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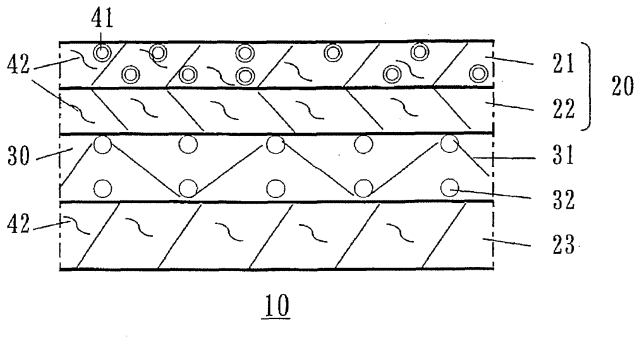
(54) PRESS FELT FOR PAPERMAKING

(57) A press felt 10 comprises a base body 30, a wet paper web side batt layer 20, and a press side batt layer 23. The wet paper web side batt layer 20 has a wet paper web contact side batt layer 21 and a base body side batt layer 22, the wet paper web contact side batt layer 21 being made of a core-in-sheath fiber 41 which has a core member made of high-molecular-weight nylon with an absolute viscosity of 80mPa·s or more and a sheath member made of nylon with a lower melting point than the core member, and the base body side batt layer 22 being made of a nylon fiber 42 which does not include the core-in-sheath fiber 41.

Rewetting of the wet paper web can be prevented, because water within the press side batt layer 23 is blocked from moving to the wet paper web side due to increased density of the wet paper web contact side batt layer 21 resulted from melting of the sheath member of the core-in-sheath fiber 41. Moreover, since the base body side batt layer 22 is made of nylon without the core-in-sheath fiber, the press felt is provided with a balanced combination of smoothness, resistance to dehairing, abrasion and compression fatigue, and dewatering capability.

Fig. 1



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Description

FIELD OF THE INVENTION

[0001] This invention relates to a press felt for papermaking used in a papermaking machine (hereinafter referred to as a "press felt").

BACKGROUND ART

[0002] Press machines have been used to dewater a wet paper web in a papermaking process. In a press machine, a wet paper web formed with layers therein is dewatered within a press nip, sandwiched between a pair of press felts. Press machines generally have a plurality of press nips.

[0003] Figure 5 is a schematic view of a press nip in a press machine.

[0004] A pair of press rolls P', P' and a pair of press felts 11', 11' form a press nip. The press felts 11', 11' and a wet paper web W' are compressed within a pressure portion between the press rolls P' , P', where water is removed from the wet paper web W' and absorbed by the press felts 11', 11'.

[0005] The volume of the wet paper web W' and the press felts 11', 11' rapidly expands when they travel through the middle of the press portion (the nip) to the exit thereof, as they are rapidly released from compression. This expansion generates negative pressure within the press felts 11', 11' which, coupled with the capillary phenomenon within the wet paper web W' associated with thin fibers therein, results in rewetting, a phenomenon in which water absorbed by the press felts 11', 11' backs to the wet paper web.

[0006] Unexamined Japanese Patent Publication No. 143627/2004 (patent document 1) discloses an example of a press felt intended to prevent rewetting. This felt comprises a base layer, a paper side batt layer, and a press side batt layer, with a hydrophilic nonwoven fabric being disposed within the paper web side batt layer. According to this invention, water is absorbed by and retained in the hydrophilic nonwoven fabric due to its hydrophilic nature, resulting in effective prevention of rewetting.

[0007] Moreover, it is also essential for a press felt to have a capability of recovering to its uncompressed state after compression without being flattened (resistance to compression fatigue), a capability of improving smoothness of the wet paper web by smoothness of the felt itself (smoothness), and dehairing and abrasion resistance.

[0008] Unexamined Japanese Patent Publication No.302584/1996 (patent document 2), for example, discloses a felt with such capabilities which includes fibers with a core-in-sheath structure made from a two-component material.

[0009] According to this invention, 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 enhances dewatering capability and compression resistance of the press felt.

[0010] Further, press felts made of a woven fabric with improved dewatering capability and smoothness are employed in recent high-speed papermaking machines. The fabric is woven with a warp yarn (CMD yarn) and a weft yarn (MD yarn), both of which are monofilament single yarns (see Unexamined Japanese Patent Publication No. 170086/2000: patent document 3).

DISCLOSURE OF THE INVENTION

[0011] However, the press felts disclosed in the patent documents 1 and 2 tend to be vulnerable to repetitive compression by a press machine.

[0012] In addition, the press felt with the batt layer made from the two-component material, as disclosed in the patent document 2, tends to require short-term replacement due to cutoffs of fibers during use, dehairing or abrasion, because thermal pressurization in the manufacturing process of the felt causes deterioration of mechanical strength or chemical degradation.

[0013] On the other hand, the press felt disclosed in the patent document 3 is known to be much inferior to conventional felts using twist yarns in terms of dehairing and abrasion resistance, because batt fibers and the woven fabric are not firmly integrated by needlepunching.

[0014] Thus, there is a need for a press felt not only with an anti-rewetting capability but with a balanced combination of advantages, such as resistance to compression, smoothness, dehairing and abrasion resistance, and dewatering capability.

[0015] In view of the above problems, the object of the present invention is to provide a press felt for papermaking being capable of preventing rewetting and having superior smoothness, resistance to abrasion and compression fatigue, and dewatering capability.

[0016] The present invention solved the above-mentioned problems with a press felt comprising a base body and batt

layers having a wet paper web side layer and a press side layer, characterized in that said wet paper web side layer is composed of a wet paper web contact side batt layer and a base body side batt layer, said wet paper web contact side batt layer having a core-in-sheath fiber comprising a core member made of high-molecular-weight nylon with an absolute viscosity of 80mPa·s or more and a sheath member made of nylon with a lower melting point than the core member, and said base body side batt layer being made of nylon without said core-in-sheath fiber.

[0017] "An absolute viscosity of 80mPa·s or more" was measured at the temperature of 25 degrees C after solving nylon in 100ml of 0.5g/95% sulfuric acid, which can be measured using an oscillating viscometer.

[0018] The content rate of said core-in-sheath fibers within said wet paper web contact side batt layer is preferably in the range of 25-75%.

[0019] Said wet paper web contact side batt layer can be multi-layered, in which the content rate of said core-in-sheath fibers increases incrementally from the press side toward the paper side thereof.

[0020] Further, said base body (hereinafter also referred to as a "base layer") is preferably a fabric woven with a warp yarn (CMD yarn) and a weft yarn (MD yarn), both of which are monofilament single yarns.

[0021] According to this invention, the wet paper web contact side batt layer is made dense due to melting of the sheath member of the core-in-sheath fiber. As a result, said wet paper web contact side batt layer works as a barrier to block water within the press side layer from moving to the wet paper web side, thereby preventing rewetting.

[0022] Moreover, the invention successfully enhances resistance to dehairing, abrasion, and compression fatigue of the press felt by providing the core member of the core-in-sheath fiber with high viscosity, i.e. by using high-molecular-weightnylon. As a result, the press felt of this invention 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 dehairing and abrasion, and is capable of maintaining smoothness of the wet paper web contact surface.

[0023] Further, since the wet paper web contact side batt layer is made of the core-in-sheath fiber while the base body side batt layer formed on the wet paper web side surface of the base body is made of nylon without the core-in-sheath fiber, the press felt of this invention is provided with a balanced combination of smoothness and resistance to dehairing, abrasion, compression fatigue, and dewatering capability.

[0024] Furthermore, the present invention improves dewatering capability of the felt by using a fabric woven with monofilament single yarns for the base body and thus improving water permeability thereof.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

Figure 1 is a sectional view of an embodiment of the press felt of the present invention.
Figure 2 is a sectional view of another embodiment of the press felt of the present invention.
Figure 3 is a schematic view of an apparatus to evaluate the effects of the press felt of the present invention.
Figure 4 is a schematic view of an apparatus to evaluate the effects of the press felt of the present invention.
Figure 5 is a schematic illustration of a press apparatus of a papermaking machine.

PREFERRED EMBODIMENTS OF THE INVENTION

[0026] A press felt of this invention is to be detailed hereafter.

[0027] Figure 1 is a CMD sectional view of a press felt 10 of the present invention.

[0028] "Machine direction (MD)" refers to the longitudinal direction in which a press felt is transferred in a papermaking machine, whereas "cross machine direction (CMD)" refers to the lateral direction which crosses the machine direction.

[0029] As shown in Figure 1, the press felt 10 comprises a base body 30, a wet paper web side batt layer 20, and a press side batt layer 23, the wet paper web side batt layer 20 having a wet paper web contact side batt layer 21 and a base body side batt layer 22 which is formed on the inner side of the wet paper web contact side batt layer 21.

[0030] The wet paper web contact side batt layer 21, the base body side batt layer 22, and the press side batt layer 23 are made of staple fibers, with the base body side batt layer 22 and the press side batt layer 23 intertwiningly integrated by needlepunching with the wet paper web side and the press side of the base body 30 respectively. The wet paper web contact side batt layer 21 is intertwiningly integrated with the base body side batt layer 22 by needlepunching.

[0031] In the press felt 10 of this invention, the wet paper web contact side batt layer 21 is made of 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 80mPa·s or more and a sheath member made of nylon with a lower melting point than the core member, whereas the base body side batt layer 22 is made of a staple fiber of a conventional nylon fiber 42 without the core-in-sheath fiber 41.

[0032] "An absolute viscosity of 80mPa·s or more" was measured at the temperature of 25 degrees C after solving nylon in 100ml of 0.5g/95% sulfuric acid, which can be measured using an oscillating viscometer.

[0033] In Figure 1, the core-in-sheath fiber 41 is enlarged for the purpose of illustration.

[0034] 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 two-component material is used for a batt layer of a press felt. However, the present invention successfully achieved a balance of such advantages as smoothness, dehairing and abrasion resistance, and resistance to 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 this core-in-sheath material (the wet paper web contact side batt layer) on the outer side of the base body side batt layer formed on the wet paper web side surface of the base body.

[0035] Nylon used for the core member of the core-in-sheath fiber 41 should be high-molecular-weight nylon with an absolute viscosity of 80mPa·s or more at 25 degrees C and with a higher melting point than the sheath member. When nylon with a high viscosity (80mPa·s or more) is used for the core member, dehairing, 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 80mPa·s (moderate viscosity) can not be sufficiently advantageous in enhancing dehairing, abrasion, and compression resistance.

[0036] 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. More specifically, nylon obtained by way of polycondensation of nylon salt is preferable, such as polymerization of E caprolactam (nylon6), 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 100ml of 0.5g/95% sulfuric acid is 80mPa·s or more. These high-molecular-weight nylon is produced with a well-known polymerization procedure or a solid phase polymerization procedure in which polimerized 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).

[0037] 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, nylon 66/610, and ternary copolymerized nylon such as nylon 6/66/12 and nylon 6/66/610. 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.

[0038] The sheath member is melted by thermal pressurization in the manufacturing process of the press felt, which leads to constriction of the core-in-sheath fiber 41, thereby making the wet paper web contact side batt layer 21 more dense and adding smoothness to the felt surface.

[0039] The wet paper web contact side batt layer 21 with added density is also effective in preventing rewetting, because it blocks water within the base body 30, the base body side batt layer 22 formed on the wet paper web side surface of the base body, and the press side batt layer 23 from moving therein, as the press felt 10 is released from nip pressure.

[0040] In the present invention, only the wet paper web contact side batt layer 21 is composed of the core-in-sheath fiber 41, with the base body side batt layer 22 being made of the normal nylon fiber 42 without the core-in-sheath fiber 41. This composition enabled the press felt to have a balanced combination of smoothness, dehairing and abrasion resistance, resistance to compression fatigue, and dewatering capability. When the base body side batt layer 22 has the core-in-sheath fiber 41, batt layers formed on the wet paper web side surface of the base body are made incompressible as a whole due to melting of the sheath member. Accordingly, such a press felt exhibits improved dehairing and abrasion resistance, but dewatering capability in a press section is degraded.

[0041] The wet paper web contact side batt layer 21 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 resistance. Preferably, the blend consists of 75-25% of the core-in-sheath fiber 41 and 25-75% of the nylon fiber 42.

[0042] When the content rate of the core-in-sheath fiber 41 is less than 25%, the press felt lacks smoothness due to insufficient density of the wet paper web contact side batt layer 21 and is incapable of preventing rewetting effectively.

[0043] On the other hand, when the content rate of the core-in-sheath fiber 41 exceeds 75%, the felt tends to be flattened with the wet paper web contact side batt layer 21 susceptible to compression fatigue, while it has smoothness, abrasion resistance and is effective in prevention of rewetting.

[0044] The wet paper web contact side batt layer 21 can be multi-layered, in which the content rate of the core-in-sheath fiber 41 increases incrementally from the press side toward the paper side thereof to provide more improvements in smoothness and abrasion resistance.

[0045] Figure 2 illustrates an embodiment in which the wet paper web contact side batt layer 21 comprises a first layer 21a and a second layer 21b, the first layer 21a having more core-in-sheath fibers 41 than the second layer 21b.

[0046] Such a structure enables the wet paper web contact side batt layer 21 to achieve a balance between anti-rewetting and dewatering capabilities. More specifically, the first layer 21a with relatively higher content rate of the core-in-sheath fiber 41 has anti-rewetting capability and smoothness due to its density, while a second layer 21b with relatively lower content rate of the core-in-sheath fiber 41 is provided with improved dewatering capability due to its compressibility added in exchange for lowered density, thereby providing the wet paper web contact side batt layer 21 with both of anti-rewetting and dewatering capabilities. Thus, as compared to the embodiment in which the wet paper web contact side batt layer 21 is a single layer, the felt has an advantage in achieving a plurality of effects: enhanced anti-rewetting and dewatering capabilities due to the doubled dense layers in addition to improved smoothness and resistance to dehairing and abrasion.

[0047] On the contrary, when the wet paper web contact side batt layer 21 is formed with incrementally decreasing content rate of the core-in-sheath fiber 41 from the press side toward the paper side, smoothness, dehairing and abrasion resistance, and anti-rewetting property of the felt are degraded, as compared to the embodiment in which the wet paper web contact side batt layer 21 is a single layer.

[0048] Although the wet paper web contact side batt layer 21 is double-layered in Figure 2, it may comprise three or more layers.

[0049] The ratio of the volume of the core and the sheath members of the core-in-sheath fiber 41 has no limitation, but can range from 5:1 to 1:5, with a preferable rate of 1:1.

[0050] The nylon fiber 42 used for the wet paper web contact side batt layer 21, the press side batt layer 23, 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.

[0051] Preferably, the base body 30 is a fabric woven with a warp yarn 31 (CMD yarn) and a weft yarn 32 (MD yarn) which are monofilament single yarns. It can be a double cloth such as [2/1, 1/2], [3/1, 1/3], and [5/1, 1/5], a triple cloth, or multilayered texture such as [a single cloth + a double cloth], [a double cloth + a double cloth] . The monofilament single yarn can be the one with a diameter of 0.1mm-0.6mm and a yarn density of the texture can be 10-100 yarns/25mm.

[0052] However, the base body 30 need not be a woven fabric, and other structures and methods can be employed as appropriate, such as simply overlapping an MD yarn and a CMD yarn, a film, a knitted fabric, or winding a narrow belt-shaped body to make a belt-shaped body of relatively large width. Further, materials to be used for the base body 30 include natural fibers such as wool, and synthetic fibers such as polyester, nylon 6, and nylon 66 which have superior abrasion and fatigue resistance, distensibility, and antifouling property.

[0053] Preferable fineness of the core-in-sheath fiber 41 is 15-25dtex for a pick-up felt used in a first press in a press section of a papermaking machine, 10-20dtex for a felt in a second and third press, and 5-20dtex for a felt in a fourth press and a shoe press.

[0054] Preferred fineness of the nylon fiber 42 is 10-25dtex and 15-25dtex for the paper side batt layer 20 and the press side batt layer 23 of the pick-up felt used in the first press respectively, whereas it is 10-15dtex and 10-20dtex for the corresponding layers of the felt used in the second and third press, and 5-15dtex and 5-20dtex for the corresponding layers of the felt used in the fourth press and the shoe press.

[Examples]

[0055] The press felt of this invention is to be described using following examples. However, the scope of the present invention is not limited to these examples.

Production of the core-in-sheath fiber;

[0056] Refined nylon 6 (caprolactam, melting point: 220 degrees C) and copolymerized nylon 6/12 (caprolactam/laurolactam, melting point: 140 degrees C) are individually put into an extruder with a vent to remove volatiles. Melted nylon 6 of the core member and copolymerized nylon 6/12 of the sheath member are quantified by a metering gear pump and sent to respective spinning nozzles. Core-in-sheath fibers spun out of the spinning nozzles undergoes cooling in a spinning chimney and oiling processes, which are then reeled at a natural draw ratio, stretched, crimped, and cut with a fixed length.

[0057] In the procedure above, a spinning machine of MODEL-EMF made by Toyo Seimitsu Kogyo Co., Ltd. can be employed, which can be used with an extruder, a multistage stretching machine of a Nelson roller system, and winder.

[0058] In the examples, high-molecular-weight nylon 6 (absolute viscosity: 85mPa·s at 25 degrees C, melting point: 220 degrees C) and middle-molecular-weight nylon 6 (absolute viscosity: 70mPa·s at 25 degrees C, melting point: 220 degrees C) are used for the core member and copolymerized nylon 6/12 (melting point: 140 degrees C) is used for the sheath member to produce two kinds of core-in-sheath staple fibers in which a volume ratio of the core and sheath members is 1:1. A fiber with the core member made of high-molecular-weight nylon 6 is hereinafter referred to as a composite fiber A, while the one with the core member made of middle-molecular-weight nylon 6 is referred to as a composite fiber B.

[0059] The absolute viscosity of 85mPa·s and 70mPa·s are 4.5 and 3.0ηr respectively in relative viscosity (ηr) measured by generally-used measuring method (Ubbelohde viscosimeter). For reference, absolute viscosity of 80 mPa·s equals 4.0ηr. Production of the press felt for papermaking;

Examples and comparative examples are all provided with a basic structure as follows so as to make them have conditions in common;

[0060]

Base body:	Woven fabric A [a double cloth of (3/1, 1/3) using plied yarns made by twisting two yarns made of two twined nylon monofilaments of 240dtex for an MD yarn and a CMD yarn], basis weight: 300g/m^2 : Woven fabric B [a double cloth of (3/1, 1/3) using single yarns of 1100dtex nylon monofilament for an MD yarn and a CMD yarn], basis weight: 300g/m^2
Batt layers:	staple fibers of 17dtex nylon 6 and 17dtex composite fibers A or B for the wet paper web contact side batt layer (the first layer, "wet paper web contact fiber layer" in Table 1), total basis weight: 120g/m^2 : staple fibers of 17dtex nylon 6 and 17dtex composite fibers A for the wet paper web contact side batt layer (the second layer), total basis weight: 120g/m^2 : staple fibers of 17dtex nylon 6 and 17dtex composite fibers A for the base body side batt layer, total basis weight: 120g/m^2 : staple fibers of 17dtex nylon 6 for the press side batt layer, total basis weight: 100g/m^2
Needling frequency:	700 times/cm^2
Thermal pressurization:	a needled felt was subjected to compression 5 times between a pair of calendar rolls (heated at 160 degrees C, with a pressure of 30kg/cm) at a speed of 5m/min to have a density of 0.5g/cm^3

[0061] The compositions of Examples 1-8 and Comparative Examples 1-6 are shown in Table 1 and 2 respectively.

(Table 1)

Examples	1	2	3	4	5	6	7	8
Wet paper web contact fiber layer (First layer)	Composite fiber A 60%	Composite fiber A 40%	Composite fiber A 10%	Composite fiber A 60%	Composite fiber A 40%	Composite fiber A 70%	Composite fiber A 70%	Composite fiber A 60%
Wet paper web contact fiber layer (Second layer)	Nylon	Nylon	Nylon	Composite fiber A 40%	Composite fiber A 10%	Nylon	Composite fiber A 40%	Nylon
First batt layer	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon
Base layer	Fabric A	Fabric A	Fabric A	Fabric A	Fabric A	Fabric A	Fabric A	Fabric B
Second batt layer	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon

(Table 2)

Comparative Examples	1	2	3	4	5	6
Wet paper web contact fiber layer (First layer)	Nylon	Nylon	Composite fiber A 5%	Composite fiber A 10%	Composite fiber B 40%	Nylon
Wet paper web contact fiber layer (Second layer)	Nylon	Nylon	Composite fiber A 5 %	Composite fiber A 40%	Nylon	Nylon
First batt layer	Composite fiber A 60%	Nylon	Nylon	Nylon	Nylon	Nylon
Base layer	Fabric A	Fabric A	Fabric A	Fabric A	Fabric A	Fabric B
Second batt layer	Nylon	Nylon	Nylon	Nylon	Nylon	Nylon

[0062] Tests are conducted with fol lowing conditions and methods to evaluate anti-rewetting and dewatering capabilities, resistance to compression fatigue, dehairing and abrasion resistance, and smoothness, using Examples and Comparative Examples listed above.

Evaluation of anti-rewetting and dewatering capabilities;

[0063] Tests to evaluate anti-rewetting and dewatering capabilities are conducted by using apparatuses shown in Figures 3 and 4.

[0064] In Figures 3 and 4, P is a press roll, 110 is an upper side felt, 10 is a downside felt, SC is a suction tube, and SN is a shower nozzle.

[0065] Examples and Comparative Examples of the above are all used as the downside felt 10, whereas Comparative Example 2 is used for the upper side felt.

[0066] The apparatuses shown in Figures 3 and 4 drive the felt at a speed of 800m/min with a pressure of 80kg/cm.

[0067] In the apparatus of Figure 3, a wet paper web released from compression within a nip is placed onto and transferred by the downside felt 10. Accordingly, water content data of a rewetted paper web can be gathered by measuring humidity of the wet paper web when it passes through the nip and is placed onto and transferred by the downside felt 10 (at a press exit 1).

[0068] On the other hand, in the apparatus of Figure 4, the downside felt 10 contacts with the press roll over a larger area, which means the wet paper web released from the nip pressure is in contact with the press felts 10 and 110 only briefly. Therefore, water content data of a slightly rewetted paper web can be gathered by measuring humidity of the wet paper web immediately after it traveled out of the nip (at a press exit 2).

[0069] The degree of rewetting and dewatering capability were determined based on the data gathered using the apparatuses of Figure 3 and 4. In evaluating dewatering capability, a felt with water content in the range of 48%-less than 49% was evaluated as "good", while one with a water content of 49% or more was evaluated as "failure". The degree of rewetting was determined based on the difference of water content data gathered with apparatuses of Figures 3 and 4; a felt with the difference of less than 0.5% was regarded to be not rewetted (evaluated as "good"), whereas one with the difference of 0.5%-less than 1.0% was regarded to be slightly rewetted (evaluated as "fair"), and one with the difference of more than 1.0% was regarded to be rewetted (evaluated as "failure").

Compression fatigue resistance test;

[0070] Felts are subjected to 300,000 times of 5 Hz pulse load at 120 kg/cm^2. Resistance to compression fatigue is evaluated based on a ratio of density after tests to that of a finished felt, where the ratio of less than 1.3 was evaluated as "excellent", 1.30-1.39 as "good", and 1.40 or more as "failure".

Dehairing and abrasion resistance test;

[0071] Dehairing and abrasion resistance of the felts was determined by means of a Taber abrasion tester based on JIS1023-1992. The amount of fibers dropped was measured by placing a discoidal sample piece on a rotating turntable and applying a rotating roll with intense resistance on the sample piece (load: 0.5kg, wheel: CS-17, rotation: 3000 times, unit of measurement: mg).

[0072] The amount of less than 40mg was evaluated as "good" and over 40mg was evaluated as "failure".

Surface roughness test;

[0073] Smoothness of felt surfaces are determined by measuring average roughness Rz (μm) of 10 points of finished felts (JIS-B0601) before the dehairing and abrasion test. The average roughness of less than 60 μm was evaluated as "excellent", with 60μm-99μm evaluated as "good" and 100μm or more evaluated as "failure".

[0074] Results of measurement and evaluation are shown in Table 3.

(Table 3)

	Density of finished felt (g/cm^3)	Compression Fatigue Resistance Test	Abrasion Resistance Test (mg)	Surface Roughness Test (μm)	Dewatering & Anti-rewetting Tests			
					Water Content at Press Exit 1 (%)	Water Content at Press Exit 2 (%)	Dewatering Capability	Anti-Rewetting Capability
Example 1	0.470	1.36 (Good)	20 (Good)	50 (Excellent)	48.6	48.3	Good	Good
Example 2	0.465	1.33 (Good)	35 (Good)	70 (Good)	48.6	48	Good	Fair
Example 3	0.455	1.29 (Excellent)	45(Failure)	100 (Failure)	48.9	47.5	Good	Failure
Example 4	0.475	1.39 (Good)	25 (Good)	50 (Excellent)	48.5	48.5	Good	Good
Example 5	0.475	1.36 (Good)	30 (Good)	65 (Good)	48.4	48	Good	Good
Example 6	0.475	1.39 (Good)	25 (Good)	45 (Excellent)	48.6	48.4	Good	Good
Example 7	0.485	1.39 (Good)	20 (Good)	50 (Excellent)	48.5	48.5	Good	Good
Example 8	0.485	1.38 (Good)	30 (Good)	50 (Excellent)	48.1	47.8	Good	Good
Comparative Example 1	0.465	1.38 (Good)	60(Failure)	120 (Failure)	49	48.3	Failure	Fair
Comparative Example 2	0.450	1.20 (Excellent)	60(Failure)	125 (Failure)	49	47.3	Failure	Failure
Comparative Example 3	0.455	1.26 (Excellent)	55(Failure)	100 (Failure)	49	47.6	Failure	Failure
Comparative Example 4	0.470	1.38 (Good)	45(Failure)	100 (Failure)	48.8	48.2	Good	Fair
Comparative Example 5	0.465	1.43 (Failure)	65(Failure)	80 (Good)	49	48.3	Failure	Fair

(continued)

	Density of finished felt (g/cm^3)	Compression Fatigue Resistance Test	Abrasion Resistance Test (mg)	Surface Roughness Test (μm)	Dewatering & Anti-rewetting Tests			
					Water Content at Press Exit 1 (%)	Water Content at Press Exit 2 (%)	Dewatering Capability	Anti-Rewetting Capability
Comparative Example 6	0.455	1.20 (Excellent	60(Failure)	125 (Failure)	48.4	47	Good	Failure

[0075] As indicated by the test results of Examples 1-8 in Table 3, it is determined that the press felt of this invention not only prevents rewetting but achieves a balanced combination of resistance to compression fatigue, dehairing and abrasion resistance, smoothness, and dewatering capability.

[0076] Although Comparative Examples 1, in which the base body side batt layer is made of the core-in-sheath fiber, is superior in terms of resistance to compression fatigue, dehairing and abrasion, it lacks smoothness of the surface.

[0077] Example 3 and Comparative Example 3 with less than 25% of the core-in-sheath fiber in the wet paper web contact side batt layer and Comparative Example 2 without such fibers, on the other hand, have resistance to compression fatigue but not anti-rewetting property.

[0078] Further, Comparative Example 4, in which the content rate of the core-in-sheath fiber decreases incrementally from the press side toward the paper side of the wet paper web contact side batt layer, is inferior in smoothness, while it exhibits resistance to compression fatigue and anti-rewetting capability. The explanation may be that the first layer of the wet paper web contact side batt layer with less core-in-sheath fibers makes the surface of the felt.

[0079] Furthermore, Comparative Example 5, in which middle-molecular-weight nylon is used for the core member of the core-in-sheath fiber, is inferior to Example 1 with high-molecular-weight nylon in terms of resistance to compression fatigue, dehairing and abrasion.

[0080] And finally, Example 8, in which the fabric B woven with monofilament single yarns is used for the base layer, is superior to Example 1, in which the base body is the fabric A woven with monofilament twist yarns, in terms of dewatering capability as indicated by low water content rate at both the press exits 1 and 2.

INDUSTRIAL APPLICABILITY

[0081] According to the present invention, the wet paper web contact side batt layer works as a barrier to prevent rewetting. The invention successfully enhances resistance to dehairing, abrasion, and compression fatigue of the press felt by enhancing viscosity of the core member of the core-in-sheath fiber, i.e. by using high-molecular-weight nylon. As a result, the press felt of this invention 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 dehairing and abrasion, and is capable of maintaining smoothness of the paper contact surface thereof.

[0082] Further, since the wet paper web contact side batt layer is made of the core-in-sheath fiber while the base body side batt layer formed on the wet paper web side surface of the base body is made of nylon without the core-in-sheath fiber, the press felt of this invention is provided with a balanced combination of smoothness, resistance to dehairing, abrasion, and compression fatigue, and dewatering capability. Furthermore, the present invention provides a press felt with improved dewatering capability by using a fabric woven with monofilament single yarns for the base layer and thus enhancing water permeability thereof.

Claims

1. A press felt for papermaking comprising a base body and a batt layer having a wet paper web side layer and a press side layer;
   characterized in that said wet paper web side layer is composed of a wet paper web contact side batt layer and a base body side batt layer;
   said wet paper web contact side batt layer having a core-in-sheath fiber comprising a core member made of high-molecular-weight nylon with an absolute viscosity of 80mPa·s or more and a sheath member made of nylon with a lower melting point than the core member; and
   said base body side batt layer being made of nylon without said core-in-sheath fiber.

2. A press felt as claimed in Claim 1, in which a content rate of said core-in-sheath fiber in said wet paper web contact side batt layer ranges from 25% to 75%.

3. A press felt as claimed in Claim 1 or Claim 2, in which said wet paper web contact side batt layer has a plurality of layers in which the content rate of said core-in-sheath fiber increases incrementally from the press side toward the paper side thereof.

4. A press felt as claimed in Claim 1 to Claim 3, in which said base body is a woven fabric made of a warp yarn and a weft yarn which are monofilament single yarns.

Fig. 1

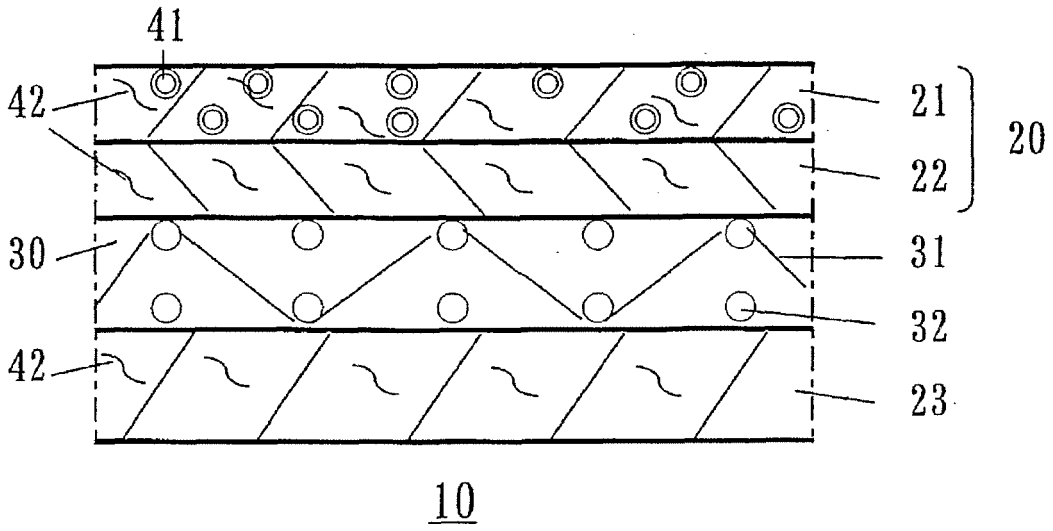


Fig. 2

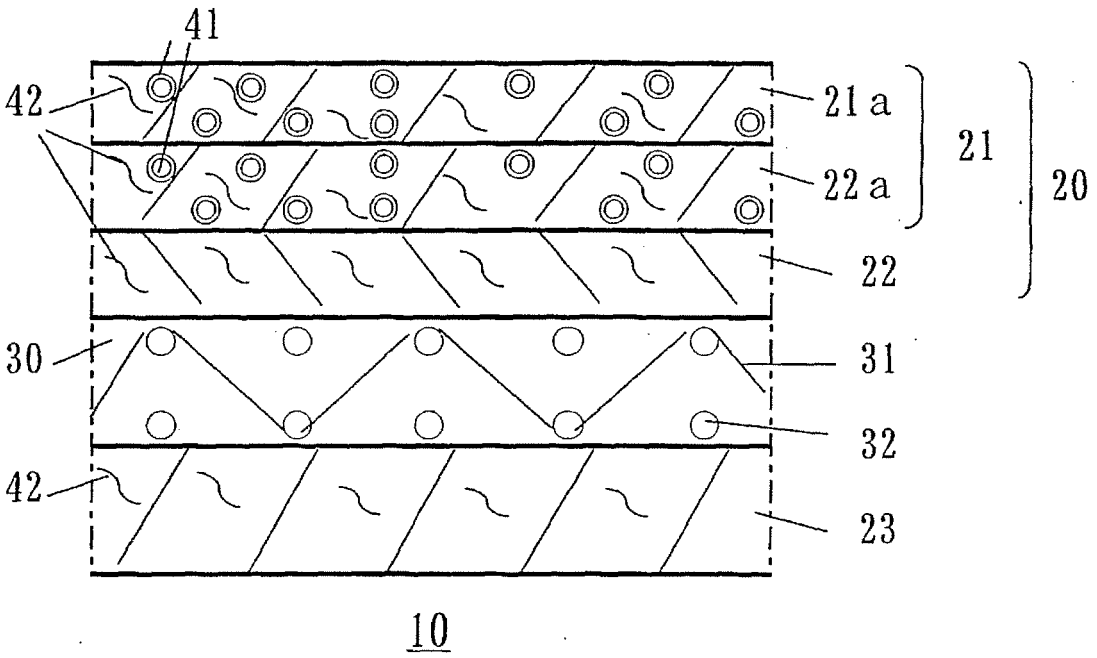
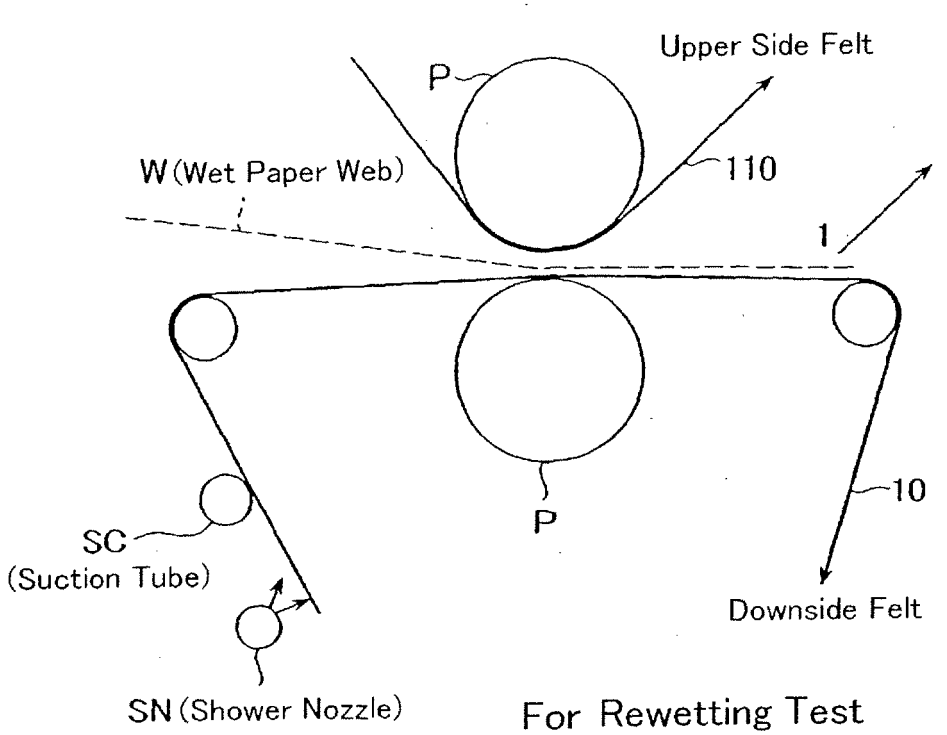
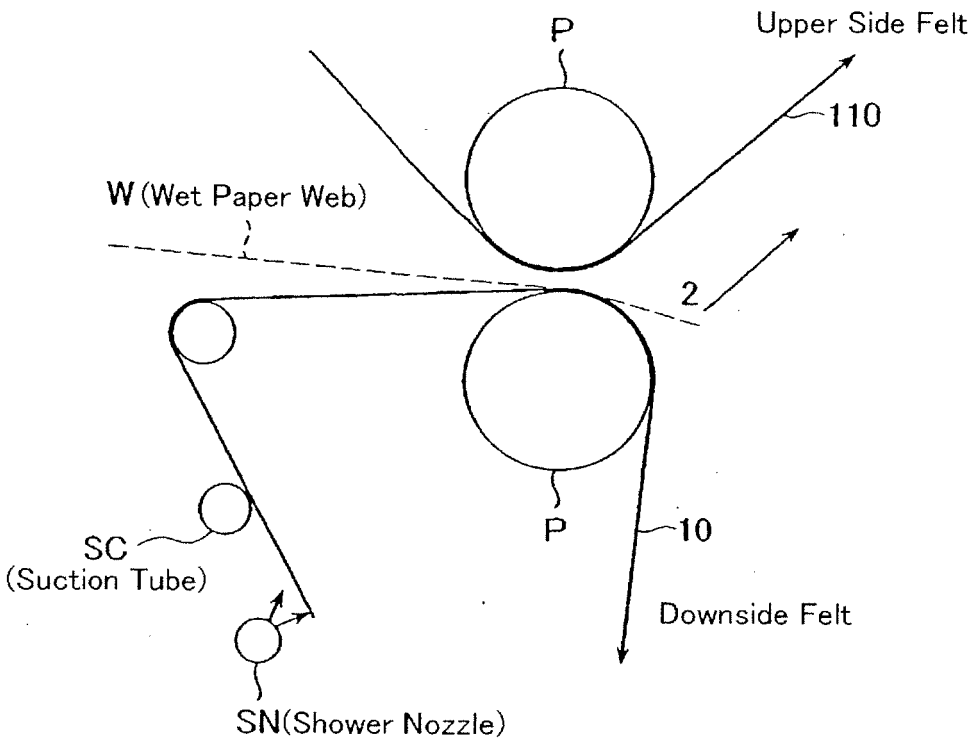


Fig.3



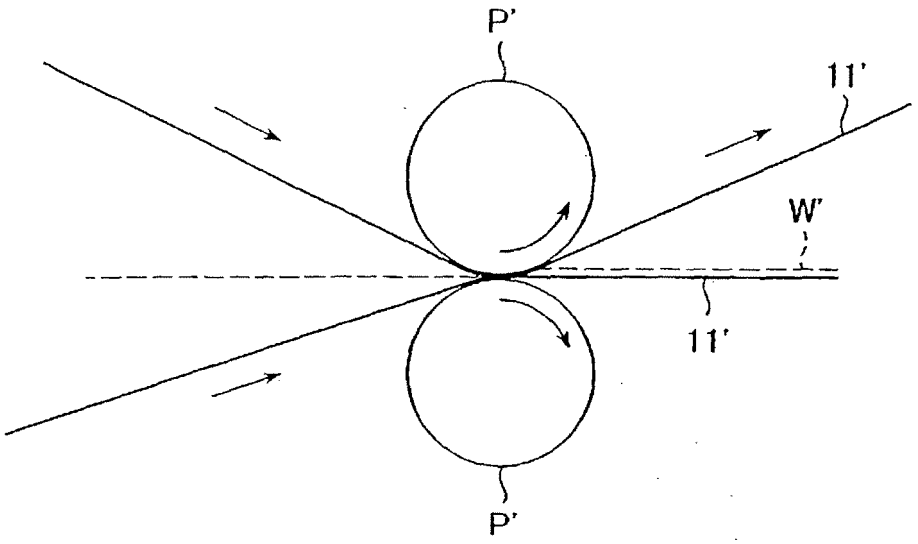
For Rewetting Test
(to gather water content data at press exit 1)

Fig. 4



For Rewetting Test
(to gather water content
data at press exit 2)

Fig.5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/052067

A. CLASSIFICATION OF SUBJECT MATTER
D21F7/08(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D21F7/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-268794 A (Ichikawa Keori Kabushiki Kaisha), 17 October, 1995 (17.10.95), Claims; Par. No. [0010] (Family: none)	1-4
A	JP 11-200274 A (Ichikawa Keori Kabushiki Kaisha), 27 July, 1999 (27.07.99), Claims; Par. Nos. [0008], [0011] (Family: none)	1-4
A	JP 8-302584 A (Huyck Licensco, Inc.), 19 November, 1996 (19.11.96), Par. Nos. [0028], [0029], [0032] & US 5549967 A & EP 741204 A2	1-4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 April, 2007 (04.04.07)	17 April, 2007 (17.04.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/052067

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3-104995 A (Daiwabo Co., Ltd.), 01 May, 1991 (01.05.91), Claims; page 2, lower right column, lines 12 to 15 (Family: none)	1-4
A	JP 7-082685 A (Nippon Felt Co., Ltd.), 28 March, 1995 (28.03.95), Claims; Par. No. [0005] (Family: none)	1-4
A	JP 2006-009188 A (ICHIKAWA Co., Ltd.), 12 January, 2006 (12.01.06), Claims & WO 2006/001191 A1	1
A	JP 8-506629 A (E.I. Du Pont De Nemours & Co.), 16 July, 1996 (16.07.96), Claims; page 5, lines 26 to 29 & US 5236652 A & EP 683828 A	1
A	JP 2000-170087 A (Ichikawa Keori Kabushiki Kaisha), 20 June, 2000 (20.06.00), Par. Nos. [0005], [0006] (Family: none)	4

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2004143627 A **[0006]**
- JP 8302584 A **[0008]**
- JP 2000170086 A **[0010]**
- JP 2002529604 A **[0036]**