

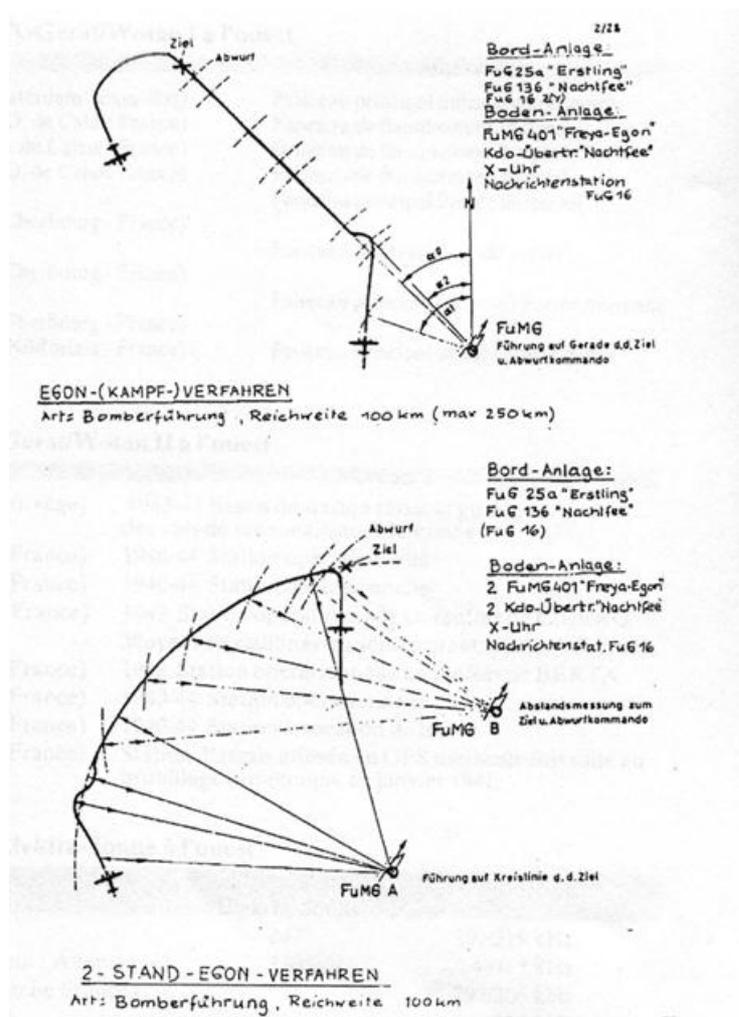
## Nachtfee working hypothesis 3

The following discussion paper proposes working hypotheses concerning the operational terms of reference (list of duties), the information to be handled by an operator and possible deductions with respect to the functioning of Nachtfee as far as such proposals can be based on our limited knowledge of literature.

### Terms of reference

We know that Nachtfee was to guide pathfinders during the Baby Blitz to London in spring 1944 (Trenkle, Jones).

To guide the bombers, EGON principles were used, meaning that Nachtfee was a ground based command system using Freya as transmitter, Nachtfee for the commands and FuG 25A as airborne receiver. Decoding of information was to be done by an airborne Nachtfee device.



Freya together with Gemse was used:

- to get information where the bomber is (azimuth and distance),
- to identify the bomber and
- to transmit the following information:
  - address of a particular pathfinder
  - correction of direction
  - order to release bombs or mines (pauke)

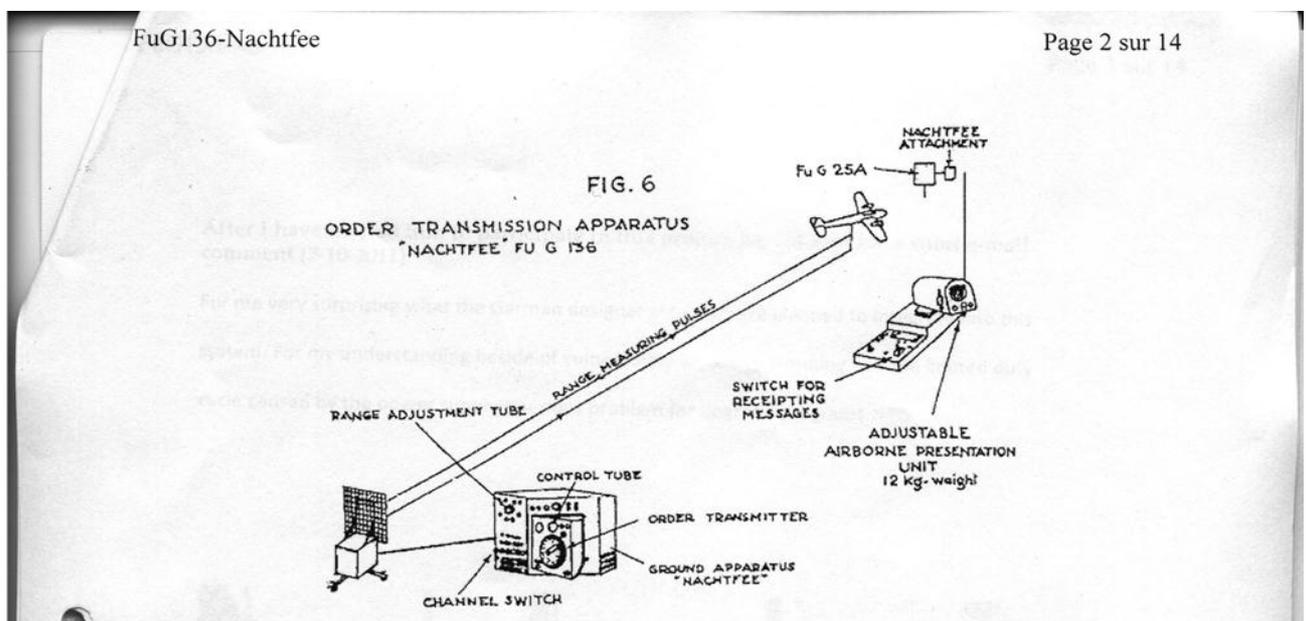
The receiver used in the airplane is FuG 25A:

- To identify the bomber (Morse coded return signal at 156 MHz)
- To receive the orders transmitted by Freya signals, to extract them from the Freya signal and to hand it over to the Nachtfee apparatus which is exposing them as orders displayed on a CRT (LB2) as polar co-ordinates to which particular orders are attributed.

The job on hand was to guide several pathfinders to different positions to mark the territory to be bombed. This means different planes had to be identified and to be given different orders. (Could be that each pathfinder was guided by one particular Freya. The Meissner station had 4 Freyas: info from Beck)

Identification of individual planes is possible through the signal emitted by Fug 25A which can be individually coded by its 2 keys

## Information to be handled by an operator



The above pictures permit a description of the work of the operator. He has to dispose of the information of the present co-ordinates of the pathfinder and its identity: This is provided by Freya/Gemse and very probably exposed directly on the CRT (Range adjustment tube).

He knows the co-ordinates of the place to which the plane has to be guided. He deduces the corrective orders to be given. These orders have to be given in the form provided by the "Order transmitter". The orders have to be given in a code which has to change for each sortie. (If the enemy finds out what the order "Pauke" is in terms of Freya signals, he can give this order and have the bombs dropped somewhere in the landscape.) The operator has therefore a code table which indicates which of the 10 switches has to be turned on for a given order.

He controls on the "Control tube" that order given and read in the plane is exact.

## Functioning of Nachtfee

The question is than "how to give orders to the pilot using Freya as transmitter?" There are 2 possibilities: The first one consists in transmitting the Freya pulses as a Morse signal (digital coding). This had already been tried as "Nachlicht" reproducing the Morse signals through lighting the Neon lamp of the Bediengerät of the FuG 25A (Trenkle).

The second one consists in phase modulating the Freya pulses (mentioned in several publications). However, Fug 25A is not capable of distinguishing phase differences of the received radar signal without considerable design changes. This suggests that, by phase modulation, modification of the repetition frequency is meant. This of course can only be done within certain limits of the Freya repetition frequency, (being 500 to 2000 Hz) i.e. for example several tenth of Hz.

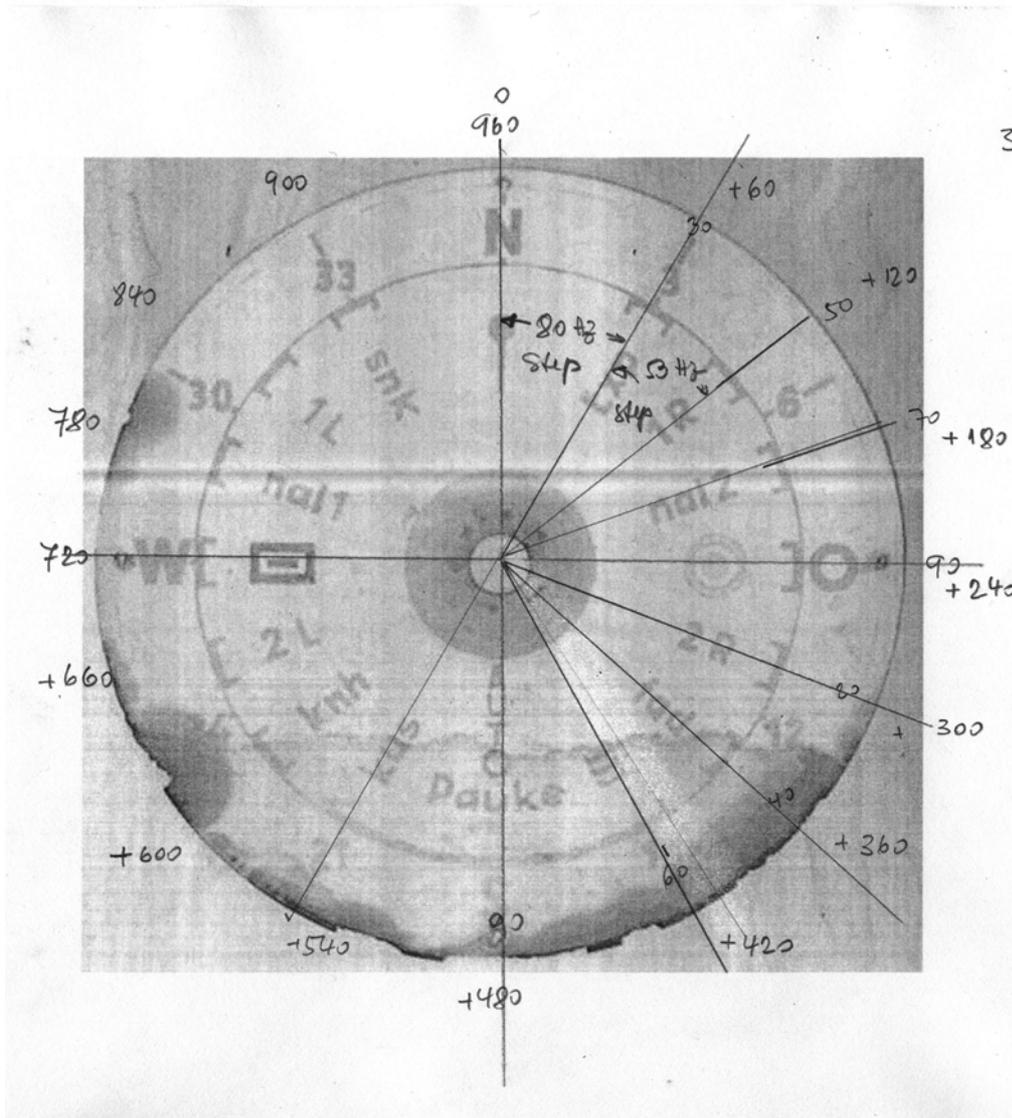
There are no quartz oscillators available for such low frequencies. Now this may be used to explain the 10 modules of the Nachtfee. 15kHz + the low frequency quartzes were used. This supposes that the low frequencies (60, 120 etc. Hz) are yielded by mixing 14760 and 14820Hz for example.

By the way, there is no possibility to transmit 15 kHz information with Freya technology.

The orders given to planes could be imagined as being of 2 kinds: orders concerning direction and orders concerning bombe release. Directional orders could be the main orientation (north, west, east etc.) or course corrections such as 10° left or 10° right (1L, 1R).

The enemy can disturb this system in 2 ways: He can jam the Freya transmission or he can give wrong orders by Freya like signals. For this he would have to know the codes. In order to prevent this one could imagine that the codes were changed for each sortie by switching on some of the 10 modules each time in a different way.

**We tried to measure accurately the signal output frequency versus locked or unlocked. Locked the output frequency is read-off our frequency counter about 964 Hz (never getting a stable reading, sometimes showing about 970 Hz) and unlocked, thus no quartz-channel-signal is provided, its output measured at the anode of Rö 18 at about 944 Hz. We have to be aware, that the indicated frequency might differ quite well from the actual output frequency, as the counter triggering, as well as often the scope triggering, is being hampered by the existence of various signal components.**



Now 960 Hz divided by 60 Hz, which is the step frequency of the quartz oscillators gives exactly 16 orders which can be transmitted.

This may suppose that the circular frequency of the LB2 is 960 Hz.

This poses a lot of questions:

The distance between N and Exp is 30° meaning a step of 80 Hz.

The distance between Exp and 1R is 20° meaning a step of 53 Hz.

We have only 10 quartz frequency but 16 orders.

It may be assumed that the entire control of the repetition frequency is done by the Nachtfee. We know from Kroge's book Gema, that Freya can be piloted by an external source instead of the internal "Summer" (500 Hz). Why not 960 + or - Nx60 Hz. However, Freya power supply supports up to 2000 Hz repetition frequency.

This would lead to the conclusion that the 11<sup>th</sup> module is indeed a mixer.

The consequence of all this would be that the LB2 in the Nachtfee and in the airborne indicator work as **identical** spectrum analyzers exposing frequencies from 0 to 960 Hz on a circle. The blips corresponding to the distinct frequencies (30, 60 etc Hz) are read as orders to be executed by the pilot.

The technology of such spectrum analyzers is well mastered by the German industry since at least the '30ies by using ferrite coils.

However, this is where the Feuerstein Laboratory's competency comes into the play. In the TOCIM report it is clearly stated that the main competencies of Feuerstein are acoustics (low frequency) filter and quartz design.

All this means that these working hypotheses can be checked by verifying whether the following components exist in the Nachtfee:

- Filters between 30 and 960 Hz to build the spectrum analyzer
- The cabling of the "Range adjustment Tube" is similar to the one of Freya.

## Literature

EUROPEAN AXIS SIGNAL INTELLIGENCE IN WORLD WAR II ) AS REVEALED BY "TICOM",  
INVESTIGATIONS AND BY OTHER PRISONER OF WAR INTERROGATIONS AND CAPTURED MATERIAL,  
PRINCIPALLY GERMAN

Nachtfee", a night fighter control system: based on phase modulation (209).

209.: E-7, p. 54'. USA got two complete sets.

E 7. "Final Report on the Technical Exploitation of the Feuerstein Laboratory (Director: Dr. Oskar Vierling) carried out by a Special Team under TICOM auspices." A TICOM publication.

Salles Jean-François : Organisation des systèmes de radionavigation de la Luftwaffe en Normandie en 1944, „Radar News 19“

Trenkle: Bordfunkgeräte, Die deutschen Funk-Navigations und Funk-Führungsverfahren,

Felkin S.D. Radio and Radar equipment in the Luftwaffe, Vol VI (not yet found but cited by Trenkle)

Helwig Schmied 30.12.2011