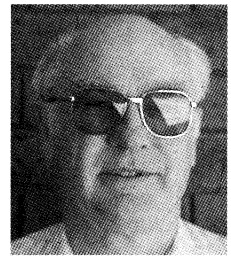
VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG



Behind the Lines: A Short History of Spy Radios in WW II; Pt.1

Operating a spy radio within occupied Europe during World War 2 was a risky business. In this, the first of three articles, we take a look at the equipment used and the techniques employed to avoid getting caught.

Since World War II, we have seen many films which have shown snippets of the French Resistance and the spy radios that were used for their clandestine activities. These films, although based on fact, were dramatised and were certainly not always as accurate as they could have been. After all, why should the facts spoil a good story!

Gathering information about a country that you are at war with and arranging for people behind the lines to create sabotage was considered a legitimate activity by all sides. In Britain, the organisations that were very involved in this activity during World War II were the Special Operations Executive (S.O.E.) and Military Intelligence (MI6).

How did these radio transmitter units get into the hands of the Resistance? They were largely flown in by the various aircraft such as the Westland Lysander and the Lockheed Hudson. These aircraft were able to land on makeshift airfields, to drop off materiel and to transport agents in and out of the country. Two and four-engine bombers were used for larger airdrops.

The radio operators who used the small radio transceivers were always in considerable danger of discovery. German radio direction finding groups from the Gestapo had large numbers of receivers with panoramic displays attached to them and could monitor virtually all high frequencies (HF) at the one time.

Once a suspect signal was detected, it was then observed on a normal communications receiver and a recording made on a wire recorder. Radio direction finders were also immediately put into operation and a direction obtained from each station listening to the signal. It was normal to use three of these stations to get the direction to a clandestine station. The three directions were plotted onto a map and a small area, called a "cocked hat", was obtained where the three lines nearly intersected (the direction finding equipment wasn't accurate enough to have all three lines intersect at the one point).

The clandestine radio transmitting station would be within the cocked hat, which was a triangle of about 16km per side. A triangle of this size occurred because the direction finding stations were usually several hundred kilometres away from the transmitter being traced. The main fixed direction finding stations were at Brest, Nuremberg and Augsbourg.

Because the radio operator usually only had about three different crystals to control the transmitter frequency, the German monitoring service could easily keep an eye on these frequencies. When transmissions were again heard they started from the extremities of the cocked hat triangle and took more bearings. By this means, often over a period of several days or even weeks, the size of the area that the transmitter was located in would be reduced to something like a triangle of about 200 metres a side. If the clandestine/spy radio operator kept on operating from this location he or she was very likely to be caught.

Countermeasures

To minimise the chances of being caught, the operator was told to only transmit for very short periods - about 3 minutes maximum - and to shift location regularly. One feature of the early spy radios was the use of a simple two or three-valve regenerative receiver. However, when being used for Morse code (CW) reception, the regenerative detector would radiate enough signal for it to be picked up by any German radio detection groups in the near vicinity. As a result, superhet receivers quickly superseded TRF receivers.

Another favourite technique of the Gestapo radio detection groups when closing in on a spy radio installation was to remove the mains power from a building block. If the transmission immediately ceased, then it was highly likely that the clandestine radio was located in that block. After that, it was only a matter of time before the operator was found and "suitably dealt with".

To overcome this tactic, many of the later sets were fitted with both

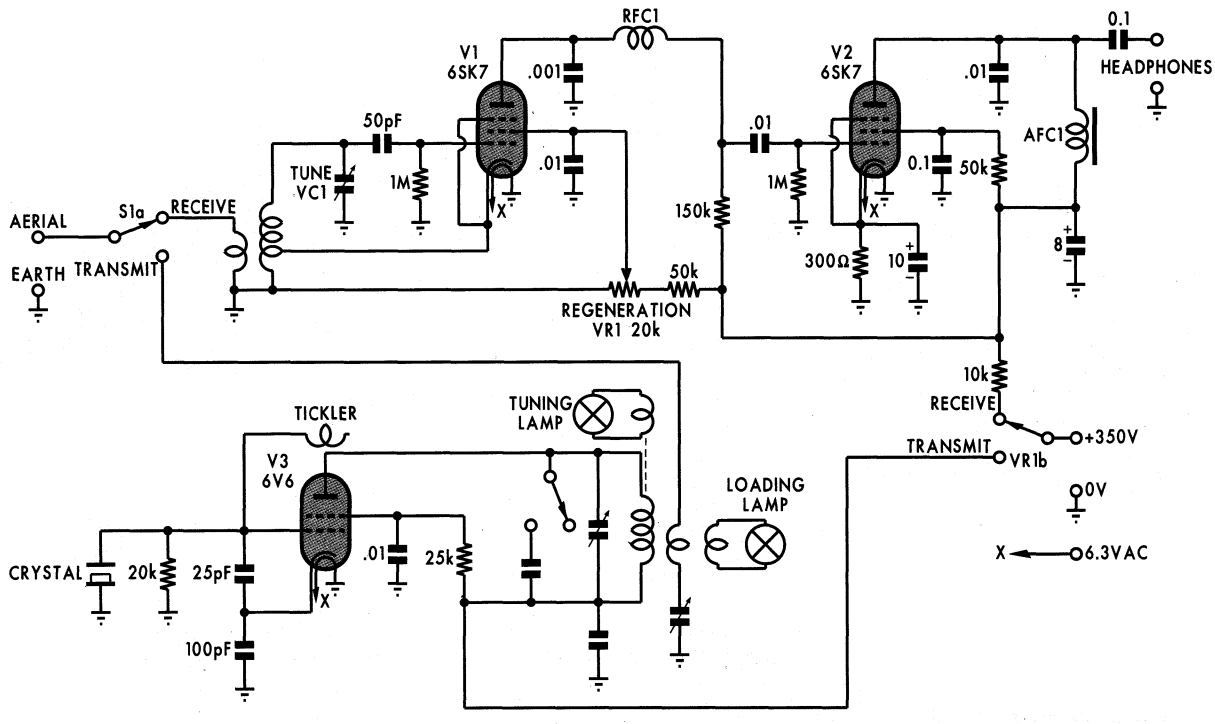


Fig.1: the 3-valve Paraset featured a regenerative receiver based on detector stage V1 and audio output stage V2, plus a crystal-controlled transmitter stage (V3). The RF power output was 4-5W, while the operating frequency range was from 3-7.6MHz.

battery and mains power supplies and could be switched from mains to battery operation within a second or so. The break in the transmission was so short as to be unnoticeable and this could be a real life saver.

The operators also often had what we would call "cockatoos" or look-outs to warn of suspicious activities, so that they could close down quickly. Although the Germans had a very extensive network of listening sets and radio direction finding equipment, not many of the spy radio operators were caught. However, the activities of the radio direction finding troops meant that the agents couldn't go about their clandestine work in a careless way. If they did, they soon ended up in a German prison, which usually had fatal results.

Technical history

Obviously, the radio transmitting and receiving equipment used by the resistance radio operators was purpose-built to suit the job in hand. The equipment needed to be:

(1). Small enough and light enough to be carried in an inconspicuous suitcase. Small enough to fit in a coat pocket was even better and such equipment was available late in the war.

(2). Usable with both mains (110V and 230V) and battery supply (usually 6V).

(3). Able to change over from mains to battery operation quickly to avoid detection as detailed earlier in the article.

(4). Able to transmit on a variety of radio frequency bands between about 3MHz and 8MHz and preferably up to around 16MHz. This meant that communications could be maintained at almost any time of the day or night from anywhere in occupied Europe.

(5). Sufficiently powerful to achieve the previous requirement. This usually required 3-30 watts of radio frequency (RF) output. The receiving stations in Britain and elsewhere had sensitive receivers and large antennas.

(6). Able to transmit CW (Morse code). Transmitters for Morse code are simpler to make and have a much greater range for the same power than an AM (amplitude modulated) transmitter. Additionally, the voice of the operator would not be recognised by those hunting him/her and Morse code is much more accurately copied than voice transmissions under difficult reception conditions.

(7). Simple in design and easy to use.

(8). Fitted with a non-radiating receiver, which ultimately ruled out regenerative receivers. The receiver did not have to be tremendously sensitive as the transmitters in Britain were reasonably powerful at 250 watts. And there was access to a 15 kilowatt transmitter if needed.

(9). Maintained accurately on frequency so that the operator at the listening station knew where to look for the signal. This was achieved by using a small selection of quartz frequency crystals.

(10). Headphone operation only. Radios were banned in occupied countries, so no "radio" noise could be tolerated. In any case, it was easier to produce sets for headphone operation. The Third Reich did have a number of approved broadcast band only sets which had limited reception range so that stations outside their borders could not easily be tuned.

(11). A quiet Morse key. Some were quieter than others and many were enclosed to keep noise down and to make sure the operator didn't receive an electric shock.

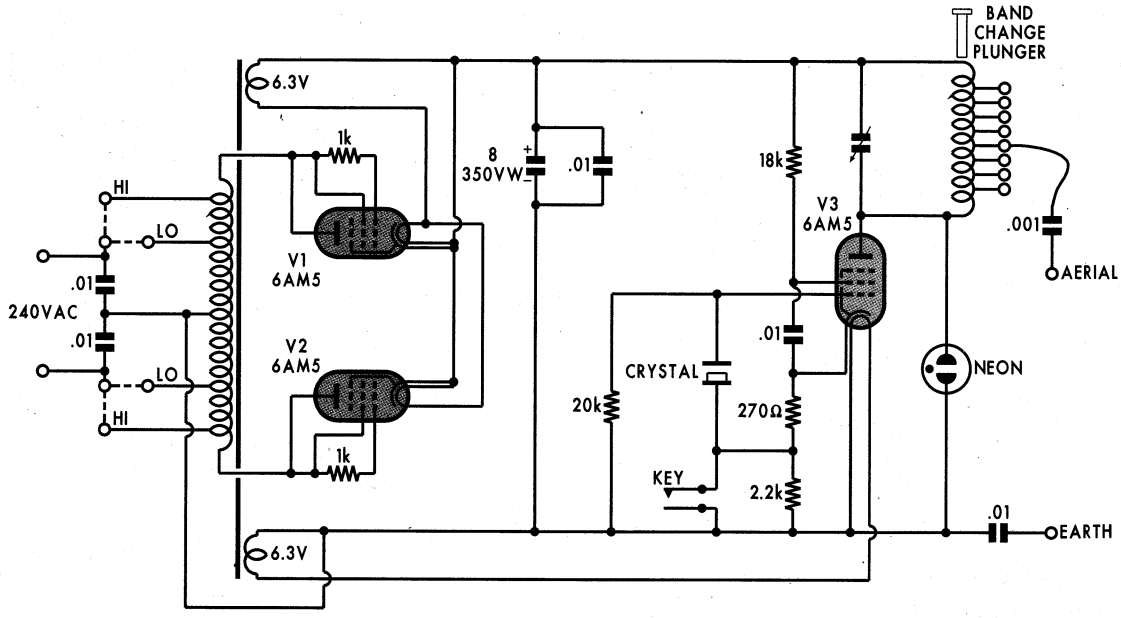


Fig.2: the 51/1 transmitter used three 6AM5 valves, two to rectify the high voltage from the transformer and the third as the oscillator. The whole circuit operated at half mains supply and this, together with the dangerously high DC voltages that were present at many points, meant that it had to be well insulated from the operator.

Did the spy radios achieve all of these ideals? No, but there were a number of really good tries and most of the later sets did incorporate most of the criteria listed above.

The sets of the Resistance

A number of radios had been developed prior to World War II and the Mark XV transceiver is probably the oldest and best known of its kind. Built around 1938, it weighed in at more than 20kg and certainly wasn't a lightweight suitcase set.

The Mk.XV operated from 3.5-16MHz and the transmitter had two valves - a 6F6 crystal oscillator and a 6L6 RF power amplifier - which produced an output power of 15-20W. The receiver was a 3-valve regenerative set and had the disadvantage of radiating a signal which proved useful for the German radio location groups.

Following on from the Mk.XV was the Paraset transceiver. This set, complete with its power supply, weighed in at around 4.5kg and featured an operating frequency range was from 3-7.6MHz. It was a very simple unit with a 2-valve regenerative receiver based on 6SK7 valves – one used as a regenerative detector and the other as the audio output.

Like the Mk.XV, this receiver also radiated a handy signal for the Gestapo radio detection groups. Because of this, the Paraset was mainly used in country areas where the receiver's signal would not be detected.

The transmitter section was based on a single 6V6 valve, used as a crystal controlled oscillator cum power output stage. The RF power output was of the order of 4-5W and the communications range was around 800km.

Following on from the Paraset were the "Polish Sets", designed and built by a group of Polish civilian refugees. These sets were a considerable improvement over the previous sets and were only surpassed by the British-designed Type 3 Mk.II and the Type A Mk.III later in the war.

The BP3 was a relatively large and heavy set that could be operated from either the AC mains or from 12V DC. It covered the frequency range from 2-8MHz and was suitable for both AM and CW operation. It used a 2-valve 30W transmitter stage and a 4-valve superhet receiver. Correct tuning of the transmitter was achieved by observing the meter on the front panel and three neon or incandescent lamps.

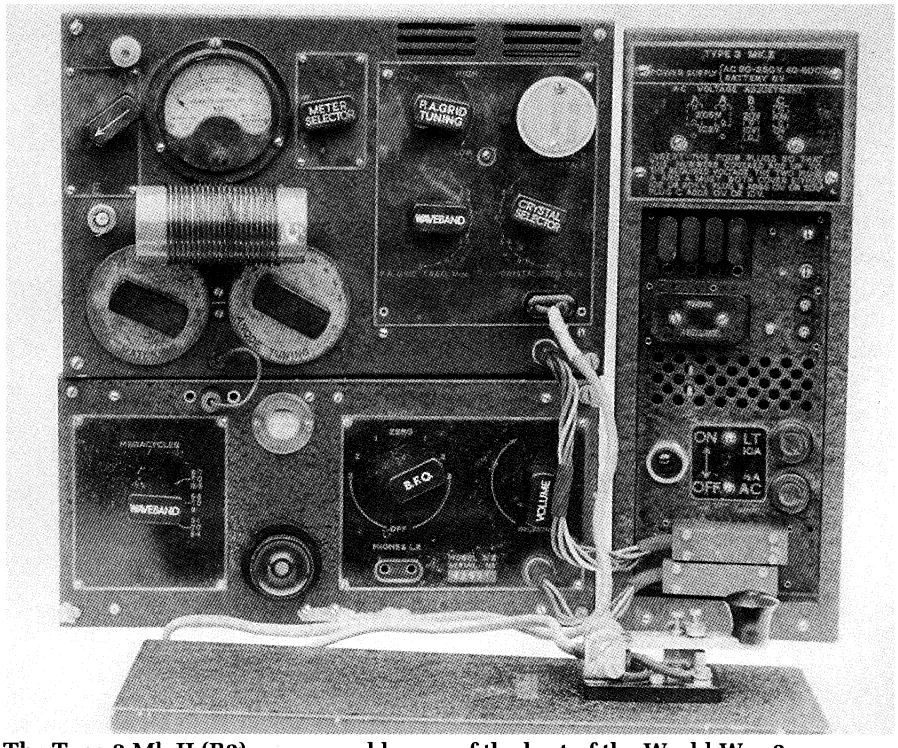
The AP3 was manufactured in 1943 and weighed about 18kg without the ancillary pieces of equipment that went with it.

By contrast, the AP4 was a smaller transceiver which weighed in at about 4kg (including the 120/220V AC power supply). It operated from 2-8MHz using a single valve in the transmitter (with 8W output) and a 3-valve superhet receiver. The correct tuning of the transmitter was accomplished by observing the brightness of a neon and an incandescent lamp.

In 1942, SOE (Special Operations Executive) was authorised to build its own sets. The Type A Mk.II was the first transceiver produced and started the trend towards using the more rugged American Loctal valves. This set would appear to be the predecessor of the Type A Mk.III, as many of the features are similar although not as well thought out as in the Mk.III.

The Mk.II came as three separate units: transmitter, receiver and power supply. Its operating frequency range was from 3-9MHz and it used a single valve for the transmitter stage and another three valves for the superhet receiver (with a regenerative detector). Receivers like this were commonly called "super-gainers" within the amateur radio fraternity.

Packed in its suitcase, this set weighed about 8kg. The Mk.II was superseded by the much improved Mk.III which will be described in the third article in this series. The Type 3



The Type 3 Mk.II (B2) was arguably one of the best of the World War 2 spy radios. It was supplied in either a suitcase or in two waterproof steel boxes and consisted of three separate assemblies (more on this set next month).

Mk.II (B2) and the Type A Mk.III, arguably the best of the spy radios, will also be described in future articles.

Miniature valves

From 1944 onwards, sets using miniature valves became available and these sets were much smaller than earlier types. They did not replace the earlier sets like the Type 3 and the Type A however, as each had its own niche in the clandestine radio communications networks.

One example was the 53 Mk.I receiver which used some of the first miniature valves and measured just 100 x 89 x 32mm. Its accompanying 110/220V AC power supply was the same size and the combined weight of the two units was just over a 1kg. This was a 3-valve TRF unit with regenerative detector and a tuning range from 3-12MHz. It was quite an achievement to fit the parts into such a small space at that time.

Another interesting set is the MCR1 "Biscuit" receiver. It was given the name "Biscuit" because it was delivered in a biscuit tin! About 10,000 of these sets were produced and a number made their appearance on the Australian surplus market somewhere around 1947.

The MCR1 measured 240 x 89 x 64mm and weighed about 1kg. It covered the frequency range from 150kHz to 15MHz using four plug-in coil boxes, with a gap above the broadcast band. The set is somewhat unusual in that the lowest band tunes from 150-1600kHz in one go. I suspect that it used low pass filters in lieu of tuned circuits in the aerial and RF stages to get this tuning range.

The MCR1 was a 5-valve superhet and was based on miniature 1.4V battery valves. I understand that it used 1T4s, a 1R5 and a 1S5 and fed headphones. It could be used on batteries or with a separate AC/DC power supply that could operate from 97-250V.

Smallest transmitter

The smallest transmitter commonly used was the coat pocket-sized 51/1. It measured 146 x 114 x 38mm and weighed 0.6kg complete with its inbuilt 200/260V AC power supply. It operated from 3-10.5MHz, the output power from the transmitter stage was 3-4W and the transmitter tuning controls were adjusted for maximum brilliance from an inbuilt neon tube.

This set was intended as an emergency transmitter, to be used where there was considerable risk attached to using the superior but much more obvious Type A Mk.III or Type 3 Mk.II. A person carrying a suitcase could easily create some suspicion whereas a transmitter carried in a coat pocket was much less obvious. The set used three 6AM5/CV136 valves, two as mains rectifiers and one as the transmitter oscillator/output valve (Fig.2).

Summary

In the period from 1941-1945, the equipment used was progressively miniaturised and reduced in weight. Some types like the 51/1 transmitter weighed in at only 600 grams, had a power output of 3W and could be carried in a coat pocket. In general, the transmitters were improved while the receivers evolved from simple TRF regenerative units to high-performance multi-band superhets.

The early regenerative receivers were a liability when used for Morse code reception as the oscillating detector could easily be picked up by any radio direction finding equipment in the near neighbourhood. This made capturing a spy radio operator and the equipment a relatively easy task.

Next month, we'll take a close look at the Type 3 Mk.II set. **SC**