

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 810 092 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.12.1997 Bulletin 1997/49

(51) Int. Cl.⁶: **B41F 33/00**

(21) Application number: **96830307.3**

(22) Date of filing: **30.05.1996**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**

(71) Applicant: **GRAFICHE EIKON S.r.l.**
I-20068 Peschiera Borromeo (Milan) (IT)

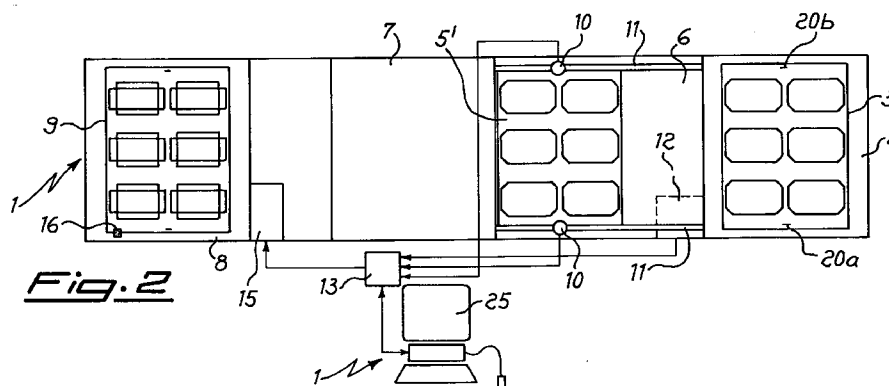
(72) Inventor: **De Fiori, Giacinto**
20135 Milano (IT)

(74) Representative: **Gislon, Gabriele**
Marietti e Gislon S.r.l.
Via Larga, 16
20122 Milano (IT)

(54) Apparatus and method for checking printed sheets

(57) An apparatus for checking printed sheets, comprises means of optical detection (10), mounted immediately upstream of the production station (7) of a machine performing a subsequent phase of production of the sheet (5), for detecting the images of groups (20a,20b) of reference signs (21a-23a,21b-23b) suitably

printed on the sheets (5). It is provided a processing device (14) that allows of displaying the images of the reference signs and of determining the deviation of them with respect to a preset position.



Description

The present invention relates to an apparatus and a method for checking printed sheets which must be subjected to subsequent phases of production, such as die-cutting, embossing, painting, gluing and the like.

An example of application of the present invention is the manufacture of cardboard boxes (or made from other similar material) from a flat sheet which is printed and subsequently die-cut. The sheet thus obtained is then cut to give a plurality of portions comprising the various elements of the box, e.g. the walls, the fixing flaps and similar.

Currently, an initial check on the production method is carried out by examining a pre-determined sample of sheets coming out of the printing machine. For instance, the multiple-colour images require the subsequent printing of the prints corresponding to each colour. There may be errors of alignment between the prints of the various colours, for instance an unwanted overlap of the colours, that could be caused by the tolerances inherent in the printing machines or by deformations of the sheet subjected to the printing of the preceding imprints.

To verify the mutual alignment of the printed colours, the printing of each colour makes a series of thin crossed lines in the corners of the printed sheet, in such a way as to superimpose the subsequently printed lines from each imprint. The visual examination of each "cross" in the corner of the sheet reveals whether the printing of the colours, and particularly their alignment, is correct. Of course, in large-scale industrial production, a similar check could not be done on all the sheets printed, but only on those in the sample.

Another important factor is a check on the presence of all the imprints corresponding to each colour. In some cases, like for instance that of the containers destined for the pharmaceutical industry, it is necessary to ensure that each colour is really transferred to the sheet in the printing phase. The complete absence of the imprint of any one of the colours, for instance the red colour with which the instructions and the information to the public are printed, could constitute a serious risk for the consumer.

The sampling check allows slowdowns in production to be avoided, but doesn't ensure the same quality for all the printed sheets or the presence of all the imprints of the printed colours on all the sheets.

Besides, in the case in which the printed sheets are then subjected to subsequent processes, further defects could occur - due for instance from the aforementioned deformations of the sheet or from incorrect introduction of the sheet into the workstation. Therefore, if an high level of productivity is to be maintained, the check on the printed sheets coming out of the machines after subsequent processes must be done by sampling. As has already been mentioned, that does not guarantee a good level of quality of the printed sheet, and does not even guarantee a level of quality conforming to the contractual requirements of the final product produced

by this work procedure.

According to the known technique, it is therefore very difficult to get a finished or semi-finished product of high quality and at the same time maintain a high rate of production.

One object of the present invention is to provide an apparatus that allows precise and reliable checking of the printed sheets, assuring in particular a check on the presence of each imprint on all the sheets.

Another object of the present invention it is that of providing an apparatus that enables, without exception, a check on all the printed sheets subjected to subsequent phases of production without slowing down the normal rate of production.

A further object of the present invention is to provide an apparatus that enables the printed sheets to be checked between the subsequent phases of production.

These objects are achieved by the present invention, which relates to an apparatus for checking printed sheets subjected to subsequent phases of production, characterized by comprising: means of optical detection, mounted to a machine that performs a subsequent phase of production upstream of the production station, and act to generate an electric signal representing a plurality of printed images in pre-set positions on each of the sheets; means for generating an electric signal of synchronization with the movements of the machine; at least one processing device to method the signals coming from the means of optical detection and the synchronizing means; and interface means to allow the exchange of signals at least between the processing device, the means of optical detection and the synchronizing means, so as to detect the positions of the images on each of the sheets fed into the machine that performs a phase of production subsequent to the printing.

Thus, a single check is sufficient to reveal defects in the printing, i.e. misalignment of the colours, as well as possible errors of alignment of the sheet going into the production station.

It is also evident that the apparatus according to the invention allows the presence of each imprint on all the sheets previously printed to be checked in a secure way.

According to an advantageous aspect of the invention, the apparatus comprises means for applying an identification element to a sheet coming out of a machine that performs a phase of production subsequent to the printing. For instance, in the case in which any defect is detected on the sheet, it is possible to apply a label to the same sheet, for instance in a projecting position, to identify it easily and separate it from the rest of the sheets.

In particular, the means of optical detection are mounted above a plane of transit of the sheets along the machine that performs a subsequent phase of production, in correspondence with a position in which the sheet is stopped before being inserted into the production station.

That allows the quality of the sheet to be checked

without slowing down the production rate of the machine.

The means of optical detection are mounted in a sliding manner on guides parallel to the plane of transit of the sheets, and they comprise at least one fixing device to allow correct positioning along the guides. The means of optical detection further comprise at least one device of regulation of the focal distance with respect to the plane of transit to allow the correct focusing of the images on the sheets in each case.

Such means of optical detection employs preferably two charge coupled type image detectors (CCD), for each of which a source of ultraviolet light is provided. In this way even images printed with clear colours can be detected with high precision.

Furthermore, the invention concerns a method for checking printed sheets to be subjected to subsequent phases of production, comprising the steps of:

printing the sheets including at least two groups of reference signs, each group of signs comprising at least one reference sign for each of the printed colours on the sheets;
feeding the printed sheets to a machine that performs a phase of production subsequent to that of printing;
generating a synchronizing signal to enable means of optical detection arranged on said machine;
detecting the image of the reference signs on each of the sheets in correspondence with a position in which each of the sheets is stopped before being inserted into the production station;
sending the signal generated by the means of optical detection to a processing device; and
determining and signalling the deviation of the reference signs with reference to the correct printing position of the signs on the sheet and of correct alignment of the sheet entering the production station.

The method advantageously comprises the application of an identification element to a sheet coming out of the machine in the case where the sheet is found to have an image in which at least one of the reference signs is misplaced with respect to the pre-set position by more than a pre-set distance.

The reference signs are preferably grouped in two printed groups near to the longitudinal opposite edges of each sheet, in position substantially central with regard to the total length of the edges. That allows an effective determination of whether the position of the imprint of each colour, independently of the others, is within a preset tolerance for that particular colour.

Each of the groups comprises at least one reference sign for each of the printed colours on the sheet, in order to verify the presence of all the colours.

Further advantages and characteristics of the invention will be more evident from the description that follows, which is illustrative and not limiting, with refer-

ence to the schematic drawings attached, in which:

- Figure 1 is a side elevation view of a die-cutting machine equipped with an apparatus according to the invention;
- Figure 2 is a plan view of the machine equipped with an apparatus according to the invention, with some sheets arranged in accordance with the varied phases of the production cycle;
- Figures 2A and 2B are enlarged views of some details of Figure 2; and
- Figure 3 is a representation of a possible display that is presented on the monitor connected to the processing device.

Figures 1 and 2 show a die-cutting machine 1 comprising a store 2 in which it is stored a stack 3 of printed sheets that must be die-cut. Downstream of the store 2 a feeding device 4 is arranged, provided with known means (not shown) of withdrawing the sheets 5, 5' from the stack 3 and sending them along a plane of transit 6 to the subsequent die-cutting station 7. The sheets 5" leaving the die-cutting station 7 are transferred on a stack 8 placed in a collection bin 9 for die-cut sheets.

The apparatus according to the invention comprises a pair of image detectors 10, for instance of the charge coupled type, that are mounted in a sliding manner on respective guides 11 and that could be fixed in position with suitable means of known type. The guides 11 are substantially parallel to the plane of transit 6 of the sheets 5, 5' that flow between the store 2 and the die-cutting station 7.

A source of ultraviolet radiation (not shown) is linked to each of the image detectors 10 to allow an effective reading also of the clearer colours. Furthermore, the image detectors 10 comprise preferably at least one device of regulation of the focal distance with respect to the plane of transit 6 of the sheets 5 and 5'.

With the die-cutting machine 1 it is also provided a synchronizing device 12 that allows to generate an enabling signal of the reading at the moment in which a sheet 5' is in position of reading under the image detectors 10. The synchronizing device 12 could be realized for instance with a proximity sensor arranged in a suitable position, or also with a disk encoder mounted on a rotating shaft of the die-cutting machine 1. In any case, the synchronizing device 12 must be predisposed so as to generate an electric enabling signal for the image detectors when a sheet 5' transits in the pre-set position.

It is particularly advantageous to effect the reading of the underlying images in a point in which the sheet 5' is stopped before being inserted in the die-cutting station 7. In this way it is therefore possible to check the sheet without slowing down the cycle of production of the die-cutting machine 1.

The signal generated from the synchronizing device 12 and the signals deriving from the image detectors 10 are addressed to a processing device 14

through an interface unit 13.

Downstream of the die-cutting station 7, there are preferably provided means for applying an element of identification on a sheet 5' that comes out of the die-cutting machine 1. Indeed, if a printed and die-cut sheet 5' is considered not in conformity with the requirements of production, it can be identified, for instance, by means of a label 16 (Figure 2) applied on an edge or an angle of the sheet in order to allow the immediate identification also after the end of the complete cycle of production.

The method according to the invention involves, during the usual operations of printing of the images on the sheets, also the printing of at least two groups of reference signs, indicated with 20a and 20b in Figure 2, in correspondence of the opposite edges of each sheet 5.

As shown in the magnified views of Figures 2A and 2B, each group of signs 20a and 20b comprises a reference sign 21a-23a, 21b-23b for each of the printed colours on the sheet.

In the example shown, there has been represented, for sake of simplicity, the reference signs for a printing of three colours, and the signs are schematically represented by points. However, it should be pointed out that the reference signs could have any other suitable shape, and they could be provided in a greater or smaller number on the base of the colours that must be printed on the sheet.

During some experimental tests, printed sheets with twelve colours have been used, the reference signs having been grouped in groups of six colours each on the longitudinal opposite edges of the sheet.

The printed sheets 5 thus predisposed are therefore fed to the die-cutting machine 1 that withdraws them from the stack 2 in the store 3 and addresses them, with intermittent movement, along the plane of transit 6, to the die-cutting station 7. When a sheet 5', during his intermittent movement, is stopped temporarily before entering the die-cutting station 7, that is in the position in which the groups of signs 20a and 20b are placed below the image detectors 10, the device 12 generates a synchronized signal that enable the reading of the detectors 10.

The images of the reference signs 21a-23a, 21b-23b are thus detected and transmitted under form of electric signals to the processing unit 14 through an interface unit 13 that can also be housed inside of the processing unit itself.

The processing unit, for instance consisting of a central unit, a monitor 25, a keyboard and/or a mouse, is equipped with a program that allows to receive the images transmitted from the image detectors 10 and display them on the monitor 25.

An example of the images displayed on the monitor 25 is shown in Figure 3, in which the views of the reference signs 21a-23a and 21b-23b are represented. Each of these signs is surrounded by a small circle 26 identifying the area of the maximum accepted deviation with respect to a pre-set position for each reference sign.

The program allows to determine the detected deviation for each sign with respect to the position of correct alignment of the sheet 5' in the die-cutting station 7.

That allows therefore to effect on the same time the verification of the presence of all the imprints of different colours, the check of the mutual alignment of the imprints of different colours, as well as the check of the correct alignment of the sheet entering in the die-cutting station. Furthermore, the deviations of the position of each sign with respect to the expected position can be detected in any case, thus allowing to display and/or store in a memory at least the relevant data of the deviations detected during the operation of the die-cutting machine 1.

The computer is also assigned for the control of the device 15 that allows to apply an identification element 16 on a sheet coming out of the die-cutting station 7, when it is detected an image in which at least one of said signs of this sheet is misplaced with respect to the expected position for a distance larger than a pre-set distance. With reference to Figure 3, if only one of the reference signs 21a-23a, 21b-23b intersects the correspondent circle 26 that should contain it, or it is out from the circle, this anomalous condition is detected and stored in memory and, in the case in which the device 15 is provided, it is applied an evident identification mark, for instance a label or the like, on the sheet coming out of the die-cutting station 7.

The positions and dimensions of the circles 26 are determined during the starting phase of the die-cutting machine 1. At first, a pre-set number of correctly printed sheets is selected, for instance from five to twenty sheets on the base of the required precision of working.

These sheets are fed to the die-cutting machine in such a manner to allow the regulation of the position of the image detectors 10 along the respective guides 11, and the regulation of the focal distance of the detectors 10 with respect to a sheet 5, 5' disposed on the plane of transit 6. It is therefore also detected the position of the reference signs 21a-23a, 21b-23b with respect to the shot of the detectors, that is with respect to the system of reference integral with the die-cutting machine, to allow the statistic calculus of the position of the reference signs on the sheets 5'. They are therefore calculated the dimensions of the maximum deviation of each reference sign on the base of the desired working tolerances.

Furthermore, the program is able to classify the type of each anomaly detected on the printed sheet to allow the identification of the machine that provoked this anomaly. In fact, the apparatus according to the invention can be applied between each pair of machines carrying out subsequent productions to the printing. In this case, it is again possible to easily identify the machine that has provoked possible anomalies of production of the sheet. In Figures 2 and 3, the reference signs 21a-23a, 21b-23b have identical dimensions and are spaced each for a same length with respect to an adjacent sign, as well as the circles 26. However, on the base of the

alignment between the different colours or on the base of the different tolerances of production, the positions of the reference signs 21a-23a, 21b-23b and the dimensions of the relative circles 26 within which they must be contained, can of course be different.

Claims

1. Apparatus for checking printed sheets that must be subjected to subsequent phases of production, characterized by comprising: means of optical detection, mounted upstream of the production station on a machine performing a subsequent phase of production, and act to generate an electric signal representing a plurality of printed images in pre-set positions on each of said sheets; means for generating an electric signal of synchronization with the movements of said machine; at least one processing device to method the signals coming from said means of optical detection and said synchronizing means; and interface means to allow the exchange of signals at least between said processing device, said means of optical detection and said synchronizing means, so as to detect the positions of said images on each of said sheets fed to said machine.
2. Apparatus according to claim 1, characterized by comprising means for applying an identification element to a sheet coming out of said machine.
3. Apparatus according to claim 1 or 2, characterized in that said means of optical detection are mounted above to a plane of transit of the sheets along said machine, in correspondence of a position in which a sheet is stopped before being inserted in said station of production.
4. Apparatus according to any one of claims 1 to 3, characterized in that said means of optical detection are mounted in a sliding manner on guides parallel to the plane of transit of said sheets, and that said means of optical detection comprise at least one fixing device on said guides.
5. Apparatus according to any one of claims 1 to 4, characterized in that said means of optical detection comprise at least one device of regulation of the focal distance with respect to said plane of transit.
6. Apparatus according to any one of the preceding claims, characterized in that said means of optical detection consist of at least two image detectors of the charge coupled type.
7. Apparatus according to claim 6, characterized by comprising a source of ultraviolet light joined with said image detectors.
8. Apparatus according to claim 1 or 2, characterized in that said processing device comprises a central unit, a monitor, a keyboard and/or a mouse, said central unit running a program for carrying out the following functions: detecting and displaying the images received from said means of optical detection; determining and signalling the deviation of said images with respect to the position of correct alignment of the sheet in said station of production; displaying and storing at least the data relevant to the deviations during the operation of said machine; and operating said means for the application of an identification element on a sheet coming out of said machine in the case in which, for said sheet, a deviation larger than a pre-set tolerance is detected.
9. Method for checking printed sheets to be subjected to subsequent productions, comprising the steps of:
 - printing said sheets including at least two groups of reference signs, each group of signs comprising at least one reference sign for each of the printed colours on said sheets;
 - feeding said printed sheets to a machine that performs a subsequent phase of production to that of printing;
 - generating a synchronizing signal to enable means of optical detection arranged on said machine;
 - detecting the image of said reference signs on each of the sheets in correspondence with a position in which each of said sheets is stopped before being inserted into the production station of said machine;
 - sending the signal generated by said means of optical detection to a processing device; and
 - determining and signalling the deviation of said reference signs with reference to the correct printing position and to the correct alignment position of the sheet entering the production station.
10. Method according to claim 9, characterized by comprising the application of an identification element on a sheet coming out of said machine in the case where said sheet is found to have an image in which at least one of said signs is misplaced with respect to the pre-set position by more than a pre-set distance.
11. Method according to claim 9, in which at the starting of said machine there are provided the steps of:
 - selecting a pre-set number of sheets that result correctly printed;
 - feeding said sheets to said machine;
 - regulating the position of said means of optical detection along the respective guides in correspondence with the pre-set positions of read-

ing;

regulating the focal distance of said means of optical detection with respect to the plane of transit of said sheets;

detecting the position of said reference signs 5
on each of said selected sheets for calculating statistically the position of each of said signs;
and

setting the dimensions of the maximum deviation of each reference sign on the base of the 10
desired tolerances of production.

12. Method according to claim 9, characterized in that said groups of signs are printed near to at least two opposite edges of each sheet. 15

13. Printed sheet for carrying out the method according to any one of claims 9 to 12, characterized by comprising at least two groups of printed signs in proximity of at least two opposite edges of each sheet. 20

14. Printed sheet according to claim 13, characterized in that said groups of signs are arranged in a substantially central position with respect to the total length of said edges. 25

15. Printed sheet according to claim 13 or 14, characterized in that said groups comprise at least one reference sign for each of the printed colours on said sheet. 30

35

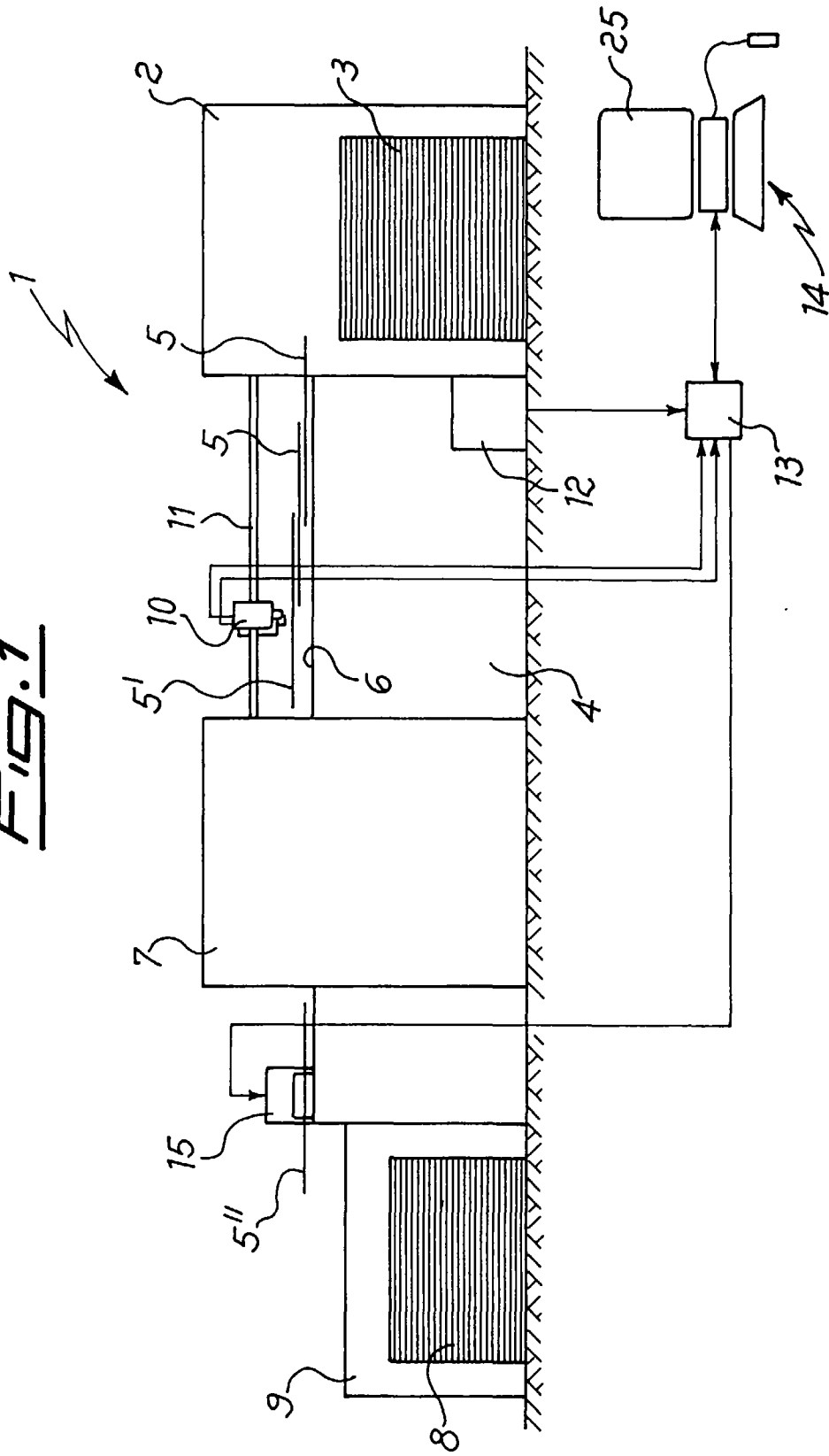
40

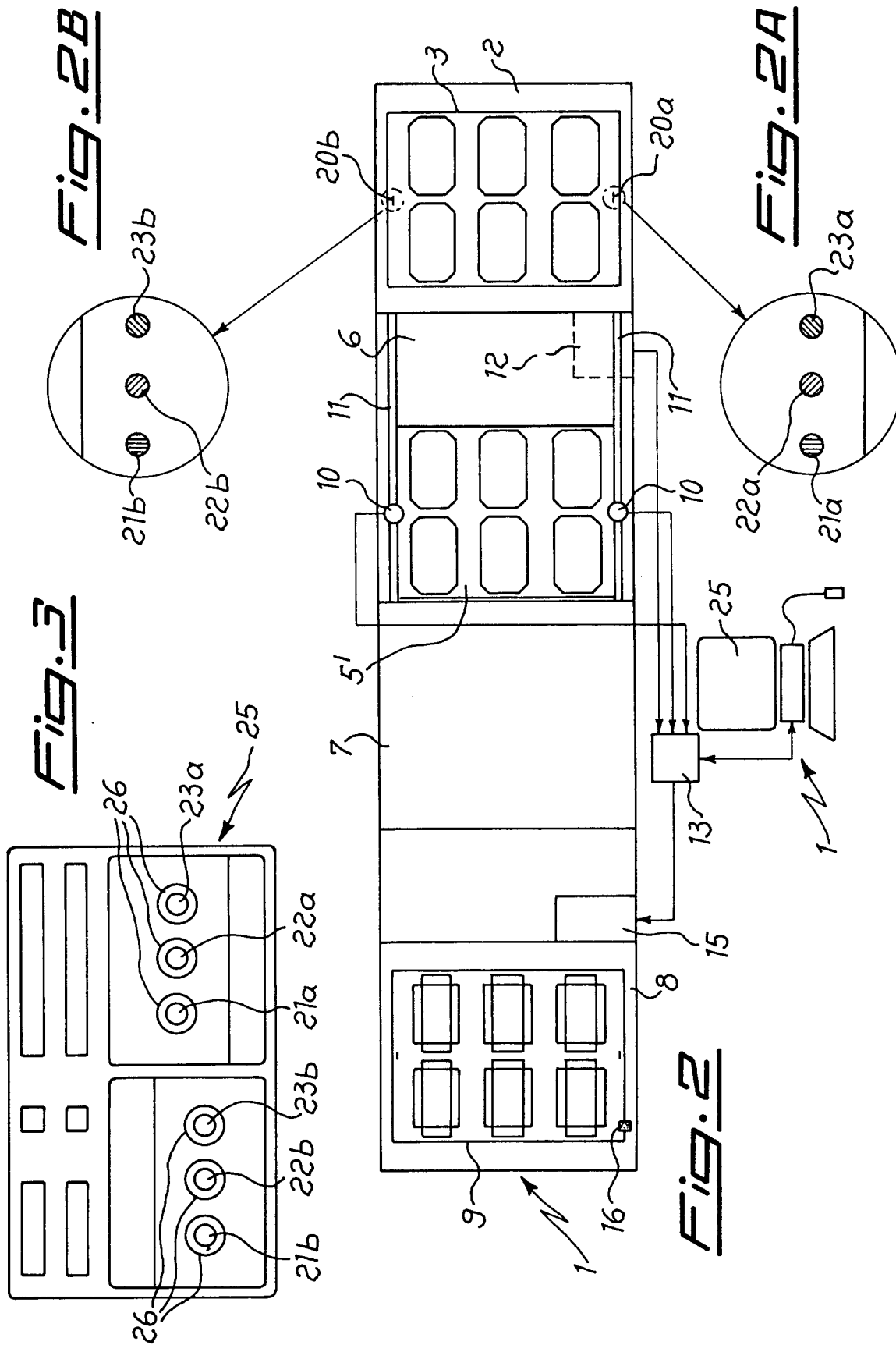
45

50

55

Fig. 1







European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0307

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 453 974 (BOBST S.A.)	1-4,8-15	B41F33/00
Y	* the whole document *	6,7	

Y	EP-A-0 554 811 (BOBST S.A.)	6	
	* the whole document *		

Y	PATENT ABSTRACTS OF JAPAN vol. 18, no. 55 (M-1550), 28 January 1994 & JP-A-05 278206 (MATSUMOTO), 26 October 1993, * abstract *	7	

X	EP-A-0 452 769 (BOBST S.A.)	1,2,4,8-15	
	* the whole document *		

X	EP-A-0 685 420 (FERAG AG)	1,9,11	
	* the whole document *		

X	WO-A-89 01867 (VALTION TEKNIILLINEN TUTKIMUSKESKUS)	1,11	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
	* the whole document *		

A	DE-U-91 16 439 (KOENIG & BAUER AG)	1,6	B41F
	* the whole document *		

The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		31 October 1996	DIAZ-MAROTO, V
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P4/C01)