(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 476 989 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
**01.05.2019 Bulletin 2019/18**

(21) Application number: **16915639.5**

(22) Date of filing: **06.09.2016**

(51) Int Cl.:
***D03D 11/00*** *(2006.01)* ***D21F 1/10*** *(2006.01)*

(86) International application number:
**PCT/JP2016/076093**

(87) International publication number:
**WO 2018/047219 (15.03.2018 Gazette 2018/11)**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**MA MD**

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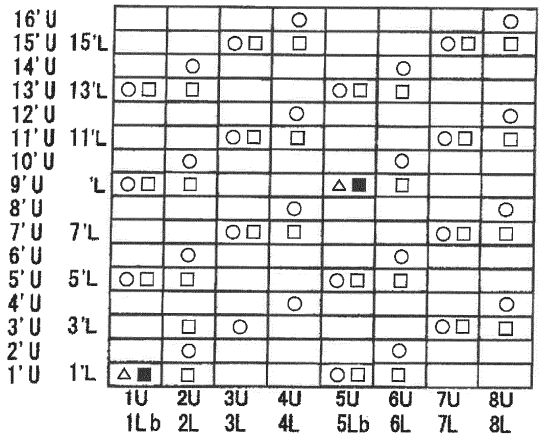
# (54) INDUSTRIAL TWO-LAYER WOVEN FABRIC

(57) [Problem] To provide, in a woven fabric in which the yarn diameters of upper and lower warps are different, an industrial two-layer woven fabric having improved wear resistance, surface smoothness and marking characteristics, and having a long life by adjusting the balance between warps and wefts. [Solution] This industrial two-layer woven fabric is an industrial woven fabric in which an upper-surface-side woven fabric made of upper-surface-side warps and upper-surface-side wefts and a lower-surface-side woven fabric made of lower-surface-side warps and lower-surface-side wefts are joined by a joining yarn, wherein: a portion of the lower-surface-side warps is a lower-surface-side warp joining yarn that functions as the joining yarn for joining the upper-surface-side woven fabric and the lower-surface-side woven fabric by being woven with the upper-surface-side wefts; the yarn diameter of the lower-surface-side warp joining yarn and the yarn diameters of the respective upper-surface-side warps are all the same; and the yarn diameters of the respective lower-surface-side warps that do not function as the joining yarn are all the same and are greater than the yarn diameter of the upper-surface-side warps and the lower-surface-side warp joining yarn.

Fig. 1

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## Description

### TECHNICAL FIELD OF THE INVENTION

**[0001]** The present invention relates to an industrial two-layered fabric with a long durability which exhibits an excellent surface smoothness and an excellent marking characteristics, while at the same time improving wear resistance characteristics to balance warps and wefts. In particular, the present invention relates to an industrial two-layered fabric which is capable of attaining the binding in the vertical direction which prevents the surface smoothness from being worsened by the fabric with the diameter of the upper warps and the diameter of the lower warps being different from each other.

### BACKGOUND ART

**[0002]** Fabrics obtained by weaving warps and wefts have conventionally been used widely as an industrial two-layered fabric. They are, for example, used in various fields including papermaking fabrics, conveyor belts and filter cloths and are required to have fabric properties suited for the intended use or using environments. Of such fabrics, a papermaking fabric used in a papermaking step for removing water from raw materials by making use of the network of the fabric must satisfy a severe demand.

**[0003]** For example, there is a demand for the development of fabrics which do not transfer a wire mark of the fabric and therefore have excellent surface property, the ones which have enough hydration property for sufficiently and uniformly hydrating excess water contained in the material and enough rigidity or wear resistance to be usable desirably even under severe environments, or the ones which are capable of maintaining conditions necessary for making good paper for a prolonged period of time.

**[0004]** In addition, fiber supporting property, improvement in a paper making yield, dimensional stability and running stability are demanded.

**[0005]** In recent years, owing to the speed-up of a paper making machine, requirements for papermaking fabrics become severe further.

**[0006]** Since most of the demands for industrial fabrics and solutions thereof can be understood if papermaking fabrics on which the most severe demand is imposed among industrial fabrics is described, the papermaking fabric will hereinafter be described as a representative example.

**[0007]** Recently, particularly excellent hydration property and surface smoothness have been required due to the high speed operation of a machine for fabric. Although the required hydration property varies in accordance with the machine and the product papers, the uniform hydration property and the fiber supportability are commonly required for all the product papers. In addition, the fiber supportability is considered to be crucial, since old papers in which much fine fibers are contained has been increasingly used in recent years, and the fabric with an excellent hydration property has become required, since the hydration property is decreased upon the formation of the sheet with much fine fibers contained therein.

**[0008]** Further, in the fabric for producing papers, a hydration operation in a centrifugal or a pressing manner is generally conducted by utilizing a network of the fabric, however, water is sucked to be hydrated from an underside of the network in order to obtain a sufficient hydration property, so that the required properties such as the fiber supportability, the hydration property influences much on the operation or the cost for producing papers.

**[0009]** In this connection, it is publicly known that the diameters of the upper surface side warps and the upper surface side wefts may be preferably reduced, while at the same time, the number of the yarns may be preferably increased in order to improve the surface smoothness of such an industrial two-layered fabric. On the other hand, it is publicly known that the diameters of the lower surface side wefts arranged to be the running side which contacts the machine may be preferably increased in order to improve the wear resistance.

**[0010]** Here, the industrial fabric in which the diameter of each of two kinds of yarns, that is, the lower surface side warps and the lower surface wefts constituting the lower surface side fabric is set to be larger than the diameter of each of the upper surface side warps and the upper surface wefts opposed to the lower surface side warps and the lower surface wefts has been developed (refer to Patent Publication 1). A technical problem of the wear resistance is considered to be solved to restrain the generation of the extension or the curl by using such an industrial fabric.

**[0011]** However, the industrial fabric disclosed in the Patent Publication 1 is the one in which the upper surface side fabric layer and the lower surface side fabric layer are bound by the wefts. Accordingly, a technical problem which arises in a case where the industrial two-layered fabric is bound by the warps is not taken into account. If the diameters of yarns only constituting the lower surface side fabric are made large and the industrial fabric is bound by the warps in the industrial fabric disclosed in the Patent Publication 1, the warps with small diameters and the warps with large diameters being woven with the upper surface side wefts from the lower surface side are mixed on the surface of the fabric. Therefore, since undulation due to the warps is caused to generated on the upper surface side fabric, the surface smoothness is deteriorated.

**[0012]** In addition, there is a risk in which the warps serving as binding yarns which are woven with the lower surface side wefts with large diameters can be cut with time. The tensions of the warps are high, as compared with the wefts, so that another technical problem in which the durability of the fabric can be worsened, since the cutting problem of the warps leads to the destruction of the fabric.

**[0013]** Such being the case, the present invention was made in order to solve the technical problem of the conventional technology such as the worsening of the surface smoothness, the deterioration of the durability of the fabric under the fabric with the diameter of the yarns on the lower surface side fabric being set to be larger than the diameter of the yarns on the upper surface side fabric.

**[0014]** Patent Publication 1: International Publication WO2014/202277

## DISCLOSURE OF THE INVENTION

### TECHNICAL PROBLEMS TO BE SOLVED BY PRESENT INVENTION

**[0015]** The object of the present invention is to provide an industrial two-layered fabric with a long durability which exhibits an excellent surface smoothness and excellent marking characteristics, while at the same time improving wear resistance characteristics to balance warps and wefts.

**[0016]** The object of the present invention is to provide an industrial two-layered fabric which is capable of preventing the surface property from being worsened by the fabric with the diameter of the upper warps and the diameter of the lower warps being different from each other, despite the fact that the upper surface side fabric and the lower surface side fabric are bound by using the binding yarns of the warps.

### MEANS TO SOLVE TECHNICAL PROBLEMS

**[0017]** The industrial fabric of the present invention includes following technical features in order to solve the above technical problems.

(1)The industrial two-layered fabric formed by binding at least one upper surface side fabric constituted by upper surface side warps and upper surface side wefts and at least one lower surface side fabric constituted by lower surface side warps and lower surface side wefts, by binding yarns, a portion of said lower surface side warps is woven with said upper surface side wefts to constitute binding yarns of the lower surface side warps serving as the binding yarn binding said at least one upper surface side fabric and said at least one lower surface side fabric, diameters of said binding yarns of the lower surface side warps are set to be the same as diameters of said upper surface side warps, and diameters of all of the lower surface side warps not serving as the binding yarns are set to be the same and larger than diameters of said upper surface side warps and said binding yarns of the lower surface side warps.

**[0018]** Here, by setting the diameters of the lower surface side warps to be larger than the diameters of the upper surface side warps, the balance between the warps and the wefts can be improved, as compared with the lower surface side warps with small diameters. In particular, in a case where the diameters of the lower surface side warps are set to be larger than the diameters of the upper surface side warps in order to improve the wear resistance, the balance of the two-layered fabric can be improved. In addition, the cutting of the warps due to the wear can be reduced by setting the diameter of the lower surface side warps to be large, so that the two-layered fabric with an excellent durability can be provided.

**[0019]** Further, the worsening of the surface smoothness on the upper surface side fabric can be prevented by setting the diameter of a portion of the lower surface side warps serving as the binding yarns to be the same as the diameter of the upper surface side warps. More specifically, in the present invention, since the warps with different diameters on the upper surface side fabric are not mixed by adopting the binding yarns of the lower surface side warps to set the diameters of the binding yarns of the lower surface side warps to be same as the diameters of the upper surface side warps, the worsening of the surface property on the upper surface side fabric can be prevented so that the surface smoothness and the marking characteristics can be improved.

(2) The industrial two-layered fabric formed by binding at least one upper surface side fabric constituted by upper surface side warps and upper surface side wefts and at least one lower surface side fabric constituted by lower surface side warps and lower surface side wefts, by binding yarns, a portion of said lower surface side warps is woven with said upper surface side wefts to constitute binding yarns of the lower surface side warps serving as the binding yarn binding said at least one upper surface side fabric and said at least one lower surface side fabric, a portion of said upper surface side warps is woven with said lower surface side wefts to constitute binding yarns of

the upper surface side warps serving as the binding yarn binding said at least one upper surface side fabric and said at least one lower surface side fabric, diameters of all of said binding yarns of the lower surface side warps, said upper surface side warps and said binding yarns of the upper surface side warps are set to be the same, and diameters of all of the lower surface side warps not serving as the binding yarns are set to be the same and larger than diameters of said upper surface side warps, said binding yarns of the upper surface side warps and said binding yarns of the lower surface side warps.

The technical feature of the industrial two-layered fabric of the present invention (2) lies in the fact that a portion of the upper surface side warps and a portion of the lower surface side warps are made to serve as the biding yarns, in other words, the binding yarns of the upper and lower warps are adopted. In addition, in the present invention, the warps with different diameters are not mixed on the upper surface side fabric by setting the diameters of three kinds of yarns, or the binding yarns of the upper surface side warps, the binding yarns of the lower surface side warps and the upper surface side warps to be same, so that the worsening of the surface property can be prevented to improve the surface smoothness and the marking characteristics.

(3) The industrial two-layer layered fabric according to (1), wherein the difference of the diameters among said upper surface side warps, said binding yarns of the lower surface side warps and said lower surface side warps are set be within a range of the following equation.

$$\text{the diameter of lower surface side warp}(\varphi) \,/\, \text{the diameter of upper surface side warp or binding yarn of the lower surface side warp}(\varphi) = 1 < \varphi <= 2$$

Here, in a case where the diameter of lower surface side warp(φ) / the diameter of upper surface side warp or binding yarn of the lower surface side warp(φ) is smaller than, or equal to 1, the wear resistance cannot be improved, as compared the conventional fabric. In a case where the diameter of lower surface side warp(φ) / the diameter of upper surface side warp or binding yarn of the lower surface side warp(φ) is larger than 2, since the density of the warps on the upper surface side warps becomes too small, the surface property on the upper surface side fabric can be worsened.

In view of the above, it is more preferable that the diameter of lower surface side warp(φ) / the diameter of upper surface side warp and binding yarn of the lower surface side warp(φ) be between 1.2 and 1.5.

(4) The industrial two-layer layered fabric according to (2), wherein the difference of the diameters among said upper surface side warps, said binding yarns of the upper surface side warps, said binding yarns of the lower surface side warps and said lower surface side warps are set be within a range of the following equation.

$$\text{the diameter of lower surface side warp}(\varphi) \,/\, \text{the diameter of upper surface side warp or binding yarn of the upper surface side warp and binding yarn of the lower surface side warp } (\varphi) = 1 < \varphi <= 2$$

Here, in a case where the diameter of lower surface side warp(φ) / the diameter of upper surface side warp, binding yarn of the upper surface side warp and binding yarn of the lower surface side warp (φ) is smaller than or equal to 1, or exceeds 2, the technical trouble can arise due to the same reason the same as the above (3).

In view of the above, it is more preferable that the diameter of lower surface side warp(cp) / the diameter of upper surface side warp, binding yarn of the upper surface side warp and binding yarn of the lower surface side warp (φ) be between 1.2 and 1.5.

(5) The industrial two-layer layered fabric according to any of (1) to (4), wherein the difference of the diameters of said lower surface side warps not serving as the binding yarns and said lower surface side wefts are set to be within a range of the following equation.

the diameter of lower surface side warp not serving as the binding yarn(cp) / the diameter of lower surface side weft(φ)=1<φ< =2.5

**[0020]** Here, in a case where the diameter of lower surface side warp not serving as the binding yarn(cp) / the diameter of lower surface side weft(cp) exceeds 2.5, the balance of the lower surface side fabric can be worsened due to the fact that the diameter of the lower surface side warp becomes too large as compared to the diameter of the lower surface side weft, so that it is speculated that the property of the entire two-layered fabric is deteriorated.

**[0021]** In view of the above, it is more preferable that the diameter of lower surface side warp not serving as the binding

yarn(φ) / the diameter of lower surface side weft(cp) be between 1.2 and 2.3.

## EFFECT OF THE INVENTION

**[0022]** According to the industrial fabric of the present invention, by adopting an industrial two-layered fabric with a long durability, an excellent surface smoothness and an excellent marking characteristics can be improved, while at the same time wear resistance characteristics can be improved.

**[0023]** According to the industrial fabric of the present invention, by adopting an industrial two-layered fabric, the worsening of the surface property can be prevented by the fabric with the diameter of the upper warps and the diameter of the lower warps being different from each other, despite the fact that the upper surface side fabric and the lower surface side fabric are bound by using the binding yarns of the warps.

## BRIEF EXPLANATION OF DRAWINGS

**[0024]**

Fig.1 is a design view of the industrial two-layered fabric according to the first embodiment of the present invention.
Fig.2 is a longitudinal cross section view showing a structure of the yarns with respect to the industrial fabric according to the first embodiment of the present invention.
Fig.3 is a design view of the industrial two-layered fabric according to the second embodiment of the present invention.
Fig.4 is a longitudinal cross section view showing a structure of the yarns with respect to the industrial fabric according to the second embodiment of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0025]** Now, the structure and the effect of the fabric of the present invention will be described below. Since the following embodiment is a mere example of the present invention, any embodiment which is not explicitly described below can be within the scope of the present invention.

**[0026]** The industrial two-layered fabric of this embodiment is constituted by binding the upper surface side fabric including the upper surface side warps and the upper surface side wefts and the lower surface side fabric including the lower surface side warps and the lower surface side wefts by means of the binding yarns.

**[0027]** No particular limitation is imposed on a yarn to be used in the present invention and it can be selected freely depending on the properties which an industrial fabric is desired to have. Examples of it include, in addition to monofilaments, multifilaments, spun yarns, finished yarns subjected to crimping or bulking such as so-called textured yarn, bulky yarn and stretch yarn, and yarns obtained by intertwining them. As the cross-section of the yarn, not only circular form but also square or short form such as stellar form, or elliptical or hollow form can be used. The material of the yarn can be selected freely and usable examples of it include polyester, polyamide, polyphenylene sulfide, polyvinylidene fluoride, polypropylene, aramid, polyether ketone, polyethylene naphthalate, polytetrafluoroethylene, cotton, wool and metal. Of course, yarns obtained using copolymers or incorporating or mixing the above-described material with a substance selected depending on the intended purpose may be used.

**[0028]** The fabric of the present invention includes the biding yarns of the lower surface side warps serving as the binding yarns binding the upper surface side fabric and the lower surface side fabric by a portion of the lower surface side warps being woven with the upper surfaces side wefts.

**[0029]** Here, in the fabric of the present invention, the diameters of all the biding yarns of the lower surface side warps are set to be the diameters of the upper surface side warps. In addition, the diameters of the lower surface side warps not serving as the binding yarns are set to be same.

**[0030]** Further, the diameters of the lower surface side warps not serving as the binding yarns are set to be the diameters of the upper surface side warps and the binding yarns of the lower surface side warps.

**[0031]** In a case where the diameters of the lower surface side wefts are set to be larger than the diameters of the upper surface side wefts, the balance of the two-layered fabric can be improved. In addition, the cutting of the warps due to their wear can be alleviated by setting the diameters of the lower surface side warps to be large, so that the two-layered fabric with a long durability can be provided.

**[0032]** Further, the worsening of the surface property can be prevented by adopting the binding yarns of the lower surface side warps serving as the binding yarns and setting the diameters of the binding yarns of the lower surface side warps and the diameters of the upper surface side warps to be same. In particular, in the present invention, the upper surface side fabric with different diameters are not mixed by adopting a portion of the lower surface side warps as the binding yarns, setting the diameters of all the upper surface side warps to be same, and setting the diameters of all the lower surface side warps not serving as the binding yarns to be same, so that the worsening of the surface property can

be prevented, whereby the surface smoothness and the marking characteristics can be improved.

**[0033]** Now, the embodiments of the present invention will be described below with reference to the drawings. Fig.2 is a design view of the industrial fabric according to the first embodiment of the present invention. Fig.1 is a design view of the industrial two-layered fabric according to the first embodiment of the present invention.Fig.2 is a longitudinal cross section view showing a structure of the yarns with respect to the industrial fabric according to the first embodiment of the present invention.Fig.3 is a design view of the industrial two-layered fabric according to the second embodiment of the present invention.Fig.4 is a longitudinal cross section view showing a structure of the yarns with respect to the industrial fabric according to the second embodiment of the present invention.

**[0034]** Here, the design view corresponds to the complete structure of the fabric defining the minimum unit to be repeated of the fabric structure. A structure of the whole fabric is formed by the complete structures woven with each other in the upper and lower directions, and in the left and right directions. In addition, the longitudinal cross sectional view is the one showing a situation in which the warps are woven with each other in the complete structure. In each of the design views, the warp is indicated by a reference number such as 1,2,3 ..... The warp binding yarn weaving the upper and lower wefts is indicated by the reference number to which b is attached. The upper and lower warps are indicated by the reference number to which U and L are attached, respectively. In each of the design views, the warps with the same reference numbers indicate to form a set, so that, in Fig.2, the upper surface side warp U and the lower surface side warp L, the upper surface side warp U and the binding yarn b, and the upper surface side binding yarn Ub and the lower surface side binding yarn Lb form a set, respectively, for instance. In Fig.3, the upper surface side warp U and the lower surface side warp L, the binding yarn of the upper surface side warp Ub, and the binding yarn of the lower surface side warp Lb form a set.

**[0035]** The weft is indicated by a reference number such as 1', 2', 3' ..... There is a case in which the upper surface side wefts and the lower surface side wefts are arranged upper and lower, respectively, and there is another case in which the only upper surface side wefts are arranged upper. The upper surface side weft and the lower surface side weft are indicated by the reference number to which U and L are attached, respectively, such as 1'U, 2'L, etc..

**[0036]** In each of the design views, a symbol "□" indicates that the lower surface side warp (L) or the binding yarn of the lower surface side warp (Lb) is arranged below the lower surface side weft to form a knuckle, and a symbol "○" indicates that the upper surface side warp (U) is arranged above the upper surface side weft to form a knuckle, and a symbol "Δ" indicates that the binding yarn of the lower surface side warp (Lb) is arranged below the lower surface side weft to form a knuckle, and a symbol "■" indicates that the binding yarn of the upper surface side warp (Ub) is arranged below the lower surface side weft to form a single knuckle. More specifically, all the symbols show a position where the upper surface side fabric and the lower surface side fabric area bound with each other.

**[0037]** In the design view, the warps and the wefts on the upper surface side are depicted to be precisely arranged over the warps and the wefts on the upper surface side, because of the clarity of the drawing. In the real fabric, it does not matter if they are arranged to be offset.

First Embodiment

**[0038]** Figs.1 to 2 are a design view and a cross section view showing an industrial two-layered fabric according to the first embodiment, respectively.

**[0039]** As shown in Figs.1 and 2, the industrial two-layered fabric of the first embodiment includes upper surface side warps (1U~8U), lower surface side warps (2L~4L, 6L~8L), and lower surface side warps 1Lb, 5Lb each serving as a binding yarn. In this connection, the diameters of the upper surface side warps (1U~8U) are set to be same as the diameters of the binding yarns of the lower surface side warps 1Lb, 5Lb. In addition, the diameters of all the lower surface side warps (2L~4L, 6L~8L) which do not serve as the binding yarns are set to be same.

**[0040]** Further, the diameters of the lower surface side warps (2L~4L, 6L~8L) which do not serve as the binding yarns are set to be larger than the diameters of the upper surface side warps (1U~8U) and the lower surface side warps 1Lb, 5Lb. By adopting such a structure, the cutting of the warps due to their wear can be alleviated, so that the industrial two-layered fabric with an excellent durability can be provided.

**[0041]** Still further, as shown in Figs.1 and 2, the industrial fabric of the first embodiment includes upper surface side wefts (1'U~16'U), and lower surface side wefts (1'L, 3'L, 5'L, 7'L, 9'L, 11'L, 13'L, 15'L) to form sixteen shafts.

**[0042]** An arranging ratio of the upper surface side wefts (1'U~16'U) to the lower surface side wefts (1'L, 3'L···· ) is two.

**[0043]** In the first embodiment, as shown in Fig.2, the upper surface side warps 1U~8U pass below the three upper surface side wefts and above the one upper surface side weft. In addition, the lower surface side warps 2L, 3L, 4L,6L,7L, 8L pass below the one lower surface side weft and above the one lower surface side weft in an alternate manner. Further, the lower surface side warp 1Lb which serves as the binding yarn passes above the upper surface side weft 1'U toward the lower surface side to pass below the lower surface side weft 5'L, the lower surface side weft 9'L and the lower surface side weft 13'L.

**[0044]** In the industrial two-layered fabric of the first embodiment, by adopting such a structure, as shown in Figs. 1

and 2, the upper surface side fabric with the warps of different diameters are not adapted to be mixed with each other. As a result, the worsening of the surface property can be prevented, so that the surface smoothness and the marking characteristics can be improved.

Second Embodiment

**[0045]** Figs.3 to 4 are a design view and a cross section view showing an industrial two-layered fabric according to the second embodiment, respectively.

**[0046]** As shown in Figs.3 and 4, the industrial two-layered fabric of the second embodiment includes the upper surface side warps 2U~4U,6U~8U, the lower side warps 2L~4L,6L~8L and upper surface side warps 1Ub, 5Ub each serving as a binding yarn. In this connection, the diameters of the upper surface side warps 2U~4U,6U~8U, the upper surface side warps 1Ub, 5Ub each serving as a binding yarn and the binding yarns of the lower surface side warps 1Lb, 5Lb are all set to be same. In addition, the diameters of all the lower surface side warps (2L~4L, 6L~8L) which do not serve as the binding yarns are set to be same.

**[0047]** Further, the diameters of the lower surface side warps (2L~4L, 6L~8L) which do not serve as the binding yarns are set to be larger than the diameters of the upper surface side warps (2U~4U, 6U~8U), the upper surface side warps 1Ub, 5Ub, and the lower surface side warps 1Lb, 5Lb. By adopting such a structure, the cutting of the warps due to their wear can be alleviated, so that the industrial two-layered fabric with an excellent durability can be provided.

**[0048]** Still further, as shown in Figs.3 and 4, the industrial fabric of the second embodiment includes upper surface side wefts (1'U~16'U), and lower surface side wefts (1'L, 3'L, 5'L, 7'L, 9'L, 11'L, 13'L, 15'L) to form sixteen shafts.

**[0049]** An arranging ratio of the upper surface side wefts (1'U~16'U) to the lower surface side wefts (1'L, 3'L····) is two.

**[0050]** In the second embodiment, as shown in Fig.4, the upper surface side warps 2U,3U,4U,6U, 7U,8U pass below the three upper surface side wefts and above the one upper surface side weft. In addition, the lower surface side warps 2L, 3L, 4L,6L,7L, 8L pass below the one lower surface side weft and above the one lower surface side weft in an alternate manner. Further, the lower surface side warp 1Lb which serves as the binding yarn passes above the upper surface side weft 1'U toward the lower surface side to pass below the lower surface side weft 5'L, the lower surface side weft 9'L and the lower surface side weft 13'L. Still further, the upper surface side warp 1Ub which serves as the binding yarn passes below the lower surface side weft 1'L toward the upper surface side to pass above the upper surface side weft 5'U, the upper surface side weft 9'U and the upper surface side weft 13'U.

**[0051]** In the industrial two-layered fabric of the second embodiment, by adopting such a structure, as shown in Figs.3 and 2, the upper surface side fabric with the warps of different diameters are not adapted to be mixed with each other. As a result, the worsening of the surface property can be prevented, so that the surface smoothness and the marking characteristics can be improved.

**[0052]**

1Ub, 5Ub binding yarn of upper surface side warp serving as binding yarn
1Lb, 5Lb binding yarn of lower surface side warp serving as binding yarn
1U~8U upper surface side warp
2L~4L, 6L~8L lower surface side warp
1'U~16'U upper surface side weft
1'L, 3'L, 5'L, 7'L ,9'L, 11'L, 13'L, 15'L lower surface side weft

## Claims

1. The industrial two-layered fabric formed by binding at least one upper surface side fabric constituted by upper surface side warps and upper surface side wefts and at least one lower surface side fabric constituted by lower surface side warps and lower surface side wefts, by binding yarns, a portion of said lower surface side warps is woven with said upper surface side wefts to constitute binding yarns of the lower surface side warps serving as the binding yarn binding said at least one upper surface side fabric and said at least one lower surface side fabric, diameters of said binding yarns of the lower surface side warps are set to be the same as diameters of said upper surface side warps, and diameters of all of the lower surface side warps not serving as the binding yarns are set to be the same and larger than diameters of said upper surface side warps and said binding yarns of the lower surface side warps.

2. The industrial two-layered fabric formed by binding at least one upper surface side fabric constituted by upper surface side warps and upper surface side wefts and at least one lower surface side fabric constituted by lower surface side warps and lower surface side wefts, by binding yarns, a portion of said lower surface side warps is woven with said upper surface side wefts to constitute binding yarns of the lower surface side warps serving as the binding yarn

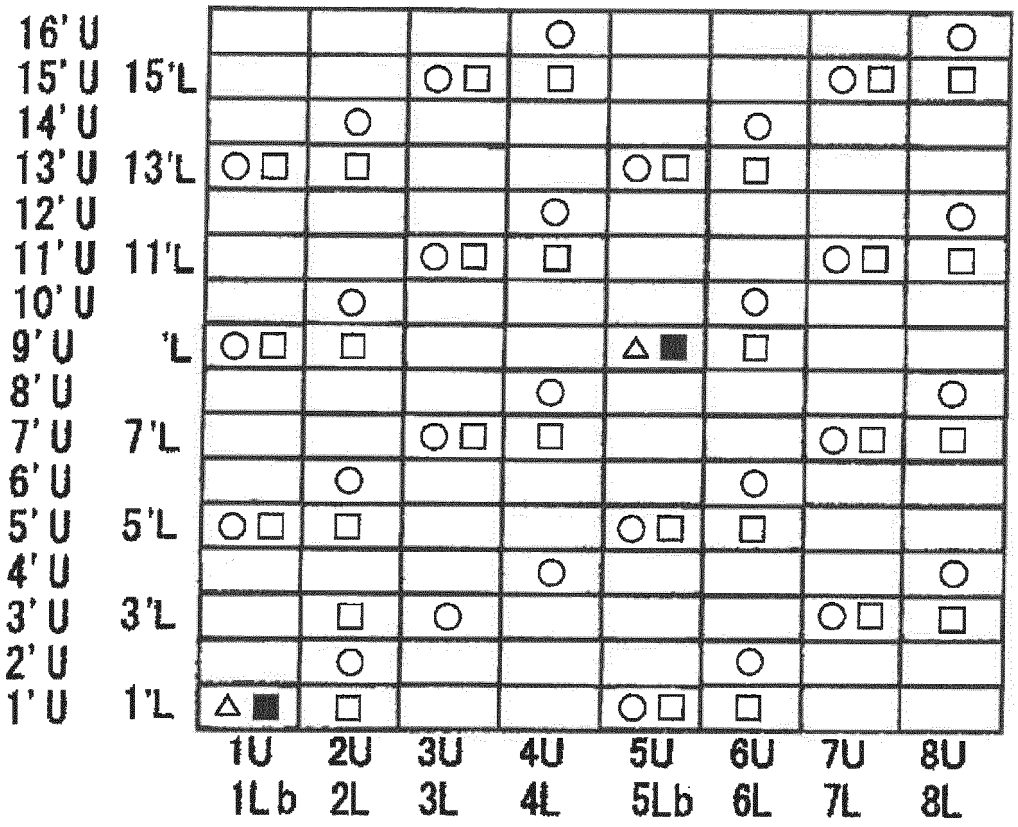
binding said at least one upper surface side fabric and said at least one lower surface side fabric, a portion of said upper surface side warps is woven with said lower surface side wefts to constitute binding yarns of the upper surface side warps serving as the binding yarn binding said at least one upper surface side fabric and said at least one lower surface side fabric, diameters of all of said binding yarns of the lower surface side warps, said upper surface side warps and said binding yarns of the upper surface side warps are set to be the same, and diameters of all of the lower surface side warps not serving as the binding yarns are set to be the same and larger than diameters of said upper surface side warps, said binding yarns of the upper surface side warps and said binding yarns of the lower surface side warps.

3. The industrial two-layer layered fabric according to claim 1, wherein the difference of the diameters among said upper surface side warps, said binding yarns of the lower surface side warps and said lower surface side warps are set be within a range of the following equation.
the diameter of lower surface side warp($\varphi$) / the diameter of upper surface side warp or binding yarn of the lower surface side warp($\varphi$)=1<$\varphi$< =2

4. The industrial two-layer layered fabric according to claim 2, wherein the difference of the diameters among said upper surface side warps, said binding yarns of the upper surface side warps, said binding yarns of the lower surface side warps and said lower surface side warps are set be within a range of the following equation.
the diameter of lower surface side warp(cp) / the diameter of upper surface side warp or binding yarn of the upper surface side warp and binding yarn of the lower surface side warp ($\varphi$)=1<$\varphi$< =2

5. The industrial two-layer layered fabric according to any of claims 1 to 4, wherein the difference of the diameters of said lower surface side warps not serving as the binding yarns and said lower surface side wefts are set to be within a range of the following equation.
the diameter of lower surface side warp not serving as the binding yarn(cp) / the diameter of lower surface side weft($\varphi$)=1<$\varphi$< =2.5

Fig. 1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14'U
13'U 13'L
12'U
11'U 11'L
10'U
9'U 'L
8'U
7'U 7'L
6'U
5'U 5'L
4'U
3'U 3'L
2'U
1'U 1'L
1U 2U 3U 4U 5U 6U 7U 8U
1Lb 2L 3L 4L 5Lb 6L 7L 8L

Fig. 2

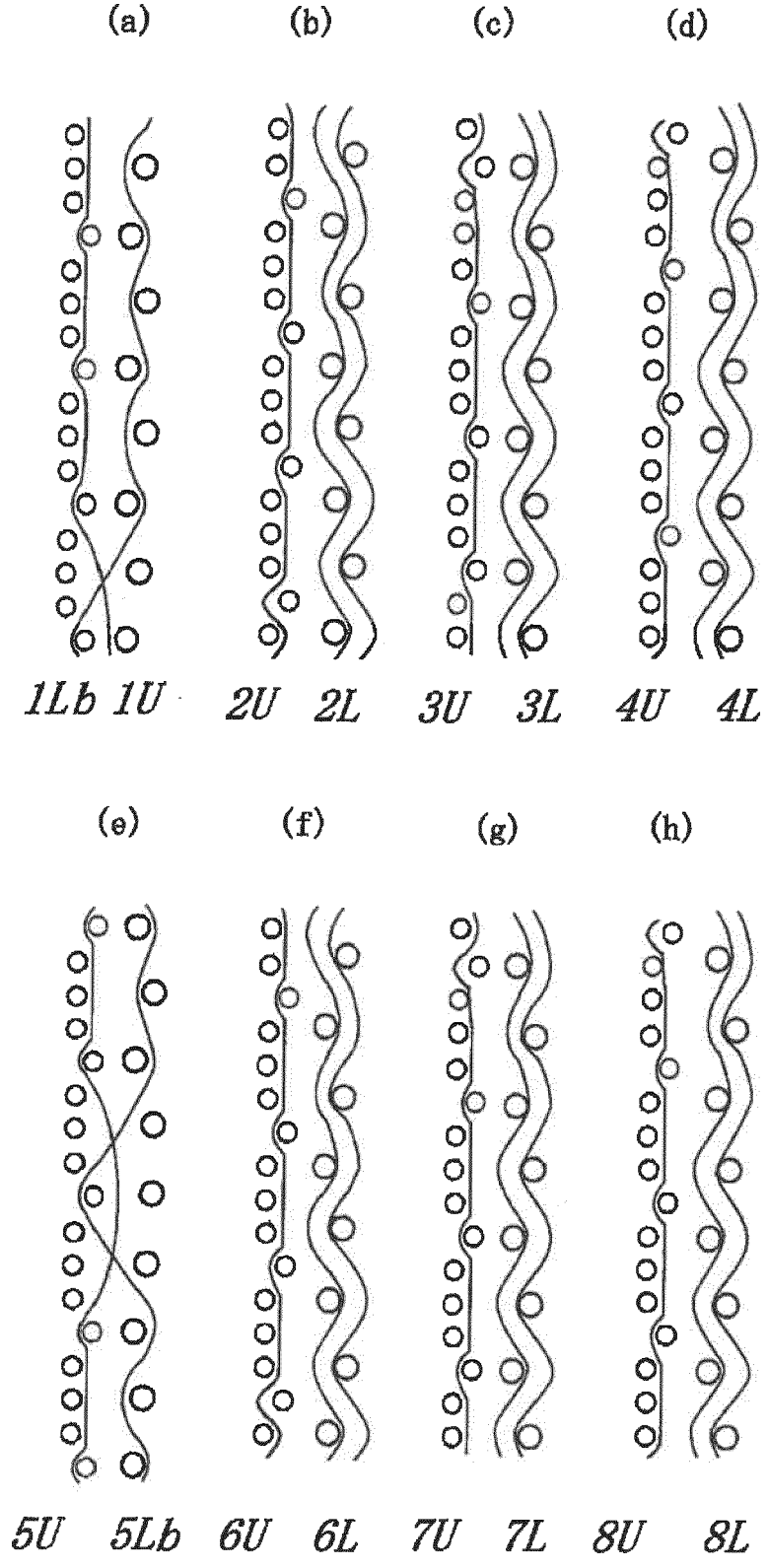


Fig. 3

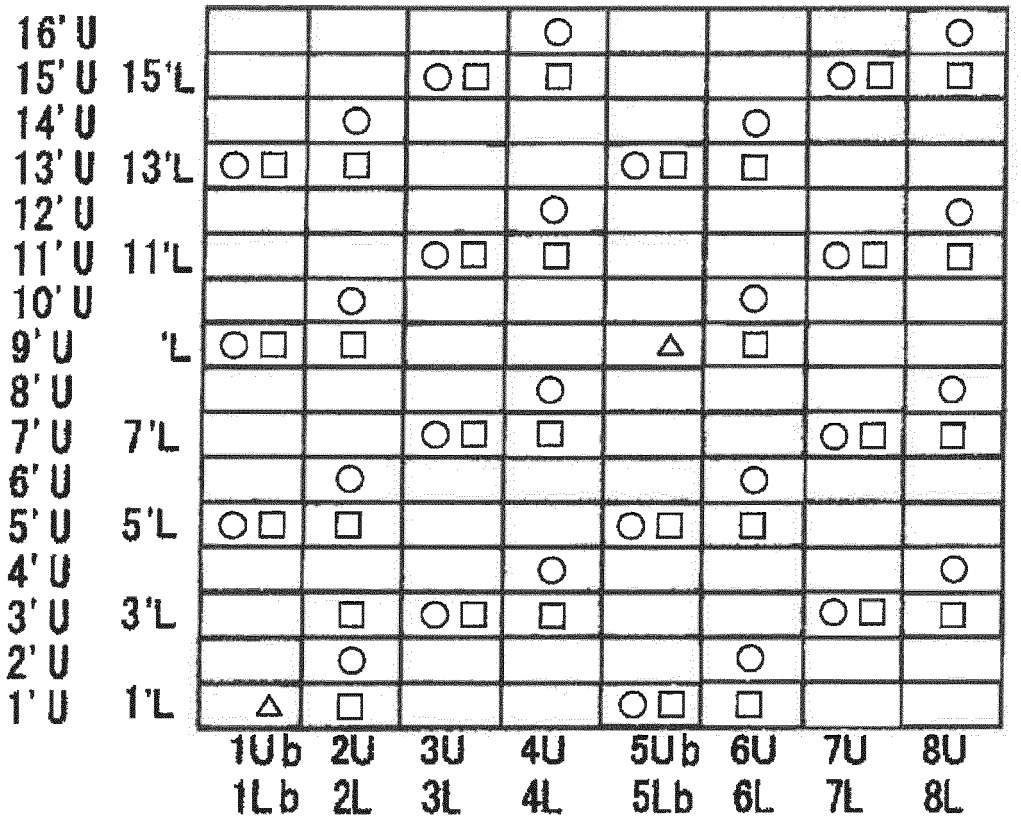
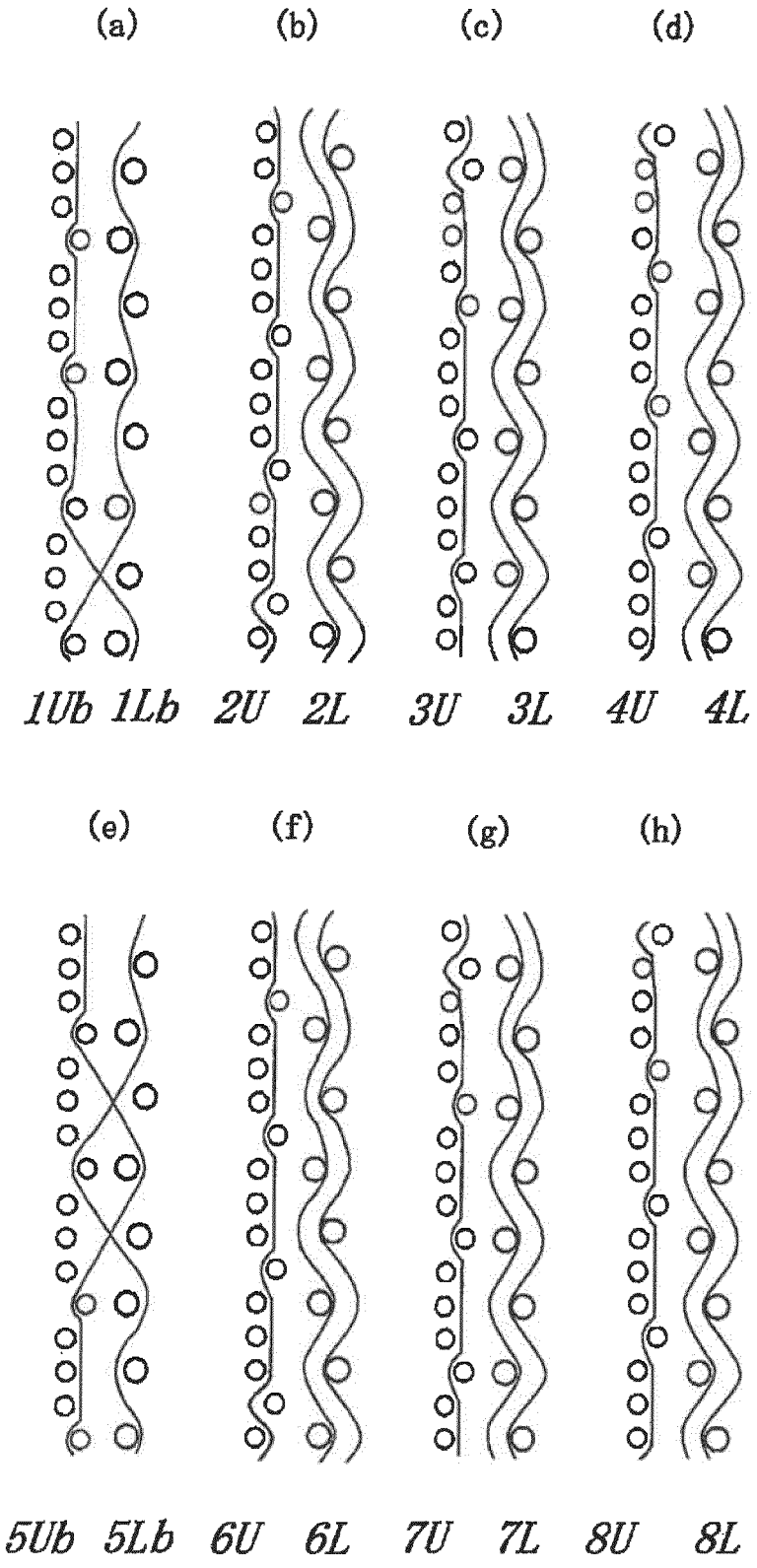

16'U
15'U 15'L
14'U
13'U 13'L
12'U
11'U 11'L
10'U
9'U 'L
8'U
7'U 7'L
6'U
5'U 5'L
4'U
3'U 3'L
2'U
1'U 1'L
1Ub 2U 3U 4U 5Ub 6U 7U 8U
1Lb 2L 3L 4L 5Lb 6L 7L 8L

Fig. 4



## INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/076093

A. CLASSIFICATION OF SUBJECT MATTER
*D03D11/00*(2006.01)i, *D21F1/10*(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)
D03D1/00-27/18, D21B1/00-1/38, D21C1/00-11/14, D21D1/00-99/00,
D21F1/00-13/12, D21G1/00-9/00, D21H11/00-27/42, D21J1/00-7/00

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 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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 2001-288612 A (Nippon Felt Co., Ltd.), 19 October 2001 (19.10.2001), paragraphs [0010], [0012], [0015], [0020] (Family: none) | 1-5 |
| A | JP 2004-156164 A (Nippon Felt Co., Ltd.), 03 June 2004 (03.06.2004), claims 1 to 5; paragraph [0018] (Family: none) | 1-5 |

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

* Special categories of cited documents:
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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 |
|---|---|
| 15 November 2016 (15.11.16) | 22 November 2016 (22.11.16) |
| Name and mailing address of the ISA/<br>Japan Patent Office<br>3-4-3,Kasumigaseki,Chiyoda-ku,<br>Tokyo 100-8915,Japan | Authorized officer<br><br>Telephone No. |

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**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2016/076093

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| A | JP 2006-520860 A (Weavexx Corp.), 14 September 2006 (14.09.2006), paragraphs [0053] to [0057], [0071]; fig. 9A to 9E & US 2004/0182465 A1 fig. 9A to 9E; paragraphs [0063] to [0067], [0081] & WO 2004/085740 A2 & EP 1606450 A2 & KR 10-2006-0002828 A & CN 1791719 A & CN 102817268 A | 1-5 |
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| A | JP 2007-119957 A (Nippon Filcon Co., Ltd.), 17 May 2007 (17.05.2007), claim 1; paragraphs [0006], [0013] (Family: none) | 1-5 |
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## REFERENCES CITED IN THE DESCRIPTION

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