

A		B		C	X
---	--	---	--	---	---

File Number: T 641/91 - 3.2.4

Application No.: 84 109 895.7

Publication No.: 0 143 188

Title of invention: Method of and device for detecting displacement of paper sheets

Classification: B65H 9/20

D E C I S I O N
of 16 February 1993

Applicant: KABUSHIKI KAISHA TOSHIBA

Opponent: GAO Gesellschaft für Automation
und Organisation mbH

Headword:

EPC Articles 52(2)(c), (3); 56; 123(2)(3)

Keyword: "Inventive step (yes)"

Summary of Facts and Submissions

- I. European patent No. 0 143 188 comprising 15 claims was granted on 30 November 1988 in response to European patent application No. 84 109 895.7 filed on 20 August 1984.
- II. The patent was opposed by the Appellant on the grounds that its subject-matter lacked novelty or inventive step with respect to the state of the art (Article 100(a) EPC).

The Opponent relied on the following state of the art documents:

D1 = EP-A-0 080 158
D2 = DE-A-2 325 717
D3 = DE-A-2 729 830
D4 = DE-A-2 749 641
D5 = DD-A-2 005 634
D6 = JP-A-56/118 605.

- III. By interlocutory decision dated 13 May 1991 and dispatched on 15 July 1991 the Opposition Division maintained the European patent in an amended form on the basis of 15 claims filed during the oral proceedings on 13 May 1991, during which also an English translation (D6') of document D6 was filed.
- IV. On 22 August 1991 the Appellant (Opponent) lodged an appeal against the decision, paying the appeal fee simultaneously. The Statement of Grounds was received on 15 November 1991. The appeal was based mainly on prior art document D1 intending to prove that the subject-matter of the European patent was not patentable within the terms of Articles 52 to 57 EPC.

The Appellant filed with the Statement of Grounds a copy of page 8 of the book Gerthsen-Kneser-Vogel, "Physik", 14th Edition, (1982), Springer Verlag Berlin, which describes the calculation method of linear regression (D7).

V. Oral proceedings took place on 16 February 1993.

The Respondent (Proprietor of the patent) filed during the oral proceedings a set of new Claims 1 to 15, an amended part of the description, columns 1 to 4, with new pages 3, 3a, columns 13 and 14, new drawing sheets 8, 9, and 14 as part of the main request.

Claim 1 of the main request reads as follows:

"A displacement detection method for detecting displacement of paper sheets (13) in transit, comprising the steps of:

(a) detecting a part of the leading edge of each paper sheet at a predetermined location along a conveyance line of conveyance belts for conveying the paper sheets (13),

(b) detecting at several times, at a second predetermined location downstream of the first location and along the line of conveyance, the distance (Y_i) between only one side edge of the paper sheet (13) and a reference line (JJ) set up along the conveyance line after elapse of the time taken for the part of the leading edge of said paper sheet to reach the said second predetermined location, following the detection of the part of the leading edge of each paper sheet,

(c) detecting the transportation time interval between the detected part of the leading edge of each paper sheet

(13) and the detected part of the leading edge of the next,

(d) calculating the distance (X_i) from the leading edge of the paper sheet (13) for each corresponding distance (Y_i) between one side edge of the paper sheet (13) and the reference line (JJ);

(e) calculating an inclination (α), and lateral shift (Y_0, Y_2) of each paper sheet in transit by linear regression of the distances (X_i) from the leading edge of the paper sheet (13) and the distances (Y_i) between one side edge of the paper (13) and the reference line (JJ)."

Independent Claim 7 of the main request reads as follows:

"A displacement detection device (14) for detecting the displacement of paper sheets (13) in transit in a conveyance device by the method of Claim 1 having: sensing means (17,18) for sensing a part of the leading edge of the paper sheet (13) in question, displacement detection means (19) provided downstream of said sensing means (17,18) for detecting at several times the distance (Y_i) between a side edge of the paper sheet (13) and a reference line (JJ) which is set up along the conveyance line of the paper sheet (13) the positions of said displacement detecting means (19) and said sensing means (17,18) being spaced by a predetermined length (l) along the conveyance line of the conveyance device and calculating means for calculating the lateral shift (Y_0, Y_2) and the inclination (α) of the paper sheets (13) in transit after elapse of the time which is required for the part of the leading edge of the paper sheets (13) to pass from said sensing means (17,18) to said displacement detection means (19) and is determined based on the predetermined length and the speed of conveyance, said

displacement detection means (19) having a single detection portion ranging from one edge of said conveyor to a predetermined distance, the range of detection including only one side edge of said paper sheet (13) characterized by said calculating means calculating the distance (X_i) from the leading edge of said paper sheet (13) for each corresponding distance (Y_i) between one side edge of said paper sheet (13) and the reference line (JJ) and calculating inclination (α) and lateral shift (Y_0, Y_2) of each paper sheet (13) by linear regression of said distances (X_i, Y_i)."

The Appellant argued that newly filed Claims 1 and 7 contravened Article 123(2) and (3) EPC and that Claims 6 and 8 lacked clarity. Even if these deficiencies were overcome the claims could not be allowable because of lack of inventive step having regard to prior art documents D1 and D6. Except for feature (c) of Claim 1, which is generally well known and which solves a quite different problem than the features (d) and (e), and except for the use of linear regression for calculating the inclination and lateral shift, all other features of Claim 1 are known from prior art document D1. On page 24, lines 15 to 19 of document D1 a hint is given to use only one side edge of the transported paper sheet for skew detection. Furthermore, document D6 clearly discloses a method for determining skew and lateral shift of a paper sheet on the basis of only one side edge detection. On page 8, last paragraph of the translation D6' an averaging method for determining inclination on non-linear sides is proposed. Since the method of linear regression is generally well known and in particular used for determining a straight line on the basis of measured values close to that assumed line, it is obvious for the skilled person to use this method for determining the inclination of a damaged side edge of a transported sheet. Therefore, in the view of the

Appellant, even an amended Claim 1 could not be patentable.

With regard to Claim 7 the Appellant argued that this Claim 7 could not be allowable mainly for the reasons already pointed out with respect to Claim 1. Furthermore, calculating means specified in the characterising portion of Claim 7 are not disclosed in the original application. Furthermore, nearly every normal computer is able to carry out the calculation on the basis of linear regression.

The Respondent contested the arguments of the Appellant.

VI. The Appellant requested that the decision under appeal be set aside and that the European patent No. 0 143 188 be revoked.

The Respondent requested that the decision be set aside and that the patent be maintained according to the main request on the basis of the following documents

Claims: 1 to 15 filed on 16 February 1993 during the oral proceedings;

Description: Amended columns 1 to 4, with pages 3, 3a, and amended columns 13, 14 filed on 16 February 1993 during the oral proceedings, columns 5 to 12 of the granted patent EP-B-0 143 188;

Drawings: Sheets 1 to 7, 10 to 13 of the granted patent EP-B-0 143 188; sheets 8, 9, 14 filed on 16 February 1993 during the oral proceedings.

The Respondent furthermore put forward subsidiary requests.

Reasons for the Decision

1. Admissibility of the Appeal

The Appeal is in accordance with Articles 106 to 108 and Rule 64 EPC and is admissible.

2. Allowability of the main request with regard to Article 123 EPC

2.1 Claim 1

Feature (a) of Claim 1 is disclosed in the originally filed Claim 10 and the originally filed description page 5. Original Claim 10 comprises the detection of a leading edge of the paper sheet at a prescribed location on a conveyance line whereas on page 5 conveyance belts for conveying paper sheets are mentioned.

Feature (b) of Claim 1 is disclosed by page 3, line 33 to page 4, line 4; page 7, lines 15 to 21; and in Claims 1 and 10 of the originally filed application (and is described in lines 48 to 58 of column 2 of the patent as granted). In these parts of the application (see the originally filed Claim 1) a clear distinction has been made between the "conveyance time required for passing the paper sheets from said paper sheet sensing means (17,18) to said displacement detection means (19)" which is a specific time on the one hand, and the time when detecting the conveyance state of the paper sheets starts which is a time after elapse of said conveyance time on the other hand and which is not limited to a particular time, such

as defined by t_1 in Claim 4 of the present patent. The argument of the Appellant that the time t_1 should be restricted according to the original disclosure to the value as defined in Claim 4 therefore cannot be accepted.

Feature (c) is disclosed in the originally filed description, page 3, lines 23 to 28; page 12, lines 26 to 34 and page 18, lines 7 to 16.

The Appellant objects that feature (d) of Claim 1 is not disclosed in the application as originally filed since no disclosure indicates that the distance " X_i " is calculated. The Board cannot agree with this argument. Feature (d) is disclosed on page 13, lines 26 to 28 of the originally filed description, where the relation between the displacement Y_i and the distance X_i is stated, and on Figure 6A, step 430 in combination with page 11, lines 19 to 21, which indicates that the distance from the leading edge of a paper sheet to the position at which the optical position detector (19) takes in the data is calculated.

Feature (e) is disclosed in the originally filed description, page 7, lines 15 to 33, according to which the inclination α is determined by linear regression and page 13, lines 26 to 35, in which the formula for calculating the inclination α by linear regression is indicated. According to page 14 of the originally filed description, lateral shift (Y_0, Y_2) is calculated on the basis of the inclination α .

2.2 Claim 7

The Appellant argued that the originally filed application does not disclose firstly the single detection portion of the displacement detection means ranging from one edge of the conveyor to a predetermined distance, and secondly

calculating means for calculating the distance (X_i) from the leading edge of the paper sheet for each corresponding distance between one side edge of the paper sheet and the reference line.

The sensing means for sensing the part of the leading edge of the paper sheet and the displacement detection means are specified in the originally filed Claim 1 and are illustrated in Figure 2 which shows a single detection portion of the displacement detection means. On page 7, lines 7 to 11 and in Figure 3 of the originally filed application it is disclosed that the detection range of the light receiver of the photo position detector extends from the side edge H of the conveyor belt to a point J, where the distance HJ corresponds to the length of the light receiving section of the light receiver.

The means for calculating the distance (X_i) from the leading edge, the lateral shift (Y_0, Y_2) and the inclination α are necessary parts for carrying out the calculation steps of Claim 1 and are described on page 11, second paragraph to page 13 with respect to Figures 6A and 6B of the original application. The objection of the Appellant with respect to Claim 7 therefore is unfounded.

2.3 Dependent claims

The subject-matter of Claims 2 to 4 is disclosed in the originally filed description between page 7, line 15 and page 8, line 19. The subject-matter of Claims 5, 6 and 8 is disclosed in the originally filed description between page 13, line 26 and page 15, line 9. The subject-matter of Claims 9 to 15 is disclosed in the respective originally filed Claims 3 to 9.

2.4 Description and drawings

The amendments to the description only relate to the cited relevant state of the art documents, adaptations to the new claims and minor corrections. The amendments to the drawings only concern minor corrections of the wording used.

2.5 Claims 1 to 15, the description and the drawings of the main request therefore do not contravene Article 123(2) EPC.

2.6 The amendments to Claim 1 with regard to the granted Claim 1 comprise the limitation of the detection of distances to "only one side edge" in feature (b); the rewording of feature (b) wherein the reference sign in parentheses (t_1) has been cancelled; and the replacement of feature (d) by new features (d) and (e).

According to Rule 29(7) EPC, reference signs in parentheses shall not be construed as limiting the claim. Therefore, the content of feature (b) is not changed by cancellation of the reference sign. Furthermore, deletion of the reference sign avoids possible contradictions and possible unclarities between claims and description.

New feature (d) comprises the calculation step for the distances from the leading edge of the paper sheet for each corresponding distance between one side edge and the reference line, and feature (e) the particular calculation step according to the linear regression, which are additional features restricting the protection conferred by granted Claim 1. The additional reference sign Y_2 in parentheses has been added only with regard to Rule 29(7) EPC.

2.7 The new Claim 7 has been reworded with respect to granted Claim 7 in order to acknowledge the prior art document D1 and new features have been added. All the features of granted Claim 7 are contained in new Claim 7. Reference signs have been corrected or cancelled in accordance with Rule 29(7) EPC. The features added in the characterising portion of the Claim 7, concerning the calculating means, restrict the protection conferred by granted Claim 7.

2.8 Therefore the amendments made do not contravene Article 123(3) EPC.

3. Closest prior art and novelty (main request)

3.1 Novelty was not disputed by the Appellant during the Appeal. The Board ascertained during the examination of the cited prior art documents that none of the cited documents D1 to D7 discloses a method step according to which an inclination and a lateral shift of a paper sheet in transit is calculated by linear regression of detected and calculated values or means for carrying out this method step. The method of Claim 1 and the detection device of Claim 7 therefore are novel (Article 54 EPC).

3.2 The Board shares the opinion of the parties that document D1 discloses the closest prior art, since this document discloses a method for detecting displacement of paper sheets wherein a part of the leading edge of each paper sheet is detected at a predetermined location along the conveyance line and wherein, at several times at a second predetermined location downstream of said first location and along the line of conveyance, the distance between the side edge of the paper sheet and a reference line set up along the conveyance line is detected after elapse of the time taken for the part of the leading edge of said paper sheet to reach said second predetermined location

following the detection of the part of the leading edge of the paper sheet.

Document D1 clearly discloses neither the step of detecting the transportation time interval between the detected part of the leading edge of each paper sheet and the detected part of the leading edge of the next paper sheet, nor the step of calculating an inclination and a lateral shift of each paper sheet in transit by linear regression of the distances from the leading edge of the paper sheet and the distances between one side edge of the paper sheet and the reference line.

The basic idea of the method known from document D1 is to scan, with sensor means disposed in a direction perpendicular to the paper sheet feeding direction, at least two detection areas split with respect to a center of feeding (see Claim 1 of document D1). Indeed, the embodiment shown and described in document D1 comprises a line sensor with a detection range divided into three areas, whereas on page 16, lines 10 to 12 it is stated that the detection range may be divided into areas which number more than three.

Although it is described on page 24, lines 15 to 19 that skew detection need not be performed by obtaining the skew values for both of the two long sides but may be performed by obtaining a skew value for at least one of the two long sides, measuring of the two side edges is still necessary at least for determining the lateral shift of the paper sheet.

According to document D1 a delay timer is set and if the delay time has passed then the line sensor starts scanning the paper sheet (see page 10, lines 11 to 18). The delay time t necessary for the paper to pass the distance l

spaced apart from the leading edge to the position where scanning starts and the time sequence of scanning must be set in accordance with the transportation speed of the paper sheets and the stored data must be related to the counted sequence, so that calculation of the inclination according to the embodiment shown in Figure 15 can be carried out. However, this calculation is based on the distance between two distant scanning lines and not based on linear regression of the specific values as defined in present Claim 1.

4. Technical problem to be solved and solution (main request)

4.1 In order to determine the inclination of the paper sheet and the lateral shift, the closest prior art document D1 proposes measuring steps at the two side edges of the paper sheet and a calculating step to determine the width (step 95). Damaged portions of the side edges are determined on the basis of these measurements and calculation by comparing the width of the paper sheet with a reference value (steps 113, 155, 179). Width values which are considered to be unallowable, since they are outside a predetermined range, are not taken into account for further calculations (inclination, lateral shift). This approach is only possible if measuring takes place at the two side edges of the paper sheet. Therefore, if the measuring took place only at one side edge a considerable deviation from the real inclination of the paper sheet would be expected in case of a damaged side edge.

The advantages of the displacement detection method according to Claim 1 of the patent in suit over the method known from document D1 are therefore the possibility of measuring the displacement of the paper sheet only at one side edge, having nevertheless a high reliability in

determining paper skew and paper shift, and the possibility of providing a smaller detection device.

It follows from the description of the patent in suit (cf. column 2, lines 18 to 39) with regard to the closest state of the art known from document D1 that the technical problem to be solved by the invention is to provide a method and a device which allow a quick and precise check of the operation of a conveyance and stacking device for paper sheets and a reduction of the size of the detection devices resulting in a high degree of manageability.

- 4.2 The problem is solved by the method of Claim 1 and the device of Claim 7. Since measuring of the displacement of the paper sheet is necessary only at one side edge reduction of the size of the detection device and improvement of its manageability is attained. By calculating the inclination and lateral shift in accordance with linear regression of the defined values it is possible to improve this determination even with damaged side edges of the paper sheet.

5. Inventive step (main request)

- 5.1 The most relevant prior art document D1 discloses a displacement detection method and device wherein at both sides of the paper sheet in transit the distances between reference lines and the side edges are measured, in order to determine the width of the paper sheet and therewith the acceptable measuring points and skew and lateral shift of the paper sheet. Even if skew detection may be performed by obtaining a skew value for at least one of the two long sides, reliable determination of the skew angle only can be expected if acceptable measuring points are determined based on the measurements of both long

sides, and based on the elimination of unallowable measurements.

Neither a suggestion to detect a distance (measurement) at only one side edge to calculate inclination and lateral shift, nor a suggestion to calculate by linear regression of the claimed distances can be found in document D1. Even the passage on page 24 (lines 15 to 19) quoted by the Appellant cannot be considered to be a hint towards the claimed solution, since apart from the fact that the passage relates only to the detection of skew, it does not even imply a restriction to a measurement at only one side edge but rather relates to the calculation using the values obtained for only one side.

- 5.2 It is true that document D6 (D6') also discloses a detection method and device for detecting displacement of sheets in transit. The device illustrated in document D6 (D6') comprises a set of sensors (26a to 26i) in the conveyance direction and a transverse distance detector (23) covering only one side edge of the sheet in transit. Displacement detections are performed each time one of the sensors is uncovered by the trailing edge of the sheet. An average inclination of an article with non-linear sides may be determined by using the values of this displacement detection. The statement in the translation D6' of document D6 that it suffices that at least two pairs of the detecting system for use in so-called timing setting, each of which comprises the light-emitter and the light receiver, are provided in the apparatus, may give rise to consider, with regard to document D1, the use of only one sensor for initiating displacement detection at determined time intervals in the transverse distance detector. However, according to document D6 (D6') the trailing edge would be used for starting displacement detection.

5.3 Even if the skilled man combined the knowledge of documents D1 and D6, stimulated by the demand to create a small and easily manageable displacement detection device, he would not arrive at the method of Claim 1 and at the device of Claim 7.

According to document D6 (D6') the inclination is determined on the basis of a simple trigonometrical equation. The determination of an average inclination would again be based on this equation. Although linear regression is a well known method, mainly used for statistical calculations, there is no hint or suggestion in any of the cited documents to determine according to this method the inclination of a paper sheet in transit with a possibly damaged side edge.

5.4 Detecting the time interval between the detected part of the leading edge of each paper sheet and the detected part of the leading edge of the next, as claimed in a method step of Claim 1 (feature c), is generally known in the art, although not disclosed in documents D1 and D6 (D6'). This feature - as such - which, for instance, is described in document D3 (page 70, second paragraph) has no influence on the determination of the inclination and lateral shift of the paper sheet and is not necessary to support inventive step of the method of Claim 1.

5.5 The Appellant argues with regard to Claim 7 that calculating means with which calculation on the basis of linear regression can be carried out are well known and nearly every computer could be considered to comprise such means.

This argument however cannot convince the Board that the particular device of Claim 7 is obvious. It is true that the displacement detection device of Claim 7 comprises

calculating means which work according to a particular mathematical program. Since, however this program produces in combination with the device a technical effect, namely indicating conditions prevailing in the device (e.g. a displaced sheet), Claim 7 cannot be considered as being a claim seeking protection for the program as such within the meaning of Articles 52(2)(c) and (3) EPC. The Board is of the opinion, in accordance with the Decisions T 42/87 and T 26/86 (OJ EPO, 1988, 19), that in such a situation, all the features (whether implemented in hardware or software) recited in the claim which contribute to the solution of the technical problem have to be taken into account when assessing the inventive step (Article 56 EPC) of the claimed subject-matter. A hint to provide a computer with the program of linear regression of values in combination with a displacement detection device however is not given in any one of the cited documents.

5.6 Prior art documents D2 to D5 are less relevant than documents D1, D6 (D6') and D7 and were not considered by the parties anymore during the oral proceedings. These documents cannot support the arguments contesting the presence of an inventive step.

5.7 Starting from the most relevant prior art document D1, several steps are necessary to arrive at the method of Claim 1 and the device of Claim 7. It is not only needed to combine features from two prior art documents, which although disclosing subject-matter in the same technical field, disclose methods having a completely different working concept, but also to choose additionally, without any direct suggestion and out of several generally known mathematical calculating methods, a specific calculation, to arrive at a simplified displacement detection method and device, which calculation is moreover different to

that suggested by prior art document D6 (D6'). Such an approach, to arrive at the method of Claim 1 as well as at the device of Claim 7 would be the result of an ex post facto analysis.

The method of Claim 1 and the device of Claim 7 involve an inventive step within the meaning of Article 56 EPC.

6. In view of the above, the patent in suit can be maintained on the basis of the Respondent's main request, i.e. the independent Claims 1 and 7, together with the dependent Claims 2 to 6 and 8 to 15 and with the description as well as the drawings as defined in above section VI.
7. Therefore, there is no need to examine the Respondent's subsidiary requests.
8. At the end of the oral proceedings, the Appellant had an opportunity to comment on the amendments submitted by the Respondent (main request). Therefore, it is not necessary to issue a communication pursuant to Rule 58(4) EPC (see Decision T 219/83, OJ EPO 1986, 211).

Order

For these reasons, it is decided that:

1. The impugned decision is set aside;
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the documents

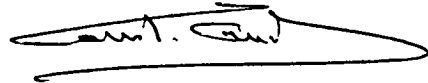
defined in the above section VI as forming the Respondent's main request.

The Registrar:



N. Maslin

The Chairman:



C. Andries

By
385