Some Early Admiralty Wireless Equipment

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Following on from the recent IEE reprint articles on Naval Wireless equipment and practice prior to WWII, I thought it might be interesting in taking a slightly more detailed look at an example of some early wireless equipment. First though, a slight but not unrelated digression.

Some time ago Colin, G4DDI, noted the lack of information or articles on Naval radio equipment in the Newsletter. This is certainly true and it is also true for vintage radio literature in general – there is sadly very little written about naval radio equipment. It is true of course that we know about the B40 & CR100 receivers, the Transmitter 5G – the Admiralty version of the WS76 , Receiver Unit 62H – the Admiralty version of the R1392 but what about the rest. Many of us will have a copy of the Admiralty Handbook of Wireless Telegraphy so we at least have some idea of naval radio practice. I don't know when the AHWB was first issued but I have copies of the 1920, 1925 and 1938 editions. I know that there was a 1931 edition but perhaps someone in the group knows if there was anything prior to 1920 or what happened after 1938. Years ago when I was living in Sussex, I was in conversation with a fellow vintage military radio enthusiast. The discussion turned to naval equipment and my friend made the point that naval equipment presented something of a difficulty for the collector as it generally only appeared as isolated items and (at that time) it was difficult to determine the system they belonged to. What follows is the story of one such isolated item.

Fig.1 K7 heterodyne unit

Not long before moving to my present location I came across a Heterodyne Unit K7. As can be seen the K7 has the typical look of Admiralty equipment and is a single valve oscillator covering 60kHz – 600kHz in 5 ranges intended for battery operation. From it's designation as a heterodyne unit the immediate assumption that it was used with a receiver to facilitate CW reception. The fact that the oscillator has a relatively wide frequency range indicated that it was probably used with a TRF receiver where the heterodyne signal would effectively be introduced at carrier frequency. That was as far as I got until some time later when an article on the Naval Communications Museum at HMS Collingwood appeared in Radio Bygones. I contacted the Curator and his very helpful staff quickly identified the K7 and kindly provided some information on it together with some details of associated equipment.

The K7 was originally designed in 1931 and intended to be used with DF outfits (or systems) SG & SHX. These were rotating frame coil DF sets with a separate vertical sense aerial. The primary difference between the two outfits was that in SG, the WT office was located immediately below the frame coil, whereas in SHX, the rotating frame coil was remotely controlled from the WT office. Each outfit included Tuner A46, Amplifier M9, Heterodyne Unit K7 and Note Magnifier N20.

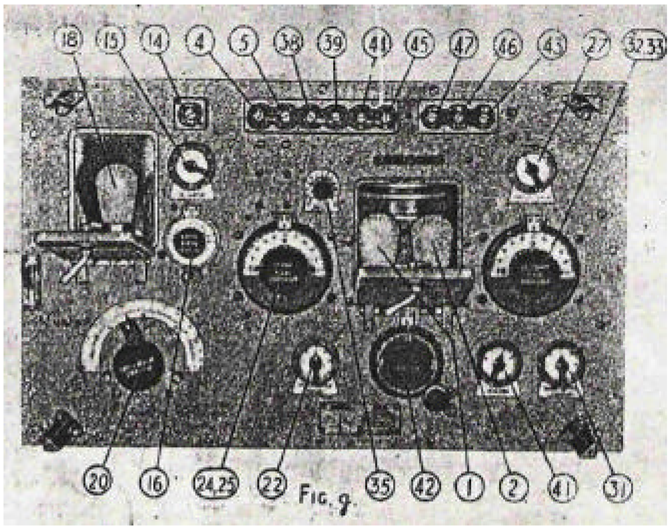

Fig.2 Tuner A46

Apart from the Frame Coil and Sense Aerial, the principal piece of equipment in the DF outfits was the Tuner A46.
This was a 3 valve amplifier covering the range 60 – 600 kHz and also designed in 1931. For proper operation it was highly desirable to maintain the balance of the frame coil as far as possible and for this reason a tuneable balanced amplifier was provided in the A46. The sense aerial was connected to the input a of a single valve aperiodic amplifier. In addition to providing aerial tuning, the A46 included a number of corrector circuits that were used to compensate for errors introduced by the inevitable presence of metal superstructure near to the frame coil.
Provision was also made for introducing reaction from the following M9 amplifier in order to assist in searching for signals. A filament rheostat was included in the balanced amplifier circuit to give some form of control of the amplifier. This may have been used as means of counteracting the effect of interfering signals using a technique known as "balancing". Two NR16A (Mullard PM4DX) were used in the balanced amplifier and a NR15A (also apparently a PM4DX) in the sense aerial amplifier. Presumably the NR16A was a selected version of the NR15A perhaps to ensure that each valve in the balanced amplifier had similar characteristics.
Signals from the A46 passed to the M9 Amplifier. As can be seen from the illustration of the front panel shown below, this

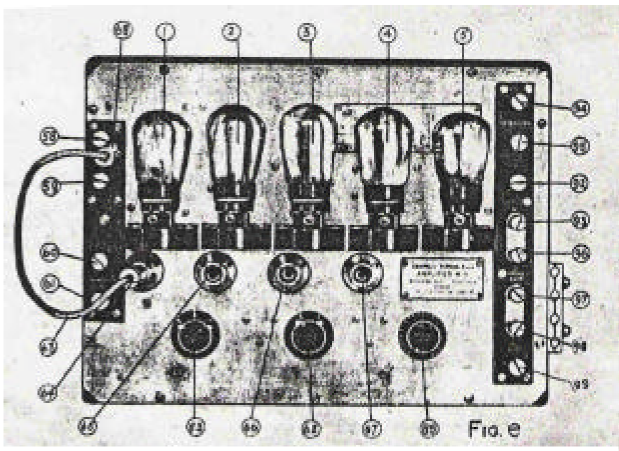

Fig. 3 Amplifier M9

was a somewhat earlier design, dating in fact from 1928. In some respects the M9 appears to have been inspired by the "5 Triode" portable receiver designs that appeared on the domestic market soon after the introduction of the national programme on long wave in 1925

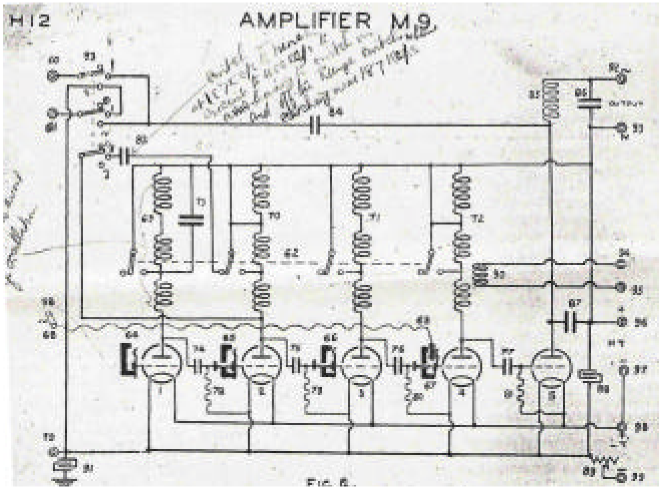

Fig.4 M9 Circuit

Looking at the circuit the M9 can be seen to be a multi-stage choke coupled HF amplifier with a cumulative grid (grid detector) as a final stage. The anode chokes are similar in design, each being wound in three sections. Some resonance effects due to inherent self-capacitance are inevitable and to prevent all three chokes tuning to the same frequency, one section in each of the chokes for valves two and four is permanently shorted out. This gives an essentially flat response over the required bandwidth. The band is covered in two ranges, 60 – 430 kHz and 430 – 670 kHz, selected by switches that short out further sections of the anode chokes on the high range. The operator was able to select the amount of gain required by using a plug and jack arrangement to bypass stages.

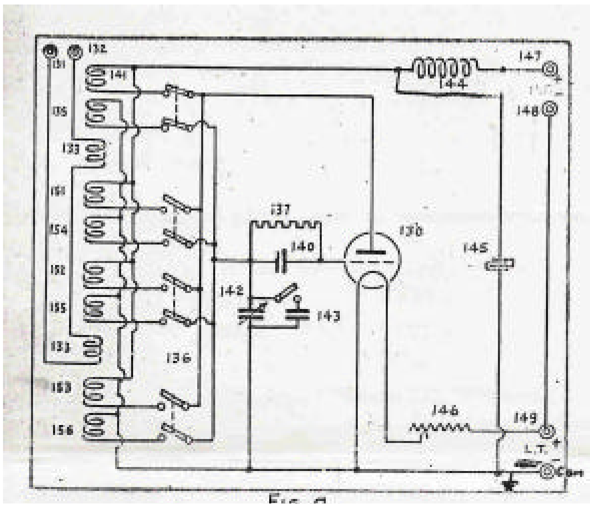

Fig. 5 K7 Circuit

Overall reaction can be applied from the Tuner A46 to the anode circuit of valve 5 and a 3 position switch is provided for reversing the sense of the reaction or disconnecting it. Heterodyne input from the K7 is coupled into the anode choke of valve 4. Audio output is taken from valve 5 anode via a coupling capacitor and passed to the Note magnifier N24. No details are to hand on the N24 but it can be assumed that this was an audio amplifier of one or more stages intended for feeding headphones.

Passing now to the K7 itself, it can be seen that this is simply a single valve tuned grid oscillator and there is little to be said about the circuit as such. The arrangement of the tuning inductor is worthy of note in that it is sectionalised and the output coupling coils arranged to give a relatively constant out put across the tuning range of the oscillator. As a sample is to hand it is worth looking at the construction in a little more detail.

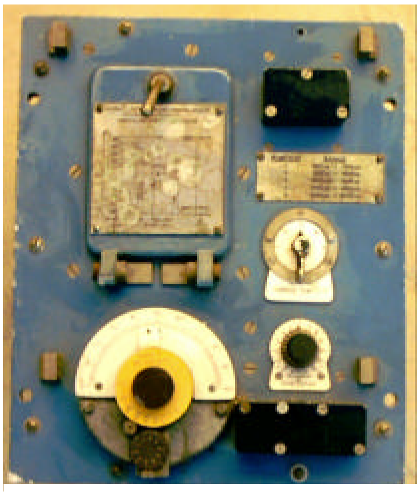

Fig. 6 K7 Front panel

All controls and connections are brought to the front panel and the small door provides access to the valve. The 60 – 600 kHz band is split into 5 ranges and slow motion dial is used for fine tuning. Frequency calibration is provided in a rather novel way. A set of 5 yellow discs is attached to the tuning dial by a knurled screw. Each disc is engraved with the frequency calibration for each range and in use, the knurled screw is undone and the disc corresponding to the range in use is brought to the front and the screw replaced. The K7 can then be set to the required frequency. The remaining control on the front panel is the filament rheostat. This has an "off" position and can be used to switch the oscillator on and off. Power supply connections are made to the lower terminal block and the heterodyne taken from the upper block. Both blocks have cast aluminium covers and bases and provide a means of clamping the sheath of a lead covered cable.

The components are mounted on the front panel and as can be seen, the tuning coil assembly dominates the internal construction. A point of interest is the tuning capacitor. This appears to be an example of what was termed a "Die-cast Condenser" in the service. The construction is similar to a differential, or "butterfly" capacitor except that the stator sections are connected together. This gives a wide capacitance swing and for this particular capacitor, the maximum value is stated to be 1 Jar. Mention of the Jar brings us neatly to another point of interest in respect of early Admiralty wireless equipment, namely, the practice of expressing capacitance in Jars. Historically, the Jar was a sub-division of the Farad specifically used by the Admiralty as a more convenient unit for dealing with the values of capacitance used in wireless circuits. Contemporary commercial wireless textbooks make no mention of the Jar, so it would appear that the only the Admiralty used the unit.

Fig. 7 K7 innards

By definition, 1 Jar was equal to 1000 electrostatic or absolute units of capacitance. As 1 Farad is also by definition, equal to 9×10^{11} electrostatic or absolute units of capacitance, 1 Jar is therefore equivalent to $1 / 9 \times 10^{8}$ Farads. Thus 1µf = 900 Jars. In today's terms therefore, a capacitance of I Jar is approximately 1,100pF.

An Admiralty Fleet Order in 1937, AFO 1552/37, discontinued the use of the Jar and required the gradual changeover to use of sub-multiples of the Farad.

I hope the foregoing has at least provided a "taster" of early Admiralty wireless equipment. It is indeed a great pity that so little has been written on this subject as the Admiralty were heavily involved in early shipboard wireless development, especially through the work of Captain Henry Jackson, a contemporary of Marconi. In closing it is worth noting that Captain Jackson is credited with the earliest known requirement for military radio equipment. This was set out in a letter to Marconi written in September 1896.

"I think personally" he wrote, "that your apparatus is worth a trial, and would be of use to the service, if the signals can be made over 3 miles, without reflectors; all round lenses would be permissible".

"The size of the transformer would not be of importance to but I would state roughly 4 cubic feet, and a weight of 2 cwt, should not, if possible, be exceeded. The power available would be a continuous pressure of 80 volts, of which 5 horsepower would practically not be much felt and be always available. All parts of the apparatus would have to be protected from wet and capable of standing rough usage and heavy shocks from the firing of guns".

The lenses referred to, were made of pitch and used to direct the Hertzian waves and the transformer intended to replace the induction coil as a source of power from the transmitter.

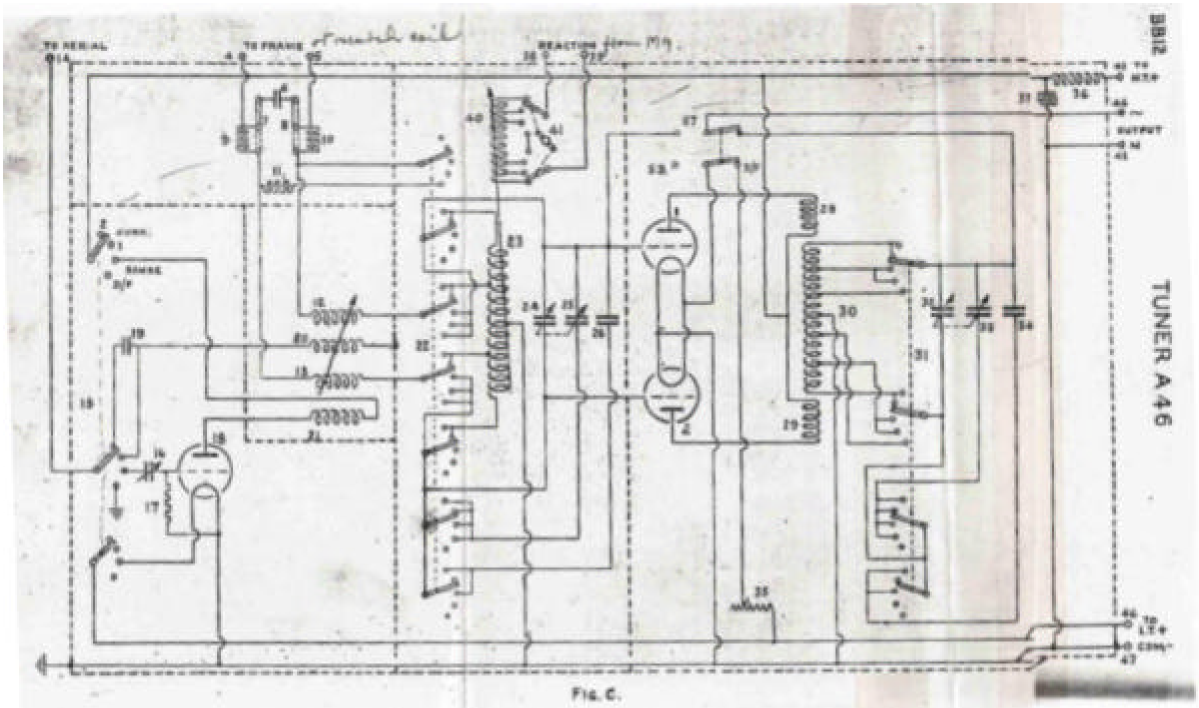

Fig. 8 A46 circuit