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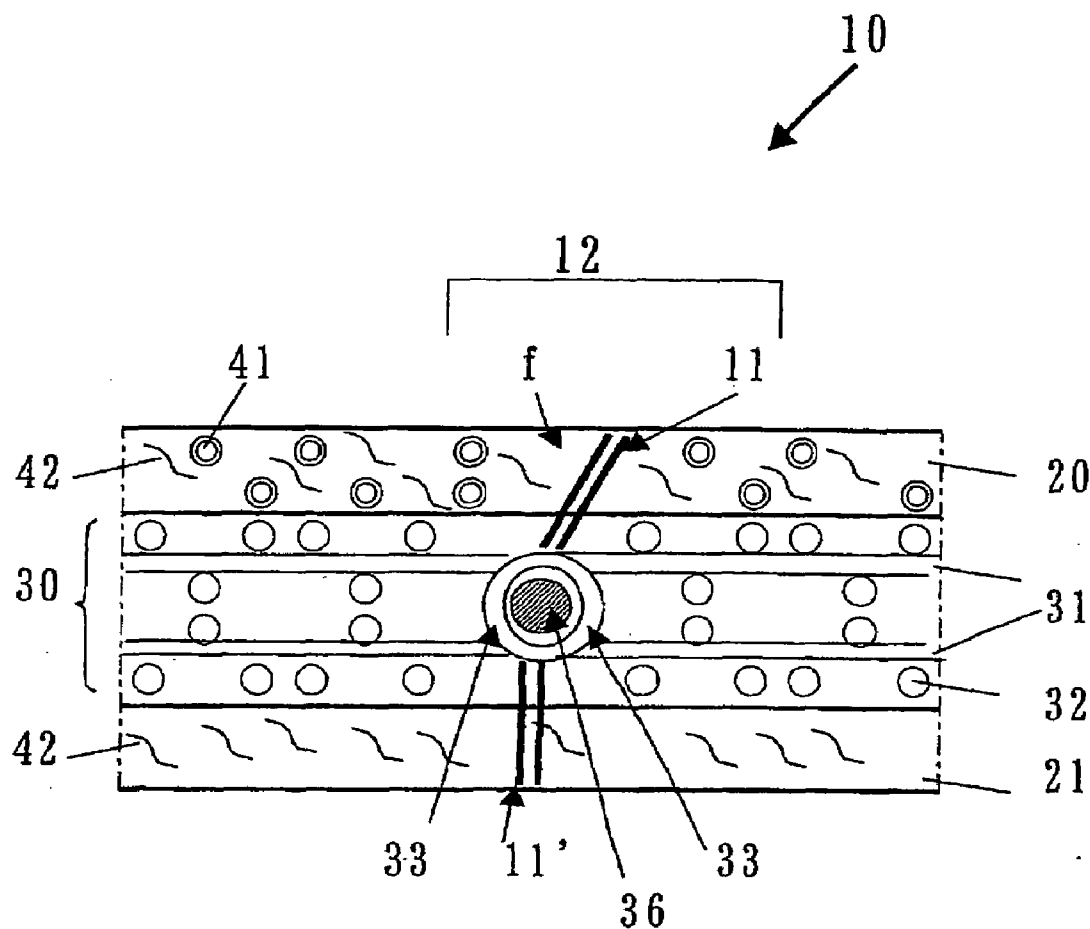


Fig. 1

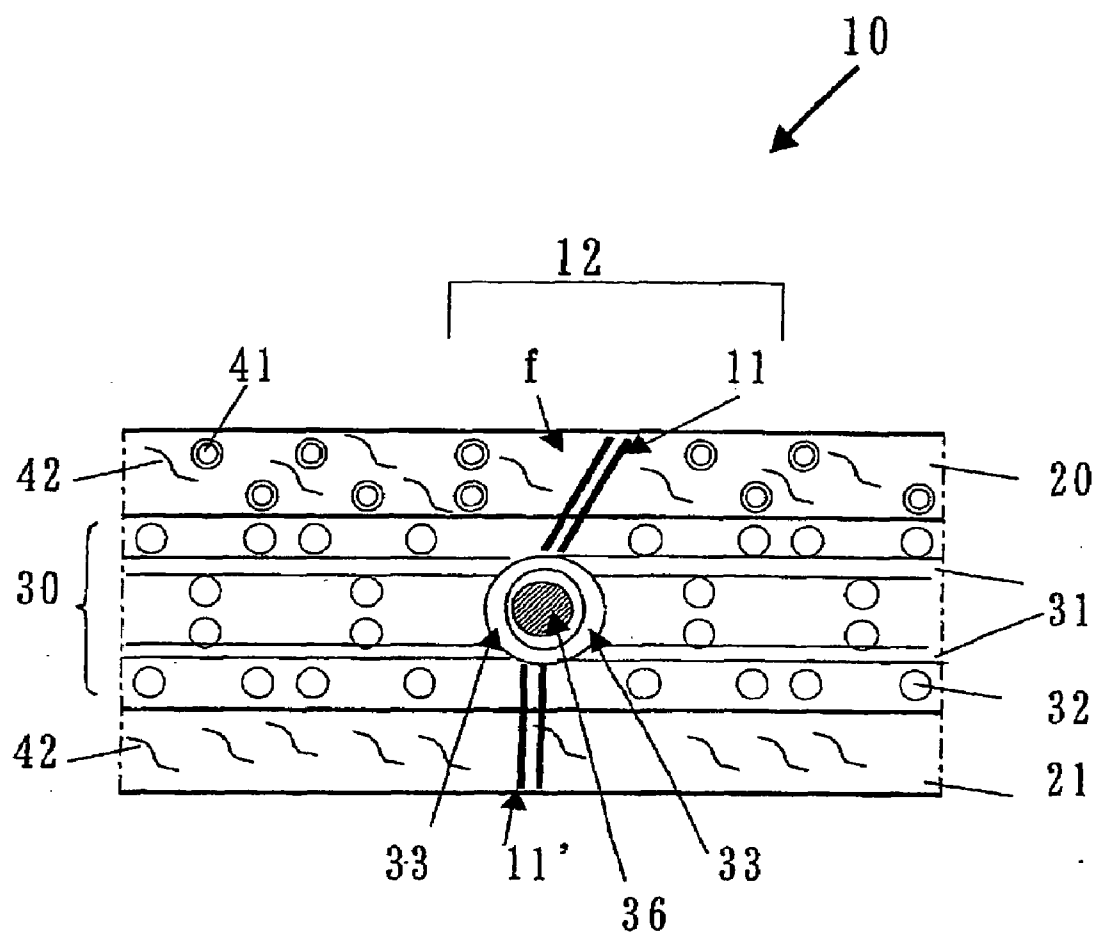
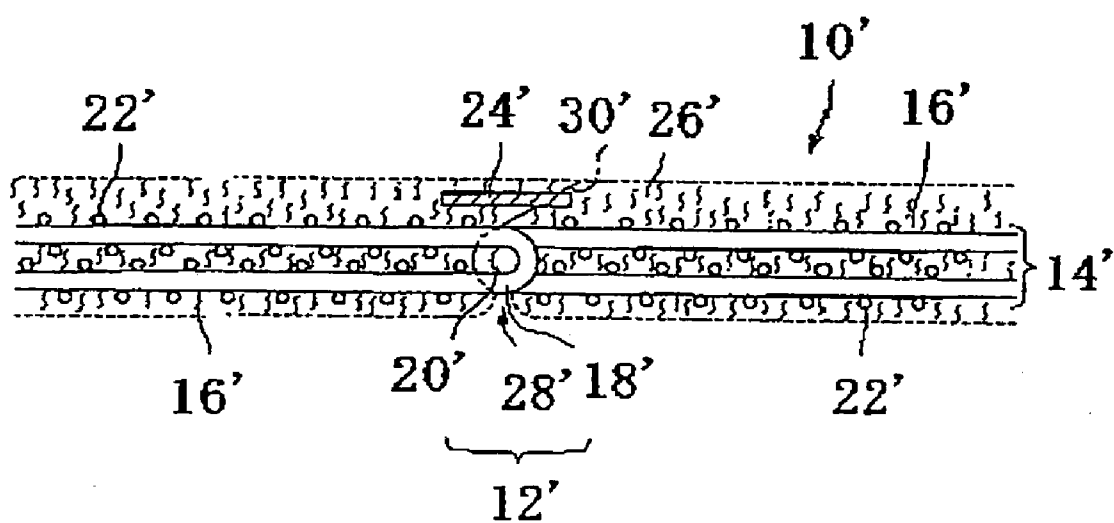


Fig. 2



SEAMED FELT FOR PAPERMAKING

TECHNICAL FIELD

[0001] The present invention relates to a seamed felt for papermaking (hereinafter referred to as a “seamed felt”).

BACKGROUND ART

[0002] Recently, high-speed and high-pressure loading papermaking machines are prevailing, and papermaking felts are required to have high water permeability. Accordingly, a mainstream type of papermaking felts is the one in which a base part has a fabric structure made of monofilaments so as to improve water permeability.

[0003] Conventional on-machine-seamable seamed felts (for example, see WO2002/035000) include a fabric for a papermaking machine in which a batt fiber layer and a strip made of flow-resistant material are provided above or adjacent to a seam part, so that the seam part of a seamed felt has substantially the same air and water permeability as in the other parts of the felt.

[0004] FIG. 2 shows a machine direction sectional view of a conventional seamed felt 10'.

[0005] The seamed felt 10' has a base fabric 14' woven with a monofilament, and is made into an endless form on-machine by joining of seam areas 12'.

[0006] The base fabric 14' is a woven fabric comprising machine direction yarns 16' and cross machine direction yarns 22'.

[0007] The machine direction yarns 16' form seaming loops 18'.

[0008] The seaming loops 18' provide a passage for a pintle 20', and the base fabrics 14' are joined by the combination of the seaming loops 18' and the pintles 20'.

[0009] A strip 24' is disposed in the seam area 12', extending 0.5-2.0 inches (1.27-5.08 cm) long on its top side. The strip 24' is a ribbon made of either a woven fabric, an unwoven fabric, or a polymeric film, punched into the base fabric 14' by needling. A batt fiber layer 26', made of staple fibers, is provided on at least one side of the base fabric 14' by means of needle punching etc.

[0010] Further, the batt fiber layer 26' is removed from the seaming loop 18' on the bottom side of the base fabric 14' to provide a gap 28'.

[0011] A slit 30' is cut obliquely through the batt fiber layer 26' and the strip 24'; however, the strip 24' is supposed to contribute to provide a seamed felt 10' wherein air and water permeability in the seam area 12' can be maintained.

[0012] On the other hand, endless papermaking felts have often been used, which does not require on-machine seaming. In order to maintain a capability to dewater a wet paper web (dewatering capability), it is deemed important for both the endless felts and seamed felts to have a capability to rebound from a compressed state without flattening when depressurized, a capability to improve smoothness of the wet paper web with smoothness of the felt itself, and resistance to shedding and abrasion.

[0013] Unexamined Japanese Patent Publication No. 302584/1996, for example, discloses a press felt with such capabilities which includes fibers with a core-in-sheath structure made from a two-component material. In this press felt, the two-component material used for a fiber to form a batt layer is composed of a sheath member with a low melting point and a core member with a high melting point. With heat

hardening processing of the press felt, the sheath member with a low melting point gets softened to form a matrix within the batt layer, which supposedly enhances dewatering capability and compression resistance of the press felt.

DISCLOSURE OF INVENTION

[0014] In the above-mentioned seamed felt with a slit, it was necessary to dispose a strip or apply resin in the seam area to maintain or strengthen integration of the batt fiber layer in the seam area so as to prevent shedding of the batt fiber layer thereof. Inevitably, therefore, it has been difficult to make the seamed felt to have the same air and water permeability and felt properties (compressibility, water permeability, clogging elements accumulation) throughout the seam areas and the non-seam areas.

[0015] When using a seamed felt in which the seam areas and the non-seam areas have different air and water permeability and felt properties, the texture of the wet paper web on the seam area is affected in a papermaking process, leading to risks that the quality of the wet paper web can be degraded or the wet paper web can get torn. In addition, there has been a problem that durability and quality of the seamed felt are impaired.

[0016] Further, the papermaking felt disclosed in Unexamined Japanese Patent Publication No. 302584/1996 tends to be vulnerable to repetitive compression by a press machine. More specifically, the above-mentioned papermaking felt with the batt layer made from the two-component material tends to require short-term replacement due to cutoffs of fibers during use, shedding or abrasion, because hot pressing in the manufacturing process of the felt causes deterioration of mechanical strength or chemical degradation of the core material.

[0017] Thus, it is the object of this invention to provide a seamed felt wherein resistance to compression fatigue of a batt fiber-layer in seam areas can be improved and which has superior smoothness, resistance to shedding and abrasion, and a dewatering capability, while providing the felt with the same properties throughout seam areas and non-seam areas.

[0018] The present invention resolved the above problems by a seamed felt for papermaking comprising a base layer having a seam part, a wet paper web side batt fiber layer formed on the wet paper web side surface of said base layer, and a press side batt fiber layer formed on the press side surface thereof;

[0019] said wet paper-web side batt fiber layer having a core-in-sheath fiber comprising a core member made of high-molecular-weight nylon with an absolute viscosity of 80 mPa·s or more and a sheath member made of nylon with a lower melting point than the core member, wherein a net-shaped fiber layer is formed with melted sheath members of said core-in-sheath fiber.

[0020] “An absolute viscosity of 80 mPa·s or more” was measured at the temperature of 25 degrees C. after solving nylon in 100 ml of 0.5 g/95% sulfuric acid, which can be measured using an oscillating viscometer.

[0021] The content rate of said core-in-sheath fibers within said wet paper web side batt fiber layer is preferably in the range of 20-80%.

[0022] Said wet paper web side batt fiber layer can be multi-layered, in which the content rate of said core-in-sheath fibers increases incrementally from the press side toward the wet paper web side thereof. It is specifically preferable to

provide a fiber layer without said core-in-sheath fibers on the wet paper web side surface of said base layer.

[0023] The present invention can effectively prevent shedding of batt fibers in the seam area, while achieving uniform properties throughout the seam areas and the non-seam areas. Therefore, this invention can provide a seamed felt which is capable of improving the quality of a wet paper web, less likely to tear a wet paper web, and demonstrates improved durability, in papermaking processes.

[0024] Moreover, in this invention, a net-shaped fiber layer is formed with melted sheath members of the core-in-sheath fiber, which makes the wet paper web side batt fiber layer dense. Resultantly, wet paper web side batt fiber layer works as a barrier to block water within the press side layer from moving to the wet paper web side, thereby preventing rewetting.

[0025] Further, the invention successfully enhances resistance to shedding, abrasion, and compressions fatigue of the felt by providing the core member of the core-in-sheath fiber with high viscosity, i.e. by using high-molecular-weight nylon. As a result, the felt is made more durable, reducing the need for replacement, contributes to improve the quality of the finished paper with less fibers attached thereon due to shedding and abrasion, and is capable of maintaining smoothness of the wet paper web contact surface.

BRIEF DESCRIPTION OF DRAWINGS

[0026] FIG. 1 is a machine direction sectional view of an embodiment of a seamed felt of the present invention.

[0027] FIG. 2 is a machine direction sectional view of a conventional seamed felt.

PREFERRED EMBODIMENT OF THE INVENTION

[0028] A seamed felt of the present invention is to be detailed.

[0029] FIG. 1 illustrates a machine direction (MD) sectional view of a seamed felt 10 of this invention.

[0030] "Machine direction (MD)" refers to a longitudinal direction in which a papermaking machine drives a seamed felt, whereas "cross machine direction (CMD)" refers to a lateral direction which crosses the direction in which a papermaking machine drives a seamed felt.

[0031] As shown in FIG. 1, the seamed felt 10 comprises a base layer 30 having a seam part, a wet paper web side batt fiber layer 20 formed on the wet paper web side surface of said base layer, and a press side batt fiber layer 21 formed on the press side surface thereof.

[0032] The wet paper web side batt fiber layer 20 formed on the wet paper web side surface of the base layer and a press side batt fiber layer 21 formed on the press side surface thereof are made of staple fibers, intertwiningly integrated with the wet paper web side and the press side of the base layer 30 respectively by needle punching.

[0033] The base layer 30 is produced by weaving a strip of an open-ended fabric on a loom with a warp (MD yarn) 31 and a weft (CMD yarn) 32.

[0034] The seam part of the base layer 30 is to be described. The warps 31, 31 form so-called seaming loops 33, 33 on the end of the base layer 30, which are aligned in the cross machine direction. Stick core wires (pintle wires) 36 are set into the seaming loops 33, 33 to make the base layer 30 endless. Thus, a seam part refers to a part where a seaming

loop is formed on the end of the base layer 30, into which a core wire is inserted to make the base layer endless.

[0035] A slot 11 is formed by obliquely cutting the wet paper web side batt fiber layer 20 above the core wire 36 down to the base layer 30 along the cross machine direction of the seamed felt 10. The wet paper web side batt fiber layer 20 is cut obliquely to form a slot 11 sloping in the machine direction, because a mark of a seam area 12 is less likely to be transferred onto a wet paper web compared to the wet paper web side batt fiber layer 20 cut vertically in the cross machine direction. Accordingly, a cut 11' on the press side batt fiber layer can be vertical.

[0036] As shown in FIG. 1, a triangular section is a flap f having the slot 11 as a hypotenuse against the base layer 30. In this case, the seamed felt 10 drives from the right to the left in FIG. 1 on a papermaking machine.

[0037] In the seamed felt 10 of this invention, the wet paper web side batt fiber layer 20 includes a core-in-sheath fiber 41, sheath members of said core-in-sheath fiber being melted by heat and/or hot pressing to form a net-shaped fiber layer, which makes the wet paper web side batt fiber layer dense, and hence durability of the seam area 12 is enhanced. In other words, while a seamed felt is being used on a papermaking machine, shedding and abrasion of the flap f in the seam area 12 and slots 11, 11', which are vulnerable to damage, can be dramatically diminished.

[0038] Other features of the seamed felt of the present invention are to be explained below.

[0039] A net-shaped fiber layer is formed with melted core-in-sheath fibers 41 of the seamed felt 10, which makes the wet paper web side batt fiber layer 20 dense and improves surface smoothness of the seamed felt 10.

[0040] As the wet paper web side batt fiber layer 20 is made dense, it works as a barrier to block shifting of water within the base layer and the press side batt fiber layer 21 formed on the press side thereof when the seamed felt 10 is released from nip pressure, thereby preventing rewetting effectively and improving the dewatering capability.

[0041] In the seamed felt 10 of this invention, the wet paper web side batt fiber layer 20 comprises a core-in-sheath fiber 41, a staple fiber, which has a core member made of high-molecular-weight nylon with an absolute viscosity of 80 mPa·s or more and a sheath member made of nylon with a lower melting point than the core member, whereas the press side batt fiber layer 21 formed on the press side surface of the base layer 30 is made of a staple fiber of a conventional nylon fiber 42 which does not include the core-in-sheath fiber 41.

[0042] "An absolute viscosity of 80 mPa·s or more" was measured at the temperature of 25 degrees C. after solving nylon in 100 ml of 0.5 g/95% sulfuric acid, which can be measured using an oscillating viscometer.

[0043] In FIG. 1, the core-in-sheath fiber 41 is enlarged for the purpose of illustration.

[0044] Conventionally, no attention has been paid to viscosity of a core member, or its molecular weight, when a fiber with a core-in-sheath structure made from a two-component material is used for a batt fiber layer of a papermaking felt. The present invention achieved balanced improvements of smoothness and resistance to shedding, abrasion, and compression fatigue by providing the core member with higher viscosity compared to conventional practices, i.e. by using high-molecular-weight nylon, and by disposing a layer made of such core-in-sheath fibers on the wet paper web side sur-

face of the base layer of the seamed felt so that a net-shaped fiber layer is formed with melted core-in-sheath fibers.

[0045] Nylon used for the core member of the core-in-sheath fiber **41** should be high-molecular-weight nylon with an absolute viscosity of 80 mPa·s or more at 25 degrees C. and with a higher melting point than the sheath member. When nylon with a high viscosity (80 mPa·s or more) is used for the core member, shedding, abrasion, and compression resistance of the felt can be enhanced. It is probably because high-molecular-weight nylon has a longer molecular chain, which improves mechanical strength (intensity or durability such as abrasion and attrition resistance) as a result of entanglement of such molecular chains. Nylon with an absolute viscosity of less than 80 mPa·s (moderate viscosity) can not be sufficiently advantageous in enhancing shedding, abrasion, and compression resistance.

[0046] Preferable nylon used for the core member includes high-molecular-weight nylon 6, high-molecular-weight nylon 66, high-molecular-weight nylon 46, high-molecular-weight nylon 610, and high-molecular-weight nylon 612 and others. More specifically, nylon obtained by way of polycondensation of nylon salt is preferable, such as polymerization of ϵ caprolactam (nylon 6), polycondensation of hexamethylenediamine adipate (nylon 66), polycondensation of 1,4-diaminobutane adipate (nylon 46), polycondensation of hexamethylenediamine sebacate (nylon 610), polycondensation of hexamethylenediamine dodecanedioic diacid (nylon 612), and aliphatic nylon can also be included which has a melting point of 200 degrees C. or more measured by DSC (Differential Scanning Calorimetry). Preferably, an absolute viscosity of the high-molecular-weight nylon above in 100 ml of 0.5 g/95% sulfuric acid is 80 mPa·s or more. These high-molecular-weight nylon is produced with a well-known polymerization procedure or a solid phase polymerization procedure in which polymerized nylon flake is placed in an inert gas atmosphere of 120-200 degrees C. without oxygen (for example, Unexamined Japanese Patent Publication No. 529604/2002).

[0047] Nylon used for the sheath member of the core-in-sheath fiber **41** should have a lower melting point than the core member. Preferred nylon includes binary copolymerized nylon such as nylon 6/12, nylon 6/610, nylon 66/6, nylon 66/12, and nylon 66/610, ternary copolymerized nylon such as nylon 6/66/12 and nylon Jun. 66, 19610. As is known in the art, a melting point of these copolymerized nylon fluctuates depending on their composition (or weight percentages of copolymerized elements), and only those with a melting point of 180 degrees C. or less is usable for this invention.

[0048] The wet paper web side batt fiber layer **20** is preferably made of a blend with a predetermined rate of the core-in-sheath fiber **41** and the normal nylon fiber **42** to achieve a better balance of smoothness, abrasion and compression fatigue resistance. Preferably, the blend consists of 80-20% of the core-in-sheath fiber **41** and 20-80% of the nylon fiber **42**.

[0049] When the content rate of the core-in-sheath fiber **41** is less than 20%, the wet paper web side batt fiber layer **20** is made less dense. Therefore, the felt lacks resistance to shedding, abrasion and compression fatigue, and smoothness, and is incapable of preventing rewetting effectively.

[0050] On the other hand, when the content rate of the core-in-sheath fiber **41** exceeds 80%, the felt tends to be flattened with the wet paper web side batt fiber layer **20** susceptible to compression fatigue, while it has smoothness, abrasion resistance and is effective in prevention of rewetting.

[0051] The wet paper web side batt fiber layer **20** can be multi-layered, in which the content rate of the core-in-sheath fiber **41** increases incrementally from the press side toward the wet paper web side thereof to provide more improvements in smoothness and resistance to shedding and abrasion.

[0052] It is especially preferred to provide a batt fiber layer without the core-in-sheath fiber **41** on the wet paper web side surface of the base layer. More specifically, when the seam part of the base layer **30** is intertwiningly integrated with the wet paper web side batt fiber layer **20** by needle punching, melted and netted fibers obstruct the seaming loops **33**, **33**, blocking insertion of the core wire (pintle wire) **36**. However, when a batt fiber layer without the core-in-sheath fiber **41**, preferably a batt fiber layer with a basis weight of 50 g/m² or more, is provided on the wet paper web side surface of the base layer, the seam part is prevented from being intertwined with the core-in-sheath fiber **41**.

[0053] Although the ratio of the volume of the core and the sheath members of the core-in-sheath fiber **41** should not be limited, it can range from 5:1 to 1:5, with a preferable rate of 1:1.

[0054] The nylon fiber **42** used for the wet paper web side batt fiber layer **20**, the press side batt fiber layer **21**, and for the blend with the core-in-sheath fiber **41** is preferably nylon 6, nylon 66, nylon 46, nylon 610, and nylon 612 etc.

[0055] Preferable fineness of the core-in-sheath fiber **41** is 15-25 dtex for a picking-up seamed felt used in a first stage in a press section of a papermaking machine, 10-20 dtex for a seamed felt for a second and third press used in a middle stage of the press section, and 5-20 dtex for a seamed felt for a fourth press and a shoe press used in the last stage of the press section.

[0056] Preferred fineness of the nylon fiber **42** is 10-25 dtex for the wet paper web side batt fiber layer **20** and 15-25 dtex for the press side batt fiber layer **21** respectively of a picking-up seamed felt used in a first stage of a press section of a papermaking machine.

[0057] In the seamed felt for a second and third press used in a middle stage of a press section of a papermaking machine, preferred fineness is 10-15 dtex for the wet paper web side batt fiber layer **20** and 10-20 dtex for the press side batt fiber layer **21** respectively.

[0058] In the seamed felt for a fourth press and a shoe press used in a last stage of a press section of a papermaking machine, preferred fineness is 5-15 dtex for the wet paper web side batt fiber layer **20** and 5-20 dtex for the press side batt fiber layer **21** respectively.

INDUSTRIAL APPLICABILITY

[0059] The present invention can effectively prevent shedding of batt fibers in the seam area, while achieving uniform properties throughout the seam areas and the non-seam areas. Therefore, this invention can provide a seamed felt which is capable of improving the quality of a wet paper web, less likely to tear a wet paper web, and demonstrates improved durability, in papermaking processes.

[0060] Moreover, a net-shaped fiber layer is formed with melted sheath members of the core-in-sheath fiber, which makes the wet paper web side batt fiber layer dense. Resultantly, wet paper web side batt fiber layer works as a barrier to block water within the press side layer from moving to the wet paper web side, thereby preventing rewetting.

[0061] Further, the invention successfully enhances resistance to shedding, abrasion, and compression fatigue of the

felt by providing the core member of the core-in-sheath fiber with high viscosity, i.e. by using high-molecular-weight nylon. As a result, the felt is made more durable, reducing the need for replacement, contributes to improve the quality of the finished paper with less fibers attached thereon due to shedding and abrasion, and is capable of maintaining smoothness of the wet paper web contact surface.

What is claimed is:

1. A seamed felt for papermaking comprising a base layer having a seam part, a wet paper web side batt fiber layer formed on the wet paper web side surface of said base layer, and a press side batt fiber layer formed on the press side surface thereof; characterized in that said wet paper web side batt fiber layer includes a core-in-sheath fiber comprising a core member made of high-molecular-weight nylon with an absolute viscosity of 80 mPa·s or more and a sheath member made of nylon with a lower melting point than the core

member, wherein a net-shaped fiber layer is formed with melted sheath members of said core-in-sheath fiber.

2. A seamed felt as claimed in claim 1, wherein the content rate of said core-in-sheath fiber within said wet paper web side batt fiber layer is in the range of 20-80%.

3. (canceled)

4. A seamed felt as claimed in claim 1, wherein said wet paper web side batt fiber layer is multi-layered, in which the content rate of said core-in-sheath fiber increases incrementally from the press side toward the wet paper web side thereof.

5. A seamed felt as claimed in claim 2, wherein said wet paper web side batt fiber layer is multi-layered, in which the content rate of said core-in-sheath fiber increases incrementally from the press side toward the wet paper web side thereof.

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