

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

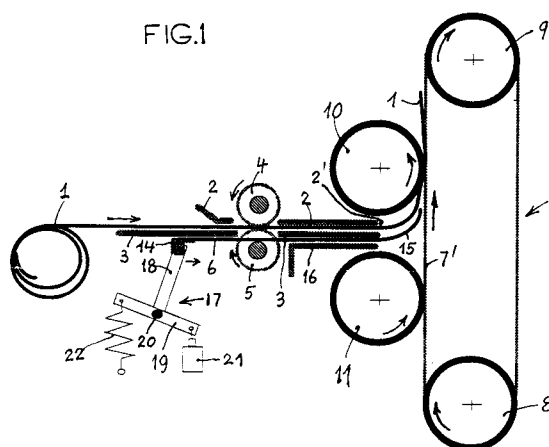
0 645 335 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **94110513.2**(51) Int. Cl.⁶: **B65H 45/20**(22) Date of filing: **06.07.94**(30) Priority: **24.09.93 IT MI932050**(43) Date of publication of application:
29.03.95 Bulletin 95/13(84) Designated Contracting States:
CH DE FR IT LI(71) Applicant: **RIGOLI F.I.M.E. S.p.A.**
Via Riva di Trento, 24
I-20139 Milano (IT)(72) Inventor: **Rigoli, Vittorio**
Via Riva di Trento, 29
I-20139 Milan (IT)(74) Representative: **Klausner, Erich et al**
c/o Ufficio Internazionale Brevetti
Ing. C. Gregorj S.p.A.
Via Dogana 1
I-20123 Milano (IT)

(54) **A device for guiding the leading edge of a sheet to be folded, and a folding machine provided with such device.**

(57) Device for guiding the front edge of a sheet (1) to be multi-folded on itself having, parallel with the rectilinear path (2-3) of feeding of the sheet, an elastically flexible lamellar means (6). Such lamellar means (6) takes two positions, an operative position in which the lamellar means is moved forward to the outlet point of the sheet from the feeding path (2-3), the lamellar means end (15) being bent, with bending shape memory, at said outlet point of sheet (1) in the same directions the sheet front edge of the sheet is to be deviated to, to guide the latter towards a folding unit (10,7) and a rest position in which the lamellar means (6) is brought again to the initial retracted position in such a way that the bent part (15) of the lamellar means (6) does not hinder the movements of the sheets during the folding phase thereof.

**EP 0 645 335 A1**

The present invention relates to a device suitable for guiding in sure way in a desired direction, in a paper sheet folding machine, the front edge of a sheet to be multi-folded accordion-like on itself, during the initial sheet folding phase, and to a folding machine provided with such a device.

Folding sheet machines for sheets, having a considerable length and width, suitable to fold said sheets more times on themselves in one or both directions so as to obtain an accordion-like, or zigzag, folded sheet, such as for instance the folding machine described and illustrated in Italian Patent N.2.083.484 and in the corresponding European Patent N.0.171.486 of the same applicant, are already known.

The main problem in folding machines is to provide a means which may assure that the front edge of the sheet to be multi-folded on itself be surely directed towards an element of the folding unit during the initial phase of forming the first fold and that said fold, as well as the subsequent folds, be perfect, namely that it does not show dog eared corners, wrinkles or other defects due to the front edge of the sheet to be folded which, in the initial phase, could possibly hit against an element of the folding unit or other unwanted obstacle, be it fixed or movable, in that said front edge is not guided in a sure and reliable manner in the desired direction and along the pre-established path.

Such problem was solved, both in the above-mentioned patents and in other folding machines, in a more or less satisfactory manner.

In the case of the aforecited patents, though said problem has been brilliantly solved, the folding machine structure is become somewhat complex and consequently more expensive.

The purpose of this invention is therefore to solve such problem in a simpler, less expensive, and most of all more reliable manner. This is achieved by providing a shaped guiding assembly which directs in a sure way the front edge of the sheet to be folded in the desired direction and in the required position during the initial phase of forming the first fold, without any possibility of unwanted deviations and without encountering hindrances that might result in the formation of the so-called dog eared corners in the sheet front edge, whereupon said guiding assembly is retracted to a non-operative position, outside the sheet stacking area for the formation of folds, and the folding operation goes on in the usual way, imparting to the sheet, in succession, different folds as required.

According to the present invention an assembly of guiding laminae is provided for the sheet to be folded, said laminae being made of a suitably shaped elastically flexible material which is endowed with shape memory, and being moved forward parallel to the sheet to be folded in a continu-

ous advancing phase, from a retracted position in a suitable stationary slide housing, which slide is suitably provided parallel to the sheet advancing path, until the laminae reach an area between the folding means where the sheet is to be accumulated in order to form in it bends that are preliminary to forming folds, said elastically flexible laminae having their ends protruding from the slide in a curved or bent shape, said ends having moreover been imparted a shape memory in respect of said bending, said bent shape of the laminae allowing a reliable guide action for the front edge of the sheet to be folded which is directed towards one of the two folding stations so that, after the sheet front edge has reached the first folding station, the assembly of laminae is moved backwards and returned into its slide housing, while the remaining part of the sheet is subsequently folded repeatedly on itself according to the need in an already known manner (for instance, as explained in the aforecited patents), alternately entering into the two folding stations.

The forward and backward movements of the elastically flexible laminae assembly may be carried out by means of various drives of a known type and an embodiment of this invention may consist of a T-shaped, fixed geometry rocker lever, the control rod of which, corresponding to the T stem, is articulated on a slider bar to which is connected the end of each one of the flexible laminae which is opposite in respect of the elastically bent operative end of the laminae which end acts as a guide element for the front edge of the sheet to be folded, the opposite end of said control rod being pivoted, similarly to a first class lever fulcrum, on the central part of a cross-arm of the rocker lever, one end of said cross-arm of the rocker lever being actuated by a drive system for the advancement of the flexible laminae assembly, and the other one being biased upon by an antagonistic means moving the laminae assembly to the retracted position into the slide housing for the laminae.

To better understand the invention, the same will be described and illustrated hereinbelow, illustratively referring to a schematic, non limiting, embodiment as shown in the attached drawings, where:

Figures 1, 2 and 3 are schematic vertical elevation views, respectively showing three different operational phases of a folding machine, namely an initial phase of an of a cross-arm 14. The opposite end of said laminae 6, indicated by 15, is bent upward in a permanent way, which is to say with a memory of such bent shape, in the direction towards the upper folding roller 10, passing through a suitable slide housing consisting of said lower plate 3 and by a further plate 16 below plate 3. The

cross arm 14 is articulated on a rocker lever member 17 consisting of a rod 18 and a cross-arm 19 which is pivoted in 20. One end of the cross-arm 19 of the rocker lever 17 is connected to a traction-type drive means, such as for instance an electromagnet 21, while the other end of arm 19 of the rocker lever 17 is joined to a return member, such as for instance a spring 22.

The operation of the device according to the invention is described hereinbelow.

At the start-up phase as shown in Figure 1, the electromagnet 21 is energized, so that the rod 18 of the rocker lever 17 swings in clockwise direction, reaching the position indicated in this Figure. By such movement the laminae 6 are caused to move forward to the slide housing consisting of plates 3 and 16, whereby their end 15, which is elastically bent, is situated in the space between the folding rollers 10 and 11 and the tape 7, namely in the position in which the sheet front edge exits from its slide housing consisting of plates 2 and 3 and is directed in a sure way upwards before engaging tape 7. At this stage, since the sheet front edge system, the sheet, continuing its advancing movement, would proceed until it hits against the left section 7' of a continuous tape 7 rotating around two drums, a lower one 8 and an upper one 9, of a folding unit also comprising upper roll 10 and lower roll 11. Said drums 8 and 9 are rotated alternately in the clockwise and the counter-clockwise direction, as will be explained hereinafter; therefore, when they rotate in the clockwise direction, the left section 7' of the tape has an upward movement while when they are rotated in the counter-clockwise direction said left side section shall have a downward movement.

In Figure 1, representing the initial folding phase, said left tape section 7' has an upward movement, and therefore the tape front edge, as a consequence of the upward movement of continuous tape 7 left section 7', tends to be directed upwards as shown in Figure 1, subsequently being compressed and then held between the first upper folding roller 10 and the left section 7' of the continuous tape 7 of folding system 7, 10, 11.

Under continuation of the sheet advancing and reversal of the rotation of drums 8 and 9, one of which is a driving one, the other one being idle, an excess of the sheet material is accumulated (Figure 2) in the space between said upper 10 and lower 11 rollers and the left tape section 7', a bight or bend 12 being thereby formed in the sheet 1. Such bight 12 proceeds downwards as the sheet moves forward until it passes between the tape left section 7' and the lower folding roller 11, until forming a first fold 13 in the sheet (Figure 3). The cycle is then repeated with a further reversal of the movement of tape 7, so to form various folds in the

sheet. This all is already known from the aforecited patents.

However, unless a device is provided to initially drive in a sure way the front edge of the sheet upwards, in the direction toward the first folding roller 10, when such sheet front edge, in the starting phase shown in Figure 1, engages the left section 7' of continuous tape 7, such edge might bend downwards instead of upwards and would be dragged upwards with said sheet edge bent downwards, in the direction towards the upper folding roller 10, so that, when the continuous tape 7 comes to pass and to be pressed between said roller 10 and section 7' of the endless tape 7, an unwanted, downward oriented fold or dog eared corner would form. In order to avoid this drawback, a somewhat complex and costly mechanism was provided in the aforecited patents.

On the contrary, according to the present invention, a set of laminae 6 (Figure 4), made from an elastically flexible material susceptible to be shaped in a permanent way, namely with shape memory, such as for instance armonic steel or suitable synthetic resins, are mutually connected by means operative cycle, after a first reversal condition of the folding unit, and after a second reversal condition of the folding unit, to obtain an accordion-like or zizag- folded sheet, respectively; and

Figure 4 is a schematic top plan view of the plurality of laminae made of an elastically flexible material, as seen from above, in combination with a sheet feeding or advancing roller means consisting of a plurality of separate small rollers.

A folding machine of the known type (as known from the aforecited patents) will first be described in a schematic form, to which the elastically flexible laminae means according to the present invention is provided for surely guiding the feeding, in the desired direction, of the front edge of the sheet to be folded.

The sheet to be accordion-like folded is indicated in Figures 1-3 by the reference numeral 1 while wound on itself like a roll. A first section of said sheet is passed within a slide housing consisting of an upper plate 2 and a lower plate 3. Said sheet, passing between the upper cylinder 4 and the lower cylinder 5, one of which is the driving cylinder, proceeds until it exits through the output end 2' of the sheet-guiding means consisting of said elements 2 and 3. At this stage, if there was not the laminae means 6 according to the present invention or any other known sheet directing has been positively directed upwards, the laminae means 6 is caused to be retracted, provisionally straightening, into the straight slide housing consisting of plates 3 and 16 due to the de-energization of the electromagnet 21, whereby spring

22, acting on the other end of arm 19 of the rocker lever 17, causes the latter's rod 18 to swing towards the left side (Figure 2), thereby causing the backward movement of laminae 6 to a retracted position inside the slide housing 3, 16, in a temporarily straightened condition.

With laminae 6 retracted inside their housing, the folding cycle goes on as previously explained referring to folding machines as known from the aforecited patents.

It is evident that laminae 6, owing to their flexibility, can easily revert to a straight shape when they are retracted into their housing and, owing to their shape memory, they shall be ready to take again their shape, curved at their free operating end, as soon as they will be pushed again out of their housing as a consequence of electromagnet 21 being energized, at the initial phase of insertion of a new sheet to be accordion-like folded.

So far the various rotating elements that cause the paper advancing, its folding and its pressing in a folded condition were considered as integral elements for convenience; as a matter of fact such elements are constituted by several contiguous elements. For instance, tape 7 consists of a series of belts arranged side by side and, as it may be understood observing Figure 4, the various blades 6 pass through a series of small rollers 23, that in their whole constitute the roller 5, said rollers 23 being spaced apart from one another and mounted on a common shaft 24, that can be for instance a driving shaft.

The structure of the forward and backward movement element of the blade means, herein exemplified as rocker arm 17, may be replaced by any device that is suitable for this purpose, and the same applies to the rocker lever control system, here consisting of an electromagnet and a spring, that may be replaced by any other known control system suitable for the purpose.

Claims

1. A device for reliably guiding in the desired direction, in a sheet folding machine, the front edge of a sheet to be multi-folded on itself accordion-like in the initial folding phase, the folding machine including a feeding unit for the sheet to be folded and a folding unit to fold the sheet many times on itself, characterized in that in parallel relationship with the rectilinear advancing path of the sheet to be folded, at the sheet advancing group there is provided an elastically flexible laminae means at a position adjacent to the sheet to be folded, said laminae means sliding in an own slide housing parallel to said sheet advancing path, said

laminae means having two positions, an operative one in which the laminae means is caused to move forwards to the sheet outlet or exit point from the advancing path, the laminae means end at said outlet point of the sheet being bent, with shape memory of such bent, in the same direction to which the sheet front edge is to be deviated to guide the latter towards a folding element, and a second non-operative or rest position in which the blade means is taken back to its initial retracted position in such a manner that the bent-portion of the laminae means, retracted to its slide housing, does not hinder the movements of the sheet in the folding phase of the same.

2. A device according to claim 1, characterized in that the laminae means consists of one lamina or more laminae.
3. A device according to claim 2, characterized in that the lamina or laminae are made of a material suitable of being shaped with shape memory, to which, at one end thereof, a bent shape was given which is permanently kept.
4. A device according to claim 3, characterized in that each one of said laminae, at the end opposite to the bent end, is connected with a bar-like joint element on which a control system acts to move the laminae means to the retracted position and to the projecting position towards the sheet folding unit.
5. A device according to claim 4, characterized in that the said control system for the forward and backward movement of the laminae means consists of a rocker lever which comprises a T-shaped rigid piece, the vertical rod of which corresponds to the stem, is articulated onto the union bar of the laminae means, the arm center being pivoted on the relevant fixed structure of the folding machine in a first class lever fulcrum-like manner, the first end of the arm of the rocker lever, closer to the folding unit, being connected to a control element exerting a traction force on said end of the rocker lever, while the after end of said arm is connected to an antagonist traction element.
6. A device according to claim 5, characterized in that the control element connected with said first end of the rocker lever is an electromagnet and said antagonist traction element, connected with said second end of the rocker lever, is a traction spring.

7. A folding machine including a feeding unit for the sheet to be folded and a folding unit for repeatedly folding the sheet on itself, characterized in that, at a position adjacent to or underlying the feeding unit for the sheet to be folded on itself, there is provided a device according to one or more of claims 1-3, which device is apt to guide in a positive way the front edge of said sheet in the desired direction, said device being operated by a control system according to one or more of claims 4-6.

5

10

15

20

25

30

35

40

45

50

55

5

FIG.1

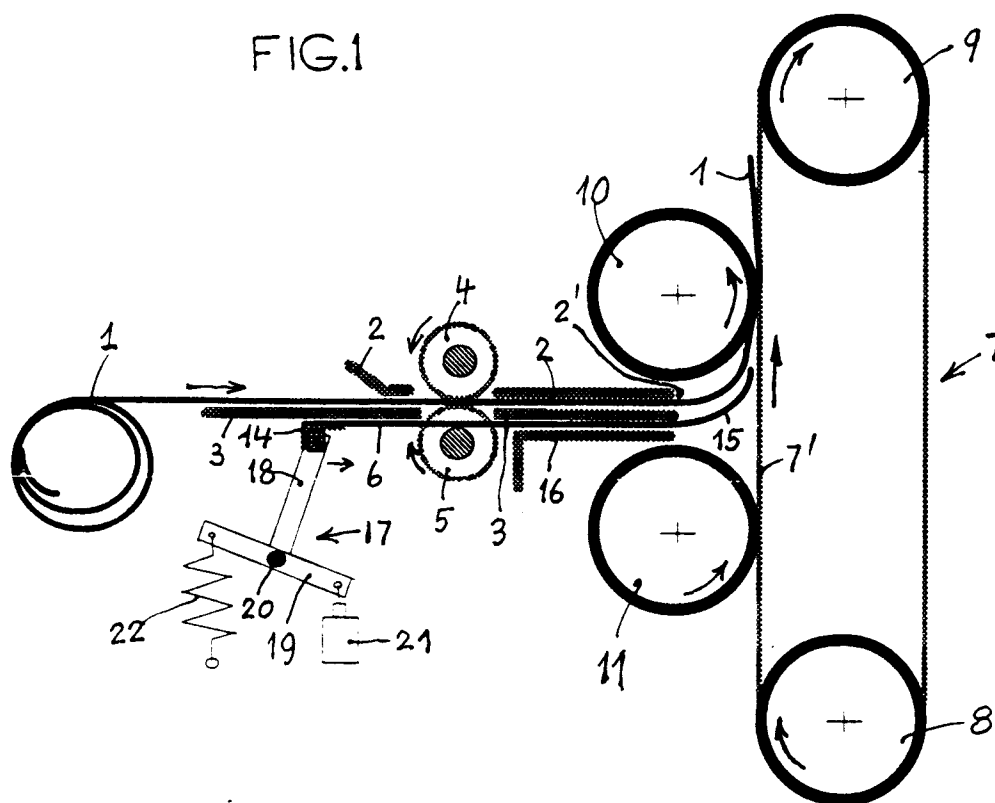


FIG.2

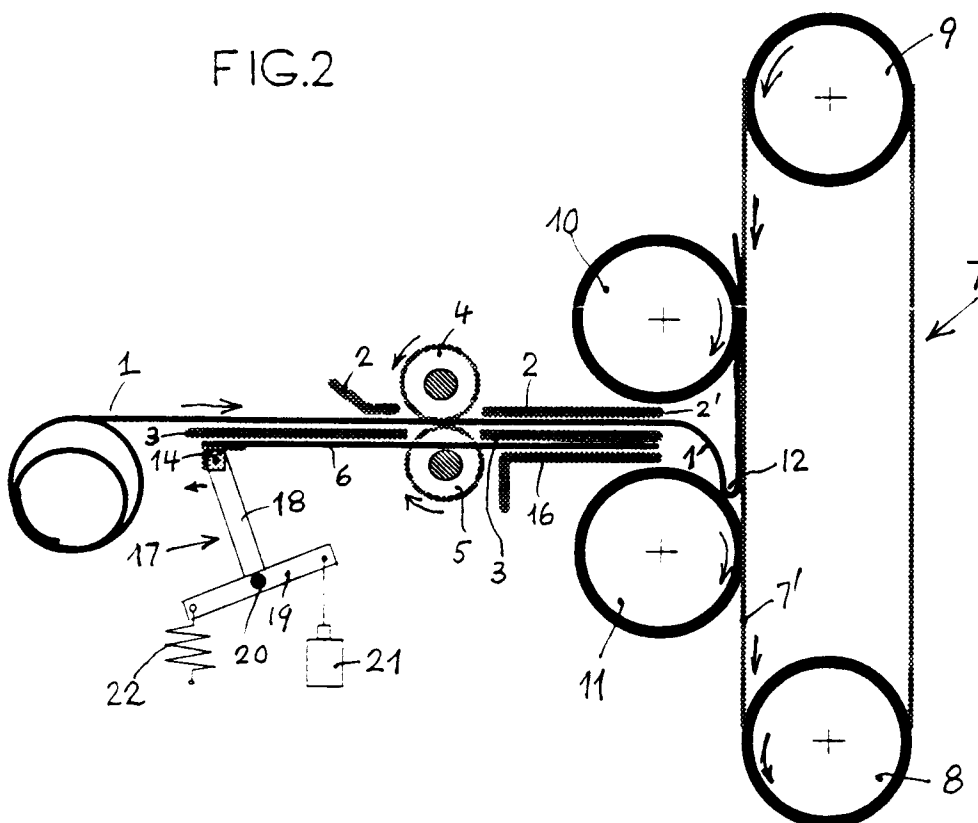


FIG.3

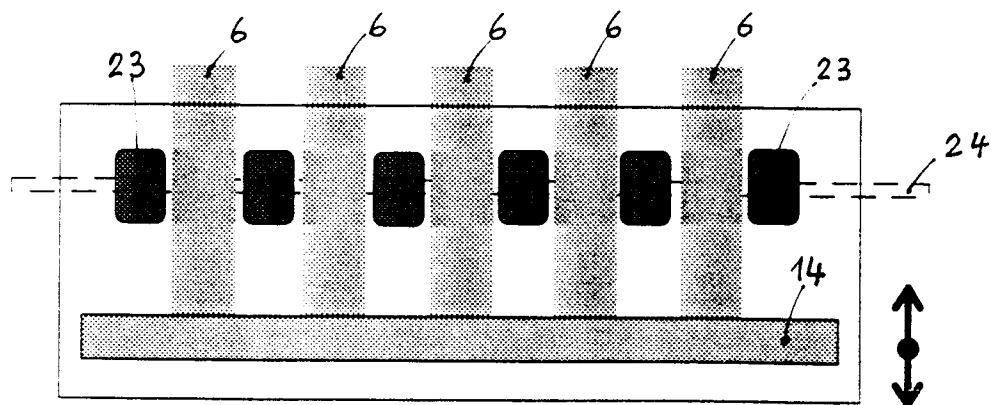
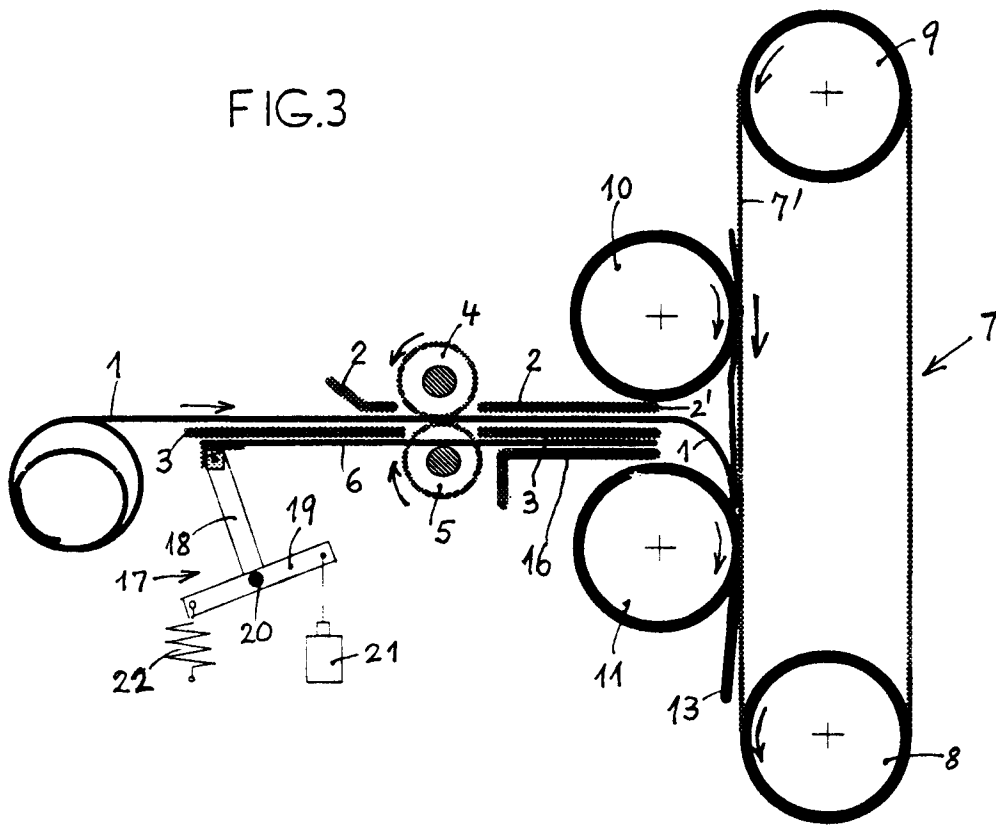


FIG.4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 0513

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)
A, D	EP-A-0 171 486 (RIGOLI F.I.M.E. S.P.A.) ---		B65H45/20
A	EP-A-0 037 650 (HARPER & TUNSTALL LTD) ---		
A	DE-A-37 38 496 (FUJI XEROX) ---		
A	FR-A-842 423 (RIVLOIS) ---		
A	DE-A-21 10 964 (VEB POLYGRAPH LEIPZIG) -----		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B65H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 6 January 1995	Examiner 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			