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Method of spreading patterned sheet materials for automatic match-up and cutting.

METHOD OF SPREADING PATTERNED SHEET MATERIALS FOR AUTOMATIC MATCH-UP AND CUTTING, which is characterized by being made up of the following operations: a) On the basis of specific graphic information, the number and position of several cuttable spikes is determined: b) these spikes are placed on a horizontal surface in the positions determined for this purpose and on this surface a laminar layer is impaled on these spikes: c) the layers of the material to be cut are impaled on the spikes laid out in the preceding stages in such a way that each spike penetrates all the layers at the same point of the pattern: d) the whole assembly of spikes, holding layer and spread material are moved to the cutting table for the cutting operation.

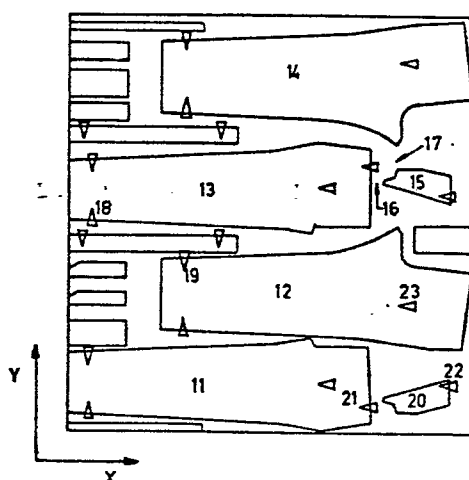


Fig. 1

METHOD OF SPREADING PATTERNED SHEET MATERIALS FOR AUTOMATIC MATCH-UP AND CUTTING

FIELD OF TECHNICAL APPLICATION

The method of spreading patterned sheet materials for automatic match-up and cutting covered by this patent allows several superimposed layers of patterned materials to be spread in such a way that any distortions present in the pattern can be corrected, thus guaranteeing that the pattern always occupies the same position in all the layers, and that any lines present in the pattern (striped or checked materials) are straight and, where applicable, orthogonal, and allowing material already spread to be moved from the spread table to the cutting table without losing the alignment of the pattern in all the various layers. This makes it possible to apply automatic match-up and cutting operations to material spread in this way.

STATE OF THE ART

At the present time, integrated computerized systems for cutting sheet materials are well-known and widely used. These systems usually use a computer or digital processor, which is the central control device for the remaining sub-systems which make up the system; a digitizing device by means of which the numerical information corresponding to the geometry of the pieces or patterns to be cut is entered into the computer memory; programmes and devices which make it possible to manage all the information present in the computer memory and also to configure the layout of the pieces (markers) to be cut; one or several numerically-controlled cutting machines that consist basically of a table on which the material to be cut is spread, and a head which moves over this table, driven by motors controlled by the central computer and equipped with the appropriate cutting tool (blade, laser, water jet, plasma, etc.).

These systems are described in Derek Parker's English Patent no. 993,705, Takashi Mochizuke et al.'s United States Patent no. 3,715,945, and in Juan Sellabona's Spanish Patent no. 489,476.

The use of these systems, which we shall henceforth call integrated marking and cutting systems, for the automatic cutting of materials, has brought about considerable improvements in productivity and in the efficient utilisation of the material to be cut. In the case of the clothing and upholstery industries, for example, the use of such systems has considerably reduced the costs per unit (garment or piece of furniture) manufactured.

The use of these integrated marking and cutting systems for materials bearing some kind of pattern, e.g. checked cloth, striped material or prints, presents a different kind of problem. This problem which, for a long time, has prevented the use of such a system for any other than plain materials, is mainly due to three reasons:

1. The existing need for the pattern on the material to occupy a given position in each of the various pieces when the material is cut. The aim of this is to achieve a quality of finish in the finished product made up by the different pieces (e.g. a garment in the case of material cutting for the clothing industry) that ensures the continuity or symmetry of the pattern in the finished product.

2. The non-rigid nature of the materials makes the presence of distortions in the pattern a common phenomenon. Thus, in striped or check patterns, lines will often not be completely straight, or check squares of uniform dimensions, while in printed patterns the position of these patterns on the material will not always be constant, etc. These distortions make it impossible to predict the exact position of the pattern on the cloth before it is spread. Therefore, it is equally impossible to predetermine a layout of the different pieces (marker) that will ensure that the pattern will occupy the correct position in each piece when these are cut from the cloth.

3. The problems posed by these distortions in any attempt to ensure that the position of the pattern is the same in all layers when several superimposed layers of material are to be cut at the same time.

Thus, for example, in the clothing industry, when cutting check, striped, or printed materials, it is necessary to first achieve a match-up of the various pieces making up a single garment. The term match-up is used to indicate that the pattern occupies a position in each of the pieces that ensures that the pattern in the finished garment will present the desired continuity or symmetry.

Recently, in Spanish Patent no. 553,646, belonging to Vicente Calzado, a match-up method and device has been described that makes it possible to use integrated marking and cutting systems for patterned materials.

This match-up method envisages various operational phases which might be summarised as follows:

1. The definition, in each of the patterns corresponding to the pieces to be matched up and cut, of several match-up points, to which an identification code is assigned.

2. The definition of certain "match-up relationships" which unambiguously establish the match-up between all the various pieces. Consequently, these relationships define the effect that it is intended to achieve in the final set of pieces, once they have been cut.

3. The layout of pieces for cutting. In other words, the assignment of an initial position to each piece, while simultaneously establishing separation margins between them which will later make it possible to adjust their position to ensure their match-up and thereby avoiding any possibility of overlaps when this positional adjustment takes place.

4. The match-up operation itself, which consists of the adjustment of the position of each piece to match it up to all the others. This is done using the match-up device prescribed in the abovementioned Spanish Patent no. 533, 466. This device is fitted with a vision sensor that scans the material once it has been spread and prepared for cutting. This scanning takes place at the match-up points previously defined in the first phase and image processing techniques are used to determine the precise true position of the pattern at each of these points. Using this information, together with the match-up relationships defined in the first phase, the position adjustments for each piece are carried out to ensure the match-up of all the various pieces.

5. Cutting. Once the match-up operation has been completed, the pieces are cut using normal automatic cloth-cutting techniques.

Although this method and device makes it possible to apply automatic marking and cutting systems for patterned materials, the problem is not completely overcome if one wishes to cut several superimposed layers of patterned material. This is a very common situation, since cutting machines, especially those which use a blade as the cutting tool, are able to cut a great many superimposed layers of material indeed, since the vision device can only detect the image on the top layer; if the match-up method is to be applied a spreading method must be devised that will ensure that all layers of the pattern occupy the same position so that the same match-up will be obtained for all layers once the correct match-up has been achieved for the top layer.

Various match-up methods are known that seek to achieve this aim of ensuring that all the layers of the pattern occupy the same position, but none of them can be applied to the problem under consideration here, since they have not been conceived as a preparation for the automatic cutting of material, but only for manual procedures. All known methods are based on "impaling" the various layers of material on sharpened pins or spikes (which

we shall henceforth refer to simply as spikes) placed in a vertical position for this purpose. The impaling is carried out in such a way that each spike penetrates each layer in the same position with respect to the pattern. The impossibility of applying these spreading methods when using automatic cutters is mainly based on two factors:

1. In many cases, the spreading methods known are based on spikes that are fixed to the spread table, as a result of which it is impossible to move the material layers once they have been spread, for their transfer to the cutting table, since the spikes will prevent this. Nor is it possible to apply certain spreading methods in which the spikes in the spread table are retractile. It has been shown that, if the spikes are retracted after the material has been spread, in order to enable the material to be transferred to the cutting table, it is no longer possible to guarantee that the pattern will occupy the same position in all the various layers. The tensions present between the various layers of material, and the tensions produced when the material is moved to the cutting table make the various layers change position with respect to each other, thus disarranging the position of the pattern.

2. Some spreading methods exist which envisage the use of independent spikes (i.e. spikes which are not fixed within the spread table) that maintain a vertical position by being equipped with a flat horizontal base into which the spike is fixed. These methods allow previously spread material to be moved from the spread table to the cutting table, but these methods cannot be applied either, since these spikes are made of metal and therefore cannot be placed onto an automatic cutting table due to the damage that would be caused to the cutting tool (generally a blade) if this were to collide with any of the spikes. Nor is it possible to position these spikes at points through which it is known that no cutting will take place, for two reasons;

a) On the one hand, it is not possible to know beforehand through which points the blade (or other cutting instrument) will pass, since the positions of the pieces are not yet fixed in the spread stage, being determined only after the match-up stage.

b) Furthermore, the position of the spikes is normally critical if one is to achieve an acceptable degree of quality in the match-up of the final set of pieces. Therefore it is simply not possible to place spikes at any point whatsoever, but at only those points which guarantee the degree of quality required. Thus it is not always possible to avoid situations in which their position coincides with the course of the cutting tool.

This same fact makes it impossible to spread the material directly on to the cutting table itself. Nor is it feasible to remove the spikes once the spreading lay has been placed on to the cutting table since, as already indicated above, as soon as the spikes are removed, the material becomes disarranged and it is impossible to guarantee a perfect alignment of the pattern throughout all the various layers.

The method for spreading patterned sheet material for automatic match-up and cutting covered by this invention provides a solution to this problem, allowing several super-imposed layers of patterned sheet material to be spread on top of one another in such a way that any distortions present in the pattern are corrected, thus guaranteeing that the pattern occupies the same position in all layers, as well as ensuring that any lines in the pattern, (striped or check materials) are either straight or, where desired, orthogonal.

Furthermore, this method for spreading materials allows material which has already been spread (spreading lay) to be moved from the spread table to the cutting table without losing the alignment of the pattern in all the various layers, before going on to match up and cut the material, using automatic processes, with the pattern always remaining perfectly aligned and any lines remaining perfectly straight and/or orthogonal, throughout the operation. The method also seeks to minimise both the amount and the complexity of any manual operations to reduce as far as possible their repercussion on overall production costs, thereby enabling this method to be used for industrial applications.

SUMMARY OF THE INVENTION

The method for spreading patterned sheet materials for automatic match-up and cutting operations, covered by this patent, embraces a series of operations that are summarised below:

Using a full-scale drawing containing, in more or less detail, graphic information on the layout of the pieces to be cut, and on the basis of information on how and in what areas these pieces are to be matched-up, the number of spikes that will be necessary, and the exact positions they are to occupy are determined. These spikes are used to fix all the layers of material to be spread and consist of a kind of needle which is kept vertical by being perpendicularly fixed to a flat horizontal base which supports it. A further characteristic of these spikes is that they can be cut by the same cutting tool that is used to cut the material.

Once the number and position of the spikes have been determined, the spikes are pushed through a sufficiently rigid laminar material until they occupy the positions assigned to them. This may be done by driving the spikes through the same support (paper, cardboard, etc.) of the pattern used in the preceding operation. In this way, one can ensure that the spikes are in the positions they are intended to occupy and they will not change their position at any point during the process.

Once this has been done, all the material layers that are to be cut in a single operation are impaled onto these spikes. This "impaling" operation is carried out in such a way that each spike pierces all the layers at the same point in the pattern, and also makes any spikes lying in straight lines parallel to any of the edges of the material pierce all the layers at points in the pattern that likewise define straight lines parallel to the edge of the material.

Finally, once the so-called spreading lay has been constructed, this can be taken over to the cutting table. This transfer will be easier if, as a first step, prior to all the other operations, an initial layer of any laminar material that can be used as a support for the spreading lay and allows the latter to be pulled along without interference due to the presence of the spikes, is first laid out over the spread table beneath all the spikes.

During the transfer to the cutting table, the spikes continue to hold all the layers of the material in place. Once on the cutting table, there is no need to remove the spikes due to the fact, mentioned above, that they are themselves able to be cut. Thus the alignment of the pattern is assured in all the layers until all the pieces have been cut. This makes it possible to apply automatic match-up techniques, with the aim of adjusting the position of each piece to be matched up on the basis of the true position occupied by the pattern in the top layer of the material, since the material-spreading technique described herein ensures that the pattern will occupy this same position in all the other layers.

BRIEF DESCRIPTION OF FIGURES

Figure 1 represents an example of the layout of pieces to be cut out of a patterned material, showing the points at which the match-up requirements of these pieces is greatest.

Figure 2 shows an example of the detailed graphic information that can be used as a basis for determining the positions that should be occupied by the spikes in the spread method covered by this patent.

Figure 3 shows an example of the simplified graphic information that can be used as the basis for determining the positions that should be occupied by the spikes in the spread method covered by this patent.

Figure 4 is a cross-section diagram of the various layers to be formed using the spread method covered by this patent in order to obtain the "spreading lay".

Figures 5 and 6 are perspective views of one of the possible shapes of the disposable spike and of the different layers used in the spread method.

DETAILED DESCRIPTION OF THE INVENTION

The method of spreading patterned sheet materials for automatic match-up and cutting operations covered by this patent allows materials to be spread in superimposed layers in such a way that the pattern always occupies the same position in each layer and maintains this property during its subsequent transfer from the spread table to the cutting table, and during any later match-up or cutting operations.

Figure 1 shows a small-scale example of a layout of pieces (some identified by the numbers 11, 12, 13 and 14) which are ready for cutting out of patterned material. This figure shows pieces which make up a garment, but the process can be equally applied to other industrial processes outside the clothing industry in which patterned materials have to be cut (upholstery, footwear, etc.).

Normally, pieces are laid out in such a way that none of them are in direct contact with each other, but instead have a given margin between them. Thus it will be observed that, in Figure 1, there is a margin (16) between pieces 13 and 15, and that there is a similar margin (17) separating piece 14 from piece 15. Especially when automatic match-up systems are used, these margins are employed to make it possible to subsequently adjust (prior to cutting) the position assigned to each piece to achieve the match-up of all pieces. With these margins, the risk is avoided of producing any overlap between adjacent pieces when carrying out these position adjustments.

As a rule, the match-up requirements for each piece are concentrated around various areas or points of the pieces. The main reason for this is that these will be the most visible areas in the final ensemble or because they will be where any match-up defects will be most easily noticeable. Apart from the outline of the various pieces, Figure 1 also shows the hypothetical distribution of the points occupied by the match-up points for each

piece, these being indicated by small triangles (e.g. 23). In this figure it will also be observed that it is possible for some pieces to have no match-up assigned to them.

A series of match-up requirements might be applicable between all the pieces shown in Figure 1. For example, it could be that piece 13 should present the same pattern position at point 18 as piece 12 and point 19, or, alternatively, that piece 11 should present the same pattern position at point 21 as piece 20 at point 22. The reason for this would be that these pieces will be joined up in the final ensemble and that continuity of the pattern will be necessary at these points to satisfy quality-of-finish requirements.

To apply the spread method covered by this patent, it is necessary to begin with a life-size drawing containing sufficient graphic information with which to determine the position to be occupied by the spikes that will be used to pierce the various layers of material.

This graphic information may present varying degrees of detail. Thus, Figure 2 shows (at reduced scale) a variation consisting of a life-size diagram of all the pieces to be cut, some of which are referenced by the numbers 31, 32, 33 and 34, preferably with an indication of the match-up points defined for them. A rectangular grid with equally spaced lines (36) along the X (37) and Y (38) axes has been superimposed over this diagram. The usefulness of this grid and its contribution to the spread method in question will be examined later. The spacing of the grid lines along the X and Y axes should preferably coincide, although this is not absolutely necessary, with the spacing of the pattern on the material in these two directions, as long as the pattern, as is often the case, is repeated at regular intervals along these axes.

Using this full-scale diagram, the operator(s) responsible for spreading the material will be able to decide at exactly which points he/they should place the spikes which are to be used as the support for the "impaling" of all the material layers and the formation of the "spreading lay". These positions are shown in the example given in Figure 2 as small circles (39).

As shown in Figure 5 for purely illustrative purposes, these spikes can be fitted with a flat, horizontal base and a fixed perpendicular needle (52) in such a way that, when the assembly rests on its flat base, the needle remains in a vertical position. The point of the needle (53) must be sharp, to enable the spike to penetrate the material without damaging it. The height of the spike is not relevant to the definition of the method, but it should range between a minimum that will allow easy penetration of the material and a maximum

that will not impede the movement of the head with which automatic cutting machines are usually equipped, since these spikes continue to pierce the material throughout the cutting operation.

Furthermore, these spikes are made of a material that is sufficiently rigid on the one hand to hold the material in place in the correct position, and yet is sufficiently soft on the other hand to be cut by the cutting tool used in the cutting machine, (e.g. a blade). The dimensions and shape of the flat base are not relevant either, but they should also be capable of being cut by the cutting tool in use.

The need for the spikes to be cuttable is due to the fact that, as will be seen in greater detail further on, the spikes are not removed from the spreading lay when this is transferred to the cutting table but instead remain in the layer throughout the operation, in the course of which they may be cut and are, therefore, disposable. Nevertheless, any spikes which are not cut because they do not happen to lie in the path of the cutting tool may be recovered and re-used in further spread operations.

The designation of the positions of the spikes or needles for the formation of the spreading lay is very important, since the quality of the eventual finish of the ensemble will greatly depend on this factor. As has already been mentioned above, these spike positions will be determined from the available graphic information and will be directed towards the following objectives:

1. The spikes must be as close as possible to the match-up areas or points at which the match-up requirements are greatest, and may even coincide with the match-up points. This is to ensure that, if it proves impossible to achieve a total alignment of the pattern at all points of the surface and between the different layers in the spreading lay due to spread problems (large distortions in the pattern), these defects will not coincide with the areas in which a good match-up is most important.

2. It is advisable for the spikes to be aligned along straight lines parallel to either the X or Y axis. The aim of this is to facilitate the spread operation by making the lines defined by the spikes coincide with lines in the material. This also allows any lack of straightness or orthogonality in these lines to be corrected. This is particularly important in such patterns as stripes or checks, in which it is vitally important to achieve this straightness or orthogonality if one is to obtain the desired finish.

3. The number of spikes positioned should not be very high to avoid making the spread operation a very complicated, slow and, therefore, costly process.

4. The spikes should not be placed very close to each other, since this will impede the spread operation and, furthermore, offers no addi-

tional advantages. A single spike ensures the alignment of the pattern in all the various layers, not only at the point at which it is placed, but also in an area around it, the size of which will depend on the characteristics of the material.

If the initial graphic information is similar to that shown in Figure 2, one way to achieve these aims is by placing the spikes in lines or at the cross-points of the grid the lie closest to the match-up points or areas of the pieces. The advantage of placing the spikes on the lines or cross-points of the grid is that this produces the greatest number of aligned spikes (objective no. 2). If the spacing of the grid is suitable, it may also be possible to achieve objective no. 4, that of not placing the spikes too close together, since the distance between any two spikes will be at least that of the spacing along the X or Y axis. For example, in Figure 2, two of the match-up points (40 and 41) have been replaced by a single spike (39) which has been placed at one of the grid cross-points.

To determine the positions that the spikes should occupy to meet the abovementioned requirements, such detailed information as that shown in Figure 2 is not necessary. Instead it is sufficient, as shown in Figure 3, to possess a full-size drawing of the rectangle (43) corresponding to the layout of the pieces to be cut and a number of marks (44) within this rectangle that precisely indicate the position to be occupied by these spikes. Whatever the degree of detail shown in the initial diagram, this may be obtained by means of the graphic methods with which integrated cutting and marking systems (graphic plotters) are normally equipped. These systems can also be fitted with a sufficient degree of automation that will enable the system to produce the appropriate diagram, whether of the type shown in Figure 2 or Figure 3, thus releasing the operators in charge of the spread operation from having to decide where to place the spikes.

Once the positions to be occupied by the spikes have been defined, the latter can be placed at the appropriate points. To ensure that the spikes do not change their relative positions during the remaining stages of the spread operation, these are now fixed in place. This is done by pushing them through a layer of laminar material sufficiently rigid for this purpose. Preferably, this will be paper, but it may also be plastic, cardboard or any other laminar material with enough rigidity to ensure that the spikes do not move with respect to each other. If the cutting machine to be used employs a suction device to hold the cloth, the laminar material should also be air permeable to ensure the efficacy of the suction device.

The best thing to use for this purpose is the same support on which the graphic information used to determine the spike positions was drawn. The procedure to be followed to simplify this operation consists of spreading this diagram out over the spread table and placing the spikes below it in such a way that they pierce the diagram at exactly the same points shown in it as the spike positions. Figure 4 is a cross-section diagram of a spreading lay. In this diagram it will be seen that the first layer (47) which is pierced by the spikes (49) is precisely the layer referred to above, the purpose of which is to fix the positions of the spikes and which may consist of the same drawing used to define these positions in the first place.

Once this first layer (47) has been laid in place, the layers of material to be simultaneously cut (48) may then be "impaled" into place. To do this, it is only necessary to ensure that each spike penetrates all the layers of material at the same point in the pattern, and also make each spike defined for straight lines parallel to either the X or Y axis pierce the material at points that also define straight lines in the pattern that are parallel to the edges of the cloth. In this way, as has already been mentioned several times above, not only can one ensure that the pattern always occupies the same position in all the layers, but also that the pattern meets all the pertinent requirements of straightness and orthogonality.

Figure 6 shows in a perspective view the different layers after spreading. It can be seen how the pattern in all layers lies in the same position and how each spike pierce all the layers of the material at exactly the same point of the pattern.

As the spikes are aligned along straight lines parallel to either X or Y axis, thus facilitating the spread operation, especially when the lines defined by the spike coincide with lines in the material. This refers to very usual cases like checked or striped fabrics, in which there are lines in the pattern which run parallel to the edge of the material. In these cases it is very useful for the spread operation if two or more spikes are in lines also parallel to one of the edges. This allows the operator to take this line as a reference line for the spreading operation, and, in this way, he or she can compensate lack of straightness or orthogonality of the material just piercing the spikes in the same line of the pattern. The spacing between the X and Y lines of the grid 36 in Figure 2 represents the minimum allowable distance between spikes if the spikes are placed on the cross-point of the grid. If the pattern is not repeated at regular intervals, this spacing can be determined in an empirical way in order to guarantee that one spike ensures the perfect alignment of the pattern in all the layers not only at the point at which it is placed,

but also in an area around it corresponding to this spacing. A typical value for the spacing is 5 cm, but it will depend on the characteristics of the material, its distortions, its lack of straightness etc., and also on the quality of the spreading operation. Anyway the spacing is not a critical point in the method described. It is much more important a good definition of the positions of the spikes in points close to the matching points defined for the pieces to be matched and cut. One reason of using the grid is to get the maximum number of the spikes on straight lines in order to facilitate the manual spreading operation; a second reason for using the grid is to avoid putting spikes too close, which can make difficult the spreading operation with no benefit at all.

The spread operation itself is made manually. One or more operators pierce each of the material layers in such a way that guarantees that one spike pierces all the layers on the same point of the pattern. And in such a way that spikes which are in lines pierce the material in the same line of the pattern to correct misalignment of the material. (Case of checked or striped materials).

Although, once the first layer of material has been laid on the sheet 47 containing the drawing with the positions of the spikes, drawing cannot be seen anymore, this is not a problem at all because the spikes already are in their positions and piercing the first layer. The operator just needs to look at this first layer to know where he or she has to pierce all the spikes in the second layer. And this is the same for the following layers, just looking at the previous layer one knows where to pierce the layers in the next one. In this way all the layers have the pattern in the same position at the end.

Once the layers of the material have been spread, the next step is to transfer the spreading lay to the cutting table for the match-up operation - if a match-up system is available - and the cutting process. Although it is not strictly necessary, it is advisable to lay another layer 46 (Figure 4) which may be of any laminar material like paper, cardboard, plastics, etc.. The purpose of this layer which, when used, is the first to be spread on the spread table, is to facilitate the transfer of the whole spreading lay from the spread table to the cutting table without the base of any spike snagging on any projection during the course of this operation, since this would seriously impede the transfer operation and, worse still, might disarrange the relative position of these spikes.

The usefulness of this lower layer is limited to the transfer operation and, if desired, it may be removed once the spread pattern has been placed on the cutting table.

The "spreading lay" formed in the described way can be moved to the cutting table manually or with the help of some automatic mechanism. During this operation the pattern keeps on the same position without suffering any movement. This can be ensured because of several reasons: First of all the transfer operation from the spreading table to the cutting table is carried out by pulling the "spreading lay" from the bottom laminar material 46 which supports all the "spreading lay"; in this way no force is applied to the different layers of material; second the material is perfectly fixed by means of the spikes; third no spike will snag on any projection during the course of this operation thanks to this bottom laminar material. This transfer operation is not needed if the spread operation is carried out directly on the cutting table. This is possible, but it is not advisable because this means to occupy the cutting table during the spread operation, which can be much longer than the cutting operation.

As previously indicated, the spikes remain in their assigned positions throughout the whole spread, match-up and cutting operation. This is possible thanks to the spikes being made of a material that can be cut by the cutting tool itself. The fact that these spikes remain in their original positions throughout the process is what makes it possible to match-up the various pieces in all the layers contained in the spreading lay once they have been matched up on the top layer.

Claims

1. METHOD OF SPREADING PATTERNED SHEET MATERIAL FOR AUTOMATIC MATCH-UP AND CUTTING OPERATIONS maintaining the alignment of the pattern in all the superimposed layers of material characterized by consisting of the following steps of operations:

a) An initial operation in which specific graphic information is used to determine the number and position of certain cuttable spikes that will be used in other phases to hold the material to be spread and subsequently cut. Preferably, although not essentially, this will consist of the full-size drawing of the layout of the pieces to be cut, in which the areas or points for which match-up requirements have been defined are known or even drawn in.

b) A second operation, in which these spikes are placed on a horizontal surface, preferably the spread table, in the positions assigned to them and on which a laminar layer is impaled in order to keep the spikes in their respective allotted positions. This layer of laminated material or holding strip needs only to satisfy the following require-

ments: to be capable of being pierced by these spikes once it has been pierced by them; to be air permeable if the cutting machine to be used needs to apply suction to the cloth for correct cutting operation.

c) A third operation in which all the various layers of the material that are to be cut at the same time are impaled on the spikes laid out in the previous phases, in such a way that each spike passes through each layer at the same point in the pattern, as well as ensuring that any spikes that run in straight lines parallel to any edge of the material pierce all the layers of the material at points of the pattern that are likewise parallel to the same edge. All this is done in order to correct any pattern distortions present in the material and thus ensure that the pattern in all the various layers is the same as that in the top layer.

d) A final operation in which, where necessary, the whole unit formed by the spikes, holding layer and spread material can be transferred from the place in which the material was spread to the cutting table where the material is to be cut. This operation is performed without removing any of the previously fixed spikes, which continue to hold the material and ensure the alignment of the pattern and, where applicable, its orthogonality, throughout the various layers until all the pieces have been cut. These spikes can remain in place throughout the operation due to the fact that they can be cut by the same cutting tool used for the material.

2. METHOD OF SPREADING PATTERNED SHEET MATERIALS FOR AUTOMATIC MATCH-UP AND CUTTING OPERATIONS according to claim 1, characterized by using spikes fitted with a flat, horizontal base and a fixed needle perpendicular to this base, so positioned that, when the spike rests on the base, the needle lies vertical and, thanks to the sharpness of its point, can pierce and hold the material without damaging it. This spike is made of a material that is sufficiently soft to allow it to be cut by the same cutting tool used to cut the sheet material without producing any damage to the cutting tool itself. This makes it unnecessary to remove the spikes which thus remain in place to hold the material during the cutting operation. Consequently, any spikes cut during this operation are disposable and can be thrown away. At the same time, these spikes possess sufficient rigidity to allow them to hold in place any material impaled on them, thus making it possible to ensure the alignment of the pattern in this material throughout all the various layers spread.

3. METHOD OF SPREADING PATTERNED SHEET MATERIAL FOR AUTOMATIC MATCH-UP AND CUTTING OPERATIONS, in accordance with the first claim, characterized by the fact that a lower layer of laminar material on which everything

else rests is laid beneath the assembly made up by the spikes, the holding layer and the spread material to facilitate the transfer of this assembly, with the result that, by pulling on this lower layer, the whole unit can be pulled along to the cutting table without any of the spikes acting as an obstacle in the course of the transfer. This lower laminar layer may be of any material that can be used for the purpose and, given that its usefulness is limited to this transfer operation, it may either be removed or left in position once the assembly has been placed on the cutting table, without modifying the spread method in any way.

4. METHOD OF SPREADING PATTERNED SHEET MATERIALS FOR AUTOMATIC MATCH-UP AND CUTTING OPERATIONS, in accordance with claim 1, characterized by the fact that all the spread operations are carried out directly on the cutting table itself, thus making it unnecessary to carry out the last operation involving the transfer of the material from the place in which it was spread, to the cutting table.

5. METHOD OF SPREADING PATTERNED SHEET MATERIALS FOR AUTOMATIC MATCH-UP AND CUTTING OPERATIONS. Just as described in the above Report, preferably represented in the accompanying diagrams and for the purposes specified.

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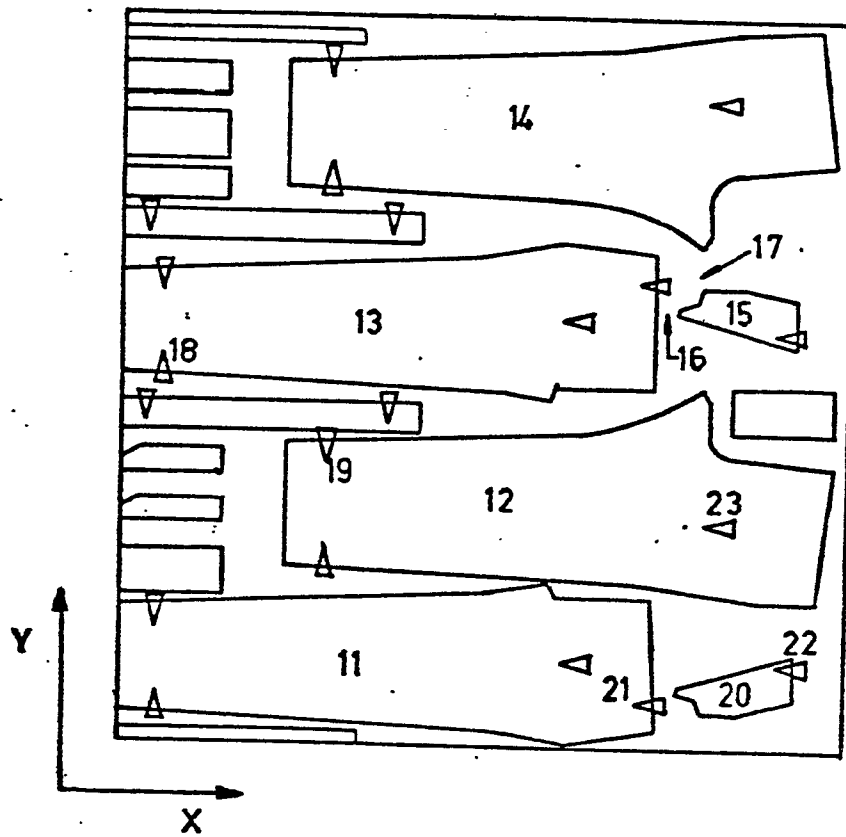


Fig. 1

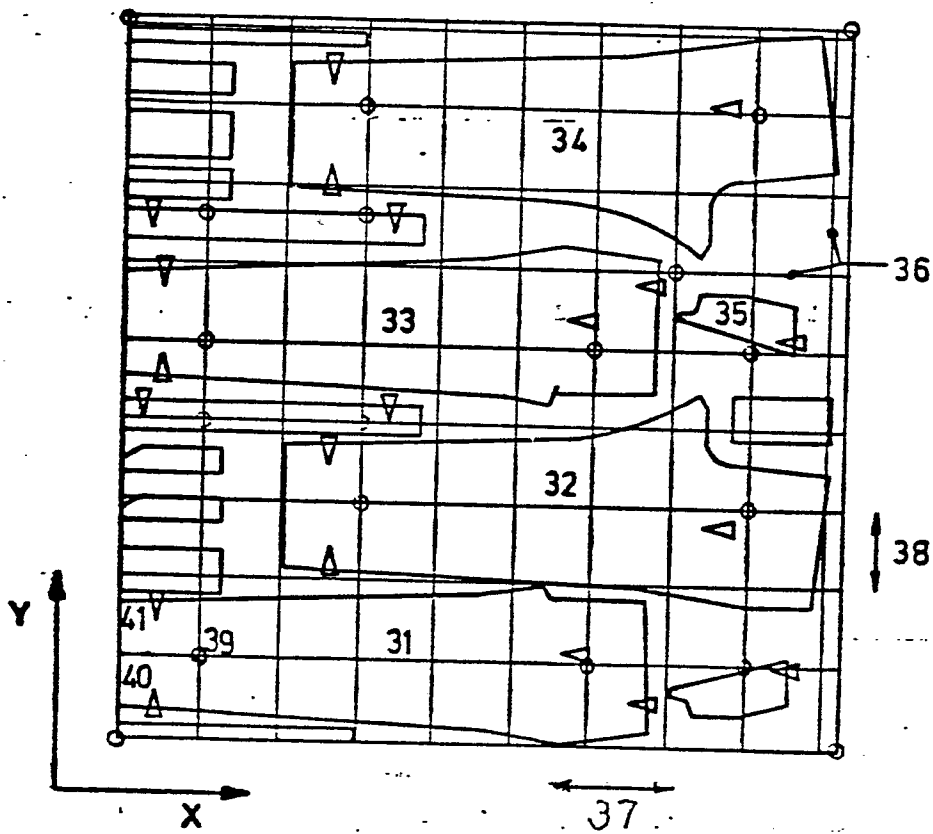


Fig. 2

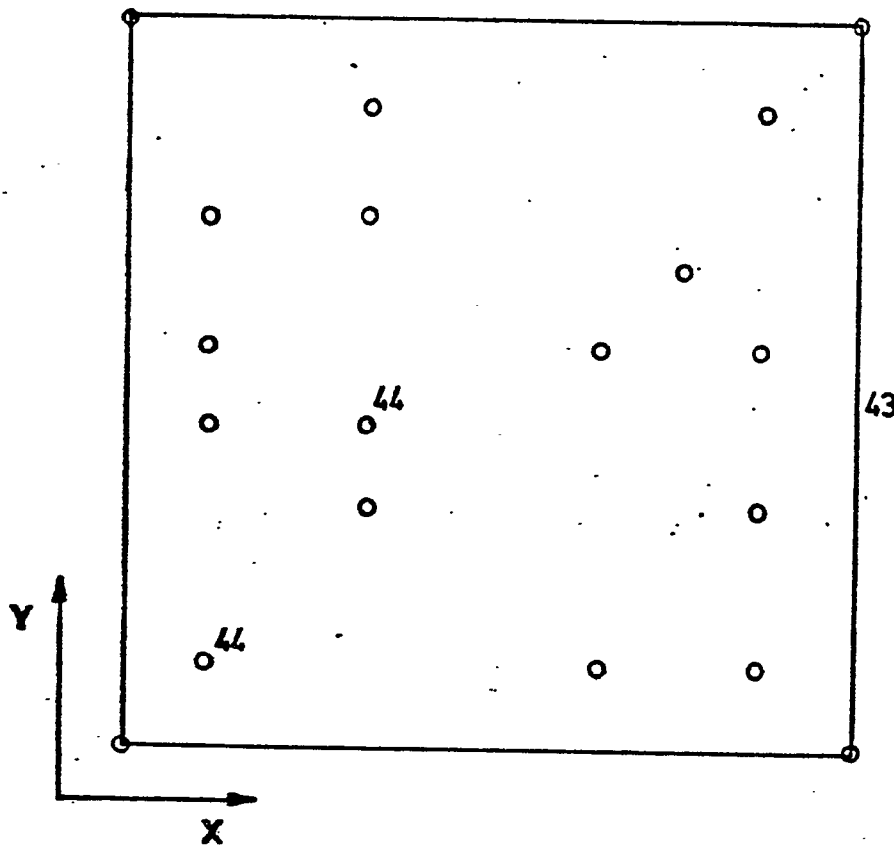


Fig. 3

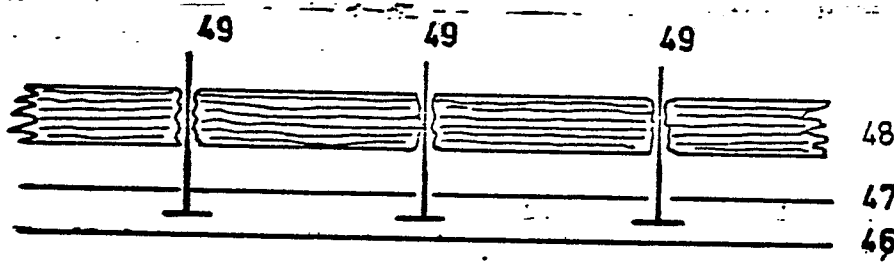


Fig. 4

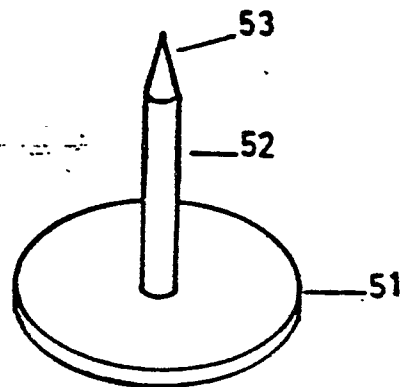


Fig. 5

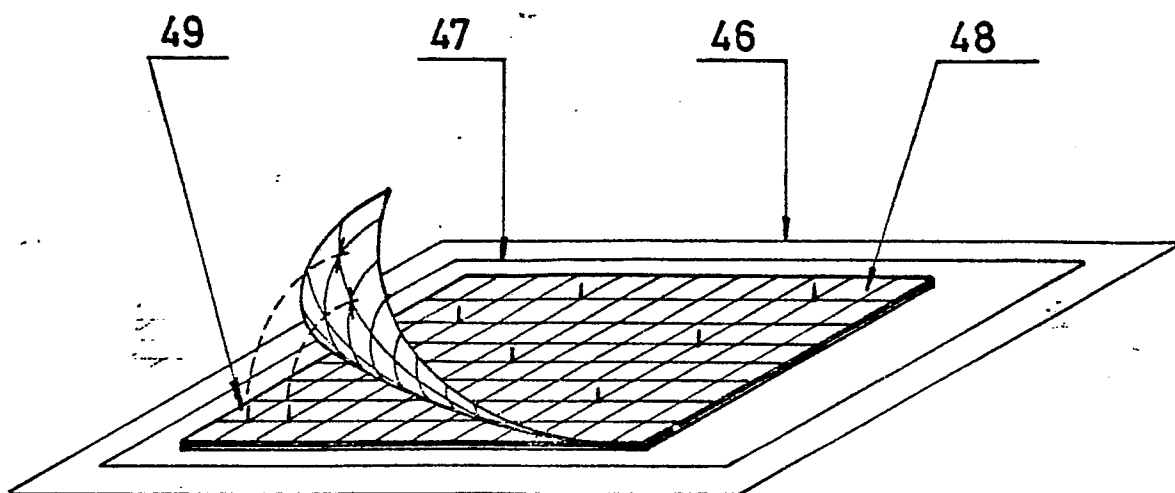


Fig. 6