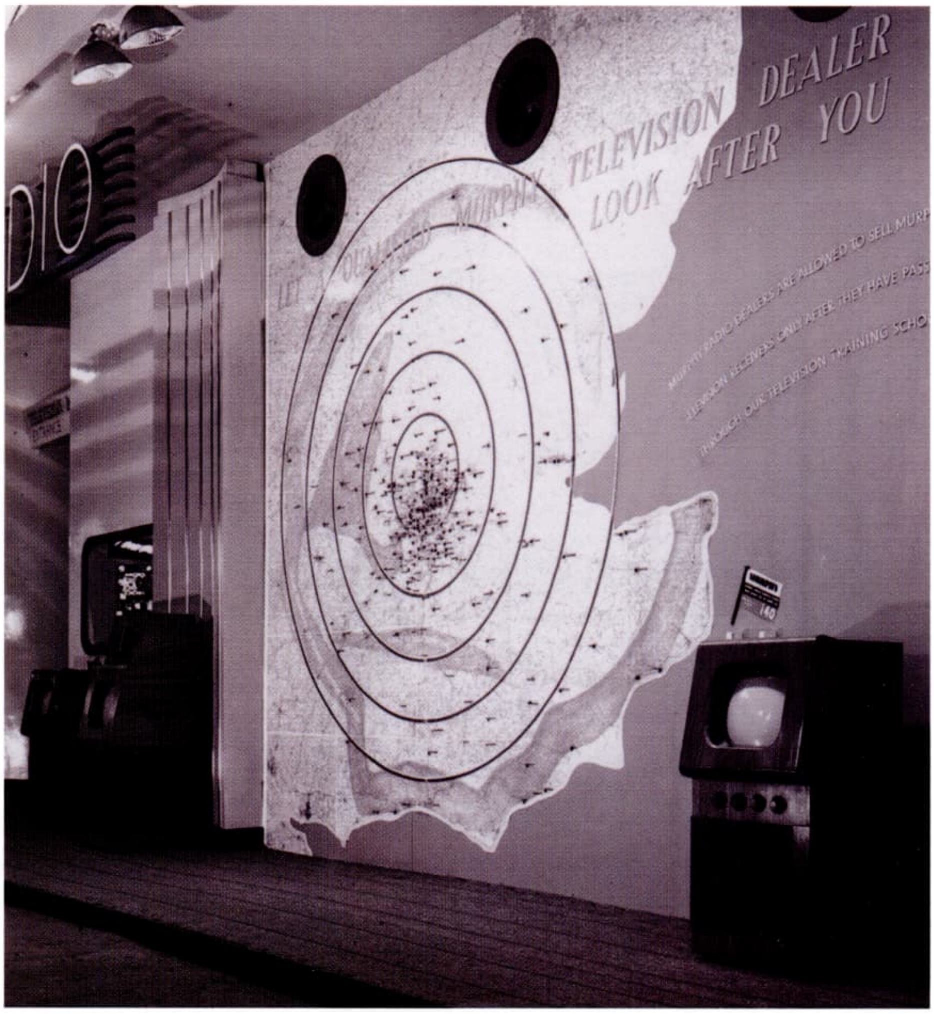
As with most manufacturers, the new Murphy radio and TV receivers were shown each year at 'Radiolympia' prior to being available for the public to purchase in the new sales season.

Wednesday 23rd August 1939 saw the opening of such a show and the first public display of their newest television receivers, the V84, V84C, V86C and lastly the V88C.

We know that none of these had gone into production, so there could only have been a very few made. Certainly only a tiny number are known to have been dispatched out to the larger 'Television trained' Murphy dealers as show pieces from which to take customer orders.

Murphy Radio weren't to know that a couple of weeks later there would be no television service and that all the different manufacturers would be in a position of holding redundant stocks and receivers.

By way of a taster for a restoration article to come later this year, here is a sales brochure for the Murphy 1939 Television range and a shot of the Radiolympia stand. Note how the V88C looks so very bulky and awkward in it's form of a radio grafted onto the top of the Television. Has anyone ever seen any of these in the flesh?



V 88 CONSOLE

V88C. TELEVISION AND ALL-WAVE RADIO RECEIVER

Picture Size 10 ins. × 8 ins.

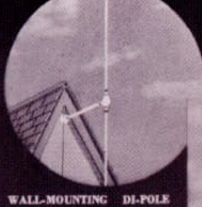
On the Television side this model provides exactly the same quality of performance and picture size as the 86C, illustrated and described overleaf. It gives, in addition, the excellent all-wave radio reception provided by a standard Murphy Radio receiver. Over fifty station-names are printed on the three-colour scale, and the high quality of reproduction associated with all Murphy console receivers is provided.

The Radio and Television receivers are separately "grouped" in order to avoid confusion in operation. A simple switch changes over from "Television" to "Radio." The cabinet arrangement provides maximum comfort in viewing the picture and in tuning the radio set. The cabinet is in two tones of walnut.

Cash Price:
200–250 volts A.C. 50 cycles only **£50**

TELEVISION AERIALS

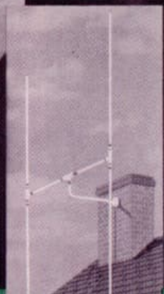
The usual type of radio aerial cannot be used for Television reception. The two Television aerials shown below are recommended in order to obtain the best results and are both available from your Murphy Dealer who will advise you on which type is best for your locality.



WALL-MOUNTING DI-POLE

As shown in the sketch above for fixing to a wall. Is also available for mounting on a pole at no extra cost.

PRICE **25/-**



WALL-MOUNTING DI-POLE AND REFLECTOR

Also available for pole mounting at the same price. This type is advised in a locality where there is interference and/or where the signal strength is weak.

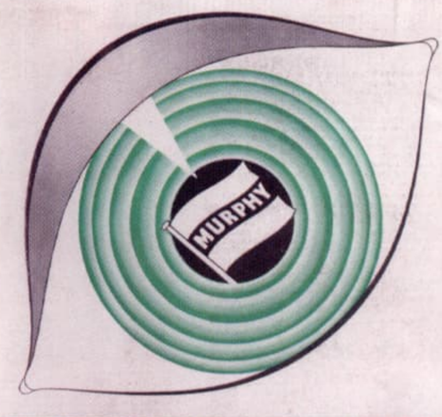
PRICE **44/-**

MURPHY DEALERS ARE PEOPLE YOU CAN TRUST

At Murphy Radio we like to be certain that any dealer who sells and services Murphy Television Sets is competent both to advise you and handle our sets properly. This is one of the reasons why we sell only through a limited number of selected dealers, and, what is more, no Murphy Dealer is allowed to sell Murphy Television Receivers until he has satisfied us that he has the necessary Television engineering qualifications, or has passed through our own Television School at Welwyn Garden City.

You may rest assured that your Murphy Television Dealer knows his job, and has the knowledge and ability to give you sound advice and good service.

Issued by Murphy Radio Ltd., Welwyn Garden City, Herts. PRINTED IN ENGLAND



SEE WORLD EVENTS ON MURPHY

TELEVISION

V84 TABLE MODEL. TELEVISION, SOUND AND PICTURE RECEIVER

Picture Size 7½ ins. × 6 ins.

For those to whom space and cost are important, a table television receiver is obviously the best proposition. Until recently such compactness could only be obtained by serious reduction of the picture size. Rapid development in design has now enabled us to produce a first-class Television receiver in a cabinet not much bigger than that of an ordinary radio set. It gives a brilliant picture of a size which has proved to be very satisfactory for use in the average home, and the high sensitivity of this model ensures good reception anywhere within the service area of the Alexandra Palace Station.

There are only four controls on the front of the cabinet, and operation is, if anything, easier than with an ordinary radio set. The freedom from adjacent station interference enjoyed on the Television wavelength enables very good quality of reproduction to be provided, and noise caused by motor cars has been minimised by a newly-developed circuit arrangement.

The cabinet is very simply designed in walnut without ornamentation, and the cathode ray tube on which the picture is seen is protected by a window of toughened glass.

Cash Price:
200–250 volts A.C. 50 cycles only. **£29**

V 84 TABLE MODEL

V 84 CONSOLE

V84C. TELEVISION, SOUND AND PICTURE RECEIVER

Picture Size 7½ ins. × 6 ins.

This set is a companion model to the table receiver illustrated above, giving exactly the same high standard of performance on the television sound and picture programme. The larger cabinet permits the use of a bigger and better loud-speaker and a greater control of resonances, so that sound quality is even better than that of the table set, with the same freedom from noise.

The very attractive cabinet is carried out in two tones of walnut, and the panel containing the picture aperture is tilted slightly to give the most comfortable viewing angle from a sitting position.

Six or eight people can watch a set of this type without any difficulty, and the controls are not only very simple, but, once set, need little further attention.

Cash Price:
200–250 volts A.C. 50 cycles only. **£33**

V86C. TELEVISION, SOUND AND PICTURE RECEIVER

Picture Size 10 ins. × 8 ins.

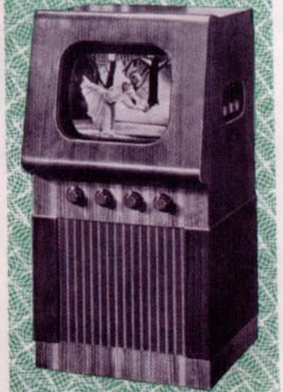
Some people who have never seen Television in the home still have the idea that it will only become "practical" when the picture is very much larger than at present. For home entertainment, however, that is quite unnecessary.

Of all the available sizes the happiest is, perhaps, a 12-in. cathode ray tube. This gives a picture size of roughly 10 ins. × 8 ins., which is large enough for comfortable viewing by up to ten or a dozen people, and small enough to minimise the effect of the "lines" of which a Television picture is made up.

This receiver is therefore exactly the same as the cheaper console, except for the larger picture size. Brilliance of picture, simplicity of control, adequate reception range, freedom from noise and the very high quality of sound reproduction are of the same high standard.

Cash Price:
200–250 volts A.C. 50 cycles only. **£40**

V 86 CONSOLE



MURPHY TELEVISION

Seats in all parts!

QUITE a lot of people are still inclined to be doubtful about the quality of Television because they think it is not, so to speak, the local luxury cinema screen brought into their own house. They say this, quite cheerfully, without ever having "looked in" to a Television programme. Actually, I can tell you from my own personal experience, that anyone seeing Television for the first time in a home is astonished at the reality of it. See a Television show on one of our Murphy Receivers, or you can have one brought to your home. I know you'll be impressed by the clarity of the picture, and most of all by the reality of the characters on the screen, without any feeling of crampedness which people, who have not seen Television, imagine they will experience.

You can buy a Murphy Television with a good-sized screen, and which will give you consistently reliable performance, for as little as £29, and you can take it from me that it will be a very long time before prices are likely to drop much lower.

E. J. POWER, *Managing Director.*

Book review

Radio Days

Australian Bakelite Radios
by Peter Sheridan and Ritchie Singer

Reviewed by Carl Glover

I had been aware of this book for the best part of a year before a review copy landed on the the doorstep. The first thing that struck me was its size – measuring an impressive twelve inches across by ten inches deep. The page count is equally striking at 264 pages, all in full colour.

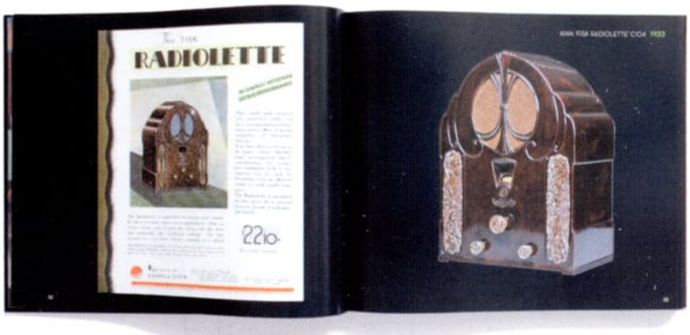
Like Philip Collins' *'Radios - The Golden Age'* of 1987 this book is a game–changer. Since publication the desirability of many Australian bakelite radios has increased and deservedly so. For many collectors (myself included) *Radio Days* will be the conduit to more than a few worthy additions to the wireless collection.

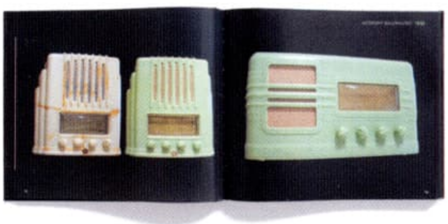
Peter Sheridan and Ritchie Singer present the radios with a black background along similar lines to Collins' *Radios - The Golden Age* but with the research more associated with John Sideli's *'Classic Plastic Radios of the 1930s and 1940s'* of 1990. The photography is of a standard high enough for one to truly appreciate the sets at a level close to seeing the radios in the flesh.

Early on in the book a page illustrates Peter Sheridan's collection which has a few UK sets in it making a useful yardstick for seeing what sizes some of these Australian radios come in. The product of AWA (Amalgamated Wireless Australasia) features heavily – the Fisk Radiolette 'Empire State' of 1934 to 1937 probably being the most internationally recognisable Australian radio to most collectors, followed by AWA's 'Fret and Foot' model 35, which looks stunning in black and green.

Having looked through the book several times one gets a better feeling for Australian cabinet styling, which starts along North American lines (the Empire State resembles an Air King Skyscraper, but more solid and assertive – I prefer the Radiolette) evolving into a uniqely Australian style illustrated by such sets as the Astor 'Mickey', Kriesler 'Beehive', Astor 'Baby, and Healing 'Moderne'.

Readers might recognise a few Philips/ Mullard cabinets from the 1950s but with a stylistic twist and certainly brighter colours. The cabinet of Alba's C112 of 1947 with examples in brown, white, and green makes an appearance gracing sets by Palmavox and Howard, I wonder if there are any blue and pink variants similar





to Alba's offering? There probably are!

It was a surprise to see a previously unseen Ekco set – the 'Gondola' of 1958, a well proportioned set along typical postwar, pre–transistor lines.

The book contains 400 colour variations of 130 different sets; enough to sort out the next decade or two for any collector ambitious enough to want to acquire examples of the sets illustrated in *Radio Days*. For those of a less acquisitive nature the book is definitely worth having as an object in its own right.

Radio Days is unapologetic in being about appearances only, the authors referring to themselves as 'cabinet freaks'. Speaking as a designer I do not have a problem with that at all, authors like John Stokes and his *Golden Age of Radio* and *More Golden Age of Radio* cover the broader picture of Antipodean wireless.

It is refreshing to see a book of this magnitude and dedication being succesfully published. Peter is currently working on another ambitious radio book which will be of a more global nature, it is currently entitled DecoRadio. It will highlight the influence of industrial designers in the 1930's with particular emphasis on the USA and UK. The book will be published by Schiffer Books in the USA and be out at the end of 2013.

It is a shame that the UK has not produced a book along similar lines regarding its' own classic and beautiful radios as it would certainly attract new enthusiasts. The same could also be said for French, Italian and Spanish wireless too!

If you are a collector of stylish radios, or would like a radio book with a difference, this is the book for you!

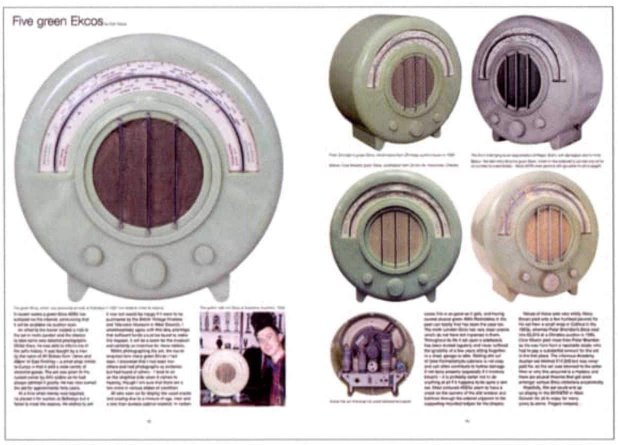
Radio Days is not available in the UK and will have to be purchased from Amazon, ebay and the catalinradio.com website.

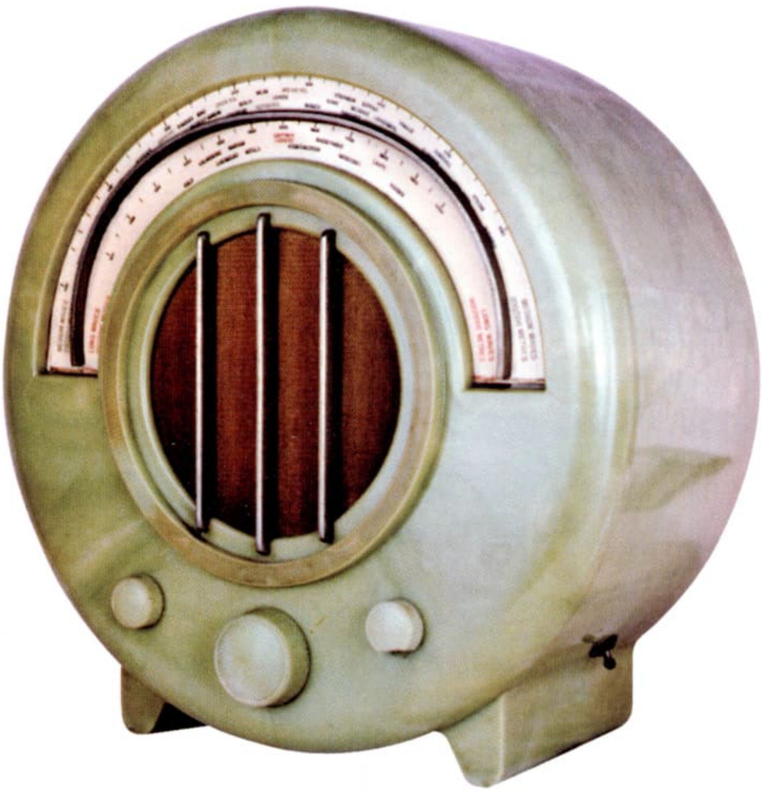
Radio Days (hardcover)
by Peter Sheridan and Ritchie Singer
Published by Bakelite, Sydney
isbn 978-0-646-49046-9
www.radiodays.com.au
email: peter@petersheridan.com

Available from catalinradio.com
at $79.90 plus postage

Green Ekco update

Roger Grant was kind enough to find an original colour print of his friend's green Ekco AD65 that he had a chance to photograph several years ago. As it can be seen, it is fairly damaged with hairline and medium cracks in all the usual places. A black and white photograph of this set appeared in the 'Five green Ekcos' article in the Winter 2012 issue of The Bulletin.


Five green Ekcos



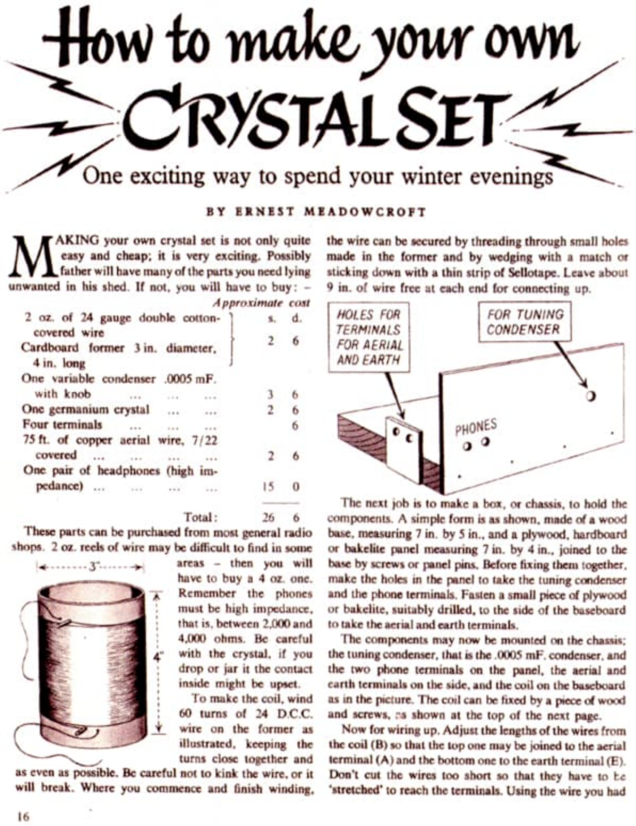
A Project of a Lifetime

by Keith Fishenden

It was difficult to know where to start explaining how I got myself into this! I waited until now to pitch myself into it.

I had the vision as a schoolboy, of working in the aircraft industry, as I was keen on aircraft in my early teens in the mid 50's. My grandparents lived in Cricklewood at the back of the Handley Page works, and I used to see huge parts of Victor bombers going past the front of the house on the old 'Queen Mary's' on their way to Radlett for final assembly. I could stand on a box and see into the workshops on a good day, if they left the doors open. For a while, my grandparents had a lodger who was the Company Secretary for Handley Page, and he used to bring all sorts of interesting literature about the aircraft they were building in the factory. He was keen on flying himself and owned a glider at the London Gliding Club where he spent his weekends. I myself have been a member of that gliding club for 9 years, and I keep my glider there.

Me at Elliott Brothers Ltd.



How to make your own CRYSTAL SET

One exciting way to spend your winter evenings

BY ERNEST MEADOWCROFT

MAKING your own crystal set is not only quite easy and cheap; it is very exciting. Possibly father will have many of the parts you need lying unwanted in his shed. If not, you will have to buy: –

	Approximate cost s.	d.
2 oz. of 24 gauge double cotton-covered wire; Cardboard former 3 in. diameter, 4 in. long	2	6
One variable condenser .0005 mF. with knob	3	6
One germanium crystal	2	6
Four terminals		6
75 ft. of copper aerial wire, 7/22 covered	2	6
One pair of headphones (high impedance)	15	0
Total:	26	6

These parts can be purchased from most general radio shops. 2 oz. reels of wire may be difficult to find in some areas – then you will have to buy a 4 oz. one. Remember the phones must be high impedance, that is, between 2,000 and 4,000 ohms. Be careful with the crystal, if you drop or jar it the contact inside might be upset.

3"

4"

To make the coil, wind 60 turns of 24 D.C.C. wire on the former as illustrated, keeping the turns close together and as even as possible. Be careful not to kink the wire, or it will break. Where you commence and finish winding, the wire can be secured by threading through small holes made in the former and by wedging with a match or sticking down with a thin strip of Sellotape. Leave about 9 in. of wire free at each end for connecting up.

HOLES FOR TERMINALS FOR AERIAL AND EARTH

FOR TUNING CONDENSER

PHONES

The next job is to make a box, or chassis, to hold the components. A simple form is as shown, made of a wood base, measuring 7 in. by 5 in., and a plywood, hardboard or bakelite panel measuring 7 in. by 4 in., joined to the base by screws or panel pins. Before fixing them together, make the holes in the panel to take the tuning condenser and the phone terminals. Fasten a small piece of plywood or bakelite, suitably drilled, to the side of the baseboard to take the aerial and earth terminals.

The components may now be mounted on the chassis; the tuning condenser, that is the .0005 mF. condenser, and the two phone terminals on the panel, the aerial and earth terminals on the side, and the coil on the baseboard as in the picture. The coil can be fixed by a piece of wood and screws, as shown at the top of the next page.

Now for wiring up. Adjust the lengths of the wires from the coil (B) so that the top one may be joined to the aerial terminal (A) and the bottom one to the earth terminal (E). Don't cut the wires too short so that they have to be 'stretched' to reach the terminals. Using the wire you had

16

'How to Make your own Crystal Set', reproduced from The Eagle Annual, 1956

when you see me at a BVWS meeting, say hello.

By the late 1950's the aircraft industry was in trouble and starting to downsize (collapse) and become much less of an opportunity, just as I was grinding through my 'O' levels. I thought "What do I do now?". It just happened that my interest in Radio was growing. I built the crystal set out of the 1956 Eagle Annual that was a Christmas present, and it worked perfectly

I was allowed to put up a 100 ft aerial from my upstairs bedroom right down to the bottom of the garden, and that made all the difference. Spurred on by this success, and by then an avid reader of Practical Wireless magazine, I picked on the one valve radio designed by E V King, titled ' A Beginner's Constructional Course – II'. Quote – 'A New Series Written Especially For The Amateur' i.e. me.

The series of articles started in April 1958 and completed in December 1958 at issue 7 of the course, with the description of 'How to Diagnose Faults in the Set'. If there was a problem, you had to wait seven months to find a solution! With the build and test in progress, I experienced my first few electric shocks, and blew the fuses in the house a few times. I became good at repairing fuses, as my mother was not too happy to be suddenly put in the dark, when cooking the dinner or reading the paper. I blacked out my father one day when he was under the car in the garage with a lead lamp, he wasn't too happy either. By the time I left home the fuse box was black. I used to go to Proop Brothers in Tottenham Court Road on a Saturday morning on the tube from Edgware to buy (and scrounge) parts. I also found Laskys and Henry's Radio, and a few shops in Lisle Street. Happy days. I digress - this was another satisfactory build and worked very well. I still have the magazines and go back now and again for a read when I feel nostalgic.

Then one day I came across a recruiting advert from Elliott Brothers (Borehamwood) Ltd, for apprenticeships in electronics engineering and avionics. The answer to 'What Do I Do Now' had arrived. After success with my GCE 'O' levels I was able to apply, and got the job having 'passed' the interview. I had a superb time during my apprenticeship under Mr George Cock (ex Royal Navy Artificer) who was a kindly and inspirational man who encouraged me to 'do my best at all times'. He allowed me to use all the wonderful workshop equipment to make my radio aluminium chassis' with welded corners which were like aviation standard flight hardware. I never again matched that standard. Like most good companies, I was sent off to day release and night school to study for the National Certificate in Electrical Engineering. I passed all that and went on to the Grad. IERE part 5 course at what was then the Harrow Technical College. I passed that. By that time I had finished my apprenticeship, and was a budding electronics development engineer. One day (in summer 1967) an offer appeared on the staff notice board for any engineers who wanted to continue their studies into electronics engineering. This appealed to me as I had not had the experience of university education, and I saw this as an opportunity to take another step up the ladder. I applied and was sent for interview at Cranfield University. I was accepted, and two years later completed a Masters Degree in electronics and communications engineering. Now I knew how Radio worked!

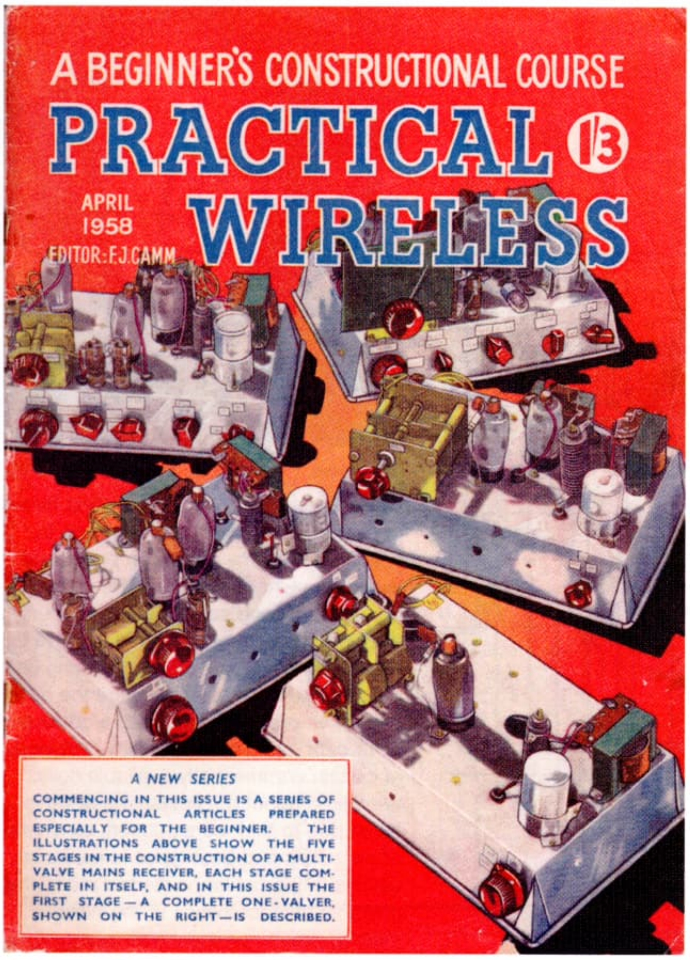
I continued employment with the company through its amalgamation with Marconi and the GEC empire. After about two years, it dawned on me that it was ok to carry on as an engineer, but if I wanted to progress (and earn a bit more money) then I would need to join the ranks of management, and look further afield for better opportunities. That's when my career really started, as I moved from company to company with increasing levels of position and responsibility. I had several roles as Technical Management, Project Management and Director of Research.

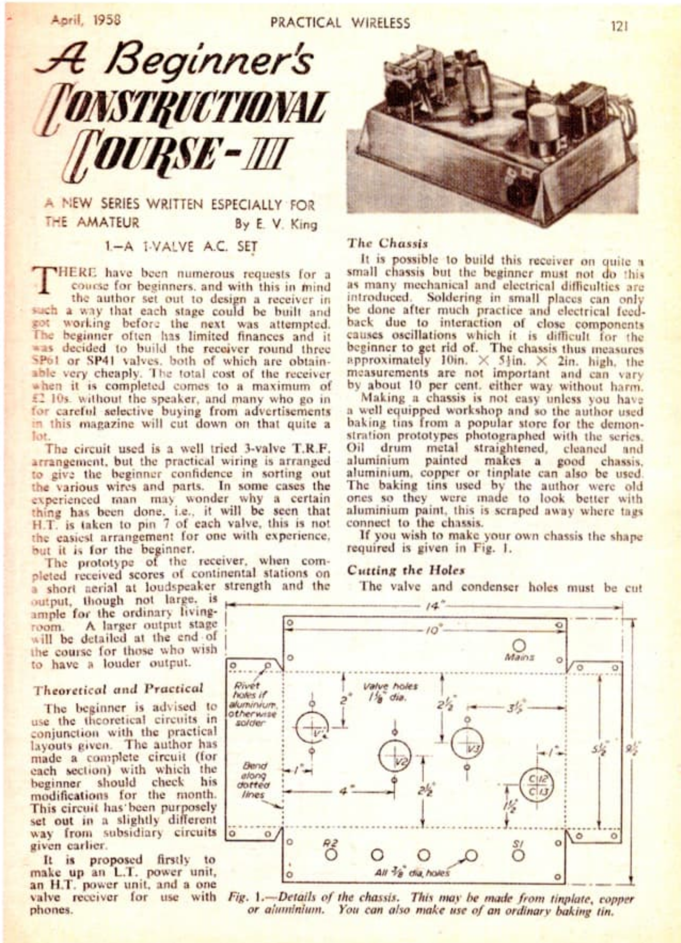
By now you will be thinking 'what was the point of all that?'. The point is that I left my roots a long way behind. I continued with Radio as a hobby, not as a career, as I worked in computer manufacturing, ships and oil transportation, colour print, and big IT projects in the service industry like 'call centres'. Over the years I enjoyed making old valve radios work again, made valve receivers of various types, trying out different ideas and looking at their performance. I have a small collection of radios that caught my eye, usually for reasons of performance rather than looks, one of which is an RCA AR88D. I learnt a lot going through that receiver from end to end, particularly the RF and IF alignments. With the AR88 the AF is questionable (as leaving the OP transformer off load can damage it, an oversight maybe) but probably not a war time priority. So over the years I have come across all sorts of ideas and applications of valve radio technology that I though might come in useful. I never used much of what I learnt in my M.Sc as I went off in a different direction. One day I promised myself that I would design and build a broadcast receiver with many performance enhancing circuits, proved practical, that would be interesting and enjoyable to do: and use some of which I learnt during my technical training. Commercial sets are what they are, commercial, mostly built to a price for the enjoyment of the listener. There were the exceptions like the McMurdo Silver, and others who designed and produced the most advanced broadcast receivers of their day. I always felt that the performance of the RF front end of commercial receivers was weak, and better designs would have made sets more versatile for long distance reception. The application of some communications receiver techniques and circuitry, could have improved things a lot. More about this later.

So much has been done with valve technology and radio circuitry, that I cannot claim that any of what I ended up using or producing was original. Just look at the Radio Designers Handbook by F Langford-Smith or Feedback Amplifier Design by Bode for instance. Practical applications come with all sorts of limitations, not everything is possible. What we do is 'stand on the shoulders of giants'. If it has been done and been proven to work in the past, you don't have to do it all again, use it and be thankful for the gift.

A dedication

I would like to dedicate this effort to two people. One you know, the other you probably will not. First of all I wish to thank




April, 1958 PRACTICAL WIRELESS 121

A Beginner's CONSTRUCTIONAL COURSE – III

A NEW SERIES WRITTEN ESPECIALLY FOR THE AMATEUR By E. V. King

1—A 1-VALVE A.C. SET

THERE have been numerous requests for a course for beginners, and with this in mind the author set out to design a receiver in such a way that each stage could be built and got working before the next was attempted. The beginner often has limited finances and it was decided to build the receiver round three SP61 or SP41 valves, both of which are obtainable very cheaply. The total cost of the receiver when it is completed comes to a maximum of £2 10s. without the speaker, and many who go in for careful selective buying from advertisements in this magazine will cut down on that quite a lot.

The circuit used is a well tried 3-valve T.R.F. arrangement, but the practical wiring is arranged to give the beginner confidence in sorting out the various wires and parts. In some cases the experienced man may wonder why a certain thing has been done, i.e., it will be seen that H.T. is taken to pin 7 of each valve, this is not the easiest arrangement for one with experience, but it is for the beginner.

The prototype of the receiver, when completed received scores of continental stations on a short aerial at loudspeaker strength and the output, though not large, is ample for the ordinary living-room. A larger output stage will be detailed at the end of the course for those who wish to have a louder output.

Theoretical and Practical

The beginner is advised to use the theoretical circuits in conjunction with the practical layouts given. The author has made a complete circuit (for each section) with which the beginner should check his modifications for the month. This circuit has been purposely set out in a slightly different way from subsidiary circuits given earlier.

It is proposed firstly to make up an L.T. power unit, an H.T. power unit, and a one valve receiver for use with phones.

The Chassis

It is possible to build this receiver on quite a small chassis but the beginner must not do this as many mechanical and electrical difficulties are introduced. Soldering in small places can only be done after much practice and electrical feedback due to interaction of close components causes oscillations which it is difficult for the beginner to get rid of. The chassis thus measures approximately 10in. × 5¼in. × 2in. high, the measurements are not important and can vary by about 10 per cent. either way without harm.

Making a chassis is not easy unless you have a well equipped workshop and so the author used baking tins from a popular store for the demonstration prototypes photographed with the series. Oil drum metal straightened, cleaned and aluminium painted makes a good chassis, aluminium, copper or tinplate can also be used. The baking tins used by the author were old ones so they were made to look better with aluminium paint, this is scraped away where tags connect to the chassis.

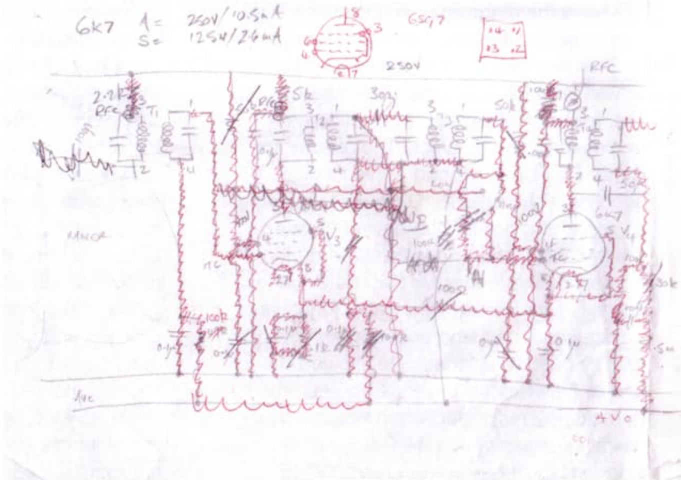
If you wish to make your own chassis the shape required is given in Fig. 1.

Cutting the Holes

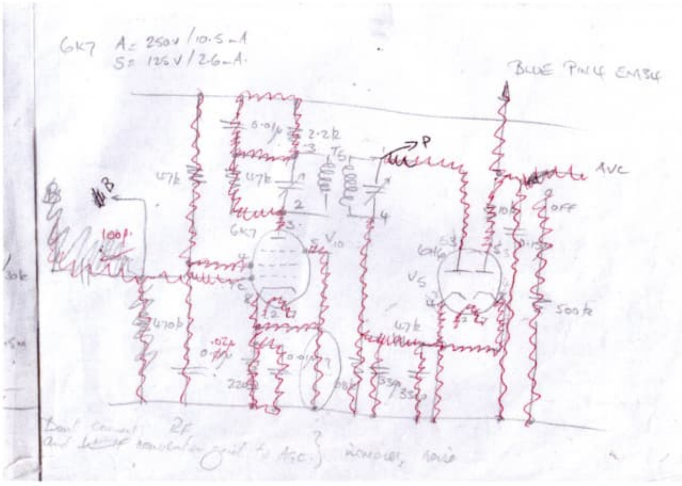
The valve and condenser holes must be cut

Fig. 1.—Details of the chassis. This may be made from tinplate, copper or aluminium. You can also make use of an ordinary baking tin.

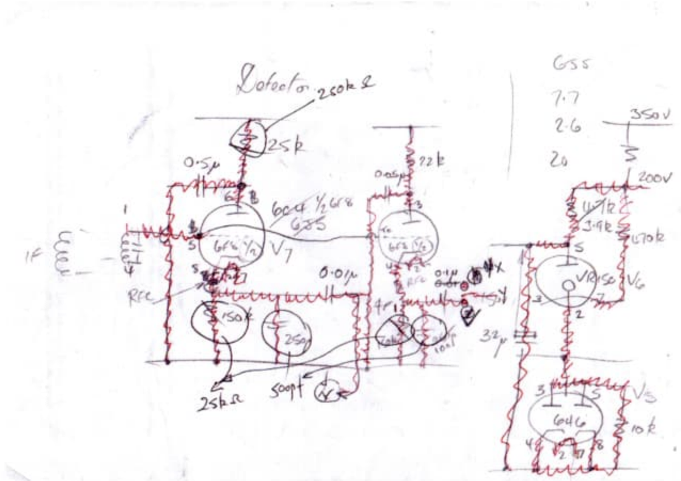
George - the supervisor of the project



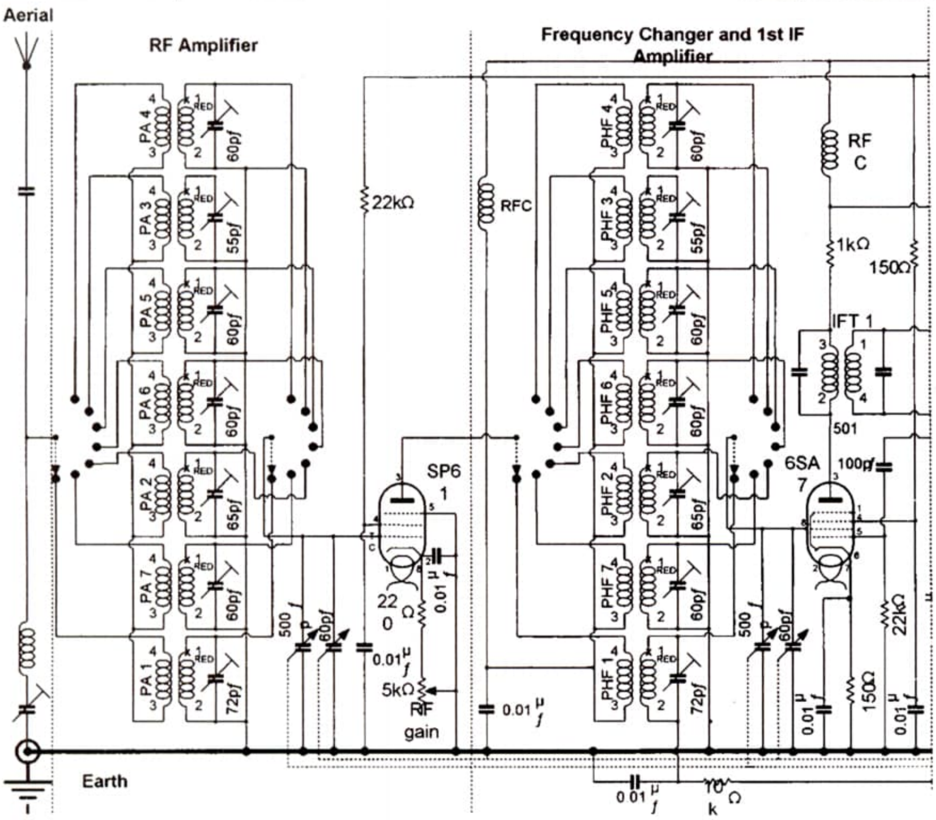
Initial thoughts for the IF strip circuit



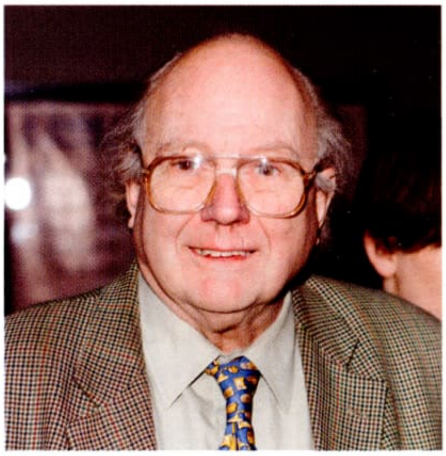
First ideas for the amplified AVC circuit



The original idea for the detectors



RF front end



Gerry Wells

Gerry Wells. When I was in the first throes of design about 4 years ago, I went to see Gerry with my design on paper and asked him what he thought. He looked at it carefully and said "there is so much gain in this, that you will need an anvil to hold it down". Oops! . We had a long chat about valve line-ups, what were the best type of valves, what generally worked and what didn't, and some stability problems of certain commercially available coils. We talked about the limitations of valve types due to their construction, elimination of parasitics and best types in particular circuits. In particular he alerted me to the unstable characteristics of the Wearite medium wave coil that I was intending to use, and how to dampen it with screening and series/parallel resistances. He went on to go through many valve set line-ups from memory, and the problems associated with getting the AVC to work properly, and where and how to use it. He suggested that I might use an ultra linear output stage as the performance improvement in AF was so great in comparison to the circuitry needed to actually do it. He was right. The amount of information in his head was astonishing. Gerry's given nick name for me, is 'fishing line'. Thank you Gerry.

The second person, was my tutor at Cranfield University, Mr Sydney Deards. This man was a genius in his subject. Top people of the day (the 1960's) from America, would fly over to discuss problems and issues with him. In turn, his guiding light or inspiration came from a man named Gabriel Kron, who devised and advanced Tensor Theory, into a mathematical system used to design such things as power stations. The method was known as Network Tearing. When Sydney took his class of students he gave an Albert Hall performance every time. When we had finished his course, we could synthesise a circuit from the transfer function that specified the requirement mathematically, by extracting elemental matrices that represented the components required to actually make it. This included transmission line and data encoding techniques now used in satellite communications. Another astonishing outcome. I once called into his office to admit that there was something that I did not understand. I suppose I expected a bit of admonishment. No, he sat me down, asked me if I would like a little drink of brandy from his cupboard, took out his Conway-Stewart fountain pen, and wrote the whole thing out for me. I still have that sheet of paper framed and hanging on the wall in my workshop. He passed away at an early age from heart problems that would be easily contained these days by medication. In his memory, I searched for a book he published in 1963 called 'Recent Developments in Network Theory'. I eventually found one, ex-libris, stamped 'Property of US Army, Technical Library, White Sands Missile Range'. That is the mark of the man. Thank you Sydney.

The project

What did I want to accomplish?

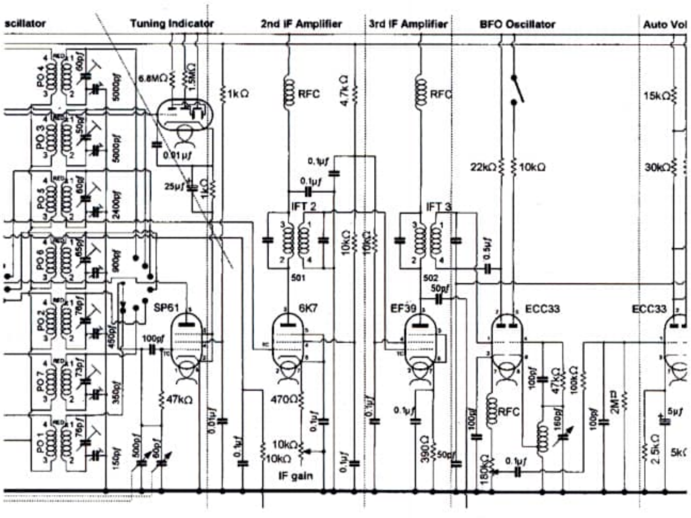
At the end of the exercise I wanted to have something that I could use and get some satisfaction from. Which meant that if I made something that did not work well enough, I should be prepared to take it out and start again. (I did a lot of that). Have a look at the scribblings I did that turned into first-pass designs that Gerry saw.

I wanted to use components that were obtainable from either new old stock, or from stripped downs from old radios. i.e. special components were out.

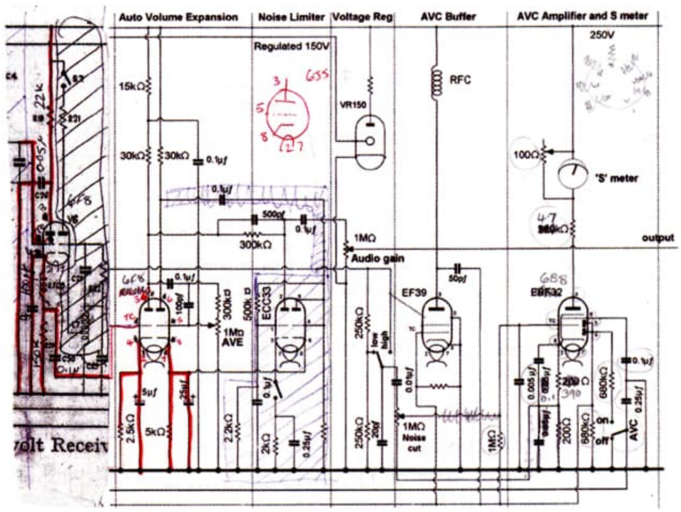
I had enough test gear to enable me to build and test sophisticated circuits. I would design some of my own circuits, and copy circuits known to perform well.

Coils and transformers would be hard to source, so I would use my Wearite coils and IF transformer parts that I had to hand. I had both a large capacity Radiospares mains transformer and a Partridge output transformer type P4014 (C core for ultra linear output stage) presented to me by Gerry. I had a full set of Wearite 'P' Type coils and Type 501/502 IF transformers saved for this project.

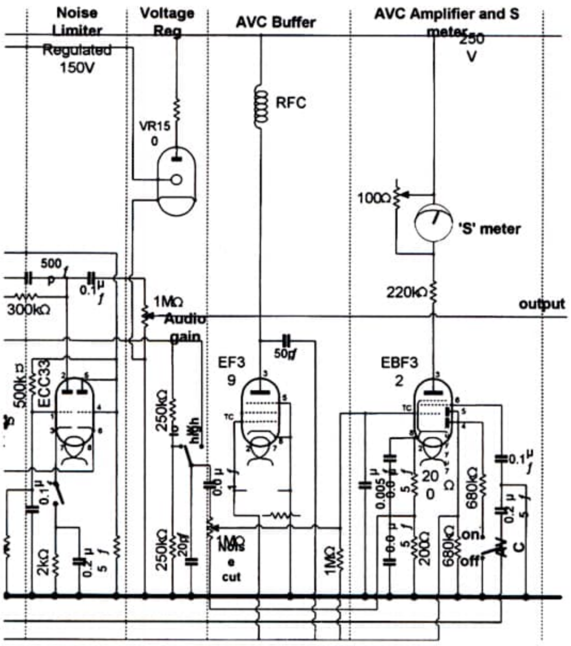
I incorporated switches and separate gain controls so that the circuitry could be modified and adjusted to test the effect of different configurations. (That was the fun part.)

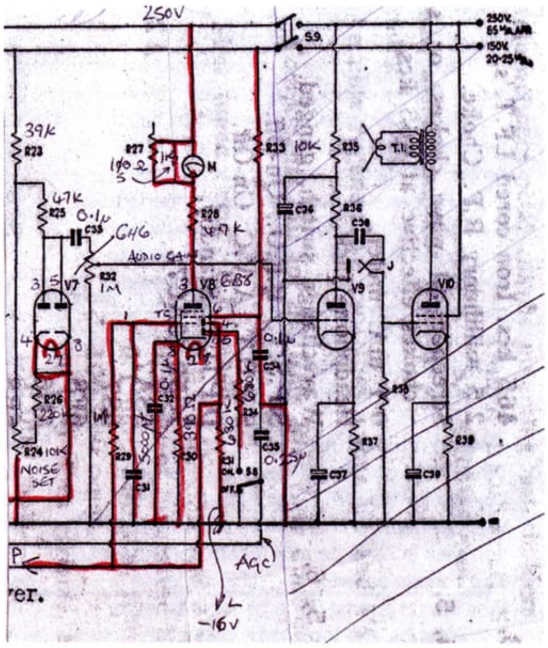


RF and IF



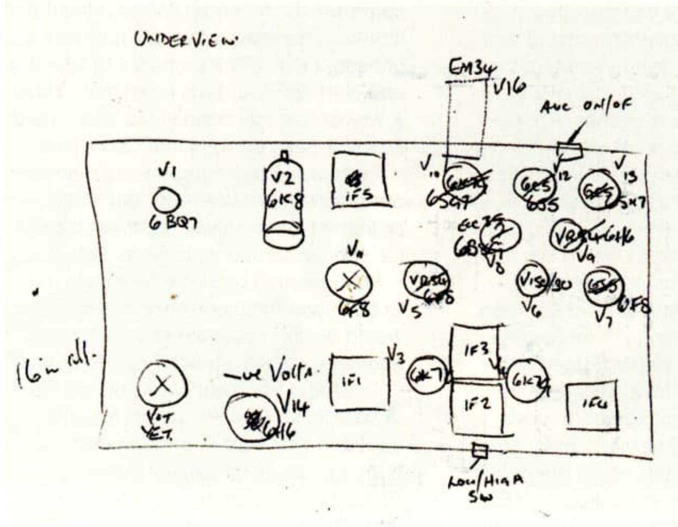
AVE, AVC, and S





Left: different valves

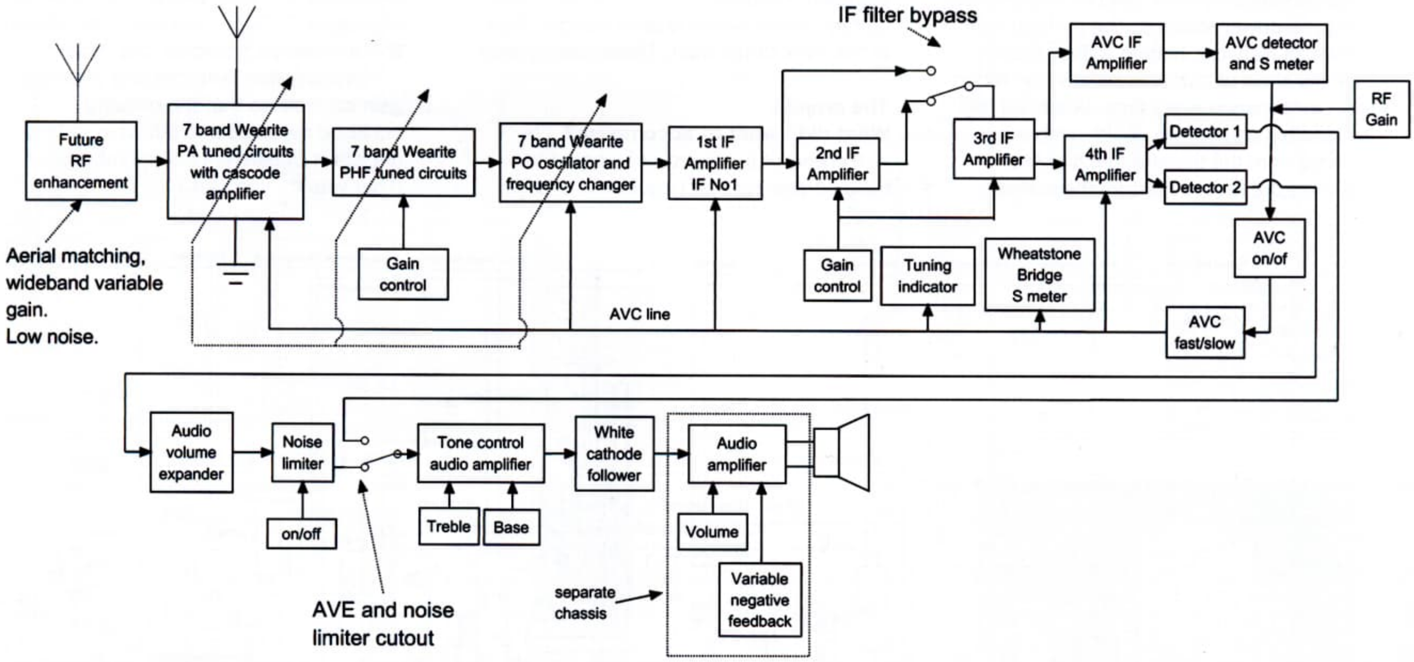
Far left: simple audio output



Rough layout

The System Block Diagram

This diagram shows the separate elements that make up the receiver as it is now. I have left myself with more RF front end work to do. The reason for this is (I am not short of ideas) that it took me a lot more work than I expected to get the RF coil circuits tuned up and working properly, and the other circuits needed sorting out. There was too much gain in the IF section in the original. The infinite impedance detector stages were introducing modulation hum. The 'S' meter was not sensitive enough. The AVC did not work properly. The Audio Volume Expander introduced too much bass emphasis that caused instability in the Tone Control pre-amplifier, and the main Audio Amplifier did not like the cable connection between the chassis, and was prone to 'motor-boating'. The first stage of the Audio Amplifier was noisy. Apart from that everything was fine.



Radio system block diagram

I built the RF/IF, AF amplifier and power supply on separate chassis and coupled them together with Jones plugs cables. Otherwise the physical size of a single chassis would have been unwieldy.

The Wearite coil set I had covered all seven frequencies in their ranges.

Because there were expected to be a lot of changes to the circuits as the project developed, I would not be able to incorporate metal screening. I needed a clear chassis to work in. I would tackle any instability from cross coupling as and when it happened. So a lot of electronic decoupling and gain control would be incorporated in preparation for trouble. This was to be a broadcast receiver, not a communications receiver.

Getting it tuned up

What I had with the circuitry suggested by Wearite for their 'P' type coil set, are coils with aperiodic primaries (means untuned) and tank (means parallel tuned) secondaries. The pundits called them 'tank' because they stored energy (for a periodic time) for a few cycles and the energy dies away exponentially and quickly. To maintain energy the tanks must be pumped continuously. Also, all the coils had a natural resonant frequency due to the self capacitance of the windings. If the self capacitance was near, or was a harmonic, of the frequency that was wanted, the coil would probably have been 'unstable' (as Gerry had warned me about regarding the Wearite PA/PHF7 coils).

During the process of tuning, I discovered that there were several peaks present in the range of the coil. I did not realise this for a time. I found the problem when adjusting the values of the trim and padder capacitors to get a nice peak, only to find that I could not get the tracking right when up or down the ends of a range. The ends of the frequency ranges were not where I had expected them, or the oscillator would stop before I got to the upper frequency end, or it would just not track. I thought 'hang on a minute there is something wrong here', and decided I had better start again. From then on things got more complicated! I sat back and thought where would I expect the right peak to be? In the centre, yes? In the centre of what? Was that the physical centre of the dial, or the arithmetic mean or the geometric mean, or the log (base 10 or 'e') mean? As the wiring was quite extensive, there would be an effect due to the stray and parasitic capacitance/inductance of the wiring. Would that increase or reduce the frequency ranges, and the end points at the edge of the dial? If the stray effects were not the same with the two RF gangs and the oscillator gang, would it ever work? A this point I was beginning to break out into a cold sweat. Would I ever get this to work? I then got to realise just what the men had achieved in the early days of radio design and manufacture, when the technology was new.

To digress for a moment, I recalled what it was like checking out the alignment of the AR88. As one would assume, the AR88, was something near right when one started. So lets look at the medium wave band end frequencies, find out what frequency is in the centre, then check the mathematics. I remember having a real job trying to tune the coils at the high frequency bands. I discovered that you could get the peak very nearly right by twiddling the caps and the cores. But, by physically altering the positions of the wiring with a plastic knitting needle, you could get it spot on. The selectivity and sensitivity was then superb. You don't see that trick mentioned in the books. The setting up of my radio was done by injecting a 1kc/s modulated RF signal at each tuned stage in the gang series. That means connecting the signal generator with a 47pf (there abouts) capacitor to the anode pin, with all the up-stream valves taken out, the capacitors were tuned for maximum at that stage. Pundits would say, use a dummy aerial, i.e. match the aerial impedance to the input terminals. That would be 200pf in series with 20μH, and 400pf in series with 400Ω that would be connected in parallel with the 20μH – discuss. However, the impedance changes with frequency so the component values have to change with the frequency to be inserted, so stuff it, 47pf worked for me. Then I put the valve in and move the signal injection to the preceding stage and repeated the process until I got to the aerial input. The output for the peaks could be heard (detected) at the loudspeaker terminals of the output transformer, which were terminated with a matching resistor and a decent AVO meter across the resistor measuring the voltage.

Now on the AR88 (or any suitable radio would do really) the ends of the medium wave band go from 540 metres to 190 metres, that is 555kc/s to 1430kc/s. The physical centre comes up at 343 metres, 875Kc/s. The arithmetic mean was 993kc/s, so it was not that. The geometric mean came up at 400kc/s, so it was not that. The log (base 10 and e) came up to 890kc/s, that would do me, as near enough. Using the same method, the centre frequencies of the other ranges were determined. Things were looking better. The signal generator was set up for the centre frequency for each range in turn. The oscillator circuit was tuned for maximum output at the 465kc/s IF frequency. Then the signal generator was tuned progressively towards the upper and lower ends in turn, trying to maintain maximum output. The trim was tuned for maximum output at the upper end, and the padder was tuned for maximum at the lower end; normal practice. This process was repeated for the HF and aerial coil circuits. So by this method I forced the centre frequency to turn up (roughly) in the centre of the dial. Now came the interesting bit. I started to increase/reduce the signal generator frequency and tracked it by tuning the main gang. When I got to a reasonable frequency step away from the centre, the trim was peaked when the step was higher than the centre and the padder was peaked when the step was lower than the centre. This standard process was repeated until I got to the ends of the bands. The top end is with the main gang capacitor wide open, the bottom end is with the main gang capacitor is fully closed. It is at the ends where you can see the effect of stray capacitance in the wiring and chassis. None of the bands reached the ends suggested in the Wearite data sheets, they were all lower frequency (longer wavelength) as expected. However, none of the bands reach the higher frequency ends by quite a margin, something was not right. The techies amongst us know the standard formulae for calculating frequency from known capacitance and inductance:

$$f = 1/2\pi\sqrt{(1/LC - r^2/4L^2)}$$

Where: f = resonant frequency in c/s
L = inductance in Henries
C = capacitance in farads
r = series resistance in ohms

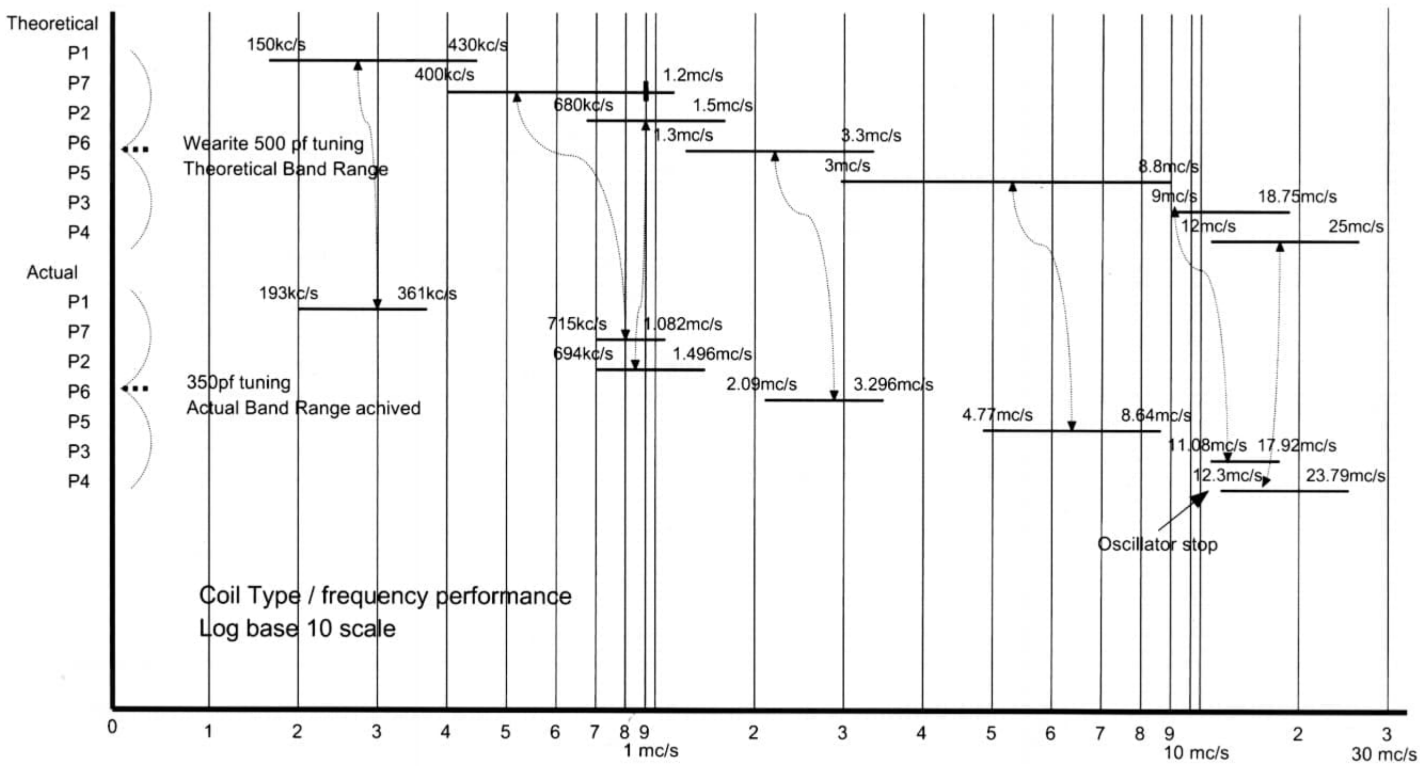
however the term at the right involving r is, usually in practical cases, so small as to be negligible. This leaves us with the familiar formula:

$$f = 1/2\pi\sqrt{(1/LC)}$$

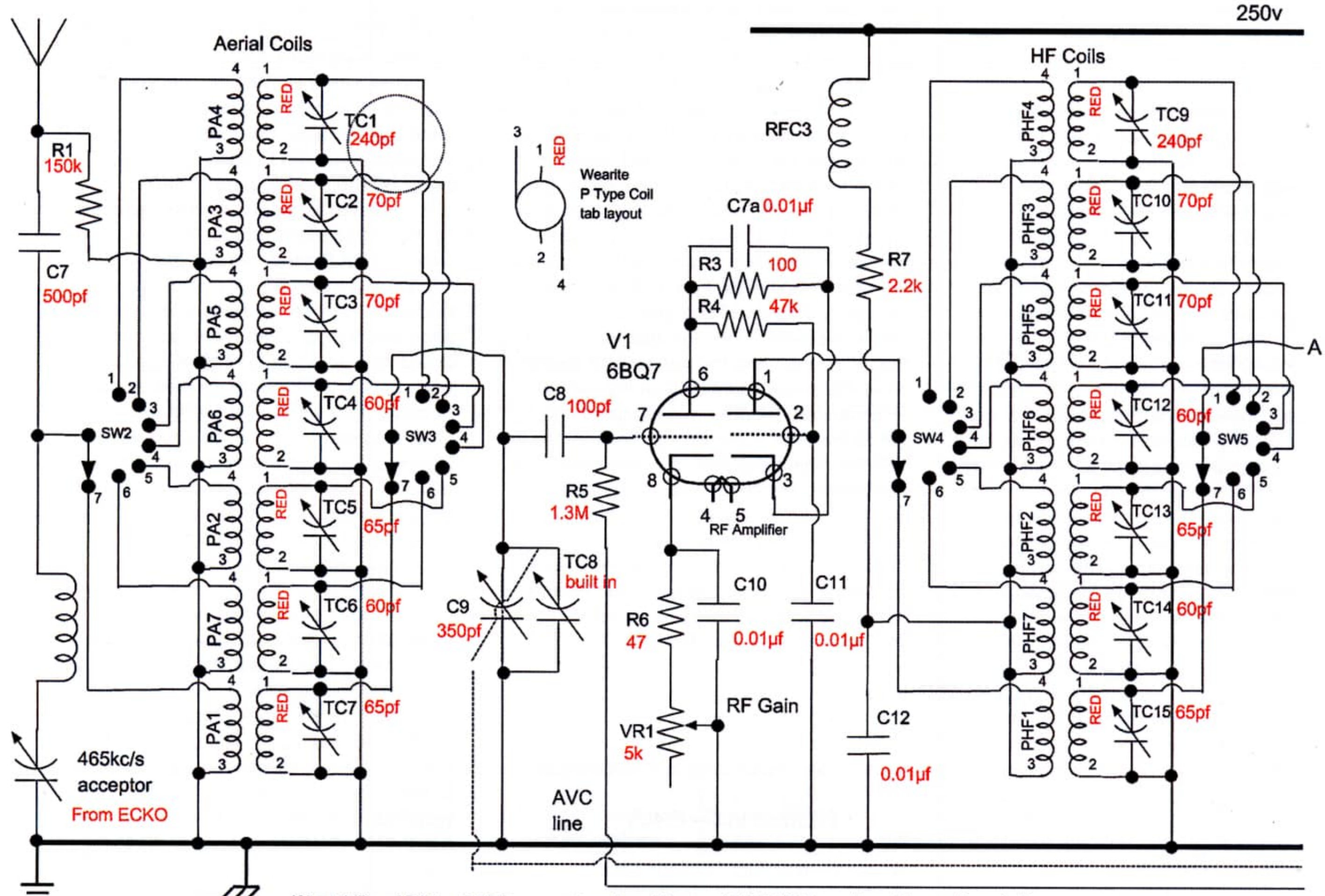
With this formula you can see that as the capacitance goes up, the frequency goes down.

Armed with this, a quick check showed that the high frequency end of the bands were about 150pf short of where they should be. (?) I took the screen cover off the main 3 gang capacitor, disconnected a few wires and connected up my capacitance bridge. Result... it was a 350pf 3 gang, not a 3 gang 500pf capacitor. I bought it off one of the nice traders at Harpenden Halls a few years back at a BVWS swap meet, as it was a brand new Jackson in original box dating back to the 1930's. A really nice piece of equipment with built in trimmers, the shaft was earthed between each gang (important at high frequencies), and had a screen cover incorporated around it, but the wrong value, that's another lesson in the bag. I would have to put up with short span wavebands, that was that.

The last part of the tune-up is known as Rocking the Gang (no, not with Elvis, although for some could be more interesting). This involved the peaking up of the triple gang tuning capacitors C9, C13 and C18 with their respective trimmers TC8, TC16 and TC17. The process starts (the way I did it) by injecting an RF signal of 890kc/s (in the centre of the medium wave band) modulated at 1kc/s, into the aerial socket. There is a 250pf blocking capacitor already in series with the aerial input. Only a small signal input voltage was required as we are now running through the RF amplifier, IF's and main amplifier. The AVC was switched off (SW10), and the AVE was switched off (SW12). The result was measured by placing my AVO meter across the loud speaker terminals in parallel with a 15Ω resistor. The Signal was tuned in with the main gang. When tuned to maximum volume, the oscillator

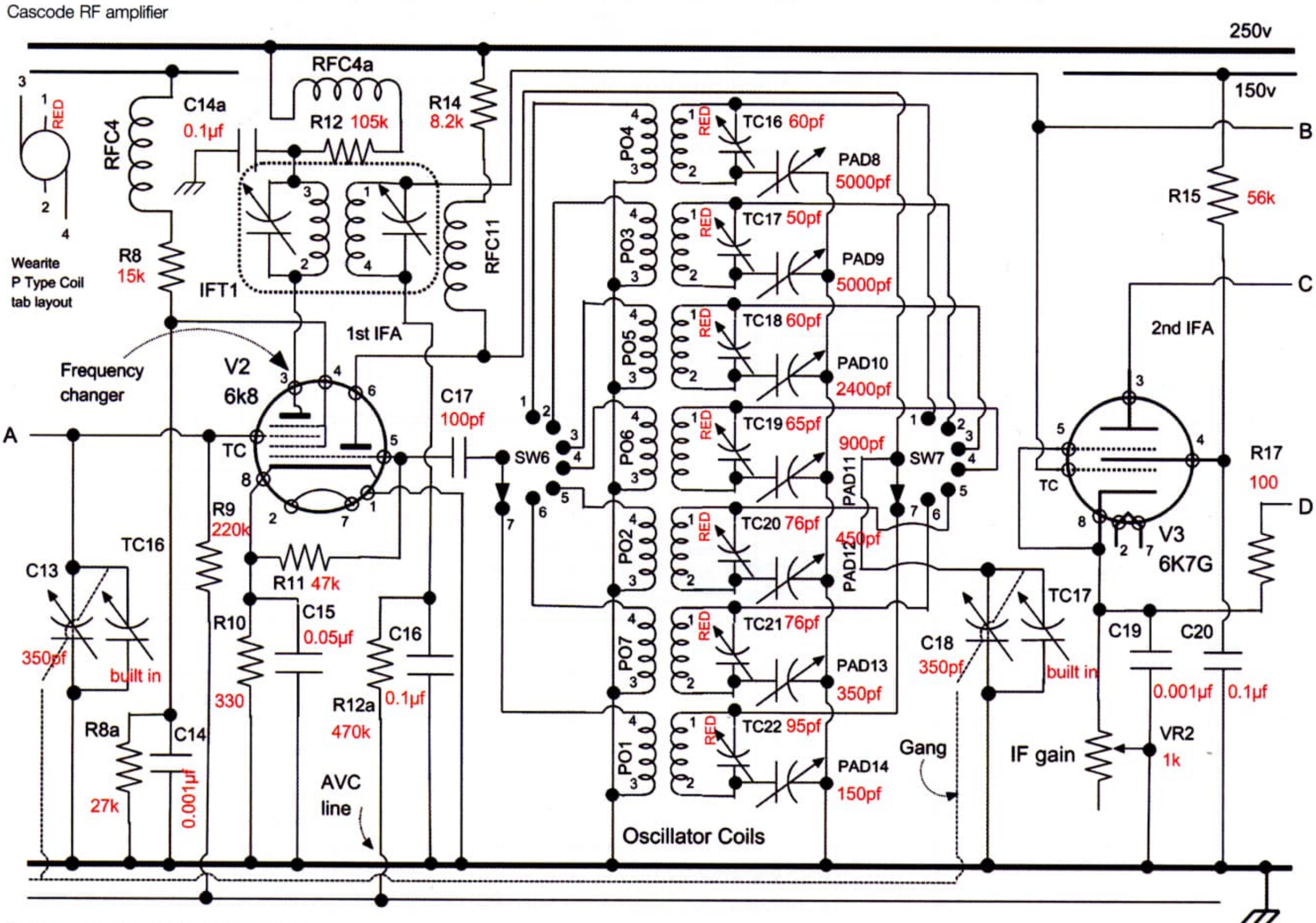


Frequency Range Graph

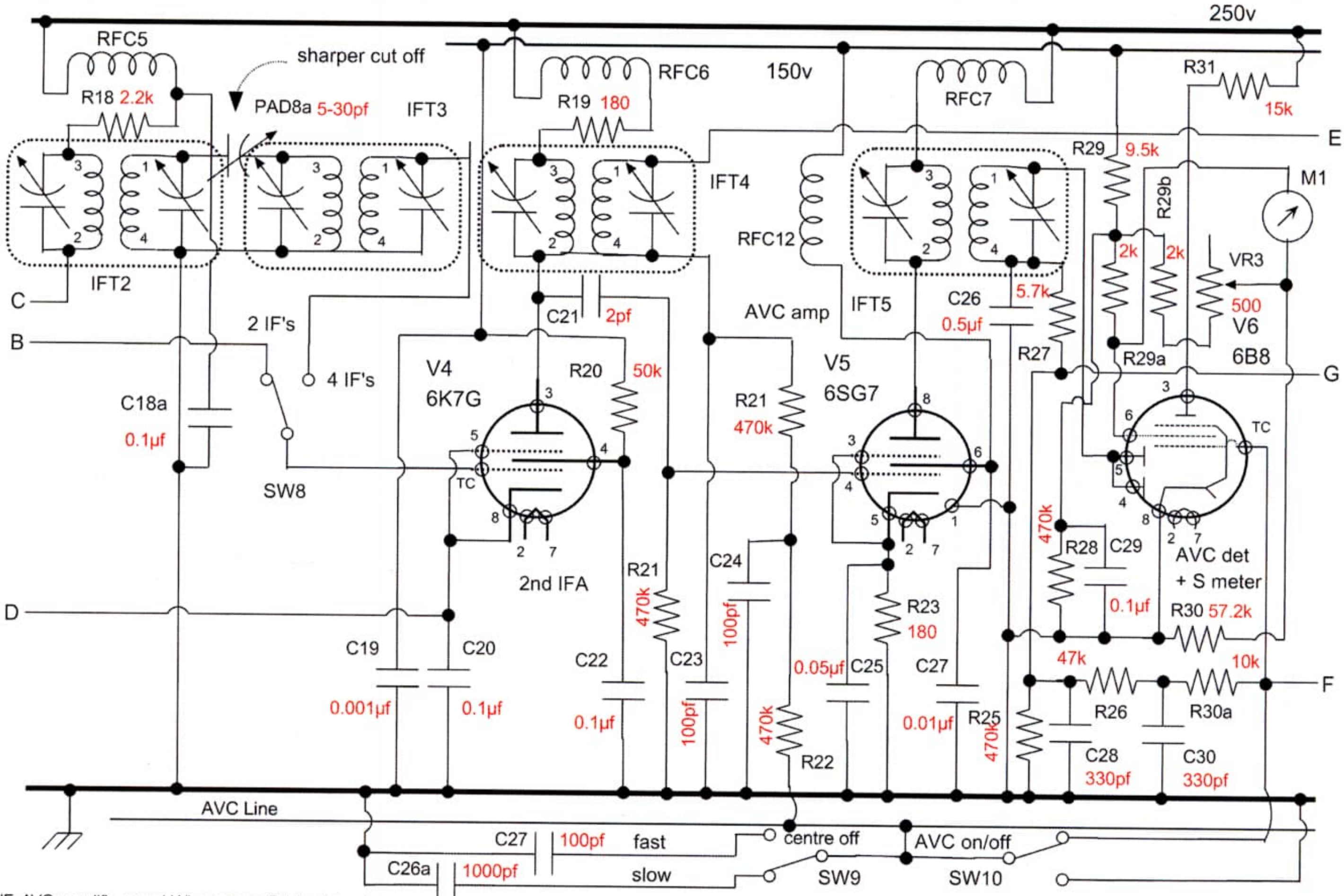


If instability of PA7 or PHF7 occurs, insert resistance of 50-500Ω in series with reaction winding.

Cascode RF amplifier



Frequency changer and 1st IF amplifier



IF, AVC amplifiers and Wheatstone Bridge S meter

trim TC17 was peaked by twiddling the adjustment screw to maximum volume. Then back to the main gang and adjust it again for maximum volume (rocking the gang). Then back to TC17 for another twiddle to get the maximum volume. Then back to the main gang and adjust again for maximum volume (rocking the gang). This was repeated until no further improvement could be made. Then I moved on to the HF trim TC16, and repeated the process just described as before for the oscillator. When that was done, I moved on to the aerial gang trim TC8, and again repeated the process. If you are a perfectionist, go back to TC17 and do it all again until no further improvement is apparent.

However with a bit of luck I did not have to resort to bending the main tuning gang capacitor leaves to maintain tracking. That's what the slots are for in outer leaves of tuning capacitor gangs, for bending with the nearest blunt instrument to hand, if you were wondering?

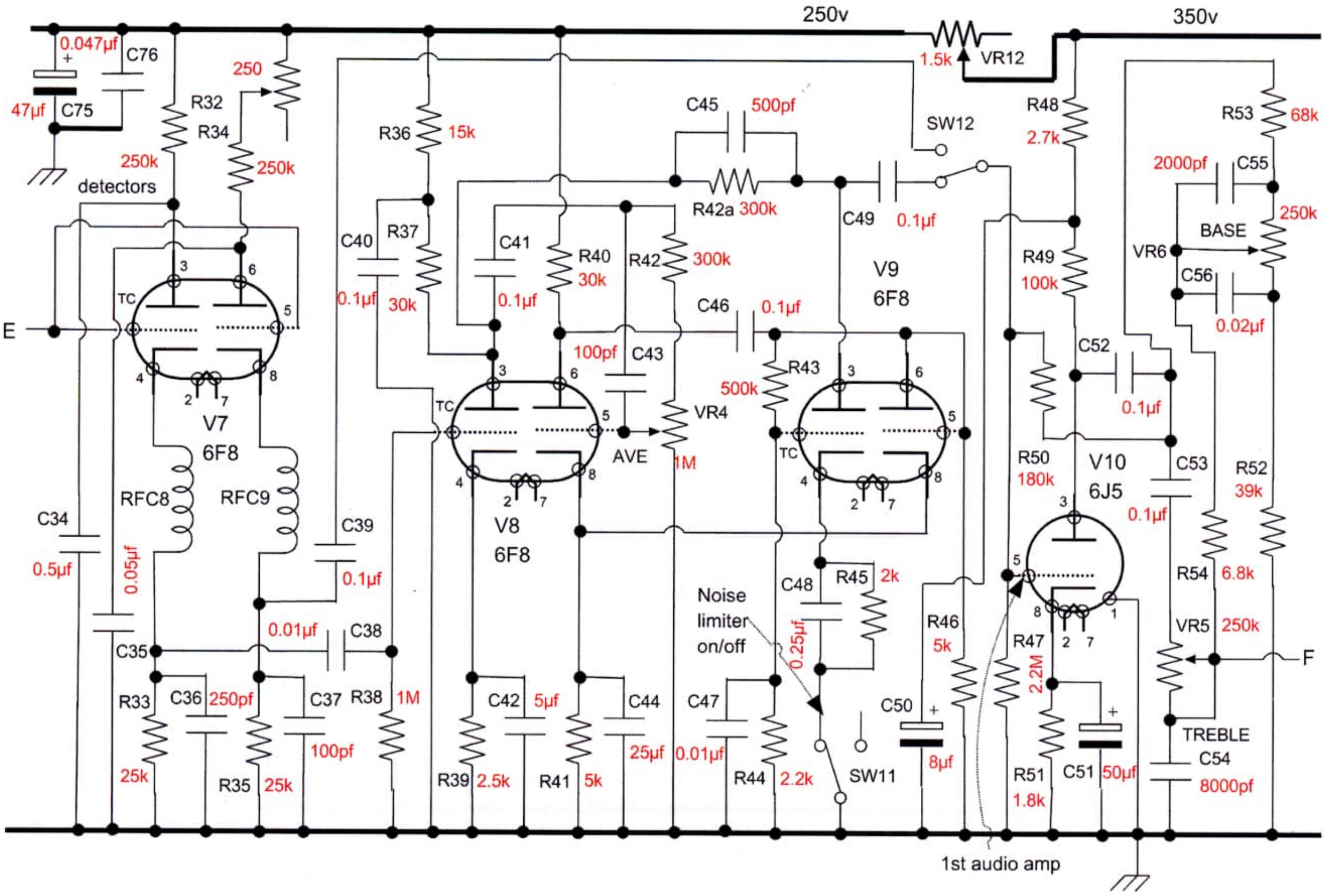
The other trick that used to be used in past design was to have separate accessible (tuneable with a knob on them out through the front panel) trim capacitors associated with the RF gangs. Therefore the critical maintenance of tracking was not then a concern. It seems that it would have been much easier to correct errors to achieve peak performance all the time. Now why didn't I think of that? Maybe there are drawbacks that I am not aware of, maybe three knobs to twiddle instead of just one.

When you tune up your AR88, the first thing you do is make your sandwiches and a flask of coffee ready for the day.

If you look at the graph, the actual frequency ranges achieved can be compared with the theoretical ones offered by Wearite in their data sheets. The frequency range bands are plotted on a three cycles of log 'base 10' format sheet, generated on a computer to make the lines more visible, as there is no fine line background to confuse the eye (that there would have been had I used pre-printed graph paper).

The data used to create the graph came from the calculation table on page 39. For each Coil type, the theoretical wavelength and frequency are shown at the top of the columns. The higher frequency is shown to the left of the centre, and the lower frequency is shown to the right of the centre frequency. The centre frequency is the log base 10 mean, the derivation of which is described earlier. The main gang effect for 500pf and 350pf is shown in the middle rows, by which I mean the frequency range that could be achieved. The actual wavelengths and frequencies achieved are the bottom two rows. The graph on page 25 is constructed from the theoretical and actual frequency results from this table. The thought crossed my mind that it would be possible to derive formulae, to enable the actual stray capacitance and inductance to be calculated from the differences between the theoretical and actual frequencies measured. If it is assumed that the inductance and trim capacitance for the Wearite coils on their data sheets are correct. The self capacitance of the coils could be measured on a suitable meter (of which I have two). It is the tolerances of the data provided, and the measurement accuracy that would lead to approximate results. I decided not to bother.

The RF amplifier.
The Wearite coils used in this design are air cored; that is, there are no cores for permeability tuning and would consequently have a lesser 'Q'. In recognition of this feature in this superheterodyne receiver, it was decided to incorporate a tuned aerial coil stage with a good performance amplifier, to aid discrimination against unwanted signals manifesting themselves as images and other spurious responses. By image, is meant RF signals arriving out of the RF circuits, into the IF strip, 465kc/s above or below the oscillator frequency. These can be rather tedious as they result in the station appearing at two or three places on the dial. It is normal convention to design the system so that the higher 465kc/s signal is used, and the lower one rejected. This problem cannot be sorted out by the IF strip, both are amplified equally. Rejection is effected by high Q tuned circuits. The pundits say that tuned circuits require coils of Q above 50. So lets see what the Wearite medium and long wave coils came up with. The equation for the calculation of Q (assuming a single layer coils)(keep it simple) is:



Detectors, AVE, noise suppression and 1st AF amplifier

$$Q = 2\pi fL/r$$

Where f = resonant frequency in c/s
L = Inductance in Henries
r = series resistance in ohms of the primary coil

For the long wave PA1 coil, r = 34Ω
At the upper frequency 430kc/s, Q = 174
At the lower frequency 150kc/s, Q = 60

For the medium wave PA7 coil, r = 5.5Ω
At the upper frequency 1.2Mc/s, Q = 3016
At the lower frequency 400kc/s, Q = 1005

So you can see why the long wave stations have a spread peak when tuning in! Well, they do on this receiver anyway.

In the original valve line-up I tried a 6K7GT, a 6S7, an EF39 and an SP61 as the RF amplifier. The gain performance was variable. As the gain went up so did the noise as the AVC worked harder to keep it down, right again Gerry. Now it is not normal practice to apply AVC to the front end RF amplifier, but allow it to run flat out. BUT the next iteration in the design of this receiver is to place another RF amplifier ahead. So I cheated a bit and looked at what some communications receivers were using, and came to the conclusion that a cascode stage (variable µ valve) with manual setting gain would be best.

The cascode is a double triode valve that gives the advantages of a pentode with none of its disadvantages. The cascode bears considerable similarity to the pentode in that the arrangement of components (R3,R4,C7,C11) acts like a screen grid bias supply. The circuit has a very high 'ra', approximately equal to the 'ra' of the input, multiplied by (µ+1) of the output section. The operation is as follows. The output section has an anode load R7, but instead of modulating Vgk by varying the grid voltage, and holding the cathode constant, the cathode voltage is modulated, and the grid is held constant. The upper grid is biased to a voltage that is necessary for linear operation of the output section, and is held at AC ground by the capacitor C11. This is significant, because it means that the cathode is screened from the anode by the grid, so Miller capacitance is eliminated. The 'Miller Effect' is the capacitive coupling between the grid and anode of a valve, and limits the upper frequency capability of the valve by damping tuned circuits connected to it. Because we are modulating the cathode rather than the grid voltage, this part of the section is non-inverting. Although the output section has a grid in the way of the electron stream, it does not draw current, so partition noise does not occur. The input section operates as a normal common cathode, except that it has as its anode load the cathode of the output section. Because the impedance looking into the cathode is low, the gain of the input section to its anode is low, so its Miller capacitance is also low. Another way to view the cascode is to consider that both the cascode and the pentode mask the changing voltage across R7 from the sensitive input circuit, and thereby reducing the input capacitance. A pentode does this by adding an internal screen between the input grid and anode, and directly reduces Cag. Whereas the cascode grounds the grid of the output section(which then acts as a screen) and drives the output cathode from the input section. Because the input section has a low value of load resistance, it would generate considerable distortion if it were allowed to swing very many volts. Fortunately, most of the gain is provided by the upper section, and so distortion of the lower section is not a significant problem.

The only general purpose valve that was designed to work well in a cascode was the 6DJ8 (special quality version). However, as I did not have one of those in stock, I put up with a 6BQ7.

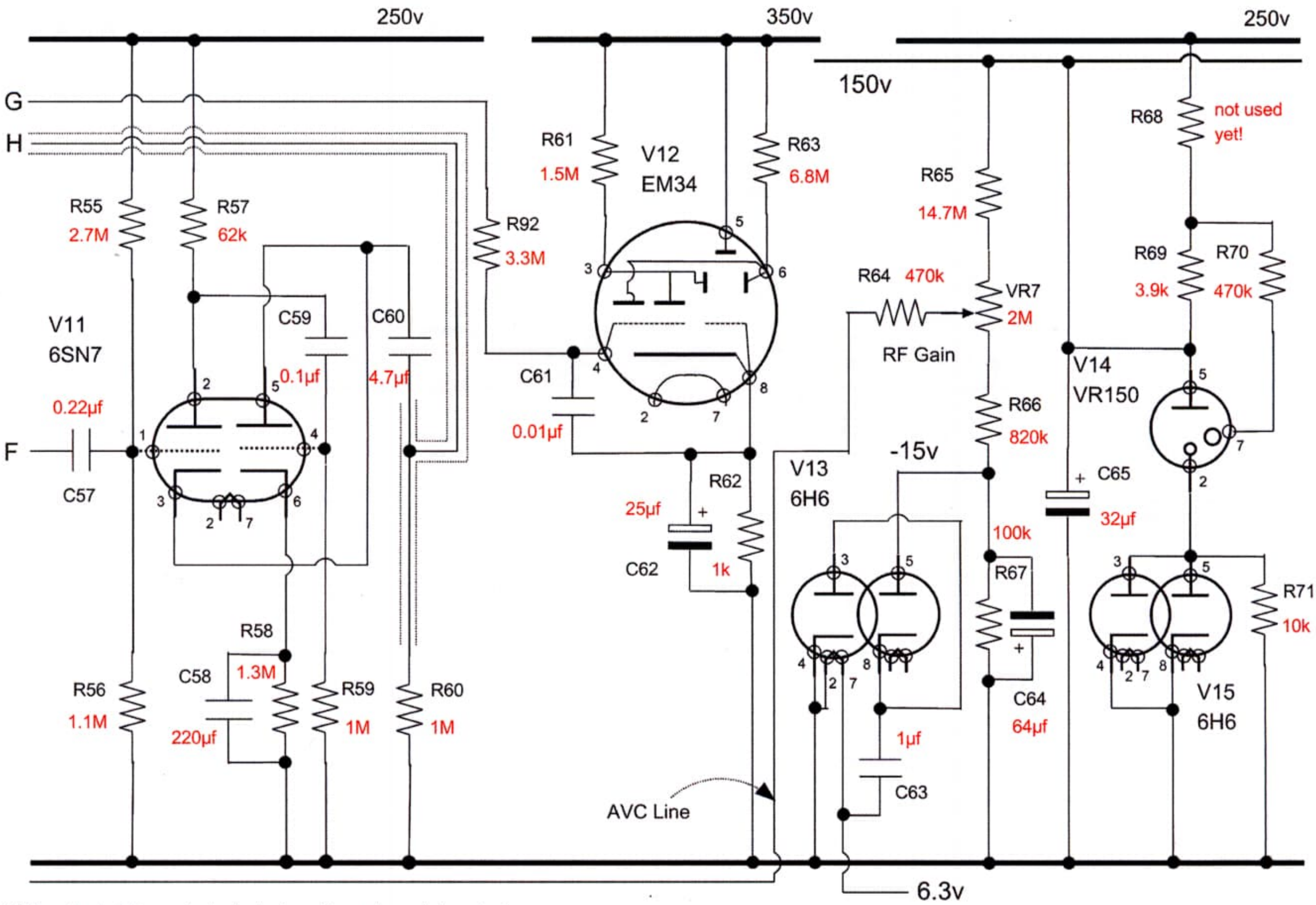
Finally, to incorporate a manual gain control for this stage, I incorporated in the input valve cathode a bias circuit R6 and VR1, bypassed by C10. The result was excellent.

The formula for the RF gain is:

$$Av = \frac{1}{\frac{1}{gm_1 \times R_L} + \frac{r_{a2} + R_L}{R_L} \times \frac{1}{\mu 1(\mu_2 + 1)}}$$

It is sufficient to say it works. It has high input impedance, has low noise up to frequencies like 70Mc/s and high variable (controllable) gain.

Proven practice says that best low noise radio is obtained by making the first stage have as high a gain as possible, and then reducing the gain



White cathode follower, tuning indicator, -15 supply, and slow start

of the following stages to compensate. That meant that the gain of the IF stages would have to be controllable (another change in the design – right again Gerry)

The Mixer (Frequency Converter) and 1st IF Stage.

I tried a few valve circuits of different types and came across problems. Where the mixer and 1st IF valves were separate types, the wiring and physical spacing became real issues. Wearite recommended the Hartley oscillator type for their PO coils, so that's the way I went. No point in trying to be clever here as I would never match their knowledge and experience. There is nobody available from Wright and Wear Ltd to ask now, pity.

With my original layout, the oscillator would cease working as the frequencies got into the top short wave bands, and the set would go deaf. If the physical spacing of separate valves and their components got close, they would go unstable and start self oscillation. Now what? I had to resort to mounting the mixer valve under the chassis to get as close to the HF and oscillator coils as possible, as the tuning gang capacitor occupied the position where the valve should go. I tucked my pride out of sight, and resorted to tried and tested proven circuits. The well known 6K8 (triode–hexode, variable µ) came to the top of the list as it was designed purposely as a frequency changer and 1st IF driver, and with belts and braces on it, could be obtained with a metal casing (screening incorporated). The biasing and control voltages are well known. I think that it was designed by RCA in the USA. It worked, and worked nicely. It would go nearly all the way right to the top of the 12 meter band at 25Mc/s, where stray capacitance in the wiring became very significant. I can see now why so much design effort is put into things like turrets and separate compartment screening. I reckon I have done well to get my non screened layout to go as high as it did.

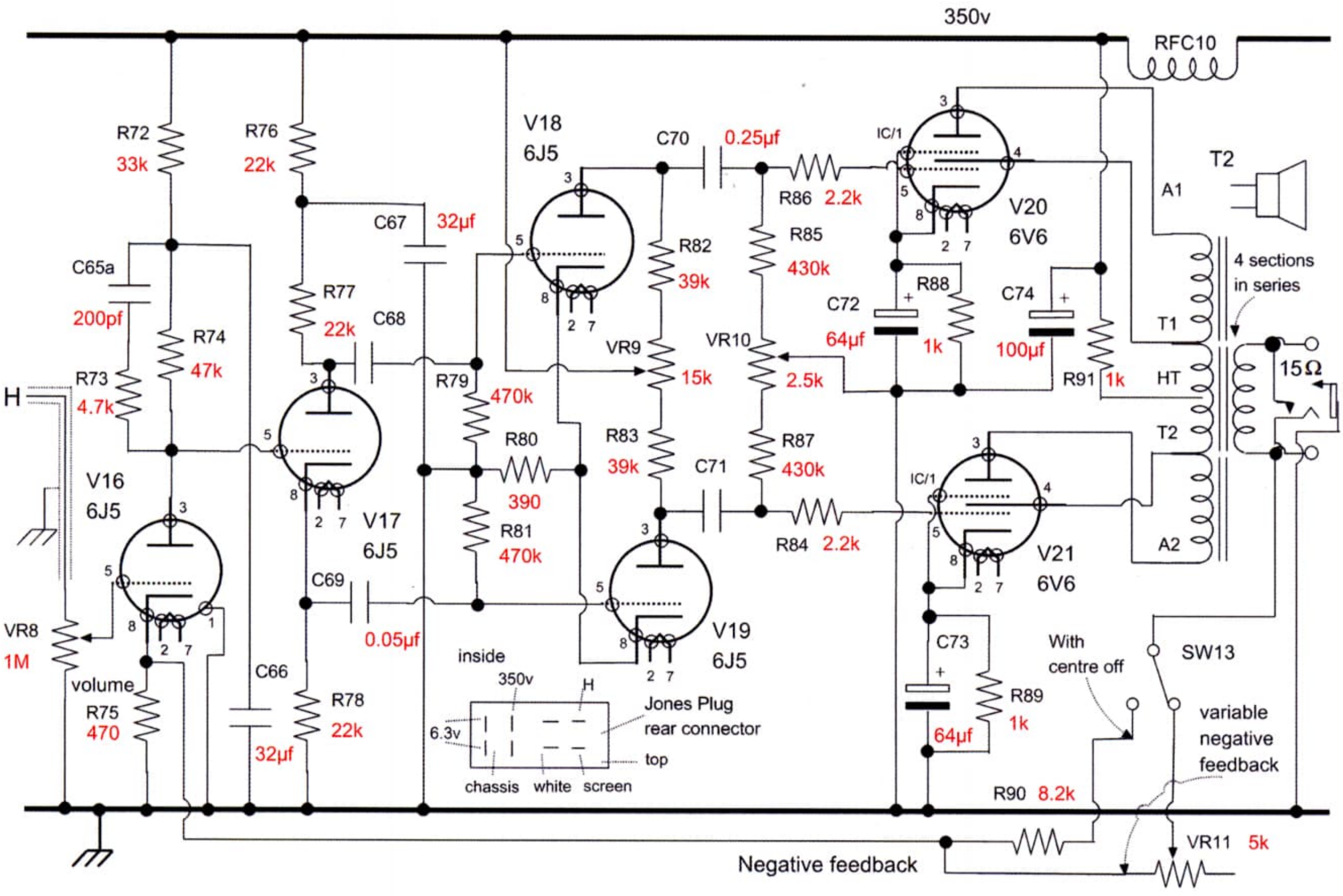
The IF Amplifiers

The IF frequency of 465kc/s was used as the Wearite IF transformers types 501/502 were designed for that frequency. I had enough nice new(old) ones in stock. A little bit of insight helps here. The type 501's were critically coupled and had grid connections from the top of the can, while the 502's were increased (over-coupled) coupling for use in a diode stage, i.e. AVC input diode, but did not have a top connection on the can. At 465kc/s with average valves (6K7) and circuit conditions, the approximate bandwidth obtained from a pair of transformers (standard super heterodyne radio setup) was 8kc/s at 2db, 9kc/s at 6db and 18kc/s at 20db. It was odd that Wearite quoted the bandwidth at 8kc/s because a designers normal gauge point was always at 3db (being the linear half power point). As the range of adjustment was quoted at 450kc/s to 470kc/s it allowed for some experimentation later on. The 501's being already critically coupled made setting up much easier. When each half was peaked up properly, the pass band was nicely centered around the 465kc/s.

As far as I was concerned there was no contest on what valves to use, they would be 6K7G types (Thank you Gerry). They were designed for the job. The characteristics are well known, they work well, and are variable µ. The variable µ was going to be necessary to control the gain of valves V3 and V4. I designed the cathode circuits of these two valves to come together with R17, VR2 and AC decoupled by C19 and C20. Testing showed that the circuit worked well. I did not bother to calculate the actual range of gain as it worked quite satisfactorily. But of course the AVC line was then disconnected, otherwise the set would have been shaking hands with itself.

The IF strip consisted of three stages, comprising Valves V2, V3 and V4. Switch 8 selects either IFT1 and IFT4, or IFT1, IFT2, IFT3 and IFT4. The aim here was to be able to make the IFT strip more selective to reduce signals arriving from the mixer outside a 10kc/s (that looked on the wobulator/oscilloscope about were the 3db points were) wide pass band. Introducing 4 IFT's was much more preferable than resorting to special windings added to the IFT's themselves. The IFT's 1 and 4, were tuned to the standard 10kc/s pass band using a 465kc/s signal injected at pin 3 of the socket of V2 with it out of the base.

The inclusion of IFT2 and IFT3 enabled me to experiment with different setups and to listen to the results. These IFT's could be tuned straight at 465kc/s, or to high and low offset or to variable



Ultra linear audio amplifier

coupling by PAD8, in a similar way to some communication receivers. An offset adjustment was interesting. This was done by setting IFT2 to 462.5kc/s and IFT3 to 467.5kc/s, giving a theoretical pass band of 5kc/s. Such setups are sometimes called stagger tuned. The AR88 has this facility. Reducing the coupling between IFT2 and IFT3 via PAD8, and increasing the gain to compensate, produced a 'pointy hump' shape characteristic. This sounded like a telephone conversation on a bad day (OK for Morse code), or news radio station LBC 1152kc/s medium wave on a good day. LBC 1152 have a really peculiar (very annoying) habit of superimposing background music (Spike Milligan referred to this type of behavior as 'drums along the Limpopo') over the announcer to heighten the tension, then you can't understand it at all.

Detectors, Audio Volume Expander and Tone Controls.

Detectors

I rather fancied trying detectors known as 'infinite impedance' or otherwise known as reflex, as this design would offer the least loading on the output of IFT4. One does not come across these very often in commercial radios, probably because there were a few components involved as opposed to one resistor in the leaky grid type - cheapskates! The reflex has is roots in the cathode follower circuit with negative feedback. The detector valve in circuit is V7, a 6F8. Apart from having a very high input impedance, if the values R33, C36,R35 and C37 are adjusted for low R's and high C's, a lot of negative feedback is introduced that improves the fidelity (distortion decreases) but reduces gain (note for Gerry). This could be taken all the way to 100% feedback, which gave superb fidelity but with less than unity gain, accomplished by controlling the size of the cathode bypass capacitor and the load resistance between the anode and cathode. This design is very tolerant of highish input voltage. The pundits say that the total harmonic distortion of around 3%, even when the modulation depth approaches 100%, is achieved. The only point to note is that these detectors cannot provide AVC, so additional circuits were required. I designed into this radio a separate AVC amplifier to feed separate AVC diodes.

However, it was not all plain sailing. When the set gain was turned up there was an appreciable hum in the audio output. I chased this around for a long time getting frustrated, until I found by luck that putting my hand near the detector 6F8 raised the hum significantly. Luckily the hum was practically eliminated by screening the valve. I used the one and only Goat valve screen that I had for years and never had a use for it. It is rather an odd thing, in that it is a very close fit to the glass envelope, comes in two halves held together by a circular wire ring. The job was completed by linking the screen to chassis by a soldered wire. The next problem was that this valve turned out to be microphonic. Apart from mounting the valve base on rubber grommets, this problem was not going to be solvable. This problem does not manifest itself until the gain is turned up high. I decided to put up with it.

One of the design considerations for this radio, was to be able to select the AVE circuit, or bypass it, into the tone control amplifier. This was done with SW12.

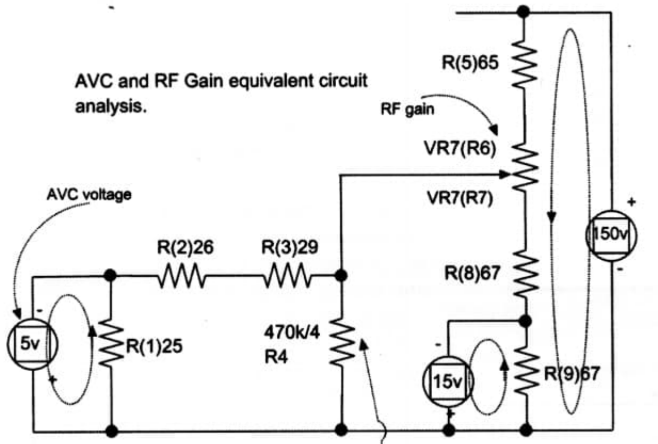
The AVE circuit.

The inclusion of an Audio Volume Expander was a real experiment. In circuit, the AVE valves are V8 and V9, both 6F8's. I wanted to hear what the effect was on the 9kc/s bandwidth limitation on AM broadcasts. It was one of those facilities designed into the ultra–luxury receivers of the 1920's and 30's, like the McMurdo Silvers, Scott-Taggart, and Majestic. The pundits describe the maximum volume range as the difference in decibels between the maximum sound output and the level of masking by background noise. The maximum volume range of a good AM broadcast transmitter is about 50db. Apparently the average norm is about 35db (but not station LBC 1152). So if the original programme material volume range like music is to be reproduced, it needs to be expanded. One big advantage is that the background noise is reduced; and it does do that. Listening results show that the normal background hiss when tuning through the bands between stations is indeed reduced to the point where it can hardly be heard. When the AVE is switched into circuit, you think the radio has stopped working! As the circuit is not clairvoyant, it can't be perfect as it does not know what the original levels were, so you can have fun by knob twiddling and see what you get.

The circuit chosen was that which was developed by the chief engineer of McMurdo Silver Corporation of America. The actual types specified were 6F8's, so the biasing was already set up correctly in the circuit; I did not have to change biasing for a different type of valve. The essential operation is by time delay to eliminate background noises due to atmospherics, so that they become inaudible against strong signals. The essential time delaying capacitor is C47. The recommended values for the control capacitor were 0.001µf up to 0.5µf, and the shunt resistor R44 were 1kΩ to 3kΩ. After experimenting, I settled on C47 as 0.01µf, and R44 as 2.2k, as a good average effect. The actual degree of expansion contrast is controlled by VR4. The noise suppression is cut in/out with SW11.

The signal into the tone control valve is selected by SW12.

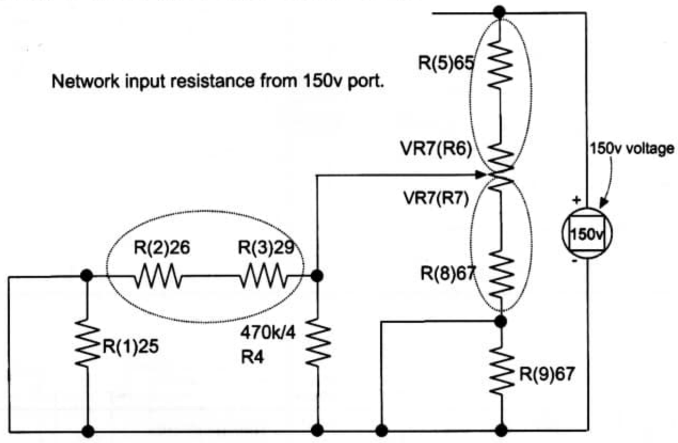
Below: AVC and RF gain equivalent circuit

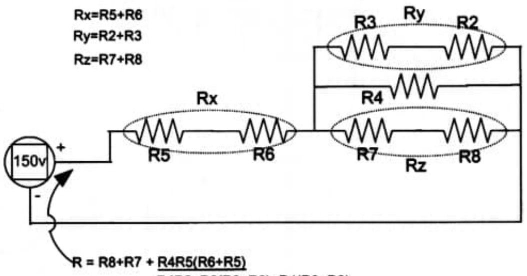


	VR7 min		VR7 min		VR7 max		VR7 max	
	AVC 0v		AVC -5v		AVC 0V		AVC -5v	
R1	0	0	-74µA	-5v	0	0	-74µA	-5v
R2	6µA	280mv	-26µA	-1.2v	-3.2µA	-152mv	-33µA	-1.5v
R3	6µA	60mv	-26µA	-255mv	-3.2µA	-32mv	-33µA	-330mv
R4	-3µA	-340mv	-30µA	-3.5v	1.6µA	184mv	-27µA	-3.1v
R5	9µA	132v	9µA	135v	10.2µA	150mv	10.4µA	153v
R6	9µA	18v	9µA	18.4v	0	0	0	0
R7	0	0	0	0	5.4µA	10.7v	4.2µA	8.4v
R8	18µA	15v	14µA	11.5v	5.4µA	4.4v	4.2µA	3.5v
R9	-150µA	-15v	-150µA	-15v	-150µA	-15v	-150µA	-15v

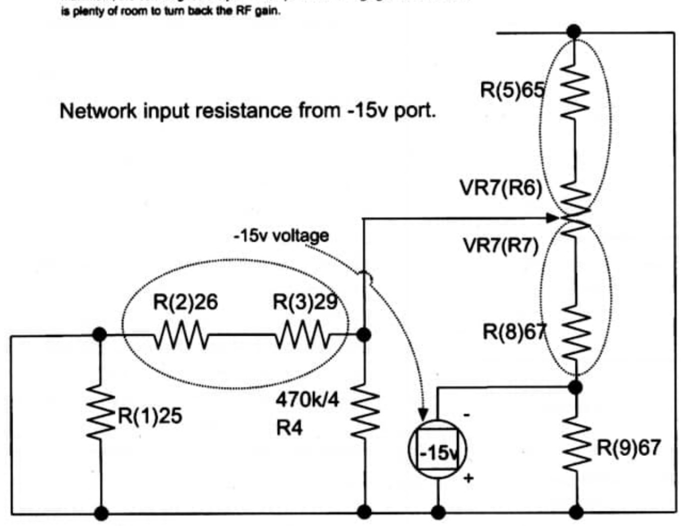
This is the critical number, when there is a weak signal and RF gain turned to maximum, the control grids are just driven positive. If things go unstable there is plenty of room to turn back the RF gain.

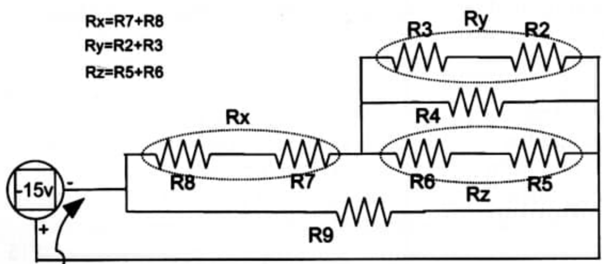
Below: AVC and RF gain equivalent circuit 150v input





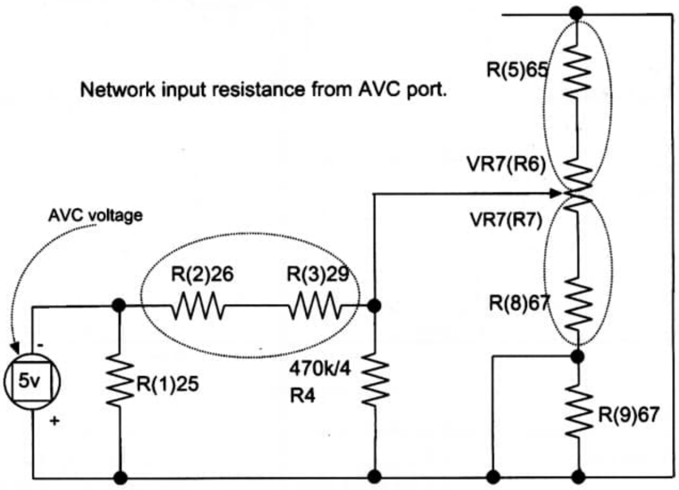
$$R = \frac{R8+R7+\dfrac{R4R5(R6+R5)}{R4R2+R2(R3+R2)+R4(R3+R2)}}{R8+R7+\dfrac{R4R5(R6+R5)}{R4R5+R5(R6+R5)+R4(R6+R5)}}$$

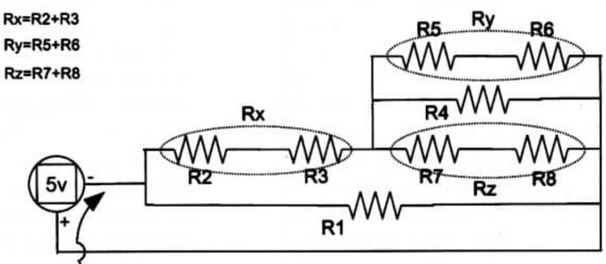




$$R = \frac{R9\left(R8+R7+\dfrac{R4R2(R3+R2)}{R4R2+R2(R3+R2)+R4(R3+R2)}\right)}{R9+R8+R7+\dfrac{R4R2(R3+R2)}{R4R2+R2(R3+R2)+R4(R3+R2)}}$$

Above: AVC and RF gain equivalent circuit 15v input

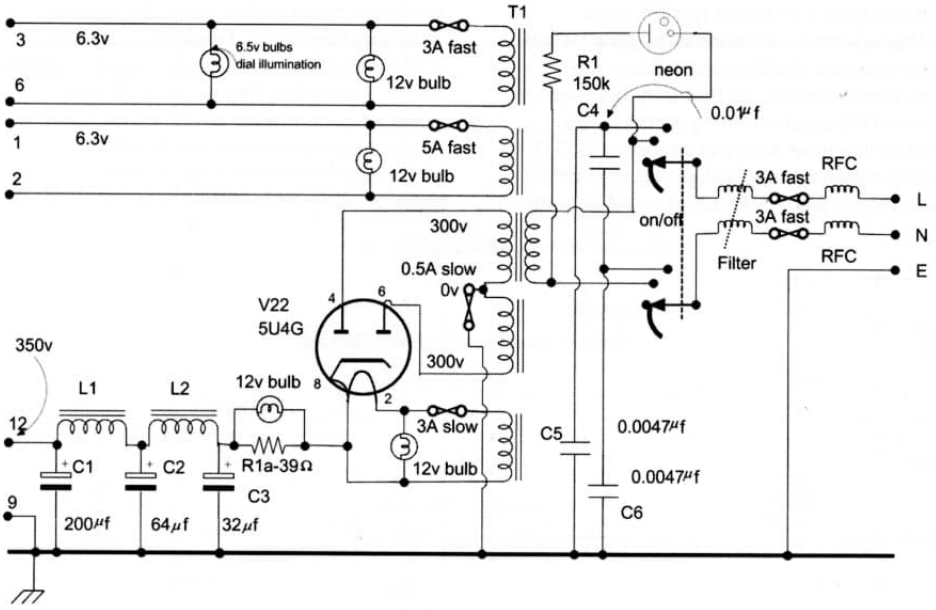


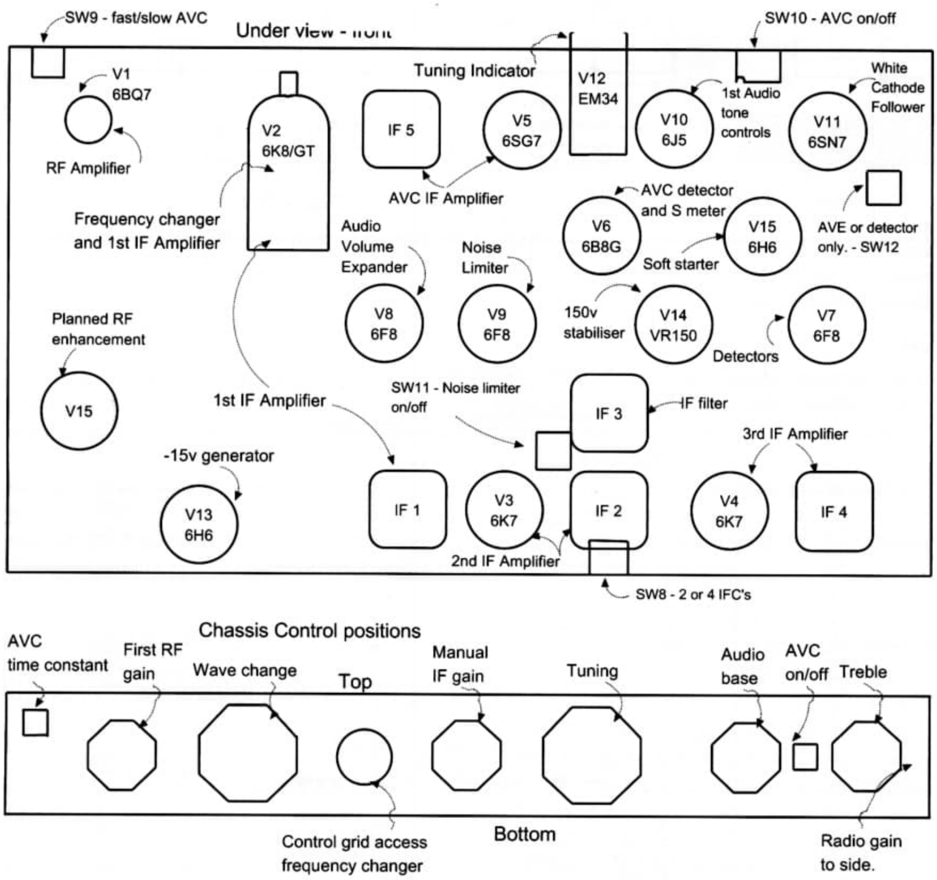


$$R = \frac{R1\left(R2+R3+\dfrac{R4R6(R5+R6)}{R4R6+R6(R5+R6)+R4(R5+R6)}\right)}{R1+R2+R3+\dfrac{R4R6(R5+R6)}{R4R6+R6(R5+R6)+R4(R5+R6)}}$$

Above: AVC and RF gain equivalent circuit AVC input

Below: Power supply circuit





Above: Valve and IF transformer layout

The tone control circuit.

There is nothing special to note about this circuit, it is a standard twin 'T' to control the slopes of the treble and Bass tuned networks. I chose this design of tone control as it does not use inductors. V10 a 6J5, works nicely in this application. Originally there was another 6J5 following the tone circuits as a pre-amplifier feeding through the cable round to the main amplifier. It turned out that this was a bad idea. The wiring formed a ring via out and back through the cable and introduced a nasty low frequency instability that I could not get rid of. There was an induced audio feedback loop caused when an intense draw of current by the output stage of the main amplifier was required. That induced a very low frequency oscillation (motor boating) that caused the pre-amplifier HT and signal screen to feed back in. No amount of reservoir capacity or thicker wiring or other forms of decoupling would stop it. A rethink was needed. How could the effect be stopped? The thought of a form of cathode follower occurred that has a very low output impedance. If I removed the pre-amplifier that was in position V11, I could build in a form of low output impedance buffer. I had known about the White cathode follower for many years and I though this could be its big chance.

The White cathode follower

The White Cathode Follower circuit was derived to perform as a very low output impedance stage for amplifiers, usually the output stage, (by Mr. White nonetheless). It has high input impedance, low output impedance, has low distortion and a wideband frequency range. That did nicely, and solved the problem (thank goodness for that). In terms of thermionic technology, it was quite a newcomer, and you don't find much literature about it. One of the best rigorous descriptions and analysis can be found in the book Valve Amplifiers by Morgan Jones, pages 110 to 115, published by Newnes (yes, they are still about). I designed the circuit application around the 6SN7. These days there is a surge in the popularity of valve audio amplifiers, which makes good examples of triode and double triode valves harder to find.

Having got to the point of solving this instability problem, a slight hum became apparent when turning the main amplifier up a bit. That was a surprise because as the output impedance of the cathode follower is low, it was ideal to pass the signal through the flying lead. Low impedance does not have a propensity to pick up hum or noise. I was about to go and lie down in a darkened room (thinking, oh no not another problem) when I discovered that putting my hand up against the first valve, a 6J5 (V16) the hum increased a good deal. I replaced this valve with a metal envelope 6SG7, and the problem was eliminated (phew!). I like simple solutions, as I was getting a bit paranoid.

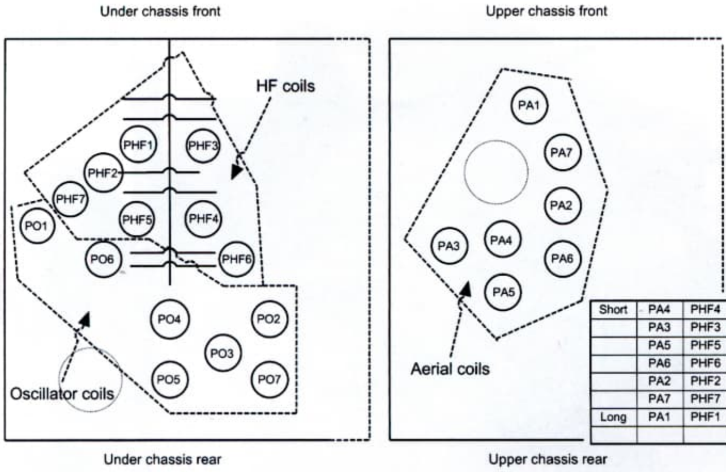
Before I go on to the main amplifier, I need to go back to the IF circuits and explain how the AVC works.

The requirement here was to enable an RF gain control to be effective in a similar way to that available in communications receivers, because in marginal reception conditions it could be really useful. In order to get a reasonable range of control, I designed in a negative 15v supply (V13, 6H6) and used the 150v stabilised supply (V14, VR150) for the screen grids, to make it as stable as possible. Having a wide voltage range available would enable the control resistances R65, VR7 and R66 to be very high, which would allow the AVC circuit to remain dominant, and superimpose on the RF gain setting. To get this right you use the Superposition Theorem, a basic piece of electrical engineering. Page 165 in Langford-Smiths book.

Amplified AVC and the S meter.

The AVC source was obtained by tapping a signal from the anode of the last IF amplifier V4 through C21. The capacitance of C21 was kept very small at 22pf, so as to minimise the load on the last IF stage. This small signal was amplified by V5 (6SG7) to the maximum possible, the primary of IFT5 being the anode load of V5. V5 was also a metal can type to keep IF radiation down to a minimum. The secondary of IFT5 drives the AVC diodes in V6 (6B8), pins 4 and 5. The 6B8 valve is often found in this application as a double diode pentode. The pentode section was used as the AVC

Below: Wearite P coils layout

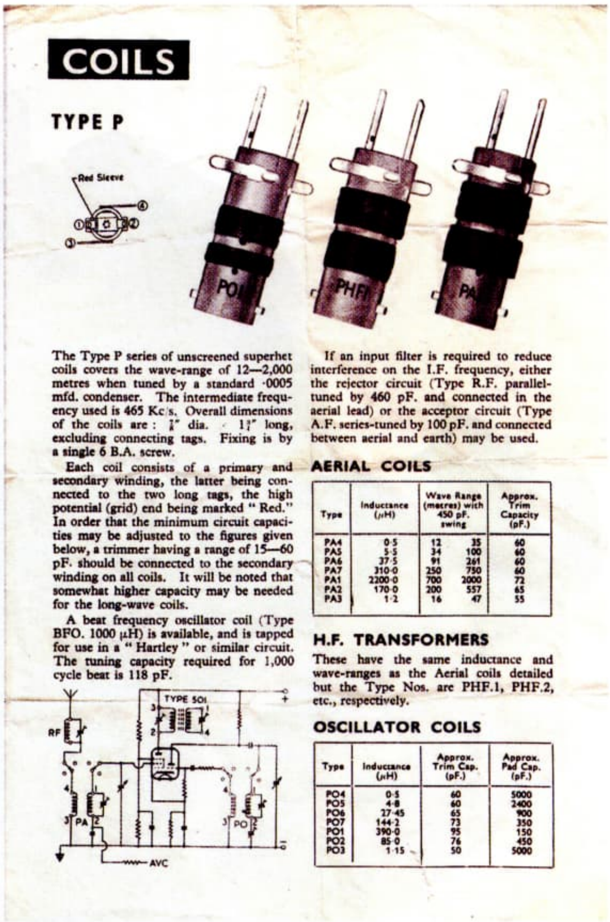


Short	PA4	PHF4	PO4
	PA3	PHF3	PO3
	PA5	PHF5	PO5
	PA6	PHF6	PO6
	PA2	PHF2	PO2
	PA7	PHF7	PO7
Long	PA1	PHF1	PO1

Wearite recommend 1/2 inch spacing between coils to maintain Q.

Type	Inductance	Wave Range metres and frequency kc/s with 450pf tuning cap swing	Approximate Trim capacity pf
PA4	0.5	12 35 25000 12000	60
PA3	1.2	16 47 18750 9000	55
PA5	5.5	34 100 8800 3000	60
PA6	37.5	91 261 3300 1300	60
PA2	170.0	200 557 1500 680	65
PA7	310.0	250 750 1200 400	60
PA1	2200.0	700 2000 430 150	72

Below: Wearite P coils



COILS

TYPE P

Red Sleeve

The Type P series of unscreened superhet coils covers the wave-range of 12—2,000 metres when tuned by a standard ·0005 mfd. condenser. The intermediate frequency used is 465 Kc/s. Overall dimensions of the coils are: 7/8" dia. · 1 3/4" long, excluding connecting tags. Fixing is by a single 6 B.A. screw.

Each coil consists of a primary and secondary winding, the latter being connected to the two long tags, the high potential (grid) end being marked "Red." In order that the minimum circuit capacities may be adjusted to the figures given below, a trimmer having a range of 15—60 pF. should be connected to the secondary winding on all coils. It will be noted that somewhat higher capacity may be needed for the long-wave coils.

A beat frequency oscillator coil (Type BFO. 1000 μH) is available, and is tapped for use in a "Hartley" or similar circuit. The tuning capacity required for 1,000 cycle beat is 118 pF.

TYPE 501

RF

PA

PO

AVC

If an input filter is required to reduce interference on the I.F. frequency, either the rejector circuit (Type R.F. parallel-tuned by 460 pF. and connected in the aerial lead) or the acceptor circuit (Type A.F. series-tuned by 100 pF. and connected between aerial and earth) may be used.

AERIAL COILS

Type	Inductance (μH)	Wave Range (metres) with 450 pF. swing		Approx. Trim Capacity (pF.)
PA4	0·5	12	35	60
PA5	5·5	34	100	60
PA6	37·5	91	261	60
PA7	310·0	250	750	60
PA1	2200·0	700	2000	72
PA2	170·0	200	557	65
PA3	1·2	16	47	55

H.F. TRANSFORMERS

These have the same inductance and wave-ranges as the Aerial coils detailed but the Type Nos. are PHF.1, PHF.2, etc., respectively.

OSCILLATOR COILS

Type	Inductance (μH)	Approx. Trim Cap. (pF.)	Approx. Pad Cap. (pF.)
PO4	0·5	60	5000
PO5	4·8	60	2400
PO6	27·45	65	900
PO7	144·2	73	350
PO1	390·0	95	150
PO2	85·0	76	450
PO3	1·15	50	5000

amplifier to drive the 'S' meter M1. The diodes in parallel rectify the amplified AVC coming out of the secondary of IFT5. The AVC voltage is developed across R25 and smoothed by the chain of C29, R26, C32, and R29 (to remove ac from the signal). With zero AVC, valve V6 draws maximum current and M1 is at maximum deflection, controlled by R30, R31 and VR3. VR3 is adjusted to set M1 at maximum on the deflection scale. One day I might get round to calibrating M1 which would be a logarithmic scale. As I have not finished the RF front end design, I might be wasting my time with calibration at this time. The AVC voltage is either on or off as set by SW10, and is set fast or slow by SW9. The AVC voltage is connected to the signal grid of V6, the TC, and modulates the DC current drawn through V6. The 'S' meter circuit is the anode load of V6, pin 3. V6 is configured as a current amplifier, as the cathode is connected directly to ground, the chassis. The AVC voltage is distributed through the radio by R5 the grid bias for V1 the RF amplifier, R9 the grid bias for V2 the frequency changer, R12 the grid bias for V3 the 1st IF, and R22 the grid bias for V7 the detectors for experimentation.

An interesting and useful calculation to make is that for the AVC time-constants. The time constant is equal to the products (multiplications) of all the resistors in the AVC circuit and the total capacitance following them in the circuit.

Generic example:

T_C seconds $= R1(C1+C2+C3\ldots C_N)+R2(C4+C5+C6\ldots C_{N+1})+RN(C_{N+2}+C_{N+3}\ldots)$

For this application:

$= (R26+R29)(C26+C29+C32)+R22C23+R12C16$

$= (47k+10k)(0.5\mu f+330pf+330pf)+470k100pf+70k0.1\mu f$

fast $= 0.1$ seconds.

And: $= (R26+R29)(C27+C29+C32)+R22C23+R12C16$

$= (47k+10k)(1.5\mu f+330pf+330pf)+470k100pf+70k0.1\mu f$

slow $= 0.3$ seconds.

So what we have to control the gain of the radio, are separate manual gain controls for the RF amplifier and the IF amplifier, the distributed AVC as described above and a manual gain control superimposed on the AVC line. One has to be careful how all these are adjusted as it is possible to make the set go from being deaf to completely unstable. I hope this has satisfied Gerry Wells' worry about the control of the overall gain designed into the set. I hope to present this to Gerry before the 2013 BVWS Garden Party so he can have a play with it.

Tuning indicator

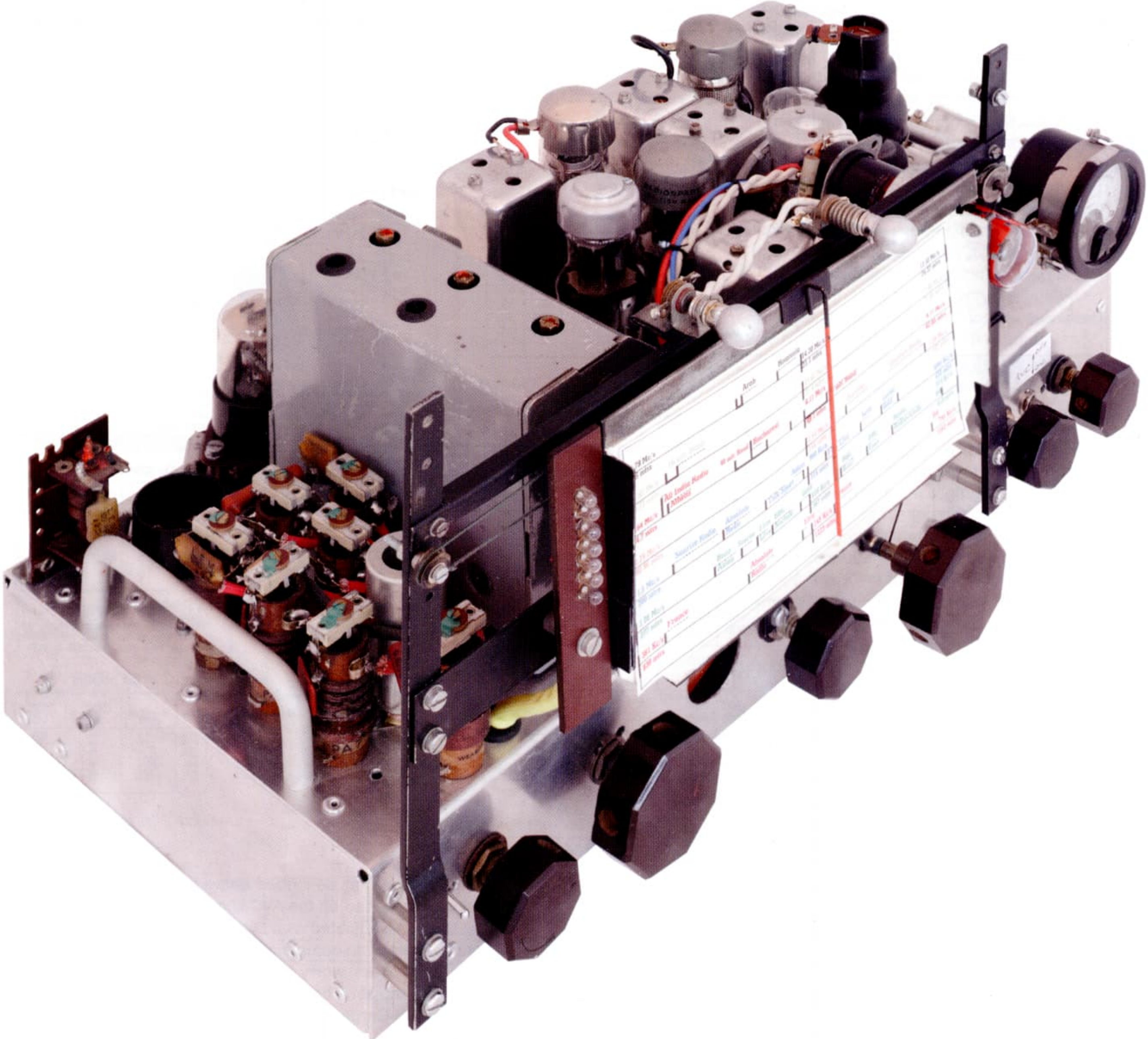
Having decided to use an EM34 (I had a new one in a box) tuning indicator (V12), there is not much that can be done with the circuit for it. In stead of connecting the cathode to chassis, it is possible to insert R62 and C62 as a standard bias to enable the triode section to produce an element of gain to make the indicator a little more sensitive.

The valve has two electrode assemblies, a triode amplifier and a display section consisting of a conical-shaped target anode coated with zinc-silicate. The display section's anode is directly connected to the HT+ voltage, whilst the triode-anode is connected to a control electrode mounted between cathode and the target-anode, and externally connected to HT+ via R61.

When the receiver is switched on but not tuned to a station, the target-anode glows green due to electrons striking it, with the exception of the area by the internal control electrode. This electrode is typically 150-200V negative with respect to the target-anode, repelling electrons from the target in this region, causing a dark sector to appear on the display.

The control grid of the triode amplifier section is connected to the negative control voltage of the AVC line. As a station is tuned in, the triode grid becomes more negative with respect to the common cathode.

The EM34 is a dual shadow indicator, where maximum indications are when the control grid input is 0v. The minimum fine shadow occurs at -5v and the minimum course shadow occurs at -12v.



Soft start
One circuit I fancied using to try out claims and performance, was a soft or slow start buffer. This is incorporated as V15 (6H6). The rise in output voltage of the 150v stabiliser V14(VR150) is controlled by the speed of the heater warm up of V15. Current in VR14 rises as V15 starts to conduct, and reaches full flow when V15 heater is at full temperature. It works OK, and controls the pentode screen grids in the various stages through the +150v stabilised bias supply.

The audio amplifier.
What I wanted to do was build a Williamson amplifier. Because of the way it was originally designed, the component count was low due to the nature of the direct dc coupling between the first two valves V16 and V17. The biasing of the cathodes for V16, V17, V18 and V19 had no AC bypass capacitors, this has the effect of each valve having its own negative feedback. I concluded that it could be built on quite a small chassis. I knew about the special output transformer, but as I had the Partridge P4014 I would try that and see what happened. I designed in SW13 and potentiometer VR11 to enable the negative feedback to be adjusted for best performance (or acceptable gain). The amplifier worked but was unstable at low frequencies and exhibited motor-boating at anything other than very low volume. I tried all sorts of modifications but nothing worked, including valve pair changes to different types. What I really needed was the design data for the transformer, so that I could find out what the primary match to valve anode resistance (Ra) and push-pull load resistance RL(a-a) should be when running at an anode voltage of 285v to 300v. Looking at what some of the chat sites were saying on the internet (very dubious sources), the indications were that the P4014 transformer was designed for EL84 valves with an RL(a-a) of 8kΩ, and screens running at 285v. An EL84 has an Ra of 70 to 77kΩ when running at these voltages. Apparently the ultra linear taps on the transformer were at 43%. On the face of it, 6V6 valves were a pretty good match at the voltage my supply was running at, having an RL of 8kΩ, same as the EL84. So out came the EL34's, along with the circuitry for the Williamson output stages. I designed the cathode and grid biasing circuits with values that would suit 6V6's working in class A mode. It worked fine. Resistors R84 and R86 are parasitic suppressors and add to the high frequency stability margin. Larger values of C70 and C71, increases the time constants of the network pairs and increases low frequency stability. I inserted a 1kΩ in series with the primary centre tapping of the P4014 transformer to reduce the standing current, as I did not want or need the theoretical 17 watts audio output. Resistors R88 and R89 at 1kΩ are larger than need be for the same reason. An output of 4 or 5 watts would be more than adequate, or probably less than that. There are two potentiometers to adjust, one as per the original Williamson, VR10; and the other VR9, which adjusts the AC signal balance of the phase splitter and mid-stage drivers V18 and V19. To adjust VR10, an AVO set to the 0-10v range was connected

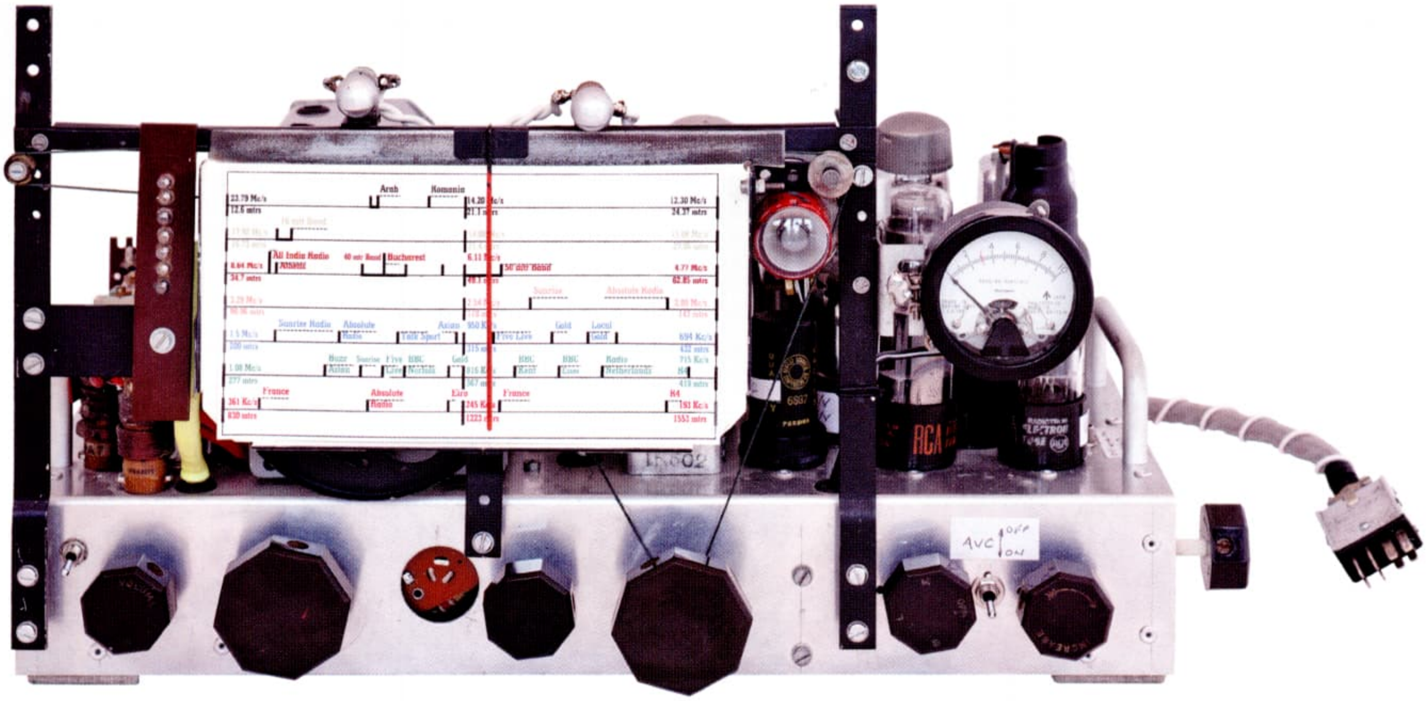
across the primary of the P4014 transformer and adjusted until the reading was zero. The flickering of the needle showed noise from the mains and the valve fluctuations. To adjust VR9 as described by Mr. DTN Williamson, a small output transformer was connected in series with the centre tap of the primary of the output transformer. A 15Ω resistor was connected across the secondary of the P4014 transformer. A 400c/s signal was applied to the amplifier input and adjusted (and also VR8, the volume control) to give about half maximum voltage across the secondary. An oscilloscope was connected across the secondary of the series connected transformer. VR9 was adjusted for a minimum signal.

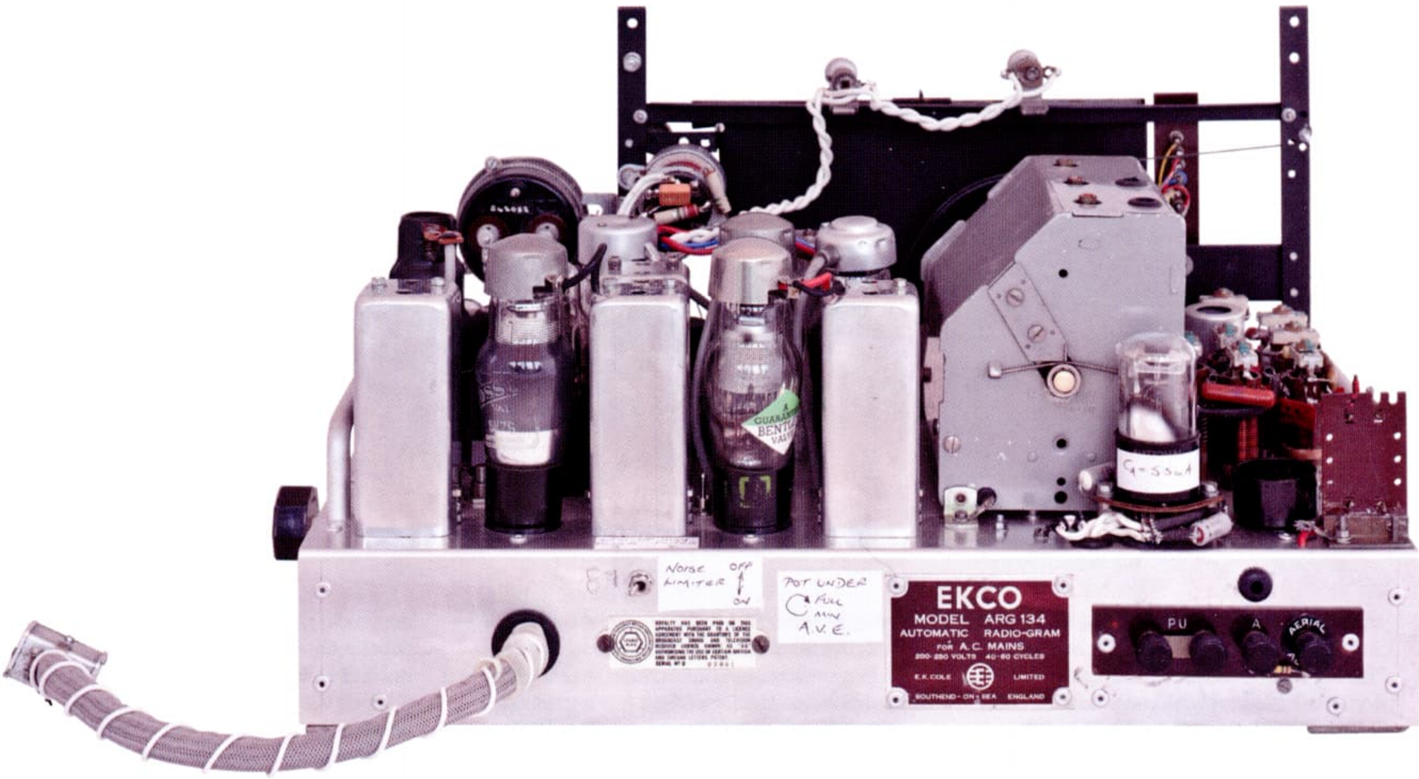
It was interesting to note that whenever the negative feedback was out of match, the amplifier always went unstable at low frequencies, never high. It never screeched, it only grunted!

Just to check that the feedback was working, I connected the feedback the other way round. Then I got a big screech, point proved. The amplifier remained stable with the feedback disconnected, a good sign at maximum amplification. Altering the resistive feedback by VR11 (value chosen after experiment), worked well. The other component involved in the feedback is C65a. The signal being fed back via R90 is subtracted from the voltages generated across R75. Now, if there is a timing change between the peaks across R75 there has been a change in phase, that's where C65a comes in. The only way to really sort out C65a is to apply a square wave from a signal generator, and look at the shape of the output. The output should be square too. It is likely that you would see overshoot and ringing. The process is to alter C65a to obtain the best square shape across the loudspeaker terminals.

More feedback reduced the output volume as you would expect. Whether or not this also improved the fidelity with reduced harmonic distortion, I would not know, as I do not posses an audio harmonic analyser.

The front half of this amplifier is an application of the Williamson design, with a substitution of a 6SG7 in place of a 6J5 as the first valve, up to the inputs to the control grids of V20 and V21. The output stage using 6V6 valves and a Partridge P4014 output transformer is my adaption of the well known class 'A' ultra linear design. Class 'A' is where anode current is flowing all the time. There are many designs like this, all similar. The critical part is the matching of the load line characteristic of the push-pull configuration of the output valves to the input impedance of the output transformer. Running close, is the match of the ultra linear tapings to the screen grids of the same valves. When connecting the screen to a tap of the primary, the valve operates as a pentode with negative feedback applied to the screen, with a section of the load impedance common to both anode and screen. Minimum distortion is derived when a tapping point is 43% (or 18.5% of the primary impedance when measured from the centre tap) of the total primary turns of the output transformer. This transformer was listed as an





option for the Mullard 5-10, with 8kΩ normal load and 8kΩ for 43% screen-grid taps.

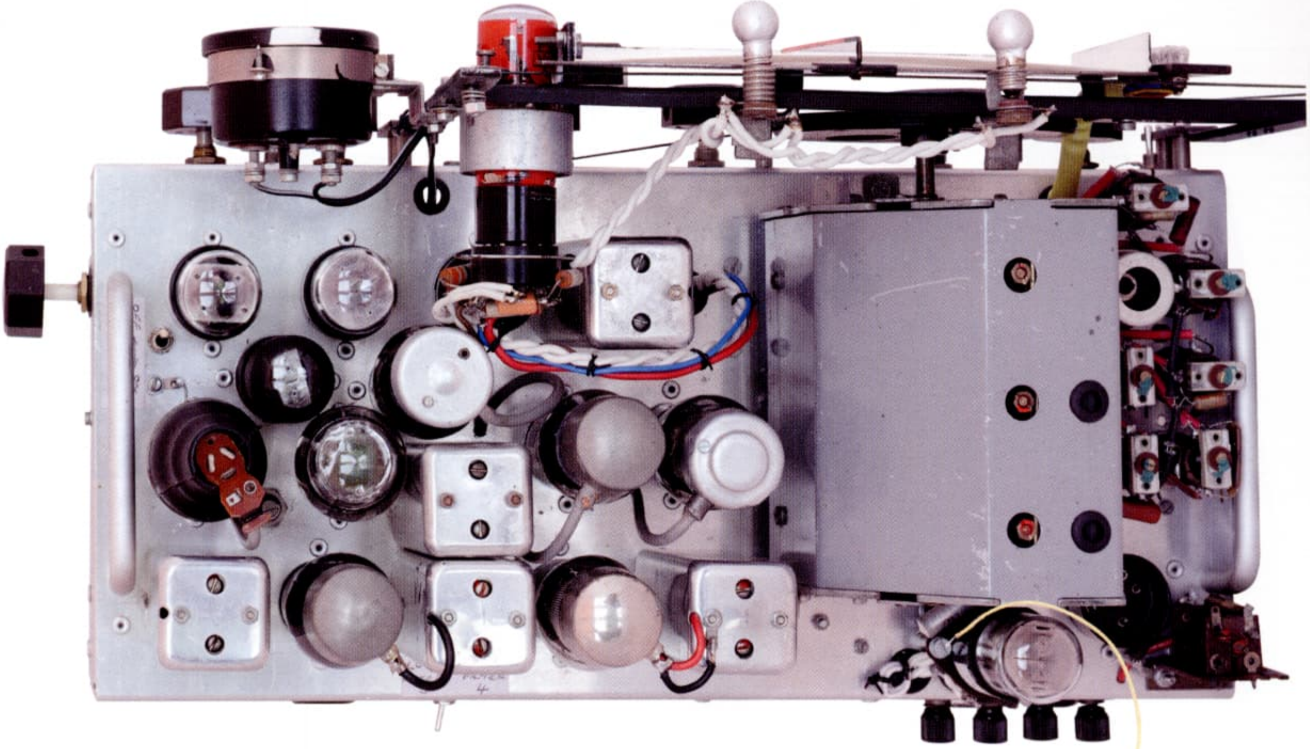
The ultra linear circuit was developed by Alun Blumlein of Cavity Magnetron fame in WW2, and patented in 1937 ('Improvements in or relating to Thermionic Valve Amplifying Circuits', Patent No. 496,883). In later work by Hafler and Keroes demonstrated (in 1951) that for a 6V6, the screen grid load of 5% of anode load impedance (22.5% of anode voltage) is to be preferred. So I might have the anode load line right (if I am lucky) but probably not the screen load voltage.

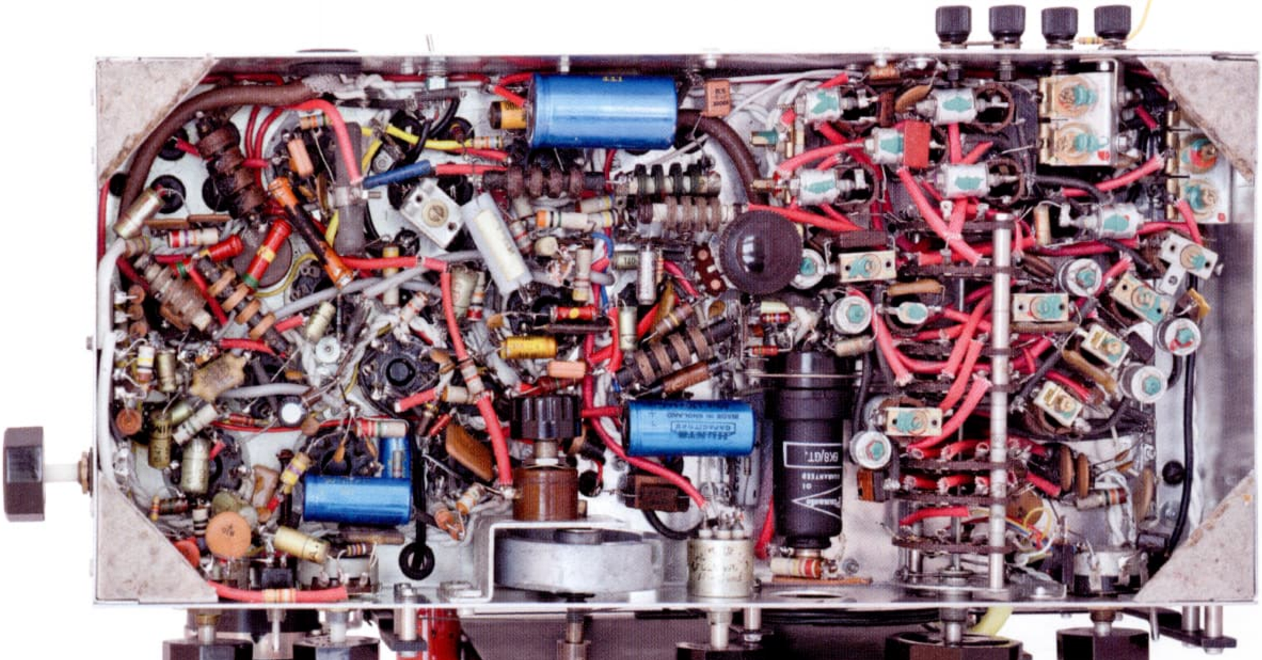
The internet states – 'By judicious choice of the screen-grid percentage tap, the benefits of both triode and pentode vacuum-tubes can be realised'. So they don't know how to derive the tapping percentages either. F Langford-Smith doesn't tell you in his compendium. So you probably need Blumlein brains to work it out. Or put it another way, I have not come across any references that explain the theory and practice behind output transformer percentage taps for ultra-linear application. There is plenty of chat, but no hard facts like load line plots on valve characteristics. The sort of thing for instance one would do to find out the core loss and hysteresis of the core material.

The -15v supply and RF gain control

The -15v supply was thought desirable, as was the stable 150v supply to provide biasing for an RF gain control facility as is found in many communication receivers. Using these voltages enabled very high value balancing resistors R65, VR7, R66 and R67, to be used so that the controlling effect of the AVC circuit was not overridden.

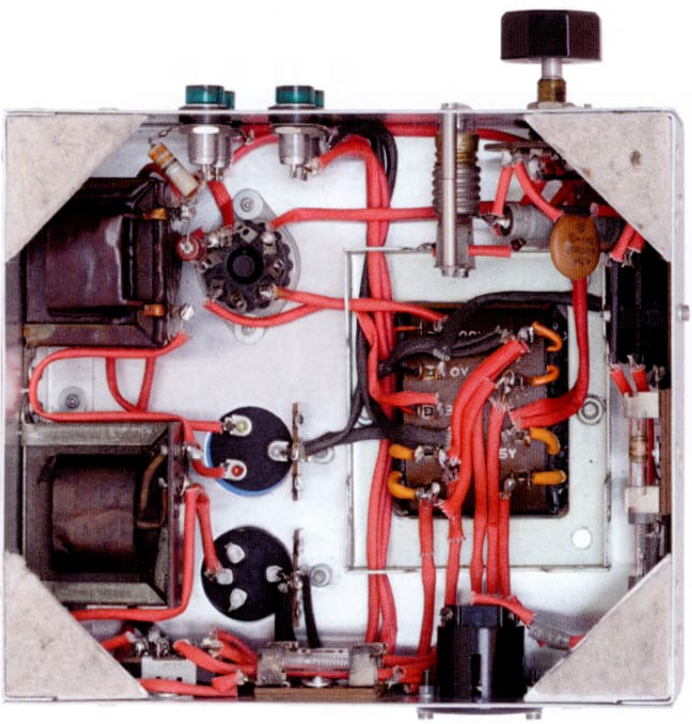
The -15v circuit is a half-wave voltage doubler configured by connecting the second diode in series with the first of valve V13. 6.3v is injected by C63 and rectified by diode one. A voltage of about -7.5/8.0v appears on the anode, pin 3. The cathode of diode two sits on this voltage, and further rectifies the half-wave in-phase to double the voltage to -15/16v, that appears across C64. In terms of electron flow, the diodes are upside down, hence creating a negative voltage by grounding the cathodes. Clear enough!?

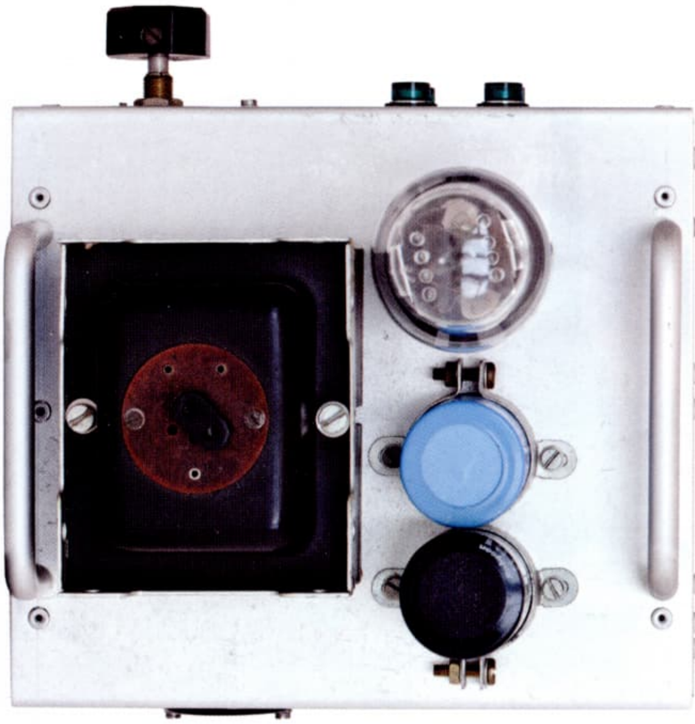




The calculation of AVC and gain voltages combined.
The equivalent network of the AVC and RF gain control circuit is shown on page 31. The three voltage sources are shown in circuit with correct polarity. The resistor notation in brackets, were used in the calculations, and the notation without brackets are the real ones in the radio circuit. Each voltage generator passes currents to each network loop. What was required was a design that provided a good manual gain control of the radio stages, that did not override the AVC effect of keeping the radio stable; as I went to a lot of trouble to get an effective amplified AVC system in the first place! So Kirchoff's current rule is used to calculate the current flowing in each resistor in each network. Then superposition is used to impress each current from each source onto each network. Once this stage has been reached, then one can calculate the voltage across each resistor. The voltage we are interested in is the one across R4 which is the parallel of four 470kΩ that bias the control grids. The value is of R4 is 117kΩ. The critical calculations are the ones to find out what the network resistances are for each voltage source. i.e. the resistance looking into the network from the voltage source terminals, with the assumption that the other voltage sources are at 0v and have zero ohms resistance. This is where you see how complicated the calculations are (real world), as opposed to the simple networks you get taught at college. Once the formulae have been determined, the good old computer comes in handy. It takes a couple of hours to get a computer set up and programmed, and then the calculation is instantaneous. Goodness knows how long it would take to wring it out by hand. I can feel a migraine coming on.

After analysis, using the assumptions that we have two cases of AVC, one with no signal, 0v; the other with a good strong signal giving a -5v voltage on the line. And we have two cases of RF gain applied, one at minimum setting the other at maximum





setting. The analysis is shown in the table on page 31. You could have fun here drawing graphs etc to prove points, but for me the circuit either worked or it didn't. As the analysis showed, when AVC is low with no signal and the gain is turned to max, the control grids are forced just positive, a full-on maximum gain for the radio. When the gain is turned down to a lower setting when there is a good signal, the AVC remains effective. Another little calculation showed that when the gain was set to maximum, the AVC applied to the control grids was 0V when the AVC rectifier was generating 278mV. This voltage plus the forward bias voltage drop across the AVC diodes of about 1v, represents a delay in the AVC. As the gain is turned up the delay is increased, another way of visualising the AVC action. Just right, a happy circuit.

Now to the voltage source equations. The analysis of the network was calculated for each voltage source in the three figures on page 31, where 'R' was the network resistance to the source. What I wanted was the voltage across R4 (the AVC line control resistors in parallel, and I found this by superposition, that is by adding the current in R4 from each source, noting the polarity. Once this had been determined, the use of simple ohms law enabled the voltage to be calculated. (Thank you Mr. Deards)

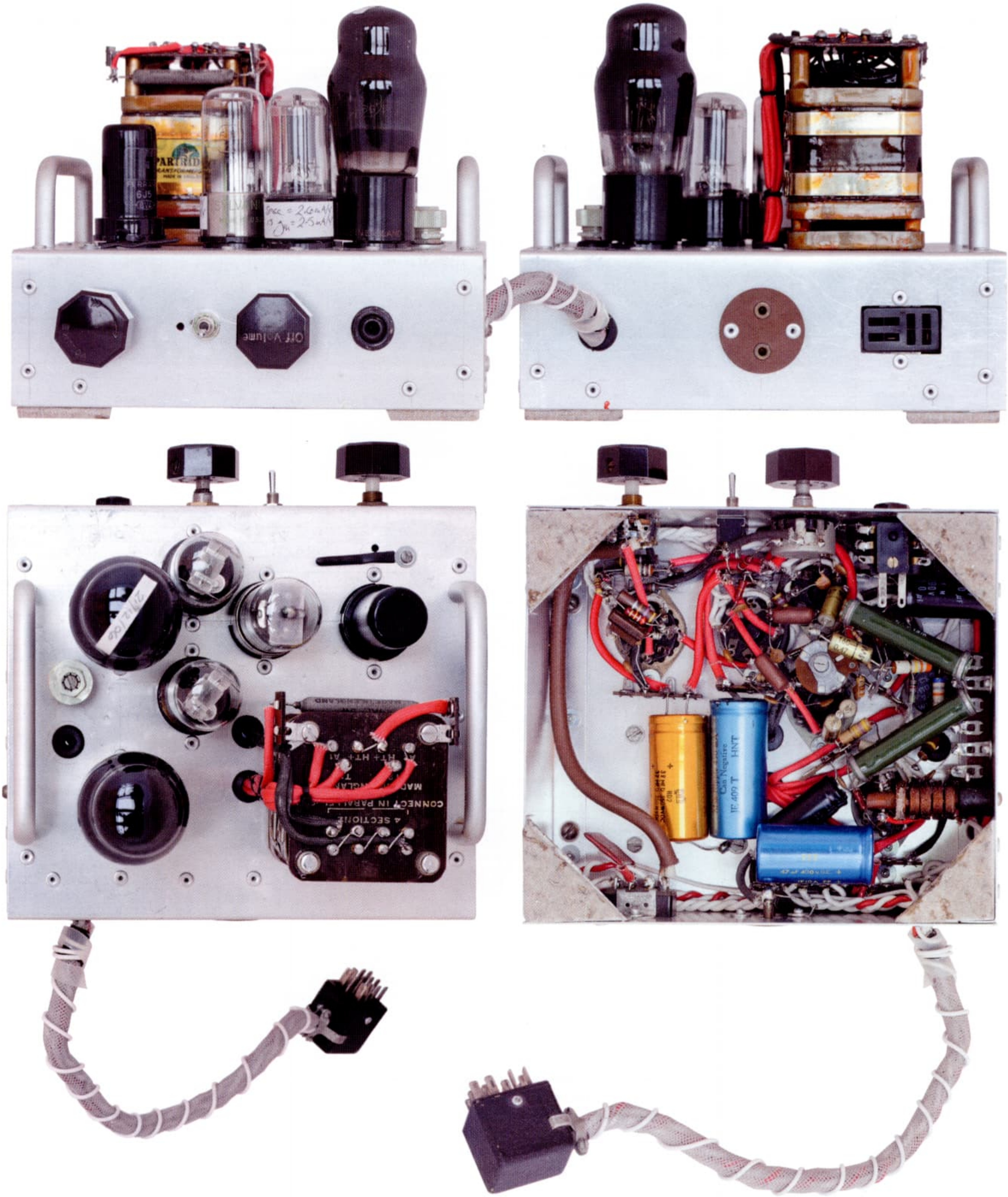
Actually it is not as hard as you may think to design radio stages. For instance, once you have the equivalent circuit for say a pentode valve, the circuit can be applied to all pentodes. What you have is a perfect amplifier immersed in a network of all sorts of things connected together, most of which spoil the amplifier and limits its performance. Take an 8 pin valve (pentode) connecting to the internal electrodes for instance, all these are theoretically connected together that makes (factorial) 5760 possible combinations. Then you have each connection with inductance, capacitance and resistance characteristics, that's factorial 8 by 8 by 8, which is huge with 10's to the power of 10's as multipliers. My calculator went into error in less than two thirds of the way through. So assumptions are made that the effect of most connections are too small, so are ignored. Then we are left with the significant ones like the 'Miller effect' (capacitance between grid and

Radio tuning analysis.										
All capacitance in pf										
type			**pf**	**inductance µH**	**capacitance µf**	**metres**	**K/cs**	**centre k/cs**	**meters**	**K/cs**
PA4	Theoretical wavelength					12			35	
Short	Theoretical frequency						24985			8566.286
Wave								16775.643		
trim C	190	Main gang	500	0.5	0.001	12.278	24420.165		34.981	8571.040
		Main gang	350		0.000		24420.165		30.946	9688.603
								17054.384		
	Actual wavelength					12.603			24.376	
	Actual frequency						23790	14200		12300
PA3	Theoretical wavelength					16			47	
Short	Theoretical frequency						18738.75			6379.149
Wave								12558.949		
trim C	60	Main gang	500	1.2	0.001	15.980	18761.900		47.045	6373.101
		Main gang	350		0.000		18761.900		39.683	7555.298
								13158.599		
	Actual wavelength					16.731			27.060	
	Actual frequency						17920	14000		11080
PA5	Theoretical wavelength					34			100	
Short	Theoretical frequency						8818.235			2998.2
Wave								5908.218		
trim C	60	Main gang	500	5.5	0.001	34.212	8763.672		104.518	2868.585
		Main gang	350		0.000		8763.672		89.432	3352.508
								6058.090		
	Actual wavelength					34.701			62.855	
	Actual frequency						8640	6110		4770
PA6	Theoretical wavelength					91			261	
Short	Theoretical frequency						3294.725			1148.736
Wave								2221.730		
trim C	60	Main gang	500	37.5	0.001	89.332	3356.231		267.997	1118.744
		Main gang	350		0.000		3356.231		0.228	1316421.983
								659889.107		
	Actual wavelength					90.965			143.455	
	Actual frequency						3296	2540		2090
PA2	Theoretical wavelength					200			557	
Trawler	Theoretical frequency						1499.1			538.276
Band								1018.688		
trim C	65	Main gang	500	170	0.001	197.970	1514.474		559.943	535.448
		Main gang	350		0.000		1514.474		472.327	634.772
								1074.623		
	Actual wavelength					200.414			432.017	
	Actual frequency						1496	950		694
PA7	Theoretical wavelength					250			750	
Medium	Theoretical frequency						1199.28			399.76
Wave								799.52		
trim C	60	Main gang	500	310	0.001	256.847	1167.311		748.830	400.384
		Main gang	350		0.000		1167.311		629.143	476.553
								821.932		
	Actual wavelength					277.098			419.329	
	Actual frequency						1082	816		715
PA1	Theoretical wavelength					700			2000	
Long	Theoretical frequency						428.314			149.91
Wave								289.112		
trim C	65	Main gang	500	2200	0.001	712.173	420.993		1994.867	150.296
		Main gang	350		0.000		420.993		1676.024	178.888
								299.940		
	Actual wavelength					830.526			1553.472	
	Actual frequency						361	245		193
							400.005			

anode), and impedance and admittance coefficients of the other electrodes. The 'Miller' is the capacitive coupling between the grid and the other electrodes (particularly the anode), and presents loading to the output of a previous stage. However, these effects can be eliminated by adding neutralising capacitance between the grid and cathode, called 'Cgk'. With the capacitance 'Cgk' included, it completes (forms) a full wave bridge circuit with the other capacitances in the input circuit components (look at page 1066 in the Radio Designers Handbook – F Langford-Smith). (thank you again Mr. Deards). Hang on a minute, did I say that design of radio stages is not as hard as you think; forget it, it is if you want to get it right.

Power supply.

The design of the power supply is standard. There is a bit more smoothing than normal, with an additional series choke and a 200µf reservoir capacitor. This shows in the main amplifier's output as very little hum at the loudspeaker (at full volume). There are RFC's in the live and neutral mains wire input, with a coupling inductance after the protection fuses, to aid in removing mains born interference. The on/off switch has the facility to select bypass capacitors C4, C5 and C6 in a delta configuration, to remove ingress of mains born spikes. Each secondary has fuse protection, being either fast or slow acting to suit the application. The transformer is shrouded to help hold back emf magnetic induction from affecting circuits in the radio. The primary has a neon indicator, and each secondary has a light bulb to show that voltage output is present. The output from the rectifier also shows that current is flowing by a bulb in parallel with R1a. All the bulbs are 12v working, they are all overrated for the job, and can take surges. I don't know what type of RadioSpares transformer T1 is, it is just big! (and gets warm after a few hours operation). The 5U4G rectifier is pretty hefty as well with choke input, the RMS input is 550v maximum, with peak inverse voltage of 1550v maximum and with 225mA maximum rectified current output. It is correctly specified with the first reservoir capacitor in the circuit at 32µf, according to the Brimar Radio Valve & Teletube Manual from Standard Telephones and Cables Ltd, Radio Receiving Valve Division, Footscray, Kent, price 4/- in 1950 (about £12.80 today). I paid £2 for my copy, a price inflation of only times ten, a bargain.



The station names on the dial.
I had as much fun creating this dial/escutcheon display as I did with all the other parts of the design and build. I have left the background grid on the display so that the way the set up was done can be seen. It feels like creative art to do; satisfying. The design was done using Microsoft Excel on Windows 7. Excel is superb for this job. There is control over the text typeface, font size and colour. There is control over the cell height and width through the row and column spacing, any size you like. So once the scale ends are put in position, it is possible to tweak the display bit by bit (excuse the pun) to make it fit the real physical positions of the tuned bands. The positions of the station names can be moved to coincide exactly with the tuning pointer.

When the radio was up and running, I was able to pick up on the stations coming in as they identified themselves by name and took notes of their positions on the scales. There were far more stations coming in than shown here. What I need is a mechanical display arrangement like three time the size of the one I used so that a lot more intelligent information could be displayed, such as frequency markers.

But I like names, it looks good, and fun to do. I actually used the mechanical tuning dial and mechanism from an EKCO automatic radio-gram Model ARG 134, made in Southend-on-Sea (so says the label), at last a use for a radiogram. It was a nice linear motion dial with brackets that made chassis mounting easy, and the flywheel drive could be chassis mounted such that the depth facing for the drive cord remained parallel with the front face of the chassis. All the wheels and grooves for the drive cord lined up in other words.

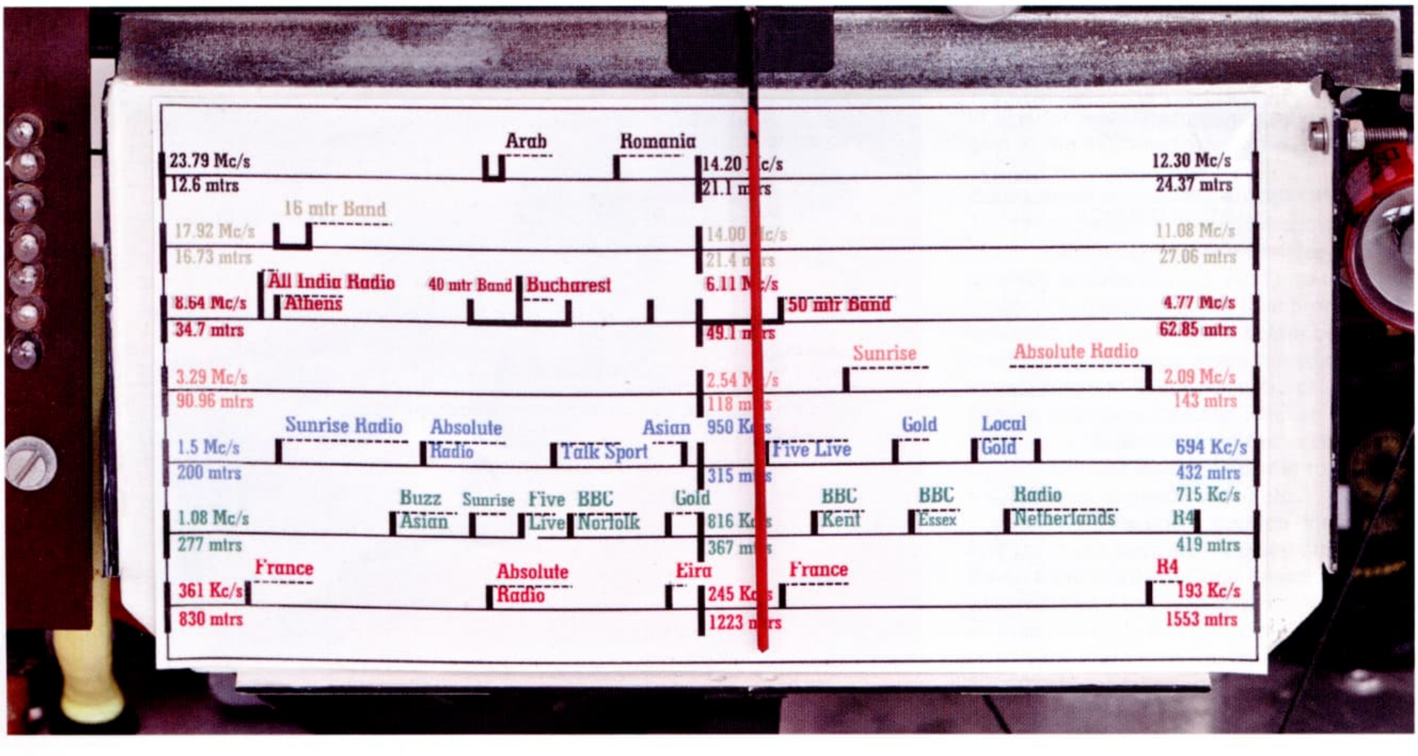
Circuit description, the final chassis layout.
The final layout I ended up with was not an ideal one. It was well planned when I started out, but redesigns and circuit modifications, forced the positioning of changes to where space was available (then not so neat). Looking at the chassis from underneath with the front at the top, the aerial input is bottom left and the audio output is top right. The Frequency Changer valve V2 is under the chassis right up against the coils and the band change switch. The IF circuits are in a straight line across the back of the chassis, with the final stage in the bottom right corner. If I wanted to move it all about then: the Frequency changer V2 should be nearer the first IF; IF5 and V5 should have been nearer IF3, and the AVE valves V8 and V9 should swap with valves V6 and V15. BUT, then I would probably find something else to complain about.

The Coils and their layout on the chassis.
The layout of the coils on the chassis was given some careful thought. Although it may not be obvious here, the wiring was as near point to point as possible. The shortest wavelength coils were nearest to the switch contacts. The common switch contacts were very nearly dead under the connections to the main gang tuning capacitor, and fed through the chassis (not luck this time, it was designed that way). The Wearite recommended spacing of one half inch spacing between coils was nearly met, only the PHF coils 1, 2 and 7 were a bit closer, a compromise with the switch contact point to point distances.

RF Amplifier
The input (signal RF everything) to the RF amplifier comes in via the aerial terminal on the rear of the chassis, and is connected to chassis via R1 which decouples any static build up in the aerial to the chassis/earth. A blocking capacitor of 250pf(C7) connects the aerial onto gang SW2 first gang common and the IF acceptor. This could be a variable capacitor in the near future, to make the primaries tuneable if it turns out to be an advantage. SW2 selects the frequency range required by connecting the aerial input to the untuned primaries of the PA aerial coils. The secondary's of the aerial coils are tuned by parallel trimmer capacitors (TC1 to TC7) for each frequency range (signal tuned RF); these are selected by SW3 and are fed to the grid of V1(pin 7) by the common of the switch, which also is connected to the first stage tuning capacitor C9/TC8. The RF signal is passed into the RF amplifier V1 via C8. R5 provides AVC bias offset into grid pin 7 of V1. The gain of V1 is controlled by VR1 that connects to the cathode pin 8 via resistor R6. V1 output from pin 1 (signal amplified tuned RF) connects to the common of gang SW4 that selects the primaries of the PHF coils. The secondary's of the PHF coils are tuned by parallel trimmer capacitors (TC9 to TC15) for each frequency range, and are the grid feed of V2 through the common of the fourth gang SW5, and are tuned by C13/TC16. The circuit connection point is 'A' between the figures on page 26.

Frequency changer and first IF
The connection point 'A' passes the amplified RF signal to the top cap of V2. The input grid voltage of V2 (top cap) is controlled by the AVC line via R9. The oscillator grid pin 5 modulates (mixes) with the hexode section with the oscillator signal via C17, to create the IF frequency that appears on pin 3 of V2 (signal 465kc/s). The mixer anode load is the primary of IFT1 and R12. RFC4 decouples the IFT1 from the HT+. The secondary of IFT1 connects to the control grid (top cap) of V3 (signal 465kc/s), and SW8 via connection point 'B' between the figures on pages 26 – 27. SW6 gang five common feeds the oscillator triode grid via C17 (signal RF + 465kc/s). SW6 selects the untuned primaries of the PO coils. The secondary's of the PO coils are tuned by parallel trimmers (TC16 to TC22) and series padders (PAD1 to PAD7) and are connected to the sixth gang of SW7. The common of SW7 connects to pin 6 of V2 (signal RF + 465kc/s) and the triode anode load, and the third tuning gang C18/TC17. The gain of V3 and V4 is controlled by VR2, where the connection point via R17, is 'D' between figures on pages 26 – 27.

IF and AVC amplifiers
The anode load of V3 (pin 3) (signal 1st amplified 465kc/s) connects via point 'C' to the primary of IFT2 and is decoupled from HT+ by RFC5. The secondary of IFT2 is connected via PAD8 to the primary of IFT3. The common of SW8 feeds the control grid TC of V4, where SW8 selects either the secondary of IFT1 or IFT3. The anode load



Component types and values.

Resistors

R1a	39(5W)
R1,R33,R35,	150k
R3,R17,R19,R30,	100
R4,R11,R26,R74,	47k
R12a,R9,R12,R21,R22,R28,R64,R70,R79,R81,	470k
R5	1.3M
R6	47
R7,R18,R44,R84,R86,	2.2k
R8	4.3k
R10	330
R14	40k
R15,R20,	50k
R21,R37,R40,	30k
R23	180
R24,R72,	33k
R25,R53	68k
R27	5.7k
R29,R71	10k
R31	27k
R32	25k
R34,R76,R77,R78,	22k
R36	15k
R38,R59,R60,	1M
R39	2.5k
R41,R46	5k
R42,R42a,	300k
R43	500k
R45	2k
R47	2.2M
R48	2.7k
R49,R67,	100k
R50	180k
R51	1.8k
R52,R82,R83,	39k
R54	6.8k
R55	2.7M
R56	1.1M
R57	62k
R58	1.3k
R61	1.5M
R62,R88,R89,R91	1K(1/2 W),1k(25W), 1k(10W)
R63	6.8M
R65	14.7M
R66	820k
R68	If and when required
R69	3.9k(5W)
R73	4.7k
R75	470
R80	390
R85,R87,	430k
R90	8.2k

Potentiometers

VR1,VR11,	5k
VR2	1k
VR3	500
VR4,VR8,	1M
VR5,VR6	250k
VR7	2M
VR9	15k
VR10	2.5k
VR12	1.5k

Capacitors

C1	200µf(450v)
C2,C72,C73,	64µf(450v)
C3	32µf(450v)
C5,C6,	4700pf(1000v)
C4(1000v)C7a,C10,C11,C12,C38,C47,C61,	0.01µf
C8,C17,C23,C24,C37,C27,C43	100pf
C9,C13,C18,	350pf
C14,C19,	0.001µf
C15,C25,C28,C35,C68,C69,	0.05µf
C16,C18a,C19,C20,C22,C31,C39,C40,C41,C46, C49,C52,C59,	0.1µf
C21	22pf
C26,C34	0.5µf
C27	1.5µf
C29,C32,	330pf
C36	250pf
C42	5µf
C44, C62	25µf
C48	0.25µf
C50	8µf(350v)
C51,C64,	50µf(25v)
C53	560pf
C54	8000pf
C55	2000pf
C56	0.02µf
C57	0.22µf
C58	220µf
C60	4.7µf
C63	1µf
C65,C66,C67,	32µf(350v)
C65a	200pf
C70,C71,	0.25µf
C74	100µf(450v)
C75	47µf
C76	0.047µf

Component types and values.

Trim capacitors

TC1,TC9,	240pf
TC2,TC10	70pf
TC3,TC11	70pf
TC4,TC6,TC12,TC14,TC16,TC18,TC8,TC16,TC17,	60pf
TC5,TC7,TC13,TC15,TC19,	65pf
TC17	50pf
TC20,TC21,	76pf
TC22	95pf
PAD1,PAD2	5000pf
PAD3,	2400pf
PAD4	900pf
PAD5	450pf
PAD6	350pf
PAD7	150pf
PAD8a	30pf

Radio Frequency Chokes

RFC1,RFC2,RFC3,RFC4,RFC5,RFC6,RFC7,RFC8, RFC9,RFC10,	Radio frequency choke

Coils and Transformers

PA1,PA2,PA3,PA4,PA5,PA6,PA7	Wearite P type aerial transformers
PHF1,PHF2,PHF3,PHF4,PHF5,PHF6,PHF7	Wearite P type HF transformers
PO1,PO2,PO3,PO4,PO5,PO6,PO7	Wearite P type Oscillator transformers

465kc/s acceptor from ECKO Model AGR 134

Intermmediate Frequency Transformers

IFT1,IFT2,IFT3,IFT4	Wearite type 501
IFT5	Wearite type 502
T1 Large Mains Transformer, 300-0-300,6.3-0,6.3-0,5-0,	Radio Spares (big)
L1,L2, smoothing chokes	source old radios!
Inductive Coupled mains filter	Radiospares twin suppressor choke
Output Transformer	Partridge P4014 (about 8kΩ slope match)
Loud Speaker	15Ω moving coil Rank Wharfedale Ltd 8 inch Bronze RS/DD Flux Density 10,500 lines 5 watts

Valves

V1	6BQ7
V2	6K8/GT
V3,V4	6K7G
V5,	6SG7
V6,	6B8
V7,V8,V9,	6F8
V10	6J5
V11	6SN7
V12	EM34
V13,V15,	6H6
V14	VR150
V16,V17,V18,V19	6J5 (metal jacket) ,1st amplifier,phase
V20,V21	6V6
V22	5U4G

Switches

SW1	Yaxley 3 position 2 leaf rotary
SW2,SW3,SW4,SW5,SW6,SW7	Yaxley 7 position rotary
SW8,SW9,SW10,SW11,SW12,SW13,	Maplin minature SP changeover
S meter	Ferranti moving coil FSD 1mA Type 6625-99-404-1312

Standard jack socket, with normally open contacts, for low impedance ear phones

Fuses and lamps

Neon(240v) small edison screw fit	
B1,B2,B3,B4	miniature flange 12v bulb (overrated)
F1,F5,F6	3A fast, 1 1/4 inch
F2	5A fast, 1 1/4 inch
F3	0.5A slow, 1 1/4 inch
F4	3A slow, 1 1/4 inch

Jones Plugs

8 way, 1 free plug, 1 chassis mounted socket.
12 way, 1 free plug, 1 chassis mounted socket.
and all the nuts, bolts, washers and grommets you can think of!

of V4(pin 3) (signal 2nd amplified 465kc/s) is the primary of IFT4 which is decoupled from the HT+ by RFC6 and C19. The secondary of IFT4 connects to the detector grids of V7 via connection point 'E' (signal 3rd amplified 465kc/s) between figures 18 and 19. The anode of V4(pin 3) feeds the grid of V5(pin 4) via C21. The primary of IFT5 is the anode load of V5(pin 8) (signal 3rd amplified 465kc/s), decoupled from the HT+ by RFC7. The secondary of IFT5 is connected to the anodes of V6(pins 4 and 5) (signal 4th amplified 465kc/s for AVC). The diodes of V6 (pins 4 and 5) rectify the amplified IF from IFT5, and the AVC voltage is developed across R25. The AVC voltage is filtered by C29, C32, R26 and R29. R29 feeds the AVC to the grid of V6(TC), switches SW9 and SW10, and connection point 'F'. The current draw through the anode of V6 (pin 3) deflects the S meter M1. VR3 provides series resistance to M1 in order to set zero.

Detectors, AVE, noise suppression and first AF amplifier.

The input to the two detectors is via connection point 'E' (signal 3rd amplified 465kc/s) to the grids TC and pin 5. RF and IF frequencies are removed by RFC8, RFC9, C36 and C37 (signal demodulated audio frequency). The AVE circuit is fed by C38 into the grid TC of V8. The level of AVE expansion is set by VR4 that feeds the grid of V8 pin 5 (signal decompressed/ expanded AF). This is mounted under the chassis as there was not enough room on the front of the chassis. The noise limiter is switched on/off by SW11 (signal decompressed lower threshold lifted AF). The input to the tone control preamplifier is fed by SW12, into the grid of V10 pin 5. SW12 selects AF input from either the AVE circuit via C49, or from a detector via C39. The tone controls are in the anode circuit of V10, pin 3 (signal AF base/treble lift/cut). VR5 controls the treble, and VR6 controls the base. The AF output is connected via 'F' from the wiper of VR5, figure 19 to figure 20.

White cathode follower

The input to the first triode grid of V11 (pin 1), is fed from the output of the AF tone control amplifier via connection point 'F' through C57. The grid (pin 4) of the second triode is fed from the anode of the first triode (pin 2) via C59. The cathode of the first triode (pin 3) and the anode of the second triode (pin 5) (signal AVE AF low impedance) are connected together, and provide the output to connection point 'H' via C60. 'H' connects between figures 20 and 21.

Main amplifier

The main amplifier is built on a separate chassis, and is connected to the radio chassis via an 8 pin Jones plug flying lead. The Jones socket pin numbering is shown at the bottom of the circuit diagram. The input to the amplifier is via connection point 'H' from figure 20, that connects to the volume control VR7 (signal AF low impedance). The 'H' wires are screened. The AF voltage is developed across VR8, and the input to the grid of V16(pin 5) is drawn from the wiper. The cathode of V16(pin 8) is connected to the negative feedback line via R90 or VR11, selected by SW13. The feedback voltage via R90 or VR13 subtracts from the V16 cathode voltage developed across R75. The amplified output from the anode of V16(pin 3) (signal amplified AF)is connected directly to the grid of V17(pin 5). V17 draws current through the resistor chain R76, R77 and R78. Voltages of opposite phase are developed at the anode (pin 3) and cathode (pin 8) of V17 (Signal AF split into anti-phase), and are fed to the grids of pre-amplifiers V18(pin 5) and V19(pin 5) via C68 and C69 respectively. V18 and V19 have a common cathode bias developed across R80. The difference in gain between V18 and V19 and tolerance of R82 and R83, is balanced by VR9. The control grids of V20(pin 5) and V21(pin 5) are fed by C70 and C71 respectively (signal AF split amplified and balanced). The biasing of beam tetrodes V20 and V21 is arranged to provide a class 'A' amplifier. The primary tapings T1 and T2 of the output transformer are connected to the screen grids of V20(pin 4) and V21(pin 4) respectively to create an ultra linear output. The cathodes of V20(pin 8) and V21(pin 8) are AF bypassed via C72 and C73 respectively. Difference in the gain of V20,V21 and resistors R85,R86, R87, R84, R88 and R89 is corrected by adjusting VR10. The anodes of V20 (pin 3) and V21 (pin 3) connect to the output transformer primary tappings A1 and A2 respectively (signal final AF amplification in class 'A'). Values of R88 and R89 have been raised, and with the introduction of R91; to limit the standing current in transformer T2. The secondaries of the output transformer are connected in series to create an impedance match of 15Ω for the loudspeaker (signal audible). The overall gain is also reduced to suppress current requirement from the power supply.

Tuning Indicator

The input to the grid of valve V12(pin 4) is via connection 'G', through R92, which is derived from the AVC voltage developed across R25, 'G' comes from (signal strength visible). The cathode of V12(pin 8) is biased by R62 with AF bypass C62. Full HT+ is connected to anode pin 5.

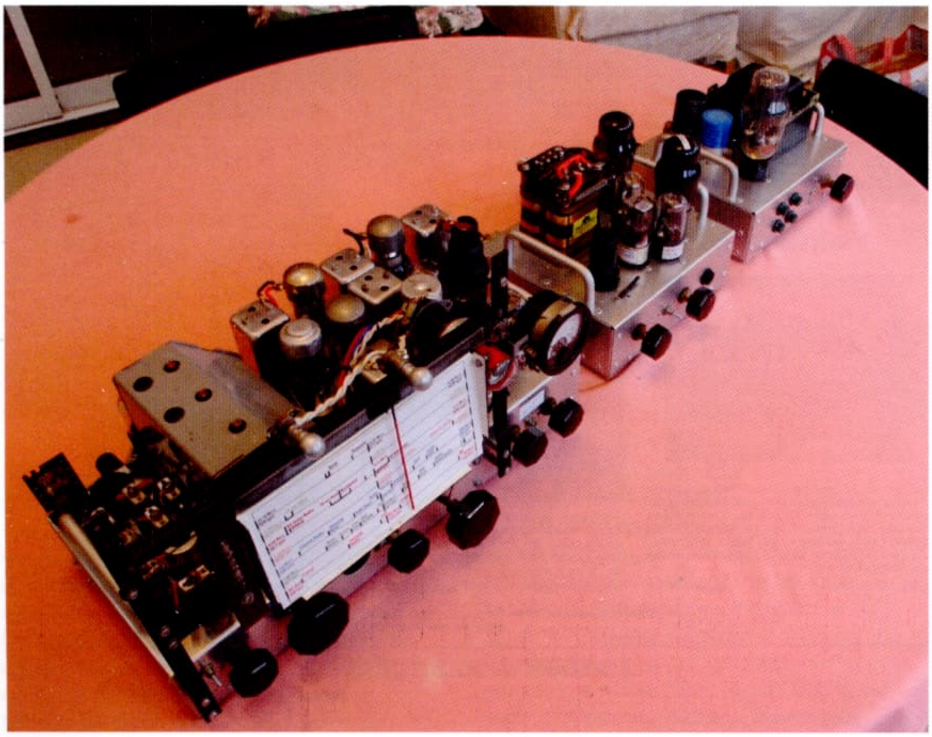
-15v Supply and RF gain control

The -15v supply is generated by the double diode valve V13. The negative voltage provides a bias through R66 to VR7 the gain control. The wiper of VR7 connects to the AVC line via R64. The positive bias is tapped from the anode of V14 through R65, which is the 150v stabilised supply. The centre tap of VR7 provides the manually adjusted gain to the AVC line through R64.

Component schedule photographs

The photographs in the article show each of the chassis from different angles to give you an idea of what went into the construction and what the final product looks like after cut fingers, solder burns (particularly the ones where the solder-splash sticks to your socks), burnt fingers, shards of insulation flicked in the eyes, holes drilled in the wrong places, bits lost inside, wires cut too short, circuit diagram wrong etc.

Well, that's the end. I avoided 'If at first you don't succeed – do something else'. In the words of Craig Breedlove when he broke the land speed record, and his crew dug him out of the salt lake at the end of the run, after both his parachutes failed– 'I ain't doing that again'. I hope you enjoyed the story.



Letters

Dear Editor
I thoroughly enjoyed the article in the Summer Bulletin by Phil Moss about the splendid Marconi CR100 Receiver.

In it Phil questions why a separate oscillator valve was used in the CR100 when the mixer valve contained a triode section intended for that very purpose. The use of a separate oscillator valve was standard practice in communications receivers with a low frequency I.F. because of the problem of oscillator frequency 'pulling' on strong signals at higher frequencies. This could be minimised by using a valve of higher mutual conductance than that of the relatively modest performance of a frequency converter valve's triode .

There is an interesting background to the story of the CR100. Professor Eric Zepler, who amongst his many achievements wrote the most informative book 'Technique of Radio Design', was in charge of Marconi's design Department during the development of the various forms of the CR100. He had come to England in 1936 after being forced by the Nazi Government to leave Germany where he had designed much of Telefunken's military equipment. This led to the unusual situation of the armed forces on both sides of WWII using equipment developed by the same designer.

A biographical article about Dr Zepler, who in his younger days designed the well known Telefunken Arcolette /GEC Victor 3 in 1927, can be found in Radio Bygones no. 60 August/September 1999.

Peter Lankshear,
Invercargill N.Z.

Dear Editor
I was sad to hear that Gordon Farrance has passed away, I got to know Gordon in the mid 1990's when, together with Mike Tonkin, we helped Barrie Phillips with the vintage wireless displays at the Steam Fairs held in the Devon village where my parents lived.

Gordon had memories of working in a radio shop before World War II which also sold televisions, he said that the Cossor 1210 15 inch combined TV/ radio had particularly impressed him at the time. He had strong opinions on which sets performed well or poorly, of sets which I brought examples of to sell on the Bring and Buy at Wootton Bassett, I can remember him saying that he didn't think that the GEC BC3850 was much good (poor sound from the relatively small speaker) although his shop sold lots of them as they were a budget model. He approved of a Beethoven portable of the same period, saying how well it worked, which it did.

Gordon always did his best to help with the Bring and Buy at Wooton Bassett, despite his advancing years and will be sadly missed, another link with the days of radio and television from before World War II is gone.

I have some information on the early Army wireless equipment shown in the slides in the last bulletin, taken from Louis Meulstee's Wireless for the Warrior Compendium 1. The bottom picture on page 55 shows a W/T Wagon Set also known as Wagon Station 1.5 kW spark, introduced in 1910, the early version used the 70 ft telescopic aerial shown on pages 57 and 58. The bottom picture on page 56 shows a Marconi 0.5kW pack set, introduced in 1914.

P.S. I include a copy of a page from an East London Rubber Co catalogue of just before the war which shows two Philco televisions which I don't think I have seen any other information on. The catalogue belongs to Alan McGregor.

Mike Butt.

Dear Editor,
I was very pleased to see Tony Fell's article on the Jewel Corp Pixie radio and enjoyed reading it as I have been a lifelong fan of the compact 67volt class of 4 valve superhet portable radios and at one time had a large collection of them including some of the lesser known American brands. These sets first appeared in the USA in the late 1930's following the introduction of the newly developed 'Button Base' valves which we refer to as B7G. RCA and Emerson produced some of the first compact receivers pre World War II and we and the rest of Europe did so from1945; the Marconi P20B, Ever Ready model B (Marconi P17B) and the Vidor 353 being some of the most notable and are still collected and restored for use. I have not come across the 'Jewel Corp Pixie' but did have an extremely compact 'Bulova Adventurer' and 'Firestone Tyre'

All converted Car Radio to domestic £

ELRCo Limited

RECEIVERS AND VISION SETS

"PHILCO" TELEVISION AND CAR RADIO

Add-on Unit, Tel. 1

"Add-on" unit for vision. Sound frequency channels for reproduction through any ordinary receiver. Seven-inch tube. Picture size: 6×4½ in. Plate-glass fronted Cathode Ray tube. Cabinet of stripy walnut with dark walnut panels. Size: 17½ in. high, 18½ in. wide, 16½ in deep. Sixteen valves. Superheterodyne vision and sound receivers. Electromagnetic scanning. Five controls on front panel. Preselector controls easily accessible on side of cabinet. 70-100 ohms aerial input. A.C. mains 200-260 volts, 50-100 cycles. Consumption 160 volt/amps. All that is needed with the Philco Add-on Television Unit is a radio set, of any type that has gramophone pick-up terminals to reproduce the sound signal. The brilliant black and white picture and high standard of definition make it unnecessary to do more than instal the unit away from the direct light of the window.

WL 275/33210 "A" - each £25 4 0
WL 276/40303 "B" - " £25 4 0

"PHILCO" U.1

A.C./D.C. All-wave Superhet Walnut Cabinet Manual Tuning

If you prefer a battery-operated set, the Philco Battery Major offers you really delightful quality of tone and exceptional all-wave performance, particularly on the short waves.
In a cabinet of the same design is the Universal Major for use on AC or DC mains. Both Majors operate on three wavebands, have slow motion tuning, the latest type 8-in. permanent magnet speakers. A feature of the Battery Major dial is a mechanical indicator which shows red when the set is on but saves the consumption of a pilot light.

WL 278/14000 - - each £10 10 0

Television Sound and Picture, Tel. 2

Television sound and picture. Floor console cabinet in straight grain walnut with solid moulding: 46 in. high, 24½ in. wide and 20½ in. deep. Picture height: 38 in. from floor. Bronze interlaced speaker grille. 12-in. tube giving a picture 10×8 in. Four only controls on front panel. Armoured glass facing to tube end. 22 valves including rectifiers. Preset controls easily accessible at side of cabinet. Both sound and vision amplifiers of superheterodyne design. Diode to restore D.C. for picture. Limiter valve and diodes to restore D.C. component and remove picture signals for synchronising. Electromagnetic scanning. Pentode output for sound signals: 4.8 watts. 10-in. energised moving-coil loudspeaker. Standard aerial connector sockets. Power input 200-250 volts, 50-100 cycles alternating current. Consumption 230 volt/amps. Extremely bright black and white pictures of high definition with good focus is maintained and the whole picture and interlacing is positive. Full advantage of the wide sound frequency band has been taken to ensure the reproduction on the audio side is of highest quality.

WL 280/66106 "A" - each £47 5 0
WL 281/75600 "B" - " £47 5 0

"PHILCO" C.5

A set at 10 gns. with real Philco quality. 6-valve superhet covering the medium wave band, 190 metres to 550 metres. The receiver, speaker and controls are all housed in one single unit 12 in. long × 4½ in. high × 5½ in. wide, and is designed for ease of installation under the dash of all cars.

WL 282/14700 - - - each £10 10 0

"PHILCO" M.522

Here again no introduction is necessary for this 5-valve model. Its unusual design makes ease of installation in even the smallest car, while the performance is true to Philco quality.

WL 283/19102 - - each £13 13 0

"PHILCO" K.728

WL 284/26408 - - - each £18 18 0

"A." Dealer terms to those who carry out installation.
"B." " " " " who do not carry out installation.

LONDON & BRANCHES 10

radio – same set, also manufactured in New York, probably by De Wald who were a prolific source of OEM radios specialising in tooled faux leather cases, which both of these had. The performance of these two sets was incidentally uniformly excellent across the band using a miniature gang condenser with the oscillator section profiled for optimum tracking, very common in American compact sets but seldom seen in this country.

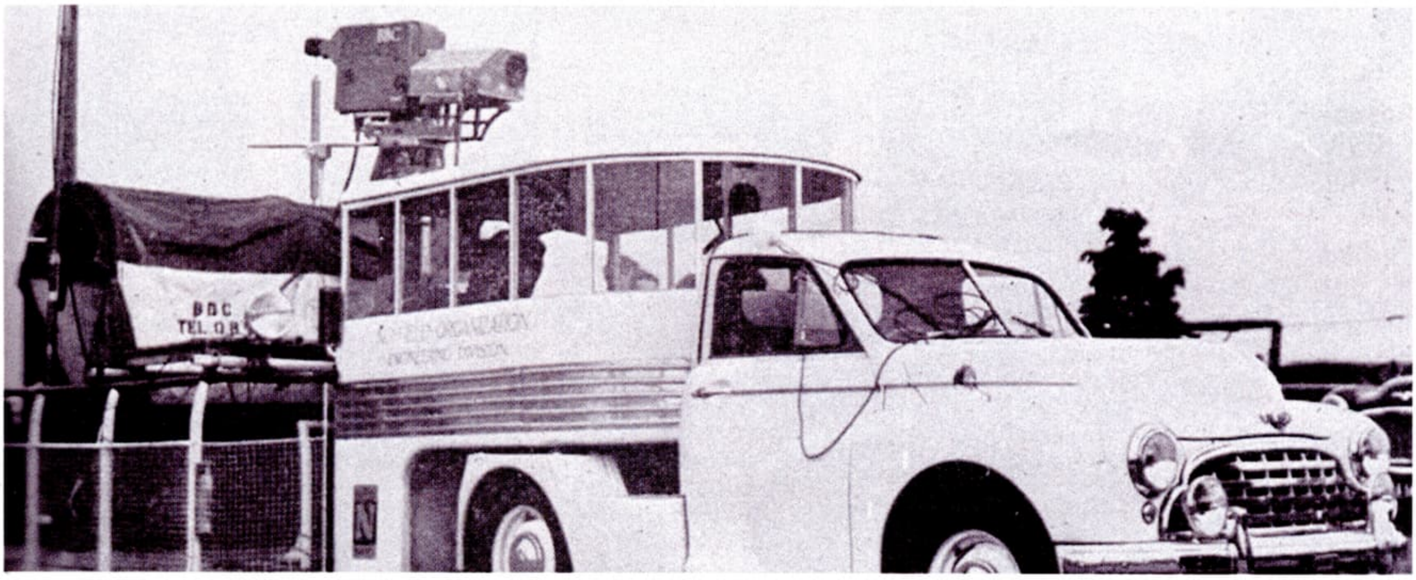
Back to the Pixie, I was puzzled by Tony's references to the requirements of the LT and HT power supplies i.e 'This supply can deliver rather more than the required 100mA at 1.4v'

In fact this set of valves had 50mA filaments with the output valve 3S4/DL92 etc having two of them in parallel making a total of 5 filaments requiring 250 mA from the power supply. To check this out I put a new D cell in my Emerson 640 and inserted a Milliameter in series and indeed it measured within a whisker of 250 mA/quarter of an amp. As the restored 'Pixie' operated OK, Tony's power unit was clearly well capable of supplying the full filament current being robust and well made. In the last phase of the valve era Mullard introduced a 25 mA version of these valves coded as the 96 series, DK96 etc meaning a similar 4 valve set required only 125 mA filament current in total.

Regarding the HT supply current, it was stated that 'only 20 mA is needed'. In fact only 8 mA is needed by this type of radio – half being consumed by the output valve, the first three valves accounting for the rest. If the set had been an Attaché Case 90volt type, the HT current requirement would still not have exceeded 10 mA. Was there an LED indicator hung off this line as well ?, or was something else drawing the extra 12 mA current?. However, it doesn't actually matter, even if the current was for example 8 mA rather than 20 with the 1k series resistor dropping only 8volts and thus supplying 80v to the set, this is no problem for the valves, hopefully not for the condensers and indeed would make the set rather 'lively'. The 'Big gun' line/battery sets such as the Zenith Transoceanics using this class of valve were designed to operate with up to 100volts HT on the output valve anode without problems.

Regarding output power we are in somewhat murkier waters as it tends to be interpreted and stated differently by various organisations and (sales !) people around the world. Tony refers to 275mW being quoted but this would represent a peak power figure for a set operating from 90v. A useful reference for a 67volt receiver is given by the Marconi 'official' P17B (Ever Ready model B) data sheet which is extraordinarily comprehensive and states that the output power (using this same set of valves) to be 80mW and of course they would not understate the figure. By convention in this country we base output power on the product of the Rms values of the respective peak output voltage and current swing values. This equals each peak value multiplied x .707 or the total product conveniently divided by 2, meaning conversely a figure of 160 mW peak power for the P17B. The peak current is easily arrived at being very close to the static 3S4 anode current of 4.2 mA which appears on the data sheet. The peak output voltage is much less obvious however as there are a number of 'subtractions' from the nominal 67 volts to be taken into account. The 3S4 anode is shown to have a 'volts to chassis' figure of 57v. 8 volts has been lost across the auto bias resistor in the HT negative lead (a system everybody used), and 2 volts across the output transformer primary resistance. The major unseen loss however – arises from the anode 'knee voltage' of around 20v – below which a symmetrical output swing cannot be obtained. This can only be got from the dynamic valve characteristics via a load line plot – Mullard show this on their data sheets for the DL92. Out of all this falls a peak voltage swing of only 38v available for output power hence the product of the two (38x4.2) giving 160 mW peak power and 80 mW rms based. Using the corresponding data for a 90v set yields a figure of around 275 mW and 137 mW respectively.
Setting all these considerations on one side however, it is clear that a splendid job has been made of restoring the Pixie and it is sets such as this and the British ones mentioned above which have given me continuous pleasure since the age of 10, that is for 63 years. Now I can't think of many other things which have done that...

Yours sincerely.
Jim Duckworth

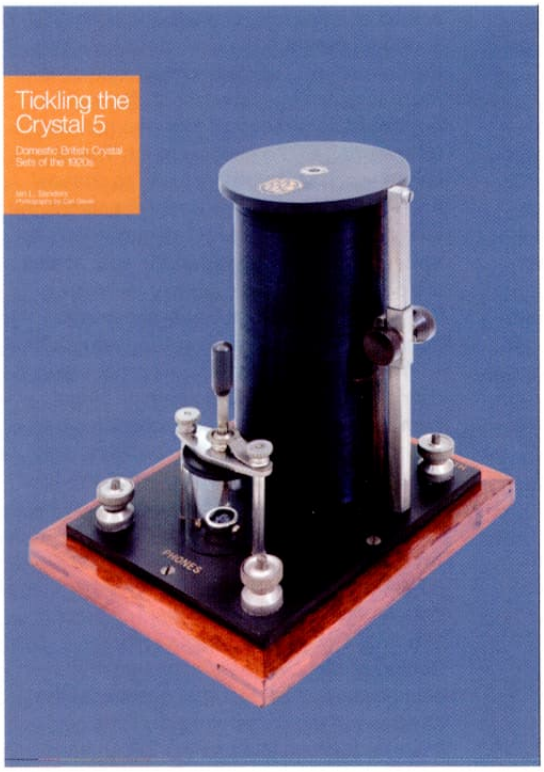


Roving eye?

Dicky Howett poses a question

Here's something we don't see very often. In fact we've never seen it before (or since). A BBC television 'Travelling Eye'. Way before the Granada Tv vehicle of the same name, this picture, published in an 1953 edition of 'TV News' magazine, shows a Marconi Mk II camera with its Watson 5:1 zoom lens and a transmitter somewhere under a sheet. This collection was installed on a trailer arrangement courtesy of the Nuffield Organisation Engineering Division. Apparently, this motorised medley was capable of a 30 m.p.h, racing along, whilst 'on air'! A vaguely American-looking rig, this was used first (and probably last) during a programme called 'Night Flight'. During the show, the lorry and camera, transmitted live images as it went, trundling along an airport runway, pacing the takeoff of a B.O.A.C airliner no less. Later in 1954, the more familiar BBC 'Roving Eye' vehicle entered service, and in 1956 a two-camera version, built on a Karrier Bantam chassis could be seen out and about, most famously at the 'Lincolnshire Handicap' race, following alongside the horses in a sequence during the 1959 documentary, 'This Is The BBC'.

BVWS Books



Out Now!

Tickling the Crystal 5 More Domestic British Crystal Sets of the 1920s
by Ian L Sanders.
Photography by Carl Glover

The final edition in Ian Sanders' thorough five volume set exploring GPO No. era British crystal sets.

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

252 pages of GPO No. era British crystal sets and many previously–unseen models in print for the very first time. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £19)

by Mark Johnson
An 80 page colour paperback guide to the Attaché portable
- Detailed specifications
- 140 radios in full colour
- Over 200 additional photos of sales literature, trade ads etc.

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

Obsession Gerry Wells
Growing up in the 1930s, young Gerry Wells preferred wireless to toys. He had a postwar career as a radio and TV engineer designing and managing amplifiers, PA's and TVs. He now runs the British Vintage Wireless and Television Museum from the home where he was born. This is the story of one man's dedication to wireless £6.00 196 pages paperback (+ £2.50 p&p UK) £3.50 EEC (rest of world £5.50)

256 pages. Over 200 full-page photographs. £14.95 for BVWS members plus £7 p&p for UK, £13 EEC (rest of world £19)

Limited, Only 750 copies printed. 208 pages. Over 125 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £19)

Limited, 500 copies printed. 240 pages of GPO No. era British crystal sets. Over 75 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £19)

Tickling the Crystal 4 More Domestic British Crystal Sets of the 1920s. 280 pages of GPO No. era British crystal sets. Over 115 full-page photographs. £29.95 (£24.95 for BVWS members) plus £7 p&p for UK, £13 EEC (rest of world £19)

Shareholders of the British Broadcasting Company Lorne Clark
68 pages. For the first time, a comprehensive listing of all of the companies, large and small, comprising the British Broadcasting Company - the forerunner to the British Broadcasting Corporation. Illustrated. £10.95 (+ £2.50 p&p UK) £3.50 EEC (rest of world £5.50)

Slipcase to house the first three volumes of Tickling the Crystal £9.95 Buy all three and get slipcase free! (postage £12 UK, £35 EEC, £55 US) BVWS members buy two and save £12 (postage £9 UK, £24 EEC £28 US)
Cheques payable to British Vintage Wireless Society

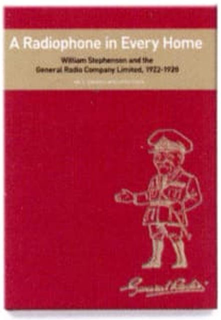
Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG

BVWS Books

Out Now!

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

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



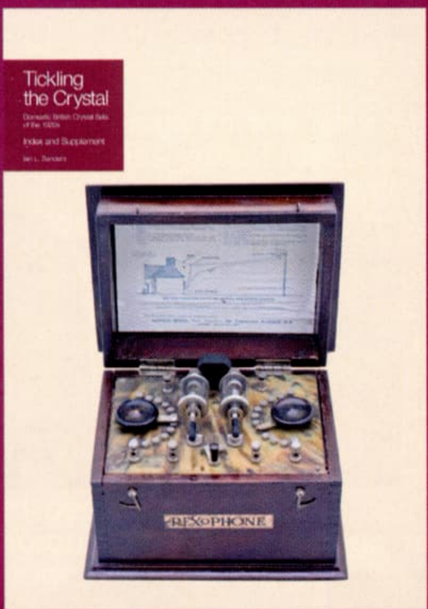
Between 1922 and 1927, during the life of the British Broadcasting Company (forerunner of today's British Broadcasting Corporation), literally hundreds of wireless manufacturing firms sprang up to take advantage of the new craze for 'listening-in'. In the fiercely competitive market of those pioneering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

In their superbly illustrated new book, Ian Sanders and Lorne Clark tell the fascinating story of one of these smaller firms, the General Radio Company Ltd., and its enigmatic Canadian founder, William Samuel Stephenson, WWI air ace and WWII secret agent, thought to be the model for Ian Fleming's James Bond character.

As well as producing an extensive range of radio receivers, the company also worked on the development of mechanical television.

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

Out Now! Tickling the Crystal index and supplement



80 pages of GPO No. era British crystal sets. including comprehensive index listing sets in all five volumes of *Tickling the Crystal*

Price is £11.95, £9.95 to BVWS members.
(+ £2.50 p&p UK) £3.50 EEC (rest of world £5.50)
Cheques payable to British Vintage Wireless Society

Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG
chairman@bvws.org.uk

24th February
Harpenden Swapmeet

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

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

The Bulletin back issues

All Bulletins and supplements are priced at £2.50 each + postage.

Postage: for individual Bulletins add £1.50, for all extra bulletins add £1 each.
Cheques to be made payable to 'British Vintage Wireless Society'.

Mike Barker, Pound Cottage,
Coate, Devizes, Wiltshire, SN10 3LG
chairman@bvws.org.uk

Coil and Transformer Rewinds for Vintage Radio and TV equipment

Power Transformers, Audio Transformers, Chokes, LOPTX and IF Transformers etc.

Special designs also undertaken.
Call Mike Barker on 01380 860787

The British Vintage Wireless and Television Museum

23 Rosendale Road, West Dulwich, London SE21 8DS
020 8670 3667 Registered Charity No. 1111516
Please make appointments beforehand

Out Now on DVD!

Valveman is the story of one man's lifetime of obsession.

Gerald Wells is Valveman. His life's work has been to amass one of the world's largest collection of valves, vintage radios and other early apparatus from the pioneering days of wireless communication. These are all kept in his house in London.

This documentary film innovatively blends, using a variety of motion design and filmed reenactments, the last hundred years since radio began through to the early days of television.

£12.00 (including p&p) £14.00 in EEC. Rest of world £15.00

Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG
chairman@bvws.org.uk

£9.99 from The British Vintage Wireless and Television Museum, 23 Rosendale Road, West Dulwich, London SE21 8DS and all BVWS meetings

www.valveman.co.uk
www.bvws.org.uk
www.bvwm.org.uk

The Radiophile

THE LEADING MAGAZINE FOR ALL VINTAGE RADIO ENTHUSIASTS

Each issue contains practical and authoritative articles on vintage radio as well as military and communication receivers, restoration and construction topics, all written by experts in their field. The Radiophile also hosts Vintage Radio Auctions and Expositions at which receivers, valves, components, test gear, etc., may be bought and sold.

If you are a Vintage Radio enthusiast you cannot afford to be without The Radiophile.

The Radiophile is available by subscription only, currently just £22* for four 48-page issues, or a sample may be had for £5†. To take out a subscription contact us by 'phone with your credit or debit card details or send your cheque to:

The Radiophile, "Larkhill", Newport Road, Woodseaves, STAFFORD, ST20 0NP.

Telephone and fax (business hours) 01785 284696.

** UK and BFPO only; all other territories £28.*
† UK and BFPO only; all other territories £6

MARCONI'S NEW STREET WORKS 1912 – 2012

Birthplace of the Wireless Age

With the centenary of the New Street Works now here ex-Marconi engineer and historian Tim Wander has spent the past two years putting together a history of the famous factory. The book is *now available* direct from the publishers priced at £12.99 – see www.authorsonline.co.uk or www.amazon.co.uk search for 'New Street' or 'Tim Wander'.

At nearly 400 pages and with over 130 photographs the book charts the history and development of the site and tells the stories behind the world beating and world saving technologies that were developed there. New Street was the birthplace of many technologies that have shaped and changed our modern world including radio, broadcasting, television, radar, satellite communications and even the computer and the technology behind the mobile telephone. But most of all the Marconi New Street centenary book tells some of the stories of the men and women who worked there from the 1930's onward. Over a hundred people have contributed to a unique oral history - everything from a paragraph or humorous anecdote through to a career history. With careful editing they have been woven together to form a permanent record of the factory and the people who served there.

Many of the photographs in the book are previously unseen and span the entire history of the New Street site and include some taken earlier this year inside the main factory showing the dreadful state of decay and dilapidation now rainwater has got into the site though the vandalised roof.

For more information on New Street, 2MT Writtle and Tim's forthcoming books on Marconi's early work please see:- **2mtwrittle.com**

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

2013 Meetings

22nd February 'Hidden Broadcasts – clandestine radios in POW camps' by Ralph Barrett 22 February at 2pm.
Institution of Engineering and Technology, Savoy Place, London WC2.
Admission Free.
24th February Harpenden
7th April Golborne
May 12th NVCF
1st June BVWS Garden Party
2nd June Harpenden
July 7th Wootton Bassett
15th September Murphy Day
29th September Harpenden
6th October Audiojumble
3rd November Golborne
1st December Wootton Bassett

The British Vintage Wireless and Television Museum:
For location and phone see advert in Bulletin.
Harpenden: Harpenden Public Halls, Southdown Rd. Harpenden.
Doors open at 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
Golborne: Golborne: Golborne Parkside Sports & Community Club.
Rivington Avenue, Golborne, Warrington. WA3 3HG
contact Mark Ryding 01942-727428
Mill Green Museum: Bush Hall Lane, Mill Green, Hatfield, AL95PD
For more details with maps to locations see the BVWS Website:
www.bvws.org.uk/events/locations.htm

We want your articles!

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

We accept: Type, handwriting, fax, email, floppy disc, CD

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

The BVWS Spares Dept

DeoxIT D5 Contact cleaner / lubricant £15.00 aerosol can. Not cheap – Just the BEST. Available at all BVWS events or by post for an additional £3.50

New manufacture high quality metallised polyester film capacitors to replace all old paper types in vintage equipment. Ideally sized for re-stuffing

All capacitors are 630 Volt working
All prices are for packs of 50 components and includes Postage and Packing

0.001µF	Price band A	0.022µF	Price band A
0.003µF	Price band A	0.047µF	Price band B
0.0047µF	Price band A	0.1µF	Price band B
0.01µF	Price band A	0.22µF	Price band B

Only available in packs of 50 within price band by post. Available in smaller quantities at all BVWS events

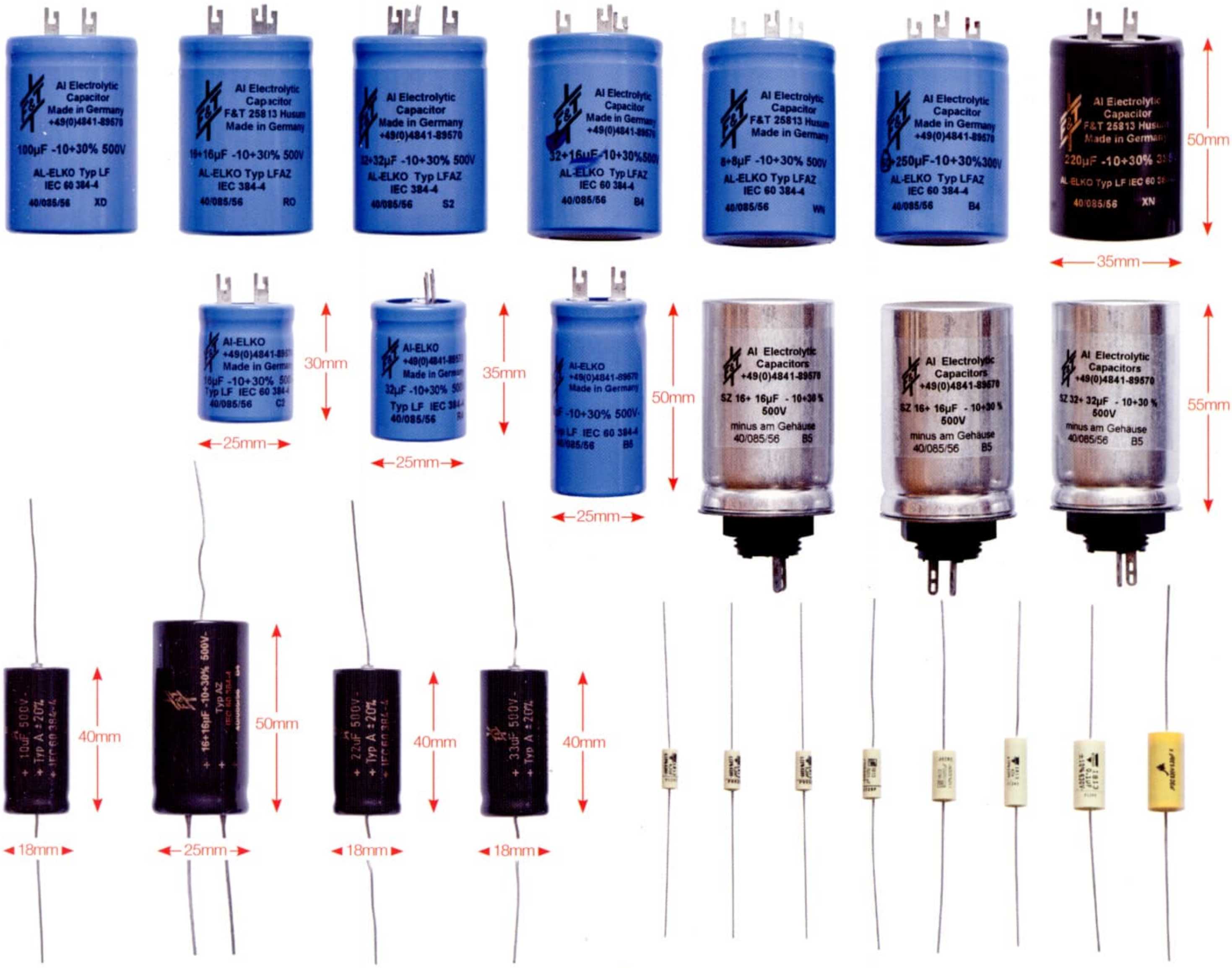
Electrolytic smoothing capacitors, Standard 'old-fashioned' size, 500 Volt DC working

8/8µF, 16/16µF, 32/32µF, 50/50µF £7.00 each
16/32µF for DAC90A £9.00 each
100µF, 220µF £9.00 each
60/250µF for TV22 £9.00
8/8µF screw-type, 16/16µF screw-type, 32/32µF screw-type £9.00 each
16/16 µF tubular axial £6.50
10µF tubular axial £4.00
22µF tubular axial £4.00
33 µF tubular axial £4.00

NEW smaller 25mm can types for re-stuffing original Single electrolytic capacitors

8µF, 16µF, 32µF, 500Volt DC working £5.00 each
Postage and Packing
1 – 4 caps £3.00 5 – 8 caps £4.50

All prices quoted are for BVWS members



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


EKCO
ALL - ELECTRIC RADIO
TYPE A.D.65. RECEIVER
FOR A.C. MAINS
200/250 VOLTS 40/100 CYCLES
OR D.C. MAINS
200/250 VOLTS
E. K COLE, LTD.,
EKCO WORKS,
SOUTHEND-ON-SEA, ENGLAND
UNDER LIMITED LICENCE
PATENT NOS 393081.
374253. 395777. 400321.
AND OTHERS.
REGISTERED DESIGN.
NO 791423