DATASHEET FOR THE DECISION
OF 19 JUNE 2009

CASE NUMBER: T 1259/05 - 3.4.02
APPLICATION NUMBER: 02425164.7
PUBLICATION NUMBER: 1258701
IPC: G01B 11/02
LANGUAGE OF THE PROCEEDINGS: EN

TITLE OF INVENTION:
A process for reading fractions of an interval between contiguous photo-sensitive elements in a linear optical sensor

APPLICANT:
Snap-on Equipment S.r.l.

OPONENT:
-

HEADWORD:
-

RELEVANT LEGAL PROVISIONS:
-

RELEVANT LEGAL PROVISIONS (EPC 1973):
EPC Art. 123, 84, 54

KEYWORD:
"Amended claims - inadmissible amendment (no)"
"Clarity (yes)"
"Novelty (yes)"
"Inventive step (yes)"

DECISIONS CITED:
-
Catchword: -
Case Number: T 1259/05 - 3.4.02

DE C I S I O N
of the Technical Board of Appeal 3.4.02
of 19 June 2009

Appellant: Snap-on Equipment S.r.l.
Via Provinciale Carpi 33
I-42015 Correggio (RE) (IT)

Representative: Gotra, Stefano
BUGNION S.p.A.
Via M. Vellani, 20
I-41124 Modena (IT)

Decision under appeal: Decision of the Examining Division of the European Patent Office posted 17 May 2005 refusing European application No. 02425164.7 pursuant to Article 97(1) EPC.

Composition of the Board:
Chairman: A. G. Klein
Members: M. Rayner
          M. J. Vogel
Summary of Facts and Submissions

I. The present appeal lies against the decision of the examining division refusing European patent application number 02 425 164.7 relating to a process for interval reading in a linear optical sensor. In the examination and/or appeal proceedings, reference has been made to the following documents:

D1 US-A-4 898 464
D2 EP-A-0 539 598
D3 WO-A-92 19 932

II. According to the decision under appeal, the statement of claim before the examining division included claims, the subject-matter of which was not novel in the sense of Article 54 EPC and claims which were not clear in the sense of Article 84 EPC. In addition, the division remarked that amended claims introduced subject-matter extending beyond the content of the application as filed. The reasoning of the examining division can be summarised as follows:

(a) While not present in any claim refused for lack of novelty, the division was not satisfied as to clarity of a feature relating to the number of elements constituting a template being different to the number of elements constituting a current image, as suggested by the mathematical statement m>n. This point was not further elaborated in the decision.

(b) Neither did the division consider clear what the formulas for S, in both the claims represent. If I
and $T$ are taken to be intensities, then $S$ should have units of intensity. However, $S$ is defined as a distance.

(c) Also, the formulas allow negative indices for $T$, which implies negative numbering (as well as zero) for the photosensitive elements. However, the numbering of the elements begins with one. It cannot be taken as implicit that $I = k+1, k+2, \ldots, k+n$, as several other values for range of the index could be chosen.

(d) Furthermore, it is unclear why, in the formula for $S$, either the variable $T$ for one element is subtracted from the variable $I$ of another element, or, the variable $T$ for one element is multiplied with the variable $I$ of another element. This suggests that the template image and current image are shifted with respect to each other, which makes no sense. Moreover, in both claims, it is not clear what is meant by "the curve passing through the distances corresponding to elements $k, k+i, k-i$".

(e) It is also unclear what the ratio $f$ shown in the claims represents. If $S$ is the distance of element $k$ from a reference point, the ratio $f$ results in a division by zero for the typical case of evenly spaced photosensitive elements.

(f) No basis could be found for defining $T_i$ and $L_i$ as light intensities. On the one hand, they have simply been defined as photosensitive elements constituting the template and current image,
respectively. On the other hand, they have been defined used to calculate distance in such a manner to imply they have units of distance.

(g) Moreover, there is no basis for substituting d, an undefined variable, with S, a variable which presumably is intended to express distance.

III. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of claims 1-4 presented with the letter dated 19.02.2009. Furthermore, requests concerning amendment of the description and for oral proceedings were presented on an auxiliary basis.

The appellant submits that none of the prior art documents disclose a comparison with a predetermined template, with a current image being defined by "m" light intensities and the template by "n" light intensities, "m" being larger than "n". The subject-matter claimed can be considered to involve an inventive step, because such technical features solve the problem of obtaining a reliable determination of light beam point of incidence with reduced computational complexity and a smaller memory.

With respect to the reasoning of the examining division concerning clarity and added subject-matter, the appellant submitted the following:

(a) the mathematical statement m>n is per se clear and needs no further explanation as to its meaning.
(b) It is apparent from the application that $I_k$ and $T_k$ are representative of light intensities, so that $S_k$ resulting from the formulae in claims 3 and 4 also represents light intensity. Furthermore, $S_k$ is defined as distance in the sense of the distance between vectors in the space in which these vectors belong as is well known in pattern matching.

(c) A person skilled in the art immediately understands that zero or negative indices are not to be considered and therefore correctly selects "i".

(d) The difference and multiplication operations are per se clear and the formulas clearly indicate the relationships between the various variables without leaving any doubt into the reader as to their meaning. The difference $I-T$ and the product $FT$ are different ways to process together the data present in the current image and in the template in order to find where (i.e. at which distance from the reference) the maximum similarity between the template and the current image takes place, namely the exact position where the optical axis of the light beam intersects the axis of the linear sensor. Thus, the expression "the curve passing through the distances corresponding to elements $k,k+1,k-1$" indicates the curve which interpolates the upper ends of the segments whose length is defined by the differences at elements $k,k+1,k-1$. 
(e) Variable "f" represents the fraction of interval between two contiguous photosensitive elements defining the point of incidence of the optical axis of the light beam. In other words, by multiplying the variable "f" by the distance between two contiguous photosensitive sensors, there is obtained the distance between the point of incidence of the optical axis of the light beam and one of said contiguous photosensitive sensors. In a case of $S_k = S_{k+1} = S_{k-1}$, the denominator would be zero, but the numerator would be zero as well, which means that the three "samples" representing the differences at elements $k-1,k,k+1$ are all equal to each other, thereby causing a $0/0$ division to be calculated. The situation means any position in the interval would be a correct indication of the point of incidence. The processing unit which controls the devices must be properly programmed to handle this particular case. Therefore the situation is mathematically clear and defined, and no lack of clarity exists with reference to the formula by which "f" is defined.

(f) The amended claims do not contain subject-matter which extends beyond the content of the application as filed. Clear support for the features concerned can be found in the description, at page 5, lines 1-8. With respect to the expression "light intensities read by the photosensitive elements", the light intensities detected by the photosensitive elements are referred to, in the description, for example, at page 4, lines 19-20 and lines 21-23, where the
diagram of figure 3 is explained. Further, when photosensitive devices are concerned, variables which are detected and processed cannot be anything but light intensities; giving "T" and "I" meanings different that light intensities - for example, physical distances - would lead to an overall nonsense. Therefore, a skilled person, when reading the formulas, would clearly understand that "T" and "I" are the light intensities read by the photosensitive elements.

(g) With respect to the replacement of "d_k" with "S_k", it is to be underlined that, once defined that S_k is a difference between light intensities, and that the term "distance" has the same meaning as "difference", the variable by means of which "f" is calculated cannot be anything but S_k, in view of the explanation given both in the description and the claims: "...the fraction of interval between two contiguous photosensitive elements is determined using an interpolation obtained considering the local minimum of the interval k+1, k-1 in the curve passing through the distances corresponding to elements k,k+1,k-1, i.e. the fraction of interval being determinable using the ratio:..."

IV. Independent claim 1 is worded as follows:

"1. A process for reading fractions of an interval between contiguous photosensitive elements (6) in a linear optical sensor (5), of a type used in a goniometer, in which the angle measured (α) is the angle formed with a reference axis (9) of the
goniometer, perpendicular to the linear optical sensor (5) by a light beam (8) which is trained on the optical sensor (5) by an optical device (7), comprising:
a reading of a current image constituted by an ordered totality of intensities of incident radiations read on contiguous photosensitive elements (6),
processing of data taken from the current image by means of a process defining, with respect to an origin determined by an intersection of the reference axis (9) with an axis of the sensor (5), a distance d of a point of incidence on the sensor (5) of an optical axis of the light beam, characterised in that said processing step comprises:
- comparing said current image with a template defined by "n" light intensities, said current image being defined by "m" light intensities, wherein the number "m" is larger than the number "n"
- an interpolation process based on the comparison to determine said fractions."

**Reasons for the Decision**

1. The appeal is admissible.

2. **Added Subject-matter (Article 123(2) EPC)**

2.1 The board concurs with the submissions of the appellant in relation to added subject-matter and is therefore satisfied that the requirements of Article 123 EPC are met by the claims as amended.
3. **Clarity**

3.1 Similarly, the board concurs with the submissions of the appellant in relation to clarity and is therefore satisfied that the requirements of Article 84 EPC are met by the claims as amended.

4. **Patentability (Articles 54 and 56 EPC)**

4.1 None of documents D1 to D3 disclose the characterising features of claim 1, nor were substantive arguments against patentability of the subject-matter now claimed advanced by the examining division. The problem solved by the novel feature is to obtain a reliable determination of light beam point of incidence with reduced computational complexity and a smaller memory.

4.2 According to document D1, phototransistors in an array 38 are subject to effects of ambient light, internal bias and so forth which can produce inaccurate information. In order to compensate for these effects, the light beam is turned off so that "off" outputs values from the phototransistors can be stored (V_{1i} in RAM array "A" - laser off update, Figure 7). The light beam is then turned on so that "on" values can be stored (V_{0i} in RAM array "B" - laser on update, Figure 9). From these "off" and "on" values, compensated values eliminating the effects are produced as they only differ where the beam impinges (Figure 8). The control program cycles through all the phototransistors (PTCTR=MAXSCALE, step 706, 816 and 906) in these procedures. A position times value type algorithm is used to weigh the beam position in relation to output of two adjacent phototransistors.
(figure 8, right hand side). It is not therefore possible to read the term template as used in claim 1 of the application onto the "off" value contents of the RAM array A taught by document D1 because that array is repeatedly refreshed in its entirety, each phototransistor having its own value, which thus precludes an n<m template, such accordingly not being reachable in an obvious way from the teaching of the document D1.

4.3 Document D2 is further away as it is in a somewhat different field, concerning a position detecting sensor for a robot used in arc welding. It follows that the optical device trains the light beam on the object not on the sensor. The document discloses a threshold value for detection by CCD sensors (e.g. Vs in Figure 6) and also position times value for determining incidence on the sensor (e.g. column 4, lines 39-41). There is a counter 45, the operation of which is related to a number N, but counting follows from the detected values, i.e. there is no template. Accordingly the board does not see how the subject-matter of claim 1 can be reached in an obvious way from this document.

4.4 Figure 4 of document D3 shows intensity curves of a laser beam received by photoelements, in the example elements 41 to 47. It is said that a microprocessor calculates the centre of gravity point to establish the exact position of the beam on the measuring scales. No further details of this calculation are given, so it is not possible to conclude in an obvious way that not a, for instance, threshold calculation, but a comparison with a template, let alone the size thereof, takes place. Accordingly the board does not see how the
subject-matter of claim 1 can be reached in an obvious way from this document.

4.5 Moreover, even taken together, for which there is no obvious reason, the teachings of the prior art would not lead to the novel features of the claim.

5. Since the subject-matter of claim 1 cannot, in the light of the available prior art, be considered obvious to the skilled person, Article 56 EPC can be considered satisfied. The remaining claims depend therefrom.

6. The board saw no other reason preventing grant of a patent. Accordingly, neither oral proceedings nor consideration of further amendment of the description as requested by the appellant on an auxiliary basis were necessary.
Order

For these reasons it is decided that:

The case is remitted to the first instance with the order to grant a patent based on the following application documents:

Description
- Pages 1, 3, 4, 8, 9 as originally filed
- Pages 2, 2_{bis} filed with the letter dated 14.09.2005
- Pages 5, 6, 6_{bis}, 7 filed with the letter dated 21.03.2008

Claims
- 1-4 (main request) filed with the letter dated 19.02.2009

Drawings
- Figures 1-7 as originally filed.

The Registrar

The Chairman

M. Kiehl

A. G. Klein