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(54) Method of and apparatus for manufacturing pile fabrics.

(57) Lengths of yarn are implanted in a layer of adhesive on a pre-formed web (10). At the implanting station, the web is supported on a flat surface (30). A short distance from the implanting position, the web passes around a bend with the tufts at the outside of the bend.

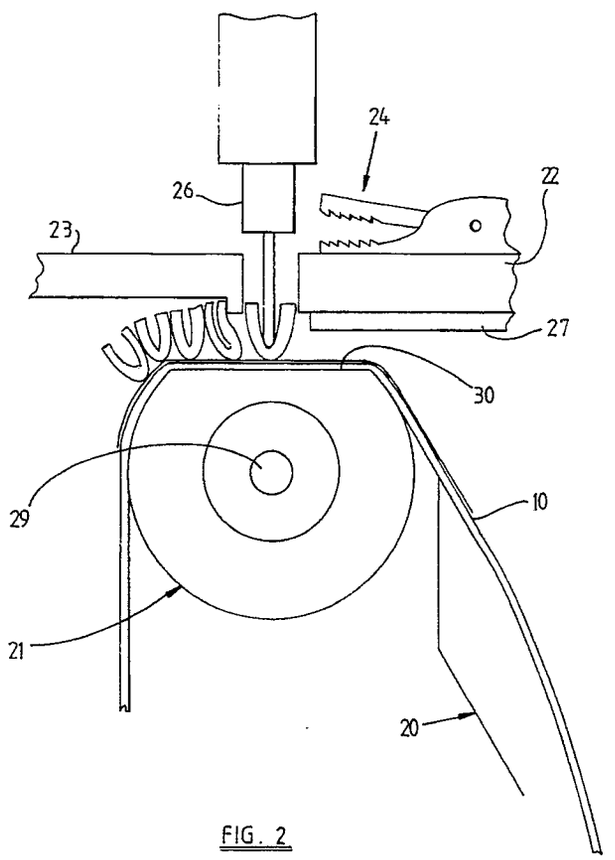

FIG. 2

EP 0 456 863 A1

Description of Invention

The present invention relates to the manufacture of pile fabrics by implanting successive rows of tuft-forming lengths of yarn in a layer of a thermoplastic adhesive on one face of a pre-formed web. An example of such a method is disclosed in GB 1,422,524A published 28th January 1976.

In the method described in the aforesaid published specification, the web is supported at an attaching station on the circumferential surface of a roll and each length of yarn is pushed onto the layer of adhesive through a slot defined between tuft-control elements which are spaced above the roll.

After each row of tufts have been implanted in the layer of adhesive, the roll is turned through an angle corresponding to the pitch of successive rows in the pile fabric and the next row is then implanted. The adhesive is required to be in a sticky condition directly beneath the slot. This condition is attained by heating of the layer of adhesive through the web at a position upstream of the attaching station.

There is provided in this upstream position a heater having a surface over which the web moves, with the layer of adhesive facing away from the heater. After leaving the heater, the layer of adhesive begins to cool. It is therefore important that the heater is near to the attaching station. For this reason, the roll which supports the web at the attaching station is of relatively small diameter.

We have discovered that implanting tufts in the layer of adhesive whilst the web bearing the adhesive is supported on a surface having a small radius of curvature results in variations, from one tuft to another, of the attitude of the tuft with respect to the web. Particularly in the case of short tufts, such variations impair the appearance of the finished fabric.

According to a first aspect of the invention, there is provided a method of manufacturing a pile fabric wherein a pre-formed web bearing a layer of thermoplastic adhesive on one of its faces is moved through an attaching station, successive rows of tuft-forming lengths of yarn are fed to the attaching station, the adhesive is at the attaching station in an adhesive condition, the lengths of each row are moved together to the layer of adhesive and mid portions of the lengths are implanted in the adhesive to form respective rows of U-shaped tufts, each row extending transversely of the direction of movement of the web through the attaching station and the two limbs of each tuft being aligned in said direction, wherein there is supported on a substantially flat surface at the attaching station a tuft-receiving portion of the web which underlies the tufts of a row being implanted in the layer of adhesive, an immediately adjacent upstream portion extending upstream from said tuft-receiving portion and an immediately adjacent downstream portion extending downstream from said tuft-receiving portion, said support surface extends downstream from the centre of the tuft-receiving portion a distance which does not exceed five times the pitch of the rows of U-shaped tufts attached to the web and wherein, at the downstream margin of said substantially flat surface, the web passes around a bend with the tufts being at the outside of the bend.

Supporting both the tuft-receiving portion of the web and an immediately downstream portion of the web on a flat surface improves substantially the uniformity of the attitude of the tufts with respect to the web and thereby improves the appearance of the finished fabric, particularly fabric having short tufts.

Passing of the web, bearing implanted tufts, around a bend downstream of the attaching station with the tufts being at the outside of the bend increases the space available to accommodate the free end portions of the tufts in the vicinity of the bend, as compared with the space available for those free end portions when the web is flat over a large area. It will be understood that the tufts bear against each other, that is to say the two limbs of one U-shaped tuft exert pressure on respective limbs of adjacent tufts, which adjacent tufts are spaced from each other in a direction of travel of the web through the attaching station.

To avoid a tuft being implanted on top of a limb of a preceding tuft, rather than beside that limb, it is necessary to push the limbs of the preceding tuft away from the path along which the tuft is moved towards the layer of adhesive. Furthermore, it is necessary to hold the limbs of the preceding tuft out of that path, as described in GB 1,422,524. We have found that this cannot be achieved reliably if the web travels along a straight path for a considerable distance downstream from the attaching station, owing to the pressure exerted by the tufts on one another. By causing the web to move around a bend downstream of the attaching station, the pressure exerted by the tufts on one another is relieved in the vicinity of the bend and, to a considerable degree, upstream of the bend.

The invention is applicable with special advantage to the manufacture of a pile fabric wherein the pile consists of rows of U-shaped tufts with the limbs of each tuft aligned with each other in a direction transverse to the length of the row which includes that tuft.

The support surface is preferably at a temperature substantially above the ambient temperature, for example a temperature which is approximately

equal to the temperature of the web after the web has been heated upstream of the attaching station to transfer heat to the layer of adhesive and so bring the adhesive into an adhesive condition. To attain the elevated temperature of the support surface, the member which presents that surface is supplied with heat other than by the web.

According to a second aspect of the invention, there is provided apparatus for applying pile-forming tufts to a pre-formed web bearing on one of its faces a layer of a thermoplastics adhesive, the apparatus comprising guide means for guiding the web along a path which extends through an attaching station, feed means for feeding successive rows of tuft-forming lengths of yarn to the attaching station, implanting means for implanting in the layer of adhesive at the attaching station a mid portion of each length of yarn in a row and a support for the web at the attaching station, wherein the support has a substantially flat support surface facing towards the implanting means, the implanting means is guided for reciprocation along a path which approaches the support at right angles to said surface, said surface has a margin spaced from the attaching station in the direction of movement of the web, the path defined by the guide means includes a bend at said margin, the support is at the inside of the bend and wherein said margin is spaced not more than 15mm from the position occupied by the centre of a yarn length during implanting of the mid portion of that length in the layer of adhesive.

An example of a method in accordance with the first aspect of the present invention and of apparatus embodying the second aspect of the invention will now be described, with reference to the accompanying drawings, wherein:-

FIGURE 1 is a diagrammatic representation of apparatus for applying tufts to a web; and

FIGURE 2 shows certain parts of the apparatus on a larger scale.

The apparatus illustrated in Figure 1 applies tuft-forming lengths of yarn to a pre-formed web 10. The web is supplied as a roll 11 which is supported in the apparatus of Figure 1 in a known manner for unwinding. The apparatus includes guide means for guiding the web from the roll 11 along a defined path through a marking station 12, a heating station 13, an attaching station 14 and a trimming station 15 to a further roll 16 formed on a take-up reel. The guide means may include rolls and other known guide elements arranged in a generally known manner for guiding the web and will not be described in detail. Representative guide elements are indicated in the drawing at 17. Drive means is provided for moving the web along the path in a controlled manner to the take-up reel and for driving the take-up reel. For example, there may be provided downstream of the roll 11 a known accumulator 18 including one or more rolls which is or are driven when the length of web in the accumulator falls to a predetermined value. A further accumulator 18a which may be identical with the accumulator 18, is provided upstream of the take-up reel. The take up reel may be driven in such a manner as to maintain tension in the web downstream of the second accumulator. The speed at which the web moves through the attaching station is controlled by a roll 17a which is driven intermittently and which has a carded surface to avoid slip of the web relative to the roll. Additional means for controlling the speed of the web at selected positions along the path may be incorporated, if required.

At the marking station 12, there is provided a pair of marking devices 19 which are operated in co-ordination with feeding of the web 10 along its path to place on respective margins of the web marks which are spaced at predetermined intervals along the margin of the web. The marks ore placed on one face only of the web, called herein the upper face. The marking devices 19 may be known devices incorporating stamps which print on the web marks, each of which is a rectilinear line of ink, the length of the line being perpendicular to a longitudinal centreline of the web. Movement of the stamps onto the web is triggered by a photodetector which responds to movement of a yarn source or other member at the attaching station which is moved intermittently.

The web in the roll 11 has on its upper surface a layer of a thermoplastic adhesive. This layer extends between the margins of the web but preferably does not cover the margins. The marks applied by the devices 19 may be applied only to those margins of the web which do not bear the layer of adhesive. Alternatively, the marks may extend onto the layer of adhesive.

The marked web moves from the marking station 12 over the surface of a heating element 20 at the heating station 13. The element 20 has a surface of substantial area which is in contact with the underside of the web 10 and transmits heat through the web to the layer of adhesive to soften the adhesive. This surface is convex in a direction along the web and in a direction across the web. The web, bearing the layer of fluid adhesive, then moves into the attaching station 14.

At the attaching station, the web 10 is supported on a heating bar 21 which engages the underside of the web and supplies additional heat to the layer of adhesive at a rate which is at least sufficient to compensate for heat losses and maintain the adhesive in a fluid-condition. A slot is defined between guide members 22 and 23 which are spaced upwardly from the web 10 and the

layer of adhesive thereon. The slot extends across the entire width of the web and lies directly above the heating bar 21. Grippers 24 are provided for drawing lengths of tuft-forming yarn from a yarn source 25 to respective positions overlying the slot and a presser 26 is arranged for reciprocation towards and away from the web 10 through the slot to press the lengths of yarn through the slot between the members 22 and 23 into the layer of adhesive on the web 10. After the presser 26 has withdrawn into the slot, the implanted tufts are pushed out of the slot by reciprocation of a pusher 27 across the underside of the slot. Movement of the web 10 through the attaching station is stepwise and is co-ordinated with movement of the pusher 27.

The general arrangement of the yarn-attaching means may be as disclosed in GB 1,422,524, to which reference should be had for further details. The yarn source 25 may be a known source, for example an assembly of spools connected together in a chain so that yarn can be drawn from successive spools.

From the attaching station 14, the tufted web passes through the trimming station 15 to the take-up roll 16. At the trimming station, there is mounted a pair of cutting blades, one adjacent to each lateral margin of the web. Each cutting blade is positioned to intersect the path of travel of the web and sever from the main body of the web either an entire margin or a part of the margin. The blades are adjustable towards and away from each other according to the required separation between the lines along which the web is to be cut. Alternatively, a single blade may be provided to sever one margin only.

Prior to or after winding of the carpet onto the take-up reel, the carpet may be treated by re-heating as described GB 1,422,524.

The heated bar 21 and other members at the attaching station 14 are illustrated in greater detail in Figure 2. The bar 21 is elongated, rectilinear and is arranged with its length extending at right angles to the path along which the web is moved through the attaching station. The bar 21 is hollow and contains one or more electrical heating elements 29. Temperature-responsive devices may be associated with the bar and incorporated in a circuit for controlling energisation of the heating element. Alternative means for supplying heat to the bar 21 may be provided.

The bar 21 has a flat surface 30 which faces towards the slot defined between the guide members 22 and 23. The surface 30 extends along the entire length of the bar, which is at least as great as the width of the web 10, and has an extent in the direction of movement of the web through the attaching station which is considerably greater than is the corresponding dimension of the slot. The surface 30 extends both upstream and downstream from the slot.

The surface 30 extends downstream from a position directly beneath a longitudinal centreline of the slot defined between the guide bars 22 and 23 for a distance which is within the range three millimetre to ten millimetre and more preferably within the range four milliemtre to eight millimetre. We have found that a flat surface which extends downstream from the longitudinal centreline of the slot for a distance of six millimetre gives particularly good results.

That portion of the web which bears the region of the adhesive layer into which a row of tuft-forming lengths of yarn is implanted, together with upstream and downstream portions of the web, is supported on the surface 30. The bar 21 has a convex surface which extends from the upstream margin of the surface 30 and which curves away from the slot defined by the guide members 22 and 23. The web approaching the attaching station rests on this convex surface and passes around a bend as the web moves moves from the convex surface onto the flat surface 30. The upper surface of the web is at the outside of the bend.

The bar 21 also has a convex surface extending along the path of travel of the web from the downstream margin of the flat support surface 30. This convex surface also curves away from the guide members 22 and 23 defining the slot. The convex surfaces may be part-cylindrical and may have the same radius of curvature and a common axis of curvature.

As shown in Figure 2, the web 10, bearing the pile tufts, extends around a bend at the downstream margin of the flat support surface 30 and the tufts are at the outside of the bend. In the vicinity of this bend, there is ample space for the free end portions of the tufts and these free end portions do not exert any significant pressure on one another, particularly pressure acting in a direction along the path of travel of the web. The free end portions of tufts in the vicinity of the bend are not subjected to pressure acting along the web such as is the case when the web is flat. Accordingly, the resistance to pushing of each newly-implanted row of tufts from the slot defined by the guide members is less than would be the case if the web continued along a rectilinear path from the implanting position for a considerable distance.

The guide member 23 has a lip immediately adjacent to the slot through which tufts are moved by the presser 26. This lip lies nearer to the web 10 than do the tips of the tufts, when the tufts are in an upright attitude with respect to the web. Pushing of the tufts from the slot by the pusher 27 necessarily involves bending of the tufts, in order

that they can pass beneath the lip of the guide member 23. Once past the lip, the tufts can spring up behind the lip. The lip then prevents free end portions of the tufts from returning towards the slot and so being contacted by a subsequently implanted tuft.

It will be understood that it is important to maintain the free end portions of previously implanted tufts out of the path along which a subsequent tuft is moved for implanting, since otherwise the free end portion of the preceding tuft may be pressed into the layer of adhesive beneath the subsequent tuft, so preventing proper attachment of the subsequent tuft.

Supporting of the web 10 on a flat surface for a considerable distance downstream from the attaching station results in such crowding of the free end portions of the tufts and consequent pressure exerted by one tuft on another that the free end portions of tufts immediatley adjacent to the lip of the guide member 23 cannot reliably be maintained out of the path of subsequently implanted tufts. Guiding of the web around a bend downstream of the attaching station and spaced only a short distance from the attaching station alleviates this problem.

We have also found that supporting the web 10 on a convex surface directly below the slot defined between the guide members 22 and 23 prevents reliable control of the attitude of the implanted tufts to the web 10. If the tufts are not implanted in an upright attitude, then the appearance of the finished fabric is impaired.

The width of the support surface 30, that is the dimension extending along the path of travel of the web 10, is selected according to the pitch of successive rows of tufts, the lengths of the tufts and the thickness of the tufts. The distance from a central plane of the slot defined by the guide members 22 and 23 to the upstream margin of the support surface 30 is not critical. However, it is desirable that the heating element 20 should approach closely to the attaching station and that only a very small area of the web 10 should be over the gap between the heating element 20 and the heated support bar 21.

The distance from the central plane of the slot to the downstream margin of the support surface 30 is not greater than five times the pitch at which the rows of tufts are implanted, is not greater than 15mm and is preferably not greater than 12.5mm. It is also preferred that the distance from the central plane of the slot to the downstream margin of the support surface 30 does not exceed five times the spacing of the guide members 22 and 23 from the support surface 30.

The featured disclosed in the foregoing description, or the accompanying drawing, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method for attaining the disclosed result, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. A method of manufacturing a pile fabric wherein a pre-formed web bearing a layer of thermoplastic adhesive on one of its faces is moved through an attaching station, successive rows of tuft-forming lengths of yarn are fed to the attaching station, the adhesive is at the attaching station in an adhesive condition, the lengths of each row are moved together to the layer of adhesive and mid portions of the lengths are implanted in the adhesive layer to form respective rows of U-shaped tufts, each row extending transversely of the direction of movement of the web through the attaching station and the two limbs of each tuft being aligned in said direction, wherein there is supported on a substantially flat support surface at the attaching station a tuft-receiving portion of the web which underlies the tufts of a row being implanted in the layer of adhesive, an immediately adjacent upstream portion extending upstream from said tuft-receiving portion and an immediately adjacent downstream portion extending downstream from said tuft-receiving portion, wherein said substantially flat surface extends downstream from the centre of the tuft-receiving portion a distance which does not exceed five times the pitch of the rows of U-shaped tufts attached to the web and wherein, at the downstream margin of said support surface, the web passes around a bend with the tufts being at the outside of the bend.

2. A method according to Claim 1 wherein said downstream portion bears at least one row of U-shaped tufts.

3. A method according to Claim 1 or Claim 2 wherein said support surface is heated other than by the web.

4. A method according to any preceding claim wherein, at the upstream margin of said support surface, the web passes around a bend with the layer of adhesive at the outside of the bend.

5. A method according to Claim 4 wherein the web approaches the attaching station sliding over a convex surface which is at a tempera-

ture substantially above the ambient temperature and which is curved in mutually orthogonal directions.

6. Apparatus for applying pile-forming tufts to a pre-formed web bearing on one of its faces a layer of a thermoplastics adhesive, the apparatus comprising guide means for guiding the web along a path which extends through an attaching station, feed means for feeding successive rows of tuft-forming lengths of yarn to the attaching station, implanting means for implanting in the layer of adhesive at the attaching station a mid portion of each length of yarn in a row and a support for the web at the attaching station, wherein the support has a substantially flat support surface facing towards the implanting means, the implanting means is guided for reciprocation along a path which approaches the support at right angles to said surface, said surface has a margin spaced from the attaching station in the direction of movement of the web, the path defined by the guide means includes a bend at said margin, the support is at the inside of the bend and wherein said margin is spaced by not more than 15mm from the position occupied by the centre of a yarn length during implanting of the mid portion of that length into the layer of adhesive.

7. Apparatus according to Claim 6 further comprising a pair of tuft-control elements which are disposed at the attaching station, are spaced apart in said direction to define between them a slot through which the lengths of yarn are pushed by the implanting means into the layer of adhesive and are spaced from said support surface by a gap through which the web moves, wherein the spacing of said margin from said position does not exceed five times the spacing of the tuft control elements from the support surface.

8. Apparatus according to Claim 6 or Claim 7 wherein there is associated with the support means for supplying heat to the support.

9. Apparatus according to Claim 8 further comprising a heater distinct from the support and having a surface which is inclined to the support surface and wherein the guide means is arranged to guide the web into sliding contact with said surface of the heater as the web approaches the attaching station.

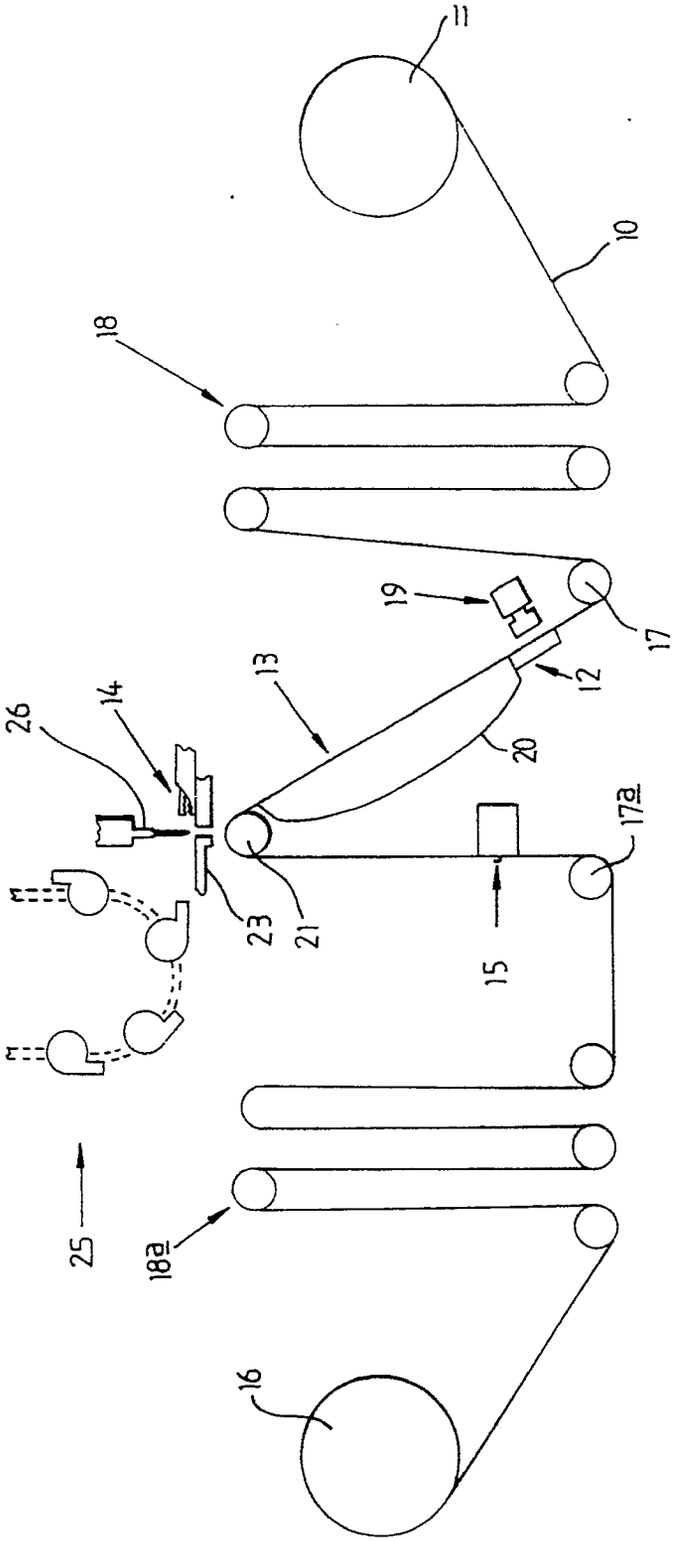

FIG. 1

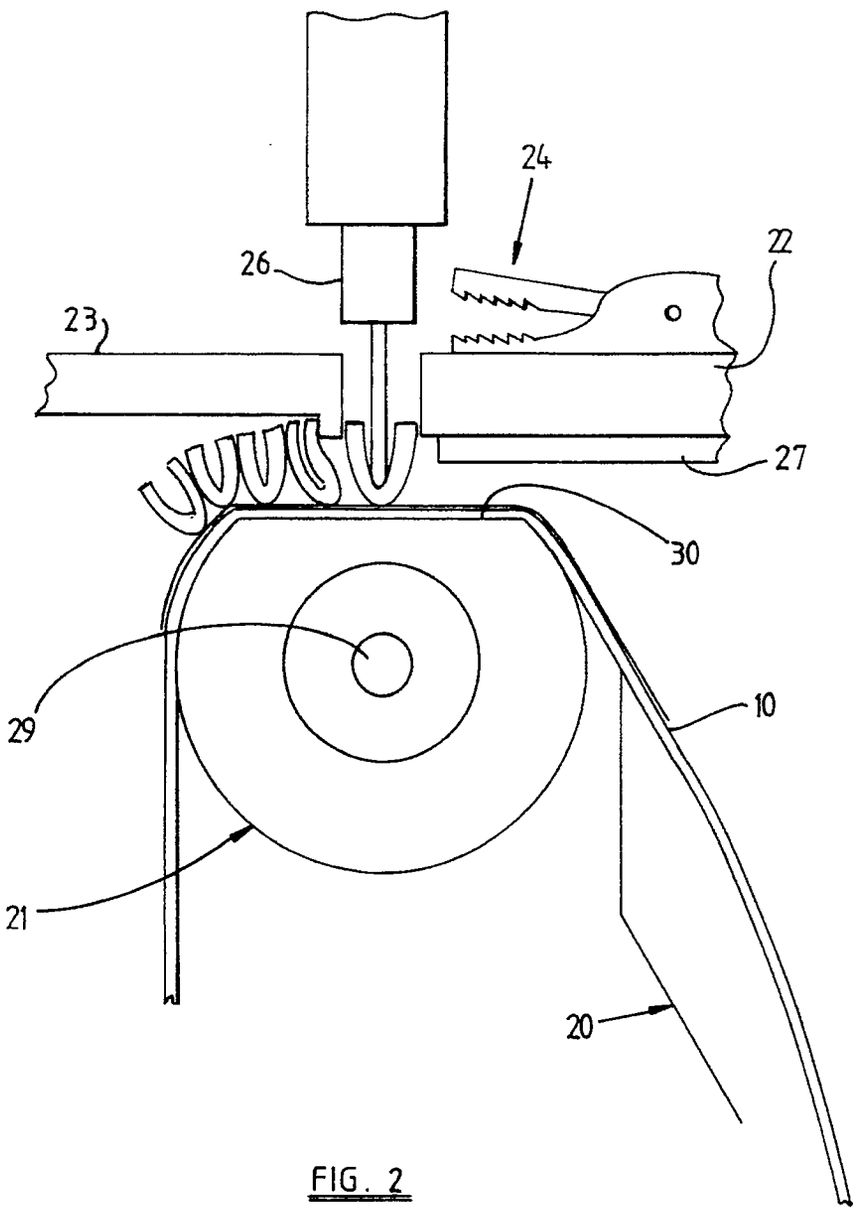

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 9344

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)

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	10 January 91	DURAND F.C.

CATEGORY OF CITED DOCUMENTS

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