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Michael Jones GW7BBY
michael@gb2mop.org

A PCR Restored!

Michael Jones GW7BBY not only covers the workings of these receivers but offers some history of their use.

The Portable Communications Receiver, or PCR, **Fig. 1**, was designed by Pye and reputedly based on the receive section of their Wireless Set No 19. It was manufactured in large quantities by Pye and Phillips who produced some 17,000 examples between April 1944 and December 1945. Its first intended use was to be dropped to the resistance and citizens of the occupied countries of Europe; the Netherlands and France in particular. It wasn't a spy set but a broadcast receiver covering Long, Medium and Short Waves. Domestic radios had been confiscated by the Germans in the Netherlands. In France most domestic radios had been exchanged for German propaganda receivers that would only tune to German stations. Although many citizens had hidden receivers at the start of the war there were severe penalties for anyone caught listening to the BBC. By 1944 the Allies at last felt they had the upper hand, D-Day was in sight, there was a need to keep the resistance appraised of invasion plans and to raise morale among the population in general. The BBC would include coded messages in their programme material. These fascinating stories could form a complete article in themselves but here are some interesting snippets.

The French Connection

In 1940 the BBC established a French service called 'Radio Londres'. Broadcasts were entirely in French and the service was run by free French who had escaped France before the occupation.

A Special Operations Executive (SOE) operative, **Georges Bégué**, conceived the idea of sending obscure, seemingly meaningless personal messages to agents in the field. In this way the volume of dangerous two-way radio traffic was reduced.

Starting in July 1940 using the programme 'Les Français Parlent aux Français' as a vehicle these overtly coded messages were preceded by an announcement, *"Before we begin, please listen to some personal messages"*. Messages included pre-arranged words or phrases, which had a clear meaning to a specific resistance group such as, *"Jean has a long moustache"* and *"There is a fire at the insurance agency"*. The meaning could be anything such as *"Blow up a particular bridge"* or *"keep civilians clear, we're bombing a certain facility"*. Of course, the Germans were monitoring Radio Londres transmissions but would have no knowledge of which resistance group was the intended recipient. Only one out of, say, three 'personal' messages might actually contain a code word or phrase. Indeed, four or five messages might be broadcast with none of them containing a code, simply to divert and confuse German resources.

It was during the approach to D-Day, the Normandy landings, that the PCR receiver featured prominently. Indeed, it is sometimes referred to as an 'Invasion Receiver'. Notice that production started in April 1944. Many thousands of PCRs must have been dropped in France by the beginning of June that year when the most famous of the coded BBC Radio Londres messages were deployed.

The BBC signalled the French Resistance to advise that the opening lines of the 1866 **Paul Verlaine** poem 'Chanson d'Automne' were to indicate the start of D-Day operations. The first three lines of the poem, *"Les sanglots longs / des violons / de l'automne" ("The long sighs of autumn violins")*, broadcast on 1 June 1944 meant that Operation Overlord was to start within two weeks. The next three lines, broadcast on 5 June, *"Blessent mon coeur / d'une langueur / monotone" ("Strike my heart with a weary tiredness")*, meant that the invasion would start within 48 hours and that the resistance should begin sabotage operations, especially on the French railroad system. Another message on 5 June, *"The carrots are cooked"*, announced the arrival of Allied Paratroops.

Following D-Day, PCRs continued to receive updates on the status of the invasion for the benefit of both the resistance and allied forces. This may be why PCRs used WS19 cases for both the receivers and the power supplies as this enabled PCRs to be strapped into the standard WS19 armoured vehicle radio set carriers – presumably Carriers 21, 22 or 23. Another explanation may simply be that the manufacturers had a ready supply of 19 set cases.

No account of the BBC's wartime broadcasts would be complete without mention of the morale boosting use of the opening motif of Beethoven's 5th Symphony. Radio Londres' broadcasts opened with the emphatic "dit dit dit dah" played on tympani to symbolise Churchill's "V for victory" in Morse code to all the occupied nations.

The work of Radio Londres is commemorated by a plaque at the Asnelles cemetery in Normandy, **Fig. 2** [1].

After the war, large numbers of these receivers

Fig. 1: PCR Receiver and its mains power supply. Fig. 2: Plaque at the cemetery at Asnelles, in Normandy, commemorating the work of Radio Londres.Fig. 3: Circuit diagram of PCR1. Fig. 4: Circuit diagram of mains power supply. Fig. 5: Above chassis view showing space for modifications. Fig. 6: PSU showing wooden chest for fuses and spare bulbs. Fig. 7: Perished wiring to be replaced. Fig. 8: Lots of pictures were taken to ensure replacement components were correctly wired. Figs. 9 & 10: Below chassis view before and after replacing capacitors.

were used as NAAFI or entertainments receivers and inevitably in the 1950s and 60s found their way via the then very healthy surplus market into amateur hands.

Circuit Description

The three versions of the PCR: PCR (or PCR1), PCR2 and PCR3 are very similar. PCR is easily recognised as it has a built-in speaker. PCR2 and PCR3 relied on an external speaker or headphones. The other differences are in the frequency coverage. The PCR covers Long and Medium Waves plus 5.8 – 18MHz Short Wave, PCR2 has a different short-wave band: 6.0 – 22MHz. PCR3 dispenses with Long Wave and covers Medium Wave, plus two Short Wave bands: 2.3 – 7.3MHz and 7.0 – 23MHz.

You may come across the PCR3TPL: this is a tropicalised version. A rare development of the PCR is the PTR, which was fitted with a BFO and was thus suitable for SSB and CW reception.

The PCR is a 6-valve superhet with an intermediate frequency (IF) of 465kHz. The circuit consists of a first RF amplifier (EF39/ARP34), mixer/oscillator (ECH35/ARTH2), two stages of IF amplification (EF39s/ARP34s), detector/audio amplifier (EBC33/AR21), audio output stage, PCR1: EL32(VT52), PCR2/3: 6V6G, **Fig. 3** [2].

The power supply was a separate unit built into a WS19 power supply case, Fig. 1. There are two types, one is for AC mains operation (Power Supply Unit Rectifier No. 17) with a 6X6GT rectifier and the other for 12V DC with a vibrator pack (Supply Unit Vibratory No. 8 or No. 9. (Tropicalised)) to supply the HT voltages. HT is 250V DC @ 65mA and LT is 12V DC @ 700mA, **Fig. 4** [2].

Some PCRs were re-built by the REME Newark Depot between 1958 and 1960, they will be marked NEW 4/60 showing the depot, month and year. Others were re-manufactured by other contractors (including RACAL) and will have a marking such as WRNW 1958.

Post War

After the war a great many of these receivers became available on the surplus market and this is where I first encountered one: the Army Surplus Store at Telford's Wharf, off Canal Street in my

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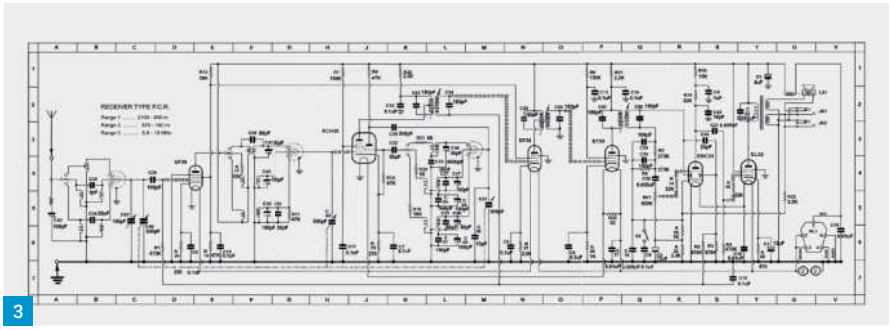
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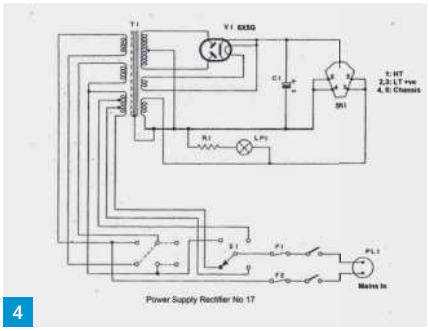
hometown of Chester. I was impressed with the dial and the general feel of the set, also it was considerably cheaper than other more sophisticated radios such as the AR88, HRO etc. In 1965 with 2/6d a week pocket money, two or three pounds for a PCR was still a lot of money. I would have to wait another 56 years until I had one!

Amateur Mods

In the 1950s and 60s many modifications for the PCR receivers were published in the radio press, including *Practical Wireless*. Such mods included improved selectivity, Beat Frequency Oscillator (BFO) for resolving CW and SSB, improved AGC, internal power supply, additional bands, notably topband, and replacing the electrostatic loudspeaker used in the PCR1. With hindsight some of these modifications would be of limited benefit on a receiver that unmodified, only gave coverage of the 7MHz amateur band and this occupied such a small span of the tuning dial that resolution of a CW or SSB signal would have been difficult. Of course, prior to the mid-60s AM would have been the most common voice mode and its wide band-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width probably allowed it to be resolved without too much difficulty. However, before condemning these modifications we need to put ourselves back in that time when PCRs were plentiful and two a penny compared to 'proper' communications receivers such as the AR88 and HRO that might set you back quite a few months' pay. The PCR provided an inexpensive base on which to experiment and learn for a very modest outlay. Looking at the chassis, **Fig. 5**, there is plenty of spare real estate for adding RF stages, BFO or internal power supplies etc.

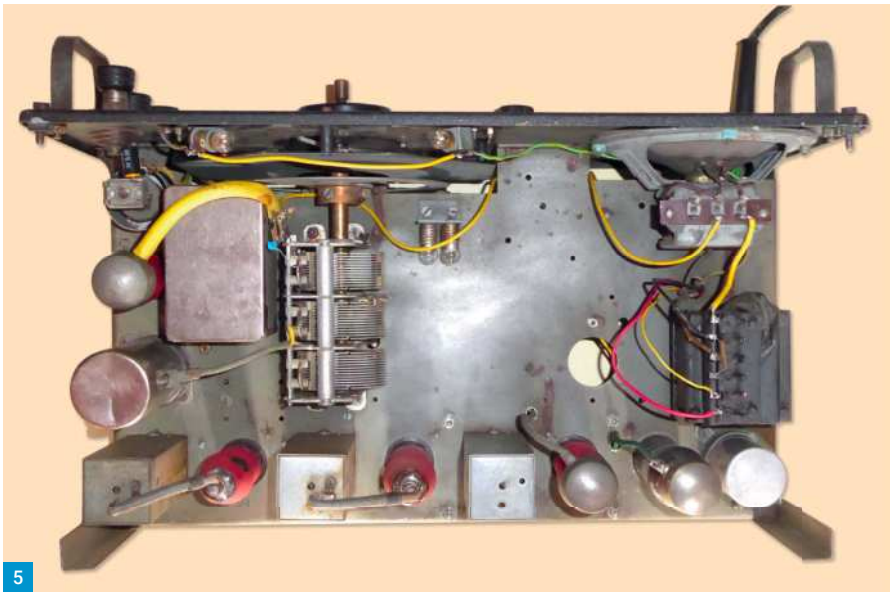
Mine

My example seems to be in remarkably original condition, free of modifications with a clean, fairly unmarked front panel. The separate power supply has been modified to provide two HT outputs, one at a slightly lower voltage. I assume that it may have been used with a different radio, a 19 set perhaps?

The power supply is worth a mention for the trouble taken to provide holders for spare dial light bulbs and a wooden chest for spare fuses, **Fig. 6**.

Much of the power supply wiring was perished and crumbling so all the PSU wiring was replaced. I was able to obtain a couple of long strain relief grommets for the power supply leads via eBay. The connecting leads would originally have been joined by 'drop' or 'snatch' connectors like those used on 19 and 62 sets. I used a pair of 4-pin in-line microphone connectors.

The original mains connector is unsuitable for modern use. I've left it in place but bypassed it and fed the mains cable through the hole left by a redundant switch fitted by a previous owner. The dial pointer had blackened and was very difficult to see against the black background to the dial. I painted the pointer white, which improved things considerably.



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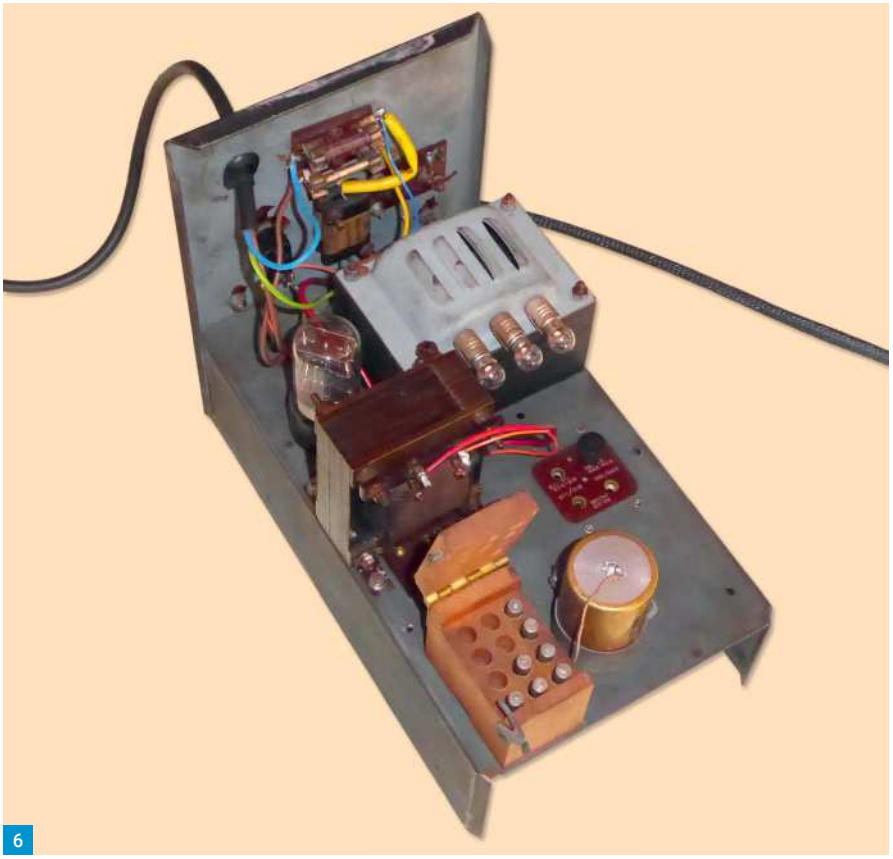

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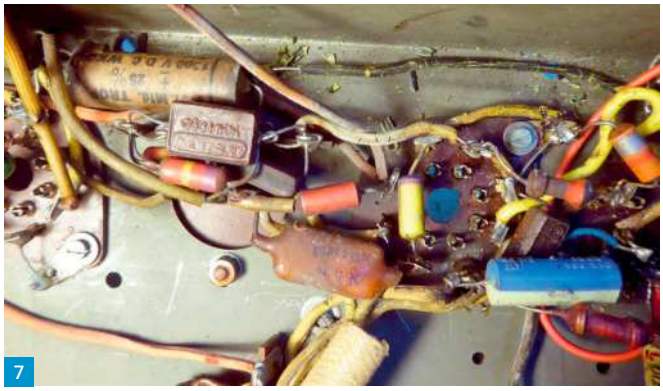
Initial Evaluation

After ensuring that none of the perished wires were likely to cause trouble, I powered it up slowly with a Variac. If there were any seriously faulty capacitors, they would reveal themselves. All went well. The dial lights came on and after a short interval static could be heard, while with a short antenna Radio 4 could be heard faintly on Long Wave accompanied by some low frequency noise (motor-boating). There was no sign of activity on Medium Wave and Short Wave was completely dead. Poking around with the oscilloscope revealed the Local Oscillator (LO) signal on the grid of the Mixer Valve (V6: ECH35) on both Long and Medium Waves but nothing on Short Wave – possibly a dose of switch cleaner needed. I have a table of expected voltages on the valve bases and found some of these to be well out of specification. I also measured some of the wax paper and electrolytic capacitors: some were short and others of dubious value. A couple of the high value resistors were high.

Repairs

All the perished wiring in the PSU and the radio was replaced, **Fig. 7**. I decided to replace all the wax paper capacitors: mostly 0.1µF or 0.01µF and a couple of 0.02µF. Two 12µF electrolytics were replaced with modern 10µF capacitors. Some high value resistors were also replaced, see **Figs. 8**, **9** & **10**. Lots of pictures were taken to ensure that replacement parts were fitted correctly, Fig. 8. Upon powering up again all the voltages fell into place. Switch cleaner restored the LO on Short Wave. Attaching about 5m of wire to the antenna terminal brought a strong signal from Radio 4 together with activity on Medium and Short Waves. This was progress but I still had intolerable motor-boating on Long and Medium Waves, but not on Short Wave. I therefore, erroneously, concluded there was a fault common to Long and Medium Wave, I was even able to capture the fault on an oscilloscope. Hereby lies a cautionary tale for the unwary radio repair man! I spent a large part of two days trying to track down the mysterious motor-boating.

It was present at all stages, so I deduced that it was emanating from the first RF stage. I poked and prodded, checked voltages swapped valves around, all to no avail. Then at last the obvious, you've probably already guessed: disconnect the antenna and the problem goes away. The issue is external to the radio and is being picked up by the antenna. In my defence, the absence of motor-boating on Short Wave led me to believe that the problem was something to do with the wave changing switch, particularly for the first RF amplifier. Furthermore, other radios in the house picked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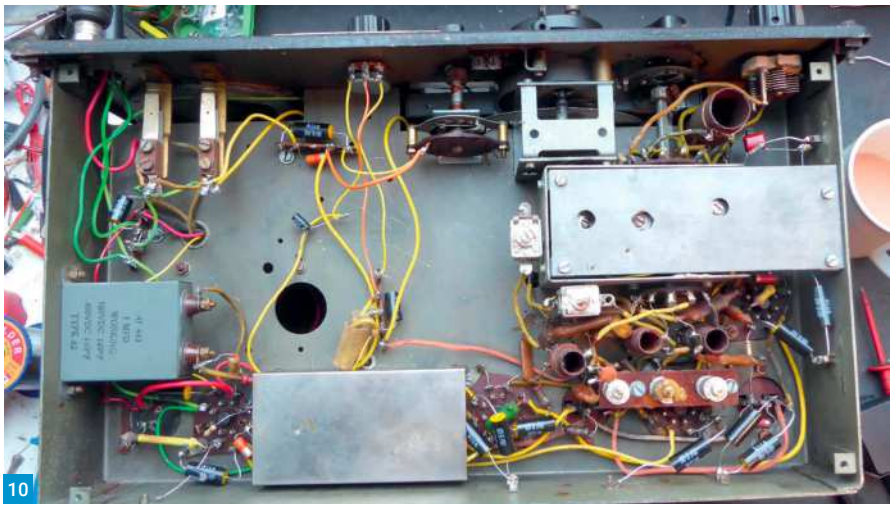
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up Radio 4 clearly. However, a big but, they were on VHF (FM). I took a portable radio tuned to long or medium wave and there it was, something being picked up from the local environment.

Walking from room to room failed to locate the source of the noise, but basic direction finding pointed me in a certain direction. We went outside and were able to pick up the noise for some 100 yards down the road before it faded. So, back home, turned off all power to the house and bingo, it disappeared! Cutting a long story short, turning on the circuit breakers, one at a time located the circuit containing the errant equipment, which turned out to be an LED yard light. Despite it being the middle of the day, of course, its circuitry was still active waiting for the sun to go down. Disconnecting the light and buying a better one solved the problem.

A final alignment check and peaking of the trimmers showed that the dial was accurate on Medium and Short Wave bands but was a bit high on Long Wave and fully unwinding the local oscillator beehive trimmer would not pull it down far enough, so a little less C was needed. The Long Wave local oscillator coil has a trimmer to ground in parallel with a fixed capacitor. What I needed to do was reduce the capacitance of the capacitor combination, but digging down through the rat's nest of wiring to the fixed ceramic capacitor was a bit daunting. It measured correctly, so I wasn't too worried about its value. I connected a small capacitor in series with the trimmer/fixed capacitor combination to the bottom of the coil and that brought the dial nicely into calibration with the trimmer approximately half meshed.

In Use

The set is a delight to use as a broadcast receiver for both national and international stations. It is simple and produces good quality sound. The dial spins very satisfyingly with a flick of the knob, the controls are simple and would have been ideal for its intended purpose. The tone control is not terribly effective but could probably be improved with judicious replacement of a couple of capacitors – *"what: modifications?"* I hear you say. So, mine has been 'modified' by fitting modern capacitors and some resistors. If I hadn't done so, it wouldn't work and I see no mileage in buying new, old stock, or second-hand period components that are as old as the originals and just as liable to failure. I know some people hollow out the old capacitors and fit modern replacements inside the old carcases. This way the unit is kept in working order while retaining its original appearance. I have done this with some museum equipment where originality was paramount.

In short, I love the PCR! It is amazing that these often overlooked radios played a significant role in the execution of the allied invasion of France. **PW**

References

1) Radio Londres plaque: Wikimedia Commons, original image by Wayne77.
2) Circuit diagrams drawn by Tor Marthinsen for the Norwegian "Hallo Hallo" magazine, no 142, May 2018, pages 28- 31: "The PCR Receivers again" written by Tore Moe Namsos.