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(54) Method and apparatus for applying a coating to a sheet material.

(57) A method of and apparatus for coating an absorbent sheet material such as a felt is described wherein the coating in liquid form is applied to an endless moving surface (10) over a length of the surface. The absorbent sheet material (12) is applied to the surface at the end of said length so that the liquid at the end of said length whilst still liquid bonds to the sheet material surface. The coating applied to the beginning of the said length has set by the time it reaches the end of said length preventing the coating from being absorbed into the sheet material.

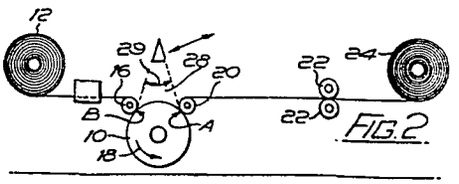

FIG.2

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Improved method of coating absorbent material

This invention relates to a method of applying an impermeable coating to an absorbent sheet material, such as a felt of synthetic fibres.

The objective of the invention is to provide a simple and effective method for the application of an impermeable coating to an absorbent sheet material to make it suitable for use for example in a pipeline or passageway lining process which we have invented. In such a process, a tubular bag of the coated absorbent material is provided, the coating being to the outside of the bag, whilst the absorbent material lies to the inside. Curable resin is injected to the bag in order to soak the resin absorbent material, the coating serving as a retention member to prevent egress of the resin through the wall of the bag. To assist in the effective impregnation of the absorbent material, the air is evacuated from inside the bag by means of a suction apparatus connected to a suction tube which is inserted in the bag and then retracted from one end as the resin is injected from the other end. After impregnation the bag is everted along a tubular pipeline or passageway by the utilisation of a fluid pressure differential, the coating again serving as the relatively impermeable membrane which permits such eversion to take place.

The coated material is usable, to achieve similar results, in different methods of application. Thus, the material

may be formed into a bag with the coating membrane to the inside, and the whole bag being enclosed in a flexible, impermeable sheath. The absorbent layer is again soaked in resin, and the whole assembly is inflated into position on to a passageway wall.

The present invention is concerned with a means of applying the coating to the resin absorbent material.

In accordance with the present invention, the coating material in liquid or fluent form, being of a nature which subsequently solidifies, is applied to a surface which defines and moves in an endless path, the coating being applied to the moving surface over a length portion of the said endless path before the absorbent sheet material is applied to the means defining the endless path so as to come into contact with the coating material applied thereto, the arrangement being that the surface of the coating material which is applied to the absorbent material will be of sufficient tackiness to bond to the absorbent material at the surface thereof whilst the underlying body of the coating is sufficiently cured to prevent excess penetration into the absorbent material and to enable the absorbent material to be separated from the means defining the endless path, and to take with it the coating material.

An important aspect of the invention resides in the fact that the coating material is applied over a length portion of the endless path, because it can be arranged within the composition of the coating material to provide that the coating material which is applied to the endless path at the beginning of said length portion, having regard to the direction of movement of the surface defining the endless path, will be solidified or partly solidified by the time it reaches the zone where the absorbent material contacts the said means defining the

endless path, whereas the coating material which is applied towards the end of the said length region, will still be wet upon reaching the location where the resin absorbent material contacts the means defining the endless path, and that wetness will serve to form a bond between the resin absorbent material and the coating material.

In a particularly suitable example, the said endless path is defined by the surface of a rotatable roller, arranged with its axis of rotation horizontal. The roller surface, which defines the endless path, may be defined by a release material, such as TEFLON (registered trade mark). By a release material, is of course meant a material which has characteristics such that the coating material will readily peel therefrom when solidified. The interior of the roller may if desired be heated or cooled depending upon the coating material which is being used, in order to accelerate the solidification or "curing" of the coating material.

The coating material is preferably applied through a spray head which reciprocates axially of the roller so as to apply the coating material in layers whilst the roller rotates. The spray head will be such as to define a spray angle to ensure that the coating material is applied over said length portion of the roller surface.

In one example, the coating material is a polyurethane resin, and the resin absorbent material may be a synthetic felt,typically polyester felt.

The felt which is of course flexible, is preferably trained around the roller between two locations so as to define a subtended angle of somewhere in the region of 270^{o}, and the coated resin absorbent material may conveniently be peeled from the roller by means of a stripper mandrel which is rotatable and has its axis

of rotation parallel to the axis of rotation of the roller.

We have obtained useful results with a roller of diameter approximately 2 feet 6 inches, and speeds of rotation of the roller have been selected to keep the felt and roller in pressure contact for approximately 38 seconds.

The method can be applied to the coating of sheet material in flat web form or in tube form.

By the method according to the invention, the thickness of the coating can be accurately controlled by controlling the volume of coating material which is sprayed from the spray head, by adjusting the speeds of the roller and felt, and by altering the speed of reciprocation of the spray head. The method enables coated material, in flat web form, for example for the purposes as herein described to be made in very large widths and much less expensively than by the current method which involves calendering the coating material onto the flat felt at a number of passes and in which there is a maximum width which can be produced. The apparatus for performing the known calendering method furthermore is extremely expensive making the resulting product expensive.

The invention also provides apparatus for carrying out the method.

The accompanying drawings illustrate diagrammatically how methods according to two embodiments of the invention may be carried out, and in the drawings:

Figure 1 is a perspective view of apparatus for use in and according a first embodiment of to the invention;

Figure 2 is a side view of the apparatus shown in Fig.

1 and looking in the direction of arrow X in Fig. 1;

Figure 3 is an enlarged view showing the location at which the felt meets the coating; and

Figure 4 is a perspective view showing apparatus for carrying out the method according to a second embodiment of the invention.

Referring to the drawings, the operative apparatus of Fig. 1 is shown only in diagrammatic form, and it is to be understood that it will comprise all of the necessary components means to enable the apparatus to function as described. It will also comprise the necessary control means to control its operation. The apparatus includes a heated roller 10 arranged on a frame 11 with its axis of rotation horizontal, the roller being coated with a release material such as PTFE. Two webs of needled felt (Fig. 2) each of which may be 2.5 metres wide are fed from storage rolls 12 in parallel to a sewing device 14, which sews adjacent edges of the felt together in butting or overlapped relationship. The thus sewed together felt passes over a guide roller 16 so as to be urged against the surface of the heated roller 10, and as the said roller 10 rotates as indicated by the arrow 18, the felt is held firmly against the roller 10 over a subtended angle of 270^{o} approximately until it reaches a take-off roller or mandrel 20, serving to strip the felt from the roller 10. The felt then passes to a slitting plant indicated by a pair of nip rollers 22, to cut the felt to size, and finally the treated felt is wound on to a storage reel 24. The slitting plant 22 has adjustable capability in order that the final width of the felt can be adjusted to suit requirements.

As the felt passes round the roller 10, it is coated by means of a spraying apparatus 27, with a coating

material 28, to provide a relatively gas and water impermeable surface to one side of the felt, at least for the purposes as explained herein. The coating material, which may for example be a two part curable resin system comprising isocyanate and polyurethane resin or a two part P.V.C. resin, is sprayed from a spray head 26 whilst still in liquid condition, over a subtended angle 29, so as to be applied over a circumferential length portion of the roller 10 between the guide and take-off rollers 16 and 20.

The spraying of the coating material over an angular portion of the roller is of significance as illustrated in Fig.3, because the material 28A which contacts the roller in region A i.e. at the beginning of the circumferential length portion has in fact cured or partially cured by the time it reaches region B which region is shown in Figure 2, or the end of the arcuate length portion, whereas the coating material 28B (as indicated by the dotted region) which impinges upon region B remains soft and uncured when it comes into contact with the felt material. Thus, the coating material is prevented from penetrating and being absorbed by the absorbent felt, but still anchors firmly to the fibrous surface of the felt. The soft material forms the bond material, whereas the partially cured portion enables ready stripping of the material from the roller 10 by the stripper roller 16. Furthermore, the spray apparatus 27 is arranged to reciprocate in a direction parallel to the axis of rotation of the roller 10 on a guide rail 13 in order to ensure that the building up of layers of coating material on the roller 10 to give the required degree of thickness of coating material in the final product. The rate or reciprocation of the spray head 10 is selected to give the required coating thickness, and for example may make three to four passes as the roller rotates between positions A and B.

Fig. 1 also shows a temperature control device 17, a drive motor 19 for reciprocating the spray head 27 and an air pump 21 for the spraying of the coating material from head 27 by means of air under pressure.

Instead of using a roller to define the endless path, other means such as an endless belt may be used.

In a modified arrangement, the coating material is applied in layers by means of doctor blades and reservoirs of the coating material, spaced circumferentially of the roller, which in this case is heated.

In another arrangement, the coating is applied by a moving film extruder which extrudes a film of the coating material and lays it, axially of the roller which in this case is cool relative to the film. The film extruder reciprocates axially of the roller and builds up the coating material in layers, similar to the spray head arrangement described.

The apparatus described can be used for coating very wide flat felts (of the order of 5 metres) which is not possible with conventional methods.

Fig. 4 illustrates another embodiment of the invention, in which the coating is applied to a tubular resin absorbent material in this case a needled felt. The felt is made up into tubular form in known fashion, from one or more carded laps 100 of fibrous material, which are wound helically around spaced cantilevered mandrels 110, 112, and 114. The overlapping coils are also moved lengthwise of the mandrels as indicated by the arrow 116, and are needled together by means of a reciprocating needle bar 118 in order to form a coherent compact felt tube, which is continuously rotating as indicated by the arrow 120. In the example illustrated the tube 122

takes up a triangular shape by virtue of travelling round the mandrels 110, 112 and 114, and one of the sides of the triangle is urged against the coating application roller 124 from which the coating is applied, in a manner similar to that already described. Reference numeral 126 indicates the spray head which reciprocates axially of the roller 124 as indicated by arrow 128. The resulting tube 122 which feeds from the ends of the cantilevered rollers 110, 112 and 114 is of course coated with an impermeable membrane similar to the flat felt previously described. The tube 122 is deposited in a container, or is wound on a roller in a fashion suitable to remove the twist which would otherwise be imparted thereto by virtue of the tube 122 simultaneously being fed axially as indicated by arrow 116 and rotating as indicated by arrow 120. A seamless even coating on the tube is achieved by this method.

CLAIMS

1. A method of coating absorbent sheet material with an impermeable coating, wherein the coating material in liquid or fluent form, being of a nature which subsequently solidifies, is applied to a surface which defines and moves in an endless path, the resin being applied to the moving surface over the length portion of the said endless path before the resin absorbent sheet material is applied to the means defining the endless path so as to come into contact with the coating material applied thereto, the arrangement being that the surface of the coating material which is applied to the absorbent material will be of sufficient tackiness to bond to the absorbent material at the surface thereof whilst the underlying body of the coating is sufficiently cured to prevent excess penetration into the absorbent material and, to enable the absorbent material to be separated from the means defining the endless path, and to take with it the coating material.

2. A method according to claim 1, wherein the said endless path is defined by the surface of a rotatable roller, arranged with its axis of rotation horizontal.

3. A method according to claim 2, wherein the roller surface is defined by a release material, such as TEFLON.

4. A method according to claim 2 or 3 wherein the interior of the roller is heated or cooled depending upon the coating material which is used in order to accelerate the solidification of the coating material.

5. A method according to claim 2, 3 or 4, wherein the coating material is applied through a spray head which reciprocates axially of the roller so as to apply the coating material in layers whilst the roller rotates,

the spray head being such as to define a spray angle to ensure that the coating material is applied over said length portion of the roller surface.

6. A method according to claim 2, 3 or 4, wherein the coating material is applied by means of multiple doctor blades arranged peripherally of the roller, which is heated.

7 A method according to claim 2, 3 or 4, wherein the coating is applied by a moving film extruder as a fluent extrudate film onto the roller which is cool or cooled relative to the extrudate film.

8. A method according to claim 5,6 or 7 wherein the absorbent material is trained round the roller between two locations, so as to define a subtended angle of approximately 270^{o}, and the coated resin absorbent material is peeled from the roller by means of a stripper mandrel which is rotatable and has its axis of rotation parallel to the axis of rotation of the roller.

9. A method according to any preceding claim, wherein the absorbent sheet material is a needled felt.

10. A method according to any preceding claim, wherein the absorbent material is in flat sheet form.

11. A method according to any of claims 1 to 9, wherein the absorbent material is of tubular form.

12. A method of applying an impermeable coating to an absorbent sheet material, substantially as hereinbefore described with reference to the accompanying drawings.

13. An apparatus for applying an impermeable coating to an absorbent sheet material comprising means for

applying thecoating material in a liquid or fluent form to a surface which defines and moves in an endless path so that the coating is applied to the moving surface over a length portion of the said endless path, means for applying the absorbent sheet material to the means defining the endless path at the end of said length so as to come into contact with the coating material applied to the endless path, and means for separating the coated material from the endless path.

14. An apparatus according to claim 11, wherein the said means defining the endless path is the outer surface of a roller.

15. An apparatus according to claim 10, wherein the means for applying the coating material is a spray head which moves back and forth axially of the roller, and sprays coating material on the roller over an arc thereof, and defining said length of the endless path.

16. An apparatus for applying an impermeable coating to an absorbent sheet material, substantially as hereinbefore described with reference to the accompanying drawings.

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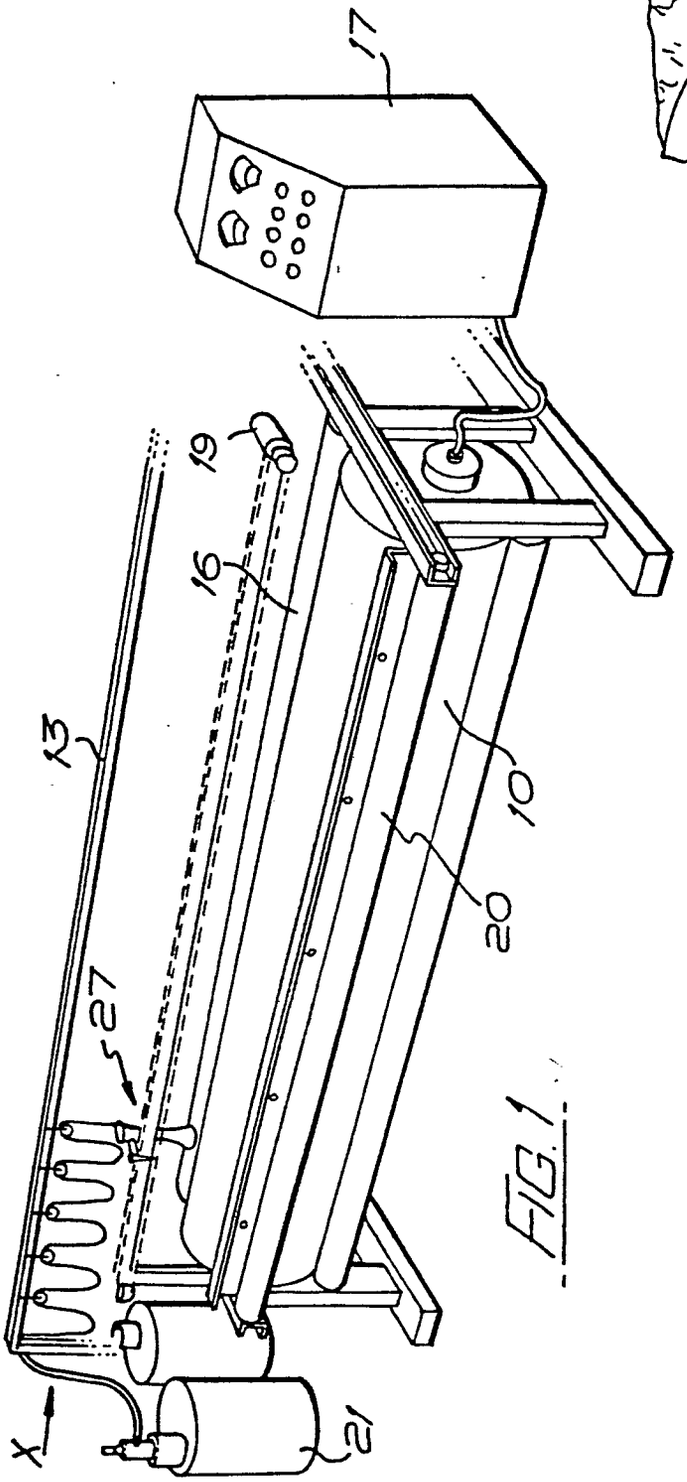

FIG. 1

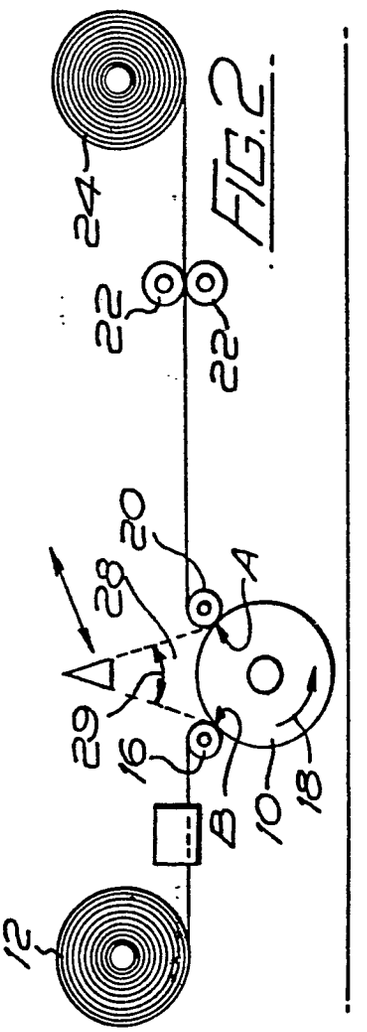

FIG. 2

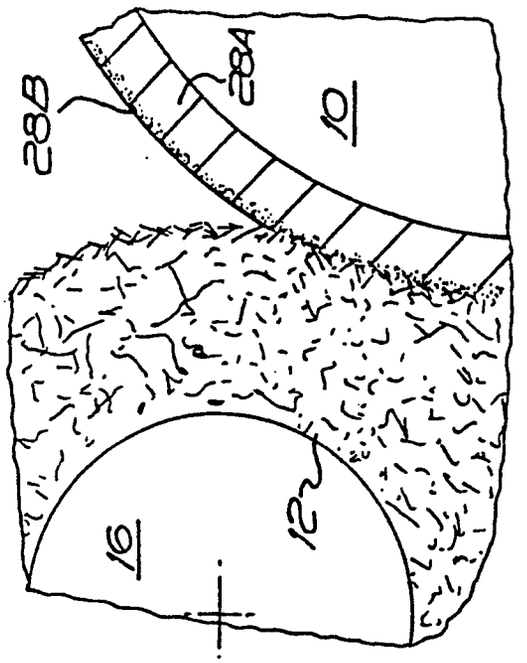

FIG. 3

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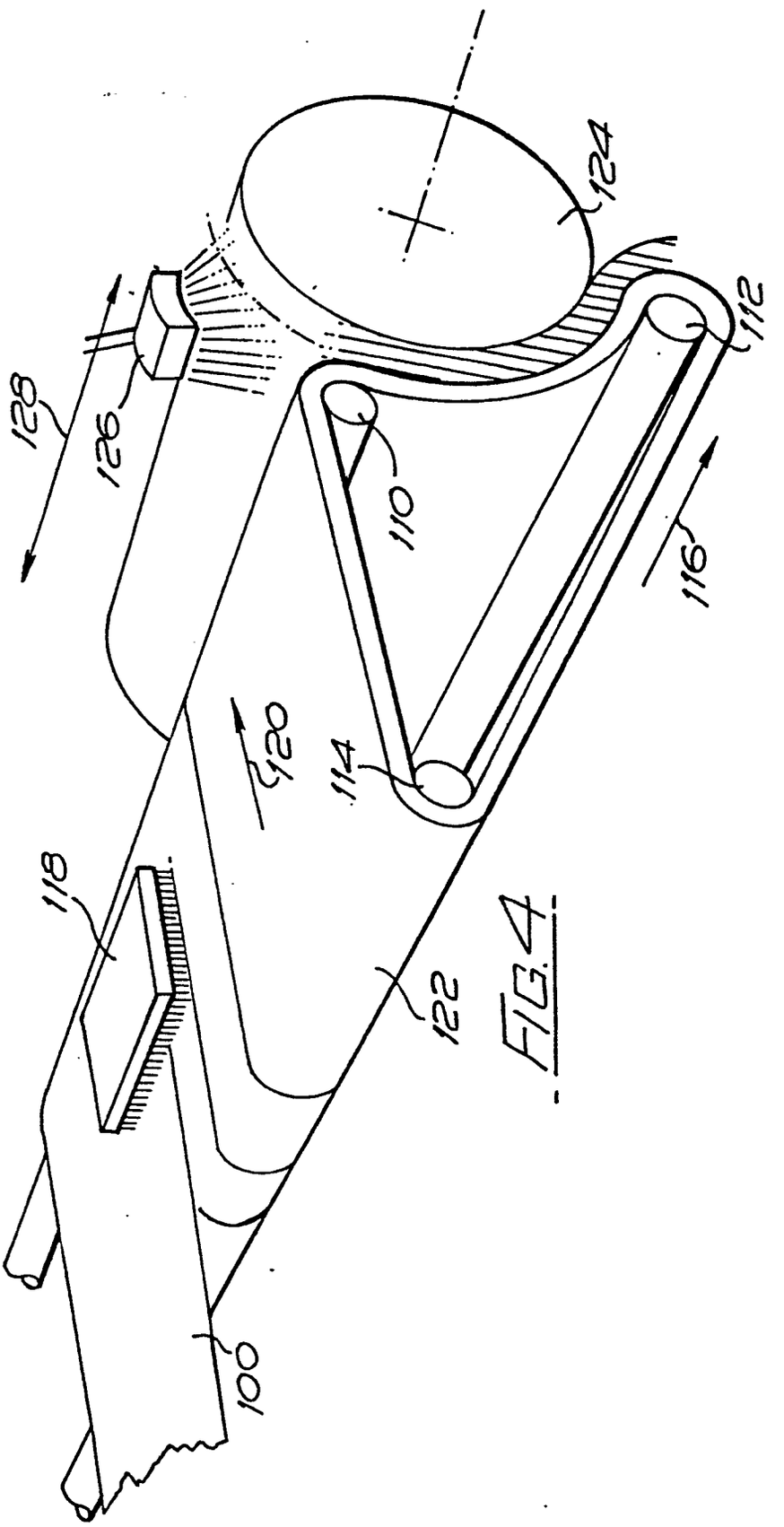

FIG.4

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EUROPEAN SEARCH REPORT

Application number EP 80 30 3072

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	FR - A - 1 388 404 (MENSCHNER) * Whole document * --	1-5,8, 10,12-16	D 06 B 1/14
	NL - A - 289 083 (DEMETER) * Claims 1-6; figures 1,2 * --	1,2,4, 6,10, 12,13, 14,16	
	US - A - 3 800 569 (RIGGS & LOMBARD) * Figure 4, abstract * --	1,2,5, 6,10-16	TECHNICAL FIELDS SEARCHED (Int. Cl.³)
	GB - A - 1 400 146 (NEWTON) * Whole document * --	1,5,13	D 06 B 1/14 1/10
A	FR - A - 1 202 421 (S.A.D'INDUSTRIE COTONNIERE) * Whole document * --	7	
A	GB - A - 587 671 (YARWORTH JONES) * Whole document * --	1,7	CATEGORY OF CITED DOCUMENTS
A	DE - A - 2 346 164 (IDEAL VLIESSTOFFABRIK) ----		X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28-11-1980	PETIT

EPO Form 1503.1 06.78