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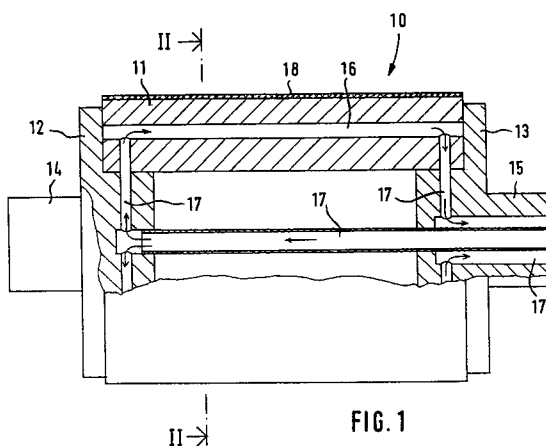
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Method for heating a roll and a heatable roll, in particular a press roll for a paper machine.

A heatable roll (10), in particular a press roll or equivalent for a paper machine, which roll is in direct contact with the paper web and a method for heating a roll are disclosed. The roll is heated by flowing a heat transfer medium into the roll. The medium is preferably arranged to circulate in bores (16) formed into a roll mantle in proximity to an outer face of the roll. The outer face of the roll is provided with a coating (18) made of a ceramic, metal-ceramic mixture, porous metal or an equivalent material whose thermal conductivity and modulus of elasticity are lower than the corresponding properties of the material of the roll body. The coating is porous, and its thickness is from about 0.03 mm to about 6 mm, preferably from about 0.05 mm to about 2 mm.



BACKGROUND OF THE INVENTION

The invention relates to a heatable roll, in particular a press roll or equivalent for a paper machine, which directly contacts a paper web running in the press section of a paper machine.

The invention also relates to a method for heating a roll located in a press section in which a heat transfer medium circulates through the roll.

In the prior art, a rock roll made of granite is frequently used in the press section of a paper machine. Granite is used because of its advantageous surface properties which provide controlled detaching of the paper web from a face of the rock roll. Moreover, granite has a high resistance to the wearing effect of a doctor used in the press section.

However, the use of granite for a roll in a press section has certain drawbacks. One drawback is that because granite is a natural material, its material properties vary. Thus, internal flaws in the granite, combined with a tendency to crack partly as a result of the internal flaws, form serious obstacles for using granite in some press section applications, particularly applications at high temperatures. In addition, a granite roll is heavy and comprises an inhomogeneous material, both factors which increase the tendency of oscillations of the roll constructions which is another significant drawback reducing the operating efficiency of the press section. The heavy weight of a rock roll made of granite is also considered when selecting the dimensions of the lifting equipment and foundations required for the paper machine.

In other prior art constructions, synthetic rock rolls are also known. These synthetic rock rolls are in principle polymer-coated rolls in which a rock powder, such as quartz sand, is mixed into hard rubber or polyurethane to thereby form a synthetic rock roll. Drawbacks of these rolls include excessive adhesion of the paper web to the roll face inhibiting detachment as well as poor mechanical strength and limited heat tolerance.

In prior art paper machines, a process called hot pressing is known in which the temperature of the web is raised in order to achieve a higher dry solids content in the pressing stage. In this manner, significant savings can be obtained with respect to the drying requirements in the drying section of the paper machine.

The heating of a press roll in a press section takes place most advantageously from the interior of the roll. Drawbacks of external heating methods, such as induction-infrared heating, include the high cost of acquisition and operation of devices to provide such external heating, and the requirement of space for the devices.

Heatable extended-nip presses have been described earlier, e.g., in U.S. Patents 4,738,752 and 4,874,469, whose drawbacks include high consumption of power as a result of the heating of the rolls in the extended-nip.

When heating rolls in press sections, it is also known in the prior art to introduce heat into the roll through bores formed into the roll mantle. In these bores, a heating medium, such as hot oil, water or steam, is circulated. A solution of this type is described, e.g., in Canadian Patent CA 1,233,763. However, a drawback of this solution of heating the roll is the high consumption of power required to produce the heat, as well as local deformations in the roll mantle because of the differences in temperature in the roll face in the circumferential direction.

From published European Patent Application EP 0 471 655, a heatable roll is known in which the roll mantle is heated by means of electric resistors arranged in ducts formed in the roll mantle. In the embodiment described therein, it is possible to make the variations in temperature in the roll face quite low in order to avoid local deformations.

With regard to heating a roll in a drying section from the interior, it is known in the prior art to heat the roll mantle by means of steam (e.g. Yankee cylinder, Tem Sec®). However, in such a case the heat transfer that takes place through the roll mantle restricts or hampers the attempt to provide an efficient heating effect, which results, e.g., in a need to increase the diameter of the roll.

Differences in the temperatures of the incoming paper web or felt, as well as transverse air flows in the press section, tend to produce an uneven distribution of temperature in the roll face, in particular when the temperatures are high. Uncontrolled differences in temperature produce undesirable deformations in the roll and, further, problems in controlling the transverse profiles of the web. This phenomenon is particularly detrimental in rolls whose coatings have a low capacity of thermal insulation, such as in the case of non-porous metallic coatings. In addition, polymer coatings are unsuitable for rolls heated from inside because they have a limited heat tolerance and their heat transfer capacity is inadequate.

In heatable rolls, in particular in rolls substituted for earlier rock rolls in the press sections of paper machines, it is known to provide the roll face with a coating of a ceramic material. Such solutions are described, e.g., in U.S. Patent 4,704,776 and in published Finnish Patent Application No. FI 84,506. However, a method of heating the rolls is not described in these publications.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a heatable roll, in particular a press roll for a paper machine, by whose means the drawbacks related to the prior art rolls are eliminated.

It is another object of the present invention to provide a new and improved heatable roll by whose means an improvement is provided over the heatable rolls currently in use.

It is yet another object of the present invention to heat press rolls in an efficient and improved manner by circulating a heat transfer medium through the rolls in proximity to the outer face of the rolls.

In view of achieving these objects and others, in the present invention a roll is heated by flowing a heat transfer medium into the roll so that the roll is heated from its interior. An outer face of the roll is provided with a coating made of ceramic, a metal-ceramic mixture, a porous metal or an equivalent material whose thermal conductivity and modulus of elasticity are lower than the corresponding properties of the material of the roll body.

By means of the present invention, a number of advantages are obtained as compared with the prior art, of which advantages, e.g., the following should be stated in this connection. In the invention, a circulating heat transfer medium, such as hot water, oil or steam, is used for the heating of the roll. The constant circulation of the heat transfer medium equalizes the temperature differences between different points on the roll and reduces the risk of thermal crown formation.

In a roll in accordance with the invention, the heating of the roll is carried out from inside the roll by introducing the heat as close as possible to the outer face of the roll. The transfer of heat taking place through a wall of the roll and the coating on the roll, and the capacity of heat delivery, will not be equally decisive as in prior art constructions.

Further, by introducing the heat in proximity to the roll face, an advantage is obtained in that the temperature of the heat transfer medium does not need to be raised to an equally high level as compared to the situation where the heat is introduced by means of a heat transfer medium onto an inner face of the roll mantle. In addition, it is possible to use low-cost energy for heating, so that the heat transfer medium is heated by means of waste steam.

The roll in accordance with the invention is heated by means of ducts formed in the interior of the walls of the roll mantle and by means of a heat transfer medium (preferably water) flowing in the ducts. As a result of this arrangement, the roll does not become a pressure vessel, which is the case, e.g., in rolls heated by means of steam from inside

the roll mantle. In addition, the roll of the present invention is constructed simpler than in the case of a pressure vessel, and does not require approval by the appropriate authorities or compliance with applicable regulations.

In the roll in accordance with the invention, large flows of heat are easily produced. Ducts in the roll mantle are placed close to the roll face so that the thermal resistance of the material of the roll mantle is lower and a larger amount of heat can be transferred with the same temperature difference within the same unit of time than if the ducts were placed further apart from the roll face. Owing to the low thermal resistance, the temperature difference in the roll mantle is little, so that the thermal stresses arising from it are also lower. The ease of manufacture may also be considered as an advantage over prior art constructions.

The coating used in a roll in accordance with the invention is preferably a thermally sprayed ceramic, metal-ceramic coating or porous metallic coating, whose composition, thickness, and porosity are selected so that a sufficient insulating effect is produced on the roll body. A coating having the desired properties is selected to equalize the differences in temperature (i.e. reduce thermal deformations) without excessive deterioration of the heat transfer capacity and to make the adhesion of the web to the roll face sufficiently low.

In the method in accordance with the invention, a heat transfer medium is caused to flow into a roll. The medium circulates in the roll in proximity to an outer face of the roll. A coating is provided on an outer surface of the roll. The coating comprising a material whose thermal conductivity and modulus of elasticity are lower than the corresponding properties of the material of the roll mantle.

In other embodiments of the method, the medium is circulated in bores located in the roll mantle. The coating may also be sprayed onto the outer surface of the roll and crown-variation means may be arranged in the roll.

Further advantages and characteristic features of the invention come out from the following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The following drawings are illustrative of embodiments of the invention and are not meant to limit the scope of the invention as encompassed by the claims.

Figure 1 is a schematic longitudinal sectional view of an embodiment of a roll in accordance with the invention used in a method in accordance with the invention.

Figure 2 is a schematic transverse sectional view of the roll in accordance with the invention

illustrated in Fig. 1 taken along the line II-II in Fig. 1.

Figures 3 and 4 illustrate effects obtained by means of a roll in accordance with the invention, wherein Fig. 3 illustrates a roll without a coating, and Fig. 4 illustrates a roll provided with an insulating coating in accordance with the present invention.

Figure 5 illustrates a schematic sectional view of an embodiment of a roll having crown variation means in accordance with the invention used in a method in accordance with the invention.

Figure 6 illustrates a schematic sectional view of another embodiment of a roll having crown variation means in accordance with the invention used in a method in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

In Figs. 1 and 2, a roll is denoted generally with the reference numeral 10. The roll 10 comprises a roll mantle 11, and roll ends 12, 13 attached to both ends of the roll 10. Roll ends 12, 13 are provided with axle journals 14, 15. The roll 10 of this embodiment is a so-called "drilled roll" in which the roll mantle 11 is provided with bores 16, or equivalent ducts, passing from one end of the roll to the other end. A heat transfer medium is circulated in these bores or ducts. For this purpose, the roll 10 is provided with the necessary duct systems 17 for the circulation of the heat transfer medium. In addition, a coating 18 is arranged on an outer surface of the roll mantle 11.

In the embodiment shown in Figs. 1 and 2, the bores 16 formed into the roll mantle 11 are illustrated. It is preferable to place the bores as close as possible to the outer face of the roll mantle 11.

In another embodiment, grooves (not shown) are machined into the outer face of the roll mantle 11, onto which grooves a separate mantle (not shown) is arranged. The coating layer 18 is arranged on this mantle.

An important feature of the construction and the operation of the roll 10 in accordance with the invention is that the roll mantle 11 is heated from inside the roll by flowing a heat transfer medium which is passed as close as possible to the roll face. It is preferable to use hot water or oil or steam as the heat transfer medium. Since the heating is applied in proximity to the roll face (via bores 16 or equivalent ducts placed near the roll face), the thermal resistance of the roll mantle is low, and a larger amount of heat can be transferred to the roll face with the same temperature difference in the same unit of time. This produces a limiting factor in the operation and construction of the roll because a large flow of heat produces a high temperature difference in the roll mantle 11

which in turn produces a high thermal stress.

When high temperatures are employed in the roll heating process, large temperature differences are formed in the roll, i.e. a considerable temperature profile is formed in the transverse direction of the machine. This produces a thermal crown formation in the roll. The bores 16, or equivalent ducts, also produce temperature differences in the roll face in the circumferential direction. These differences in temperature further produce local deformations in the roll which unfavorably affect the operation of the roll in the press section.

In the invention, in order to reduce the problems described above, i.e. the drawbacks arising from thermal stresses, thermal crown formation, and local deformations, in the invention, the roll is provided with an insulating coating 18. Owing to the insulating effect of the coating 18, the temperature differences are equalized and, as a result, the tensile stress and the thermal deformations in the mantle 11 are reduced. As an alternative, if it were desirable to keep these factors at the previous level, the heat flow through the roll face might be increased.

The following preferences are imposed on the coating 18 of the roll in the invention to achieve advantageous heat transfer to the roll face. First, the insulating capacity of the coating 18 must be within certain limits. If the coating material has a high insulating capacity, only a very thin layer is required. However, generally such materials do not have a good resistance to wear, and therefore the layer must be thick. Therefore, these materials are not suitable for use in the invention. As an example of such materials, polymers should be mentioned.

On the other hand, if the insulating capacity of the material is low, a thick layer of the material is needed. However, a thick layer produces stresses in the roll mantle, so that such materials are not suitable either. Non-porous, "pure" metals might be mentioned as an example of such materials.

Besides having a suitable insulating capacity, the coating layer preferably should have a sufficiently small thickness. This desired property of a thin coating arises from the fact that the force with which the coating layer 18 attempts to change the form of roll mantle 11 is proportional to the thickness of the coating layer. However, the coating layer must have good resistance to wear even though it will preferably be relatively thin. Moreover, the coating layer must have a low modulus of elasticity which contributes to a reduction in the forces applied by the coating layer to the roll mantle 11.

In addition, since one of the functions of the roll 10 in a press section may be to transfer the web, the layer must have good web detaching properties when operating both in cold and hot web

transfer operations.

These requirements and properties of the insulation coating layer 18 are most advantageously provided for by a coating made of a ceramic material, a mixture of ceramic and metal (CERMET) or a metal containing pores (a porous metal). The coating is preferably produced by means of thermal spraying. The thermal conductivity of such a coating material is substantially lower than that of the metallic body material of the roll 10. Further, the modulus of elasticity of such a coating material is lower than the modulus of elasticity of the roll mantle 11. In the invention, a suitable thickness of the layer of the insulation material is from about 0.03 mm to about 6 mm, preferably from about 0.05 mm to about 2 mm.

In a preferred embodiment, the ceramic may be an oxide ceramic, for example Zr-, Al-, Si-, Ti-, Y-, Cr-oxide or carbide ceramic, for example Cr-, W-, Ti-, Ni-carbide or a mixture or compound of same. With the above ceramics, it is possible to mix metals, such as Cr, Ni, Co. Preferably, the type of porous metal metallic coating 18 used in the invention might be e.g. stainless steel, stellite, bronze, or any other of the metals Ni, Cr, Co, Fe, Al, Cu or a mixture or mixtures thereof. If the metallic coating is provided with even a small porosity, typical of thermally sprayed coatings, the thermal conductivity and modulus of elasticity of the porous metals will be substantially lower. In porous metallic coatings, for example, the thermal conductivity may be as low as about 1/5th and the modulus of elasticity may be as low as about 1/2 of that of commonly used structural materials (i.e. cast iron, steel).

In view of providing an insulating effect by means of the surface layer, it is not advantageous to use a tight, non-porous and substantially metallic material, because, as was stated above, to obtain an adequate insulating effect, it would be necessary to use very thick layers of such a metallic material. The rigidity of such a thick metallic layer is considerable, the temperature differences formed in the layer would tend to increase the thermal deformations in the roll.

In another embodiment, one or more so-called adhesion layers are provided under the ceramic, metal-ceramic coating or porous metallic coating, and against the roll body to guarantee good adhesion of the ceramic, metal-ceramic layer or porous metallic layer to the roll body. Corrosion of the material of the roll body is also prevented in this manner. The adhesion layer is preferably a thin, thermally sprayed metal layer, which is as free as possible from pores and which does not have a substantial effect on the thermal conductivity either. In such a case, the thickness of the ceramic, metal-ceramic coating or porous metallic coating is from

about 0.03 mm to about 6 mm, preferably from about 0.05 mm to about 2 mm.

At least a part of the pores in the coating 18 may be filled with a sealing material, preferably polymers. Alternatively, all of the pores may be filled with polymers. Polymers which might be used to fill the pores include epoxy resins, phenolic resins, polytetrafluoroethylene (PTFE) or other equivalent materials which have good thermal insulation properties and a low modulus of elasticity. These are advantageous properties for the material to fill the pores of the coating. Such materials also have an advantageous effect on the detaching properties of the web.

The porosity of the ceramic, metal-ceramic or porous metallic coating layer 18 is selected so that good web detaching properties are obtained both with and without heating. When the web runs along the roll, water passes from it into the pores of the roll. In particular, at high temperatures, the vapor pressure of the water present in the pores rises and the adhesion of the web to the roll is lowered. Owing to the insulating properties of the coating 18, the tendency of the thermal crown formation in the roll is substantially reduced. Also, the coating provides a substantial equalization of the temperature variations especially in the heat transfer medium that runs in a drilled roll. For this reason, the ducts or bores 16 may be placed as less densely spaced or, alternatively, be placed closer the outer face of the roll.

Another advantage of a ceramic, metal-ceramic or porous metallic coating 18 is the suitable heat delivery rate to prevent burning onto the paper. The heat delivery rate is substantially slower on a face of a ceramic, metal-ceramic or porous metallic coating than on a face made of a non-porous metallic coating.

Referring to Figs. 3 and 4, the advantages obtained by means of the invention as compared with prior art rolls are illustrated. Fig. 3 shows a prior art roll without an insulation coating layer, whereas Fig. 4 shows a roll in accordance with the invention provided with a coating layer. With regard to the symbols used in Figs. 3 and 4, it should be stated for the sake of clarity that, in Fig. 3, ΔT refers to the reduction in temperature in the roll mantle, and, in Fig. 4, ΔT_1 refers to the reduction in temperature in the roll mantle, and ΔT_2 refers to reduction in temperature in the insulation coating layer.

Fig. 3 shows the transfer of heat in a roll mantle 11' from a transfer duct 16' into a face 18'. In the following, the situation in respect of the ducts 16' will be examined. In the area of the roll mantle between the ducts, the situation is, in principle, equal. The heat flow ϕ that passes through the mantle 11' is proportional to the difference in tem-

perature dT , to the distance dx across which the difference in temperature is effective, and to the thermal conductivity α and area A through which the heat flows. Thus, the equation for the heat flow is:

$$\phi = -\alpha \cdot A \cdot \frac{dT}{dx}$$

In Fig. 3, the difference in temperature and the distribution of temperature are indicated, the distribution being linear in the roll mantle 11'. The thermal stress σ produced on the roll face 18' is proportional to the thermal conductivity α , to the modulus of elasticity E , and to the difference in temperature dT . Thus, the equation for the thermal stress is:

$$\sigma = \alpha \cdot E \cdot dT$$

The force F' that produces deformations, per unit of length l , is stress (average stress σ is half the stress at the surface) times distance from the duct to the surface. The equation for stress is:

$$\frac{F}{l} = 1/2 \cdot X \cdot \sigma = 1/2 \cdot X \cdot \alpha \cdot E \cdot dT$$

Fig. 4 shows the same reduction in temperature achieved by adding the insulation layer 18 to the roll face while placing the heat transfer duct 16 closer to the roll face. Also, the force F that deforms the mantle 11 has been reduced substantially. The force arising from the insulation 18 is disregarded because the modulus of elasticity of the insulation coating layer is typically only from about 10% to about 30% of the modulus of elasticity of the roll mantle, and the thickness of the coating layer is small.

In the embodiments illustrated in Figs. 5 and 6, a roll 10 as shown in Figs. 1 and 2 may also be equipped with variable-crown means to form a variable-crown roll. In this embodiment, the roll mantle 11 is arranged to revolve around a stationary axle of the roll, and the necessary crown variation means are arranged between the roll axle and the roll mantle 11.

In Fig. 5, a roll in accordance with the invention is denoted generally with the reference numeral 30. The roll 30 comprises a roll mantle 32, and roll ends 39 attached to both ends of the roll 30. The roll ends 39 revolve with the roll mantle 32 about a stationary roll axle 31. The roll 30 is provided with bores 38, or equivalent ducts, passing from one end of the roll to the other end.

A heat transfer medium is circulated in these bores or ducts. For this purpose, the roll end 39 is provided with an axial bore or duct 40 through

which the medium flows. The medium flows from the axial bore 40 to a radial bore 41, then through annular grooves 42 formed in the roll 39 to radial bore 43 which open through a face of the roll axle 31. The annular grooves 42 open radially towards the roll axle 31. Radial bore 43 connects the annular grooves 42 to axial bores 44. Axial bores 44 correspond to the amount of bores 38 in the roll mantle and preferably align therewith. Annular seals 45,46 are provided between roll axle 31 and the roll end 39. In addition, a coating 37 is arranged on an outer surface of the roll mantle 32. The roll mantle is also provided with end bearings 33.

As illustrated in Fig. 5, the roll is provided with crown-variation means 34 (hydraulic loading means). The hydraulic loading means 34 are arranged in cylindrical bores 35 and are regulated by hydraulic pressure. A glide shoe 36 contacts an inner face of the roll mantle 32 by means of a hydraulic fluid film. Hydraulic fluid is supplied to the crown variation means 34 via hydraulic pressure fluid supply ducts 47.

In Fig. 6, another embodiment of a roll in accordance with the invention is illustrated and denoted generally with the reference numeral 130. The roll 130 comprises a roll mantle 132, and roll ends 139 attached to both ends of the roll 130. The roll ends 139 revolve with the roll mantle 132 about a stationary roll axle 131. The roll 130 is provided with bores 138, or equivalent ducts, passing from one end of the roll to the other end. A heat transfer medium is circulated in these bores or ducts. In addition, a coating 137 is arranged on an outer surface of the roll mantle 132. The roll mantle is also provided with an end bearings 133.

A body 140 is attached to the stationary roll axle 131. An annular groove 142 which opens axially towards the roll 130 is arranged in the body 140. The medium flows from a heat transfer medium supply hose or pipe 148 through a bore 141 into the annular groove 142. From the annular groove 142, the medium flows through axial bores 144 formed in the roll end 139 to the bores in the roll mantle 138. Axial bores 144 correspond to the amount of bores 138 in the roll mantle and preferably align therewith. Annular seals 145 are arranged between roll axle 131 and the roll end 139 and annular seals 146 are arranged between the roll end 139 and the body 140 attached to the stationary roll axle 131.

As illustrated in Fig. 6, the roll is provided with crown-variation means 134 (hydraulic loading means). The hydraulic loading means 134 are arranged in cylindrical bores 135 and are regulated by hydraulic pressure. A glide shoe 136 contacts an inner face of the roll mantle 132 by means of a hydraulic fluid film. Hydraulic fluid is supplied to

the crown variation means 134 via hydraulic pressure fluid supply ducts 147.

In the embodiments illustrated in Figs. 5 and 6, the heat transfer medium flows into the roll 30,130 through one of its ends (e.g. as illustrated in Figs. 5 and 6) and is removed from the roll through its other end (not shown). The other end is similar to the first end, however, the fluid flow is in an opposite direction.

The examples provided above are not meant to be exclusive. Many other variations of the present invention would be obvious to those skilled in the art, and are contemplated to be within the scope of the appended claims.

Claims

1. A heatable roll, in particular a press roll or equivalent for a paper machine, which roll directly contacts a paper web running through the press section of the paper machine, comprising
 - a mantle and an outer face,
 - said roll having passageways arranged inside said roll for circulating a heat transfer medium in said roll mantle such that said outer face of said roll is heated, and
 - a coating arranged on said outer face of said roll, said coating comprises a material whose thermal conductivity and modulus of elasticity are lower than the corresponding properties of said roll mantle.
2. The roll of claim 1, wherein said coating comprises a ceramic compound.
3. The roll of claim 1, wherein said coating comprises a metal-ceramic mixture.
4. The roll of claim 1, wherein said ducts are arranged inside said roll in proximity to said outer face of said roll.
5. The roll of claim 1, wherein said coating is a porous material.
6. The roll of claim 5, wherein said coating includes pores, at least a part of the pores in said coating being filled with a sealing material.
7. The roll of claim 6, wherein said sealing material is a polymer.
8. The roll of claim 6, wherein said sealing material is selected from the group consisting of epoxy resin, phenolic resin, polytetrafluoroethylene (PTFE), and other polymers which have good thermal insulation properties
- and a low modulus of elasticity.
9. The roll of claim 2, wherein metal particles have been added to said ceramic coating.
10. The roll of claim 1, wherein said coating is sprayed onto said outer face of said roll.
11. The roll of claim 1, wherein the thickness of said coating is from about 0.03 mm to about 6 mm.
12. The roll of claim 11, wherein the thickness of said coating is from about 0.05 mm to about 2 mm.
13. The roll of claim 1, wherein said passageways comprise bores arranged in said roll mantle in proximity to said outer face of said roll.
14. The roll of claim 13, wherein said roll is provided with crown variation means.
15. The roll of claim 1, wherein said coating is an oxide ceramic selected from the group consisting of Zr-, Al-, Si-, Ti-, Y-, Cr-oxide, an carbide ceramic selected from the group consisting of Cr-, W-, Ti-, Ni-carbide or mixtures thereof.
16. The roll of claim 15, wherein said coating is mixed with a metal compound selected from the group consisting of Cr, Ni, Co and mixtures thereof.
17. A method for heating a roll, in particular a press or equivalent for a paper machine, comprising
 - circulating a heat transfer medium in a roll mantle of the roll in proximity to an outer face of the roll, and
 - providing a coating on the outer face of the roll such that the roll is heated, the coating comprising a material whose thermal conductivity and modulus of elasticity are lower than the corresponding properties of the roll.
18. The method of claim 17, further comprising arranging bores in the roll mantle through which the heat transfer medium flows.
19. The method of claim 17, further comprising spraying the coating onto the outer face of the roll.
20. The method of claim 17, further comprising providing crown-variation means in the roll.

- 21.** A heatable roll, in particular a press roll or equivalent for a paper machine, which roll directly contacts a paper web running through the press section of the paper machine, comprising
- a roll mantle and an outer face,
 - bores arranged in said roll mantle in proximity to said outer face of said roll,
 - ducts arranged in said roll for directing a heat transfer medium to said bores such that the heat transfer medium flows through said bores and said outer face is heated, and
 - a coating arranged on said outer face of said roll, said coating comprises a porous material whose thermal conductivity and modulus of elasticity are lower than the corresponding properties of said roll.
- 22.** The roll of claim 21, wherein said coating includes pores, at least a part of the pores in said coating being filled with a sealing material.
- 23.** The roll of claim 22, wherein said sealing material is a polymer selected from the group consisting of epoxy resin, phenolic resin, polytetrafluoroethylene (PTFE), and other polymers which have good thermal insulation properties and a low modulus of elasticity.

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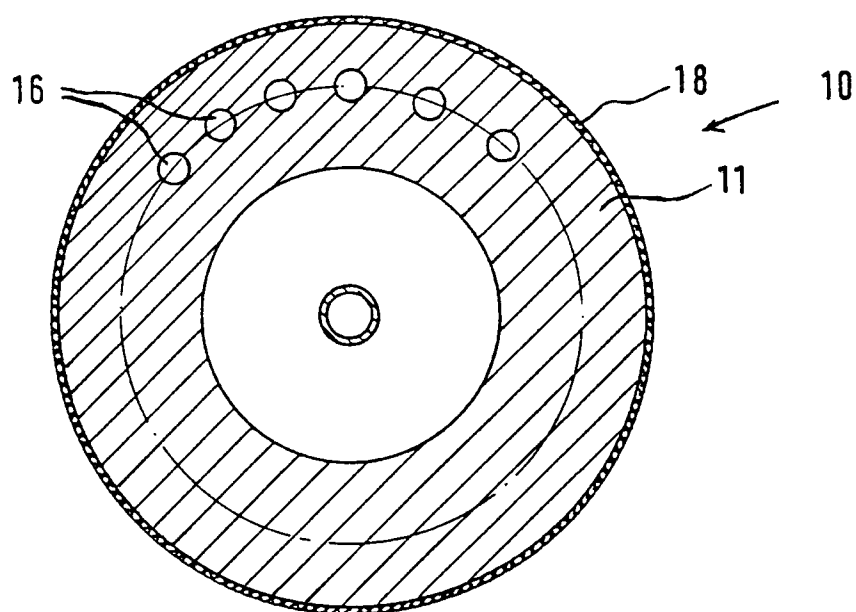
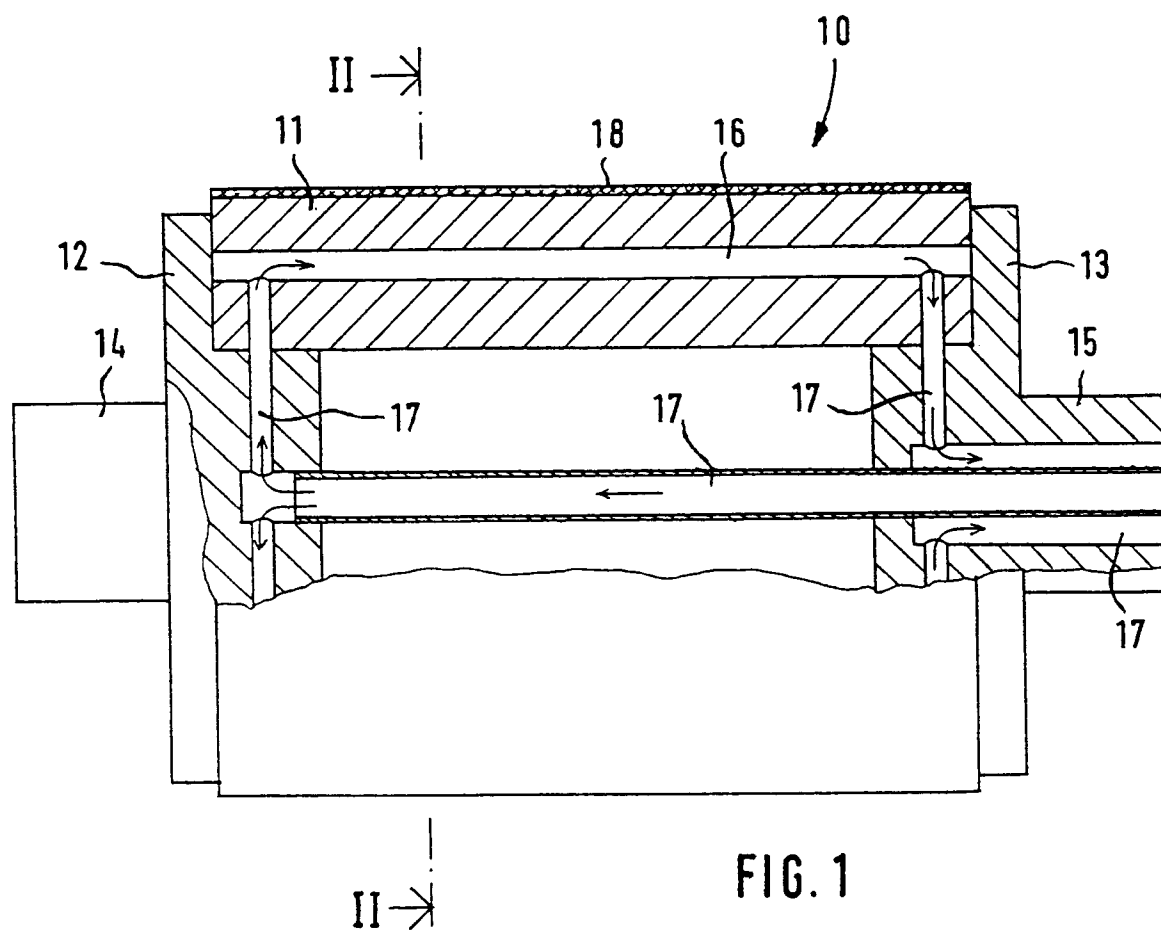
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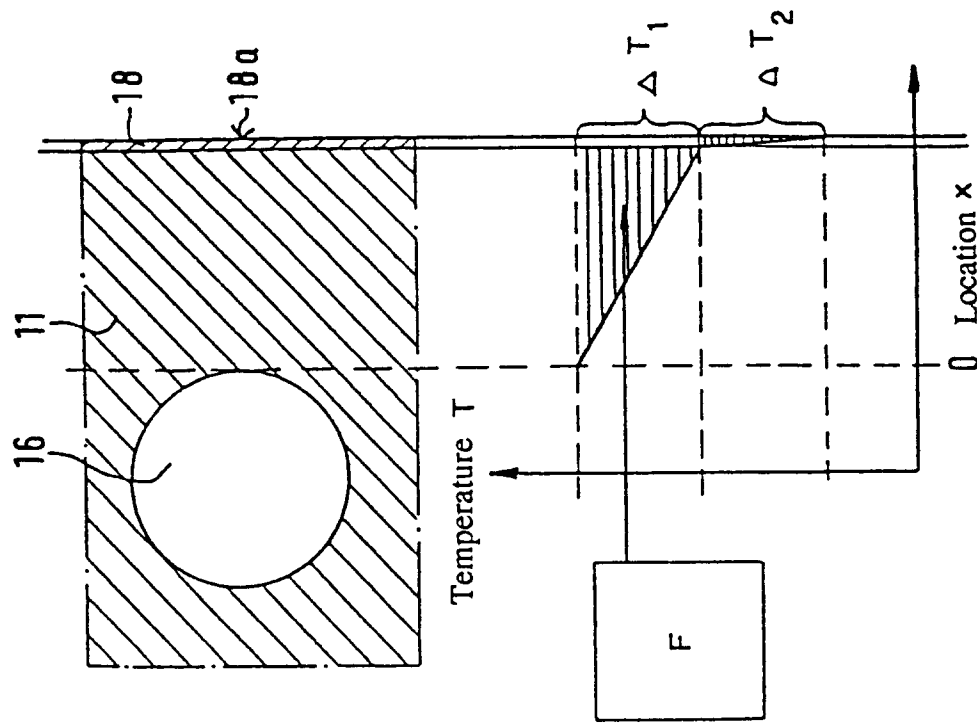


FIG. 4

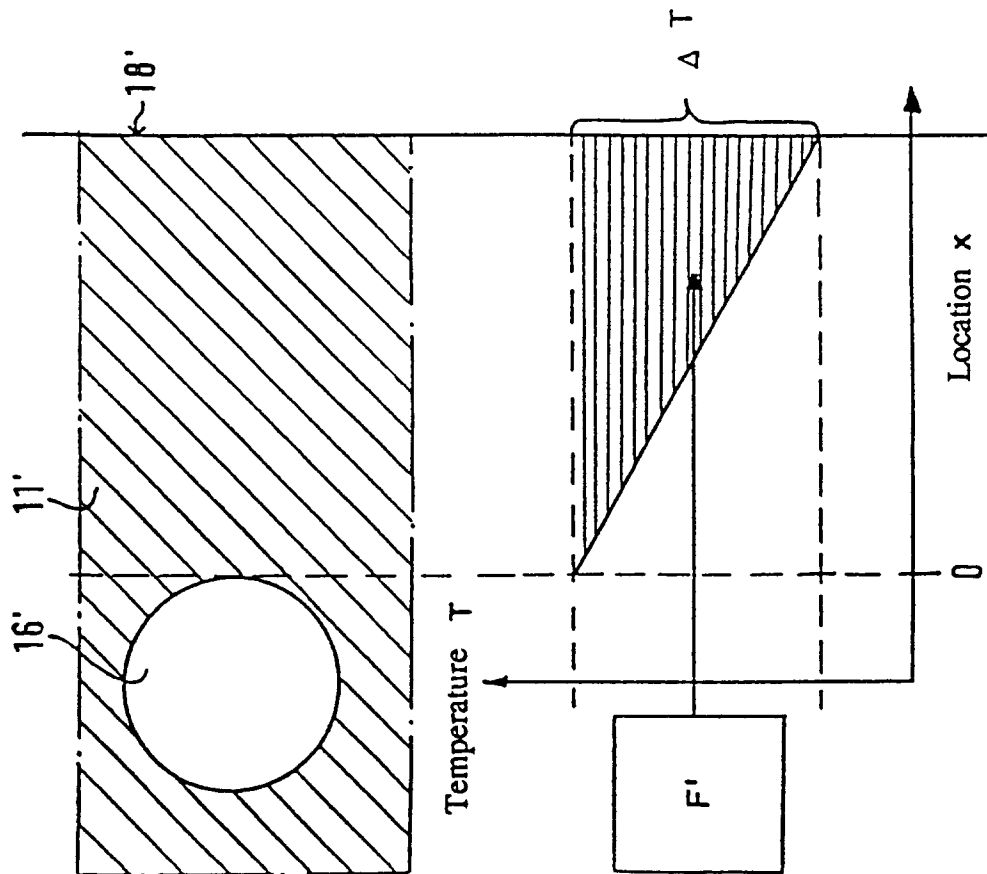


FIG. 3

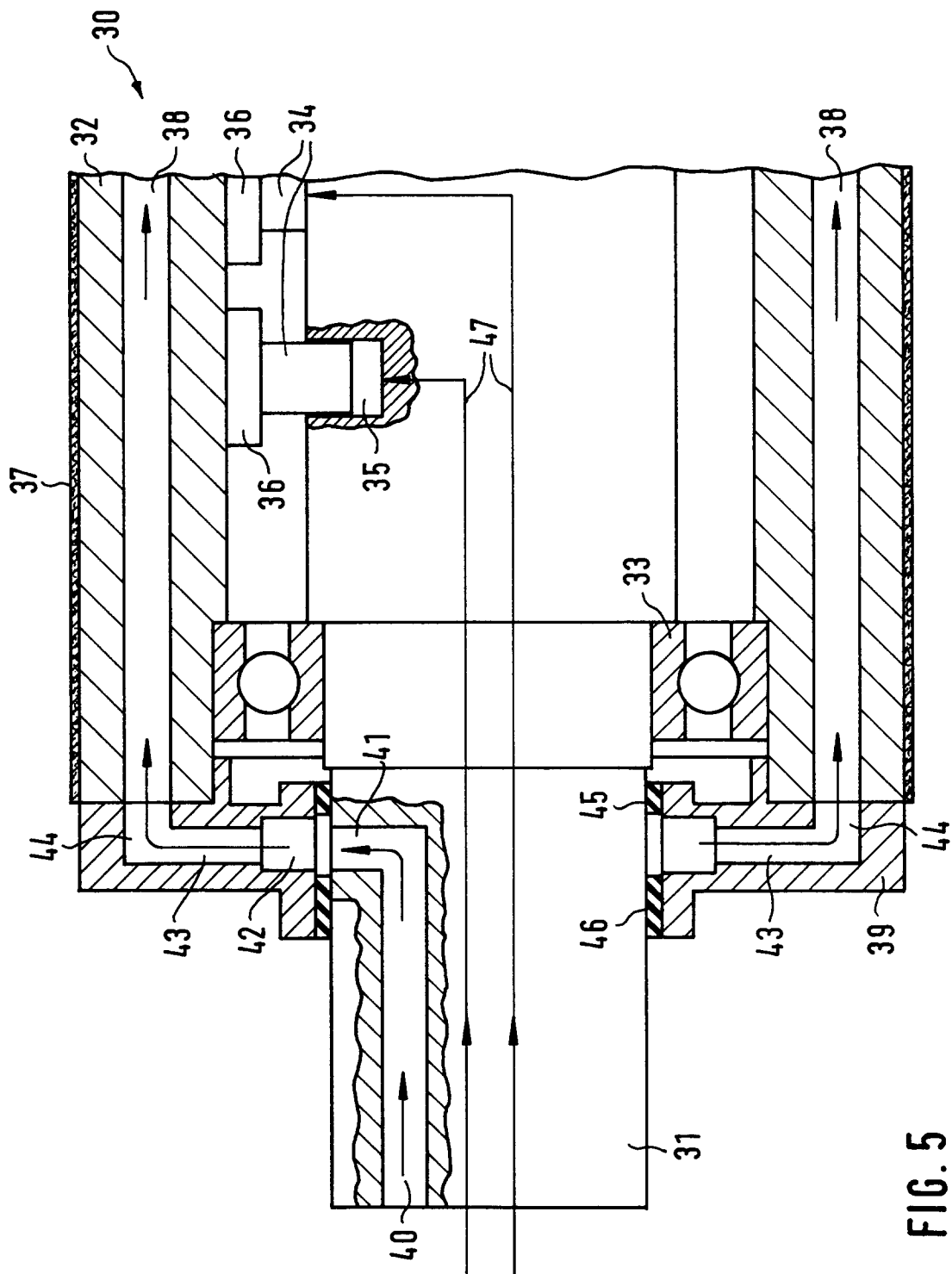


FIG. 5

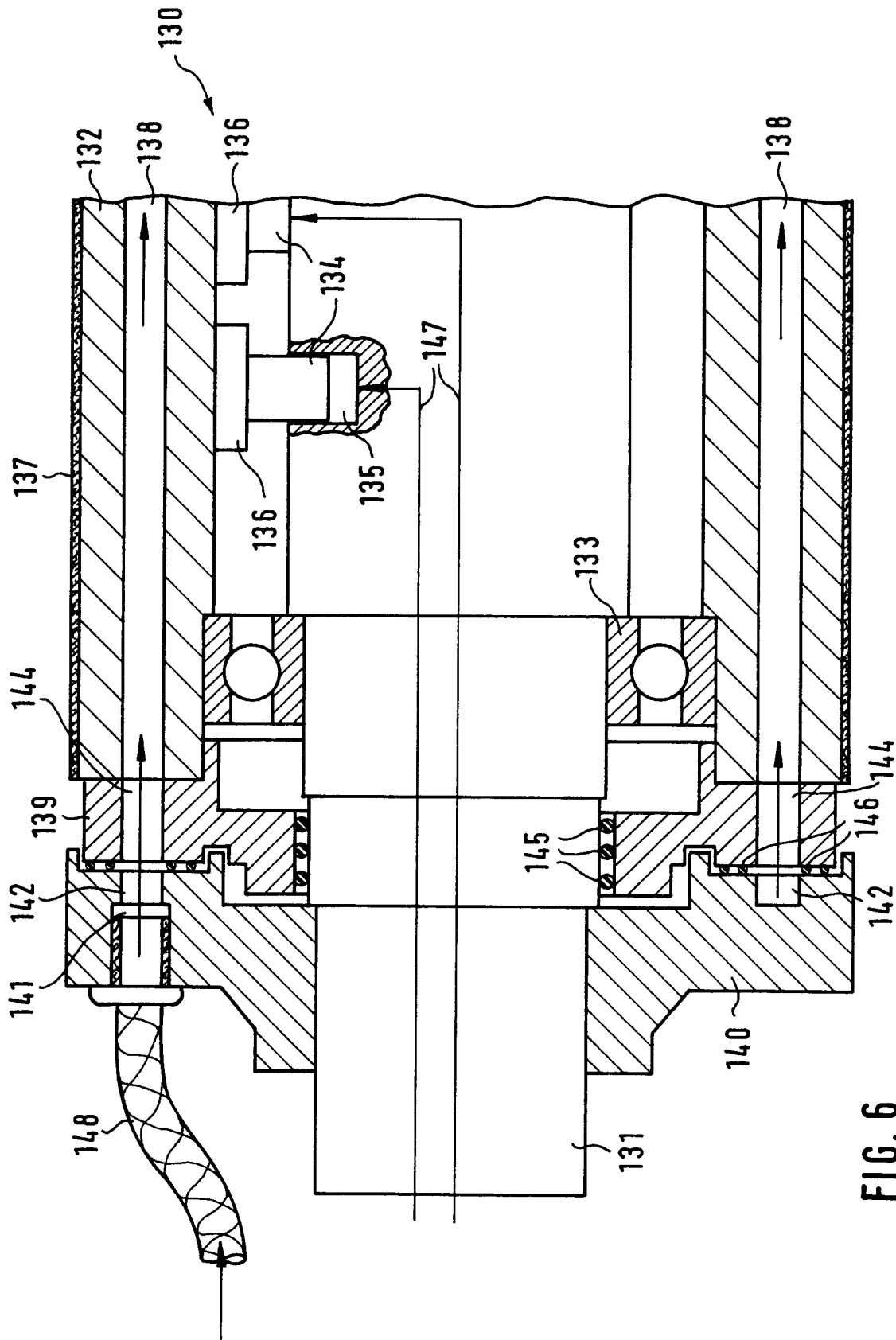


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 85 0196

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)						
Y	EP-A-0 425 464 (VALMET PAPER MACHINERY) * the whole document * ---	1-13, 15-19, 21-23	D21F3/08						
D,Y	US-A-4 738 752 (BUSKER ET AL) * the whole document * ---	1-13, 15-19, 21-23							
P,X	US-A-5 171 404 (ELLIS ET AL) * the whole document * ---	1-5, 9, 10, 13, 15-19, 21							
D,A	US-A-4 704 776 (WATANABE ET AL) * the whole document * ---	1, 2, 5-8, 10-12, 15, 17, 19, 21-23							
D,A	EP-A-0 471 655 (VALMET PAPER MACHINERY) * the whole document * -----	14, 20	<table border="1"><thead><tr><th colspan="2">TECHNICAL FIELDS SEARCHED (Int.Cl.5)</th></tr></thead><tbody><tr><td>D21F</td><td></td></tr><tr><td>D21G</td><td></td></tr></tbody></table>	TECHNICAL FIELDS SEARCHED (Int.Cl.5)		D21F		D21G	
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The present search report has been drawn up for all claims									
Place of search THE HAGUE		Date of completion of the search 22 February 1994	Examiner De Rijck, F						
<table><tr><td>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</td><td>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</td></tr></table>				CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document	T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document				
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