BESCHWERDEKAMMERN   BOARDS OF APPEAL OF   CHAMBRES DE RECOURS
DES EUROPÄISCHEN   THE EUROPEAN PATENT   DE L'OFFICE EUROPEEN
PATENTAMTS   OFFICE   DES BREVETS

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.

Opponent:
-

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:
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Beschwerdekammern   Boards of Appeal   Chambres de recours

Case Number: T 1259/05 **-** 3.4.02

D E 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

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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, ...,
      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 form 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

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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

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(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