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A Pye Service Workshop Rack 1945 viewed from the front and inside.

Photographed by Alex Hewitt
Edited by Alex Hewitt
Proof-reading by Mike Barker and Steve Sidaway

From the outgoing Chair...

Way back in the 1980s I frequented the Wednesday Antiques market in Bath.

It was a short train ride from Swindon and then a good walk, all up a hill from the station.

This is where Doug had his stall filled with vintage radios, gramophones and records.

I bought several radios from there, one being a McMicheal RV8 'Twin Supervox' which I somehow managed to carry back to the station and get home. I remember getting some very strange looks from people on the train.

On one such visit, I met another radio collector who suggested that I should join the BVWS.

At that time, I was only really interested in getting as many radios as I could find, but a few years later I did join and I remember spending far too much money at the events for anything made by Murphy Radio. A particular favourite was the Portishead meeting where I would always have a stall and mostly bring back more than I ever took.

Roll on a few years and the BVWS was having a troubled time. As a result of the events at the 1994 AGM the Society was running on an emergency Committee headed by Gordon Bussey. I remember being invited to a rather clandestine meeting in the hotel lobby at Paddington Station where I was asked if I could help and I then joined the Committee.

Some 23 years later and holding the position of Society Chairman for the past 18 years I find myself wondering where the time has gone and still having lots of things that I would like to do but can never find the time for. This has been playing on my mind for some while now which is why at an AGM two years ago I announced that I would only stay on the Committee for a further four years, well half way through that period I have decided that the time is right to Resign as BVWS Chairman and leave the Committee. Heaven knows what I am going to do with all of the peace and quiet it will bring.

Well that's the past, now to the future.

The Committee is very stable and expert at their jobs and I have every confidence in their ability to take the Society forward for many years to come.

Our Constitution dictates that the position of Chairman can only be filled by an existing committee member who has served as an officer in a named position for a period of time.

I have asked Greg Hewitt (Treasurer) to take up the position of Chairman and he has accepted.

The burden of being both Chairman and Treasurer is quite unreasonable nor ethical, so the position of Treasurer will once again be taken up by Jeremy Day who previously served as Treasurer for ten years. Jeremy also remains Vice Chairman.

I would like to be the first to congratulate Greg and wish him the very best in his new Committee role. I know he will be a fine Chairman.

I would like to say a huge THANKYOU to all the members of the Committee for their total loyalty and support and enormous amount of time and effort they give to the Society.

I will be continuing with all of the BVWS Auctions and collections. The store will still be located in Devizes and I will still be seen at all of the meetings either on the BVWS stall or as Auctioneer/organiser.

Finally, I would like to take this opportunity to thank you, our members for all of your support and kind words over the years.

Please support your Committee. They are doing a Great Job!

Mike…

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Submarine Telegraphy - Part Two

By J Patrick Wilson

This second part describes the expansion of cables around the world, the problems of speed of signalling and the various techniques that have been used to speed up transmission in order to maximise profits and reduce the number of personnel required.

Girdle round the Earth

This is the title of Hugh Barty-King's 1979 book giving the story of the development of cables running eastwards and, the origins of Cable & Wireless and its subsequent history. Whilst the Atlantic developments were taking place there had been a huge expansion of the overland network in many countries as well as on shorter submarine links. Although the Atlantic link provided the most dramatic step forward in international communication, the Indian route was of greater importance to the British Empire. Before any telegraphic links were available, it took 3 to 4 months to reach India via the Cape of Good Hope. The "Red Sea Telegraph Co" was floated in 1857 and the following year Newells were rushed into providing a cable from Suez to Aden through the Red Sea which failed repeatedly for a variety of reasons. Just before it was finally abandoned in 1861, a 1700 mile section to Karachi had been completed, and through working from Alexandria to Karachi was achieved for a few hours, although a link between Alexandria and Malta, and thus to England, was not yet in place. The Karachi section also failed about a month later, leaving the Treasury and Indian Government to honour guaranteed annual payments of £36,000 for no return. It was the combined failure of this and the first Atlantic cable that forced a thorough review of every stage of design, manufacture, storage and installation that led to the start of proper electrical engineering.

A second route to India was in fact being created simultaneously overland through the Ottoman Empire, Constantinople, Baghdad and Basra, then submarine through the Persian Gulf and Gulf of Aden to Karachi. The submarine cable was made by WT Henley to a high specification, incorporating silica to discourage attacks by the teredo mollusc, and laid during 1864 and opened in January 1865. As messages had to be transcribed and retransmitted at least a dozen times over the journey between England and India, they took an average of about six days and introduced numerous errors. The latter were blamed on "incapable and unimprovable Arabs, Turks and barbarians" although many of the operators were in fact English!

A third line was also established in 1869 along the politically less attractive route through Russia and Persia. Henleys again made the submarine cable required for the Gulf section using rubber insulation. Unfortunately the Calcutta carrying the cable collided with a Russian vessel near Land's End with considerable loss of life. Furthermore the Carnatic, taking the directors and engineers for the project via the newly opened Suez Canal, was also wrecked with the loss of many crew as well as instruments and baggage. Fortunately the laying then went ahead without further mishap. This route also involved many relay stations but, using all British operators, and slow initially, delay was soon reduced to hours rather than days.

There was considerable dissatisfaction that communication with the British Empire should be dependent upon foreign goodwill so when "The British-Indian Submarine Telegraph Co" was formed in 1869 to lay an all submarine route, it was subscribed with enthusiasm. John Pender, whose earlier cotton interests were largely with India, was the driving force behind this and got his company Telcon to supply the cable. This was laid by The Great Eastern from Bombay to Suez in March 1870. He had earlier formed the "Anglo-Mediterranean Telegraph Co", "The Marseilles, Algiers & Malta Telegraph Co" and then the "Falmouth, Gibraltar and Malta Telegraph Co" to complete the route. "Falmouth" was changed to "Porthcurno" at the last minute to avoid problems with anchors, and England was connected to India by an "all red" route in June 1870. Porthcurno became a major hub for submarine cables, later incorporating a telegraphic training school, now housing the Cable & Wireless Archives, and two tunnels dug into the hillside during WW2 to protect cable operations now housing the Museum of Submarine Telegraphy (Fig. 1&2). Porthcurno, however, is better known to the public as the site of the Minack Theatre on the cliff overlooking the sea. Optic fibre cables now pass through here without requiring attention and, looking at the peaceful sandy beach today, it is hard to imagine it as the hub of world-wide communication.

In 1870 all land telegraphs and the short sea crossings to Ireland and the Continent were taken over by the Post Office. As the government had got it's fingers burnt with ocean telegraphs in the Atlantic and Red Sea, it was happy to leave these to private enterprise, which then of course, had much spare capital to invest. Pender, who formerly had a large interest in the "Magnetic" formed "The British India Extension Telegraph Co" from Madras via the Bay of Bengal and

Fig. 1 Quiet sandy beach at Porthcurno

Fig. 2 Cable station from 1904-41 (centre) now housing archives and tunnel entrances with museum behind

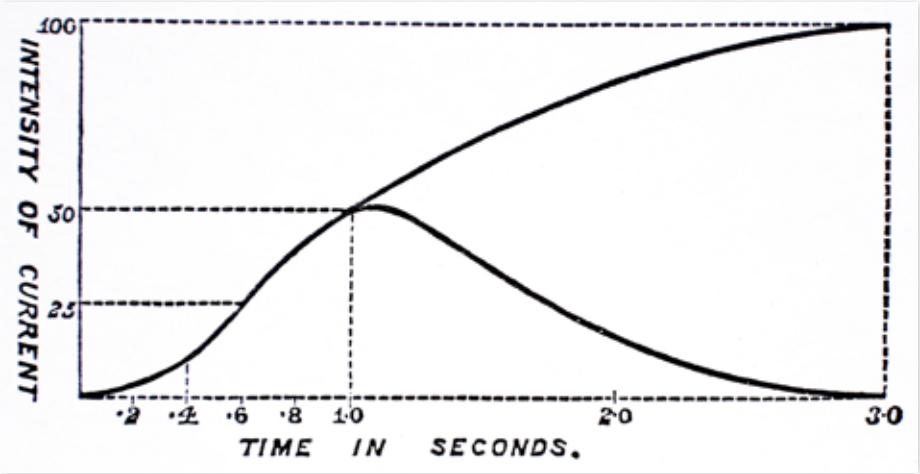


Fig. 3a Arrival curves for signals lasting for 1 sec and 3 sec for 1865/6 Atlantic cable

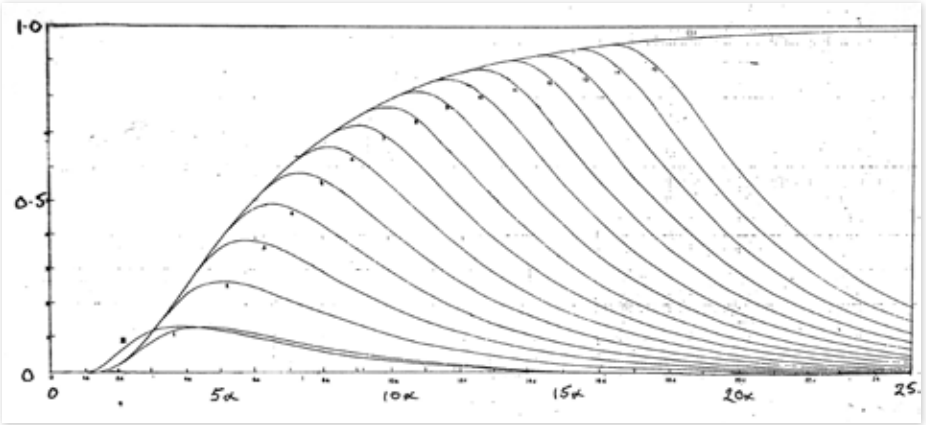


Fig. 3b Thomson's calculated arrival curves for a series of signals lasting from a to 15a (a = 0.02915xCRx10-6 secs)

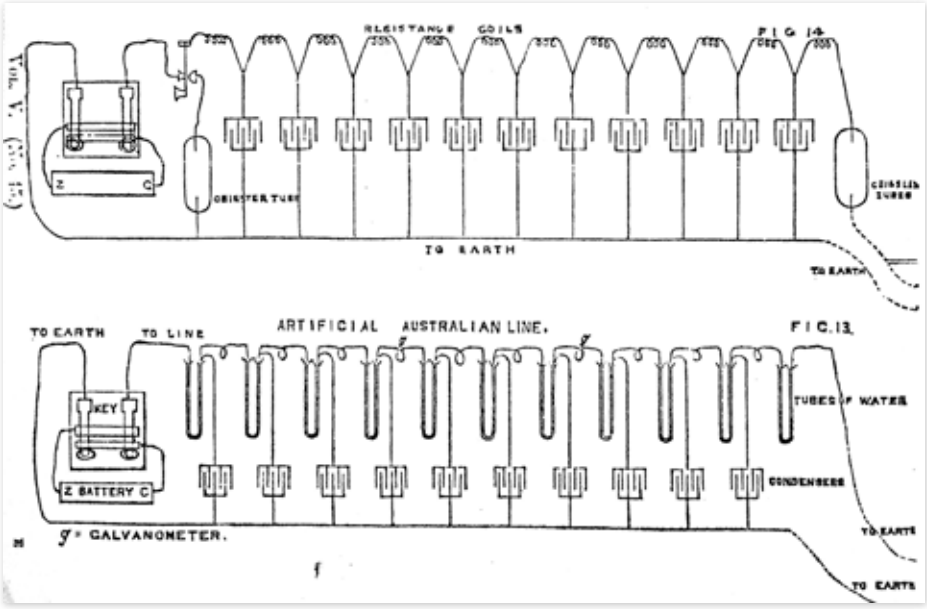


Fig. 4 CF Varley's 1867 models of Atlantic & Australian cables
(resistance coils indicated by symbol now used for inductance)

Penang to Singapore", completed January 1871, the "China Submarine Telegraphic Co" between Singapore and Hong Kong, and the "British Australia Telegraph Co" from Hong Kong to Port Darwin, whilst the Australians laid the overland section to Adelaide, the service completed in June 1872 but not fully functional until October. The final link across the Pacific from Suva & Fanning Island to Canada, however, completing the "Girdle round the Earth", did not occurr until 1902.

In 1872 the four companies to India had been amalgamated into the "Eastern Telegraph Co" and those beyond into the "Eastern Extension Co". These later combined with other companies to become "The Eastern & Associated Companies". In 1929 with the strong competition from wireless communication, by then established, they decided to join forces with Marconi and other wireless interests, eventually in 1934 becoming "Cable & Wireless".

Cable delay and message speed

Although under ideal conditions an electrical signal will pass along a conductor at the speed of a radio wave or light in free space, the conditions in a telegraph cable are quite different. This was not understood whilst the first attempts were being made. The problem lies with the effects of capacitance, or "induction" as it was known at the time, in combination with the resistance of the cable. It should be made clear that the return current path is through the ocean and earth which because of their large cross-section areas form a negligible resistance when efficient end connections are made.

The first Atlantic cable of 1857/8 had a total resistance of about 30kΩ and a total capacitance of about 700mF. With all the capacitance "lumped" at the "far end" of the resistance, this would give a time constant of RC = 21 sec. It's potential would rise exponentially, $Vo = Vi\ (1 - e^{-t/CR})$, so that the potential would be 63.2% of it's asymptotic value after 21 sec. In fact as we know, the capacitance is distributed uniformly throughout the length of the cable, so the "near bits" will get charged up first and the far bits have to "wait" for the nearer bits to charge before they receive an input. This, of course, makes the shape of the "current arrival curves" as they were called, different from the exponential, starting slowly, accelerating, then finally tending to an asymptote (Fig. 3).

Professor Thomson recognised that these could be described by the same mathematics as that for heat flow through a rod, which had been derived by Fourier, and published the arrival curves (Fig. 3b) for signals lasting from *a* to 15*a*. The time, *a*, for which the output appears negligible, is 0.029 CR and after about 0.21 *CR* reaches 63.2%. Fleming Jenkin undertook a series of experiments confirming this behaviour. The curve can be crudely approximated by an exponential of 0.2 *CR* delayed by 0.06 *CR*. Thus taking the 21 sec example of the first cable approximates to a delay of 1.25 sec followed by an exponential rise with a time constant of 4 sec. (It should be noted that, although for practical purposes *a* appears like a delay, the output actually starts rising from time zero, unlike a true delay line).

As the resistance and capacitance are both directly proportional to cable length the response curve becomes spread out in time in proportion to the square of it's length giving rise to an inverse square law for message speed. For this reason it is desirable to break up long distances by relay stations, with either manual reception and retransmission or an automatic pulse regeneration system. Thus the Atlantic route utilised the closest points of Newfoundland and the west coast of Ireland.

Models of long submarine cables

In 1867 CF Varley presented a paper to the Royal Institution "On the Atlantic Telegraph" (Proc Roy Inst 5, 45-49) which describes 10-stage models for the Atlantic and Australian cables using German silver resistance coils for the former and acidulated water resistances for the latter (Fig. 4, contrary to the text, shows 11 stages for the Atlantic circuit! Early circuits represent resistance coils by the symbol we now use for inductance). It was later claimed that it was his more retiring brother, SA Varley, who first suggested such models.

Fig. 5 shows such a model manufactured by O & FH Varley, Mildmay Park Works, Stoke Newington. Octavius and Frederick Henry were younger brothers of Cromwell F and S Alfred Varley and all were founder members of The Society of Telegraph Engineers in 1871. "O &

FH" were first recorded in London directories in 1870 and at Mildmay between 1873 and 1883 so it presumably dates from this period. It contains a string of nine resistors of 3,000 BAU plus resistors of 2,000 BAU at the ends giving a total of 31,000 BAU (=31.40 kΩ - the BA unit was soon found to be too low (about 1.35% below the Absolute ohm) but continued to be used for submarine telegraphy until about 1955). Predating low temperature coefficient alloys such as eureka and manganin, it has a coefficient of about 250ppm/°C consistent with German silver (Cu 50%, Ni 25%, Zn 25%, at 270ppm/°C) which was indicated in CF Varley's paper. The latter referred, however, to the 1866 Atlantic cable not the 1857/8 one as implied by this model's resistance. Models can, of course, be scaled both in terms of time where time constants can be increased in order to observe the shape of the response more clearly or, for a given time constant, using larger resistors so the condensers can be smaller. Before electrolytics, paper or mica condensers, directly modelling the cable, would have been extremely bulky and expensive.

There are three possible purposes for this device. Firstly, as a laboratory instrument to test the workings of other cable instruments without having to tie-up real lines. Secondly, as a training device for telegraphers to practice reading distorted signals and pacing themselves to key signals at a rate that can be read at the far end. Thirdly, as part of an artificial line in duplex working (see below). There is also a puzzle as to why it takes the form it does and how it was intended to be connected.

One set of double terminals (marked "R" at one end) connect with the junctions and terminations of the resistance chain, whilst the other ten (marked "I" at the end, presumably to indicate "induction" which was what we would now call capacitance) are not internally connected but can be connected by plugs (missing) between the brass blocks to the resistance junction points. This implies that the external condensers would be wired to these points and their own external earth line, and connected to the resistance junctions by plugs. If so, why bother with terminals at the resistance junctions? The alternative would be to connect all the "I" terminals to earth and wire the condensers between the two rows, with plugs out. Why then bother with brass blocks and plugs? My guess is that the intention was to make the unit as versatile as possible.

Increasing the speed

It is clear from the above that signalling speed can be doubled by halving either the resistance or the capacitance. The former can be achieved simply by doubling the cross-section area and therefore the mass of copper conductor, but the latter is more complex and harder to implement. The capacitance of a coaxial cable is given by C=2pkel/ln(b/a) where 'k' is the dielectric constant, 'e' is the permittivity of space, 'l' length, 'ln' natural logarithm, 'b & a' the outer and inner radii. Thus taking the 1865 cable as a starting point, it would be necessary to increase the diameter of its gutta percha insulation by a factor of 7.67 to halve its capacitance. If, of course, the resistance is halved by doubling the cross-section of the copper it would also be necessary to increase the outer diameter of the insulator by a factor of 1.41 to maintain the same ratio of 'b/a' and therefore the same capacitance. Nevertheless, it is clear that reducing resistance is much easier. As 'b/a' is greater for the 1857 cable it would appear that their similar capacitances may reflect less cable wasted in the laying process and possibly a lower dielectric constant in the 1865 cable with purer gutta percha. This allowed speeds of 17wpm. Most of the later Atlantic cables were worked at speeds of from 30 to 45wpm but the Commercial Cable Company's "Jumbo" cable of 1923 achieved 90wpm. By this time, however, loaded cable were being introduced.

Loaded cables

Oliver Heaviside had shown in 1888 that, contrary to intuition, a signal through a cable could be speeded up by an increase of inductance of the conductor. Pupin had demonstrated this in about 1900 using discrete series loading coils. An alternative approach is to increase the inductance of the conductor by wrapping it with a high permeability layer. Soft iron, however, is non-linear in its properties with low permeability at low flux densities. The problem was solved by the invention of permalloy by Bell Labs in 1919 and a satisfactory loaded cable introduced in 1923. British companies did not want to pay royalties for permalloy so they developed their

Fig. 5a O & FH Varley's 10-stage artificial cable model

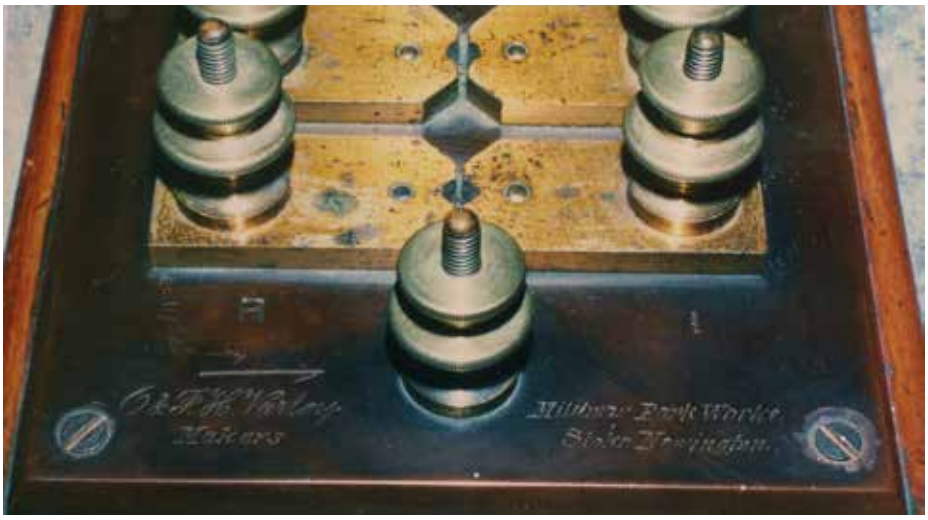


Fig. 5b Makers name & address

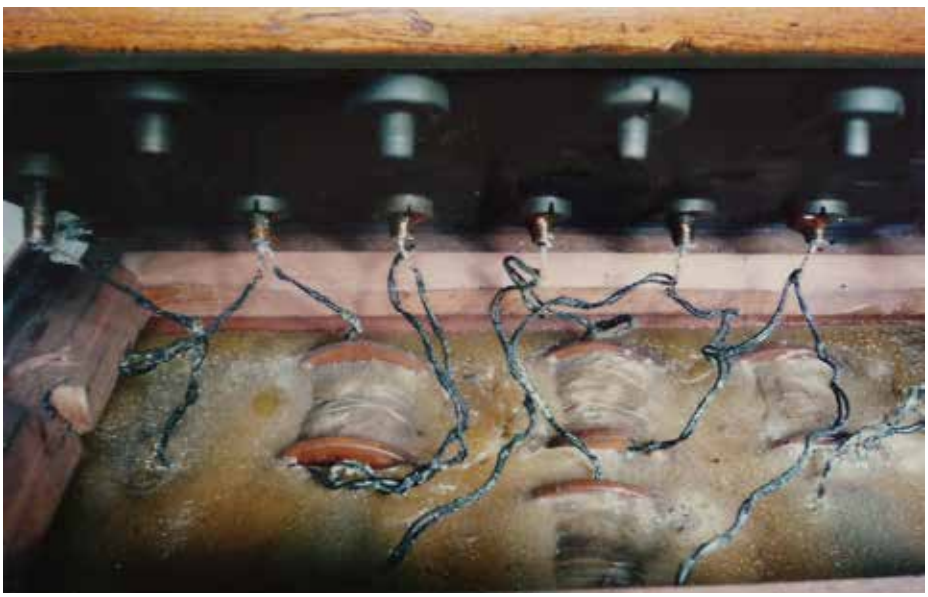


Fig. 5c Inside view showing wax embedded resistance coils

own alloy, mumetal. The Western Union loaded cable of 1926 from New York via Newfoundland to Penzance achieved a rate of about 450wpm.

As coaxial cables have a very wide bandwidth, why don't submarine cables, when fed and terminated by the appropriate characteristic impedance? An ideal cable can be modelled as a semi-ladder network of a chain of inductance with parallel capacitance. This behaves as a multi-pole, constant-k, low pass filter in which the cut-off frequency is $f^o=1/p(LC)1/2$. Thus each time the ladder is sub-divided the cut-off frequency is doubled and ultimately, when it is continuously distributed with infinitely small elements, the cut-off becomes infinite. In practice there is both series resistance in the conductor and shunt leakage and dielectric losses in the insulator. These losses become intolerably large over quite modest distances. This appears more obvious when the characteristic impedance is calculated - 36Ω for the 1857 cable and 33Ω for 1865. The effect of loading is to increase this impedance but it still acts predomintly as a low-pass RC filter.

Earth currents, blocking, and the sea earth

One difficulty encountered to various degrees was the presence of potentials between the line and its earth return even when the far end is short circuited. This can result in the deflection of the spot, or the pen of the siphon recorder, reaching its limit with signals becoming unreadable. These potentials, which can exceed 100V, originate from various causes but most change quite slowly. Thus they can be blocked by a large condenser at each end of the line without blocking the signal itself. As a bonus it was found that if this condenser was about one twelveth to one tenth of the total capacitance of the cable the lower frequency components of the signal were removed making it faster and easier to read. Even after this was done, however, there were often higher frequency components present. The earth returns were initially made with large zinc plates buried a little way from the telegraph station to avoid interference from other lines but these were still sensitive to lightning strikes and later, after mains power and tramways were introduced, it became intolerable. CF Varley had patented the solution in 1860 by using a two-core shore end cable for a few miles out to sea where the second conductor was either soldered securely to the armouring or to large thick zinc plates. It is probable that the idea had originated from his brother, SA Varley, who had solved a similar problem in about 1855 by taking an earth connection at Constantinople out into the Bosphorus. As the Varley's did not immediately apply or publicise this idea, others later claimed priority.

Curbing

Another technique employed to facilitate faster signalling was the employment of curbing. Put in non scientific language, at the end of a signal pulse, the line is left charged by its capacitance. If the source were simply disconnected at this time the whole charge would have to leak away through the detector which could be quite slow. It is therefore standard for keys to have a top contact so that the line input is grounded in its resting state, thus allowing the line to discharge at both ends. The idea of curbing, however, is to do better than this by following the signal with a reverse potential just long enough or strong enough to "suck" the charge out of the cable without overshooting zero. However, if this is the state at the input there will still be charge left at the far end of the cable. It is therefore desirable for it to overshoot at the input to completely discharge the far end and then to introduce a further pulse of the original polarity to suck out the residual charge at the near end produced by this curbing pulse.

This process can be continued, ad infinitum, with diminishing returns. A number of manufacturers produced such devices but they were mechanically complex, expensive to buy, and time consuming to maintain. A curber by Thomson and Jenkin from 1876 is shown in Fig. 6a and a Muirhead version from 1896 in Fig.6b. They both work from tape by controlling cams lifting contact arms to automatically generate positive or negative signals, immediately followed by an opposite curbing pulse. They did not give sufficient increase in speed, however, to justify themselves. The blocking condensers achieved much of the effect.

Duplex working

The first telegraph lines were "simplex" with sender switching from key to detector (galvanometer, relay or recorder) at the end of his message and the recipient switching from detector to key to send a reply. Obviously considerable time could be wasted if the recipient was having problems with the message or his recording paper ran out. In about 1853 it was realised that a line could be used "duplex", with signals travelling in both directions continuously, without mutual interference. The first method of achieving this was by using a "differential" detector having two coils connected oppositely so that if a current or voltage is applied to the junction its effects on the device will cancel if the other ends of the coils are connected to identical loads (Fig. 7). One of these would be the line plus remote detector whilst the other would be an artificial line designed to match this. Thus the sender's detector would not respond to his own key strokes.

The cable key connects the line to ground when not being pressed so that on receipt of a signal current passes though the coil connected to the line, but not the other, thus producing a deflection indicating polarity of signal. If, however, the local key is being pressed, producing the same polarity, current will no longer flow in the line coil but through the artificial line coil from the local battery producing the same deflection as before. Alternatively if the local key is producing the opposite polarity, twice the current will flow in the line coil but the artificial line coil will be energised oppositely and will subtract half of this. Thus under all conditions of signalling there is no mutual interference.

Duplex working was tried in 1853 on shorter land lines using a simple resistance to balance the line, but it was not until the 1870s, after the government had taken over the telegraphs, that it was extensively applied. In 1872 for longer lines Stearns, in the US, had patented the use of a condenser in

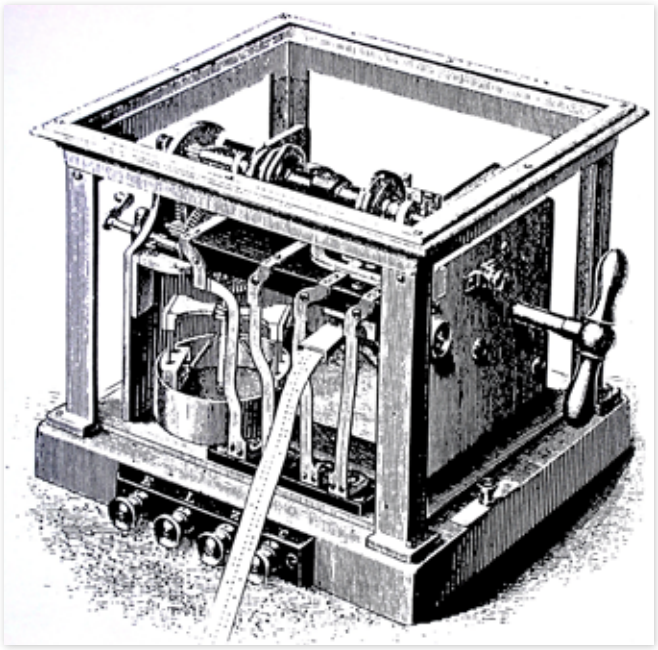


Fig. 6a Thomson & Jenkin curber

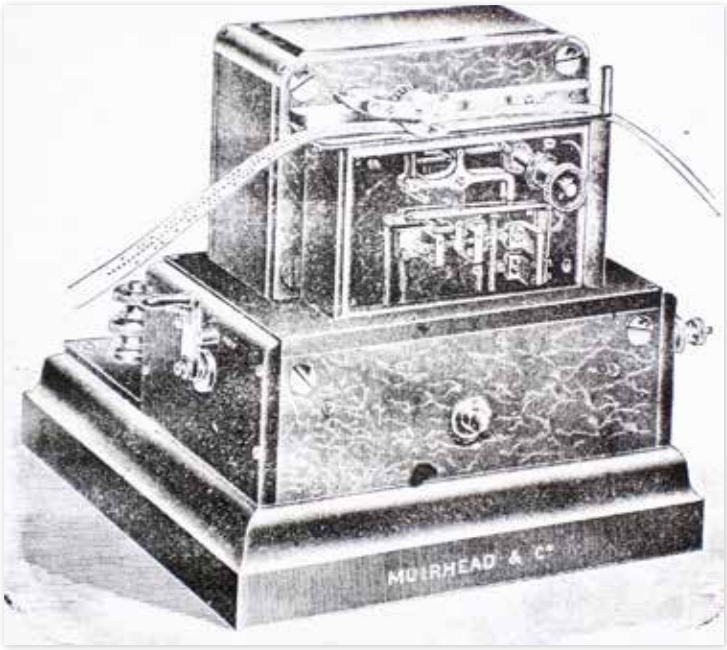


Fig. 6b Muirhead curber

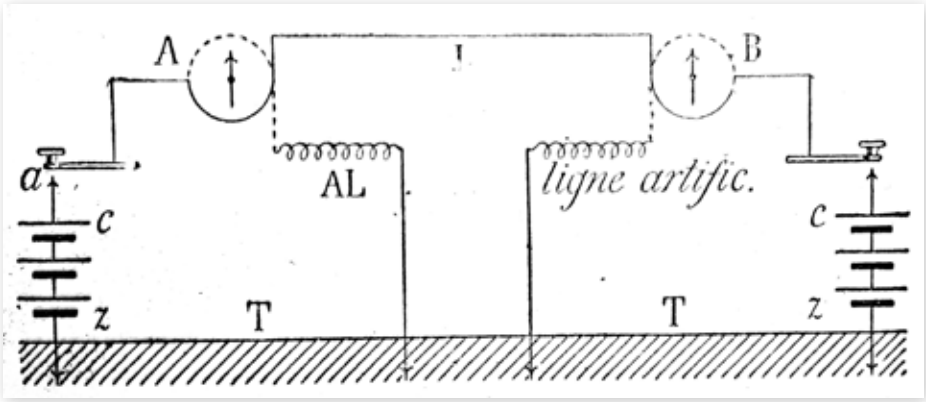


Fig. 7 Differential duplex (keys should be grounded when at rest)

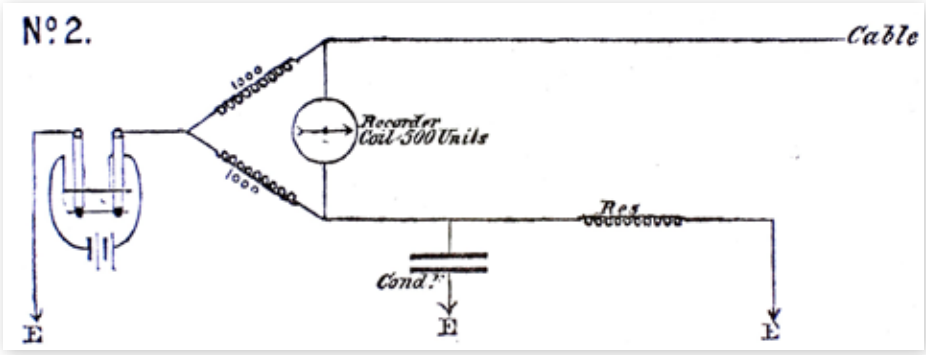


Fig. 8 Bridge duplex using single resistance and parallel condenser to model the cable

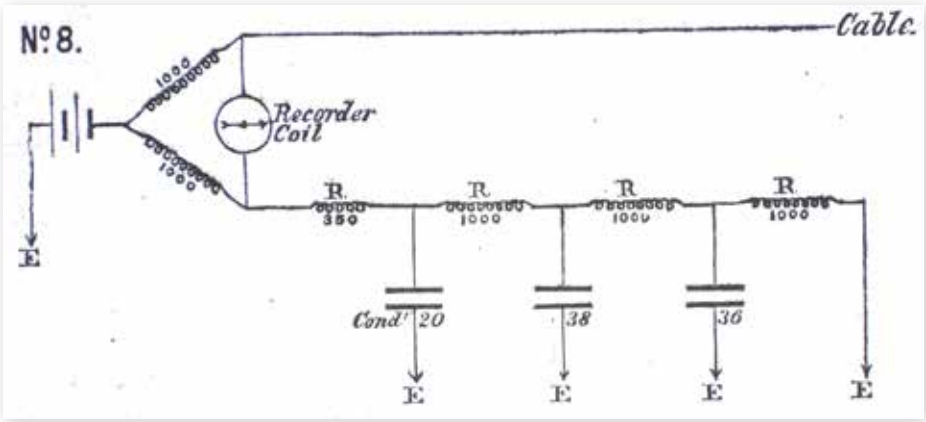


Fig. 9 Bridge duplex using three condensers and four resistances for artificial line

parallel to balance the capacitance of the line, but CF Varley had similar patents resulting in controversy over validity and royalties. Although CF Varley had published his model cable in 1867, Stearns pointed out that he had not suggested its application for duplex.

In 1873 de Sauty attempted to duplex the 417 mile submarine cable between Gibraltar and Lisbon which had a total resistance of 3,985Ω and capacitance of 78mF. He was using the second, “bridge”, method of duplex in which the differential detector is replaced by a simple instrument bridging two resistors between the sending key and connected to the cable and artificial line respectively (Fig. 8). He was unable to find any combination of resistance and capacitance which enabled full duplex working. He also tried altering the bridge ratio without success. He then tried dividing the resistance into four parts with three shunt condensers at the junctions (Fig. 9) with success sufficient to be usable although some residual interaction was still present. He later tried finer subdivision of the resistance and capacitance with almost perfect results.

Normally the two resistors would be made equal but other ratios can be used allowing different values for the artificial line components. Although sensitivity will suffer slightly by using higher bridge ratios, balance can be obtained with smaller condensers. Thus the above described device by O & FH Varley could have modelled the 1865 cable by using a bridge ratio of 31,000/3,985 and ten condensers of 1mF. Its probable dating to the 1870s is consistent with this application. Even this ten stage model, however, would not have been sufficiently finely divided to duplex a long cable such as this. The final link in the duplex story was provided by Muirhead who, in 1874, patented a distributed model using a thin tinfoil resistance on waxed paper insulation backed by an earthed tinfoil sheet to form a condenser. The tinfoil resistor was cut alternately from each side to form a zig-zag greatly increasing its resistance (Fig. 10). This proved highly effective on the Mediterranean route from Marseille to Bona (Bône, Algeria) in 1875 and the DUS Atlantic cable in 1878 and was ultimately employed on cables throughout the world.

Some difficulties were experienced initially with duplexing loaded lines but these were overcome by the design of tapered sections at the ends of the line.

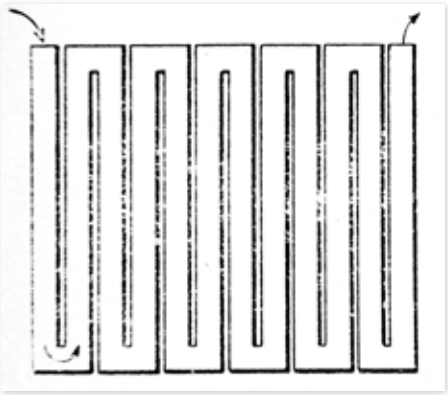


Fig. 10 Section of tin foil resistor stuck on waxed paper backed by earthed foil giving continuously distributed resistance and capacitance (Muirhead 1874)

Mutiplex working

The introduction of cables giving high message speeds made time-division multiplexing possible. The first long cables had been so slow that telegraphers needed to pace themselves for the message to be readable. Higher speeds enabled messages to be punched onto tape which could then be transmitted at a much higher rate. Ultimately the limit of mechanical instruments was reached so commutators were introduced at the ends rotating rapidly through the channels. The 1926 Western Union loaded cable mentioned above provided 8 channels in both directions.

Relays and regeneration

The necessity of breaking up long routes usually meant the presence of two telegraphers at each break, one to read the incoming message, the other to retransmit it, a task they normally took in turns. This process both delayed the signalling process and introduced errors. The long sections of cable not only restricted speed but attenuated the signal so that when relays were introduced to replace men the standard land line relay was not sensitive enough. Cable relays were sensitive moving coil devices and had to operate bi-directionally unlike the simpler Morse relay.

The other problem was that with the distortion of the signal over long cables the length and timing of pulses became erratic making reading difficult. This was overcome by the introduction of “regeneration”. This was a synchronous clocked system in which time was divided up into a series of equal intervals. When the incoming signal reached a positive or negative threshold at the start of one of these intervals it was amplified by sensitive relays to a fixed limit which was maintained until the end of that interval and then returned to zero to await the next positive or negative input.

A clock rate was chosen for the whole route set by the slowest link in the chain. Some routes contained up to fourteen links. The system was based on a 30Hz tuning fork which ran a synchronous motor driving a disc with input and output sectors, the former sampling the incoming signal, the latter determining the starting and stopping time of the regenerated signal. Between these were the relays. The tuning forks for all stations were synchronised to the same frequency by local 1 sec impulses from Synchronome clocks which in turn were checked against radio time signals. The synchronous motor

also drove a 1 sec commutator with gaps. If the 1 sec pulse arrived when the contact was over the gap the fork was synchronised and no action needed. If it made contact before the gap, it was running too slow, and current would magnetise a piece of soft iron to attract the magnetised tines of the tuning fork to speed it up. Conversely, if it made contact after the gap, an opposite current would be applied to repel the tines and slow the fork.

When initially set up, the sampling contact on the disc has to be phased so that, on average, sampling occurs when the incoming signal is at its maximum positive or negative value. This was achieved by rotating the whole motor in steps. Different signalling rates were obtained by gears between the motor and the sampling/output disc. This system was widely adopted for the remainder of the copper cable era and in principle anticipates digital computer processing and transmission.

Detectors

The moving magnet mirror galvanometer described in Part One (Bulletin Vol. 41, No.2) designed by Thomson and manufactured by James White was widely adopted in various forms by other manufacturers including Elliott, Muirhead, Siemens, Nalder Bros, Yates & others, and used universally until Thomson devised the siphon recorder in 1867 (Fig. 11). This provided a permanent written record on a narrow strip of paper tape and although it clearly anticipated the moving coil galvanometer it was never made as such at this time. The moving coil between the protruding poles pieces (Fig. 11b) was linked by silk "reins" (just visible in the photo) to the top and bottom of a small vertical wing of metal suspended horizontally by torsion wires from a horizontal brass cross-beam (see also Fig. 12a right). The fine siphon tube is attached to this metal wing with its rear end dipping into the ink tray (black) and the nozzle a few cm lower with its end bent towards the paper but not quite touching it. Thus gravity tends to siphon the ink out but surface tension normally retains it. Thus when the moving coil rotates, the silk reins cause the pen to move across the paper.

The whole siphon assembly is insulated from the rest of the instrument and connected to an electrostatic generator within the "mousemill" motor, the glazed brass device on top. A cylindrical array of brass and magnetic sectors is rotated by an armature below to drive both the paper and an electrostatic generator. The latter attracts the ink to the paper making a dot. Thus as the paper is drawn through a trace of fine dots is produced with lateral deflections produced by the positive or negative current applied to the moving coil. This was an expensive and bulky piece of equipment and many cable companies were slow to take it up but it later became almost universal over many years. It was soon found that electrostatic devices are unreliable in humid atmospheres so the electrostatic generator was replaced by a vibrator attached by a thread to the pen on later models. Several manufacturers produced their own version of the instrument, Fig. 12 showing an example by Muirhead and Fig. 13 one by Tinsley. Fig. 14 (top) shows an example of a siphon recording of the letters 'a' to 'h' with corresponding perforated tape version below. The equivalent Morse symbols

Fig. 11a William Thomson's (Lord Kelvinís) siphon recorder (Porthcurno)
Fig. 11b Closer view of moving coil and siphon assembly

are shown above the siphon recording.

In latter years cable code was replaced by the Baudot 5-dot code used with direct printing Telex machines.

Submarine telephony

After the war coaxial cables with polythene insulation, conveying wide bandwidths, became available allowing many telephone channels to be carried simultaneously. In 1956 TAT-1 was laid across the Atlantic on a route north of existing telegraph cables to avoid damage during repairs. It was a joint British, US & Canadian venture. In the summer of 1956 I happened to be working as an IAESTE student for Hasler AG in Berne helping to install and set up their carrier telephony network in the PTT. Channels were single sideband suppressed carrier at 4kHz intervals with an audio bandwidth from 0.3-3.4kHz.

The transatlantic cable carried 36 telephone channels with one devoted to 18 telegraph (telex) circuits, using carrier frequencies up to 160kHz. Although duplex working was standard with landlines using 600Ω balanced feeders and hybrid transformers it was not possible over such a long distance with its enormous overall amplification of 3060dB. Therefore a cable for each direction was laid across the Atlantic using the American thin, flexible, but unidirectional, amplifier assembly which could be coiled with the cable. Duplex was used, however, for the crossing from Newfoundland to Nova Scotia using the more sophisticated but bulky British repeaters. Because of the attenuation down the cable it was necessary to have 51 repeaters, each of 60dB, at about every 37 miles. Britain provided most of the copper and polythene and did the cable laying. The success for long life of the amplifier valves rested in never switching them off. The DC for the amplifiers had to be conveyed by separate copper conductors within the cable. By 1978 the system eventually failed through instability due tovh a gradual reduction in cable attenuation and not through deterioration of the amplifiers. By then many wider bandwidth cables were in use.

The immediate success of TAT-1 led to a similar cable in 1959, and then in 1961 a new design with the steel armouring in the centre to reduce twisting was introduced. This was worked duplex using the same amplifier for both directions using filters and hybrid transformers. Instability was avoided by carrying one direction in the upper half of the spectrum and the other in the lower. Although this allows both directions of a conversation to be carried in the same cable it provides no net advantage in channel capacity because it halves the number of channels possible in a given direction. Later cables had progressively increasing capacity up to 4000 channels with TAT-6 in 1976.

Satellites

The competing radio telephone service had by this time been eclipsed by cable but was able to fight back through satellites. Fulfilling Arthur C Clarke's 1945 prediction, the first successful satellite linkage had been achieved in 1962 with Telstar, giving live TV transmission to much public acclaim but only for the short time whilst the satellite passed overhead. In 1965 the first geo-synchronous satellite was launched giving a continuous link but only for those in range. After a full encircling array of satellites had been launched a public telephone network was started in 1971 but with a signal delay of about 0.25 sec. Even the speed of an RF signal through a coaxial cable, however, is slightly lower than electromagnetic waves in free space by the square root of its dielectric constant, and the speed of light through an optical fibre is reduced in proportion to its refractive index.

Optic fibre cables

The greatest advance in submarine communication was the introduction in 1988 of TAT 8, an optic fibre cable. A laser beam is passed into the end of a thin glass fibre coated by glass of different refractive index to make the inside surface totally reflective, like a mirror, and avoid loss of light. Just like the cable telephone, however, it is necessary to boost the signal every 35 miles or so before it becomes lost in the noise level. The optical amplifiers require electrical power to operate so copper conductors have to be incorporated alongside the optic fibres. The laser beam is monochromatic so that dispersion is not a problem, maintaining pulse shape for extremely high rates of digital transmission and of course incorporating error correction. This allows many channels of TV to be transmitted competing with, and largely supplanting, satellite.

The capacity of each fibre was later increased by using up to ten slightly different frequencies (colours) for independent bands with TAT 14. Every new cable has so much more capacity that it becomes uneconomic to repair earlier cables when they fail.

Fig. 14 shows an optic cable with four fibres identified by surrounding dyed coatings of green, blue, red and brown. The thin central core is of steel enclosed in a copper sleeve and forms one conductor whilst surrounding the central insulating core, embedding the fibres, is a heavy gauge copper tube wrapped by two layers of steel armouring. The inner layer consists of ten strands of 2.8mm diameter and the outer one 32 strands of 1.3mm. This

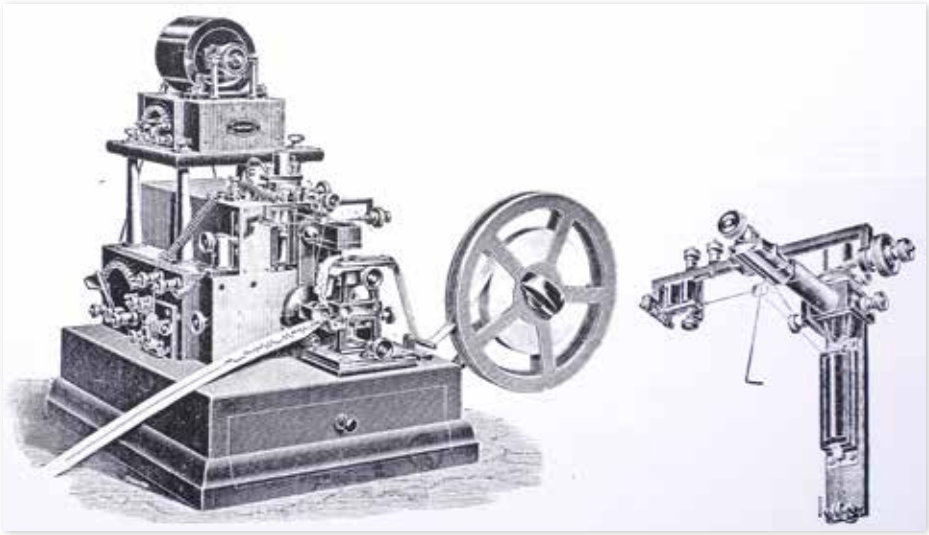


Fig. 12a Muirhead version of siphon recorder showing detail of coil and siphon assembly

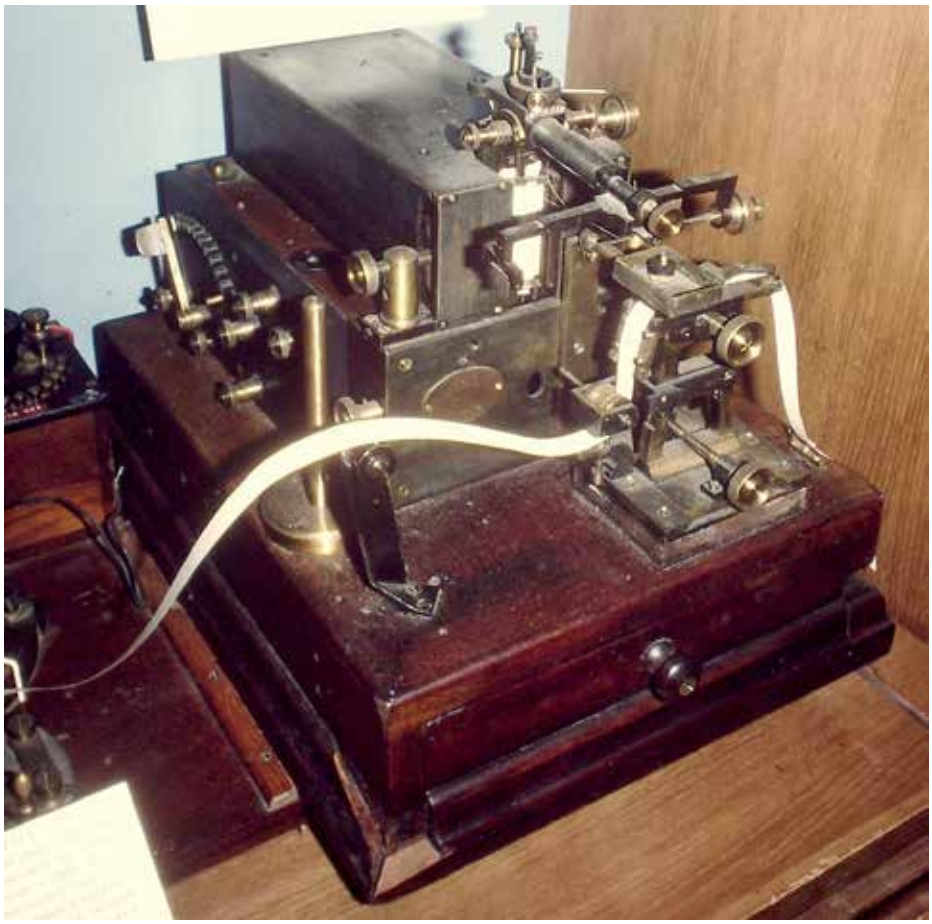


Fig. 12b Muirhead siphon recorder without mousemill motor (Porthcurno)

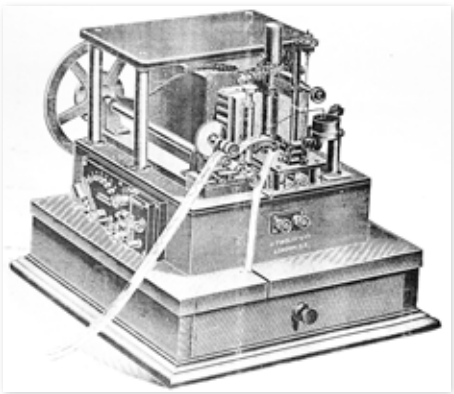
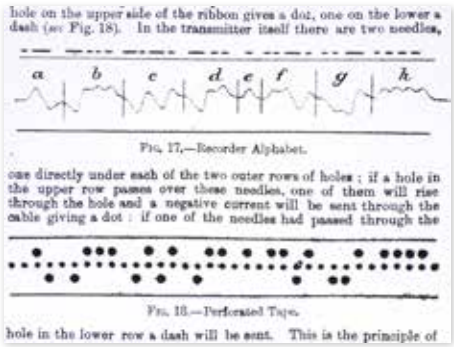


Fig. 13 Tinsley siphon recorder


hole on the upper side of the ribbon gives a dot, one on the lower a dash (see Fig. 18). In the transmitter itself there are two needles,

a b c d e f g h

FIG. 17.—Recorder Alphabet.

one directly under each of the two outer rows of holes; if a hole in the upper row passes over these needles, one of them will rise through the hole and a negative current will be sent through the cable giving a dot: if one of the needles had passed through the

FIG. 18.—Perforated Tape.

hole in the lower row a dash will be sent. This is the principle of

Fig. 14 (From top) Morse, siphon recorder and punched tape versions of letters ëaí to ëhí

is enclosed by a 6mm thick layer of polythene, an overlapping sheet of aluminium, and further 3mm layer of polythene to an overall diameter of 32mm. This should in turn have been wrapped by a further layer of armouring which is missing. Both the copper tube and layer of aluminium would provide high current capacity for the amplifiers. It is not known where or when this cable was laid. The optic fibre now dominates long distance communication but for remote locations, satellite has an advantage. For shorter distances, the internet is supported by optic cables and through mobile phone radio networks.

Thanks are given to John Packer at the Porthcurno Telegraph Museum for much useful information.

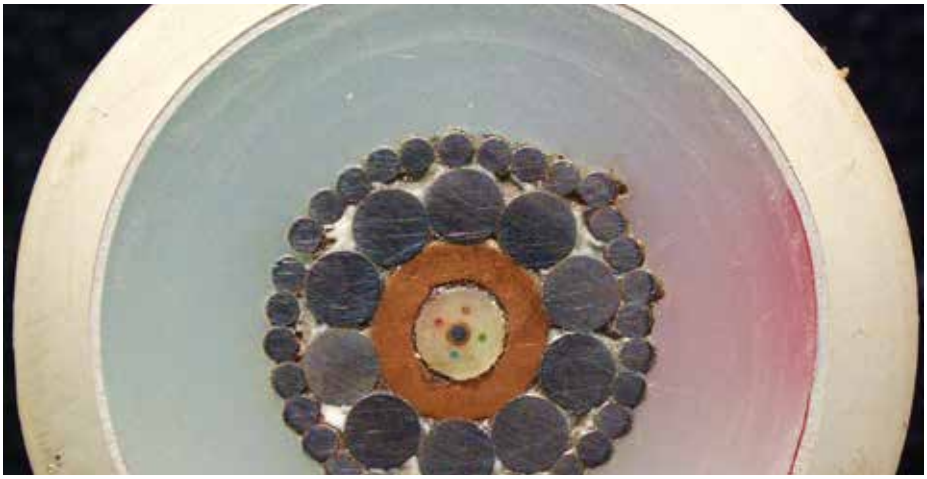
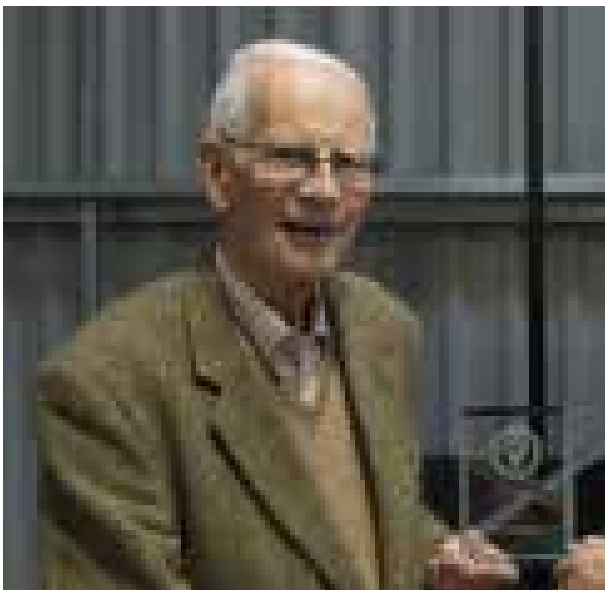


Fig. 154-fibre optic cable (outer armouring missing)

Remembering J Patrick Wilson

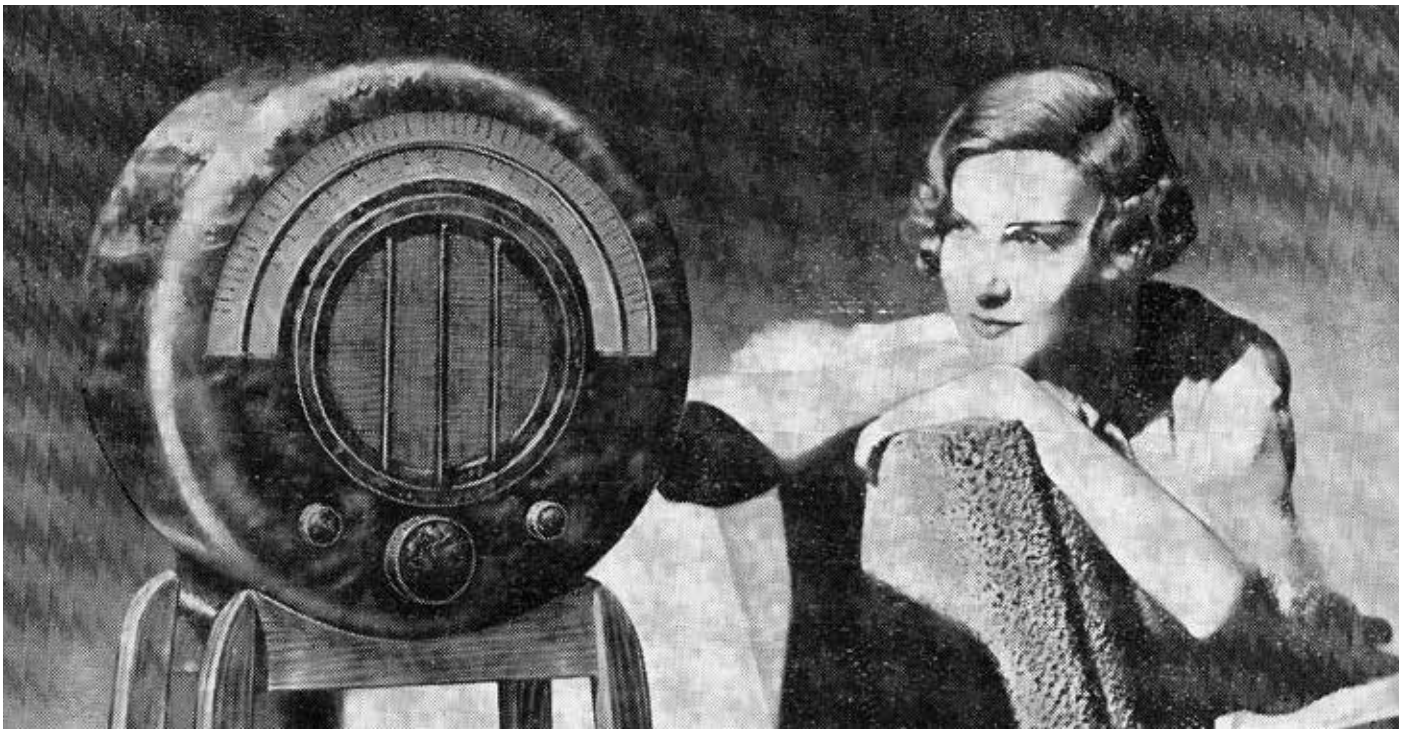
By Greg Hewitt



We were very sorry to hear that J Patrick Wilson, since submitting this article late last year, has passed away.

Pat had been a regular contributor to the Bulletin over the last 20 years. We are grateful that his well researched and extensive knowledge on both telegraphy and test meters was so generously shared with us. Our condolences go out to his family and friends.

Pictured to the left, Patrick receiving the Pat Leggatt Award for best article of 2014 at the 2015 NVCF.



Royal Wootton Bassett, December 2016

Photos by Greg Hewitt

Decca Main Transportable

Philips 2601 Console Receiver

Pye Cambridge PE60V Multi-Band Radio

Philips 1968 Dual Standard - 210 Chassis

Beethoven 77 from 1935, an early restoration

By Gary Tempest

This radio was a ‘real’ auction win around 15 years ago and I was a “newbie” to old radios, as our American friends would refer to me or very green behind the ears as we might say over here.

Back then radios fetched more money than now and bidding went higher for it than I should have gone but it was the dial, helped by the unique station name ‘cards’ in the feet, that egged me on. These cards relate station names to the dial wavelengths at a time when these were still changing. The cards and the dial are printed on a plastic, possibly still celluloid based, and a development of Ivorine later to be called Xylonite. These original materials were said not to be dimensionally stable whereas the items in the radio have not shrunk or warped. There is an interesting read at Reference 1.

The marketing idea of the cards was that you could ask your dealer for updates but I expect few did and in just a few years the names would be on the dial making them obsolete. The ones in this set; still in beautiful condition, are dated 1/3/35. It’s a rare radio although there is one pictured in “Radio Radio” that doesn’t look a bit like mine. In the intervening time I have never seen another in the flesh or advertised and there is only my one illustrated on the online Radio Museum. Not much seems to be known about the company other than it was in Chase Road, North Acton, London, NW10. The poorly drawn circuit diagram would indicate that it was a small company who was not able to afford a proper draughtsman (it would have been a man in those days).

The picture (fig. 2) shows it was in pretty awful condition and a look inside revealed nothing to feel happier about. The chassis had the worst sort of rust being quite deeply pitted but all the important parts seemed there. Someone even more novice than me, at the time, had ‘restored’ the cabinet by removing all the old finish and then slathered it with a thick coat of polyurethane varnish. I was to discover later how difficult this is to remove after its hardened for a few years. In the original picture, taken on film, it looks as if the top is dark but actually it isn’t. It’s just reflection from above and the person had not added a trace of colour which seems odd. He obviously hadn’t a clue on fitting grill cloth either. But I still pressed on with the bidding and parted with my cash, all part of the learning curve to decide on a price beforehand and stick to it (but I’m glad I didn’t).

The picture (fig. 1) of the refinished cabinet may be familiar to some as it appeared on a Bulletin cover (Spring 2009). This was from the days when our former Editor visited to take pictures of a radio to be featured in a forthcoming issue. I don’t know which of mine it was but I suggested that he take some pictures of others, not having starred before, as they might be useful sometime which was true in this case.

Fig. 1 The refinished cabinet

The electronics

Firstly, an early picture (fig. 3) of the stripped rusty chassis and the parts, obviously I was much more casual then as these days I put all items in labelled bags and boxes. The chassis has fared well since and shows that good treatment and a zinc rich paint can do wonders. It may have gone to a sand or grit blaster that did alloy wheels, and I recommend this, but helpful local places are not so easy to find now. What I should have done, before spray painting though, was skimmed all the rust pits with car body filler. As it is, they still show as a bad case of the pox.

Somewhere I found an original ‘spider’s web’ schematic that doesn’t show any valve types so I must have assumed that those present were correct. The circuit needed re-drawing before attempting a complete rebuild and it indicates that the chassis uses lots of screening including screened wires. The Murphy ‘top hats’ for the valves were two I had from a scrap chassis which were presumably better than the originals. It went back together successfully and has worked well since; the only perennial problem being the ‘camshaft’ operated type waveband switch. This has needed the chassis taken out more than once to be given a good shot of cleaner, nowadays being DeOxit see Fig. 4.

The circuit

There is no RF stage but a complex bandpass filter for second channel rejection, all designed without a computer. This is in two parts each having their own screening can. On MW, L1 couples to L2 which is tuned by the middle tuning gang. On LW, L4 joins in and couples to L3. Bottom inductive coupling is used between the tuned sections by L7 and L8. For the second section, on MW, L5 is tuned by the front tuning gang section and augmented by L6 on LW. L10 seems odd with no top connection but apparently it was a way of providing a small amount of top coupling capacitance that could be fine tuned by T1.

My notes say I optimised the filter on a Wobbulator and was impressed with it but this was before I had worked on Philips Superinductance sets. For LW it was 10 kHz wide gang closed, 20 kHz wide half open and 30 kHz wide fully open. MW not quite so good being 30 kHz wide gang closed, 40 kHz wide half open and degenerating

Fig. 2 The cabinet as obtained

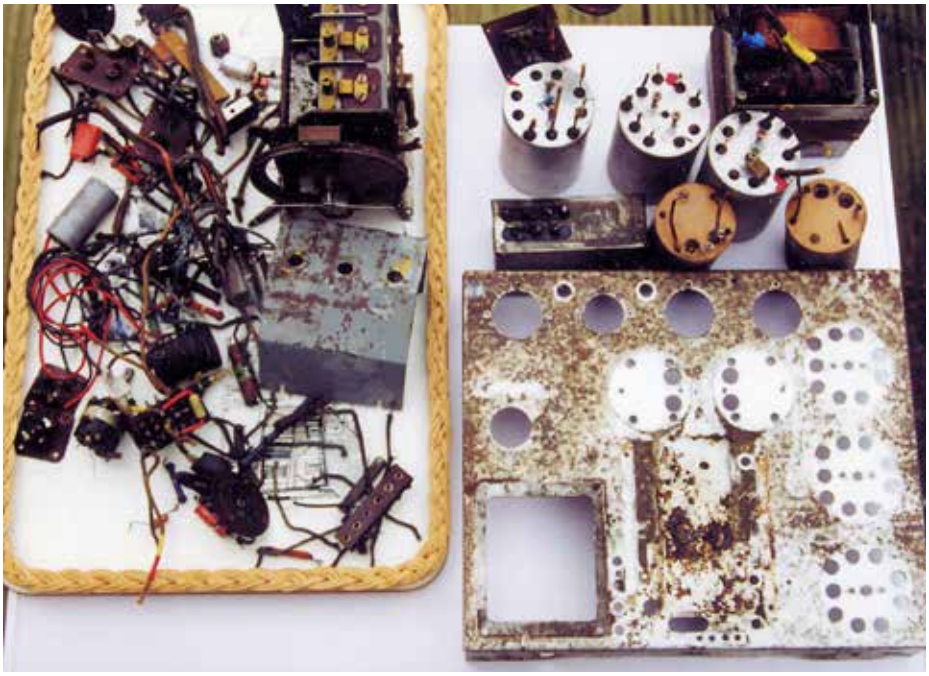


Fig. 3 The rusty chassis

to two peaks 200Khz apart gang open.

The octode mixer is an FC4 with the usual oscillator feedback transformers, with L11 being tuned for MW and it and L13 being tuned for LW by the rear section of the tuning gang. The secondary of the IF transformer feeds the IF amplifier VP4A in the usual way.

From here the designer went into some complexity with many components built into the second IF transformer can. A small capacitor, from the anode of the IF amplifier, feeds the AVC diode of the 2D4A. There is AVC delay of course from the cathode potential; rather a lot of it as it later turned out. The AVC load resistor is split and full voltage is applied to the FC4 but a lesser amount, possibly about a half goes to the VP4. This isn't unusual and many designs do this to prevent overloading of the IF amplifier on strong local signals. But he must have had concern about this as there is a gain reduction switch, labelled "AVC Switch" in the cathode of the IF amplifier.

The other diode of the 2D4A is used for audio demodulation with RF filtering before the detector load which is mainly the volume control. This is returned to the cathode of the 2D4A rather than earth but is bypassed by C12.

Why go to all this trouble for separate AVC detection and audio, the Americans rarely did? F.W. Langford Smith, in Radio Designers Handbook, says that it allows a higher audio detector load with reduced AC loading by the AVC components giving less of what he calls differential distortion. Using the two diodes is also an easy way of providing the delay before the AVC voltage is applied.

And then another funny, as the circuit shows I added a resistor from the cathode of the 2D4A to ground. I remember doing this, and thought it only a few years ago, but looking back in my now pretty good notebook it turned out to be July 2008. It had struck me as odd how the radio had virtually no AVC action and it isn't surprising considering the potential divider, R14 and R15, used in the cathode. A quick calculation shows that this would be at 32V just with the resistors and I measured 38V due to the additional cathode current. This is a huge amount of AVC delay, and even with the possibly higher signal level from the anode, it would take very strong signals to overcome it.

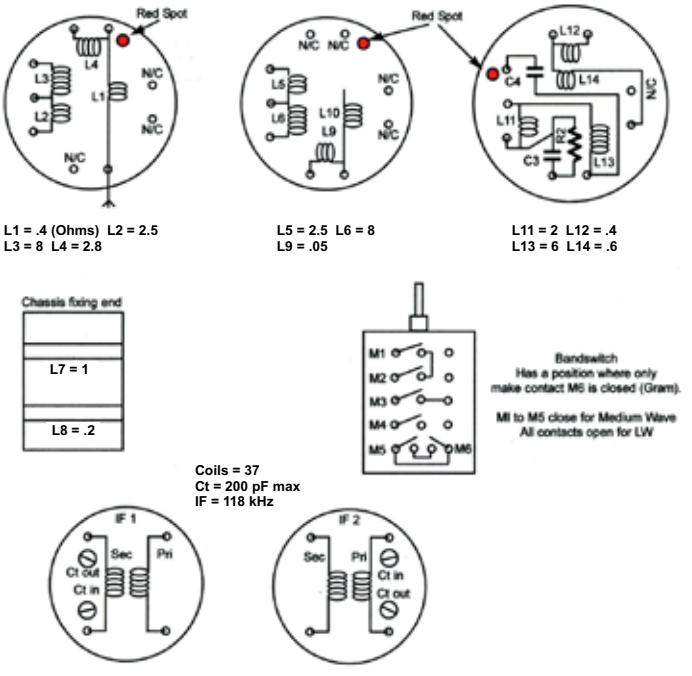
Interestingly the circuit of the Alba 815 from 1937 (Trader Sheet 255) has a similar circuit and here the AVC delay voltage is about 5V. It derives this in a component saving way, by returning the 2D4A cathode to the bypassed cathode resistor of the output valve.

My easy to fit solution was to shunt R14 with 6-8Ω which gave a delay voltage of 7V which is much more reasonable and AVC action now occurs.

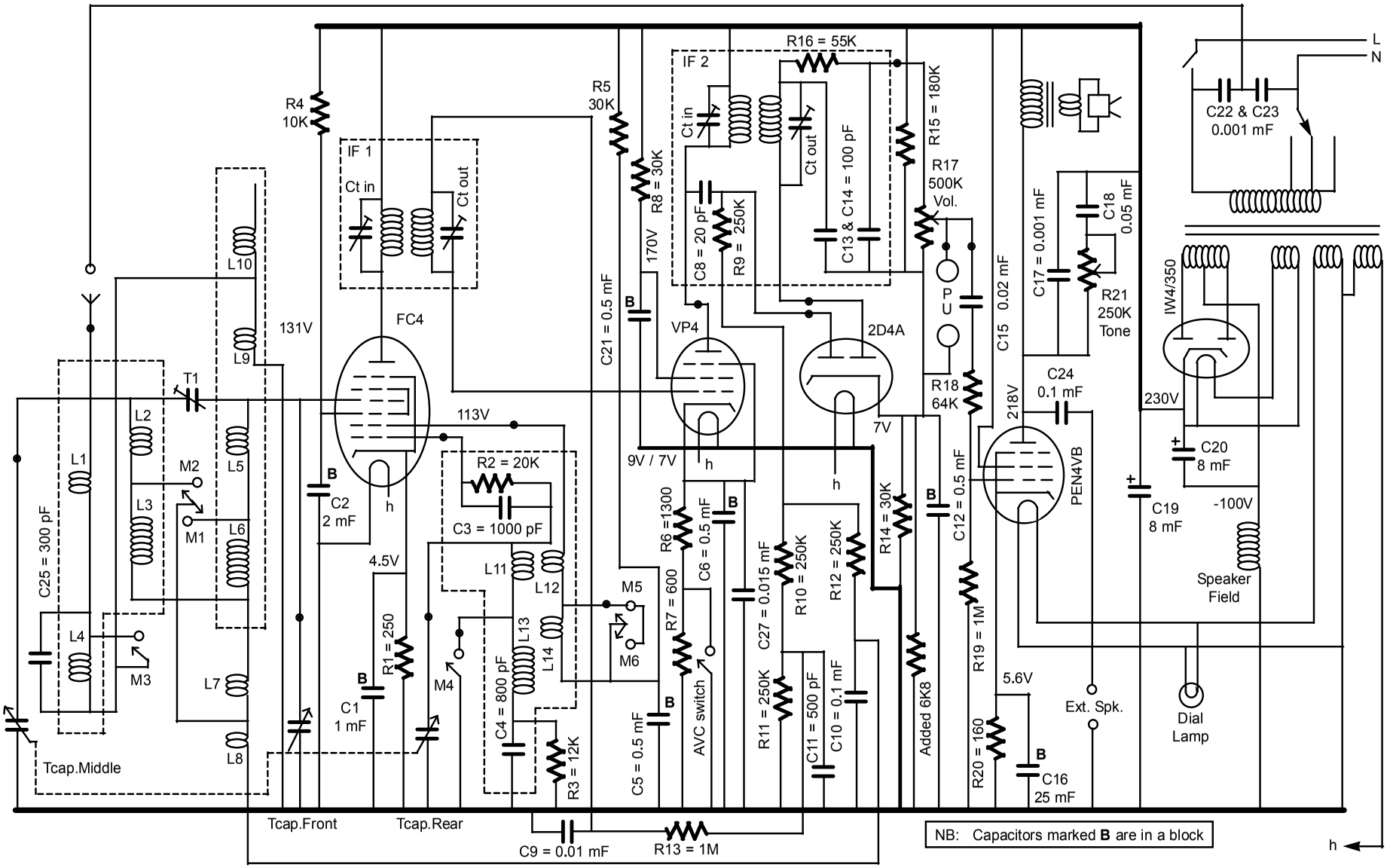
I wondered how this came about: was it designer error or not being able to read the values of the potential divider properly but I would have checked the original components. Alas, they are long gone so I'm not able to back track (true restorers would frown on me for that). Looking at the original schematic through a X8 loop the values for R14 and 15 seem to be exactly what I have used.

The output valve had a capacitor from its anode to a socket for an extension loudspeaker, this being of the high impedance type still around then. For safety it wasn't refitted and neither were C22 and C23 for using the mains as an aerial. It must have been much cleaner back then to have even considered it. However, I do have US made radios that when used on FM, where the mains, via an X cap with the original component in series, does work very well.

The speaker field was returned to the negative supply line, as per the original circuit, although it isn't used for deriving output valve bias which is why it's normally done that way. It may have been to reduce stress on the field coil insulation to earth.



Beethoven AC77 Bandpass, Osc, IF coils and waveband switch. GNT 07/02/02



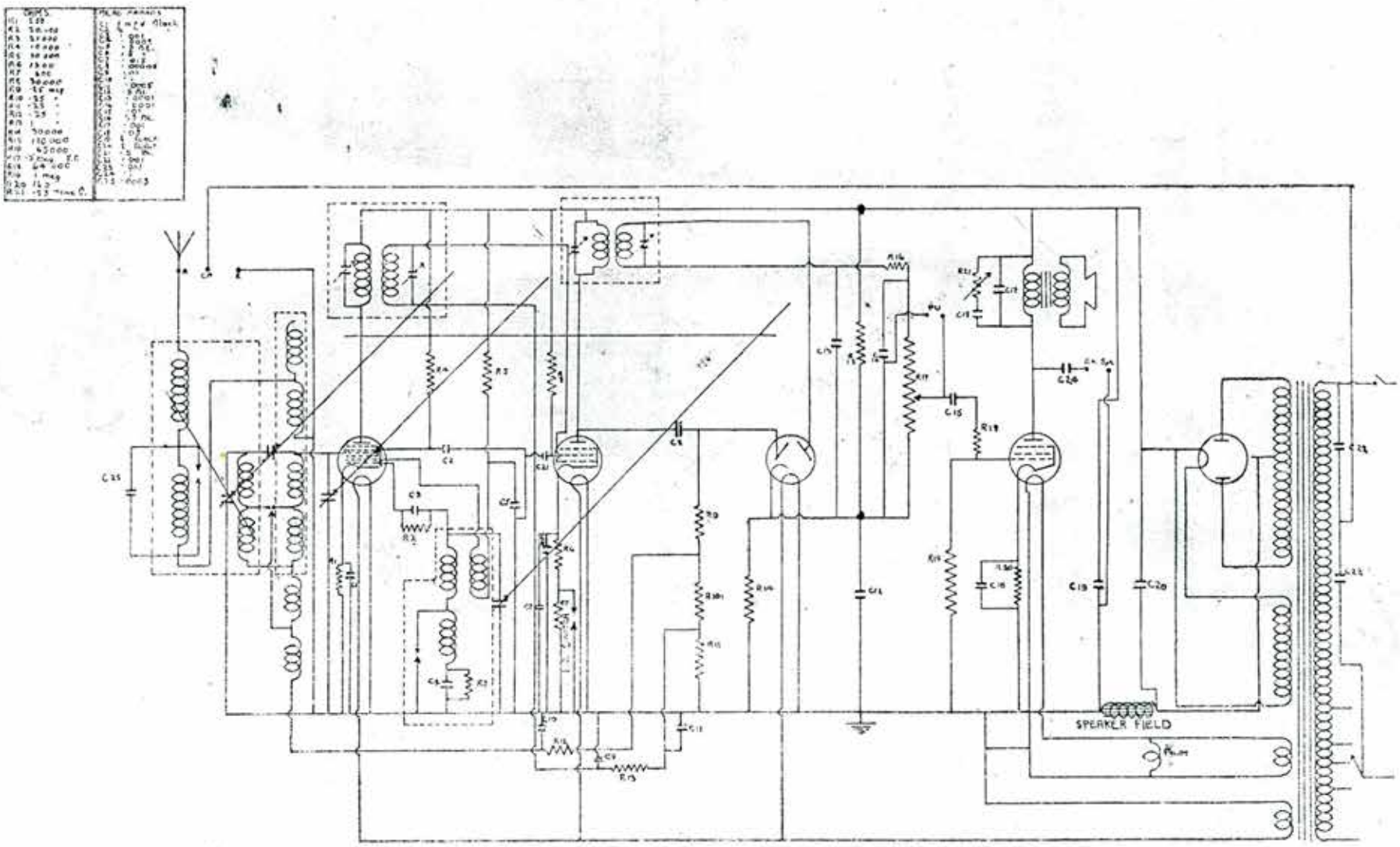
All Tcaps have a shunt trimmer.
● Indicates screened lead.

Wavechange switches are shown in the LW position.
M1 to M5 close together for MW.
Switch M6 closes for Gram position.

AVC switch closed
= "Full AVC"

Beethoven Model AC77. 1935 drn GNT 06/02/02
6K8 added across R14 to get AVC voltage

C8, 50 pF, on original schematic, was 20 pF on the model. A50 g3, strapped to earth, not cathode, as on the original schematic.
Repairer had changed R6 to 180 ohms and R7 to 330 ohms. Converted to pos smoothing and used 32 micro F caps. C25 at 0.01 not 300 pF.



MODEL No. "77"

BEETHOVEN RADIO LTD. NORTH ACTON

The cabinet

Once the chassis and speaker were removed I took off the dial bezel and the slide handles, for the pull out station names, and sent these off to be re-chrome plated. Then some luck as I was able to remove the boxes that the slides run in. As they had warped slightly time was spent with flat files inside these to open them out for smooth operation. Finally they were primed and sprayed satin black.

Of course I didn't know how long the poly' finish had been on the cabinet; the longer it's left, like modern cellulose lacquer, the harder it is to remove. Having done some reading I decided to use a well known paint stripper and back then, before all the Health and Safety impositions had rendered most of them ineffective, it worked well. But possibly too well, as with the subsequent washing off with probably thinners or 'meths,' a lot of tiny pieces of quarter veneer around the grill openings came away. This was a pity as they were an attractive striped veneer running around the curves, which could have been Zebrano; there was no hope of gluing them back as most disintegrated. There were other problems and a difficult one being that the front side strips (now dark) were slightly concave. The grain ran outwards and this almost certainly happened due to sanding or scraping and the middle receiving more abrasion than the edges. They couldn't be left and one way to correct them would have been to re-veneer. However, the cabinet looks as if it was made as a box and then the fancy front panel, with a superior veneer, added afterwards. Removing this was clearly impossible and putting new veneer over the original side pieces would have been a very bad idea so I didn't do it.

With my limited cabinet refinishing skills back then, the only way forward was to use car body filler for the strips and the missing veneer pieces. All of this flatted out well and an obscuring toner was used, and the rest of the cabinet stained, before cellulose lacquer and eventual rubbing out.

Fig. 4

Conclusions

My cabinet restoring skills have certainly improved hugely but could I do it better today? I really think not but perhaps a professional cabinet restorer might but at a cost that simply wouldn't be worthwhile. In no way do I feel I have ruined a desirable radio: it was ruined before it came to me. Strangely though it is one of the most admired radios by visitors with no knowledge of how it would have been originally.

The performance is about what would be expected and I did compare it to an Ekco AC97. Generally it was not as good on MW but far better on LW. There was none of the instability that was present on the Unknown US set written about in Bulletin Summer 2016.

References

1. http://www.polymersplus.co.uk/technical/ivorine.php

McMichael Twin Supervox – Model RV8

By Robert Lozier

Fig. 1 – My Twin Supervox after restoration.

Leslie McMichael had been involved as an amateur wireless experimenter since 1913 and was instrumental in the formation of the (amateur) Radio Society of Great Britain (RSGB). From the WW-I demobilization in 1919, at age 34, he set up a business to supply the needs of experimenters primarily from the sale of war surplus goods. By late 1922 the business was receiving very favorable reviews of their own manufactured wireless sets. The company went public around 1932.

The company aimed to produce quality receivers, sold through accredited dealers (much like Murphy Radio). For some years in the early 1930's the company even emphasized the quality of their receivers by using the advertising catch-line of "Costs a little more - so much the better". This approach was subsequently dropped though as customers seldom want to be informed that they are paying above the "market price"!

The subject receiver for this article is the "Twin Supervox" or RV8 from 1933. This is a 4 valve plus metal rectifier Tuned Radio Frequency (TRF) receiver that was quite expensive at £18.18.0. The set is housed in a large walnut veneer cabinet that is just over 2 feet long. The tuning scale is a thermometer type vertical column, calibrated in meters but with no stations marked. Two fretwork grilles protect the speaker cloths; this particular fret design was used on many McMichael receivers of the period. Looking into the rear of the set one can see the size of the primary and secondary R.F. band-pass coils, looking impressive in their bright copper cans. The whole receiver is very heavy, as might be expected from a set using premium quality components. Servicing was made slightly easier than usual since the chassis could be removed complete with tuning scale and loudspeakers as one unit, though this did entail the removal of ten under-cabinet screws. Also notable are the twin loudspeakers in the receiver (connected in parallel), which was a fairly novel feature in 1933. The set operates on either MW or LW, the band being selected by the lever at the base of the tuning scale. The other knobs are the volume and tuning controls. The valve line up is seldom seen, being the M-O Valve range of 'Catkin' metal shell valves, MS4B, MS4B, MH4, MPT4 and metal (copper oxide) H.T. rectifier by Westinghouse marketed under the trade name 'Westector' Type D31. These Catkin valves predate the initial release of the RCA metal octal tube by almost two years. More on that to follow.

Above info condensed from that found at www.mcmichael.org.uk/history.htm and in the Geddes & Bussey book, Setmakers.

Excellent circuit descriptions are given in the THE WIRELESS and Gramophone TRADER – 'TRADER' Service Sheets – for December 9, 1933 and in the Supplement to The Wireless & Electrical Trader, February 14, 1942 – "TRADER" SERVICE SHEET 577

McMichael Twin Supervox
20 years in repair…

In the Fall of 1995 my late Italian friend, Vic Franzoni, sent me this McMichael Twin Supervox. (Figure 1) I immediately hit problems in acquiring documentation and encountered some restoration issues I was not equipped to address properly. So… It sat in silence until the Fall of 2015. Some years ago I became aware of the U.K. Vintage Radio forum and had some helpful conversations on restoration and conservation of my McMichael Screened Dimic 3 receiver of 1928 that was published in Vol. 40 no. 3 – Autumn 2015 of The Bulletin. I thought it worth a shot to pose questions about restoration of this Twin Supervox. The questions were:

1. I presume that there was some sort of safety cover on the back of the cabinet. I have not found a photo of this on the Web. Any photos of this cover would be greatly appreciated so that I can fabricate a credible replica.
2. It is obvious that some sloppy repairs were done on the set. The Trader Service Sheet #557 Rev. 4 shows the Westinghouse Metal Rectifier mounted under the speaker… In my set the MR is precariously perched as shown in the picture and a 8 µFd. dry electrolytic is laying loose in the bottom of the chassis. (I presume this is a replacement of C23.) Are there any photos that show the correct arrangement of the rectifier and C23? How is C23 mounted?
3. Our sloppy repairman seems to have misjudged clearances and found he could not replace the chassis side bracket after doing his dirty work. It seems to me that this bracket is virtually identical to the other bracket except for the mounting of a small phenolic (?) board. Are they the same?
4. The loudspeaker grille cloth in my cabinet is completely wrong and having been pasted down with a terrible asphalt mastic. The Web pictures I've found don't have enough resolution to show the pattern weave… I need better snapshots.

This radio is certainly scarce on this side of the Atlantic, but very interesting to me in that it shows the first attempts to make metal shell valves (Catkins) and has the metal (copper oxide) H.T. rectifier never used in the USA. I think my set is truly worthy of restoration so that I can exhibit it here at various conferences, so answers to this query would be greatly appreciated.

I did receive some very helpful information especially from one Forum member, Richard Parker, convincing me that I could make a credible restoration.

Fig. 2 – Cabinet before showing horrid holes.

Fig. 3 – 1996 photo of rust on chassis.

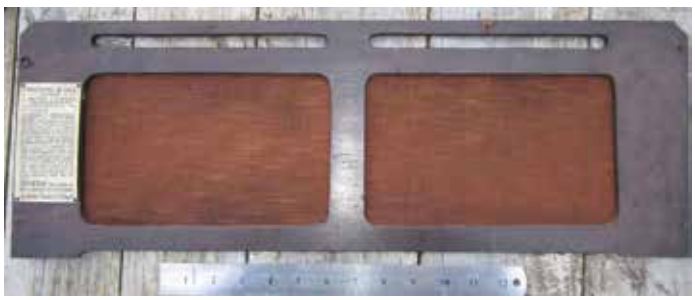


Fig. 5 – Richards back panel photo.

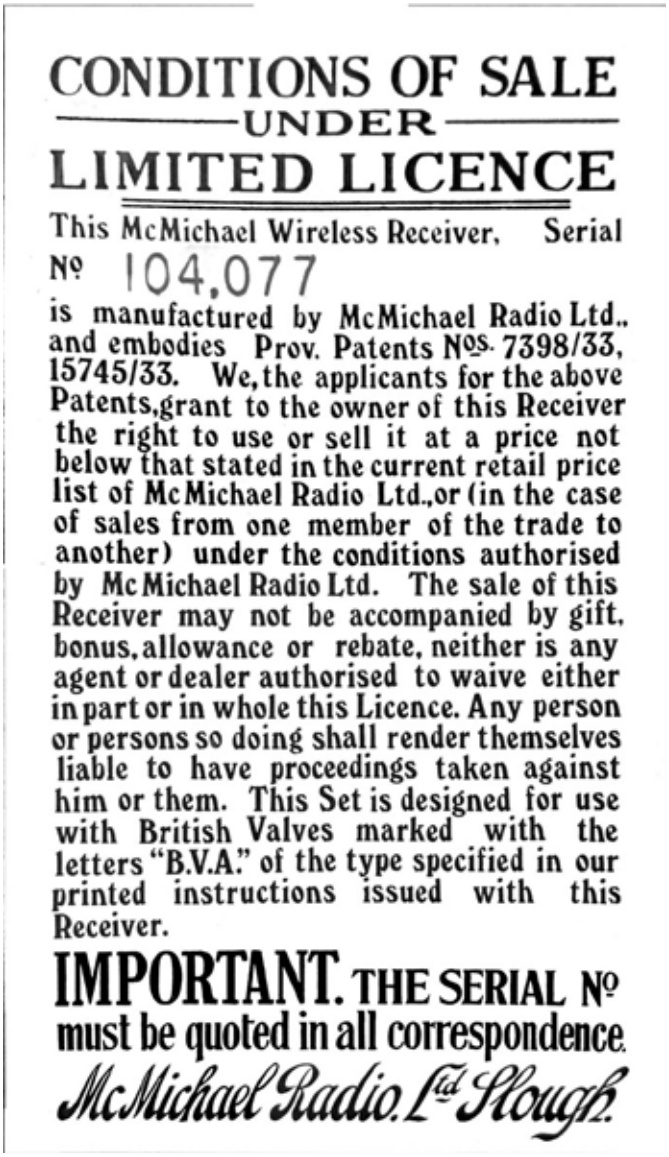


Fig. 6 – Retouched Ivorine tag graphic

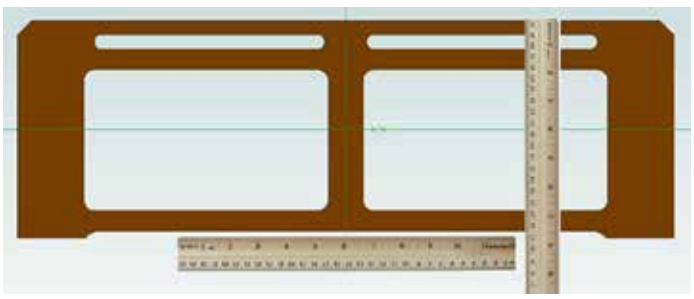


Fig. 4 – My 3D CAD back panel layout.

Cabinet issues

1. When received, the cabinet had three very crudely drilled 5/16" diameter holes along the bottom of the cabinet; two made elliptical to more than double the diameter of the drill; two on the front and one on the left side. (Probably made with a brace & screw-point bit!) Why? I can only speculate… (Figure 2)

Since this radio came from an Italian collector, I can surmise that this radio may have been mounted in a travel trailer (caravan in Euro speak) or in a canal boat or tug. Considering the political and social conditions of the day it might be reasonable to think that this could have been for a family of circus performers, entertainers, or for the living quarters of a canal boat or tug. I sort-of think that other people would have had done a much more craftsman-like installation than these ragged holes suggest. The advertising about the rugged construction of Catkin valves might have influenced the owner to choose this radio for service in these vibration prone environments. (More about this later.) There was also one more-or-less neatly drilled ¼" diameter hole in the same side of the cabinet near a ragged hole… Reason? I have no clue.

Having sat in my house attic for almost 20 years, I thought all the cabinet parts were together… They were not! The cabinet was no problem; I had walked around it at least a few hundred times… But the speaker fret work grills were not with it. That sent me off on a rather frantic search for them eventually finding them in the little room I used to have in my house for a workshop; BUT I presumed that I never did have the rear cover for the cabinet. That sent me off to the Web and posting queries on the UK Vintage Radio Forum. Richard Parker was kind enough to provide me with good photographs. From those I was able to make a 3D CAD model of the wood cover and drawing to fabricate. (Figure 4) His back panel has a Ivorine (white Celluloid) warning label stating that this receiver could not be sold for less than the advertised price, etc. (Figure 5)

I spent several hours recreating the artwork for this label using Photoshop. (Figure 6) Then a couple of hours were spent at local craft and cloth shops trying to find some appropriate fabric to match that seen in the photos sent to me…. I finally decided that it was a very loose linen weave in a sort-of mahogany color… I found a piece of cloth that I would have to dye to get an appropriate color. AND THEN!.. In passing once again thru my old workshop, I see that the original back cover is right out in plain view!... Sitting right there at arms length on the edge of a shelf since 1996! I simply

could not recognize the cover as placed on that shelf…. **Arrgh!** And apologies to Richard.

The original back cover for my cabinet does not have the Ivorine warning label. It still has the warning, but it is in the form of a plain white paper label printed in red ink and simply pasted across the back. This seems to reinforce my speculation that my receiver is from an early production run.

So what to do about these ragged, REALLY ugly holes? Well…. The radio certainly is no longer mounted in my speculative caravan / tug; do we want to attract attention to a decidedly unconventional use for this radio? My guess is probably not. Unfortunately it is going to be a real challenge to hide these since the front is covered in a walnut burr veneer. I had tried, 20 years ago, to match the existing burr pattern using wood sample packs of 100 varieties and STILL could not match the pattern… At the time I was attempting to keep the original cabinet finish. My 2015 assessment told me I must go ahead and strip the cabinet. I found that a patch I had made on the side needed to be redone. I drilled a proper hole the size of a 3/8" wood dowel. On the end of the dowel I glued a piece of veneer. The end could be easily sanded to fit perfectly in the hole and I was sure the wood dowel would be firmly glued in place with good grain alignment. (Figure 7)

I took the time to refill the grain with stained filler, sand smooth and then wipe on a thin layer of aniline wood dye. The cabinet was then given two coats of gloss lacquer and rubbed out.

2. I could not find exact grill cloth. The closest thing I have is a gold knit fabric with a seemingly random geometric pattern visible from one side… The pattern is almost invisible on the back side and looks very similar to the original! BUT it is a knit. To stabilize the knit I applied dots of adhesive to spots on the fretwork after gluing the stretched fabric in place around its edges. (Figures 8 & 9)

3. There is another Ivorine tag tacked to the inside of the cabinet near the paper label showing location of the valves. When I first started on cleaning the cabinet preparatory to stripping, I found only a tiny fragment of the tag remaining under the head of one of the tacks. But too my relief, in a little box I filled 20 years ago with bits and pieces from the set, I found a slip of folded paper containing the rest of the Ivorine tag. I laminated a thin sheet of paper to the back side to unite the pieces.

4. The shafts of the volume and tuning controls pass through the front of the chassis through large diameter holes. There is a thick brass washer fixed to the cabinet by tiny flat head brass screws. The holes for the screws are so close to the edges of the bored hole, the screw threads long ago stripped out. Because of alignment issues between the center of the shaft and the center of the bored hole, I could not just rotate the washer a bit and find new wood. I thought of plugging the bored hole with a wood dowel and then drill a new shaft clearance hole. But dimensions placed my little flat head screws very close to the glue joints and into end grain of the dowel that would not grip very well at all.

I decided to replace any wood dowel scheme with something that definitely would not strip out. (Figure 10) My solution was to take a ribbon length of cotton sheeting and wrap it around a wood dowel covered with a loose sheet of Mylar film. I then wound-on two layers of sheeting and saturated it with low viscosity CA adhesive. Wrap a few more layers then saturate that with CA and so forth until I had built up the diameter necessary for a tight fit in the cabinet. Then clamped my covered dowel in a vice and used a hacksaw to cut a section to the thickness of the cabinet. This gave me a hard bushing with fibrous nature that holds the screws perfectly.

With the cabinet to my liking, time to move on to the chassis.

Chassis conservation and restoration

1. My UK friend was able to confirm that the sheet metal side brackets of the chassis were indeed mirror parts with the exception that my missing bracket had four additional holes to mount a brown phenol resin impregnated paper plate used to support and insulate the mounting of a screw-base 8 ufd. electrolytic condenser. (Figures 11, 12 and 13)

A local business making custom HVAC ductwork supplied me with a sheet of cold rolled steel the exact thickness necessary and an afternoon of work in my home shop produced an exact replica of what I needed.

2. One bit of bother here is that when our sloppy repairman or installer failed to replace the side bracket, he also left me short the proper BA standard nuts and screws. A Google search finally produced a UK supplier of small quantity hardware at a price that was expensive but probably a reasonable price to pay for such esoteric hardware. (Emkay Screw Suppliers) No substitution of Metric or USA standard (SAE) equivalents for me thank you very much…

3. While the innards of the satin nickel plated chassis showed little rust, the back side of the chassis with its aerial pin jacks, gramophone pin jacks, builders tag, external speaker pin jacks was a first-class rusty mess! (Figure 3)

I had attempted, 20 years ago, to use Naval Jelly to remove the worst of it and the result was totally unsatisfactory. I had hoped to avoid taking off the myriad of screws and pin jacks but now realized that was not going to work. In addition some of the nickel plated brass screws were corroded and would need to be replated. ….An easy task I've done many times.

With a hardware free flat surface to work on, I could do the right thing and scrape and sand off all the rust and dig out rust from pits in the steel. With a rust free surface, I could fill the pits with automotive glazing putty, sand flat and spray-on a light gray primer coating. (Figure 14)

This chassis is plated in satin nickel not the more typical (at least for American sets of that vintage) cadmium, zinc or bright nickel. And the other faces of the chassis were in good to very good shape after cleaning. So I really did not want to paint all the original plate but at the same time did not want to establish a strong contrast with the face that had to be completely refinished. What to do?

Much to my surprise, the major spray paint suppliers in the USA, brand names – Krylon and Rustoleum, now have a metallic nickel color decorative lacquer in their range. So I masked and sprayed a coat of that over the gray primer… Of course that makes a surface that is too perfect in coloration (like new) but I found it an easy task to mix a little acrylic craft paint of maybe three parts flat black to one part yellow gold and; using a 3" gauze pad saturated with the mixture, work it over the surface of the virgin decorative nickel paint. The result tones-down the finish to make a very good blend to the original plating. I painted an empty paint thinner can the same way in order to test my technique for applying an over coat of blended paints. (Figure 15) A final 'artistic daubing' with the almost dry paints gives a slightly irregular finish that fools the eye. I finished off the 'treatment' with a coat of clear satin lacquer. The net result is that virtually no one suspects that the rear panel has had any work done at all.

4. The final insulation wrap on the mains transformer looked terrible! (Figure 16) Obviously it had been heat damaged at one point and nature had finished it off over the decades. I decided to knock out the laminations to see what could be done to recover the winding. Fortunately the perished layers of kraft paper lifted off with no trouble at all. I could then use some modern Mylar transformer tape to secure the windings. The original coverings were strips of kraft paper ¾" wide with water soluble adhesive. I just happened to have sheets of this material that I had the foresight to buy from a local motor rewinding shop some 40 years ago; a small shop long since gone.

The original winding had then received a coating of varnish. Modern varnish for transformer/motor work that I am familiar with has a red dye that certainly is going to stand out as wrong, wrong, WRONG! What alternative could I come up with? After fiddling in the shop for a while, I found that what looked best was dilute, slow-set PVA veneer wood glue with a little bit of mahogany aniline dye added. I 'sort-of' tested it by painting the mixture onto an aluminum pie tin. Using my adjustable hot air gun and my infrared thermometer, I set the air flow to about 300 degrees F. All I can say is that it did not show any signs of discoloration after 5 or 10 minutes exposure. I did not take the time to see how high the temperature could be raised before it would change color. But the resultant reassembled transformer looks exactly like NOS (New Old Stock). (Figure 17) At least I'm really happy with the results.

5. The 'TRADER' sheets told me that the replaced 8 µFd. condenser was originally identical to the one mounted on top of the chassis. Where was I going to get an exact replacement on this side of the Pond? I got lucky…. The paper label on my legitimate condenser tells me it is a Telegraph Condenser Co. Ltd. Product: "Sole Licensee by The Condenser Corpn. Of America, Inc."

By any chance, was it an exact copy? After a few enquiries on the US based Antique Radio Forum, I had a guy in the state of Georgia telling me he had a dented and very ugly unit he thought was about right. A few days later it is in my mailbox. And the answer was Yes! In every way it was exact except for body length… Dirty, big dent in the side but something to work with. A bit more luck in that the paper label for this condenser wraps round the whole can so any 'surgery' could hide beneath. So, cut it open, pound out the dent, clean it up, even fit in a 10 µFd. electrolytic,

Fig. 7 – Stripped cabinet with patched holes.

Fig. 8 - Grill with glue dots to hold stretch fabric.

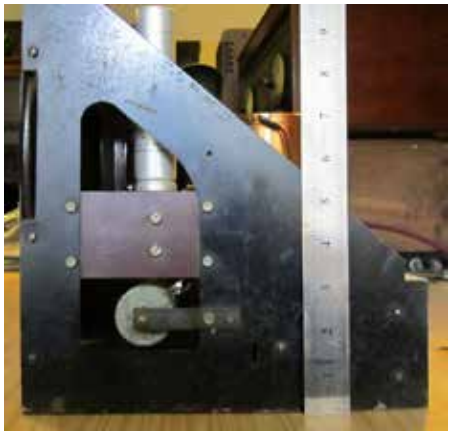


Fig. 11 – Richard's bracket photo

Fig. 9 – Comparing Richard's original grill to my replacement fabric.

Fig. 12 – Richard's Condenser bracket

Fig. 10 - Making the cloth bushings and gluing in place.

Fig. 13 – Richard's rectifier placement photo

Fig. 14 – Rear panel of chassis stripped of hardware, masked and painted.

Fig. 17 – Transformer after cleaning and rebuild. It looks like NOS (New Old Stock).

Fig. 15 – Tin can painted in same way so that I could experiment with 'artistic' over coats of pigment to 'age' the finish so that it would not contrast with the original plating on the top of the chassis.

Fig. 16 – Transformer before with its grimy perished insulation.

Fig. 18 – My home built Torch Battery scanner to capture the electrolytic condenser graphic.

Fig. 20 – Mounting replacement electrolytic to the top of the central aluminum post.

Fig. 21 – Condenser – Wire brought out of base and PVC pipe used to insulate old positive spiral plate.

Fig. 22 – Condenser – Comparison of original and rebuilt & modified replacement.

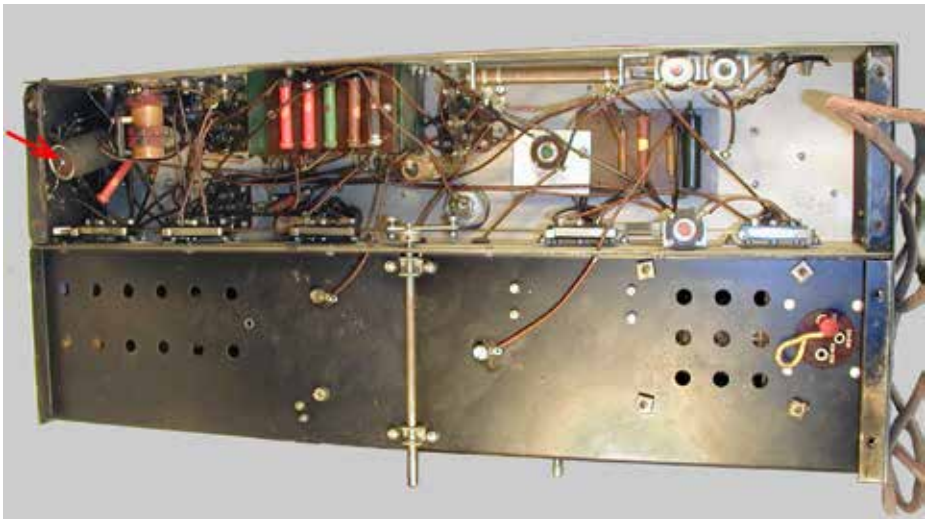


Fig. 23 – Chassis bottom – Underside of chassis appears all original except for tacked-on axial electrolytic that was simply removed.

Fig. 25 – Original paper label found still attached to one of the loudspeakers.

Fig. 24 – Front of chassis showing robust Magnavox brand loudspeakers.

Fig. 27 – Fabricating mirror image replacement chassis side bracket.

Fig. 26 – Note how well one of the speakers cleaned up after an application of phosphoric acid “rust converter”.

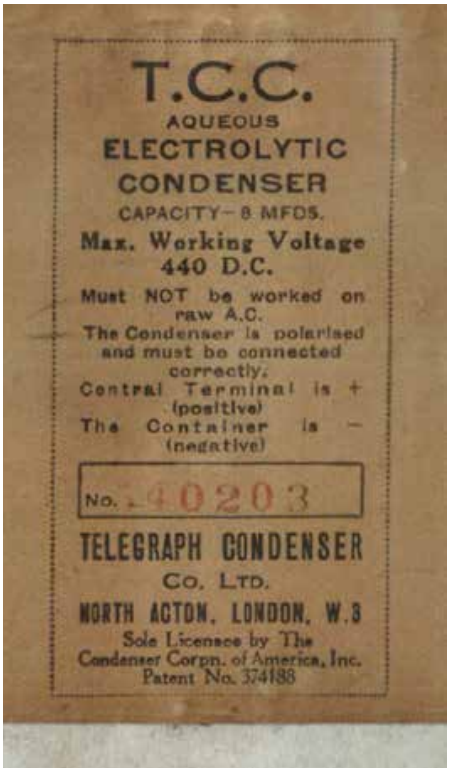


Fig. 19 – Raw scanned image for the condenser from which I could recreate an exact replica graphic.

splice the can back this time to the required length and it was ready for a reproduction label.

A few years ago I built an optical scanner for round torchlight batteries in order to capture the most accurate possible images for reproduction graphics. (Figure 18) This condenser body scanned beautifully on my little machine. Soon I had generated the exact graphic necessary. (Figure 19)

When installing the replacement 10 µFd. electrolytic inside the can, it dawned on me that I did not have to remove the guts. There is enough room above the spiral plate for a modern small electrolytic. (Figure 20) So I decided to VERY carefully drill the end of the center stud to which the spiral plate is welded and tap for a SAE 6x32 screw. This stud is dead soft pure aluminum and difficult to drill and tap without special lubrication. There are tapping fluids especially for aluminum that are well worth using. Therefore I could solder a ring terminal to the positive terminal of my new part and screw right on with a stainless steel screw. I found that a piece of PVC electrical conduit pipe made an absolutely perfect press fit into the can to prevent the old spiral plate from ever shorting. (Figure 21) I brought the negative lead with heavy insulation thru a hole near the mounting stud. I could then slide on the top of the can now spaced to add an additional ¼" to the overall height by the length of PVC pipe. A couple of drops of CA adhesive locked the parts together… I wound layers of adhesive backed aluminum foil tape to build up the gap between the parts of the can. (Figure 22)

This replica part replaced the perished box style dry electrolytic found in the bottom of the chassis frame. Over time that also perished and an axial lead electrolytic was tacked on under the chassis. (Figure 23) Other than this additional part, easily unsoldered, there is every reason to think that all other parts are original. No doubt some of these parts no longer meet specification after 80 years but I have no intention of wholesale parts replacements just to make it play until something else fails. As is, it remains an excellent reference artifact for future generations that bother to care about preserving the original craft of the builders.

6. The two loudspeakers, made by Magnavox (Great Britain) Ltd., appear identical but they are not. (Figure 24) One has a field coil with about 1,500 Ohm resistance and a hum-bucking coil. The other has a 7,500 Ohm field coil and no hum-bucking coil. The paper label on one speaker was missing. The still remaining label was in terrible shape and just holding on by a small spot of glue. (Figure 25) No problem to pop off and get under my flat bed scanner and import into a session in Photoshop. Fortunately the nearby office supply print shop has a range of metallic finish papers that very closely match that of my terrible reference label and the black graphic I generated printed out perfectly on their laser printer.

I find that I can use my air brush to spray a very fine 'fog' of lacquer tinted with a drop or two of 'amber' aniline wood dye to knock-off the 'new' look of a laser print. If you don't get too carried away with the technique, it can be very effective. If you overdo it, it stands out as being a dreadful 'antiqued' chatzki.

As you can imagine, since these two speakers are different, the part numbers are different. The TRADER sheets don't reference manufacturer's part numbers so how was I to know what part number to put on my replica label? Here I get lucky again. Instead of printing the part number on the label, they used steel number punches to emboss the part number onto the paper label already glued in place to the field coil pot, thus cutting through the paper right into the steel. All I had to do is read the figures embossed in the steel. They used more or less standard 1/8" punches which I have. I love it when I have the opportunity to recreate accurately a detail that no one in the world would have ever spotted as compromised in the first place.

Note the difference in the field coil assemblies shown in Figure 26. Both speakers were just as black with soil and oxidation. I found the most effective way to deal with this was applying a phosphoric acid "rust converter" commonly used here in the USA by automobile restorers. I simply apply very sparingly with a tiny ball of fine wire wool held in a pair of small forceps taking care to prevent the liquid from running into cracks. Afterwards I wipe-down with distilled water & denatured alcohol, force dry and immediately coat with clear satin lacquer.

Later production runs of this receiver have different brands of speakers with a slightly larger basket diameter that made it necessary for McMichaels to add notches in the front chassis plate and side brackets. My presumed first production run receiver was from a time when Magnavox in the USA had first moved from Oakland, California to a factory in Chicago and then after two years (in 1933) moved to Ft. Wayne, Indiana. I'm wondering if this transition in the depths of the Depression, lead them to shed their UK manufacture thus forcing McMichael to find another supplier? The Magnavox speakers appear to definitely be high quality components.

7. The Westinghouse metal rectifier…. As mentioned before, it is something that was never used here in the USA for H.T. power supplies. It had been repositioned precariously from horizontal to vertical mounting. (Figure 28) The only thing driving this goofy move seems to have something to do with removing the side chassis bracket in order to provide bolt clearance for that terrible hole drilled in the side of the cabinet. My UK friend provided proper dimensioned sketches and snapshots for a little missing steel bracket and the bracket to support the missing 8 µFd. electrolytic condenser. So it was not too difficult to fabricate exact replicas and return the rectifier to its proper place.

The sloppy vinyl wiring going to the perished dry electrolytic found in the bottom of the chassis frame was removed and replaced with proper stranded hookup wire with braided cotton jacket to match that in the rest of the set.

8. Having been told that the missing frame bracket was dimensionally a mirror of the other bracket, an afternoon of work in my shop produced an exact replica. (Figure 27)

9. There are two, 3 core cables in woven maroon cloth sheaths; one for the loudspeaker connections and the other to interconnect the rectifier, mains transformer and voltage doubler condenser block. They were very dirty and I did not hold out too much hope for cleaning… However I have had some success in cleaning top chassis wiring to loudspeakers and the like by simply soaking in mineral spirits (white spirits). While sloshing about in the spirits it


Fig. 29 – My replica condenser properly mounted on my replacement chassis bracket.

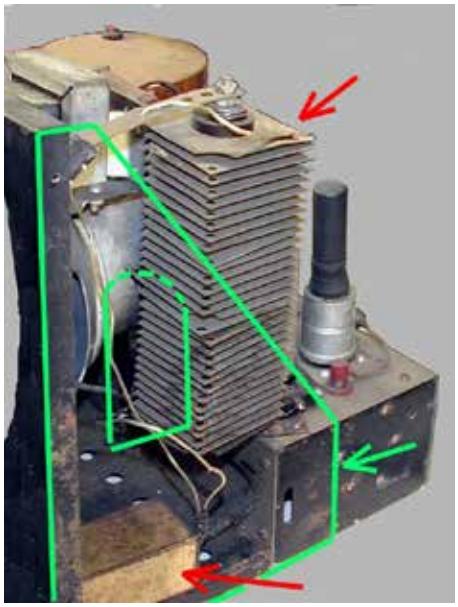


Fig. 28 – Bogus MR placement & where the missing bracket should be.

looks as if just about nothing at all is going on. I lift the dripping cable out of the pan and use a blow gun set at maybe 40 psi (275 kPa) to blow off the spirits in a spray. After doing this three times and allowing it to dry, the wire looks almost new! It appears that the ballistic removal of the contaminated liquid spirits is far more effective than just saturating with solvent, using a little brush work and allowing it to dry.

I did the same thing with the original mains cord. This cord with its hardened rubber insulation was contorted far too much to put into orderly loops. I found that setting my heat gun for maybe 125 C made it easy to coax the cord back into loops. I have no interest in fitting a new cord to get it playing along with an assortment of other modern replacement parts for the existing original items, never designed to work for 80 or so years. With my accurate recreation of the missing 8 µFd electrolytic, side bracket, etc. this receiver remains a very accurate historical record of how this receiver existed when it left Slough. (Figure 29)

10. The vernier (slo-motion) drive had me puzzled for a bit; part of the assembly was obviously bent and did not work at all and it took a while to realize that a part must be missing. I figured out that the missing part must be a, probably brass, roller that maintained pressure on a friction band. A little lathe work and my part popped right into place and works fine. (Figure 30) I thought the construction of the Polar brand three gang tuning condenser a beautiful thing to behold. So easy to release the rotor and drop it into my ultrasonic cleaner.

11. The top side of the bottom pan of the frame had some heavily rusted areas. (Figure 31) Fortunately these parts were not plated, just coated by black lacquer. Easy to scrape, fill with putty glaze and re-paint. No problem to blend the color into the other frame parts with their good original black lacquer paint in place.

12. I find the dial string method unusual. (Figure 32) The string is large diameter and rather than running on pulley sheaves, there are stamped and formed brass guide channels over which the string slips. There are five of these guides in three versions.

13. The big copper shielding cans have some tarnish here and there and the urge was present to make them look brilliant again. I suppressed the urge however to prevent a contrast with the less than perfect nickel plate on the top of the chassis.

14. The top and front side of the satin nickel plated chassis was free of any deep rusting and cleaned remarkably well using the phosphoric acid rust converter mentioned earlier. (Figure 33) As you can see, I determined it necessary to dismount the RF coils to gain proper access. Of course the cleaned plating got a proper coat of clear satin lacquer.

15. The flat white reflector behind the translucent dial scale was very dirty and flaking so had to be repainted.

16. The last step was to clean up and repaint an interesting audio coupling network called a Benjamin 'Transfeeda' a design approach never taken here but not the first time I have seen it in UK designed sets. My 1928 Solodyne has a module made by Mullard for R-C coupling but the Benjamin device claims performance advantages not matched by the earlier part. (Figure 34)

What better way to explain the device than to quote from writings in The Wireless World:

"The practice of parallel feeding intervalve L.F. transformers so that the steady D.C. anode current does not traverse the primary winding, which makes available a much higher impedance to the low audible frequencies than otherwise would be the case, has now resulted in the introduction of an entirely new type of component. The Transfeeda, as the Benjamin Electric, Ltd., appropriately designate their new model, embodies in a compact unit measuring 2 3/4in. x 2in. x 3 1/4in. high, a wire –wound resistance rated to carry I ¼ watts, a coupling condenser, and a small L.F. auto-transformer. The resistance has a total value of 50,000 ohms, but is tapped at 30,000 ohms for use with low impedance valves. The primary inductance of the transformer is of the order of 85 henrys, which value is, of course, maintained under all working conditions, since it is not affected by the magnitude of the anode current taken by the preceding valve.

The makers state that the amplification curve is sensibly straight from 37 cycles up to the limit of audibility. Our measurements were made using a valve of some 10,000 ohms A.C. resistance, and the 30,000 -ohm tapping on the unit. The curve here reproduced would seem to justify well the makers' claim, for over the full range of frequencies covered there is negligible change in the amplification afforded by the stage. The high level of the curve down to frequencies of 50 cycles is of particular interest, since this assures a correct proportion of bass response to give a full round tone to the reproduction. With the actual combination employed, a gain of 30 times is recorded, this being about 1.8 times the amplification factor of the preceding valve. The step–up ratio of the transformer is 1: 3. A neat moulded Bakelite base carries the six terminals, arranged so that they fall quite conveniently when wired in a circuit, while the various component parts are enclosed in a metal case finished in warship grey. Valves up to 30,000 ohms impedance can precede this unit without modifying its characteristics, and by including an external resistance those of still higher impedance may he employed. These units should undoubtedly have a well- merited popularity, for they enable a high quality of reproduction to be attained at the s mall cost of Ils. 6d. only. The makers are Benjamin Electric, Ltd., Brantwood Works, Tariff Rd., Tottenham, London, N.17."

17. Now to comment on the M-O Valve 'Catkin' metal shell tubes.

There is an excellent book, The Saga of Marconi Osram Valves, by Barry Vyse & George Jessop (ISBN: 0-9539127-1-X paperback). It has amazing detail on how various valves were developed at this firm. (Figure 35)

The story goes back to the very early 1920s and the desire to develop transmitting valves of higher and higher power capabilities. Simple radiation from the elements of existing designs through an evacuated glass bulb approached design limits in the 250 to 1,000 Watt range. Several people had the idea that some sort of cooling of the anode with water would be desirable. W.G. Housekeeper working for Westinghouse in the USA is credited with developing a practical scheme for joining a cylindrical copper anode, closed at one end, to a glass bulb that would support and insulate the filament and grid structures within. Thus pure water could flow in a cooling jacket directly around the outside of the anode cylinder. This made it possible to scale these transmitting valves into power ratings exceeding 100kW in just a few years. (Figure 36)

M-O Valve licensed this technology and achieved great success in manufacturing a range of CAT (Cooled Anode Transmitting) valves throughout the 1920s and 30s.

Around 1930 designers at M-O Valve were considering the possibility of making exposed anode valves for small power applications in radio receivers and audio amplifiers. They came up with a workable, robust design that could potentially provide considerably longer lifetimes and low microphonics. Rather than use water cooling, air cooling of the anodes

Fig. 36 – CAT water cooled high power transmitting valve.

Fig. 30 – The Slo-motion drive for the beautiful Polar brand tuning condenser.

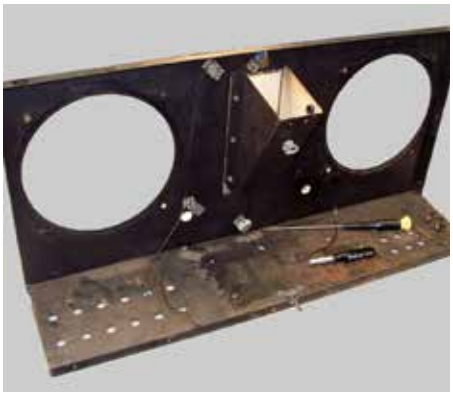


Fig. 31 – Showing rust on frame bottom

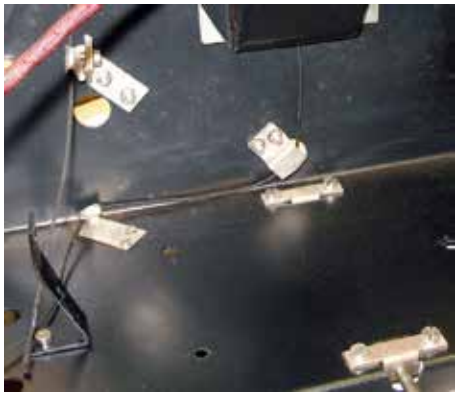


Fig. 32 – Unusual dial string channel brackets

Fig. 33 – To properly clean the top of the chassis I had to get the RF coils and mounts out of the way.

was used. The anode was in direct contact with the air with anode temperatures at least 200 degrees C lower than conventional valve designs in evacuated glass bulbs. The valves for RF amplifiers and detectors have perforated metal screens that shield the anode. The power output pentode does not, since the shielding is not necessary in the audio output circuit and the elimination of the perforated shield allowed the valve to run even cooler. (Figures 37 & 38)

The valves went into production under the trade name 'Catkin'; obviously a play on their successful high power CAT brethren. But it would be apparent that it was done with lack-luster support from significant managerial staff.

To highlight the rugged construction of these valves, M-O performed publicity stunts of throwing the valves out of an airplane clad only in retail cartons. They apparently never failed to work when retrieved from the ground and installed in a radio at the end of the demonstration. Maybe the original owner of my receiver was aware of this publicity to the point of making it part of their decision to install this set in my imagined caravan or barge tug.

McMichael was one of the few radio manufacturers to design-in this range of valves in 1933-34; there were all glass envelope valve designs in the marketplace that would work acceptably well so that they had a 'Plan B' to fall back on.

The basic construction of the valve was such that it was to be impractical to design a frequency changer valve. Thus you find only TRF receiver designs making use of these valves. (Apparently the British market was highly resistant to adding additional triodes or tetrodes to solve such problems.)

Other manufacturers world wide were at least investigating the possibility of valve designs that would eliminate a glass bulb. The Radio Corporation of America released their octal base, all metal tubes in mid 1935

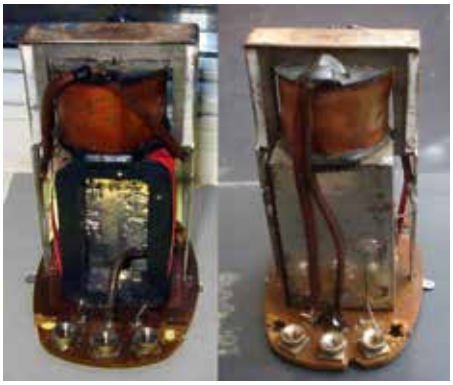


Fig. 34 – The unusual Transfeeda audio coupling device manufactured by Benjamin Electric, Ltd.

Fig. 37 – Advertising cuts shown in The Saga of Marconi Osram Valves

to great success. Their design scheme could add two more elements greatly expanding design versatility and do it at a cost equivalent very close to all glass envelope designs. Consequently finding vintage receivers with the Catkin range of valves is quite rare these days.

So here you have my third article for The Bulletin in recent years. Again you are introduced to a person that is more interested in preserving the technology of by-gone days than replacing more or less hidden components to make it appear to work as it did long ago. I have no argument with those that make repairs to vintage equipment that is no longer an accurate historical record due to extensive utilitarian repairs made over and over. But when you are presented with the opportunity to preserve artifacts essentially original in every respect that may tell an interesting story, consider holding off replacing parts that never were designed to remain operational many decades later. If you are unhappy with owning wireless sets that don't "work", consider

Fig. 35 – Book cover: The Saga of Marconi Osram Valves

Fig. 38 – Catkin cut away shown in The Saga of Marconi Osram Valves

selling or trading for another artifact where you can have fun making extensive repairs or modifications with a clear conscience.

Fig. 40 – Back view – cover off - restored McMichael Twin Supervox

Fig. 41 – Back view – cover on – Note paper label instead of large Ivorine tag seen on most models.

Fig. 42 – Chassis view back perspective 1 of restored McMichael Twin Supervox

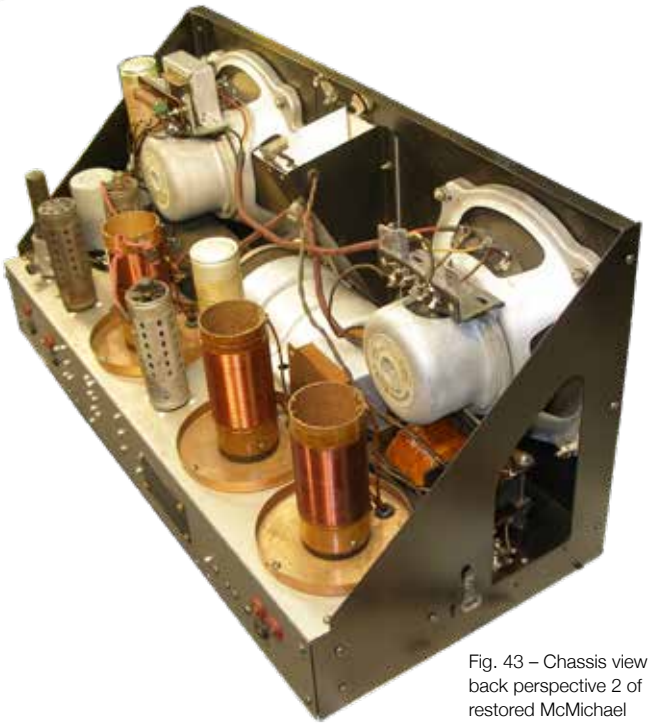


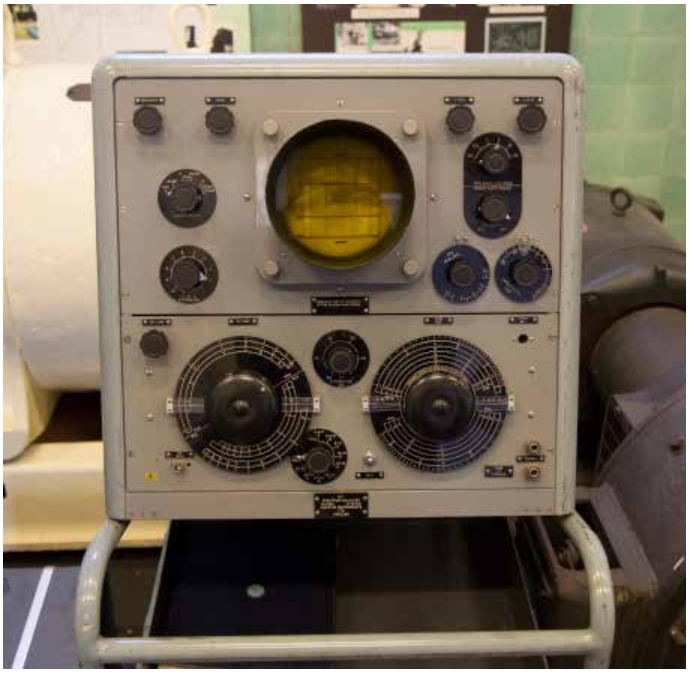
Fig. 43 – Chassis view back perspective 2 of restored McMichael Twin Supervox

The Writtle Hut Meet-up, November 2016

Photos by Alex Hewitt

Outside Sandford Mill

Murphy V204 15" 405 Line TV



Ekco AD65 ' circular Ekco' and Fleming Diode Valve

Rega Turntable made locally in Southend on Sea

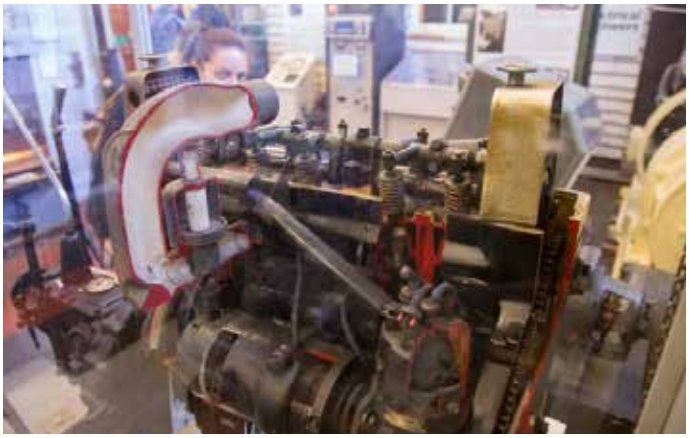
Items on show from the BVWS Archive

Tony Constable

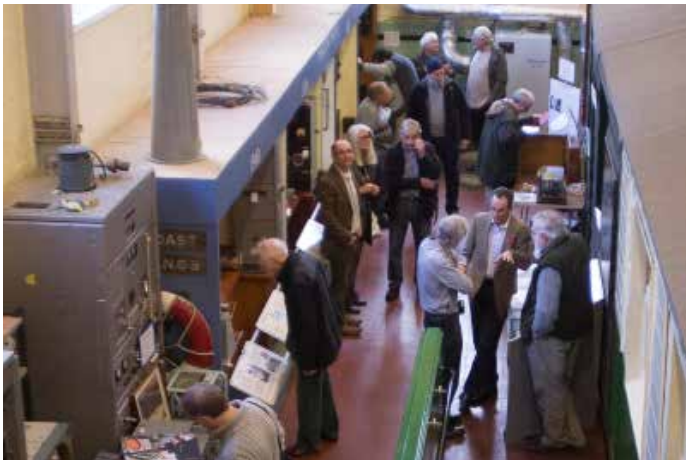
David Read

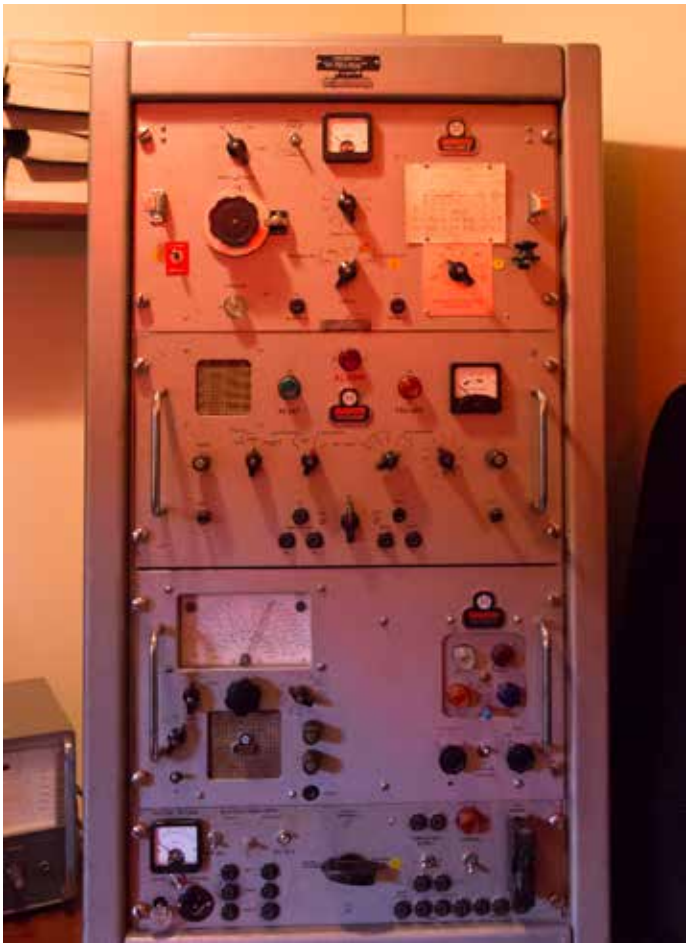
The current BVWS Committee with Tony Constable and David Read

Photo by Amy Woon




WINNER





Restoration Heaven – The Kolster Brandes EWR60 Wire recorder

By Terry Martini-Yates

A potted history of the KB EWR60 and wire recording

The project on the bench and under the spotlight this time is a Kolster Brandes EWR60 magnetic wire recorder, a machine that made a fairly brief appearance on the UK market in the latter half of the 1940s. KB had invested in developments from America which started in earnest in the immediate post war years, after the secrecy surrounding the recording technology had been lifted. By 1946, an array of home recorder models appeared, designed to suit every taste and pocket. With models produced by manufacturers that were largely unknown in the UK at the time such as Webster Chicago, Pierce, Silvertone and a host of others, all producing magnetic wire recorders.

Wire recording was seen as a clever piece of technology, and the American public were simply wowed by the fact that here was a machine that could record and then instantly replay, voices and music on to a most unlikely recording medium; stainless steel wire that was not much thicker than a human hair; 0.004 inch to be precise. Here in the UK, magnetic recording in any shape or form took far longer to take off in the domestic markets, probably because of the austerity in the immediate post war years, along with shortages of components, materials and the necessary tooling. The set makers prioritised radio and television manufacture first, after returning to peacetime production. Neither magnetic wire nor magnetic tape really appeared here for domestic consumption until the end of 1940s, and then they appeared on the market almost simultaneously.

The deck fitted to the KB was UK produced from an unlikely manufacturer, Boosey and Hawkes, the famous musical instrument maker, an early approved licensee of the wire technology. Their involvement in wire recording dated back to the war years, having supplied recording equipment to the UK military under a patent licence. The K B machine was also subject to the same patents, which at the time, were fiercely regulated and guarded by the Armour Corporation of America. (1) Before we delve into the restoration work that ensued on the work bench, a brief look at wire recording and the industry that produced it for a relatively short time here in the UK, and the ties the technology had with the US is worth closer examination.

The wire recording technology that featured in the KB was based on the research and development of the Armour Corporation, an obscure organisation which had university laboratories in Chicago. Its early years saw it surviving on small and often short lived research projects mainly to manufacturing concerns. The wire recorder side of the research was headed by Marvin Camras, who had originally secured a job in 1939 with Armour, based on the experimental work he had carried out at his home. (2)

Camras was later to be recognised as one of the inventors of modern magnetic recording, holding a significant number of patents including what would become his crucial invention, high frequency biasing. The patent covering this was successfully defended by Armour for several years. (3)

Front cover of the user instructions issued with the EWR60 Wire Recorder.

The UK division of Kolster Brandes as far as is known, was the only mainstream radio and television manufacturer to have shown any real interest in magnetic wire recording by designing and manufacturing a machine specifically for the UK market. The rest of the concerns were small, more specialised firms, such as Simon Sound Service, AGA with their AGAPHONE dictating machine and Boosey and Hawkes who produced a small number of models through their Wirek Electronics subsidiary, along with supplying their own deck to others. Very occasionally, US produced wire recorders also turn up in the UK, these having quite often been modified for the UK mains.

With the ties KB had with the US and likely knowledge of the current trends and fads there, led to the design and production of a wire recorder here in the UK, with parts of technology being bought in under an arrangement with Boosey and Hawkes. The design was a 78 RPM single play, combination record turntable and wire recorder deck. Intriguingly, KB do not appear to have entered the US market with-it , perhaps this aspect of it may have been dictated to them by the terms of the Armour patent agreement, given the glut of firms involved already over there.

Similar 78rpm playing features appeared on one or two US produced wire recorders, but the particular design of the UK produced Boosey and Hawkes deck does appear to be totally British made, with the markings on the deck suggesting a patent was being applied for at the time. (4)

The decks dual purpose capability (whilst novel) did not really protect the prospective buyer from complete obsolescence even if the wire recorder technology failed in the market place as it would have been unable to accommodate the long playing

The KB EWR60 shares the same type of deck as the Boosey and Hawkes (Wirek Electronics) Model B1 wire recorder as featured in this picture.

LP that was also starting to emerge around the same time. A compromise had to be made here, and to ensure that the Armour specifications were met, this unfortunately precluded the use at 33 ⅓ RPM.

With the appearance of the KB wire recorder on the firms stand at the 1949 Radiolympia Show, one can only surmise that the KB representative manning the firms stand must have been acutely aware of the competition. As by this time, the all British designed and produced Wright and Weaire "Ferrograph" magnetic tape recorder (amongst others) was also being exhibited and demonstrated at the same event with both firms competing with one another, separated by just a couple of exhibition spaces. (5)

In hindsight, the KB (and wire recorders in general) was probably a little too late to the UK market, as was evidenced by its complete displacement in just a year or two by its magnetic tape based competitors.

The EWR60 seems to have sold in reasonable numbers at the time though. The corresponding survival rate appears to bear some of this out with several of these machines still about, suggesting that KB had a market of sorts, even prompting them to issue an improved model.

The final death knell of wire technology was probably due in part to the general changes in public taste combined with the emerging hi-fi markets in the early 1950s. The enthusiasts were simply not interested in wire and turned to tape because of qualities lacking in the wire technology and the ease in which a tape recorder could be incorporated into a hi-fi set up and integrated with an external amplifier and speaker system. Tape was superior when it came to editing and lacing up, even in the hands of a novice. Wire however was difficult to edit and could break easily, despite its overall tensile strength.

The recorder as found once it had been slid from out of the cabinet.

The underside of the deck showing the general transport arrangements, with the Bowden cable controlling the rotation of the cams that are positioned at either side of the deck depending on the positioning of the deck control. The main control mechanism can be seen on the far right which also houses the lock solenoid.

Re-joining the wire was a fiddly affair, literally done by crudely tying the two ends back together in a knot. The dynamic range of wire not considered Hi-fi by any means.

An attempt to make comparisons of the respective formats audio capabilities were summarised in The Recording and Reproduction of Sound, a US publication first published in 1952; it concludes:

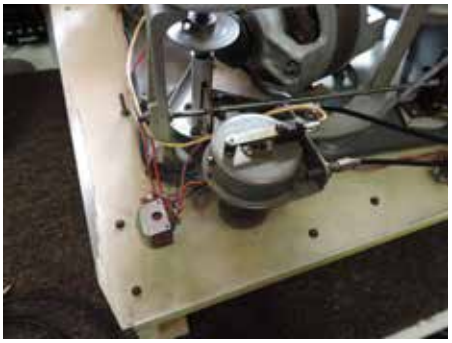
"Utilizing the best possible laboratory constructed recording heads; the relative high frequency response of tape at 7.5 inches per second is not quite as great as the response from wire at 24 inches per second. This may be compensated by slightly increasing the tape speed. At greater speeds, tape is superior."

The EWR60 in a niche market

KB appears to have aimed its EWR60 at the luxury end of the market having housed the recorder in a bureau type roll top cabinet, as with the example here, finished in cellulose dark brown paint and lacquered wood veneers. Unlike some of the competitor's offerings, the recorder is designed to sit in a semi-permanent position making it a centrepiece in the home. The designers appear to have paid little thought to the end user, as the inner areas of the cabinet are a little restricted. A couple of extra inches of head room inside the unit would have made all the difference and would have helped when changing a record over or threading a reel of wire onto the turntable drum.

KB supplied a high quality STC 4021 "Apple and Biscuit" moving coil microphone with a purpose made desk stand, an item KB described as being of "robust construction". (This probably needed to be, in a domestic setting). The general specification of this far exceeded that of the recorder that it was supplied with and would normally have been found in the hands of a professional user. STC and KB were in many ways commercially joined at the hip and was the most likely reason that this was the

The general cosmetic condition of the deck once everything had been carefully removed. The colour is still quite hard to determine.



Close up of the lock solenoid assembly and the motor supply contact.

The Boosey and Hawkes chassis stamp along with the Armour licencing plate fitted to the underside of the flywheel and motor housing.

Kolster Brandes Type EWR60 wire recorder.

Tape and Wire Recorders. Complete magnetic tape recorders in first-class cabinet work were exhibited by G.E.C. and R.G.D. The "Tape Deck" made by Wright & Weaire was also demonstrated. This unit will be made separate component (price in the region of £25) or as a complete portable instrument with amplifier, loudspeaker, etc.

Instruments using wire as the magnetic recording medium were shown by Kolster Brandes and Simon Sound Service. A design for home construction was shown by Park Radio.

How Wireless World covered the emerging technology at the 1949 National Radio Exhibition at Olympia.

microphone supplied with the equipment. As is often the case, this was missing on the equipment under discussion here having presumably parted company many years ago.

Unusually for this type of machine, a magic eye valve is used for monitoring the recording levels rather than a miniature neon lamp that simply flashed to show the peak recording, and often found on other similar machines of the period. This does give a finer degree of recording control, and without any form of indicator lamp, also lets the user know that the machine is powered on. The down side of it being kept in circuit at all times inevitably led to a shortened life in the process.

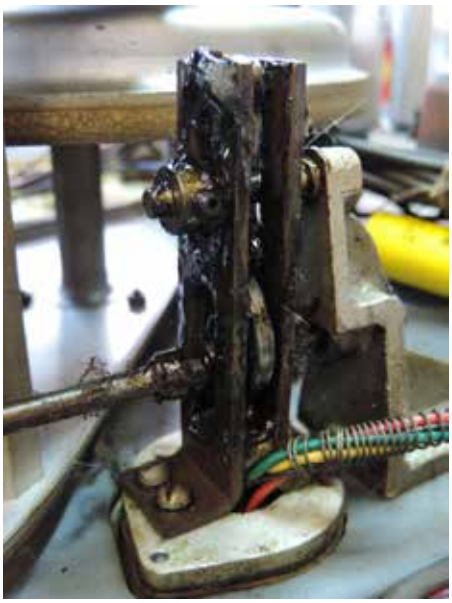
The valve line up is conventional for the time and is from the Brimar range as follows: V1 6J7, high gain preamp on replay and mic amp on record .V2 & V3 both type 6J5 GT, voltage amplifiers V4, 6J5 GT, Bias and Erase oscillator, V5, 6U5-G , recording indicator V6 6V6GT, power amplifier and V7/8 6X5GT HT rectifiers.

The careful removal of the reel carrier necessitated its complete disassembly from the rest of the deck in order that the wire reel could be freed off, without causing any further damage.

The US produced Silvertone radiogram and wire recorder shows a similar idea for playing 78 only records. Note the level of sophistication in the actual deck compared to the more basic features found on the KB unit.

The underside of the worm drive assembly that couples the spool carrier hub to the drive. The muck seen here was almost solid.

The recording head completely dismantled. The general dirt and dust that was found can be seen prior to cleaning. The slot can be seen where the wire travels across the head which is a combined type and incorporates the bias, erase and record/replay windings.



The reciprocating magnetic head assembly as found; the caked on grease had to be seen to be believed.

The bias and erase frequency of 20KC/s as found on this machine would be considered poor by the standards in the early 1950s. However, as the upper frequency response of the recorder was only 6 KHz, this would have therefore been seen as satisfactory in this application. The makers claim that the amplifier was capable of dealing with frequencies of up to 10 kHz, easily achieved with the improved recordings becoming available on 78 discs by this time.

The equipment is fitted with a Garrard arm and pick-up, more usually seen fitted to the AC6 series of 78 only turntables. These are tried and tested and generally don't give to many problems. The turntable design on the KB as mentioned previously, is so arranged that the single 78rpm speed directly conforms to the standard twenty four inches a second for the replaying of a wire spool which is wound onto a recess formed on the lower half of the turntable drum. This also insured interchangeability of wire reels with other machines conforming to the Armour standard. A full reel would typically give about an hours' worth of recording time.

As with most other wire recorders of the period, there is no capstan drive or pinch wheel of the type that would be typically found in a tape recorder. The KB is however fitted with a heavy flywheel that is rim driven by quite a large motor manufactured by Croydon Motors, providing a remarkably stable drive virtually free of wow. The play out of the spool of wire is managed quite effectively, and the arrangement is dealt with by the simple reciprocating action of the magnetic head assembly. This ensures that the wire is piled correctly onto the turntable drum when the machine is in use in the forward play mode, or when rewinding back onto the spool.

The deck functions are controlled by the three position deck control which is coupled to a pair of Bowden cables underneath. Depending on the position selected, the cables control two concentric cams spaced at opposite ends of a length of rod. When play mode is selected they rotate the rod just enough to raise the respective cam and engage with the underside of the turntable, clearing a primitive braking pad and plastic ring to engage the flywheel with the motor drive.

There is enough torque to pull the wire across the front of the magnetic head assembly while at the same time, having sufficient inertia to control the reciprocating action of the magnetic head assembly as the wire is guided through a narrow slot across the front of the head.

When the control is progressively moved through into neutral position and then on to rewind, this drops the turntable drum back into its neutral position, raising a spring loaded coupling underneath the spool carrier that engages with the large cone shaped rubber idler at the opposite end of the motor which in turn, then sets the rewind and reciprocating action in reverse motion.

The clever thing about the spool carrier coupling gear is that it relies partly on gravity to disengage from the motor drive when the control is returned to neutral, stopping any incorrect direction of motion when the motor is stopped and the deck returned to the neutral position.

The motor is slung in such a way on the underside of the deck that it pivots between the flywheel and rewind assembly depending on the position of the control knob. It is held under slight tension by an adjustable spring. This allows the motor to ride along the top of the flywheel rim or rewind idler with just sufficient tension; how frequently this had to be adjusted because of gradual wear resulting in erratic rotation is anyone's guess.

Recording from a gramophone record, microphone or via the external radio input, is achieved by setting the appropriate selector on the top of the deck; the incoming material can be monitored as required. A flaw in the design is that if the user just wants to listen to a gramophone record, the recording position for selecting the pickup is the only option, which means that the bias, erase, recording head and associated circuitry is still in operation. The maker's manual merely suggests leaving the wire un- threaded in this situation unless a direct recording is to be made from a record. No reason could be found as to why the selector switch wafer could not have incorporated an extra set of contacts to give an additional pick up only position.

Two versions of the EWR60 exist; the one here is the early production version as it features a second 6X5GT rectifier valve in the power supply whose purpose is to provide a

DC voltage via a block of smoothing capacitors to a “lock” relay. This is to prevent accidental erasure of recordings. When the deck control is actuated, a slight “clunk” can be heard as the solenoid engages with the internal control assembly. This safety function did not actually work at first until further investigation turned up the reason (more on this later).

The relay works by locking the deck control when the motor run and recording position is first selected, so that the user cannot accidently switch the machine back into rewind mode, necessitating the user to first turn off the motor, returning the main selector knob to the replay position before the deck control can then be returned to neutral. A similar sequence is applied in replay which forces the user to switch off the motor first, before releasing the control switch. This separate valve and associated circuit was omitted in later versions with a corresponding simplification of the power supply chassis. The relevant user controls and drives being altered accordingly.

It is assumed that this was partly a cost cutting measure introduced during the later production run of the machine and also due to reliability issues, as a number of small modifications were also introduced. A change that was also mirrored on later Wirek machines utilising the same deck and switching arrangements.

The restoration

The history of the machine was that it came in as a donation into the collection, from a gentleman who had inherited it from a relative. The machine had originally lived most of its life in the Sidcup area of Kent, not far from where it was made at the KB factory in Foots Cray. The deal being that I transferred any audio material from the one reel of wire that came with it.

As found, the reel of wire in question was in a poor state, sitting partly wound through on the machine. The wire was a tangled up mess with some of the wire wrapped around (and under) the spool carrier hub. The spool carrier was also completely jammed, and would not budge at all when an attempt was made to free it off by hand.

The spool of wire sits on a carrier made of Bakelite and it had been wedged so tightly against this that any force would have probably broken off the lower flanged section of the carrier. The reel was eventually freed off with plenty of patience and a little WD40 carefully dribbled down the sides along with a gentle rocking motion. Part of the geared sub assembly ended up being dismantled as well to facilitate the final removal of the spool carrier, and the remaining threaded shaft (which also forms part of the rewind and reciprocating mechanism assembly).

As it quickly become apparent from the first examination, the recorder was in need of a full restoration, before any attempt could be made to replay the spool. Luckily, it was possible to completely lift off the main turntable (after slackening off a hidden screw recessed inside). This allowed both the turntable and take up spool to be carefully transplanted, rewound and then replayed on an equivalent Wirek B1 wire recorder . There was indeed some off air recordings of fairly good quality dating from the early 1960s, plus family recordings of variable quality; these valuable recordings were transferred over to the PC for further treatment and conversion into suitable audio files. (Some of the music orientated, off air recordings that were found with this machine are on “You Tube”, the details of which will be found at the end.) (6)

It was also discovered that the KB had seen past work, with various screws loose or missing and the two angled cabinet fixing brackets missing from the back of the deck along with other tell-tale signs of past tinkering. A long length of flex was found crudely twisted together between the speaker and existing amplifier to extend the wiring, suggesting that the equipment had been in and out of the cabinet at various times. One of the pointer knobs was also missing. The deck plate was absolutely filthy to the point where it could not be decided if the yellow/cream coloured paintwork was actually a film of nicotine or the actual colour the maker intended.

The cabinet was in quite a poor condition and was missing a couple of small but noticeable pieces of veneer. The top of the cabinet was missing almost all of its original lacquer finishes with the exposed sections of veneer in a pretty dirty state. The slatted roll top was dented and badly scratched in places and any remaining areas of the cabinet were also very scruffy.

The machine appears to have led quite a hard life and then probably put away somewhere and eventually forgotten about. One or two examples of this machine have come up over the years, and in each case the cabinet seen was in very similar condition suggesting that the damage was quite easily sustained and like the one here, probably due to rough handling and poor storage.

With the additional wiring removed, the complete recorder was slid out from the back of the cabinet for further examination. The underside of the deck was caked in hard grease and it was on just about everything you could imagine, the previous owner must at some

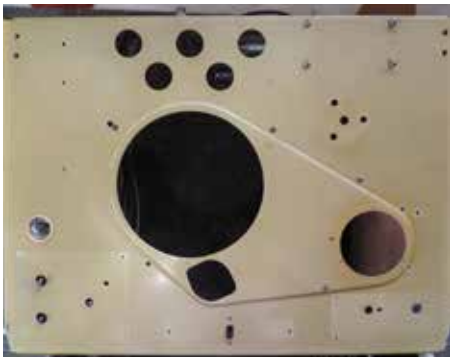
A thorough cleaning of all the major drive assembly parts was the only option. Parts degreaser was used along with various small brushes and pipe cleaners.

The damage caused to the flywheel rubber rim can be seen here and just goes to show how much damage can be caused by carelessly leaving the deck in the play position for a period of time.

The unrestored amplifier as found. Just look at all those waxies!

The power supply unit as found. The two 6X5G rectifiers and associated smoothing can be seen here.

A gut feeling about these two resistors found on V1, proved to be right. Both had nearly doubled in value.



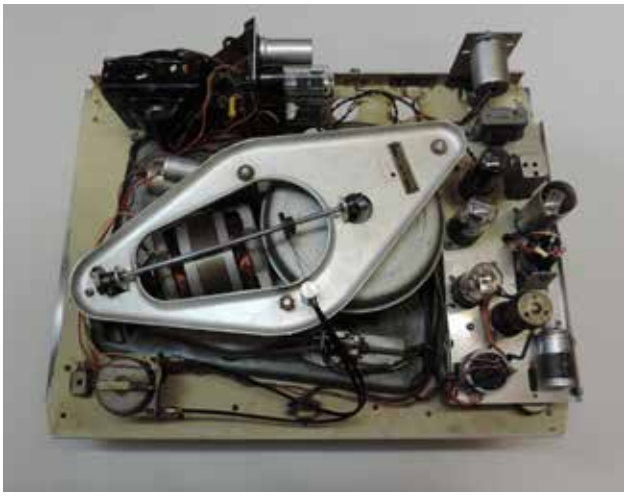
The deck responded well to the cleaning up treatment. There are some minor blemishes remaining to be expected with a machine of this age.

The underside of the turntable showing what was found including the paper spacers cut out from a newspaper. It's anyone's guess as to how it ended up like this in the first place.

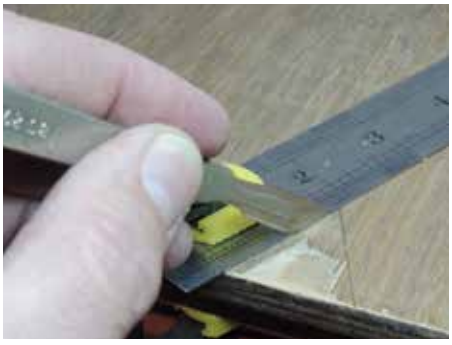
The extensive damage on the play cam can be seen in this picture.

With the turntable drum dropped into the play position the general mis-alignment with the top of the cam can be seen. The bearing should be resting on top of the cam so that turntable drum is lifted clear of the deck plate in play or rewind mode.

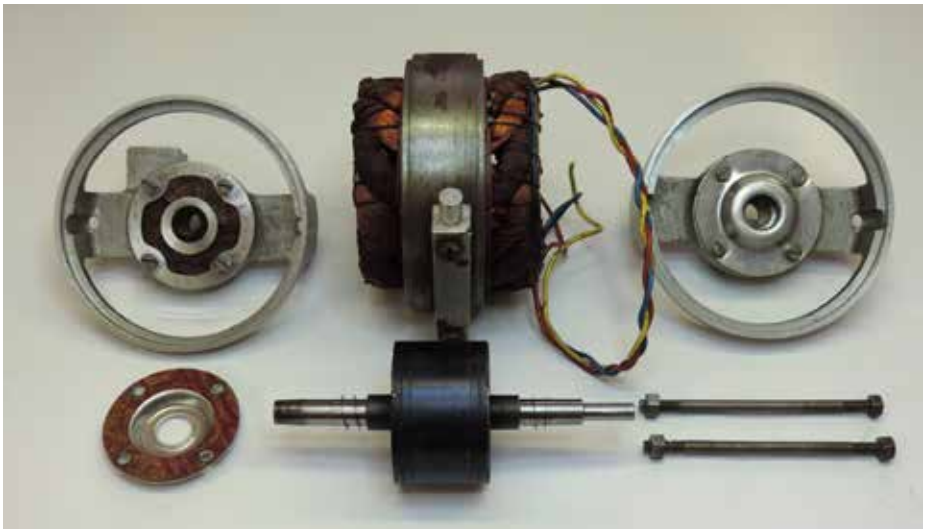
Although difficult to spot at first, the image captured here via an endoscope camera shows sections of wear seen inside the motor bearing housing, and was part of the cause of the stiffness found with-in the motor in general.



The deck and electronics reassembled after restoration work is completed.



Work to repair the damaged sections of veneer at the back edge of the cabinet so that a new piece of veneer can be let in.



The Croydon motor stripped down, showing the general construction as part of the investigation that had ensued following the reliability problems.

point have had a lot of reliability problems; perhaps the deck was noisy in operation or was sticking; either way, the extra grease could only have done more harm than good, eventually turning to a substance akin to treacle.

The first thing to be done was to set the cabinet aside for safe keeping after the separation of the recorder from the cabinet. KB had actually given some thought to the layout of the electronic chassis and it was not long before both had been separated from the

underside of the main top plate, the control assembly, and any wires linking the recording head assembly and gramophone pick-up.

Next, was the wire recorder deck itself, after having removed the pickup arm and threaded any disconnected cables through , the deck was unbolted from the main top plate along with its associated controls, allowing the Bowden cable control linkage to be lifted clear. In order that the respective deck and deck plate could be worked on in situ and to ensure the thing was setup correctly on reassembly, a timber frame was constructed to support either end so that the restored chassis and the transport arrangements could be accessed and also “run on test” without the underside of the deck or the motor fouling the work bench. This proved to be a sensible exercise when it came time to reset the mechanics and a lot of time was saved in the process.

The amplifier and power supply sub chassis were each checked over to see what work was needed. The examination revealed no other surprises, and all the major components were intact and serviceable. The amplifier chassis appeared never to have been touched at all and appeared totally original with all its wax capacitors and one or two tired looking HT capacitors all un-disturbed.

The electronics were bought back to life after having isolated the motor circuitry, and I had reformed the HT electrolytics, replacing one due to excessive leakage following the usual various safety checks for any electrical shorts and the like. Power was then applied; after a couple of minutes the amplifier showed a few signs of life but was nowhere near lively enough when the selector was set to replay, and a finger applied to the top cap of V1.

A rather weak but distorted hum emanated from the test speaker in the workshop, enough though to show things were working of a sort.

Replacing a number of wax capacitors and also a small number of resistors, particularly the higher value ones (In this instance, R2 470Ω & R3 100Ω) as in both cases, these had doubled in value on V1 screen and anode, and looked in a pretty sorry state. To preserve a bit of originality with the two cathode bypass caps, these were restuffed with modern components and discreetly labelled before being refitted into their respective positions.

With this aspect of the electronic restoration completed, power was reapplied and audio test signals injected into mic and radio inputs, the results were far better, with the amplifier very lively as expected. The only valve that was in need of replacement at this stage was the 6U5G magic eye. This was completely dead. A suitable equivalent was pressed into service. The final job was to dismantle the magnetic head in readiness for a clean. Just as well as it was in a very dirty state.

Now it was the turn of the deck. This proved to be a challenge on all fronts, poor alignment, a lazy motor, accelerated wear due to tinkering and masses of thick, hardened grease everywhere. The wear was most evident on one of the two cams underside and on which the base of the turntable shaft pivots when the deck is engaged in replay.

It was decided that the only way to get the deck back to some sort of alignment and in running order was to completely strip down

The unrestored front of the cabinet showing the wear and tear to the speaker grille.

The top of the cabinet as found, most of the original cellulose lacquer is missing.

The roll top timber slats in the process of being assessed for colour matching due to the poor and faded condition of the existing finish.

all the components associated with the drive and start from scratch. Each was treated to a thorough clean in degreaser. Pipe cleaners and small brushes were used to get into all the otherwise inaccessible areas before rinsing, drying and any final reassembly. The cause for the lock solenoid not engaging was discovered once the housing was dismantled, and simply came down to the spring loaded plunger being jammed due to misalignment. With this freed up, the plunger was able to move again. Once it had been reassembled, it worked as it should with no further problems.

The turntable flywheel was examined and it was discovered that there was a small flat embedded in the rubber surface which had been formed because the machine had been left in the play position. The only treatment for this was a very fine sanding of the rubber surface until most of the flat had been removed. This action called for very careful attention as too much sanding could have

The roll top and louvered grill ready for re-fitting into the cabinet after refurbishment and spray painting in the final colour matched cellulose paint.

caused further damage. The rubber rim was however returned to a usable state without having to remove too much material and does not appear to be much the worse for the wear.

Once all this had been done, the reverse is the opposite as they say. A through clean-up of the deck plate and paint finishes was next to being carried out. It appears that the final finish is cream/yellow enamel. (As it was mentioned earlier, it was quite difficult to say for sure if the colour was actually nicotine induced or the original makers finish it was that dirty). This was cleaned up and treated to a light going over with “T Cut”. The results have been worthwhile with just one or two minor blemishes remaining.

Later comparisons appear to show that the colour is similar to other surviving examples of this machine, which seem to vary between this and cream.

Next came the setting up of the drive, including aligning the cams, so that their positions coincided with the function control. Now I hadn’t really spotted a problem with the turntable drum to start with, but the underside just did not look right and I was convinced something was missing but what?

It would seem that someone had very carefully cut and fitted a piece of felt in the recess underneath the drum to keep it from scraping the deck plate when in rewind. Following a comparison with the Wirek, it was found that there should have been a circular spacer in place and it was this that the felt had replaced (along with three carefully cut out spacers from a copy of a 1952 newspaper). You just have to admire the ingenuity. These must have lifted the drum just enough to ensure it did not foul the deck when it was turning. It is anybody’s guess as to when this might have been done but it was perhaps a desperate attempt to keep the thing running. How it got to be like this to start with will never be known.

Faced with the prospect that if all else failed I would just have to fit the piece of felt , by a strange quirk of fate, I happened to chance upon a write up of a restoration on an identical machine carried out by Mike Edwards that had appeared on the Radios-TV web site forum. I got in touch with Mike as he mentioned the existence of a scrap machine. He very kindly put in the post, the circular spacer that was missing along with a spare drum and also an exact replacement for the missing knob. It is worth mentioning that Mike also maintains an excellent web site dedicated to KB. (7)

KB produced a service manual for this model and this covers the electrical side of things well. However there is very little information on setting the deck up so this operation was trial and error. Fortunately, its operation is very simple.

When the deck was pretty much cleaned up and back together, attention was directed at the operating cam concerned with play. The wear along the top surface due to the positioning of the turntable bearing was quite severe, suggesting incorrect running for a very long period. When the deck was briefly run like this, more out of curiosity, I was very surprised to discover that it was not unduly noisy. A careful sanding and polishing removed most of the wear from the play cam without any ill effects. Another problem that was encountered was the drum did not want to rest on the top of same cam when rewind had been selected, this was due to the brass mid-section of the turntable drum spindle being incorrectly positioned so that the whole thing sat slightly too high above the deck plate (this was probably due to user misuse). A couple of gentle taps with a rubber mallet sorted that problem and brought this into the correct position. Lastly, the Croydon motor was checked over. This is a pretty substantial thing; it needed a clean and a minor re-lubrication and appeared to run reasonably well to start with.

The one thing that was noticed, on this and the one fitted on the Wirek machine is that they are quite noisy in operation. I put this down initially to age because otherwise it seemed to be running ok. A fair bit of time was spent setting up the deck, and it was discovered that no matter what was tried, the rewind reciprocating action was laboured and struggled to run, yet when the mechanism was disengaged from the motor, appeared to turn freely by hand.

It also turned out that the motor was not always starting up first time under load (with the phase capacitor having been ruled out as this tested Ok). Determined to get to the bottom of this, I spun the motor shaft by hand, after it had seen a period of running, to give the motor time to warm up. It was quite stiff and did not turn as smoothly as it did when cold. It transpired that there was a tight spot on the rotor shaft

Fully restored: The KB wire recorder in all its splendour, reassembled into the cabinet.

As good as new; the repairs to the veneer are almost invisible.

caused by uneven wear, with-in the bearing housing at the end of the shaft associated with the rewind mechanism. The two end cheeks that form the body of the motor at each end are die cast, these appeared to be very slightly out of shape and perhaps being effected by the motor warming up, distorting enough to also affect the running after a period of time.

Nothing tried really cured it, and it was by sheer luck that some years ago, I had scrapped a wire recorder that used the exact same type of Croydon motor. Having retrieved, serviced and tested this motor it worked perfectly and was duly installed. All the odd faults had disappeared and the machine now rewinds quite fiercely. The forward drive also performs better. The minor wear with the old motor was obviously enough to cause the problems that it did. The replacement motor is certainly quieter than the old one, but the running noise is still noticeable.

Repairing the cabinet and applying the finishing touches

Attention was then turned to the cabinet which was basically intact but very shabby with most of the original lacquered coats missing on the top. No special skills were required in dealing with the damage, and the cabinet was carefully stripped of all the old varnish to reveal the veneered finishes which were in otherwise relatively good condition. Standard preparation was carried out to the remaining sections of the cabinet.

From a small selection of veneers that had been obtained from a model maker supplier, I was able to get a reasonable match for the two damaged sections at the back. These were carefully tidied up with a scalpel which also enabled the clean removal of the damaged areas prior to any preparation and letting the new veneer in. Once this had been done, the cabinet was then prepared in readiness to receive several thin cellulose lacquer coats via a spray gun. The end results have been well worth it with the cabinet repairs almost invisible.

The only section of the cabinet deliberately not touched was the timber rail that divides the front of the deck with the top of the louvered speaker grille. There were two reasons for this, firstly I wanted to gauge how close the match was to the rest of the cabinet now it had been resprayed and secondly, preserving the KB decal. Although there is some minor damage, I decided that for the moment it is not serious and only lacks a decent reproduction of the original decal. Either job can be carried out at a later time.

The louvered speaker grill timber bars were unscrewed and carefully separated from the speaker baffle; these were individually stripped of any paint and lightly sanded back to deal with any minor damage. The roll top was next to be dealt with. The wooden handle was removed first and once the two recessed pegs were removed from the runners at the rear of the cabinet, the whole assembly could be removed in one piece from the back.

Once this was laid out on the bench the individual timber slats were carefully separated from the Rexene backing that had held them together. As this was in reasonable condition and un-damaged, it was carefully wiped over for reuse later. Before the slats were stripped, they were compared against the speaker louvres to get average match against the existing paint finishes.

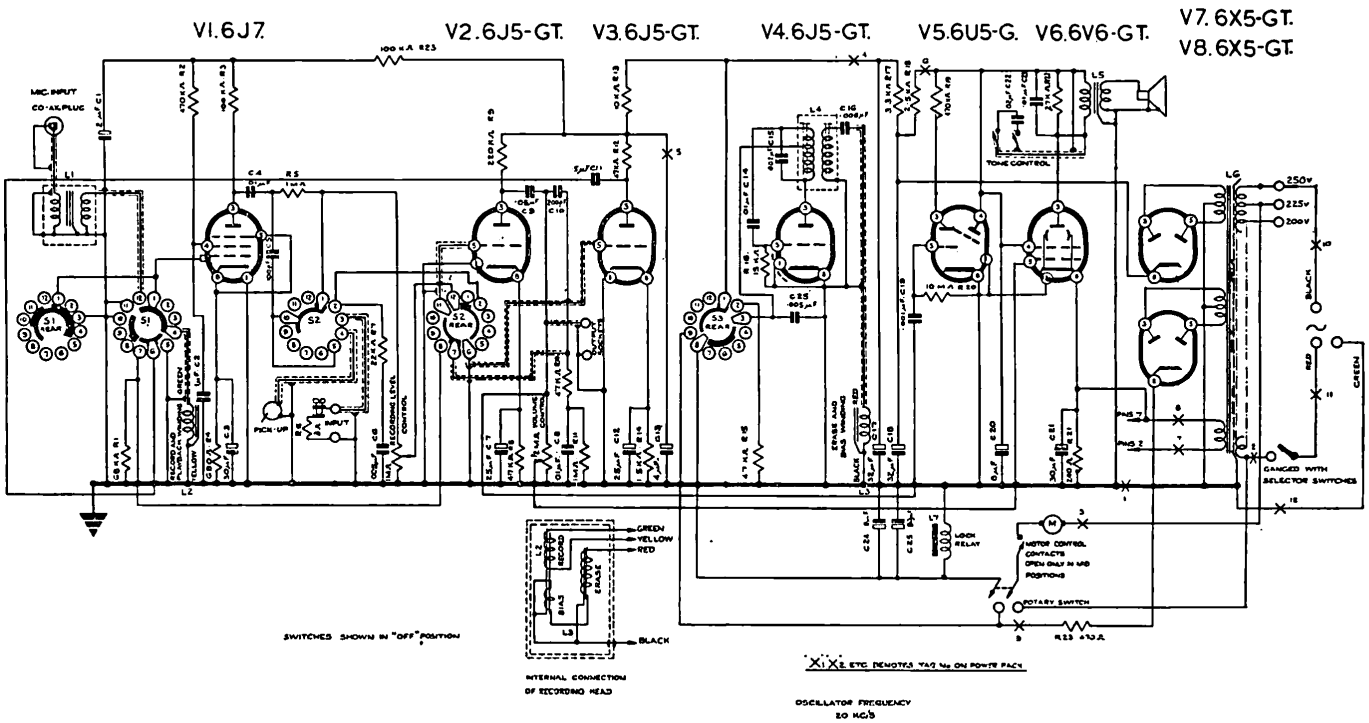
These were taken from sections otherwise normally hidden in areas where the paint had not faded, as much of the exposed painted surfaces were very badly affected by sunlight in places. Nothing came close to any of the standard BS colours, so I ended up taking a sample along to one of the automotive paint suppliers used for this type of thing , to get a custom paint made up to the exact colour . Interestingly, the wooden handle was originally painted in black so this was a straight forward match.

Having seen one or two other cabinets with the finishes intact, there seems to be minor differences in the paint colour, the louvres and bars on a later model appear to be blacker in colour and more uniform.

These surfaces received four spray coats of the cellulose paint colour and the end results are very pleasing. The final job was to reassemble everything and to deal with the minor problem of the roll top sticking randomly when trying to open or close it. I found that a light application of sandpaper in the grooves either side cured this very quickly and this may have just been down to a build-up of muck over the years.

On test - the electronics and deck

Now that everything was complete a number of tests were carried out on the recording and replay functions, before the recorder was slid back into the cabinet. With a reel of wire threaded, the turntable rotated positively when play was selected. A test recording was made from a 78 record. The results were very good and comparable to a domestic low speed magnetic tape recording; the recordings made



Circuit diagram of the early version of the EWR60.

from the record sounded virtually the same when replayed and compared. Valves V1 and V3 ended up suffering with microphony, so much so that tapping the top of the deck could actually set the thing howling at certain volume levels, luckily a spare 6J5 and a 6J7G were handy and replacements cleared the problem up completely.

Setting up the deck to rewind satisfactorily took a bit longer to get right. The primitive brakes were unsatisfactory and were either all or virtually nothing, leading to the wire being rewound erratically back onto the spool, or the turntable drum revolving just enough to cause the wire to sag and end up entangled underneath the turntable drum. How well this originally worked to start with is unknown, but working on the basis that it must have functioned at some point suggested that a little bit more setting up would be required. The fact that a number of modifications were introduced suggested that this was one of the wire recorders weak points. In the end a compromise had been reached whereby the rewind could be made to work fairly well provided the machine was not stopped mid rewind, otherwise there was a tendency for the spool or drum to unravel wire.

The repair and restoration work that had ensued on the KB has been very worthwhile overall and the machine does work surprisingly well, taking its place alongside the other wire recorders in the collection. It is just a pity that it was not a better supported recording format at the time as this may have seen further developments appear from the likes of KB.

As it was, the model was in all probability, just quietly dropped from the maker's catalogue and the technology written off as a lost cause.

Bibliography, references and resources –

References

1 – Armour Research Foundation and the Wire Recorder: How Academic Entrepreneurs Fail.

David Morton – The Society for the History of Technology, 1998

(A copy of this paper is available free of charge as a PDF to BVWS members by contacting the author of this article via the contact details given a the front of the bulletin)

2 – Marvin Camras was awarded more than 500 patents for the invention and refinement of technology that is the basis for audio and video recording and computer data storage.

3 - Method and means of magnetic recording US Patent No: US 2351004 A

4 – The online patent database Espacenet has not yielded any further information on this development.

5 - The 1949 National Radio Exhibition at Olympia exhibitor lists shows Wright and Weaire & Ferrograph at stand 63 with Kolster Brandes exhibiting on stand 65.

6 – The audio files mentioned in the article can be heard via the Ferrographworld channel on You Tube here: https://www.youtube.com/watch?v=45P72luXYJ8

7 - The web sites referred to in the article can be found here http://www.radios-tv.co.uk and the ITT KB site here http://www.kbmuseum.org.uk

Resources

The Veneers mentioned are easily obtainable from Wood Veneers UK Newacott, Treneglos, Launceston, Cornwall, PL15 8UH info@WoodVeneerUK.co.uk or Telephone 01566 781 870

There are also sellers on eBay who list various sample packs of Wood Veneers.

Paint matching and the cellulose paint used were obtained at Auto-Paint who will match and mix while you wait. They also offer a mail order service. Auto paint, 24 Sutton Oak Drive, Baxters Lane Industrial Estate St Helens, WA9 3PH . Tele: 01744 818102 the web site can be found here: http://www.auto-paint.co.uk

Cellulose lacquer is still available from a number of suppliers both in aerosol can and in quantity suitable for spray gun use. An internet search will reveal a number of reputable suppliers.

A copy of the makers service manual and circuit diagrams covering the original and later version of the EWR60 referred to as part of the restoration work, can be obtained from the author as a PDF file, free of charge.

Further reading

A fair number of publications have appeared over the years on the subject of magnetic recording and a small selection is listed below as recommended further reading.

The Magnetophon Sound Recording and Reproducing System , M.J.L Pulling – British Intelligence Objectives Sub-Committee (BIOS Report) HMSO publication 1948

(A copy of this paper is available free of charge as a PDF to BVWS members by contacting the author of this article)

Magnetic Recording: The First 100 Years – 1st published in 1998 - Eric D. Daniel (Editor), C. Denis Mee (Editor), Mark H. Clark (Editor) ISBN: 978-0-7803-4709-0

Magnetic recording : the ups and downs of a pioneer, the memoirs of Semi Joseph Begun edited by Mark Clark. - New York : Audio Engineering Society, 2000.

The Recording and Reproduction of Sound – Oliver Read. Published by Howard Sams 1952. (This book is referred to in the text).

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- **Light beam and shadow station indicator**
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EKCO RADIO

E. K. Cole Ltd., Dept. W.W., Ekco Works, Southend-on-Sea.

Re-visiting my Ekco AD65

by Roger Grant

After redecorating our lounge it was time to change my classic set on display, I find to appreciate a set fully it has to be displayed on its own, too many radio's in one room and you can't see the wood for the trees (not only that, my wife wouldn't put up with it). The Ekco A22 had been in pride of place for the last few years and now it was time for a change, but which one to choose, a look around my collection in the loft and I decided that the Ekco AD65 hadn't been run up for a long time and high time it was, it's as bright and shiny as the day I put it up there and shouting at me that it needed a run-up.

It's now twenty years since this set was the subject of my first article for the bulletin in 1996 (published Spring 1997).

Looking back through my article I realised that I had done the restoration and written the words, but I hadn't taken any photo's, this was in the days before digital camera's were around and the article written some four years after I had finished the restoration, so the photo's in the article were library photo's supplied by Carl our editor for the presentation of the article.

As the set hadn't been run for quite a few years, I'll give it a once over in the workshop and at the same time do a photo shoot of some of the handy work mentioned in the article just for the record.

On close inspection in the workshop I noticed that the chrome trim in the tuning window and the three bars in the speaker aperture were a little dull and no longer smooth to the touch, a little tarnished, the tuning scale trim will have to be removed from the scale in order to clean it and the same with the speaker bars. I removed the back and chassis from the cabinet, it was only a little dusty. With the chassis on the test bench, I ran a few basic electrical checks while I had a think about how I was going to approach the chrome cleaning and all was well, plug in and power up next, after a short period of warm-up the set burst into life and performed very well, I didn't even need to deoxit the volume control and wave change switch, so it's just clean the chrome then back together and nothing else to do.

The tuning scale is held in place by eight clamps around its periphery and easily removed, the chrome trim held in place by three 10BA screws and once removed the trim cleaned up very nicely with a drop of Brasso as chrome usually does. The speaker cloth is glued to a wooden frame held in place by four 4BA screws and once removed gave full access to the speaker bars, the speaker bars were firmly glued into the Bakelite cabinet and rather than disturb them I cleaned them in situ, again they polished up very nicely.

Now back together and a very nice example of one of these sets despite having a few reproduction parts, I think it's a much nicer set than the green AD 65 I had on loan for a few months a few years ago, who's monetary value is only enhanced by its rarity but it was a bit shabby to look at.

I very much enjoyed this sets restoration now twenty five years ago and rather than rewrite it, just re-run the original.

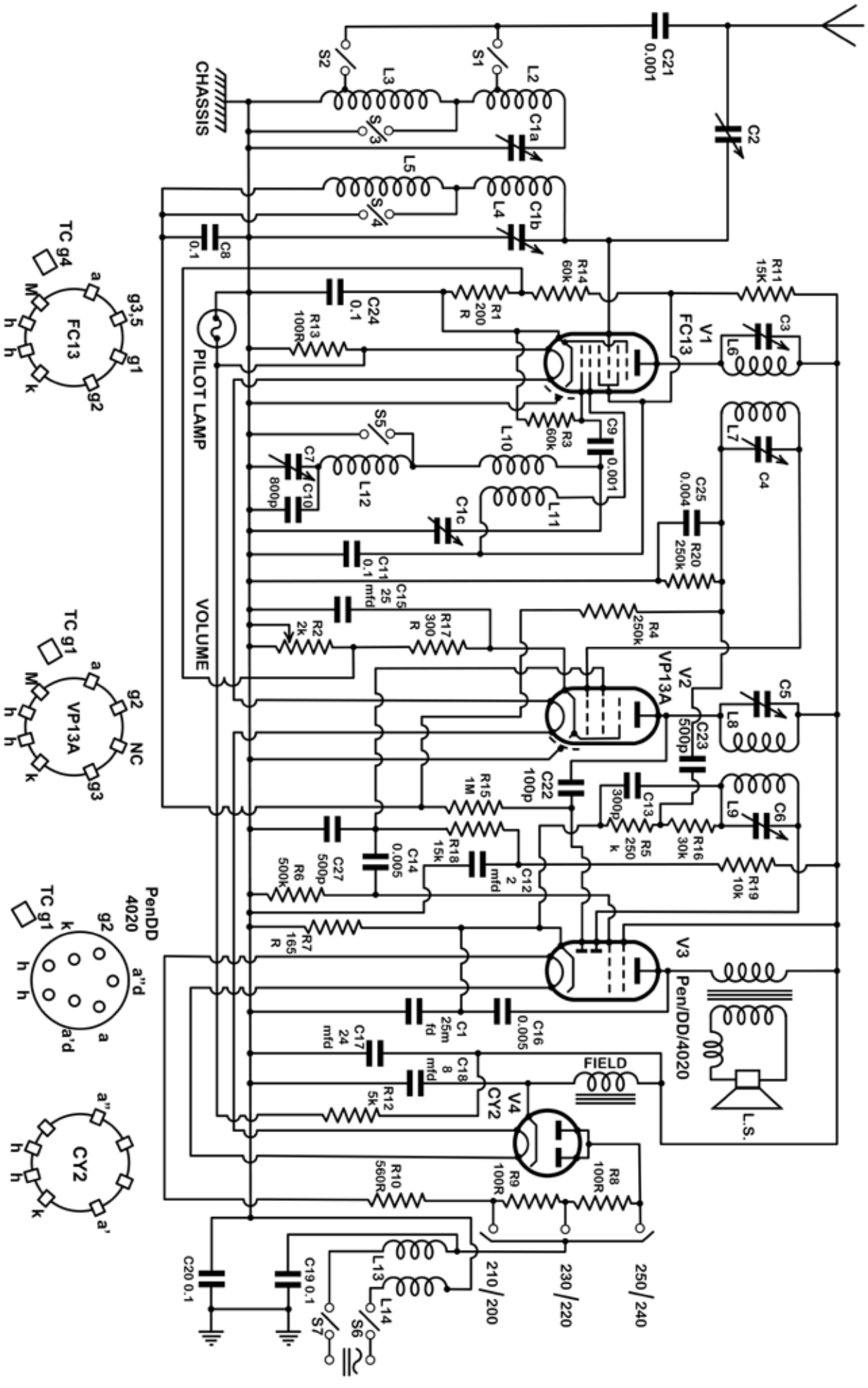
17. The finished set angled left

The article from the Spring 1997 Bulletin:- "Another AD65 Story or How I got mine"

November 1991, "There's a chap just phoned for you" said my wife as I came in from work, "He's got a lot of old radios you may be interested in and I told him you would phone him back tomorrow ". Hmmm I thought probably another nineteen fifties radiogram and a box of those 1950's cheap plastic sets that always come in three's.

The next day a phone call revealed a garage full of radio Junk inherited from an old uncle who had just passed away and a visit was arranged for the following evening. The owner thought he had struck gold and was eager for me to make him an offer, so a very careful inspection was made for any thing worth having. He wasn't prepared to split it up so it was all or nothing.

There was a pile of six draws from an old chest of draws full of second hand valves, mostly octal types but a good amount of B7's, B5's and B4's, all very dirty and stored in a damp place for a long time. There were four wooden cabbage crates full of old speakers all rusted beyond repair and another two smaller crates full of transformers of all types. next came a pile of radios, the first being an Ultra 121 from the thirties and the one with the semi-circular glass tuning scale on the top of the cabinet, but the veneer had all peeled off and the ply had started to come apart. The next was a Philips Monoknob with the chrome ring in the speaker grill, but the cabinet disintegrated when I moved it. Then came the prize piece, a black Ekco AD65, the cabinet had chalky water marks all down both sides and was very dirty but otherwise intact. Inside was a very rusty chassis complete with valves and loud speaker, but the tuning scale, all of the chrome trim, knobs, back and


EKCO AD65
CHASSIS
PILOT LAMP
VOLUME
FIELD
L.S.
V1 FC13
V2 VP13A
V3 Pen/DD/4020
V4 CY2
TC g4
g3,5
g1
g2
k
TC g1
g2
NC
g3
PenDD 4020
a"d
a'd
a"
a'
C21 0.001
C2
C1a
C1b
C1c
C3
C4
C5
C6
C7 C10 800p
C8 0.1
C9 0.001
C11 0.1
C12 2 mfd
C13 300p
C14 0.005
C15 25 mfd
C16 0.005
C17 24 mfd
C18 8 mfd
C19 0.1
C20 0.1
C22 100p
C23 500p
C24 0.1
C25 0.004
C27 500p
R1 200 R
R2 2k
R3 60k
R4 250k
R5 250 k
R6 500k
R7 165 R
R8 100R
R9 100R
R10 560R
R11 15k
R12 5k
R13 100R
R14 60k
R15 1M
R16 30k
R17 300 R
R18 15k
R19 10k
R20 250k
L1 C1 25m fd
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
L13
L14
S1
S2
S3
S4
S5
S6
S7
210/200
230/220
250/240

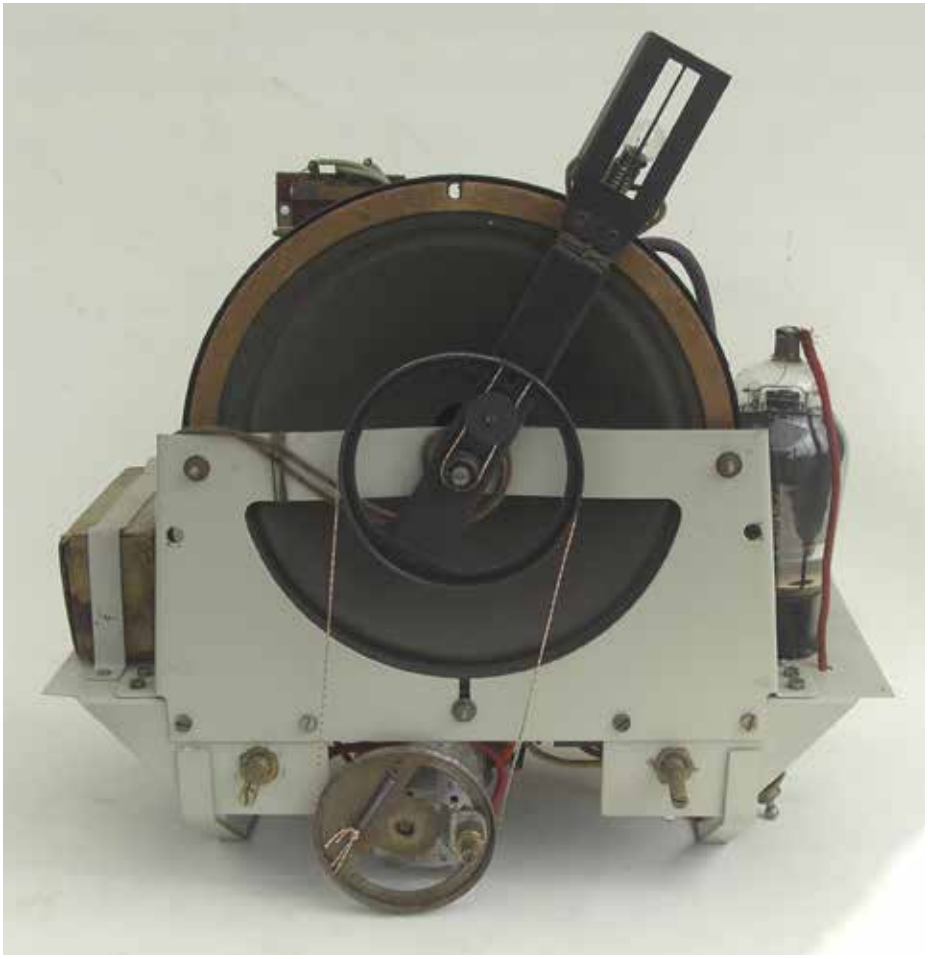
3. Inspection mark inside the cabinet.

speaker cloth were all missing. Searching on, there are about a dozen other radios all from the nineteen thirties and all in about the same condition. Right at the back was a small chest of three draws and the top draw was full of all kinds of useful knobs mostly from the thirties and forties but none for the AD65. The next draw was full of all kinds of tuning scales, glass ones all very carefully wrapped in newspaper but again no sign of one for the Ekco. The bottom draw was full of volume controls and wave change switches. The contents of this chest were in good condition and relatively damp free, and there were several cardboard boxes containing all sorts of odd spares, trims etc. After several minutes thought about how much this lot was worth and how much I could afford (and I wanted the Ekco), I finally made an offer of £100. The owner said he would let me know, but still had two other people interested.

Three weeks then passed and still no reply, it was now late November and Christmas was looming up fast, becoming a little impatient I decided to give the chap a ring to see what was happening and was told the two other parties had dropped out. He still felt that this pile of junk was worth a lot more than my offer and was trying to get a better one. I said that £100 was all I was prepared to pay in view of its condition and here the phone conversation ended.

One week before Christmas, a note was pushed through my letter box saying if I still wanted these radios, I could have them for the £100 and would I collect them as soon as possible. Isn't it amazing how these things always turn up and the wrong time, still I mustn't complain. Two days later my workshop was piled high with this junk which needed some serious sorting. Closer inspection revealed quite a lot of serviceable spares after a good clean-up. A lot of the transformers were pitch or wax impregnated and were ok, many of the others seemed to have survived after a long drying out period. A lot of the radios were stripped of their valves, knobs, trims and other spares as the wooden cabinets were way beyond restoration. The remains of the cabinets, draws, crates and unsalvageable parts were taken to the council tip and disposed of. Now the junk was cleared and the good stuff put away, the moment I've been waiting for came and I got stuck into the AD 65, my first round Ekco. I started with the cabinet, a good blast with Servisol foam cleaner shifted most of the grime, and the chalky water marks soon came off with a drop of Bake-o-

2. Inside the cabinet



4. The chassis front

bryte. Finally a good rub all over with some Brasso and a drop of Sainsbury's best silicone polish, left the cabinet gleaming. Having put the cabinet away in a safe place I then had a good look at the chassis, and it really was very rusty. There was only one way to deal with this, strip off all of the components de-rust and re-spray. Most of the major components are bolted on with BA nuts and bolts and only the valve holders are fixed with rivets. All the major components were removed having made a map of their location, orientation and wiring, and placed in a box for closer examination later

5. The chassis rear

6. Chassis top view

Next the smaller components were removed one by one, carefully labelled and drawn on the map. The interconnecting wires were carefully number tagged and drawn on the map, trying to keep their original shape. By now the map consisted of a master plan and about a dozen separate pages of each layer as the components and wires were removed. This avoided confusion on re-assembly by not having too much on one page. Next the valve holder rivets were drilled out and valve holders removed, and I was down to the bare chassis and the front plate that holds the speaker and tuning gear. The chassis and front plate were cleaned off with a rotary wire brush and primed with grey primer, which filled the pit marks quite nicely and then sprayed with a top coat. Rootes Dove Grey seemed a reasonable match and this was left to harden while I tackle the speaker. I look upon paint and varnish as not fully hard until you can't smell it any more, this avoids spoiling the job by re-assembling too early.

The loudspeaker is a round mains energised type with a seven inch cone and an output transformer bolted on the side, this was about seventy percent rusty. Originally sprayed with a semi-gloss black, the damp had un-glued the speaker cone outer rim so de-soldering the wires and removing the centre screw was all that was needed to remove the cone completely. On inspection it was in quite good condition with the coil intact. The joint between the cone and the coil and the coil itself were held together with good strong varnish and had resisted the damp. The frame of the speaker was held together with brass nuts and bolts and came apart quite easily. The field coil and output transformer were then checked and found to be intact. The output transformer lamination clamp was removed along with the rest of the frame, the outer magnet former and the cone gap plate, these were de-rusted with a rotary wire brush then primed with red oxide primer and sprayed satin black. The transformer laminations had been impregnated with a bitumastic sealer and were ok. On re-assembly the cone was re-centred using thick paper strips as shims, this proved a little difficult as the centre spider got in the way. The outer rim was then re-glued using Gloy glue leaving the shims in until the glue had set. I used Gloy glue because it can be steamed undone should the need arise in the future. Now finished the speaker was tested using an H.T. battery to power the field coil and an audio source from my workshop radio directly in to the speech coil (these were close at hand at the time). Finally the speaker was stored in the airing cupboard just in case of any damp remaining in the field coils.

Back to the chassis, the valveholders were the first components to go back but needed some attention. They are the Ct8 side contact type and can cause a lot of trouble if not properly treated while you have the chance. The contacts are held in place by a tag next to the solder tag being folded over the edge of the valveholder. Bend this tag straight and the contacts drop out quite easily. The body of the valveholders were washed in warm soapy water (Fairy liquid). The contacts were found to be very dirty and heavily oxidised and some damaged by verdigris. These were degreased with Ardrox solvent and then de-oxidised with Goddard's silver dip, making sure they

were not left in too long to avoid loosing their nickel plating. They were then washed in warm soapy water to remove any last traces of this mild etchant. The contacts that were covered in verdigris were a bit more of a problem and it seems that the only way to remove the verdigris is to scrape it off leaving bare brass, I think the verdigris had eaten the nickel plating anyway, they were then polished with Brasso to get them smooth again and then washed to remove all traces of Brasso as anything other than clean metal will cause crackling.

Checking with the circuit diagram, I noticed that not all of the contacts were used on all of the valves so the plain brass ones were put in the places where there is no electrical connection and the contact only used to assist in retaining the valve in it's socket.

Unfortunately there was not enough of these slots so I had to pinch a few contacts from my only spare valveholder of this manufacturer. The valveholders were then riveted back into the chassis, making sure of position and orientation using bifurcated rivets, these are as near as I could get to the originals (and are quite close).

The point to point wiring is of single core solid tinned copper wire of about 20 SWG with a cloth over rubber covering. The rubber had become hard but the cloth covering held it all together and was even robust enough to with stand a washing off with a small stiff paint brush and some soapy water. These wires were washed and put back one at a time as I removed their location labels and referenced them to the map. Most of the small components went back in the same way after checking that they were electrically ok.

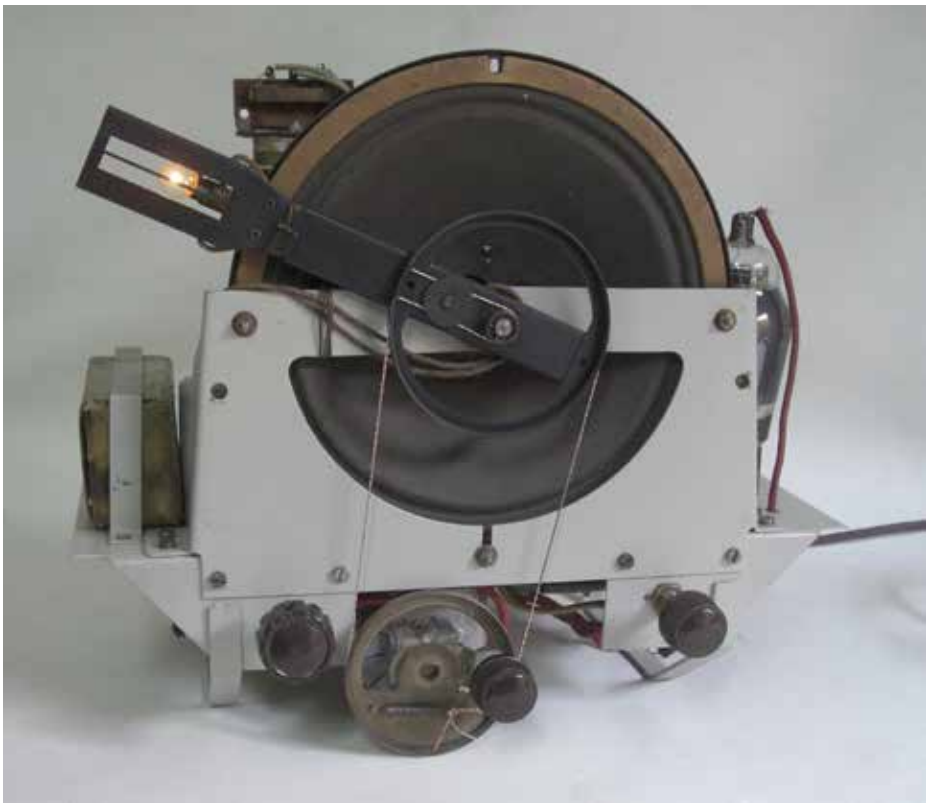
Most of the electrolytic and paper capacitors were leaky and had to be dealt with, the electrolytics in an oblong cardboard box form were easily undone when the wax was melted with a heat gun, they were put back together the same way after the innards had been replaced with new capacitors and shaped pieces of wood to take up the space as the new components are usually a lot smaller than the old. for this job I use a Black and Decker heat gun intended for stripping paint and control the temperature by the distance from the job. The paper capacitors are the paxolin or cardboard tube type with the ends sealed with a plug of pitch, this I remove with an old soldering iron running on a Variac to control the temperature, this avoids burning the pitch and all that pong and blue smoke. After replacement of the capacitor, the pitch put back in the same way and finally given a quick blast with the heat gun to smooth the ends over and put the shine back on the pitch. Some of the cardboard tubes didn't survive so the new cylindrical capacitors were wrapped with matt black cloth tank tape to disguise them. I find taking the trouble of putting the new components inside the old is well worth while as there's nothing worse than brightly coloured plastic components inside a vintage wireless.

The restoration of the chassis was coming along quite nicely now with only the big bits to go back, much to my amazement the IFT's and the tuning coil were all ok, a bit of cleaning was all that was required, a quick rub with a wet piece of Scotchbrite got the corrosion off of the screening cans and the removal of the spiders grave yard from inside with a small paint brush.

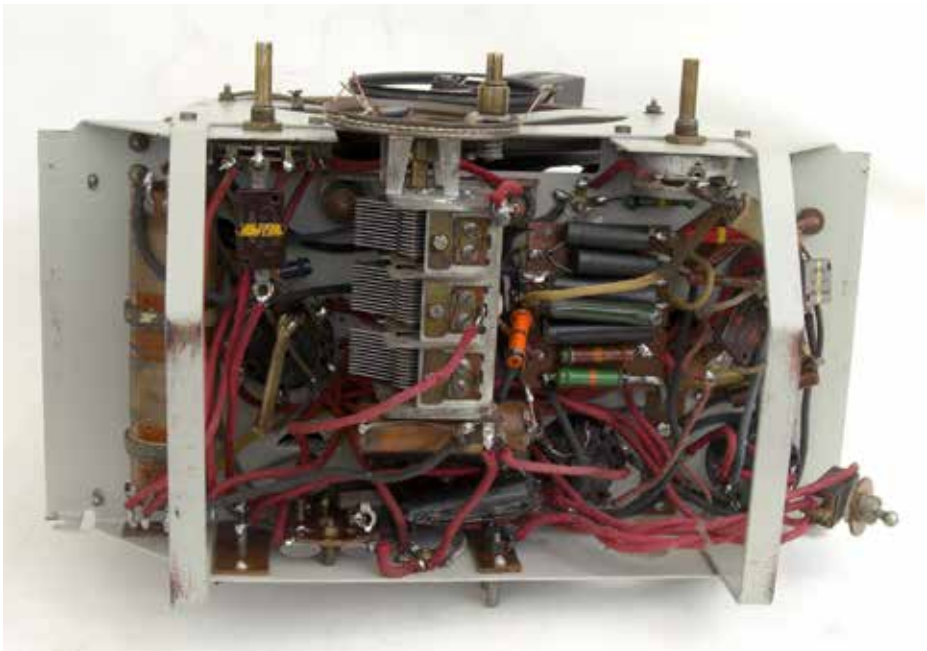
The mains dropper was more of a problem as the bottom section was open circuit and all of the brass connection clamps were heavily oxidised and corroded. After de-soldering the Eureka wire, the clamps were removed and cleaned with a rotary wire brush, then polished with a course abrasive to remove the marks made by the wire brush. The dropper itself is quite large and well able to handle its working current. The open circuit was found to be the bottom most turn so when the clamps were replaced one turn was removed to gain enough wire for reconnection, this was scraped clean with a modelling knife wrapped round and re-soldered to the clamp. The dropper is mounted vertically on the chassis with a central threaded rod and when refitted was a bit wobbly because the bottom of the granulated mica tube from which it is made had become a little compressed for the first eighth of an inch or so below the bottom clamp, this was cured by fitting a length of 28mm copper tube (an off cut from the central heating) inside the dropper, it fitted almost exactly and supported the dropper quite firmly when the central rod was tightened.

The volume control and wave change switch came to pieces quite easily and were cleaned and re-fitted with just a touch of silicone grease. The tuning gang also required little attention and the tuning wand lamp house was cleaned and re-sprayed matt black. The drive drums were well plated and rust free and re-fitted and re-strung without any problems.

The rubber wires feeding the speaker were perished and had to be replaced, fortunately I had found a length of five core rubber wire which when the outer cover was stripped off, revealed five different colours of multi-strand rubber wires of



7. Chassis powered up



8. Under the chassis

9. Close up of the rubber cloth covered wire

10. Valveholder and contact close up

about the right type and this came in very handy on several other restorations.

The chassis was now ready for valving up and testing, sorting through my stock of valves, I picked out a couple of sets selected on best emission and good looks. These valves installed, I then checked the heater chain and H.T. rails for shorts and all was well.

When switched on the dial light lit quite brightly and then dimmed slightly as the valves warmed up, a quick check with the AVO showed the H.T. rising quite nicely. A slight purr from the speaker suggested that the audio stages were working ok, soon proved with a loud buzz from the speaker when the grids of V1 and V2 were touched. Next I connected my oscilloscope on the anode of V1 and checked that the local oscillator was running and getting out the signal generator I ran through a full RF/IF alignment following the procedure in the Trader sheet, this set having an unusual IF frequency of 110 kc/s, all went well and when tuned through the band, the set proved quite sensitive even without an aerial, this was probably due to the RF tuning coil being mounted horizontally and relatively unobstructed by metal parts. The output quality was very good and the set has the bassy "whamp" as you pass through the stations very characteristic of these 1930's sets.

Now the chassis was ready to put back in its cabinet, I had the problem of where to obtain the missing trim etc. An advert in the BVWS wants page, only proved that I wasn't the only one looking for these parts, a visit to Gerry Wells wireless museum came up with a photo copy of the tuning scale and a sketch of the rest of the trim, this was at least a start so reproduction could get under way. I started with the tuning scale, for this I tried several types of Perspex, the white opaque type let no light through at all, and the translucent type was better but de-focused the indicator line from the tuning wand, I finally settled on a piece of eighth clear Perspex with the back sprayed with white primer, the station names and wave lengths printed on the front with Letraset. Unfortunately Letraset doesn't come in red or green and the photo copy I was working from was black and white so I decided to do it all in black and solve the problem later. The chrome trim on the tuning scale was made from a length of 3/16" x 1/8" brass and run through three very carefully placed ball races screwed to the bench with the middle one adjusted to get the diameter

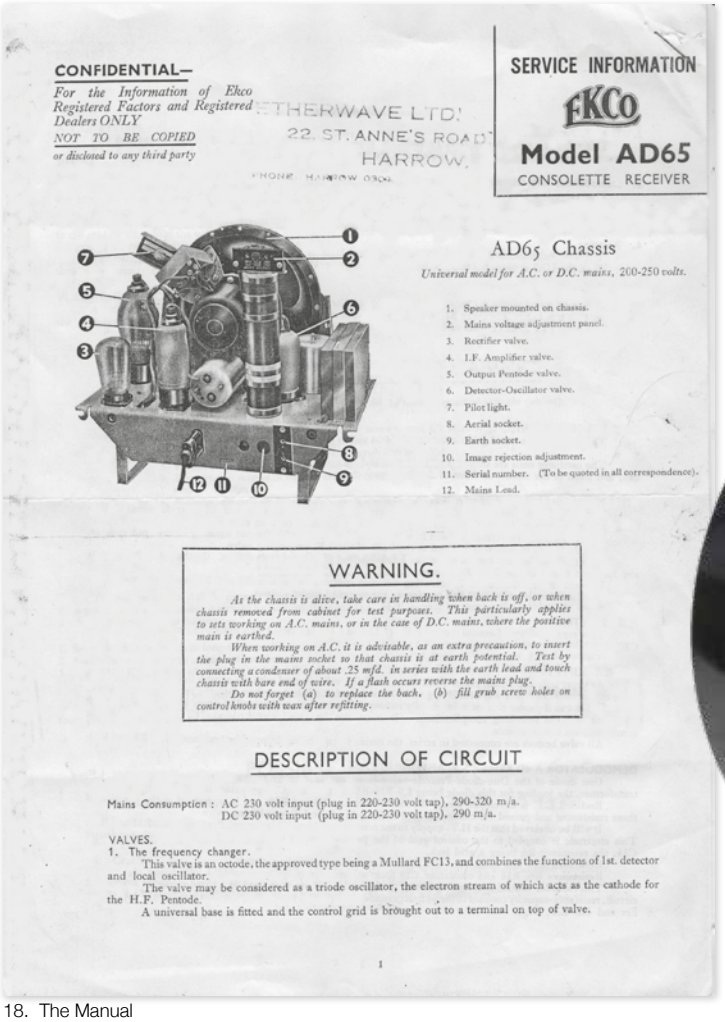
11. Tuning cursor close up

12. The repro tuning scale

14. The repro back

13. The back off

15. The finished set front



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22, ST. ANNE'S ROAD
HARROW.
PHONE HARROW 0306

SERVICE INFORMATION

EKCO

Model AD65

CONSOLETTE RECEIVER

AD65 Chassis

Universal model for A.C. or D.C. mains, 200-250 volts.

1. Speaker mounted on chassis.
2. Mains voltage adjustment panel.
3. Rectifier valve.
4. I.F. Amplifier valve.
5. Output Pentode valve.
6. Detector-Oscillator valve.
7. Pilot light.
8. Aerial socket.
9. Earth socket.
10. Image rejection adjustment.
11. Serial number. (To be quoted in all correspondence).
12. Mains Lead.

WARNING.

As the chassis is alive, take care in handling when back is off, or when chassis removed from cabinet for test purposes. This particularly applies to sets working on A.C. mains, or in the case of D.C. mains, where the positive main is earthed.

When working on A.C. it is advisable, as an extra precaution, to insert the plug in the mains socket so that chassis is at earth potential. Test by connecting a condenser of about .25 mfd. in series with the earth lead and touch chassis with bare end of wire. If a flash occurs reverse the mains plug.

Do not forget (a) to replace the back, (b) fill grub screw holes on control knobs with wax after refitting.

DESCRIPTION OF CIRCUIT

Mains Consumption: AC 230 volt input (plug in 220-230 volt tap), 290-320 m/a.
DC 230 volt input (plug in 220-230 volt tap), 290 m/a.

VALVES.

1. The frequency changer.
This valve is an octode, the approved type being a Mullard FC13, and combines the functions of 1st. detector and local oscillator.
The valve may be considered as a triode oscillator, the electron stream of which acts as the cathode for the H.F. Pentode.
A universal base is fitted and the control grid is brought out to a terminal on top of valve.

1

18. The Manual

of the arch exactly right, the sharp edges were rounded off and the whole piece polished ready for the chromium plating, the speaker bars were also made from brass and just needed cutting to shape, polishing and plating. The knobs and back would have to wait as I had nothing to work from so at this point in time all I could do was fit a set of similar knobs (black ones from an old Sobell) and a speaker cloth as near as I could get and put the set in my collection as it was and await developments.

Three years then passed with nothing more to add, then at the Summer swap Meet at Harpenden bingo! Nigel Pollicott is manufacturing reproduction backs for some 1930's radios and the AD65 being one of them (and very good they are too), at the same time Clive Mason said he had a set of reproduction knobs for an AD65 but the chap he had made them for had not turned up and if he didn't show by the end of the day they were mine. The chap didn't show and I fitted these components as soon as I got home, all I need now is a speaker cloth and the jobs finished.

Time passed and the final piece turned up at the National Vintage Communications Fair at the NEC Birmingham in the Spring of '96 where some Americans from Kansas were selling reproduction speaker cloths, doing a silver one identical to the original in the AD65. Being very pleased at obtaining the final piece, I then discovered 10 minuets later that Clive Mason was now reproducing tuning scales and his were in full colour and much better than mine.

My AD65 is now as good as it was when it left the factory and in full working order.

Restoring this classic vintage wireless has been great fun and been worth every minute spent on it. For anyone who enjoys 1930's technology this set is an excellent example and it even sounds good when you've finished. Happy Hunting.

16. The finished set angled right

Restoring a Fidelity 208 Bandspread Transistor Radio

By Stef Niewiadomski

I acquired this radio for the princely sum of £1 at the Dunstable Downs Radio Rally in 2016. I had been on the lookout for this model for some time, as it has family connections, in that I recall my sister owning one in the mid-1960s, and listening to Luxembourg and the Pirates after the family's Bakelite Philips valve radio had pretty much given up the ghost. I've seen a few 208s over the years, but they had all been either already restored and rather expensive, or complete wrecks which didn't seem worth saving.

As you can see from Figure 1, the example I bought was in very good external condition, and the only obvious thing wrong with it was that the tuning knob was missing. The front metal grille is rather delicate and can easily be 'dinged', but my example had so far escaped this sort of damage. Round the back, one of the rear panel fixing screws was missing, but that was no great loss. I couldn't power the radio at the time, so I was unsure whether it worked or not.

Before starting the restoration, I posted a question on the UK Vintage Radio Repair and Restoration forum to see if anyone had a suitable knob, and Bill Hewitt very kindly donated a scrap 208 he had towards my restoration. Bill's radio was complete with its tuning knob and still had a couple of the rear panel fixing screws. As it turned out, this scrap chassis was very useful when it came to fixing my radio.

Figure 1: My Fidelity 208 Bandspread radio, fitted with the tuning knob supplied by Bill. The blue colour of the radio is lighter than Bill's example, and so I presume the radio was originally offered in at least two colours.

Fidelity the company

The London-based Fidelity company was formed in 1946, by Jack Dickman, and released its first radio, the model 2546, a year later. This was a four valve plus rectifier set, built into an oval-shaped 'Tufnol' cabinet – available in a number of shades - with plastic knobs. Because of its rounded shape, this model is sometimes referred to as the 'caravan set'.

Fidelity produced its first transistor radio, the Ayr, in 1960. This was a two-band six transistor plus diode design, based on Mullard devices. The company then dabbled with GEC 'GET' transistors for its next design - the Coronet - and then returned to the Mullard fold for most of its subsequent models.

In May 1963, the company released the Fairline, which definitely has the looks of the 208 described here (see Figure 2, reproduced by courtesy of the Radiomuseum, see Reference 1) but contained an impressive total of twelve transistors. The radio seems to have been aimed at the more serious listener, being equipped with an RF amplifier stage, and a separate local oscillator stage (rather than a conventional combined local oscillator and mixer stage) which was advertised as being a more stable arrangement. To cover all eventualities, ferrite rod and telescopic aerials, as well as a socket for an external car aerial were provided. The radio covered long, medium and short (20m-60m) wavebands: a tuning indicator and two dial bulbs were incorporated.

The Fairline cabinet looks very similar to the 208, with the three 'piano' keys selecting the band. A rather strange (for a UK transistor radio, at least) Texas Instruments transistor line-up, of 2G417, 2G371, etc, was used, and the PCB and internal layout are very similar to the 208. I can't find much information on the Fairline, but I wonder if Fidelity imported the design from the US (hence the use of Texas transistors) and then adapted the cabinet design for its next transistor model, the 208? I may be completely wrong, but the use of twelve transistors in the Fairline may also point towards a design originating in the US, where transistors were cheaper than in the UK.

The 1965 edition of the Wireless and Electrical Trader Yearbook shows the 208 as a new model, being sold alongside the Fulmar and Galaxy models. These two radios were somewhat smaller than the 208, and being powered from a PP6 battery, were about half the weight. The company had produced no new valve-based radios since about 1963, but continued to make valved radiograms, record players (typically using the popular and minimalist UL84/UY85 combination) and tape recorders into the late 1960s. Fidelity was amalgamated into Caparo Industries in the mid-1980s and closed down completely in the late 1980s. The Fidelity name was acquired by Amstrad in the early 1990s, and was used to brand some of its Hi-Fi products.

The 208 Schematic

The schematic of the 208, taken from the Radio and TV Servicing service sheet, is shown in Figure 3. At seven transistors, the radio uses five less than the Fairline, and is more typical of the radios being produced at this time. The five 'missing' transistors were used in the Fairline's RF stage; separate oscillator and mixer stages, rather than in a single-transistor self-oscillating frequency changer; a diode-connected transistor used to stabilise the mixer transistor; another transistor used as an AGC damping diode; and yet another transistor used as a collector-bend audio detector.

A conventional IF of 470kHz is used in the 208, and the use of NPN, as well as PNP, germanium transistors allows transformer-less audio driver and output stages. A car radio aerial input socket and an earpiece / tape recorder output socket are fitted. Tape recording from the radio was popular at this time - I believe this was legal as long as you only listened to the recording yourself. It also has a tone control, somewhat of a luxury for this type of radio. Conventionally, long and medium waves are covered, but by pressing the LUX button, the radio tunes between 185m (1621kHz) and 211m (1421kHz), replacing the short-wave band of the Fairline.

A bandspread facility around Luxembourg's wavelength wasn't unique in radios available in 1965. To name a few - the Masteradio D518;

the GEC 822 Transistomatic (see Reference 2); the Kolster-Brandes KR010, RGD RR210 and Regentone TR410 - these latter three radios based on a common STC chassis – were all fitted with bandspread around 208m.

Restoring the radio

As mentioned above, the cabinet was in very good condition, apart from the missing tuning knob, and so I removed the back to apply power and see if it worked. The back came off easily, and I could see that the battery connectors had been removed, and loops twisted onto the ends of the power wires, presumably for looping onto some smaller battery. I soldered on flying leads, and connected them to an external 9V source, being very careful to get the polarity right. I switched the radio on, but nothing could be heard in any of the three waveband positions. With the PCB still in the radio, the track side is presented, and I gave the PCB some prods and taps, hoping to reveal a dry joint, which isn't uncommon on vintage transistor radios. PCB assembly in those days was very much a manual process, and joints were often missed or badly soldered. Such a radio presumably worked when it left the factory, but eventually the bad joint would result in it stopping working. But no such easy fix for me – the radio still didn't work.

At this stage I thought I'd try the PCB from Bill's radio, and if this worked, then a simple swap would be a quick fix. I applied power to it, and it didn't work either. So it was back to the original PCB for me to find out what was wrong. Interestingly, the track side of the PCB from Bill's radio had a dark coating, whereas mine was an uncoated bright copper colour, as seen in Figure 4.

I removed the PCB assembly by unscrewing a couple of cross-point screws and two hex-nuts which held the PCB in and permitted the back panel fixing screws to be screwed into them. With the PCB out of the cabinet, I could see the form of construction used, which can be seen in Figure 5. Mounted at right angles to the main PCB, there are two soldered-on sub-boards which contain the volume and tone controls (see Figure 6), and some associated circuitry. Access to these boards would not be easy if I needed to make measurements or change any components in this area.

The three grommets which formed part of the tuning capacitor mounting arrangement were perished, and resulted in the capacitor being skewed with respect to its intended position, but the tuning cord was still present and worked as the tuning knob was rotated. I decided I would fix the grommets once I had the radio working, and before the cord fell off the drum mounted on the tuning capacitor's shaft.

AF117s

The radio contains three Mullard AF117 transistors, and my suspicion immediately fell upon the possibility of the dreaded 'tin whisker disease'. This is where microscopic whiskers of tin form in the heat-conducting silicone gel, growing from the inside of the transistor's tin-plated case. The case is usually earthed via the screen lead and so the whiskers may eventually short out one or more of the terminals to ground, stopping

Figure 2: The Fidelity Fairline radio, predecessor of my radio, and with a cabinet looking very similar to the 208, with the three 'piano' keys selecting the band. Note the short wave band, covering 5MHz to 15MHz.

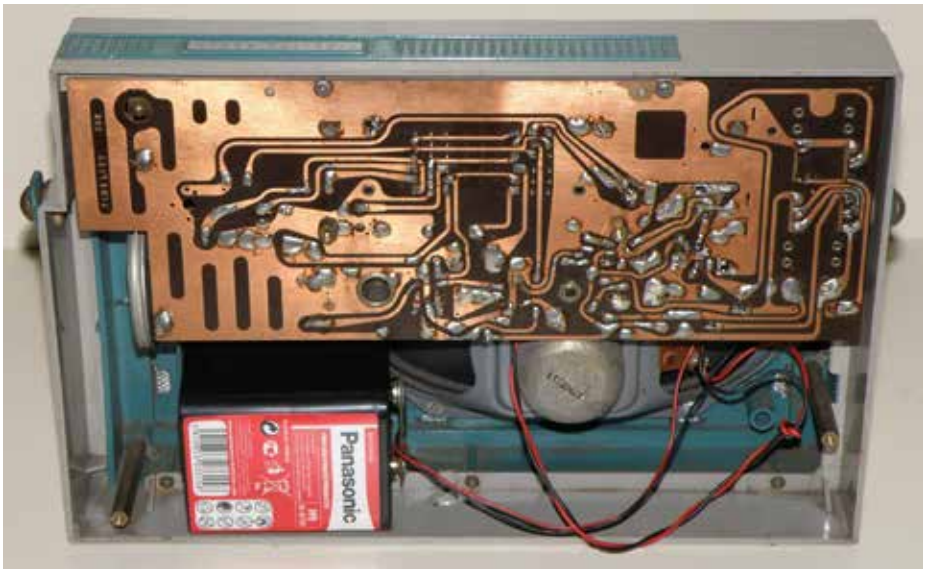

Figure 4: Rear view of my 208 with the rear cover removed. There is no battery access panel in the rear cover, and the cover has to be removed to get access to the battery. The PP9 is still available, and the Panasonic-branded version shown was purchased on eBay.

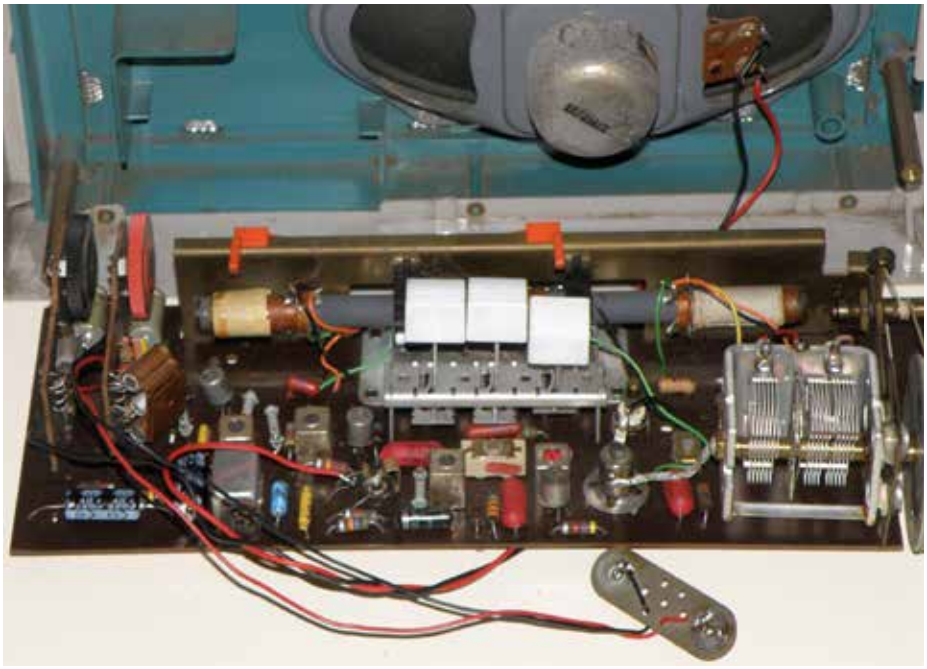

Figure 5: The PCB, still connected to the 7-inches by 3½-inches speaker, out of the cabinet.

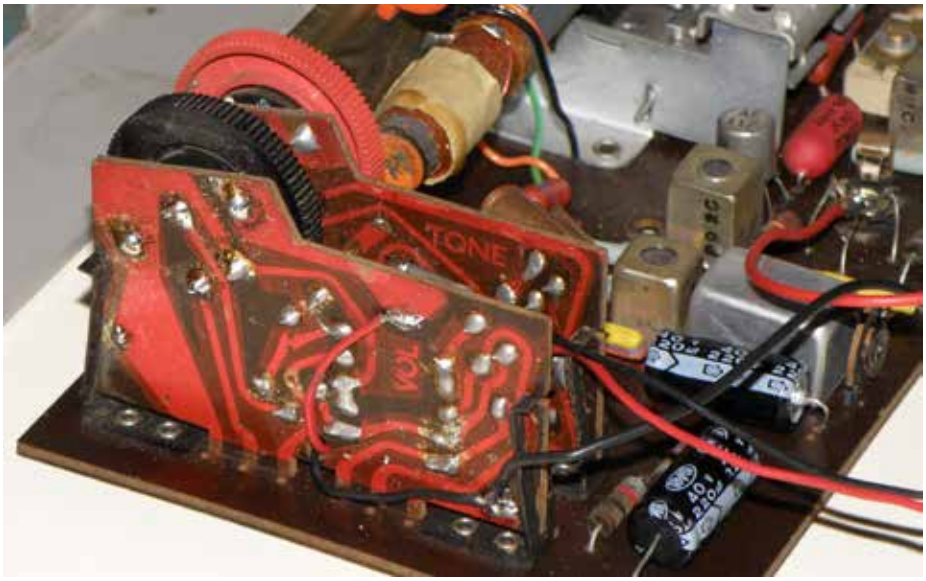

Figure 6: Close-up of the two soldered-on audio sub-boards, mounted at right angles to the main PCB, which contain the volume and tone controls and associated components.

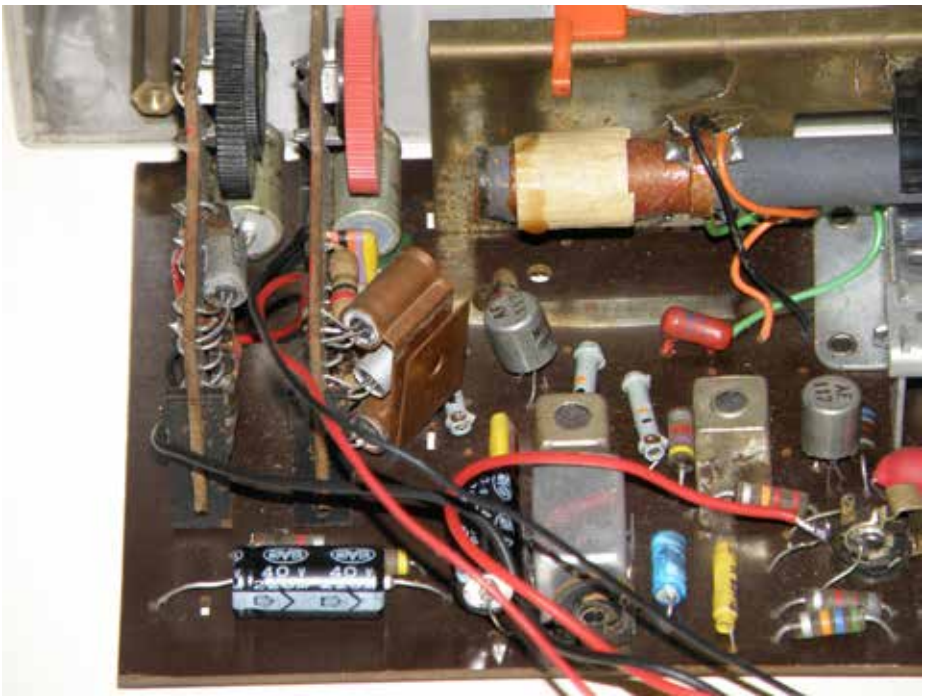

Figure 7: Close-up of the PCB area containing TR3 and IFT3. The rectangular aluminium box closer to the camera contains D1, C17 and R12, which presumably were deemed to be prone to noise pick-up and therefore merited screening.

the transistor from working. A quick and easy fix is to snip the screen lead of the suspect transistor and see if this effects a cure. So I cut the screen leads to all three AF117s, but this made no difference, so it would seem that these transistors were not suffering from the disease, not terminally at least. The internet contains many discussions of this phenomenon, with causes and potential fixes.

I now did what I should have in the first place and checked on a nearby radio to see if the local oscillator in the frequency changer stage was working. I set the radio to its LW position, tuned to the Light programme position at about 1500m, and checked around 670kHz. Yes, I could hear the oscillator, and the beat frequency changed as I rotated the tuning control. I find that most transistor radios fitted with ferrite rod aerials radiate their local oscillator frequency very weakly (which is normally a good thing) and so I usually wrap a few turns of insulated wire around the rod, and this increases the radiation level so that it can be heard.

I repeated the test for the MW and LUX positions, the latter at about 1970kHz (with the tuning set to 200m, plus the IF of 470kHz) and in both cases the oscillator could be heard. So at least I hadn't disturbed the workings of the frequency changer stage by cutting the screen lead of its AF117.

Transistor voltages

The service sheet for the radio shows the collector, emitter and base voltages for the seven transistors, and so I proceeded to measure the voltages on the PCB. Because of the way the two sub-boards were fitted onto the main boards (they are soldered on, and so removal would be rather tricky) access to the audio stages was awkward, and so I started at the front end and worked my way towards the speaker, hoping that I would find a problem before I got to the audio stages.

TR1, the frequency changer, transistor's voltages were reasonable, as were those of TR2, the first IF amplifier. However, the second IF amplifier, TR3, showed low voltages on all its terminals, the collector being the highest voltage at about 0.23V, rather than the 7V that it should have been. I suspected that the AF117 was faulty, so I unsoldered it and checked it on my Peak Atlas DCA55 semiconductor analyser. This correctly identified the transistor as a germanium PNP device, with an hfe of 171, and a reasonably low leakage current. Since the transistor was good, this suggested to me that maybe the supply to the collector was open circuit somewhere.

The collector of TR3 gets its supply from a tapping on the primary winding of IFT3, and looking at the can of this transformer, I could see that it looked rather discoloured. Probing IFT3's pins showed that this tapping point was indeed open circuit, and so I assumed that whatever corrosion had caused the can to become discoloured had also corroded the lead inside the can. I removed the can and replaced it with IFT3 from Bill's PCB, after checking that it had good continuity to all its pins, and soldered the original transistor back into the PCB.

Removal of these IF transformers was rather tricky, as the can lugs had been given a twist after they had been inserted, presumably to stop them from falling out as the board was turned over for soldering. By removing all the solder and then twisting the lugs back again, I eventually removed them, luckily with no damage to the substitute can.

I powered up the radio and it burst into life, and worked well on all three bands. A quick check of the voltages around TR3 indicated that they were now correct. I gave IFT3's core a quick tweak for maximum volume and left the rest of the radio's tuned circuits alone. The radio was very sensitive and produced a good volume level. Figure 7 shows a close-up of the area of the board containing the replaced TR3 and IFT3. The rectangular aluminium box on this side of IFT3 contains the audio detector circuitry of D1, C17 and R12, which presumably were deemed to be prone to noise pick-up and therefore merited screening.

I fitted a PP9 battery connector onto the power leads, again being very careful to get the polarity correct and tried the radio from the battery. I measured the quiescent current at 18mA, which I thought was rather high compared to what I've seen on other transistor radios, but there was no specified figure in the service sheet to compare it with. When transistor radios were first being produced, the quiescent current – and hence the battery life – was an important parameter, and many manufacturers emphasised their figure as a selling point.

Tuning capacitor mount

As mentioned earlier, the tuning capacitor was skewed as a result of the mounting grommets being perished. The grommets in the scrap chassis were good, and so I could have taken the mechanism apart and made the substitution, but since the fairly complicated drive cord was intact, I didn't want to do this if I could get away with it. I chose to hold the tuning capacitor in its correct position with a couple of lengths of tensioned string and used a few blobs of quick setting

Araldite to fix it onto its bracket, bypassing the grommets. This seems to have worked well, and the dial cord is now aligned with the drum, and in no danger of slipping off.

Summary and conclusions

My Fidelity 208 Bandspread radio was in good external condition, and only needed fitting with a replacement tuning knob and a gentle wipe over, to complete the restoration of its cabinet. Luckily the rather delicate perforated-metal speaker grille had survived the years without being dented.

I was also lucky that the dreaded AF117 disease hadn't struck the radio down (yet), and since I had a donor chassis, the radio was fairly simple to repair by replacing a faulty IF transformer. As transistor radios were first being developed, several new formats of 6V and 9V batteries were introduced by the likes of Ever Ready to fit into the available space. The PP9 was a popular battery, and is still available, and so Fidelity's use of this battery in the 208 means that it's easy to keep going today.

I had a personal connection with this model of Fidelity's range of transistor radios, my sister having owned one in the mid-1960s - bought in instalments from the Kays catalogue. She now again possesses the radio of her youth, and interestingly, much of the music she used to listen to has endured and is still broadcast by 'classic oldies' radio stations up and down the medium wave. Sadly Radio Luxembourg no longer broadcasts on 208m ….

References

Reference 1: The Radiomuseum can be found at: http://www.radiomuseum.org/

Reference 2: 'The GEC G822 Transistomatic Radio-Camera', published in the February / March 2014 issue of Radio Bygones.

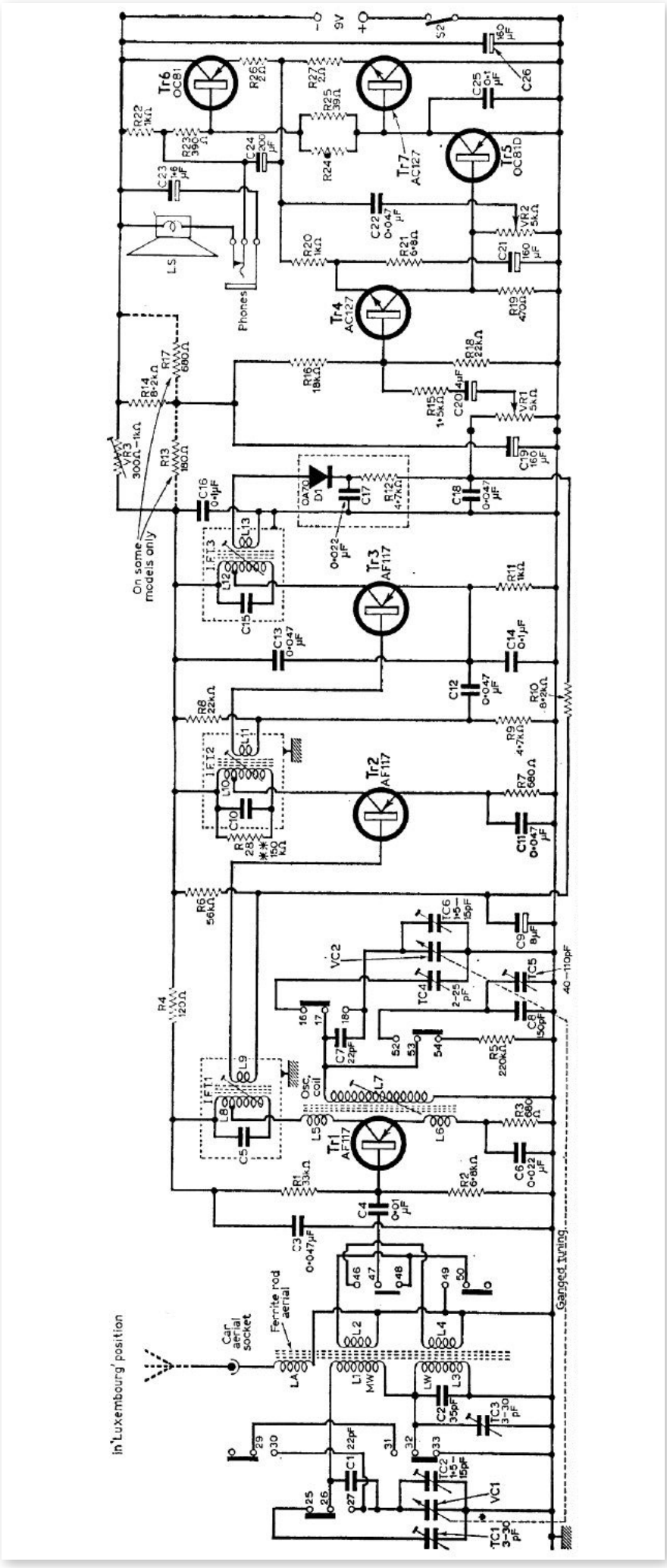

Figure 3: Schematic of the 208, taken from the R&TVS service sheet.

The Active Antenna

By Mike Rathbone

This article describes a useful little gadget I designed recently to make for easy listening on a vintage wireless.

It is basically a tuned ferrite rod aerial with a battery-powered amplifier built into a portable box with an output lead to connect to the aerial input of a vintage set. I originally developed it to try and hear signals on the 80 metre amateur band through the current 'electronic smog', it could be tuned from about 500 kHz up to 4 MHz. This unit was housed in a metal case with a ferrite rod aerial fitted into a plastic tube mounted on a metal tube with a stereo jack plug on the bottom end. (See figure 1) the leads from the aerial coils were wired to the jack plug. A jack socket in the top of the case took the aerial leads to the tuning capacitor and the RF amplifier circuit. The assembly could be rotated for best reception, also for use in direction finding as my local radio club were getting interested in DF exercises at that time. This unit was quite successful and I was pleased with its performance on medium wave as well when I connected it to various vintage sets. The next thing I tried was a miniature version, 'lashed up' on a bit of circuit board. This used a small ferrite rod aerial about 2 inches long from an old pocket transistor radio. The coil being tuned with the tuning capacitor from the same set. This worked very well and I was most impressed with the 'picking up power' of the tiny aerial.

The Circuit

Figure 5 shows the circuit of the final unit, the active device is a dual gate MOSFET type BF 964. These devices have been in use for many years so can probably be regarded as vintage electronics themselves. I seem to remember using a metal can 40673 in my first 145MHz converter a long time ago. Most modern FETs now come in a 'pill' shaped plastic package. The tuned aerial coil is fed to gate 1; this is at high impedance so no link coil is needed as is used with bipolar transistors. The FET is biased on by the voltage on gate 2 and decoupled with a capacitor. The output signal is developed across the RF choke in the drain circuit and coupled to the radio via a screened lead out. The choke gives a wide-band matching to the signal at an impedance which should match the input of most vintage radio sets. A 'phono' plug and socket is used as we don't need to worry too much about impedance matching and loss. A short length of audio screened cable is satisfactory, but steer clear of 'pound shop' phono leads. The screening on these is often poor or non-existent. The tuning capacitor is a 160 + 40pF poly-varicon with both gangs in parallel This gives full coverage of the medium wave band, in fact it tunes below 500KHz into the IF range. After using the 'active ant' for some time I thought it might be a good idea to add long wave coverage.

After many hours of experimentation I came up with the simple arrangement shown on the circuit diagram. This consists of switching an extra coil in series with the aerial winding, it does not pick up any signal, it merely increases the total inductance and extends the tuning range to a lower frequency. L3 is an RF choke with a value between 3.3 and 4.7mH. This is in series with the main coil on LW and shorted out on MW. Having finalised the design and being pleased with its performance I have sourced the Components to produce a number of these units.

Most of the parts are easily obtainable except for the ferrite rod aerials but I managed to get hold of a small batch of these that are just right for the job. A plastic project box was used to house the unit, size- 118x98mm wide and 45mm deep. I drilled the front panel to take the tuning capacitor, two mini toggle switches and the 5mm LED. Also a hole in the side for the output phono socket. The circuit was built on a PCB 93mm long which neatly fitted into the slot across the centre of the box. (see figures 2 and 3) The FET sits in a 5mm hole in the board. The longest lead is the drain terminal this goes to L2 and C5; the lettering on the body should be to the print side of the board. I found some grommets and fitted one over each end of the aerial rod, overlapping slightly. The rod could then be force fitted into the top front of the box and stayed put, though a bit of impact adhesive might help. Once the PCB had been assembled it was slid into place and wired to the tuning capacitor, switches and output socket. The LED is soldered into the board

Fig 1. the first version with external rod aerial.

with long leads, these are bent forward and the body of the LED pushes into the 5mm hole in the front panel. A battery holder for 6 AA cells with a snap connector was used, positioned in the bottom of the box. Some plastic foam was glued to the inside of the box and the rear panel to stop the battery pack rattling about.

Terminal pins were fitted to the PCB for wiring to the parts fixed into the box. The PCB was then slotted into place and the wiring carried out as shown on figure 6.

The spindle of the tuning cap' is just long enough to take a pointer knob. A short length of screened lead is then fitted with a phono plug and its other end terminated in a suitable fitting for the radio, usually a pair of wander plugs. The 'Active Ant' runs on a set of six AA batteries, these should last a long time as the current consumption is very small. The circuit takes less than 2 mA and the LED shows a bright attention getting light at about 600 micro-Amp. One could of course make up one of these on a 'bread-board' or build it into the case of an old transistor portable set using its existing ferrite rod aerial and tuning capacitor, as there are not many components in the circuit.

Fig 2. inside view of final unit.

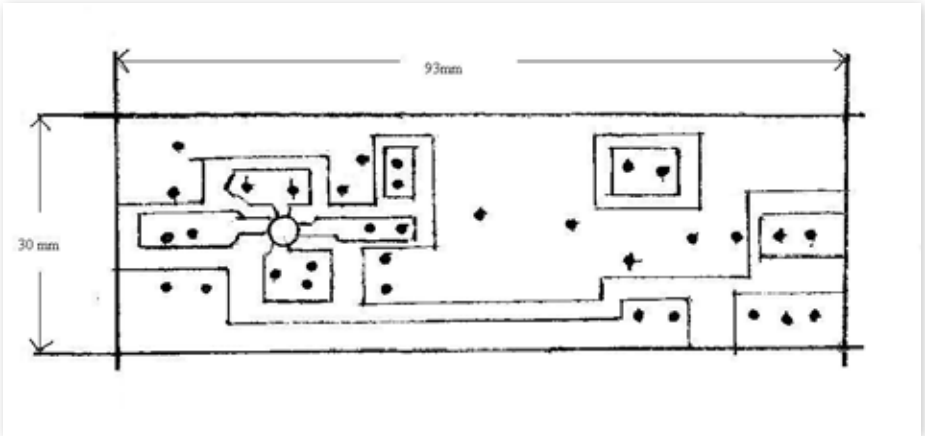

Fig 3. The PCB print side.

Fig 4. front view (to be replaced)

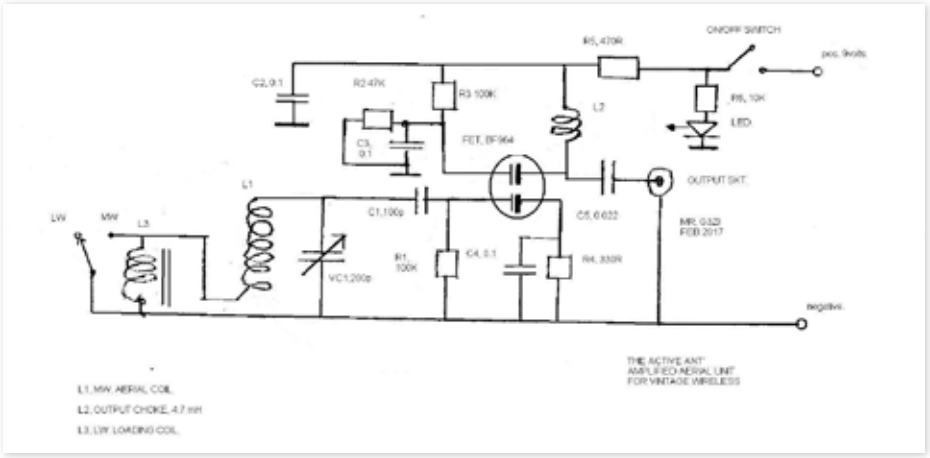

Fig 5. Circuit digram (to be replaced)

Using the Active Antenna

The unit could come in useful when one wishes to use a radio in a place where it's inconvenient to run up a wire aerial. It can also help to combat the rising tide of interference from switch mode junk, which is getting worse all the time. I have tried it on various radios, everything from a R1000 communications receiver, an Eddystone EC10 to a wartime civilian receiver (WCR) set and it performs well on all of them. The WCR is rather 'deaf' I think it needs a bit of attention, but it pulls in distant stations such as Spirit radio in Ireland at good strength. I found that it gives about the same sort of performance as a 45 foot outside wire with the added feature that the box can be turned to maximise reception and minimise interference.

These units can be supplied in either kit form or as a finished unit ready to use. Further details are available from mikerathbone@mail.com

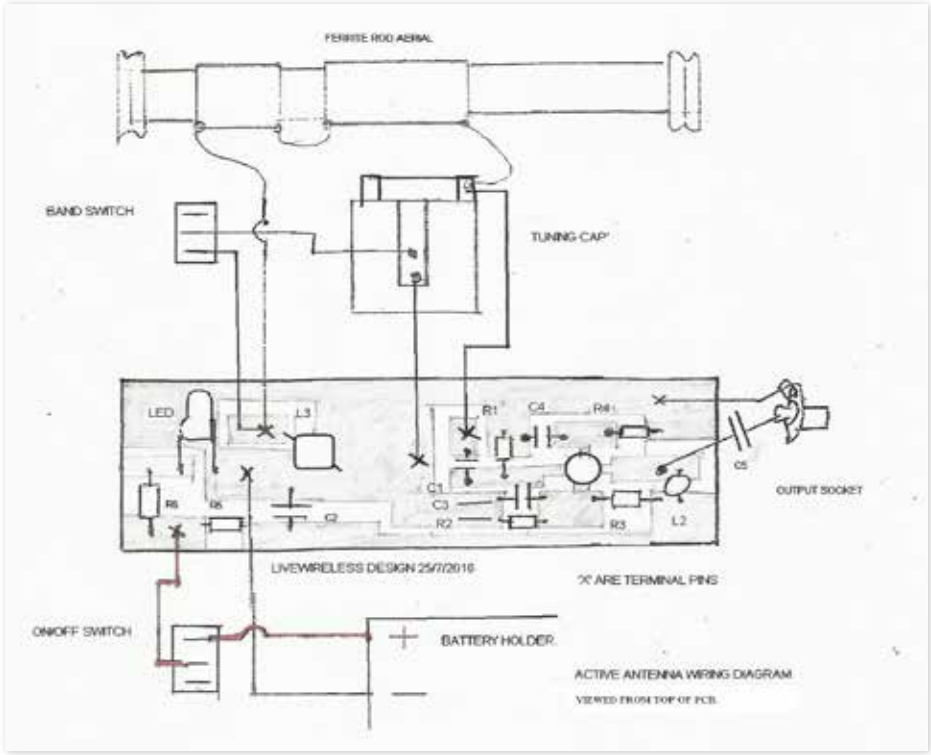

Fig 6. Wiring of components to PCB inside case.

Letters

Dear Editor

I must congratulate Stef Niewiadomski on his splendid article "British transistor manufacturers in the 1950s", published in the Winter 2016 Bulletin. It brought back many memories of using some of these devices in the early 1960s.

The idea of using a Mullard OC71 as a replacement for the far more expensive OCP71, is in fact quite correct. Early versions of the OC71 did have clear 'goo' covering the junction, and so by scraping off the black paint it would function as a phototransistor. Later versions used opaque 'goo', blue if I recall correctly, this prevented the device from its alternative use. Probably Mullards had got wind of this wheeze. However by using your mothers spin dryer as a centrifuge; it was possible to push the opaque 'goo' down to the bottom (lead end) of the case. This left the junction in the clear, and a cheap OC71 became an OCP71. Whether it performed fully to the specification of a genuine device I cannot say, but it certainly did work for me.

- Les Cates

Dear Colleagues

I agree with you that we should abolish the incorrect use of the word WIRELESS, unless it refers to a method of communication without wires, as in computer use and substitute the correct terminology of RADIO. It seems that the former word crept into the category of slang in conversational terms during the 1920's. Let us lead the way by correct example. *? Radio World ?*

While on this important subject, the title of our esteemed "BULLETIN" is quite inappropriate as the word bulletin, according to the OED, refers to "a short official statement or broadcast of public events or news ... " et cetera. I propose that we change it to the VINTAGE RADIO RECEIVER JOURNAL.

- Tony Dutton

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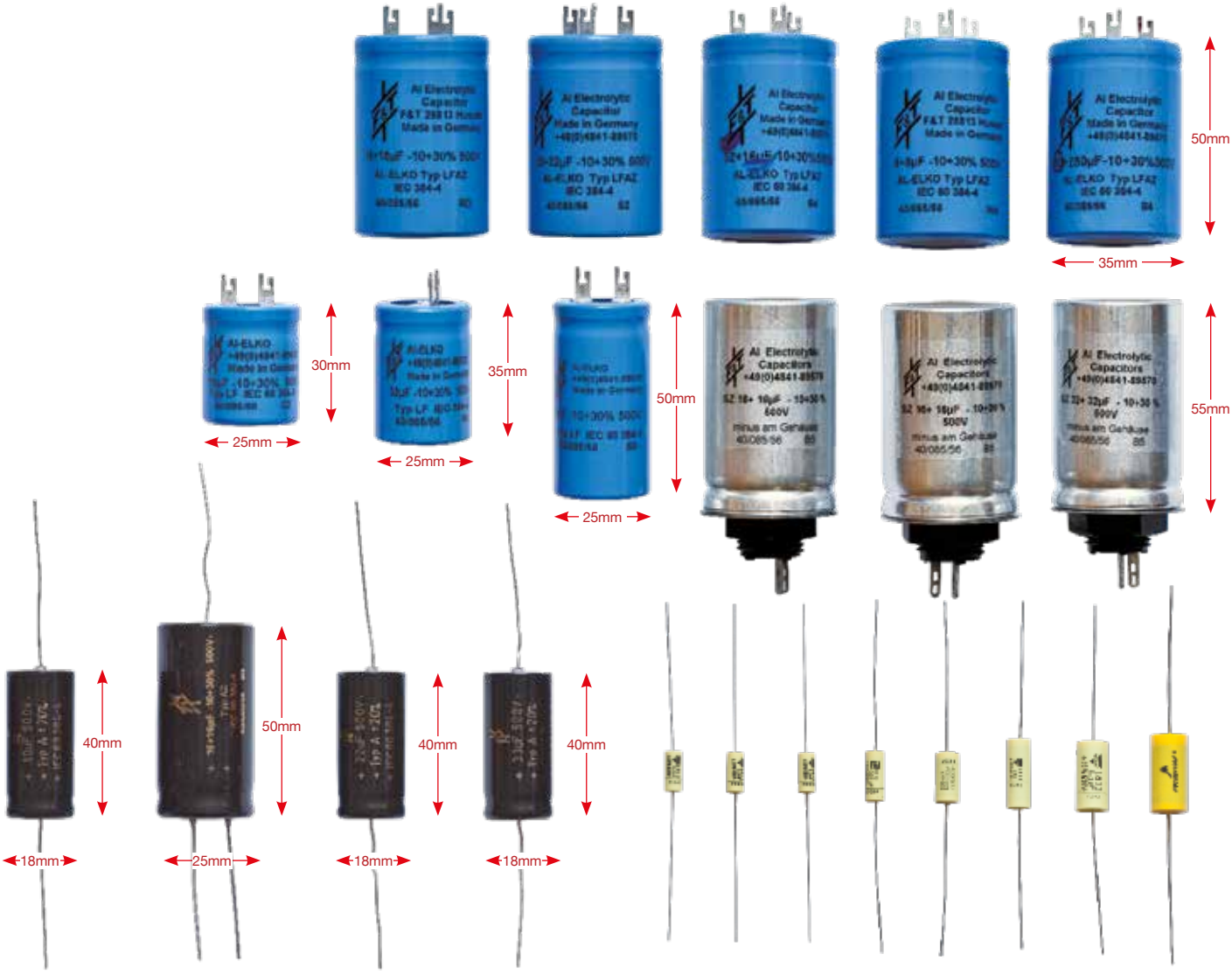

For non UK addresses, please contact Mike Barker for prices, (see below). All orders should be sent (with payment made out to BVWS) to: Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG. Cheques payable to British Vintage Wireless Society. Please allow 14 days for processing, but usually quicker!
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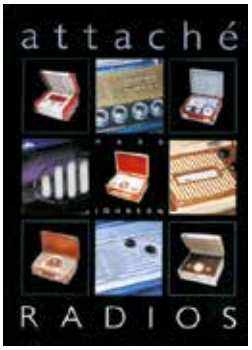

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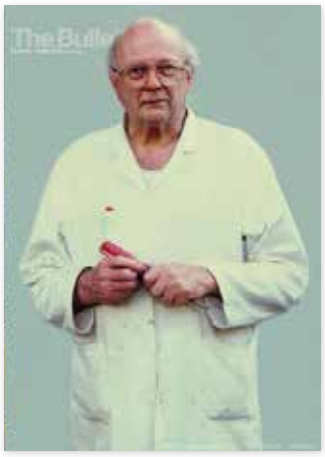

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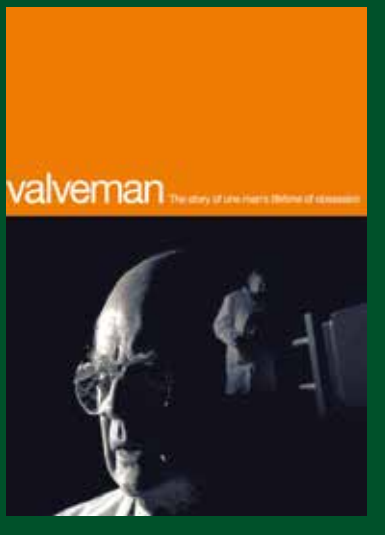

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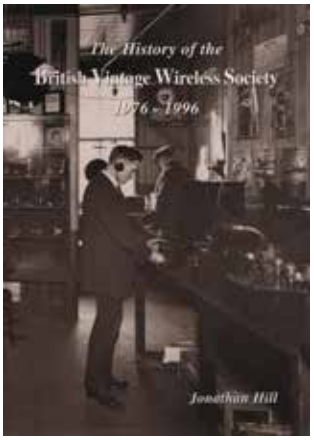

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April 9th Golborne
May 14th National Vintage Communications Fair
Warwickshire Exhibition Centre CV31 1XN
June 3rd Garden Party at BVWATM
June 4th Swapmeet at the Cinema Museum, London
July 2nd Royal Wootton Bassett
August 6th Punnetts Town
September 10th Murphy Day at Mill Green Museum
September 24th Harpenden
October 1st Audiojumble
November 12th Golborne
December 3rd Royal Wootton Bassett

GPO Numbers
Martyn Bennett is the custodian of the BVWS GPO Registration Numbers list. As many members know, the project of assembling this list was started in the early days of the BVWS and was carried on by the late Pat Leggatt. Members are strongly urged to help build the list, whenever they get the opportunity, particularly as it is something that will help with the identification of vintage wireless in years to come. The list is by no means complete and the GPO no longer have a record of the numbers granted to wireless manufacturers. The BVWS Handbook contains the current listings - one in numerical order and one ordered by name. Please let Martyn have any additions, or suggestions for corrections, by mail or over the phone.
Martyn Bennett, 58 Church Road, Fleet, Hampshire GU51 4LY
telephone: 01252-613660 e-mail: martyb@globalnet.co.uk

The British Vintage Wireless and Television Museum:
23 Rosendale Road, West Dulwich, London SE21 8DS
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Contact Vic Williamson, 01582 593102
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NVCF: National Vintage Communications Fair
For more information visit: www.nvcf.co.uk
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