



## 6.4 Differences in Enigma models

It has been stated before in this manual that the Enigma is not a single device, but a family of machines, each with their own characteristics. Because of these differences, a messages encoded on one Enigma variant, may not decode on another one. This paragraph describes the differences.

### Steckerbrett

Some models have a plug panel and some don't. The theoretical maximum number of patch cables is 13 (as we have 26 letters), but the number of cables supplied with a unit varies. The highest number of permutations is achieved when using 11 patch cables (see paragraph 6.3) and the German Army would always use between 7 and 11 cables.

### ETW mapping

The Eintrittswalze (ETW) is the static wheel (stator) to the right of the rightmost movable wheel. The way in which the keyboard is connected to the ETW differs between Enigma models. This often called the ETW *mapping* or ETW *permutation*. The ETW can be mapped in a linear fashion: ABCDEFGH... etc, but also in the order of the keys on the keyboard: QWERTZUIO... On the Japanese machine, the Tirpitz, the contacts of the ETW are organised in a random fashion: KZROUQHY...

### Wheel wiring

Although the wiring for the first five wheels used by the German Army (I to V) was the same for all machines (A, M3 and M4), Other machines, such as the models used by the Abwehr, the Railway, Swiss Army and the commercial models, had a completely different wiring.

### Number of different of wheels

Some models have 3 rotatable wheels, but the M4 has 4 wheels. Also some models have a range of wheels (e.g. 8) to choose from. The wheels may be placed in the machine in any particular order.

On an Enigma M4 (a 4 wheel machine), the extra wheel (Zusatzwalze) is not moved automatically, but can be set manually to an initial position. Furthermore the extra wheel cannot be exchanged with the other three wheels as it is a 'thin' one. The 4th wheel was supplied as a pair with an UKW. For UKWs **B** and **C**, the extra wheels **Beta** and **Gamma** were supplied, hence the name *Griechenwalze* (Greek wheel). They may be used however in any combination. The 4th wheel on an *Abwehr* Enigma (G-series) is in fact the UKW and on this model it **is** moved by the other wheels, due to the mechanical differences in this machine.

### UKW mapping and setting

Some models have more than one UKW available. On most models the UKW is fixed, but on some the UKW can be given a start position. Additionally, the G models have a movable UKW, which means that the wheel can be moved by the notches of the wheel next to it.

### Number of notches on each wheel

In the basic situation, each wheel has one notch which, after a full revolution, causes the next wheel to be stepped by one position. Some wheels however have two or even more notches, causing more frequent changeovers of the next wheel. The three wheels of the *Abwehr* Enigma have 11, 15 and 17 notches respectively.

### Double stepping feature

As a result of the mechanical principle of the stepping mechanism, the middle rotor 'suffers' from a double stepping anomaly as described in a paper by David Hamer. The G models, which use a gear box instead, do not suffer from this double stepping behaviour.

### Manufacturer

Before and during WWII, the Enigma machines were built by various manufacturers. Although these machines were mathematically compatible, there are a few cosmetic differences. Furthermore there are physical differences between the *Griechenwalze* (*thin* wheels) from some manufacturers.