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54 **Method and apparatus for automatic matching and sewing of pockets.**

57 This invention consists of a method and assembly able to handle, recognize, match and sew automatically two parts of a garment, like a pocket and a shirt front part.

The assembly includes basically a pick up and separation apparatus for big parts (8), another one for small parts (3), a vision processor system (5), a handling and positioning apparatus (6), a sewing device (7) and the adequate software and electronic

computer and processor hardware to perform the control of the different components of the assembly and their integration.

The method includes the data process required to attain the recognition and matching of a small part to a big part of a garment having a striped or checkered pattern using a videocamera and an image processor.

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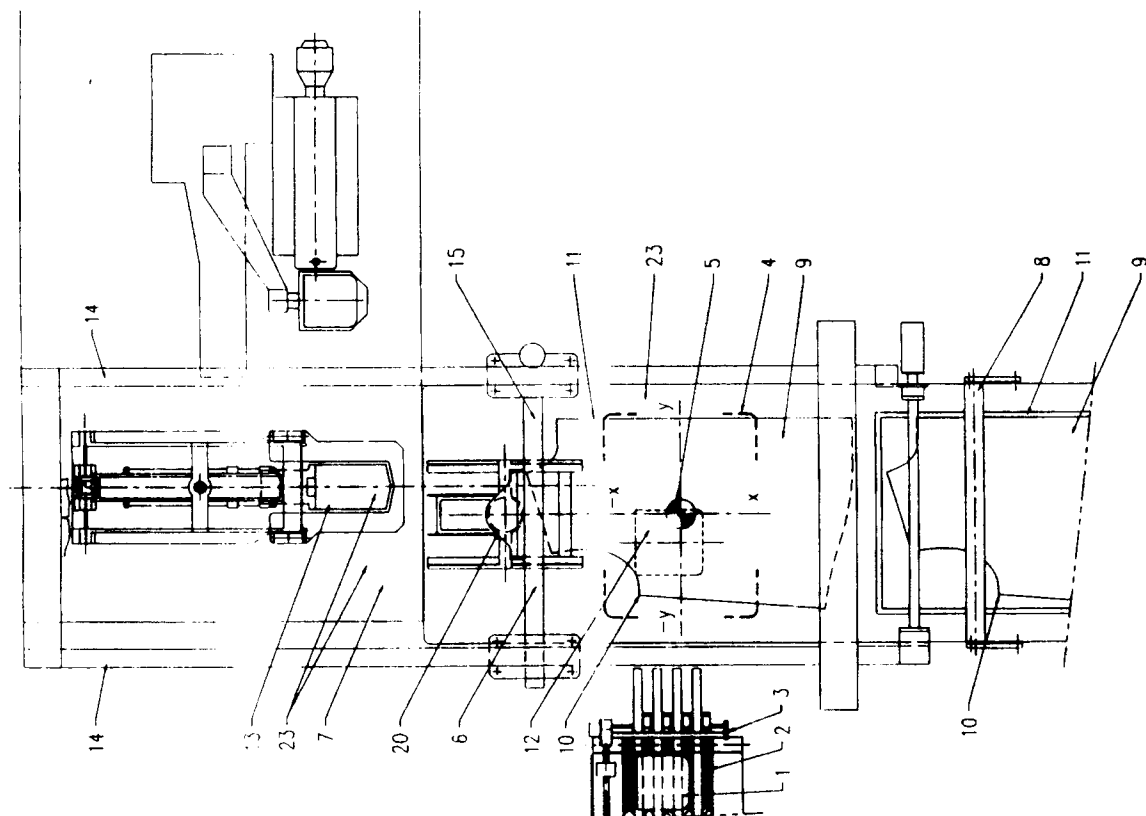


Fig. 1

TECHNICAL FIELD

The present invention relates to a method and assembly for automatic matching and sewing of different parts of a garment having or not a pattern.

BACKGROUND OF THE INVENTION

The main object of this invention is a method and assembly to match and sew automatically two different parts of a garment having a pattern, like a front part and a pocket of a shirt. This method incorporates the solution of a set of problems, solutions for some of them which are already known, and to find solutions for some other problems, are further objects of the present invention.

For performing such a method first of all it is necessary to pick up a big or small piece of fabric from a pile of similar pieces and place it in an area, without wrinkles, where said piece can be recognized. This problem may be solved in several ways, but the one used must be compatible with the present invention.

Further it is necessary to sew automatically the two parts which have been previously positioned in a determined way keeping their relative position while the sewing process. There are several systems in the market which solve this problem, but all of them require an operator for positioning each of the pieces one to one taking into account the respective patterns in order to match them.

The recognition of a piece and its pattern having a plane shape, as a fabric piece of a garment and the matching with another piece is also known at present time. Such systems are described for example in US-PS 4 853 866.

However, there is still a need for attaining an automatic matching and sewing process for at least two pieces, especially for an apparatus able to place these pieces on the automatic sewing machine, substituting the operator function, that is, on the required position with the required precision according to the data previously given to a computer which processes and compares the data obtained by a recognition system.

Therefore, this application contemplates the use of existing technologies in combination with a new manipulator of pieces of fabric in order to attain their automatic matching and sewing.

SUMMARY OF THE INVENTION

The present invention is directed to a method and assembly to perform automatically the operation of matching and sewing of two different parts of a garment having a pattern which have to be matched once they have been sewn, like a pocket and a front part of a shirt. The assembly works in

combination with an automatic sewing machine, able to sew both parts if they have been well positioned in the assembly, and two manipulators, one of them able to receive pieces like shirt pockets one by one, and deposit them without wrinkles on a plane surface when required, and the other manipulator able to pick up a piece, like a shirt front part, from a pile of them and place it without wrinkles on said plane surface when required.

The assembly includes further a videocamera which takes a snapshot of the shirt pocket on the plane surface and then the image is processed by an image processor and a computer to look for the actual shape of the pocket, its location with respect to the videocamera axis, whose position with respect to the automatic sewing machine is previously known, the type of pattern if any, and the pattern location on the piece. In the meantime, the pocket is being moved automatically by the working assembly and positioned in the starting position of the sewing machine when the related data process is finished. Once the pocket leaves the plane surface of the recognition area the front part is placed on it and its image taken and processed in a similar way to that of the pocket, then allowing a positioner to move the front part through the automatic sewing machine in such a position that the pocket will be sewn to the front part on the required location, where the pocket pattern will match the front part pattern. The positioner that takes both the front part and the pocket from the plane surface and positions them on the automatic sewing machine, is also a part of this invention. The sequence of movements can be different according to the automatic sewing machine requirements.

BRIEF DESCRIPTION OF THE DRAWINGS

- Fig. 1 is a plan view of an assembly according to the invention, integrated with an automatic sewing machine, an image processor incorporating a videocamera and pick up and separation systems for garment pieces.
- Fig. 2 is a side view of the positioner carriage of the assembly according to Fig. 1.
- Fig. 3 is a plan view of the positioner carriage according to Fig. 2.
- Fig. 4 is a plan view of the clamp apparatus of the positioner carriage according to Fig. 2.
- Fig. 5 is a front view of the clamp apparatus according to Fig. 4 for fastening a pocket piece in the open position.
- Fig. 6 is a front view of the clamp apparatus according to Fig. 5 in the closed position and

Fig. 7 is a flow chart diagram showing the operational steps of the inventive assembly.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

It can be seen schematically in Fig. 1 the main parts of an assembly able for matching and sewing automatically a pocket and a front part of a shirt.

Usually, the pocket 1 will come from a previous operation, where its upper edge has been sewn, and therefore it will come one by one, for instance on a conveyor belt 2. A pocket handling device 3 takes the pocket from the conveyor belt and places it in a recognition area 4, where the X-Y-axis have been defined on a position similar to that of Fig. 1 that is with the most of the pocket in the quadrant by -X, -Y axis. This position has really a big tolerance and can only affect slightly the data process time. Once the pocket is in such a position, a videocamera 5 of the assembly takes a snapshot of the pocket and the means - not shown - for image processing starts while the positioner 6 approaches the pocket and takes it, once it is located and the adequate orders - generated by a processor not shown - given to the positioner, to release the recognition area and place it in position on a folder 13 of a sewing machine 7. As soon as the pocket is removed from the recognition area, a handling device 8 incorporated with the assembly takes a front part 9 from a pile of them and places it on the recognition area in such a way that the corner 10 of the front part lies in the quadrants formed by -X, -Y -axis; and near the -Y-axis of the plan surface, and the edge 11 can be seen in the recognition area 4 approximately parallel to the X-axis. The tolerance position could be quantified with respect to a nominal position in about ± 25 mm, and can be easily performed by some handling devices - not shown - in combination with a position tolerance of the front part pile. A special requirement for the handling device is to separate one piece from the pile, and only one, and place it without wrinkles on the plan surface of the recognition area 4. The pile may come straight from a not shown cutting machine, as any intermediate operation is needed for the front part.

Once the front part 9 is placed on the recognition area 4, the videocamera 5 takes a snapshot of it and the image processing starts to obtain the location of a matching point 12 which means a nominal point of the front part where a corresponding matching point of the pocket must coincide when both parts are sewn. The nominal position of these matching points is previously given to a computer - not shown - that controls the assembly for each type of pocket and front part. Then, the

first action of every image processing procedure is to determine the geometry of the piece in order to relate it to some of the models and sizes stored in the computer. The geometry is determined by referring it to an axis system related to each piece, which is defined for the pocket 1 by the upper bent edge and its mediatrice, and for the front part 9 by the edge 11 (see Fig. 1) and the perpendicular line to the edge 11 that contains the corner 10.

Then once the axis and the matching point of the front part 9 are defined, the following step is to match in the computer memory the pocket and the front part in such a way that the pattern of both coincides, that means that both matching points being as near as possible. Predetermined criteria can be applied here in order to accept or not the pieces according to the correspondence between patterns (size, color) or the position tolerance between the mentioned matching points.

After the matching data are generated and transferred into the computer memory, the following parameters are known by the computer: the initial pocket position, the final pocket position - centered on the folder 13 -, the actual front part position, and the final related position between pocket and front part. Then, the necessary movements for the front part are easily deduced by the computer according to a predetermined program and performed by the positioner 6 that moves the front part under the folder 13 to its final position. In that way, both parts are in the start position of the automatic sewing machine that can start to operate under computer control. Obviously, this series of sequenced operations - see Fig. 7 - can be overlapped to optimize the cycle time, or changed according to the automatic sewing machine requirements.

The positioner 6 has two main functions as it has been mentioned above: the final positioning of the pocket 1 and the final positioning of the front part 9 after both pieces have been recognized by the videocamera and the sensed positions were transferred into corresponding data. The preferred embodiment uses only one recognition area 4. The pocket must be taken and lifted to be placed on the folder 13. The front part is preferably moved by sliding it along the surface between the recognition area and the area under the folder 13 where said front part must be positioned. Both movements imply a precision requirement of the order of $\pm 0,5$ mm or less for the final position.

A preferred configuration of the positioner 6 for performing the functions mentioned above includes a carriage 20 which can move along lineal guides 14 and 15, parallel to X- and Y-axis respectively, being the movements performed by adequate movement transmission means, including motor controlled position and the required electronic - all

not shown -. Several different means well known can be applied to perform both movements with required precision and speed. The carriage 20 includes a stiff frame 19 which supports a position controlled motor 16 and an endless screw 17 (Fig. 3) connected to the motor 16. A threaded piece 18 is connected to the endless screw and guided by a guide bar 40 of the frame 19 so that said piece 18 is lineally moved along the endless screw, without rotation, when the motor 16 acts the endless screw. A lever 21 is connected to the piece 18 and joined to a pivot 41 mounted on the frame 19. The lever 21 rotates around Z axis, relative to the carriage 20, when the piece 18 moves along the endless screw. A clamp apparatus 22 is connected to the pivot 41 so that said clamp apparatus can move up and down, along Z axis, with respect to said carriage 20. Several other means can be applied to perform this movement along Z axis. The lower position is defined by contact between the bottom surface of the clamp apparatus and the external surface 23 (Figs. 5/6) which can be either the recognition area 4, the folder 13 or the sewing machine surface under the folder 13. The upper position is limited by an end stop fixed to the frame 19.

From the foregoing description it is clear, that the positioner 6 includes a clamp apparatus 22 and adequate technical means to move it along X-, Y- and Z-axis and rotate it around Z-axis.

The carriage 20 with the clamp apparatus 22 performs different operations when the pocket or the front part has to be moved. When the pocket is to be moved, once its image is taken on the recognition area 4, the clamp apparatus is placed above the pocket whereby the clamp apparatus is in its upper position, then it is moved along Z axis to its lower position pressing the pocket and closing two blades 24 (see Figures 5 and 6) to fasten the pocket by both sides against edges 30 mounted on the clamp apparatus (see Fig. 3) in such a way that possible movements between clamp apparatus and a pocket piece are avoided, then the clamp apparatus returns to its upper position and is moved to the required position above the machine folder 13, where it is moved again to its lower position and releases the pocket by opening the blades and returning to its upper position after the pocket is fastened by the folder.

Dimensions A and B (Fig. 4) are respectively the distances between the blades 24 when in closed and open position, then allowing the fastening of any pocket whose width is intermediate between those dimensions. The lower surface of the clamp assembly which contacts with the pocket surface is provided with deformable or compression material 25 like foam, to guarantee a minimum pressure on a determined pocket surface which

avoids the possibility of local displacements or deformations while the blades 24 are closing or opening. The blades 24 are moved simultaneously by the action of the endless screw 26 (Fig. 4) which is moved by a motor 27 and adequate movement transmission means 43, 44 controlled by the computer. The movement of the blades is guided by a part of lineal guides 28. The blades 24 can have small vertical movements with respect to their guides in order to contact better with the surface where the pocket is to be taken.

When the front part 9 is to be taken, once the pocket 1 has been released on the folder 13, the clamp assembly in its upper position is placed above the front part on a determined relative position, then it is moved down to its lower position and press the front part mainly by four grip heads (points) 29 more distant from the rotation axis Z, being these main contact points provided with deformable or compression material 43 (Fig. 2), like foam. Then, the front part is moved by the clamp apparatus to its final position, previously calculated by the computer, by sliding it along the intermediate surface between the recognition area and the start position of the sewing machine, maintaining approximately constant the contact pressure. In addition to contact points 29, other points near the rotation axis contact the front part with less pressure to avoid possibility of local deformation during the movement. The contact surface on the front part is determined by the area where the pocket is to be sewn in such a way that the clamp apparatus is approximately centered on that area. The larger area of the clamp apparatus guarantees that when the front part is released, no wrinkles are transmitted to the pocket area. In this way it is not necessary to fasten the whole surface of the front part.

From the foregoing it is clear that the positioner for handling the mentioned garment pieces includes a carriage with clamp means or apparatus comprising a set of pressing points to press the larger fabric piece on the surface of an area corresponding to said larger piece that includes the area (folder) in which the pocket piece is to be sewn, and means to keep a minimum pressure load on every pressing points when pressing on the larger piece while said piece slides along a horizontal surface of the apparatus, said clamp means further comprising a pressing piece having two edges to press the pocket near the two symmetrical edges of the pocket, two blades whose sharp edges are parallel to said pressing piece edges in the same horizontal plane, and means to move the blades from an open position in which the distance between the edges of the blades is larger than the distance between the edges of the pocket to a closed position in which the blades contact along the edges of the pressing piece,

allowing to fasten a pocket piece by their symmetrical edges, said clamp means further comprising spring means to guarantee a minimum pressure of the blade edges against the surface where the pocket piece is to be taken while the blades are closing and against the pressing piece edges once the blades are closed both spring means associated with a limited capacity of rotation of the blades to guarantee optimum contact of the blade edges over the sliding surface and the pressing piece edges.

Similar configurations can be applied to any operation where a plane piece must be matched to another plane piece in such a way that each piece pattern reach a predetermined relative position after the pieces have been joined.

Claims

1. Method for automatic handling and matching of at least two garment pieces having a pattern under control of a host computer for automatically sewing the two pieces together, comprising the following steps:
 - automatically positioning of a first garment piece within a recognition area without wrinkles,
 - detecting the shape, position and pattern of the garment piece and storing the derived data,
 - clamping and transporting the detected garment piece from the recognition area to the starting position of a sewing machine maintaining thereby shape and position of said piece,
 - automatically positioning of a second garment piece within the recognition area without wrinkles,
 - detecting the shape, position and pattern of the second garment piece and storing the derived data,
 - matching the data representing shape, position and pattern of both garment pieces and storing the derived data,
 - clamping and transporting the detected second garment piece from the recognition area to the starting position of the sewing machine maintaining thereby shape and position of said second piece and placing the second garment piece on a determined relative position with respect to the first garment piece and pressing both pieces together and
 - automatically sewing both garment pieces together keeping their relative position defined by said derived data of the detecting and matching steps.
2. Assembly for programmed controlled handling, matching and sewing of garment pieces (1, 9) having a pattern comprising host computer means (3, 8) to place corresponding pieces one to another without wrinkles on the surface of a recognition area (4), means (5) to detect the shape and position of the pieces on said area and their pattern for generating data to be processed by the host computer, a positioner (6) to move the pieces (1, 9) from the recognition area (4) and place them on a determined way controlled by the host computer, and means (7) to sew automatically the placed pieces after matching to the pattern of said pieces and after the pieces have been positioned by the positioner (6) on a determined way in the sewing means.
3. Apparatus for handling garment pieces in an assembly according to claim 2, characterized in that the positioner (6) comprises a linear guided carriage (20) with clamp means (22) to fasten garment pieces (1, 9) by maintaining the shape and position of said spread out garment pieces on said recognition area (4) and to move the clamped garment pieces from the recognition area to the starting position of the sewing means (7) and to place the garment pieces on the starting position without changing the shape of the pieces and their determined relative position with respect the clamp means.
4. Apparatus according to claim 3, characterized in that means (17, 18, 21) are included to move the clamp means (22) a predetermined distance on a horizontal plane (x, y), for lifting up to a fixed position and to lower said clamp means (22) from said fixed position to a variable position determined by contact between the clamp means and an external horizontal surface (23) which represents the recognition area (4) or the starting position surface of the sewing means (7), and to rotate the clamp means (22) in a predetermined angle with respect to a vertical axis (Z) included on the apparatus said distance and said angle being predetermined by processing of data generated by the recognition means and the host computer.
5. Apparatus according to claim 2 for programmed controlled handling, matching and sewing a pocket having a pattern to a larger fabric piece having the same pattern, characterized by a positioner (6) having clamp means and comprising

- a set of pressing points (29) to press the larger fabric piece (9) on the surface of an area (23) corresponding to said larger piece (9) that includes the area (folder 13) in which the pocket piece (1) is to be sewn, and means (45) to keep a minimum pressure load on every pressing points when pressing on the larger piece while said piece slides along a horizontal surface of the apparatus, 5
 - said clamp means further comprising a pressing piece having two edges (30) to press the pocket (1) near the two symmetrical edges of the pocket, two blades (24) whose sharp edges are parallel to said pressing piece edges in the same horizontal plane, and means (27 43, 44) to move the blades (24) from an open position in which the distance (B) between the edges of the blades (24) is larger than the distance (A) between the edges of the pocket (1) to a closed position in which the blades (24) contact along the edges of the pressing piece, allowing to fasten a pocket piece by their symmetrical edges, said clamp means further comprising 10
 - spring means (25) to guarantee a minimum pressure of the blade edges against the surface where the pocket piece (1) is to be taken while the blades (24) are closing and against the pressing piece edges once the blades are closed both spring means (25) associated with a limited capacity of rotation of the blades to guarantee optimum contact of the blade edges over the sliding surface and the pressing piece edges. 15
6. Assembly for controlled handling, matching and sewing of garment pieces having a pattern, characterized by a videocamera (5) as detecting means and by an image processor for deriving data from said garment pieces (1, 9). 20

Amended claims in accordance with Rule 86 (2) EPC

1. Method for automatically handling matching and sewing of at least two patterned garment pieces (1, 9) of different size under control of a host computer, whereby a video camera (5) is used for generating reference based image data of each of said garment pieces placed on a recognition area (4) and positioning said garment pieces relativ to each other according the generated matching signals with reference to 25

the X- Y-and Z-axis in a predetermined starting position for sewing characterized by the following steps:

- transporting the first garment piece (1) under control of said host computer into the recognition area (4), detecting position shape and pattern and storing the derived data in said host computer, 5
- taking said first garment piece (1) from said recognition area (4) without wrinkles and moving said first garment piece into said starting position 10
- transporting the second garment piece (9) under control of said host computer into the recognition area (4), detecting position, shape and pattern and storing the derived data in said host computer, 15
- moving said second garment piece (9) without wrinkles into that starting position underneath of said first garment piece (1), 20
- positioning the garment pieces (1, 9) relativ to each other according to the generated matching signals with reference to the X- Y- and Z-axis in said predetermined starting position, and pressing both garment pieces (1, 9) together maintaining said shape and said relativ position which are defined by said derived matching data of said garment pieces and 25
- automatically sewing both garment pieces together under control of said host computer. 30

2. Apparatus for automatically handling, matching and sewing of at least two patterned garment pieces (1, 9) of different size under control of a host computer according to the method of claim 1, comprising a video camera (5), a recognition area (4) and means (6, 15, 22) for positioning the two garment pieces in a predetermined starting position for sewing, characterized in that said means for positioning of the two garment pieces comprises a positioner (6) movable along the X-axis between the recognition area (4) and said predetermined position and bearing a carriage (20) movable along the Y-axis and having a clamping device (22) movable along and rotatable around the Z-axis, having clamping means (24, 30) being movable from a upper fixed position to a variable lower position determined by contact between said clamping means (24, 30) and a surface (23) comprising said recognition area (4) and being fixable in said lower position for clamping in said lower position the first garment piece (1) being fed into the recognition area, 35

- lifting and transporting the clamped garment piece (1) into the predetermined position, and said clamping device (22) further having grip heads (29) for positioning the second garment piece (9) being fed into the recognition area (4) after unloading of said first garment piece (1) from said clamping means (24, 30). 5
3. Apparatus according to claim 2, characterized in that the clamping device (22) is comprising further linear guided moving pieces having blades (24) moveable over a surface (23) including the recognition area against bearing edges of said clamping device (22) whereby said bearing edges (30) are adjacent to opposite edges of the first garment piece (1) being on said surface within the recognition area (4) whereby said movable blades (24) having sharp edges which are parallel to said bearing edges (30) and are arranged in the same horizontal plane, and means (26, 28, 27, 43, 44) to move the blades (24) from an open position in which the distance (B) between the edges of the blades (24) is larger than the distance (A) between the edges of the pocket (1) to a closed position in which the blades (24) contact along the bearing edges (30), allowing to fasten said first garment piece (1) along their opposite edges, said clamping device (22) further comprising a set of pressing points (29) to press the larger garment piece (9) being fed onto the surface of the area (23) for transporting said larger garment piece (9) over said surface (23) into the predetermined position underneath the first garment piece (1) for sewing. 10 15 20 25 30 35
4. Apparatus according to claim 2 and 3, characterized by spring means (25) to press the blade edges (24) with a minimum pressure against the surface (23) where the first garment piece (1) is to be taken by closing the blades (24) against the bearing edges (30) once the blades are closed, both spring means (25) associated with a limited capacity of rotation of the blades to guarantee optimum contact of the blade edges over the sliding surface and the bearing edges (30). 40 45
5. Apparatus according to claim 2 to 4, characterized by further pressure means for initiating a minimum pressure load on every pressing point (29) when pressing the second garment piece (9) while said garment piece being slide over said horizontal surface (23) of the apparatus into said predetermined position. 50 55
6. Apparatus according to claim 2 to 5, characterized by feeding means (1, 2, 3, 8) being associated to said surface (23) for host computer controlled automatic feeding said first garment piece (1) and said second garment piece (9) one after the other into the recognition area for handling, matching and sewing.

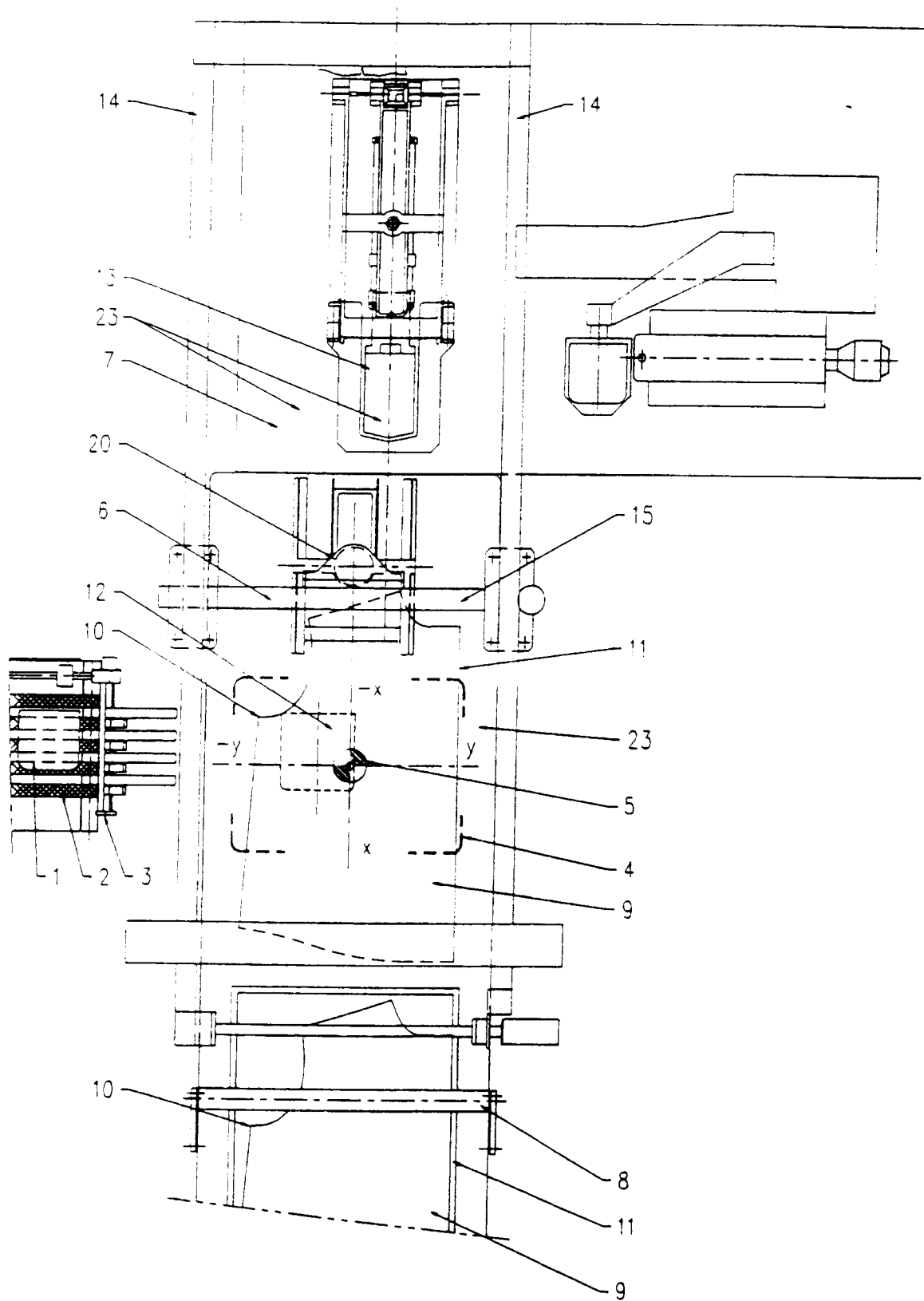


Fig. 1

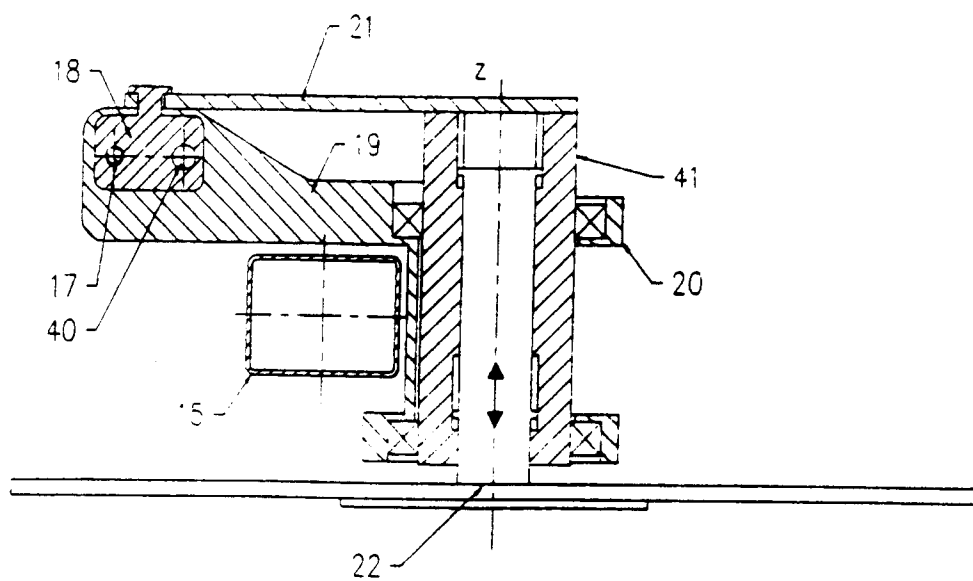


Fig. 2

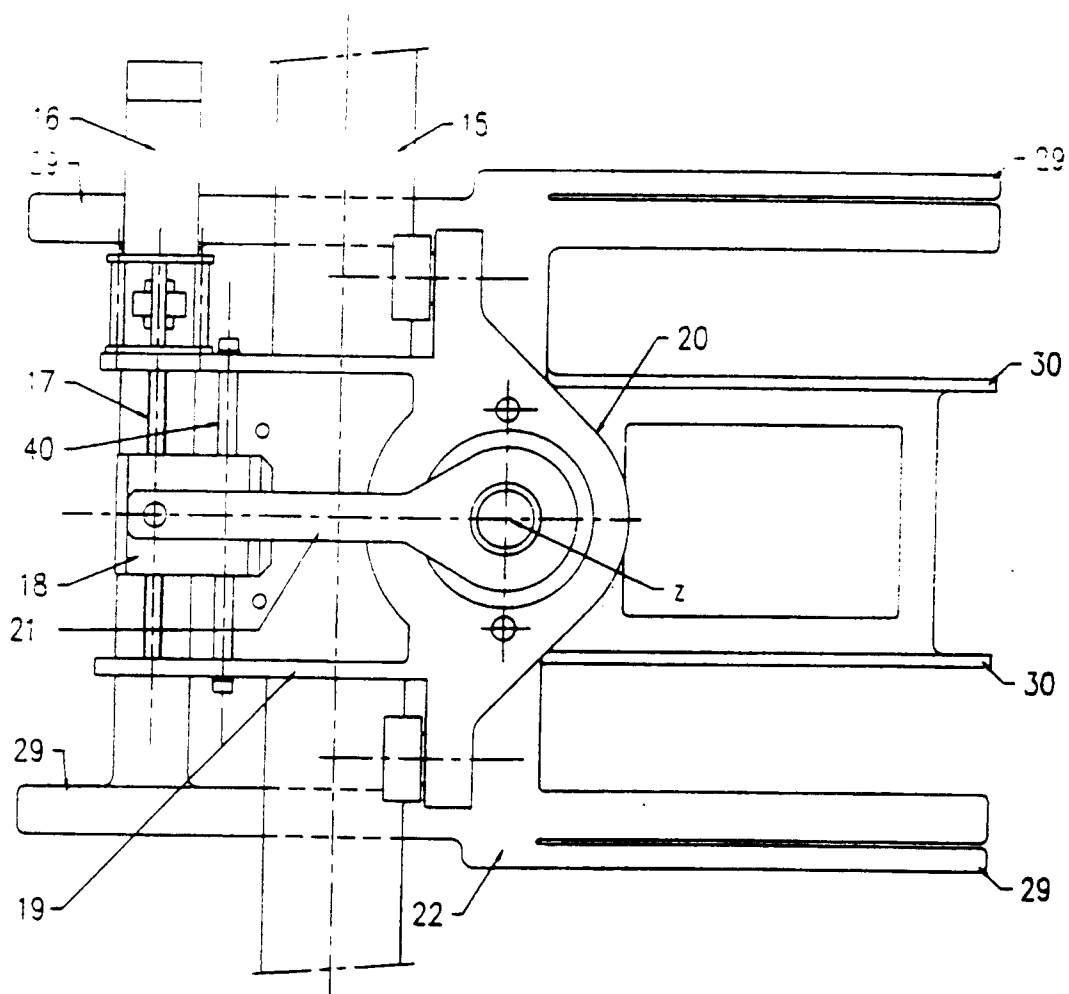


Fig. 3

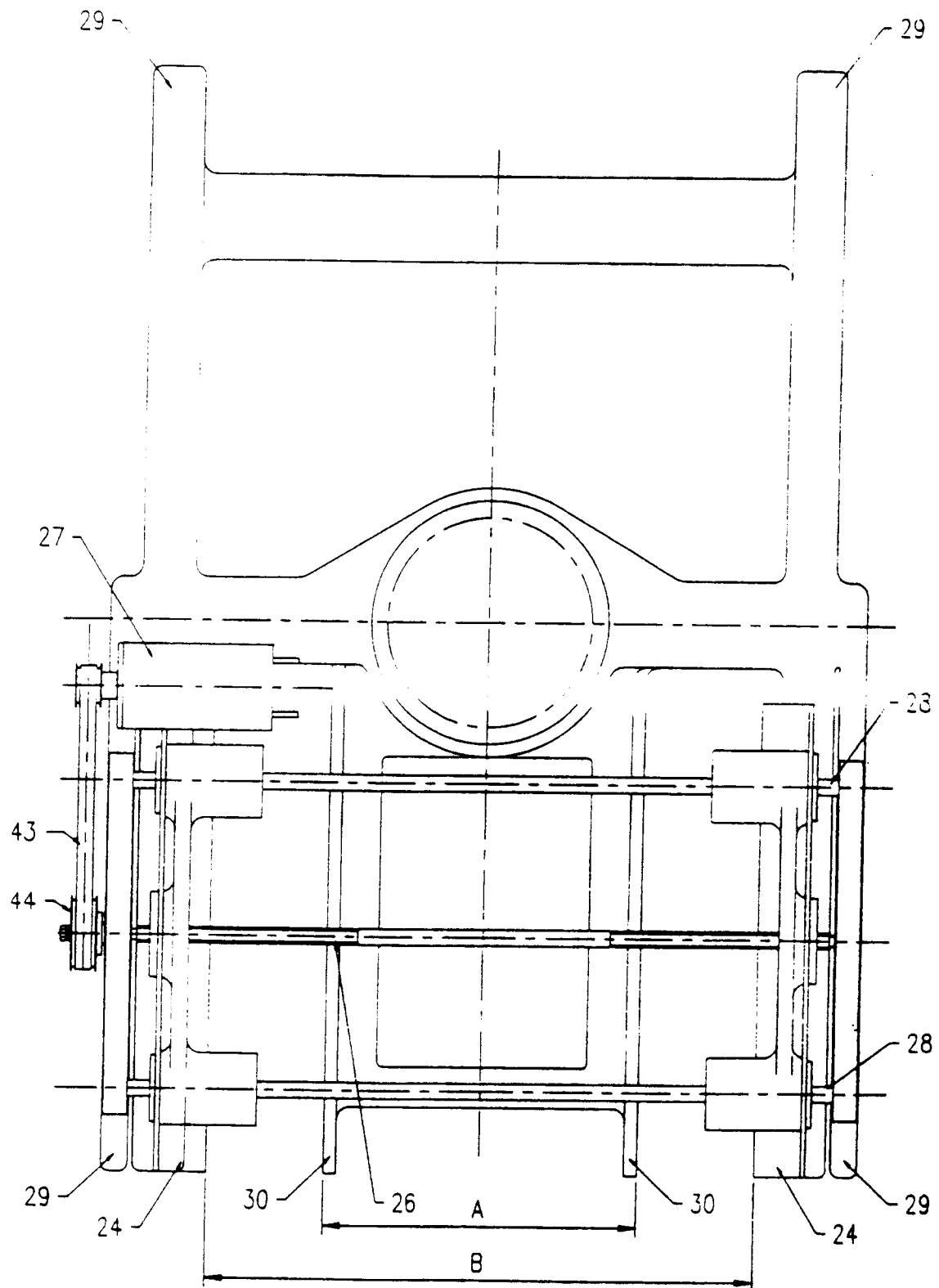


Fig. 4

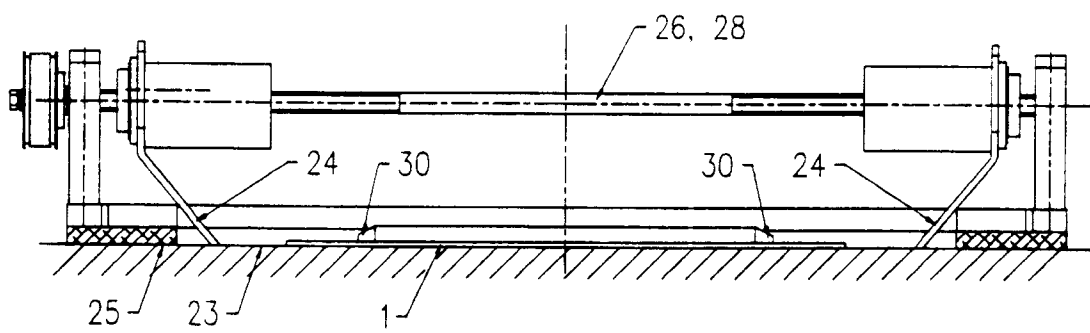


Fig. 5

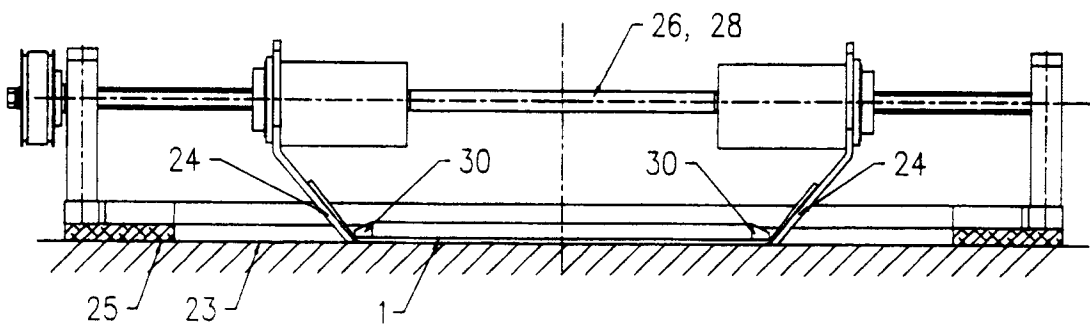


Fig. 6

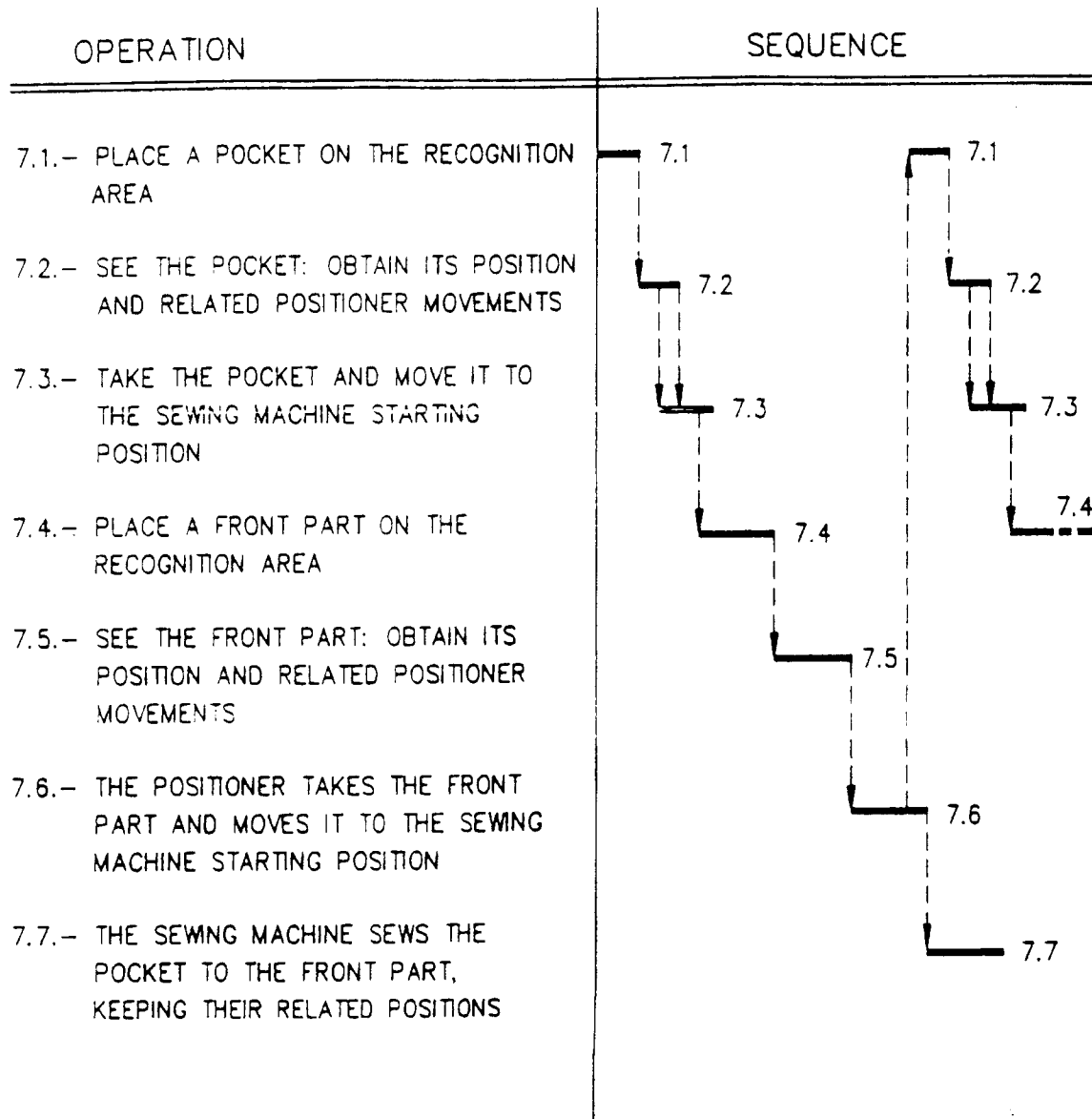


Fig.7



European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 92 50 0033

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.5)
X A	DE-A-3 921 020 (BROTHER KOGYO K.K.) * page 4, line 17 - page 5, line 17; claims 1-9; figures 12,7A-7C *	6 1,2	D05B33/00
A	DE-C-4 030 421 (G.M. PFAFF AG) * claim 1 *	1-6	
A,D	US-A-4 853 866 (ANDRADA GALAN ET AL.) * column 7, line 39 - line 66; claim 1; figures 1,2 *	1-6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D05B A41H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 04 DECEMBER 1992	Examiner TAMME H.-M.N.
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		I : 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	