Datasheet for the decision
of 20 February 2009

Case Number: T 1348/06 - 3.4.01
Application Number: 91903057.7
Publication Number: 0466869
IPC: G06K 9/00
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Title of invention:
Method and apparatus for currency discrimination and counting
Patentee:
Cummins-Allison Corp.
Opponent:
GIESECKE & DEVRIENT GmbH
Headword:
-
Relevant legal provisions:
EPC Art. 56
RPBA Art. 13(3)
Relevant legal provisions (EPC 1973):
-
Keyword:
"Inventive step (no)"
Decisions cited:
-
Catchword:
-
Case Number: T 1348/06 - 3.4.01

DECISION
of the Technical Board of Appeal 3.4.01
of 20 February 2009

Appellant: Cummins-Allison Corp.
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Representative: -

Decision under appeal: Decision of the Opposition Division of the
revoking European patent No. 0466869 pursuant
to Article 102(1) EPC 1973.

Composition of the Board:

Chairman: B. Schachenmann
Members: F. Neumann
          H. Wolfrum
Summary of Facts and Submissions

I. The appeal lies from the decision of the opposition division to revoke the European patent number EP 0 466 869.

II. The appellant (proprietor) requested that the decision under appeal be set aside and the patent be maintained in amended form on the basis of claim 1 of the main request filed on 17 November 2000 and dependent claims 2 to 10 as granted or on the basis of claim 1 of one of the auxiliary requests I to IV filed with the letter of 20 January 2009 and dependent claims 2 to 10 as granted.

The respondent (opponent) requested that the appeal be dismissed.

Both parties requested oral proceedings as an auxiliary measure.

III. During the appeal proceedings, the following citations were taken into account:

E4: US-A-4 179 685,
S10: JP-54-71673 A,

Further documents were referred to by the respondent (opponent), but were not relied upon in connection with the various requests ultimately on file.

IV. Independent claim 1 of the appellant's main request reads as follows:
"A currency counting and evaluation device for receiving a stack of currency bills, rapidly counting and evaluating all the bills in the stack, and then restacking the bills, said device comprising:

a feed mechanism (12, 14;227, 246, 248) for receiving a stack of currency bills (17; 228) and feeding said bills, one at a time, to a bill transport mechanism (16; 282-290);

said bill transport mechanism (16; 282-290) is arranged for transporting bills from said feed mechanism (12, 14; 227, 246, 248) to a stacking station (20;238, 242, 246);

an optical scanning head (18;296) located between said feed mechanism (12, 14;227, 246, 248) and said stacking station (20;238, 242, 246) for scanning a preselected segment of a portion of each bill transported by said transport mechanism (16; 282-290), said scanning head (18; 296) including at least one light source (22;340, 342) for illuminating a strip of said preselected segment of a bill, and at least one detector (26;346) for receiving light from the illuminated strip on the bill and producing an output signal representing variations in the intensity of the received light;

means (28) for digitizing said output signal;

means (30) for sampling said output signal at preselected intervals as a bill is moved across said scanning head (18;296) and providing output signal samples;
a memory (34) for storing characteristic signal samples produced by scanning said preselected segments of bills of different denominations with said scanning head (18;296) and sampling said output signal at said preselected intervals; and

signal processing means (30) for receiving said signal samples and (A) determining the denomination of each scanned bill (17) by comparing said stored signal samples with said output signal samples produced by the scanning of each bill with said scanning head (18;296), and (B) counting the number of scanned bills of each denomination,

characterised in that

said optical scanning head (18;296) is provided for scanning a preselected segment of a central portion of each bill;

said means (30) for sampling said output signal and for providing said output signal samples provides output signal samples each of which is proportional to the intensity of the light received from a different strip of said preselected segment of a bill;

said memory (34) is provided for storing signal samples that are proportional to the intensity of the light received from different strips of said preselected segment of a bill;

said signal processing means (30) is provided for comparing said stored characteristic signal samples that are proportional to the intensity of the light...
with said output signal samples that are proportional to the intensity of the light produced by the scanning of each bill with said scanning head (18;296) and determining the extent of similarity; and

said signal processing means (30) is further provided for (C) accumulating the cumulative value of the scanned bills of each denomination."

Independent claim 1 of the appellant's first auxiliary request reads as follows:

"A currency counting and evaluation device for receiving a stack of currency bills, rapidly counting and evaluating all the bills in the stack, and then re-stacking the bills, said device comprising:

a feed mechanism (12, 14, 227, 246, 248) for receiving a stack of currency bills (17; 228) and feeding said bills, one at a time, to a bill transport mechanism (16; 282-290);

said bill transport mechanism (16; 282-290) is arranged for transporting bills from said feed mechanism (12, 14; 227, 246, 248) to a stacking station (20;238, 242, 246);

an optical scanning head (18;296) located between said feed mechanism (12, 14;227, 246, 248) and said stacking station (20;238, 242, 246) for scanning a preselected segment of a portion of each bill transported by said transport mechanism (16; 282-290), said scanning head (18; 296) including at least one light source (22;340, 342) for illuminating a strip of said preselected
segment of a bill, and at least one detector (26;346) for receiving light from the illuminated strip on the bill and producing an output signal representing variations in the intensity of the received light;

means (28) for digitizing said output signal;

means (30) for sampling said output signal at preselected intervals as a bill is moved across said scanning head (18;296) and providing digital output signal samples converted to multiple bits;

a memory (34) for storing digital characteristic signal samples produced by scanning said preselected segments of bills of different denominations with said scanning head (18;296) and sampling said output signal at said preselected intervals; and

signal processing means (30) for receiving said digital signal samples and (A) determining the denomination of each scanned bill (17) by comparing said stored digital signal samples with said digital output signal samples produced by the scanning of each bill with said scanning head (18;296), and (B) counting the number of scanned bills of each denomination,

characterised in that

said optical scanning head (18;296) is provided for scanning a preselected segment of a central portion of each bill;

said transport mechanism (16) transporting bills in the direction of the narrow dimension (W) of the bills;
said means (30) for sampling said output signal and for providing said output signal samples provides digital output signal samples each of which is proportional to the intensity of the light received from a different strip of said preselected segment of a bill;

said memory (34) is provided for storing digital signal samples that are proportional to the intensity of the light received from different strips of said preselected segment of a bill;

said signal processing means (30) is provided for comparing said stored digital characteristic signal samples that are proportional to the intensity of the light with said digital output signal samples that are proportional to the intensity of the light produced by the scanning of each bill with said scanning head (18;296) and determining the extent of similarity; and

said signal processing means (30) is further provided for (C) accumulating the cumulative value of the scanned bills of each denomination."

Independent claim 1 of the appellant's second auxiliary request is identical to claim 1 of the first auxiliary request apart from the definition of "means (30) for sampling said output signal at preselected intervals as a bill is moved across said scanning head (18;296) and providing digital output signal samples converted to 10 bits" (emphasis added).

Independent claim 1 of the third auxiliary request is based on claim 1 of the main request and claim 1 of the
fourth auxiliary request is based on claim 1 of the second auxiliary request. In addition, claim 1 of both of the third and fourth auxiliary requests includes the following feature:

"said device further comprises an optical mask (350) having a generally opaque area (352) on which a wide slit (354) and a second slit (356) are defined for allowing light from the light sources (340,342) to pass through so as to illuminate light strips of the desired dimensions; said wide (354) slit is used for obtaining the output signal samples which correspond to a characteristic pattern of a bill and said second slit is adapted to generate a relatively narrow illuminated strip used for detecting a thin borderline surrounding a printed indicia on the currency bills"

Moreover, in the definition of the scanning head in claim 1 of both requests, the feature "including at least one light source" is replaced by "including light sources".

V. The arguments of the parties, insofar as they are pertinent to the present decision, are set out below in the reasons for the decision.

Reasons for the Decision

1. The appeal is admissible.
2. **Main Request - Inventive step (Articles 52(1), 56 EPC):**

2.1 It is common ground that E4 discloses a currency counting and evaluation device for receiving a stack of currency bills, rapidly counting and evaluating all the bills in the stack, and then restacking the bills, the device comprising a feed mechanism for receiving a stack of currency bills and feeding said bills, one at a time, to a bill transport mechanism, said bill transport mechanism being arranged for transporting bills from said feed mechanism to a stacking station. It was not contested that E4 discloses an optical scanning head located between the feed mechanism and the stacking station for scanning a preselected segment of a portion of each bill transported by the transport mechanism and that the optical scanning head of E4 includes at least one light source and at least one detector.

Each of the remaining features of claim 1 will be discussed feature-by-feature in the following paragraphs.

2.2 It was not contested that the output of the "scanning devices" unit 62 (Figure 3) is a digital signal. A means for digitising the output signal of the detector must therefore be provided within the unit 62 in E4.

2.3 Having regard to the embodiment of Figure 4b of E4, the linear array of sensors is strobed as the bill passes over the scanner in order to read along several successive lines across the bill (column 7, lines 3-7). This strobing of the sensors is effectively a means for sampling the output signal: the instantaneous outputs
of the sensors are registered at preselected intervals as the bill is moved across the scanning head. Each sensor, which is described in E4 as "a photo-responsive receiver, for example a phototransistor" (column 4, lines 61-63) will produce an output which is, in normal operating conditions, proportional to the received intensity. The output of each phototransistor at a specific sampling time will therefore be proportional to the intensity of the light received from a different strip of the preselected segment of the bill.

The appellant (proprietor) submitted that E4 contains no details of how the "black box" 62 in E4 functions. It was therefore not unambiguously derivable that the output of the individual sensors within the box would indeed be proportional to the intensity of the received light. It was argued that the output values in E4 were single-bit binary values, the values 0 or 1 being allocated on the basis of a simple threshold test, and that these output signal samples did not exhibit any proportionality to the received intensity.

The Board emphasises that claim 1 only defines that it is the output signal of the detector (i.e. the phototransistor in E4) which is sampled, which, due to the nature of the detector in E4, will be proportional to the intensity of the light received by the detector. The Board agrees that the output of the unit 62 is a series of single-bit binary values, but considers this irrelevant for the assessment of this particular feature in view of the fact that the strobed sensors (the phototransistors) themselves will produce a sampled proportional signal.
A memory (the PROMs 82-88) is provided in E4 for storing characteristic signal samples produced by scanning the preselected segments of bills of different denominations with the scanning head and sampling the output signal at the preselected intervals (column 9, lines 25-33).

The characterising portion of claim 1 goes on to define that the memory is provided for storing signal samples that are proportional to the intensity of the light received from different strips of said preselected segment of a bill. The appellant (proprietor) explained that this proportionality was achieved by digitally converting the measured amount of light intensity into a multi-bit binary number which represented a magnitude of light. This was in contrast to the signal samples in E4 which were apparently derived by performing a threshold test on the light intensity signal produced by each of the phototransistors along the strip to give rise to a set of single-bit values (1 or 0). According to the appellant (proprietor) these single-bit values of E4 could only be considered to be associated with a certain light intensity; they could not be considered to be "proportional to" the intensity due to their one-bit resolution which did not represent the grey level of the received signal.

The Board notes that, in the context of digitised signals, the meaning of the term "proportional" has to be regarded with some care. As pointed out by the respondent (opponent), any strict proportionality to the received intensity signal would appear to be lost when the detector signal is digitised; with decreasing resolution of the digital conversion, any
proportionality would become decreasingly apparent. To describe digital signals as "proportional" did not seem appropriate, particularly when the resolution of the digital conversion was unknown. In view of this argument, the Board considers that in the absence of any indication in the claim of how the term "proportional" is to be interpreted in the context of such digital conversion, this term must be interpreted broadly and therefore can only be understood to mean "somehow related to". Using this understanding, it may be seen that even the simple threshold test of E4, whilst not providing an output which reflects the grey level of the received intensity signal, may nevertheless be considered to provide an output which is "somehow related to" the intensity signal. The threshold test effectively creates a maximum digitisation of the detector signal and therefore must be considered to have some "proportionality".

Thus although the signal samples stored in the PROMs of E4 are the single-bit results of a threshold test, they may nevertheless be considered to be "proportional to" the intensity of the light received from different strips of the preselected segment of the bill.

2.5 It was not contested that E4 discloses signal processing means for receiving the signal samples and for determining the denomination of each scanned bill by comparing the stored signal samples with the output signal samples produced by the scanning of each bill with said scanning head and counting the number of scanned bills of each denomination.
2.5.1 The characterising portion of claim 1 goes on to define that the stored characteristic signal samples and the output signal samples are proportional to the received intensity. The appellant (proprietor) explained that this was intended to express that the signal samples, having undergone digital conversion, still retained their proportionality to the intensity signal by virtue of the conversion to a multi-bit number.

2.5.2 As shown in paragraph 2.4 above, the stored characteristic signal samples of E4 may be considered to be proportional to the received intensity. Moreover, the output signal samples discussed in paragraph 2.3 above are proportional to the intensity of the light produced by the scanning of each bill with the scanning head. The signal processing means 90-96 of E4 compares the corresponding samples, albeit after digital conversion of the output signal samples in the unit 62. Thus, E4 is considered to disclose that the signal processing means is provided for comparing the stored characteristic signal samples that are proportional to the intensity of the light with the output signal samples that are proportional to the intensity of the light produced by the scanning of each bill with said scanning head.

2.5.3 The appellant (proprietor) submitted that the extent of similarity of the compared signals was not determined in E4. It was argued that because the signals output from the unit 62 in E4 were simply just 1 or 0, an "extent of similarity" could not be determined, the system of E4 merely checking whether individual stored
signal samples were identical to the output signal samples.

However, the respondent (opponent) was of the opinion that E4 indeed disclosed that an extent of similarity was determined. It was submitted that, in the context of E4, the extent of similarity of the group of readings which make up one strip was determined. A bit-by-bit comparison of the stored samples and the output samples along the length of the strip was performed, the corresponding bits along each strip being checked for concordance. Once a predetermined number of bits were found to be identical, this was regarded as constituting a close enough match to correctly identify the denomination of the bill (column 5, line 50 to column 6, line 11). Thus, the extent of similarity of the set of individual readings along the entire strip was determined.

Noting that the wording of claim 1 does not exclude this type of similarity assessment, the Board agrees with the reasoning of the respondent (opponent) in this respect.

2.6 The optical scanning head of E4 is provided for scanning a preselected portion of a "central portion" of each bill. In particular, in Figures 4a and 4b it may be seen that the printed indicia denoting the denomination is scanned. Although this printed feature is located in the corner of the bill, this area may nevertheless be described as being a preselected portion of a central portion of the bill, the "central portion" being understood to be the area within the boundary line around the printed portion. In the
absence of a precise definition in the claim as to the intended meaning of a "central portion", E4 is considered to disclose this feature.

2.7 Turning now to the details of the optical scanning head set out in the preamble, the appellant (proprietor) maintained that the manner of operating the source and detector differed from that of E4.

2.7.1 Firstly, the appellant (proprietor) argued that E4 did not disclose a light source for illuminating a strip of the bill, and that claim 1 made clear, by virtue of the fact that the detector was arranged "for receiving light from the illuminated strip", that the light which was projected onto the bill was actually a strip of light.

The Board notes that this intended meaning is not reflected in the wording of claim 1 which defines only that a light source is provided "for illuminating a strip of said predetermined segment of a bill". In other words, a strip of the bill (i.e. a geometrically strip-shaped portion of the bill) is - to some undefined degree - illuminated by the light source; the claim contains no definition of the geometry of the projected beam itself. The fact that the detector "receiv[es] light from the illuminated strip on the bill" does not mean that the illuminating beam is indeed strip shaped. Instead, this wording simply sets out that the aforementioned geometrical portion is - in some undefined manner and to some undefined extent - illuminated and light reflected from the geometrically strip-shaped portion of the bill is received at the detector.
2.7.2 Secondly, the appellant (proprietor) emphasised that the detector of the contested patent was defined as being adapted for receiving light from the illuminated strip and for producing an output signal representing variations in the intensity of the received light. It was submitted that an essential difference to E4 was that the output from the detector of claim 1 was one continuous analog signal which was then digitised and sampled, each of the samples being proportional to the intensity received from the entire strip at the respective sampling locations. With reference to Figure 9A of the patent, it was emphasised that it was the variations in the continuous signal which were of interest and that these variations were not apparent in the output signal of E4. The appellant (proprietor) maintained that E4 only disclosed that a one-bit value per detector and per sample was output along the length of the strip in a non-continuous, pulsed manner as the bill moved along its length. It was argued that these one-bit values could not be considered to exhibit the variations in the grey level of the entire strip which were apparent in the present invention, the samples of E4 representing only the binary result of a threshold test with regard to the reflection of light received from an illuminated dot or pixel, but not the entire strip.

The Board notes that claim 1 defines that the optical scanning head includes "at least one detector for receiving light from the illuminated strip on the bill and producing an output signal representing variations in the intensity of the received light" (emphasis added). This is exactly what is disclosed in E4. The
outputs of each individual phototransistor in E4 are - as set out in paragraph 2.3 above - proportional to the intensity of the light received from the respective portion of the illuminated strip towards which the phototransistor is directed. These output signals represent the variations in the received intensity as the bill passes the detector.

Moreover, the Board notes that claim 1 does not define that the output signal samples are indicative of the intensity of light received from the whole illuminated strip. Claim 1 states that the output signal samples are proportional to the intensity of the light "received from a different strip", but this does not necessarily imply that the light is received from the entire strip. The appellant (proprietor) argued that the bits output from the scanning head are not grouped into data associated with entire individual strips but instead, are processed as individual circular pixels associated with individual detectors which collect light from only a part of any one strip. The Board does not contest this finding but holds it irrelevant in view of the wording of claim 1 which does not define that a single detector collects light from an entire strip.

2.8 As has been shown in the preceding paragraphs, all of the above-discussed features are either known explicitly from E4 or would be implicit for a skilled person reading E4. Only the final feature of claim 1, which defines that the signal processing means is provided for accumulating the cumulative value of the scanned bills of each denomination, is not derivable from E4.
This feature is however not considered to comprise an inventive step. In view of the fact that the system of E4 counts the number of bills of each denomination (Figure 3; column 4, lines 21-24) the skilled person would consider it an obvious measure to translate the bill count to a currency-value count.

In conclusion, claim 1 does not comprise an inventive step (Articles 52(1), 56 EPC).

First auxiliary request - Inventive step (Articles 52(1), 56 EPC):

Claim 1 of the first auxiliary request is distinguished from claim 1 of the main request in that the output signal samples are specified as being digital output signal samples and that these digital output signal samples are converted to multiple bits. The signal samples that are stored in the memory are also specified as being digital signal samples. Moreover, it is specified that the transport mechanism transports bills in the direction of the narrow dimension of the bills.

The respondent (opponent) submitted that the output signal samples in E4 were indeed digital output signal samples converted to multiple bits. The output signal samples from each sensor of the detector array emerged, after digital conversion, in parallel from the "scanning devices" unit 62 as a set of one-bit digital values, i.e. the complete output signal sample was comprised of multiple bits. Moreover, and with regard to the example of Figure 4b of E4, the total set of the
twelve digitised (single-bit) signals of the individual photoreceivers could be perceived as an output signal sample in the form of a 12-bit reading which was indicative of the intensity of the light that was received from the entire strip. Thus, "a means ... for providing digital output signal samples converted to multiple bits" was considered to be disclosed in E4.

The appellant (proprietor) submitted that, by virtue of the "multiple bits" in claim 1, the output signal sample reflected the grey-level of the intensity signal and was thus more than just a one-bit threshold indicator. The invention thus differed from E4 in that proportional digital samples were obtained.

The Board agrees with the respondent's (opponent's) opinion and does not consider that the actual wording of claim 1 distinguishes the subject-matter defined therein from the subject-matter of E4 in this respect. Moreover, claim 1 contains no suggestion that the multiple bits are in any way related to the grey-level of the intensity signal.

3.3 Claim 1 further defines that the means for sampling and for providing the output signal samples provides digital output signal samples, each of which is proportional to the received intensity. This differs from the situation discussed in relation to claim 1 of the main request which only set out that the output signal samples (which were not defined as being digital) are proportional to the received intensity. Thus the argumentation presented in paragraph 2.3 above with respect to this feature of the main request does not apply to the first auxiliary request.
However, the "scanning devices" unit 62 in E4 produces digital output signal samples which, in analogy to the reasoning presented in paragraph 2.4 above may be considered to be "proportional to" the received intensity in the sense of "somehow related to". Moreover, as argued by the respondent (opponent) in paragraph 3.2 above, the 12-bit output signal sample which emerges from the unit 62 may also be seen to be indicative - and thus "proportional to" - the intensity received from the strip as a whole.

3.4 Concerning the orientation of the bill in the transport mechanism, it is noted that in E4 the direction of travel is parallel to the long side of the bill (Figure 5a). However, in document S10, which also concerns an apparatus for identifying and counting currency bills, the bills are transported along the width direction (Figure 4). Similarly, the banknote scanning apparatus of E8 also transports the bills in a direction parallel to their short side (column 2, lines 4-7).

The appellant (proprietor) submitted that, starting from E4, the skilled person would not consider changing the orientation of the bill in the transport mechanism. According to the appellant (proprietor), the technique used in E4 required a large amount of data which could only be obtained by scanning the bills length-wise and not width-wise.

The Board cannot agree with this finding. As can be seen in Figure 4a of E4, a two-dimensional scanning array having a small area compared to the dimensions of
the bill can be employed. When using an array of this geometry, the direction of travel of the bill through the apparatus becomes immaterial. The decision to transport the bills in the direction of the narrow dimension of the bills thus appears to be a matter of design preference and cannot be considered to involve an inventive step.

3.5 As can be inferred from the above analysis, the subject-matter of claim 1 is only distinguished from the disclosure of E4 by the features discussed in paragraphs 3.4 and 2.8 to 2.9. As shown above, neither of these features is regarded as comprising an inventive step. Moreover, each of these two features solve a different problem and are therefore functionally independent of each other: no synergistic effect is apparent between these two features.

3.6 In conclusion, claim 1 of the first auxiliary request lacks an inventive step (Articles 52(1), 56 EPC).

4. Second auxiliary request - Inventive step (Articles 52(1), 56 EPC):

4.1 Claim 1 of the second auxiliary request is distinguished from claim 1 of the first auxiliary request in that the digital output signal samples are converted to ten bits.

As pointed out in paragraph 3.2 above, the output signal samples of E4 are converted to multiple bits. The respondent (opponent) indicated that in the embodiment of Figure 3, each digital output signal sample emerging from the "scanning devices" unit 62 was
a set of eight single-bit signals. In the arrangement of Figure 4b, twelve sensors 118 were used along the strip and so the digital output signal sample emerging from the unit 62 in this case would be a set of twelve single-bit signals. The Board agrees with the conclusion of the respondent that no inventive step can be involved in selecting an arrangement which produces a digital output signal sample made up of ten single-bit signals.

4.2 Claim 1 of the second auxiliary request therefore lacks an inventive step (Articles 52(1), 56 EPC).

5. **Third and fourth auxiliary requests - Admissibility**

5.1 The third and fourth auxiliary requests were filed one month before the date of the oral proceedings. Both of these requests include a feature relating to an optical mask which is used to generate two illuminated light strips of desired dimensions on the surface of the bill.

The respondent (opponent) indicated that this subject-matter was claimed for the first time in these new requests. The optical mask defined in the claims bore no relationship to the other details which had been the focus of the proceedings up until the filing of these new requests. Since these claims defined additional features, as opposed to further details of features which had already been discussed, it was submitted that the third and fourth auxiliary requests should not be admitted into the proceedings.

The appellant (proprietor) argued that, in reaction to the objections raised in the provisional opinion of the
Board, the aim of these amendments was to clarify what was meant by an illuminated strip by explaining how the strip was formed.

Article 13(3) of the Rules of Procedure of the Boards of Appeal (RPBA) sets out that amendments to a party's case which are sought to be made after oral proceedings have been arranged shall not be admitted if they raise issues which the other party cannot reasonably be expected to deal with without adjournment of the oral proceedings. In the present case, the respondent (opponent) was not in a position to conduct a fair discussion of the amended claims at the oral proceedings in view of the fact that the introduction of new subject-matter would have necessitated a further search. In the Board's view, even requests filed before the final date set under Rule 116 EPC, may be rejected as inadmissible under Article 13(3) RPBA if new issues arise which cannot be properly dealt with at the oral proceedings.

The third and fourth auxiliary requests were therefore not admitted into the proceedings.
Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

U. Bultmann B. Schachenmann