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Bezeichnung der Erfindung: Improvements in or relating to radar systems employing two kinds of pulses
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : G01S 13/30, G01S 13/28

ENTSCHEIDUNG / DECISION

vom / of / du 30 May 1988

Anmelder / Applicant / Demandeur : Hollandse Signaalapparaten B.V.

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56

Kennwort / Keyword / Mot clé : Inventive step (no)

Leitsatz / Headnote / Sommaire

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Case Number : T 193/86

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 30 May 1988

Appellant : Hollandse Signaalapparaten B.V.
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Representative : T.A.C. Kradolfer

Decision under appeal : Decision of Examining Division 046 of the European Patent Office dated 30 December 1985 refusing European patent application No. 82 200 459.4 pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : P.K.J. van den Berg
Members : W.J.L. Wheeler
O.P. Bossung

Summary of Facts and Submissions

I. European patent application No. 82 200 459.4 (publication No. 64 305), filed on 15 April 1982 and claiming priority from a previous application GB 8113690 of 5 May 1981, was refused by the decision of the Examining Division 046 of the European Patent Office dated 30 December 1985.

II. That decision was based on Claim 1 as originally filed, which reads as follows:

"Radar system comprising a first generator for generating frequency-modulated transmitter pulses of relatively long duration; a second generator for generating transmitter pulses of relatively short duration; a transmitter channel, coupled to said first and second generators, through which channel both the long and the short-duration transmitter pulses are transmitted; and a receiver having a first receiving channel, containing a pulse compression filter for the detection of return signals from the transmitter pulses of relatively long duration, and a second receiving channel for the detection of return signals from the transmitter pulses of relatively short duration, characterised in that the second generator comprises means for frequency-modulating the transmitter pulses of relatively short duration and the second receiving channel includes a pulse compression filter for compressing the return signals of the transmitter pulses of relatively short duration."

III. The reason given for the refusal was that the subject-matter of the claim did not involve an inventive step, having regard to the prior art disclosed in GB-A-1 552 877 and common general knowledge in the art as evidenced by Skolnik, "Introduction to Radar Systems" 1981 edition, pages 420-421.

IV. On 27 February 1986 the Appellant filed a notice of appeal against this decision. The appeal fee was paid on the same day. A statement of grounds was filed on 29 April 1986.

In the statement of grounds the Appellant argued in effect that the radar system of the present application had as its object to improve the noise situation of the receiver by passing the target echo signals derived from the short pulses jointly with the clutter signals derived from the long pulses through a single r.f. preamplifier at the input of the receiver, with subsequent separation into the first and second receiving channels in the i.f. stage. The sentence covering lines 31-34 of page 1 of the present application had to be read as meaning that if there were a coincidence of signals from strong clutter signals derived from the long pulse and from a desired target signal derived from the short pulse, the receiver would suffer from desensitisation and the desired targets could be weakened or masked. The present invention used frequency-modulation of the transmitted short pulses with pulse compression of their returns to spread the energy of the short pulses over a longer period, thereby avoiding saturation of the r.f. preamplifier.

In a letter dated 14 November 1986 (received 26 November 1986) the Appellant pointed out that the Skolnik reference cited by the Examining Division related to a problem at the transmitter, namely the disadvantage of a large peak power, whereas in the embodiment of the present invention pulse compression was applied to the short pulses to solve a problem at the receiver, namely saturation.

In a further letter dated 2 September 1986 (received 3 December 1986) the Appellant cited an article by Taylor et al in Proceedings of the IEEE, Vol.73, No. 2, February 1985, pages 284-289: "Design of a New Airport Surveillance Radar (ASR-9)" and pointed out that although this article refered to the problem of insufficient energy of the short pulse (see page 287, lines 10-24) it did not propose a solution, the radar specialists having apparently resigned themselves to accepting this.

V. In a communication dated 4 November 1987, the Board pointed out that neither the prior art system known from GB-A-1 552 877 nor the system according to Claim 1 of the present application had a preamplifier common to the first and second receiving channels. According to the description of the preferred embodiment (which has got a common r.f. preamplifier at the input of the receiver), saturation of the amplifiers was prevented by sensitivity time control (STC). There appeared to be no suggestion in the present application that frequency-modulating the short pulses and compressing their returns was done to prevent saturation of the r.f. preamplifier.

VI. In the reply dated 14 April 1988 (received 16 April 1988), the Appellant pointed out that, as the intensity of a return pulse was inversely proportional to the fourth power of the distance, the returns from the long pulses were generally weaker than the returns from the short pulses, especially when the p.r.f. of the short pulses was greater than that of the long pulses. As may be read in Skolnik, formulae 13.5-13.7, the target-to-clutter ratio of a single pulse was unaffected by the energy of the transmitted pulse. The combination of frequency-swept short pulses and frequency-swept long pulses used in the radar system of the present application represented a break with tradition.

VII. The Appellant requests that the decision under appeal be set aside and a patent granted on the basis of Claim 1 as originally filed (main request), or on the basis of Claim 1 limited to the p.r.f. of the short pulses being greater than the p.r.f. of the long pulses (auxiliary request).

Reasons for the decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. Novelty

A prior art radar system comprising a first generator for generating frequency-modulated transmitter pulses of relatively long duration, a second generator for generating transmitter pulses of relatively short duration, a transmitter channel coupled to said first and second generators, through which channel both the long and the short-duration transmitter pulses are transmitted, and a receiver having a first receiving channel containing a pulse compression filter for the detection of return signals from the transmitter pulses of relatively long duration, and a second receiving channel for the detection of return signals from the transmitter pulses of relatively short duration, is disclosed in GB-A-1 552 877, as is acknowledged on page 1 of the present application. Another prior art radar system having all the above mentioned features is known from US-A-3 945 011, which is mentioned in GB-A-1 552 877 as prior art.

The radar system according to Claim 1 of the present application differs from the prior art systems known from GB-A-1 552 877 and US-A-3 945 011 in that the second generator comprises means for frequency-modulating the transmitter pulses of relatively short duration and the second receiving channel includes a pulse compression filter for compressing the return signals of the transmitter pulses of relatively short duration.

In the opinion of the Board, no other prior art document on the file comes closer to the subject-matter of Claim 1, it being noted that this claim is entitled to the priority date of 5 May 1981 and that neither EP-A-0 049 987 nor EP-A-0 051 361 is entitled to the priority date of 27 September 1980 in respect of the idea of frequency-modulating the transmitter pulses of relatively short duration and compressing their returns.

The subject-matter of Claim 1 is, therefore, new.

3. Inventive step (main request)

According to the description of the present application, in the prior art radar system known from GB-A-1 552 877 the short pulses must be sufficiently short to assure a good range-resolution and allow a short minimum range. As a consequence, their transmitted energy is limited and their range may be smaller than the range within which strong clutter appears. Part of this range then has to be covered by the long pulses.

As is stated on page 1, line 31, to page 2, line 2, of the present application: "This, however, makes it possible that, if there is a coincidence of signals from strong clutter and desired targets, the receiver will suffer from

desensitisation and the desired target can be weakened or masked. This desensitisation will occur more frequently when the strong clutter is more frequent and when the transmitted pulse length is longer."

The Board interprets this statement to be an explanation of the problem that because the resolution cell of the long pulses is relatively large, it contains a relatively large amount of clutter with which the desired target has to compete, and that, since returns from clutter in the near part of the range covered by the long pulses are strong, they cause desensitisation of the receiver.

This interpretation is consistent with the explanation on page 2, lines 9 to 16, of the description of the present application, according to which the radar system of the present application solves the problem by giving the transmitted pulses of relatively short duration sufficient energy so that they can cover the region in which strong clutter appears.

In the opinion of the Board, then, the problem which the radar system according to the present application solves is that of avoiding masking of desired targets by strong clutter appearing in the range just beyond the range covered by the short pulses. This was a self-evident problem which presented itself in the normal use of the prior art system. A person skilled in the art, starting from the system known from GB-A-1 552 877 and seeking a solution to this problem, would realise that it would be advantageous to extend the range of the short pulses by increasing their energy to cover the region in which strong

clutter appears, since, as may be seen from the Skolnik reference cited by the Examining Division, it was common general knowledge in the art that a short pulse increases the target-to-clutter ratio by reducing the clutter contained within the resolution cell with which the target competes (see Skolnik, page 421, lines 10 and 11).

Furthermore, since, as may also be seen from the Skolnik reference cited by the Examining Division, it was common general knowledge in the art that an increase in the energy of transmitter pulses can be obtained, while retaining good range-resolution and an acceptable minimum range, by frequency-modulating the transmitter pulses and compressing their returns, a person skilled in the art could be expected to consider applying this well known technique to extend the range covered by the relatively short pulses.

The inevitable consequence of following up this idea would be to construct a radar system as defined in Claim 1 of the present application.

The fact that there could be other reasons for frequency-modulating the short pulses, for instance the avoidance of receiver desensitisation when returns from the long and short pulses are received simultaneously (see IV above), does not make it less obvious to do it in order to extend the range of the short pulses to cover the region in which strong clutter appears. Nor does the fact that the Taylor reference referred to in the Appellant's submission dated 2 September 1986 refers to the short pulses as being too weak without mentioning the solution proposed by the present application mean that the solution is not obvious. It can hardly be expected that every radar system will adopt the same solution to this problem.

Therefore, the subject-matter of Claim 1 does not involve an inventive step within the meaning of Article 56 EPC.

It follows that the Appellant's main request must be dismissed.

4. Auxiliary request

In the prior art radar system known from GB-A-1 552 877 the pulse repetition frequency of the short pulses is greater than that of the long pulses (see page 1, lines 72 to 90, page 3, lines 43 to 52, and Figure 39). Limitation of Claim 1 by introducing this feature would not therefore be of any avail, since the reasons given in section 3 above would still apply, leading to the same finding of lack of inventive step.

It follows that the Appellant's auxiliary request must also be dismissed.

5. In view of the Appellant's submissions noted under item IV above, and pursuant to Article 114(1), the Board has considered the possibility of amending Claim 1 to specify that the first and second receiving channels comprise a common part, and that the separation of the return signals from the long and the short transmitter pulses occurs after the frequency of the return signals has been transformed to the intermediate frequency region (cf. originally filed Claim 2, which was cancelled during the proceedings before the Examining Division).

However, the prior art system known from US-A-3 945 011 would then be the closest prior art, since its receiver has common r.f. and i.f. stages (see Figure 1, column 2, lines 67, 68, column 3, lines 24 to 27, and Claim 5 of US-A-3 945 011). The subject-matter of the amended claim

would therefore, differ from this prior art by only the same characterising features as appear in the present Claim 1. Consequently, it would not involve an inventive step for similar reasons to those given in paragraphs 3 and 4 above.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar The Chairman

S. Fabiani P. K. J. van den Berg