GAF ANTI-JAMMING PRACTICE

Additional Intelligence on Methods Used To Counter Allied Radar Interference

INFORMATION of considerable value regarding German procedures in countering Allied radio and radar countermeasures has been received through ADI (Science), Air Ministry, in the translation of a German manual for flak personnel. There is no doubt that Allied electronics countermeasures have presented a serious hindrance to the GAF throughout the past three years, and the elaborateness of the enemy effort in attempting to overcome them is testimony to their general effectiveness.

Previous reports, in SUMMARY No. 37 (*page* 12) and No. 53 (*page* 25), have already described certain of these procedures, and this article will consequently be devoted to the details set forth in the captured manual.

The enemy manual makes the following general remarks about jamming and anti-jamming :

" The radio war is undergoing very rapid development so that surprises must always be reckoned with —experience, thorough training and clear perception are the basis of successful defence against enemy jamming.

" Our opponent tries by various methods to make Flak control radar plotting difficult or even impossible.

" Defence against enemy jamming is possible only if the crew know the possibilities of enemy jamming and their appearances on the screen and also know what to do and which apparatus to use to restore the equipment to correct operation."

The types of jamming are next introduced : " active " jamming, which is jamming by transmitters such as Carpet, and " passive " jamming.

" By passive jamming is understood jamming by means of dropped or towed reflectors. Such reflectors reflect the transmitted energy that reaches them from the Flak control radar exactly like an air target. Because of their density they cause the picture on the cathode ray tubes to look like a pulsating ' mountain range ' of target blips.

" Tight formations of aircraft can also cause blips on the cathode ray tube of such type that operation is made very difficult. On the main range tube a formation can appear as a widened target blip or as a mountain range of blips."

Anti-jamming procedures for removing these rude pictures on the German radar screen are listed as :

" Wismar Procedure : renders possible complete mitigation of active jamming (such as Carpet).

" Stendal Procedure : permits measurement of the bearing and elevation of the jamming transmitters. In addition it facilitates bearing measurement under unfavorable conditions by rendering the target more conspicuous.

" Goldammer Procedure : facilitates range measurement in the presence of active jamming.

" Nürnberg Procedure : constitutes an audio aid to the plotting of air targets in the presence of jamming.

"Würzlaus Procedure : enables moving targets to be distinguished from stationary ones."

Wismar procedure refers to all efforts which aim, by change of frequency of the radar, at avoiding active interference, as discussed in SUMMARY No. 53. *Wismar* is given the leading place in the discussion of anti-jamming devices, perhaps indicating that it is thought the most likely antidote.

A change of wavelength necessitates first altering the transmitter/local oscillator. On going from one band to another a change on the rotating dipole is likewise necessary, provided this is *not* a wideband dipole.

Three types of transmitter/local oscillator exist : those whose waveband and spot wave can not be changed ; those units whose waveband and spot wave can be changed, and those units whose waveband cannot be changed, and the spot wave by the radar mechanic.

Three types of rotating dipoles may also be found : dipoles which do not provide for a change of length ; AB-dipoles, which provide for a change of length after a locking screw has been loosened, and wideband dipoles, which can be used, without changing, for all the wavebands.

There are thus, depending on the equipment available, several possibilities of ease of frequency change and the total frequency range possible. If only one transmitter/local oscillator assembly of the first type is available, no change at all is possible ; if, however, a reserve transmitter assembly, ready-tuned for operation on another band, is available at the site, the two units may be exchanged. If a transmitter assembly of the third type, a wideband dipole, and a spare transmitter assembly are available, the operating frequency may be changed over a small range (probably 6-10 mc.) while in operation, and in addition, a change from one band to another, a shift of some 30 mc., may be effected in a short time, if no clear channel is available in the first band.

It is apparently not possible to actually follow a target with the radar while searching for an unjammed channel and tuning the transmitter to it. However, the operators are instructed to continue turning their

handwheels smoothly according to the established direction of flight, in the hope that when the target turns up again no large readjustment will be necessary.

Wismar, therefore, while capable of elimination of interference under some conditions, involves no little training on operations which must be carried out very accurately in a few seconds.

Stendal procedure makes possible in the presence of active jamming the measurement of bearing and elevation angles of the jamming transmitter. It facilitates in addition the measurement of bearing and elevation under difficult plotting conditions by separating out the target.

This procedure can be used in two circumstances. In the presence of active jamming, elevation and bearing of the jamming transmitter can be determined. If a jamming transmitter is carried in an aircraft, the values of bearing and elevation can serve as a guide to a flak searchlight or as a basis for barrage fire. If, after laying on the jammer, a target blip can be recognised on the main range and fine range tubes the range can also be determined. In the presence of window jamming, if a target is recognizable through window, the determination of bearing and elevation is facilitated by the use of *Stendal* procedure because this target is separated out. (Danger of a false reading results here, however.) When plotting formations, measurement of bearing and elevation angles can be facilitated by changing over to *Stendal* procedure. A preliminary condition is that the range has first been correctly determined. In many cases a mean point inside the formation is plotted in this way.

Nürnberg procedure operates with an audio attachment, which under certain circumstances makes the following phenomena audible: (a) The inherent vibrations of an aircraft, which arise principally from the airscrew, result in periodic variations of the reflected wave trains, which are made audible as the "*Nürnberg* Tone." This tone has a frequency between 50 and 150 cycles, and is therefore a low humming tone. (b) With sets fitted for *Würzlaus* procedure the sequence of events which gives rise to the *Würzlaus* presentation is made audible in addition to the *Nürnberg* tone.

Nürnberg procedure makes it possible with light window jamming, in which it is still possible to recognize the target blip or *Würzlaus* blip, if *Würzlaus* procedure is used, to check whether this blip definitely originates from an aircraft. With medium to strong window jamming, in which the target blip of *Würzlaus* blip temporarily disappears, to hold and plot the aircraft until its blip again becomes recognizable; with very strong window jamming, in which no target or *Würzlaus* blip is recognizable, to pick up and plot an aircraft until the target blip becomes recognizable. (Without, however, sufficient accuracy for predicted fire.)

Taunus Presentation: *Würzlaus* procedure makes it possible to differentiate between moving and static targets during window jamming, thus facilitating the plotting of aircraft targets.

A closed echo region is resolved by the so-called *Taunus* presentation into a number of separate blips. Plotting of formations, of targets in the permanent echo region and of sea targets is thus facilitated by *Taunus* presentation during window jamming.

Würzlaus procedure depends for its operation on the physical fact that the waves reflected from a moving target experience a change in phase in relation to the phase of the oscillations of a locking oscillator.

A moving target, which changes its range in relation to the flak control radar, is shown in normal presentation on the bearing tubes as an oval "streaky" blip, called a *Würzlaus*, while blips from window clouds, permanent echoes and slowly moving targets appear as snaky lines, called "snakes."

This procedure with *Taunus* presentation makes possible the determination of range, bearing and elevation values during window jamming, with sufficient accuracy for them to serve as a basis for flak control by appropriate apparatus. The simultaneous use of *Nürnberg* procedure facilitates the picking up and tracking of air targets in window clouds and serves to check whether the target plotted is an aircraft.

Plotting of Formations: A tight formation of aircraft so far only encountered with daylight raids makes a plotting with flak control radar more difficult. This occurs because (depending on the range of the formation, the bearing from the flak control radar, and the relative positions of the aircraft in the formation) several aircraft generally appear at the same time within range of the rotating lobe.

Energy reflected from all aircraft in the beam is greater than that reflected from a single aircraft. Hence the range of flak control radars is considerably greater when plotting formations than when plotting single aircraft.

The picture on the presentation tube of the reflected energy from other aircraft in the beam prevents accurate plotting of a single aircraft. Inaccuracy of the reading is compensated for because a formation presents a large target which cannot easily take evasive action.

The values passed by a well-instructed crew, using an anti-jamming procedure, often make it possible to lay most of the battery fire on the formation.

The more aircraft of a formation which are picked up by a flak control radar, the more complicated the electrical relationships become. Electrical centers of gravity are then plotted; however, with a correct setting of the blackout, the point plotted must always be inside the formation.

Electrical-Optical Plotting : Advantages of combined electrical and optical plotting, where use is made of exact electrical range values with accurate optical bearing values, also apply to plotting formations. Therefore, when dealing with attacks by formations of aircraft, electrical-optical plots are always to be preferred to purely electrical plots, according to the enemy manual.

During night raids, it is often possible to go over to optical plotting of bearing after the predictors (*Kommandogeräte*) have been laid on the target electrically (SUMMARY No. 65, *page* 12).

As soon as the predictor, having been put on to the target by the flak control radar, is in a position to plot optically, it plots an aircraft flying in the center of the formation.

Change-over from electrical to electrical-optical plotting must take place without delays. In the same way it must be insured that when the target has been lost optically, no breaks occur when reverting to electrical plotting.

The danger of electrical-optical plotting lies in that the flak control radar and the predictor might plot different targets. Because of this the parallel running of both sets must be checked on the receiver box of the predictor.

Effectiveness of the GAF's various anti-jamming devices and procedures still remains unsettled. Certainly, much experience in their use has been gained by the Germans. Throughout the manual the importance of cooperation between the radar crew members, the necessity for constant training, and emphasis on knowing the capabilities of one's equipment are stressed. Operation of a flak radar set with no jamming whatsoever calls for these very same things. It would appear that any considerable use of countermeasures would strain even the best-trained crew to the utmost.

It has been stated that both the *Nürnberg* and *Würzlaus* procedures are very fatiguing ; according to rumor, early models of *Nürnberg* so much so that the operator's sanity was endangered. *Würzlaus* involves very critical adjustments to the equipment which have been found tricky enough in the laboratory.

The section on *Goldammer* was crossed off in the enemy manual. This procedure, which depends on selecting a plane of polarization for measurements, at which jamming was at a minimum, seems to have fallen into disuse. It is possible that carpet antennas, now in wide use by USAAF, which radiate substantially equally through all planes of polarization, may have had something to do with *Goldammer's* fall from grace.

A whole section of the manual is devoted to the procedure for taking photographs of jamming and the effect of large formations on flak radar scopes. A detailed procedure is also laid out for practice against window jamming. It is stated that the target aircraft, to duplicate the window densities actually attained during operations, must carry at least at on of chaff.

It is certainly significant that a whole section of the manual has been devoted to procedures to be followed in plotting tight formations, " so far only encountered with daylight raids." The inclusion of this section in a manual on anti-jamming makes formation flying a radio-countermeasure in itself and apparently not an ineffective one.

Unusual Smoke Screen at Bitterfeld, 14 January

A SMOKE SCKEEN of unusual whiteness and density was observed in action by Eighth Air Force bombers at Bitterfeld, a town northeast of Halle, on 14 January. Photographs taken at the time indicate that this screen may have been of a new type.

Taking into account that surface wind conditions may have been ideal, this screen formed with great rapidity from generators or tanks at a number of points, and the smoke appeared to emerge from the orifices in a manner suggesting that considerable pressure was behind it. Cones of smoke formed and fanned out very quickly, without the semi-transparent patchiness and stringiness of most incipient smoke screens. Within a very few minutes, the Bitterfeld smoke screen had spread to cover the area very thoroughly with dense white overlapping masses of smoke resembling wool-pack cumulus cloud.

It is thought possible that a new smoke-forming agent or a new type generator or projector may have been in operation—possibly both. As mentioned, ideal wind speed and direction may have been at least partially responsible for the accurate and rapid spread of the screen on this particular occasion. The degree of pressure at the sources would have only a slight and brief effect on the rapidity of spread, were wind conditions not properly favorable.

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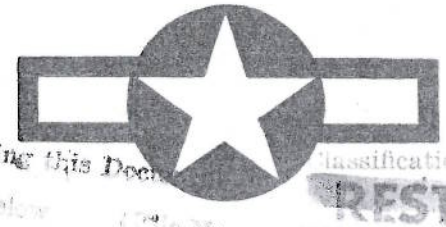

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