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# (54) WOVEN THREE-DIMENSIONAL INTERVAL GRID FABRIC WITH CROSSED WARP STRUCTURE

(57) A woven three-dimensional interval grid fabric with a crossed warp structure comprises an upper layer fabric texture (1), a lower layer fabric texture (2) and a supporting fabric texture (3), the upper layer fabric texture (1) and the lower layer fabric texture (2) being connected to form a whole body by the supporting fabric texture (3); the upper layer fabric texture (1) is a rectangular frame fabric, the lower layer fabric texture (2) is a plain wave fabric, 4 connecting yarns in the supporting fabric texture (3) in the direction of the breadth are in a triangular shape, 4 connecting yarns in the supporting fabric texture (3) in the length direction are in an Ω shape. The fabric is obtained by using a plain weaving-cross-waving-leno combination process. The fabric has a structure which comprises, in addition to crossing warp and weft warp not only from top to bottom and up and down, the upper layer fabric texture (1) having amphi-positioning warps which appears not only from top to bottom and up and down and moves transversly across many warp positions in the direction of the breadth; while the warp yarns and the weft yarns are crossing, every two amphi-positioning warp yarns tie the warp yarns therebetween in the lateral direction of the fabric to limit the postion thereof left and right.

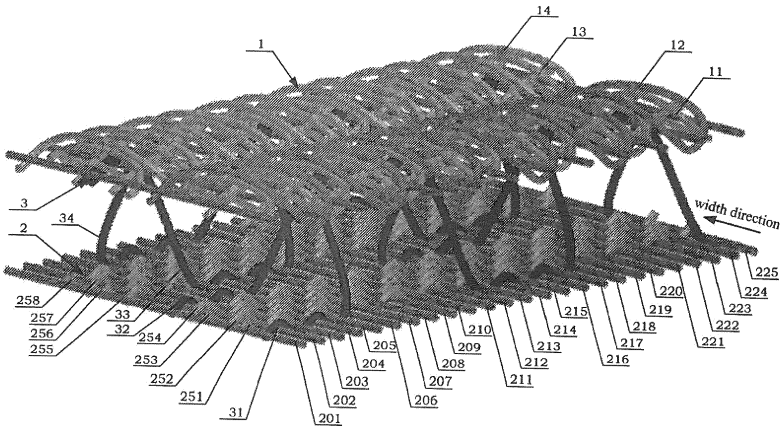


FIG. 1

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a woven three-dimensional fabric, and more particularly to a woven three-dimensional interval grid fabric with a crossed warp structure obtained by weaving through a plain weaving-twist weaving-leno combination process.

### BACKGROUND

**[0002]** A woven grid fabric is a woven fabric in a mesh appearance in which not only the warp yarns, are relatively bundled in the width direction of the fabric but also the weft yarns are relatively bundled in the length direction of the fabric.

**[0003]** An ideal woven grid fabric should have stable meshes formed in the fabric structure in which warp and weft yarns are hard to slide relative to each other, and the size of the meshes can be designed and produced depending on the use.

**[0004]** Currently, an eyelet-like grid fabric of the well-known woven fabric is such that the warp yarns, according to the structure of the texture, are classified into body warp and crossed warp, and the crossed warp and the body warp are arranged in certain proportion, during the weaving, crossed warp are twisted left and right by a doup device around one body warp so as to interweave with the weft yarns to form mesh structures. These weft yarns are tied by means of the crossed warp yarns under a tension lower than that for the body warp yarns, wherein the weft yarns and the body warp yarns are arranged substantially without gaps. From the above, it can be seen that it is hard to form larger eyelets no matter which way is adopted.

**[0005]** The reason why a woven fabric is hard to form a grid fabric with larger eyelets is that the structure of the woven fabric is formed by crossing warp and weft yarns ups and downs, which makes the connection of warp and weft yarns in a loose state in which the warp and weft yarns are very likely to slide relative to each other, resulting in an unstable conformation of the fabric, especially when warp and weft yarns are arranged sparsely to form a grid fabric with larger eyelets. So far, no effective method aiming to solve this problem in fabric structure is known.

### SUMMARY

**[0006]** The present invention aims to provide a woven three-dimensional interval grid fabric with a crossed warp structure in which warp yarns, weft yarns and amphi-positioning warp yarns do not slide relative to weft yarns, thereby ensuring stable mesh structure in the fabric and having an eyelet-array arrangement in the same plane so as to facilitate the filling of a filler.

**[0007]** According to the woven three-dimensional interval grid fabric with a crossed warp structure designed by the present invention, a weaving machine which crosses warp and weft yarns ups and downs to form a fabric comprises, in addition to crossing warp and weft yarns from top to bottom and up and down, but also amphi-positioning warp yarns which go not only from top to bottom and up and down but also moves transversely and reciprocately across many warp positions in the width direction of the fabric; while the amphi-positioning warp yarns and the weft yarns are crossing, every two amphi-positioning warp yarns limit the postion of ordinary warp yarns therebetween left and right in the lateral direction of the fabric. In this way, for the whole fabric, a fabric structure is formed in a state that the ordinary warp yarns are relavtively gathered into a bundle. Each gathering and twisting of the amphi-positioning warp yarns in the width direction of the fabric can be an amphi-positioning that moves transversely right and left relative to warp yarns. When each gathering and twisting of the amphi-positioning wrap yarn in the width direction of the fabric is relative to two warp yarns or more, the warp yarns between the amphi-positions can be of up and down rule of any texture structure such as plain weave, twill weave, satin weave and so on.

**[0008]** A woven three-dimensional interval grid fabric with a crossed warp structure according to the present invention comprises an upper layer fabric texture, a lower layer fabric texture and a supporting fabric texture.

**[0009]** The upper layer fabric texture is such structured that the first weft yarn of the upper layer, the second weft yarn of the upper layer, the third weft yarn of the upper layer, the fourth weft yarn of the upper layer, the fifth weft yarn of the upper layer, the sixth weft yarn of the upper layer, the seventh weft yarn of the upper layer, the eighth weft yarn of the upper layer, the ninth weft yarn of the upper layer, the tenth weft yarn of the upper layer, the eleventh weft yarn of the upper layer, the twelfth weft yarn of the upper layer and the thirteenth weft yarn of the upper layer are arranged in array in the length direction at an upper layer equidistance $D_{upper}$.

**[0010]** An end of the first warp yarn of the upper layer goes under the first weft yarn of the upper layer, and the other end of the first warp yarn of the upper layer along the length direction goes over the second weft yarn of the upper layer, goes under the third weft yarn of the upper layer, goes over the fourth weft yarn of the upper layer, goes under the fifth weft yarn of the upper layer, goes over the sixth weft yarn of the upper layer, goes under the seventh weft yarn of the

upper layer, goes over the eighth weft yarn of the upper layer, goes under the ninth weft yarn of the upper layer, goes over the tenth weft yarn of the upper layer, goes under the eleventh weft yarn of the upper layer, goes over the twelfth weft yarn of the upper layer, and goes under the thirteenth weft yarn of the upper layer.

**[0011]** An end of the second warp yarn of the upper layer goes over the first weft yarn of the upper layer, and the other end of the second warp yarn of the upper layer along the length direction goes under the second weft yarn of the upper layer, goes over the third weft yarn of the upper layer, goes under the fourth weft yarn of the upper layer, goes over the fifth weft yarn of the upper layer, goes under the sixth weft yarn of the upper layer, goes over the seventh weft yarn of the upper layer, goes under the eighth weft yarn of the upper layer, goes over the ninth weft yarn of the upper layer, goes under the tenth weft yarn of the upper layer, goes over the eleventh weft yarn of the upper layer, goes under the twelfth weft yarn of the upper layer, and goes over the thirteenth weft yarn of the upper layer.

**[0012]** An end of the third warp yarn of the upper layer goes under the first weft yarn of the upper layer, and the other end of the third warp yarn of the upper layer along the length direction goes over the second weft yarn of the upper layer, goes under the third weft yarn of the upper layer, goes over the fourth weft yarn of the upper layer, goes under the fifth weft yarn of the upper layer, goes over the sixth weft yarn of the upper layer, goes under the seventh weft yarn of the upper layer, goes over the eighth weft yarn of the upper layer, goes under the ninth weft yarn of the upper layer, goes over the tenth weft yarn of the upper layer, goes under the eleventh weft yarn of the upper layer, goes over the twelfth weft yarn of the upper layer, and goes under the thirteenth weft yarn of the upper layer.

**[0013]** An end of the fourth warp yarn of the upper layer goes over the first weft yarn of the upper layer, and the other end of the fourth warp yarn of the upper layer along the length direction goes under the second weft yarn of the upper layer, goes over the third weft yarn of the upper layer, goes under the fourth weft yarn of the upper layer, goes over the fifth weft yarn of the upper layer, goes under the sixth weft yarn of the upper layer, goes over the seventh weft yarn of the upper layer, goes under the eighth weft yarn of the upper layer, goes over the ninth weft yarn of the upper layer, goes under the tenth weft yarn of the upper layer, goes over the eleventh weft yarn of the upper layer, goes under the twelfth weft yarn of the upper layer, and goes over the thirteenth weft yarn of the upper layer.

**[0014]** An end of the fifth warp yarn of the upper layer goes under the first weft yarn of the upper layer, and the other end of the fifth warp yarn of the upper layer along the length direction goes over the second weft yarn of the upper layer, goes under the third weft yarn of the upper layer, goes over the fourth weft yarn of the upper layer, goes under the fifth weft yarn of the upper layer, goes over the sixth weft yarn of the upper layer, goes under the seventh weft yarn of the upper layer, goes over the eighth weft yarn of the upper layer, goes under the ninth weft yarn of the upper layer, goes over the tenth weft yarn of the upper layer, goes under the eleventh weft yarn of the upper layer, goes over the twelfth weft yarn of the upper layer, and goes under the thirteenth weft yarn of the upper layer,

**[0015]** An end of the sixth warp yarn of the upper layer goes over the first weft yarn of the upper layer, and the other end of the sixth warp yarn of the upper layer along the length direction goes under the second weft yarn of the upper layer, goes over the third weft yarn of the upper layer, goes under the fourth weft yarn of the upper layer, goes over the fifth weft yarn of the upper layer, goes under the sixth weft yarn of the upper layer, goes over the seventh weft yarn of the upper layer, goes under the eighth weft yarn of the upper layer, goes over the ninth weft yarn of the upper layer, goes under the tenth weft yarn of the upper layer, goes over the eleventh weft yarn of the upper layer, goes under the twelfth weft yarn of the upper layer, and goes over the thirteenth weft yarn of the upper layer.

**[0016]** An end of the seventh warp yarn of the upper layer goes under the first weft yarn of the upper layer, and the other end of the seventh warp yarn of the upper layer along the length direction goes over the second weft yarn of the upper layer, goes under the third weft yarn of the upper layer, goes over the fourth weft yarn of the upper layer, goes under the fifth weft yarn of the upper layer, goes over the sixth weft yarn of the upper layer, goes under the seventh weft yarn of the upper layer, goes over the eighth weft yarn of the upper layer, goes under the ninth weft yarn of the upper layer, goes over the tenth weft yarn of the upper layer, goes under the eleventh weft yarn of the upper layer, goes over the twelfth weft yarn of the upper layer, and goes under the thirteenth weft yarn of the upper layer.

**[0017]** An end of the eighth warp yarn of the upper layer goes over the first weft yarn of the upper layer, and the other end of the eighth warp yarn of the upper layer along the length direction goes under the second weft yarn of the upper layer, goes over the third weft yarn of the upper layer, goes under the fourth weft yarn of the upper layer, goes over the fifth weft yarn of the upper layer, goes under the sixth weft yarn of the upper layer, goes over the seventh weft yarn of the upper layer, goes under the eighth weft yarn of the upper layer, goes over the ninth weft yarn of the upper layer, goes under the tenth weft yarn of the upper layer, goes over the eleventh weft yarn of the upper layer, goes under the twelfth weft yarn of the upper layer, and goes over the thirteenth weft yarn of the upper layer.

**[0018]** An end of a first amphi-positioning warp yarn is placed outside of the first warp yarn of the upper layer and goes under the first weft yarn of the upper layer, while the other end of the first amphi-positioning warp yarn moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the second weft yarn of the upper layer; the first amphi-positioning warp yarn moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the first warp yarn of the upper layer and goes under the third weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the fourth weft yarn of the

upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the fifth weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the sixth weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the seventh weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the eighth weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the ninth weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the tenth weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the eleventh weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the twelfth weft yarn of the upper layer; and moves transversely to the outside of the first warp yarn of the upper layer and goes under the thirteenth weft yarn of the upper layer.

**[0019]** An end of a second amphi-positioning warp yarn is placed outside of the fourth warp yarn of the upper layer and goes under the first weft yarn of the upper layer, and the other end of the second amphi-positioning warp yarn moves transversely to the outside of the first warp yarn of the upper layer and goes under the second weft yarn of the upper layer; the second amphi-positioning warp yarn moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the third weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the fourth weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the fifth weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the sixth weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the seventh weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the eighth weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the ninth weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the tenth weft yarn of the upper layer; moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the eleventh weft yarn of the upper layer; moves transversely to the outside of the first warp yarn of the upper layer and goes under the twelfth weft yarn of the upper layer; and moves transversely to the outside of the fourth warp yarn of the upper layer and goes under the thirteenth weft yarn of the upper layer.

**[0020]** An end of a third amphi-positioning warp yarn is placed outside of the fifth warp yarn of the upper layer and goes under the first weft yarn of the upper layer, and the other end of the third amphi-positioning warp yarn moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the second weft yarn of the upper layer; the third amphi-positioning warp yarn moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the third weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the fourth weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the fifth weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the sixth weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the seventh weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the eighth weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the ninth weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the tenth weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the eleventh weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the twelfth weft yarn of the upper layer; and moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the thirteenth weft yarn of the upper layer.

**[0021]** An end of a fourth amphi-positioning warp yarn is placed outside of the eighth warp yarn of the upper layer and goes under the first weft yarn of the upper layer, and the other end of the fourth amphi-positioning warp yarn moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the second weft yarn of the upper layer; the fourth amphi-positioning warp yarn moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the third weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the fourth weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the fifth weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the sixth weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the seventh weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the eighth weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the ninth weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the tenth weft yarn of the upper layer; moves transversely to the outside of the eighth warp yarn of the upper layer and goes under the eleventh weft yarn of the upper layer; moves transversely to the outside of the fifth warp yarn of the upper layer and goes under the twelfth weft yarn of the upper layer; and moves

transversely to the outside of the eighth warp yarn of the upper layer and goes under the thirteenth weft yarn of the upper layer.

**[0022]** The lower layer fabric texture is such structured that the first weft yarn of the lower layer, the second weft yarn of the lower layer, the third weft yarn of the lower layer, the fourth weft yarn of the lower layer, the fifth weft yarn of the lower layer, the sixth weft yarn of the lower layer, the seventh weft yarn of the lower layer, the eighth weft yarn of the lower layer, the ninth weft yarn of the lower layer, the tenth weft yarn of the lower layer, the eleventh weft yarn of the lower layer, the twelfth weft yarn of the lower layer, the thirteenth weft yarn of the lower layer, the fourteenth weft yarn of the lower layer, the fifteenth weft yarn of the lower layer, the sixteenth weft yarn of the lower layer, the seventeenth weft yarn of the lower layer, the eighteenth weft yarn of the lower layer, the nineteenth weft yarn of the lower layer, the twentieth weft yarn of the lower layer, the twenty-first weft yarn of the lower layer, the twenty-second weft yarn of the lower layer, the twenty-third weft yarn of the lower layer, the twenty-fourth weft yarn of the lower layer and the twenty-fifth weft yarn of the lower layer are arranged in array in the length direction at a lower layer equidistance $D_{lower}$.

**[0023]** An end of the first warp yarn of the lower layer goes over the first weft yarn of the lower layer, and the other end of the first warp yarn of the lower layer along the length direction goes under the second weft yarn of the lower layer, goes over the third weft yarn of the lower layer, goes under the fourth weft yarn of the lower layer, goes over the fifth weft yarn of the lower layer, goes under the sixth weft yarn of the lower layer, goes over the seventh weft yarn of the lower layer, goes under the eighth weft yarn of the lower layer, goes over the ninth weft yarn of the lower layer, goes under the tenth weft yarn of the lower layer, goes over the eleventh weft yarn of the lower layer, goes under the twelfth weft yarn of the lower layer, goes over the thirteenth weft yarn of the lower layer, goes under the fourteenth weft yarn of the lower layer, goes over the fifteenth weft yarn of the lower layer, goes under the sixteenth weft yarn of the lower layer, goes over the seventeenth weft yarn of the lower layer, goes under the eighteenth weft yarn of the lower layer, goes over the nineteenth weft yarn of the lower layer, goes under the twentieth weft yarn of the lower layer, goes over the twenty-first weft yarn of the lower layer, goes under the twenty-second weft yarn of the lower layer, goes over the twenty-third weft yarn of the lower layer, goes under the twenty-fourth weft yarn of the lower layer, and goes over the twenty-fifth weft yarn of the lower layer.

**[0024]** An end of the second warp yarn of the lower layer goes under the first weft yarn of the lower layer, and the other end of the second warp yarn of the lower layer along the length direction goes over the second weft yarn of the lower layer, goes under the third weft yarn of the lower layer, goes over the fourth weft yarn of the lower layer, goes under the fifth weft yarn of the lower layer, goes over the sixth weft yarn of the lower layer, goes under the seventh weft yarn of the lower layer, goes over the eighth weft yarn of the lower layer, goes under the ninth weft yarn of the lower layer, goes over the tenth weft yarn of the lower layer, goes under the eleventh weft yarn of the lower layer, goes over the twelfth weft yarn of the lower layer, goes under the thirteenth weft yarn of the lower layer, goes over the fourteenth weft yarn of the lower layer, goes under the fifteenth weft yarn of the lower layer, goes over the sixteenth weft yarn of the lower layer, goes under the seventeenth weft yarn of the lower layer, goes over the eighteenth weft yarn of the lower layer, goes under the nineteenth weft yarn of the lower layer, goes over the twentieth weft yarn of the lower layer, goes under the twenty-first weft yarn of the lower layer, goes over the twenty-second weft yarn of the lower layer, goes under the twenty-third weft yarn of the lower layer, goes over the twenty-fourth weft yarn of the lower layer, and goes under the twenty-fifth weft yarn of the lower layer.

**[0025]** An end of the third warp yarn of the lower layer goes over the first weft yarn of the lower layer, and the other end of the third warp yarn of the lower layer along the length direction goes under the second weft yarn of the lower layer, goes over the third weft yarn of the lower layer, goes under the fourth weft yarn of the lower layer, goes over the fifth weft yarn of the lower layer, goes under the sixth weft yarn of the lower layer, goes over the seventh weft yarn of the lower layer, goes under the eighth weft yarn of the lower layer, goes over the ninth weft yarn of the lower layer, goes under the tenth weft yarn of the lower layer, goes over the eleventh weft yarn of the lower layer, goes under the twelfth weft yarn of the lower layer, goes over the thirteenth weft yarn of the lower layer, goes under the fourteenth weft yarn of the lower layer, goes over the fifteenth weft yarn of the lower layer, goes under the sixteenth weft yarn of the lower layer, goes over the seventeenth weft yarn of the lower layer, goes under the eighteenth weft yarn of the lower layer, goes over the nineteenth weft yarn of the lower layer, goes under the twentieth weft yarn of the lower layer, goes over the twenty-first weft yarn of the lower layer, goes under the twenty-second weft yarn of the lower layer, goes over the twenty-third weft yarn of the lower layer, goes under the twenty-fourth weft yarn of the lower layer, and goes over the twenty-fifth weft yarn of the lower layer.

**[0026]** An end of the fourth warp yarn of the lower layer goes under the first weft yarn of the lower layer, and the other end of the fourth warp yarn of the lower layer along the length direction goes over the second weft yarn of the lower layer, goes under the third weft yarn of the lower layer, goes over the fourth weft yarn of the lower layer, goes under the fifth weft yarn of the lower layer, goes over the sixth weft yarn of the lower layer, goes under the seventh weft yarn of the lower layer, goes over the eighth weft yarn of the lower layer, goes under the ninth weft yarn of the lower layer, goes over the tenth weft yarn of the lower layer, goes under the eleventh weft yarn of the lower layer, goes over the twelfth weft yarn of the lower layer, goes under the thirteenth weft yarn of the lower layer, goes over the fourteenth weft yarn

of the lower layer, goes under the fifteenth weft yarn of the lower layer, goes over the sixteenth weft yarn of the lower layer, goes under the seventeenth weft yarn of the lower layer, goes over the eighteenth weft yarn of the lower layer, goes under the nineteenth weft yarn of the lower layer, goes over the twentieth weft yarn of the lower layer, goes under the twenty-first weft yarn of the lower layer, goes over the twenty-second weft yarn of the lower layer, goes under the twenty-third weft yarn of the lower layer, goes over the twenty-fourth weft yarn of the lower layer, and goes under the twenty-fifth weft yarn of the lower layer.

**[0027]** An end of the fifth warp yarn of the lower layer goes under the first weft yarn of the lower layer, and the other end of the fifth warp yarn of the lower layer along the length direction goes over the second weft yarn of the lower layer, goes under the third weft yarn of the lower layer, goes over the fourth weft yarn of the lower layer, goes under the firth weft yarn of the lower layer, goes over the sixth weft yarn of the lower layer, goes under the seventh weft yarn of the lower layer, goes over the eighth weft yarn of the lower layer, goes under the ninth weft yarn of the lower layer, goes over the tenth weft yarn of the lower layer, goes under the eleventh weft yarn of the lower layer, goes over the twelfth weft yarn of the lower layer, goes under the thirteenth weft yarn of the lower layer, goes over the fourteenth weft yarn of the lower layer, goes under the fifteenth weft yarn of the lower layer, goes over the sixteenth weft yarn of the lower layer, goes under the seventeenth weft yarn of the lower layer, goes over the eighteenth weft yarn of the lower layer, goes under the nineteenth weft yarn of the lower layer, goes over the twentieth weft yarn of the lower layer, goes under the twenty-first weft yarn of the lower layer, goes over the twenty-second weft yarn of the lower layer, goes under the twenty-third weft yarn of the lower layer, goes over the twenty-fourth weft yarn of the lower layer, and goes under the twenty-fifth weft yarn of the lower layer.

**[0028]** An end of the sixth warp yarn of the lower layer goes over the first weft yarn of the lower layer, the other end of the sixth warp yarn of the lower layer along the length direction goes under the second weft yarn of the lower layer, goes over the third weft yarn of the lower layer, goes under the fourth weft yarn of the lower layer, goes over the fifth weft yarn of the lower layer, goes under the sixth weft yarn of the lower layer, goes over the seventh weft yarn of the lower layer, goes under the eighth weft yarn of the lower layer, goes over the ninth weft yarn of the lower layer, goes under the tenth weft yarn of the lower layer, goes over the eleventh weft yarn of the lower layer, goes under the twelfth weft yarn of the lower layer, goes over the thirteenth weft yarn of the lower layer, goes under the fourteenth weft yarn of the lower layer, goes over the fifteenth weft yarn of the lower layer, goes under the sixteenth weft yarn of the lower layer, goes over the seventeenth weft yarn of the lower layer, goes under the eighteenth weft yarn of the lower layer, goes over the nineteenth weft yarn of the lower layer, goes under the twentieth weft yarn of the lower layer, goes over the twenty-first weft yarn of the lower layer, goes under the twenty-second weft yarn of the lower layer, goes over the twenty-third weft yarn of the lower layer, goes under the twenty-fourth weft yarn of the lower layer, and goes over the twenty-fifth weft yarn of the lower layer.

**[0029]** An end of the seventh warp yarn of the lower layer goes under the first weft yarn of the lower layer, and the other end of the seventh warp yarn of the lower layer along the length direction goes over the second weft yarn of the lower layer, goes under the third weft yarn of the lower layer, goes over the fourth weft yarn of the lower layer, goes under the fifth weft yarn of the lower layer, goes over the sixth weft yarn of the lower layer, goes under the seventh weft yarn of the lower layer, goes over the eighth weft yarn of the lower layer, goes under the ninth weft yarn of the lower layer, goes over the tenth weft yarn of the lower layer, goes under the eleventh weft yarn of the lower layer, goes over the twelfth weft yarn of the lower layer, goes under the thirteenth weft yarn of the lower layer, goes over the fourteenth weft yarn of the lower layer, goes under the fifteenth weft yarn of the lower layer, goes over the sixteenth weft yarn of the lower layer, goes under the seventeenth weft yarn of the lower layer, goes over the eighteenth weft yarn of the lower layer, goes under the nineteenth weft yarn of the lower layer, goes over the twentieth weft yarn of the lower layer, goes under the twenty-first weft yarn of the lower layer, goes over the twenty-second weft yarn of the lower layer, goes under the twenty-third weft yarn of the lower layer, goes over the twenty-fourth weft yarn of the lower layer, and goes under the twenty-fifth weft yarn of the lower layer,

**[0030]** An end of the eighth warp yarn of the lower layer goes over the first weft yarn of the lower layer, and the other end of the eighth warp yarn of the lower layer along the length direction goes under the second weft yarn of the lower layer, goes over the third weft yarn of the lower layer, goes under the fourth weft yarn of the lower layer, goes over the fifth weft yarn of the lower layer, goes under the sixth weft yarn of the lower layer, goes over the seventh weft yarn of the lower layer, goes under the eighth weft yarn of the lower layer, goes over the ninth weft yarn of the lower layer, goes under the tenth weft yarn of the lower layer, goes over the eleventh weft yarn of the lower layer, goes under the twelfth weft yarn of the lower layer, goes over the thirteenth weft yarn of the lower layer, goes under the fourteenth weft yarn of the lower layer, goes over the fifteenth weft yarn of the lower layer, goes under the sixteenth weft yarn of the lower layer, goes over the seventeenth weft yarn of the lower layer, goes under the eighteenth weft yarn of the lower layer, goes over the nineteenth weft yarn of the lower layer, goes under the twentieth weft yarn of the lower layer, goes over the twenty-first weft yarn of the lower layer, goes under the twenty-second weft yarn of the lower layer, goes over the twenty-third weft yarn of the lower layer, goes under the twenty-fourth weft yarn of the lower layer, and goes over the twenty-fifth weft yarn of the lower layer.

**[0031]** The supporting fabric texture is such structured that an end of the first connecting yarn goes under the first weft yarn of the lower layer, and the other end of the first connecting yarn along the length direction goes over the second weft yarn of the lower layer, goes under the third weft yarn of the lower layer, goes over the fourth weft yarn of the lower layer, goes under the fifth weft yarn of the lower layer, goes over the fourth weft yarn of the upper layer, goes under the fifth weft yarn of the upper layer, goes over the sixth weft yarn of the upper layer, goes under the thirteenth weft yarn of the lower layer, goes over the fourteenth weft yarn of the lower layer, goes under the fifteenth weft yarn of the lower layer, goes over the sixteenth weft yarn of the lower layer, goes under the seventeenth weft yarn of the lower layer, goes over the tenth weft yarn of the upper layer, goes under the eleventh weft yarn of the upper layer, goes over the twelfth weft yarn of the upper layer, and goes under the twenty-fifth weft yarn of the lower layer; and when the first connecting yarn is guided from the lower layer fabric texture to the upper layer fabric texture, the first connecting yarn is placed between the second warp yarn of the upper layer and the third warp yarn of the upper layer.

**[0032]** An end of the second connecting yarn goes under the first weft yarn of the lower layer, and the other end of the second connecting yarn along the length direction goes over the second weft yarn of the lower layer, goes under the third weft yarn of the lower layer, goes over the fourth weft yarn of the lower layer, goes under the fifth weft yarn of the lower layer, goes over the fourth weft yarn of the upper layer, goes under the fifth weft yarn of the upper layer, goes over the sixth weft yarn of the upper layer, goes under the thirteenth weft yarn of the lower layer, goes over the fourteenth weft yarn of the lower layer, goes under the fifteenth weft yarn of the lower layer, goes over the sixteenth weft yarn of the lower layer, goes under the seventeenth weft yarn of the lower layer, goes over the tenth weft yarn of the upper layer, goes under the eleventh weft yarn of the upper layer, goes over the twelfth weft yarn of the upper layer, and goes under the twenty-fifth weft yarn of the lower layer; and when the second connecting yarn is guided from the lower layer fabric texture to the upper layer fabric texture, the second connecting yarn is placed between the second warp yarn of the upper layer and the third warp yarn of the upper layer.

**[0033]** An end of the third connecting yarn goes under the first weft yarn of the upper layer, and the other end of the third connecting yarn along the length direction goes over the second weft yarn of the upper layer, goes under the fifth weft yarn of the lower layer, goes over the sixth weft yarn of the lower layer, goes under the seventh weft yarn of the lower layer, goes over the eighth weft yarn of the lower layer, goes under the ninth weft yarn of the lower layer, goes over the sixth weft yarn of the upper layer, goes under the seventh weft yarn of the upper layer, goes over the eighth weft yarn of the upper layer, goes under the seventeenth weft yarn of the lower layer, goes over the eighteenth weft yarn of the lower layer, goes under the nineteenth weft yarn of the lower layer, goes over the twentieth weft yarn of the lower layer, goes under the twenty-first weft yarn of the lower layer, goes over the twelfth weft yarn of the upper layer, and goes under the thirteenth weft yarn of the upper layer; and when the third connecting yarn is guided from the lower layer fabric texture to the upper layer fabric texture, the third connecting yarn is placed between the sixth warp yarn of the upper layer and the seventh warp yarn of the upper layer.

**[0034]** An end of the fourth connecting yarn goes under the first weft yarn of the upper layer, and the other end of the fourth connecting yarn along the length direction goes over the second weft yarn of the upper layer, goes under the fifth weft yarn of the lower layer, goes over the sixth weft yarn of the lower layer, goes under the seventh weft yarn of the lower layer, goes over the eighth weft yarn of the lower layer, goes under the ninth weft yarn of the lower layer, goes over the sixth weft yarn of the upper layer, goes under the seventh weft yarn of the upper layer, goes over the eighth weft yarn of the upper layer, goes under the seventeenth weft yarn of the lower layer, goes over the eighteenth weft yarn of the lower layer, goes under the nineteenth weft yarn of the lower layer, goes over the twentieth weft yarn of the lower layer, goes under the twenty-first weft yarn of the lower layer, goes over the twelfth weft yarn of the upper layer, and goes under the thirteenth weft yarn of the upper layer; and when the fourth connecting yarn is guided from the lower layer fabric texture to the upper layer fabric texture, the fourth connecting yarn is placed between the sixth warp yarn of the upper layer and the seventh warp yarn of the upper layer.

**[0035]** Advantages of the woven three-dimensional interval grid fabric with a crossed warp structure in the present invention are as follows:

**[0036]** ① The upper layer of the fabric in the present invention is a grid fabric, the Δ (triangular shape) and Ω (omega shape) configuration in the intermediate layer form a stable support, and the lower layer is a grid fabric and/or plain fabric, thereby forming a fabric as a three-dimensional interval fabric. The intermediate support of the three-dimensional interval fabric in the length direction (warp yarn direction) is in an Ω configuration, while the intermediate support thereof in the width direction (weft yarn direction) is in a Δ configuration.

**[0037]** ② The upper layer of the fabric in the present invention is a grid fabric in which the warp yarns, the weft yarns and the crossed warp yarns do not slide relative to the weft yarns, thereby ensuring stable mesh structure in the fabric and having an eyelet-array arrangement in the same plane so as to facilitate the filling of a filler. Two amphi-positioning warp yarns move transversely, and go over and under the weft yarns, thereby the warp yarns twisting and spanning to form stable longitudinal strips of the grid.

**[0038]** ③ With regard to the mesh (also referred as rectangular frame) in the upper layer fabric texture, the number of eyelets per unit area is 1500~3000 (eyelets/per square meter). To tie with the amphi-positioning warp yarn can form

eyelets of larger size, and can make warp yarns and connecting yarns not slide left or right relative to the weft yarns.

**[0039]** ④ The fabric of the present invention may be used as reinforcement for a lightweight, high-strength composite material as well as a skeleton material for a foam material.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0040]**

Figure 1 is a structural view of a woven three-dimensional interval grid fabric with a crossed warp structure according to the present invention.

Figure 1A is a structural view of the woven three-dimensional interval grid fabric in which the crossed warp structure is not shown

Figure 2 is a structural front view of the woven three-dimensional interval grid fabric with a crossed warp structure according to the present invention

Figure 3 is a structural left view of the woven three-dimensional interval grid fabric with a crossed warp structure according to the present invention.

| | | | |
|---|---|---|---|
| upper layer fabric texture | 11 first amphi-positioning warp yarn | 12 second amphi-positioning warp yarn | 13. third amphi-positioning warp yarn |
| 14 fourth amphi-positioning warp yarn | 101 first weft yarn of the upper layer | 102 second weft yarn of the upper layer | 103. third weft yarn of the upper layer |
| 104 fourth weft yarn of the upper layer | 105 fifth weft yarn of the upper layer | 106 sixth weft yarn of the upper layer | 107 seventh weft yarn of the upper layer |
| 108 eighth weft yarn of the upper layer | 109 ninth weft yarn of the upper layer | 110 tenth weft yarn of the upper layer | 111 eleventh weft yarn of the upper layer |
| 112 twelfth weft yarn of the upper layer | 113 thirteenth weft yarn of the upper layer | 151 first warp yarn of the upper layer | 152 second warp yarn of the upperlayer |
| 153 third warp yarn of the upper layer | 154 fourth warp yarn of the upper layer | 155 fifth warp yarn of the upper layer | 156 sixth warp yarn of the upper layer |
| 157 seventh warp yarn of the upper layer | 158 eighth warp yarn of the upper layer | 2 lower layer fabric texture | 201 first weft yarn of the lower layer |
| 202 second weft yarn of the lower layer | 203 third weft yarn of the lower layer | 204 fourth weft yarn of the lower layer | 205 fifth weft yarn of the lower layer |
| 206 sixth weft yarn of the lower layer | 207 seventh weft yarn of the lower layer | 208 eighth weft yarn of the lower layer | 209 ninth weft yarn of the lower layer |
| 210 tenth weft yarn of the lower layer | 211 eleventh weft yarn of the lower layer | 212 twelfth weft yarn of the lower layer | 213 thirteenth weft yarn of the lower layer |
| 214 fourteenth weft yarn of the lower layer | 215 fifteenth weft yarn of the lower layer | 216 sixteenth weft yarn of the lower layer | 217 seventeenth weft yarn of the lower layer |
| 218 eighteenth weft yarn of the lower layer | 219 nineteenth weft yarn of the lower layer | 220 twentieth weft yarn of the lower layer | 221 twenty-first weft yarn of the lower layer |
| 222. twenty-second weft yarn of the lower layer | 223. twenty-third weft yarn of the lower layer | 224. twenty-fourth weft yarn of the lower layer | 225. twenty-fifth weft yarn of the lower layer |
| 251. first warp yarn of the lower layer | 252. second warp yarn of the lower layer | 253. third warp yarn of the lower layer | 254. fourth warp yarn of the lower layer |
| 255. fifth warp yarn of the lower layer | 256. sixth warp yarn of the lower layer | 257. seventh warp yarn of the lower layer | 258. eighth warp yarn of the lower layer |
| 3. supporting fabric texture | 31. first connecting yarn | 32. second connecting yarn | 33. third connecting yarn |
| 34. fourth connecting yarn | | | |

## Detailed description of the present invention

**[0041]** Further detailed explanations are made to the present invention as below with reference to the accompany drawings.

**[0042]** Referring to Fig.1 and Fig.1A, a woven three-dimensional interval grid fabric with a crossed warp structure according to the present invention comprises an upper layer fabric texture 1, a lower layer fabric texture 2 and a supporting fabric texture 3. The woven fabric is a cyclic fabric texture, and in order to clearly show the fabric structure designed by the present invention, in the present invention the woven three-dimensional interval grid fabric with a crossed warp structure is described in a cycle unit. The length direction is the arrangement direction of the warp yarns and the width direction is the arrangement direction of the weft yarns. In the art, the length and the width of the fabric are not limited. The thickness direction of the woven three-dimensional interval grid fabric is defined as the height $H_{height}$ in the longitudinal direction.

1. UPPER LAYER FABRIC TEXTURE 1

**[0043]** Referring to Fig.1 and Fig.1A, the upper layer fabric texture 1 in the present invention comprises a first amphi-positioning warp yarn 11, a second amphi-positioning warp yarn 12, a third amphi-positioning warp yarn 13, a fourth amphi-positioning warp yarn 14, the first warp yarn of the upper layer 151, the second warp yarn of the upper layer 152, the third warp yarn of the upper layer 153, the fourth warp yarn of the upper layer 154, the fifth warp yarn of the upper layer 155, the sixth warp yarn of the upper layer 156, the seventh warp yarn of the upper layer 157, the eighth warp yarn of the upper layer 158, the first weft yarn of the upper layer 101, the second weft yarn of the upper layer 102, the third weft yarn of the upper layer 103, the fourth weft yarn of the upper layer 104, the fifth weft yarn of the upper layer 105, the sixth weft yarn of the upper layer 106, the seventh weft yarn of the upper layer 107, the eighth weft yarn of the upper layer 108, the ninth weft yarn of the upper layer 109, the tenth weft yarn of the upper layer 110, the eleventh weft yarn of the upper layer 111, the twelfth weft yarn of the upper layer 112, and the thirteenth weft yarn of the upper layer 113.

**[0044]** The first weft yarn of the upper layer 101, the second weft yarn of the upper layer 102, the third weft yarn of the upper layer 103, the fourth weft yarn of the upper layer 104, the fifth weft yarn of the upper layer 105, the sixth weft yarn of the upper layer 106, the seventh weft yarn of the upper layer 107, the eighth weft yarn of the upper layer 108, the ninth weft yarn of the upper layer 109, the tenth weft yarn of the upper layer 110, the eleventh weft yarn of the upper layer 111, the twelfth weft yarn of the upper layer 112 and the thirteenth weft yarn of the upper layer 113 are arranged in the length direction at an upper layer equidistance $D_{upper;}D_{upper}$ = 2mm~200mm.

**[0045]** The first warp yarn of the upper layer 151, the second warp yarn of the upper layer 152, the third warp yarn of the upper layer 153 and the fourth warp yarn of the upper layer 154 are gathered, twisted and bound in the length direction by the first amphi-positioning warp yarn 11 and the second amphi-positioning warp yarn 12; the fifth warp yarn of the upper layer 155, the sixth warp yarn of the upper layer 156, the seventh warp yarn of the upper layer 157 and the eighth warp yarn of the upper layer 158 are gathered, twisted and bound in the length direction by the third amphi-positioning warp yarn 13 and the fourth amphi-positioning warp yarn 14.

**[0046]** The upper layer fabric texture 1 is such structured that the first weft yarn of the upper layer 101, the second weft yarn of the upper layer 102, the third weft yarn of the upper layer 103, the fourth weft yarn of the upper layer 104, the fifth weft yarn of the upper layer 105, the sixth weft yarn of the upper layer 106, the seventh weft yarn of the upper layer 107, the eighth weft yarn of the upper layer 108, the ninth weft yarn of the upper layer 109, the tenth weft yarn of the upper layer 110, the eleventh weft yarn of the upper layer 111, the twelfth weft yarn of the upper layer 112 and the thirteenth weft yarn of the upper layer 113 are arranged in array in the length direction at an upper layer equidistance $D_{upper}$.

**[0047]** An end of the first warp yarn of the upper layer 151 goes under the first weft yarn of the upper layer 101, and the other end of the first warp yarn of the upper layer 151 along the length direction goes over the second weft yarn of the upper layer 102, goes under the third weft yarn of the upper layer 103, goes over the fourth weft yarn of the upper layer 104, goes under the fifth weft yarn of the upper layer 105, goes over the sixth weft yarn of the upper layer 106, goes under the seventh weft yarn of the upper layer 107, goes over the eighth weft yarn of the upper layer 108, goes under the ninth weft yarn of the upper layer 109, goes over the tenth weft yarn of the upper layer 110, goes under the eleventh weft yarn of the upper layer 111, goes over the twelfth weft yarn of the upper layer 112, and goes under the thirteenth weft yarn of the upper layer 113.

**[0048]** An end of the second warp yarn of the upper layer 152 goes over the first weft yarn of the upper layer 101, and the other end of the second warp yarn of the upper layer 152 along the length direction goes under the second weft yarn of the upper layer 102, goes over the third weft yarn of the upper layer 103, goes under the fourth weft yarn of the upper layer 104, goes over the fifth weft yarn of the upper layer 105, goes under the sixth weft yarn of the upper layer 106, goes over the seventh weft yarn of the upper layer 107, goes under the eighth weft yarn of the upper layer 108, goes over the ninth weft yarn of the upper layer 109, goes under the tenth weft yarn of the upper layer 110, goes over the eleventh weft yarn of the upper layer 111, goes under the twelfth weft yarn of the upper layer 112, and goes over the

thirteenth weft yarn of the upper layer 113.

**[0049]** An end of the third warp yarn of the upper layer 153 goes under the first weft yarn of the upper layer 101, and the other end of the third warp yarn of the upper layer 153 along the length direction goes over the second weft yarn of the upper layer 102, goes under the third weft yarn of the upper layer 103, goes over the fourth weft yarn of the upper layer 104, goes under the fifth weft yarn of the upper layer 105, goes over the sixth weft yarn of the upper layer 106, goes under the seventh weft yarn of the upper layer 107, goes over the eighth weft yarn of the upper layer 108, goes under the ninth weft yarn of the upper layer 109, goes over the tenth weft yarn of the upper layer 110, goes under the eleventh weft yarn of the upper layer 111, goes over the twelfth weft yarn of the upper layer 112, and goes under the thirteenth weft yarn of the upper layer 113.

**[0050]** An end of the fourth warp yarn of the upper layer 154 goes over the first weft yarn of the upper layer 101, and the other end of the fourth warp yarn of the upper layer 154 along the length direction goes under the second weft yarn of the upper layer 102, goes over the third weft yarn of the upper layer 103, goes under the fourth weft yarn of the upper layer 104, goes over the fifth weft yarn of the upper layer 105, goes under the sixth weft yarn of the upper layer 106, goes over the seventh weft yarn of the upper layer 107, goes under the eighth weft yarn of the upper layer 108, goes over the ninth weft yarn of the upper layer 109, goes under the tenth weft yarn of the upper layer 110, goes over the eleventh weft yarn of the upper layer 111, goes under the twelfth weft yarn of the upper layer 112, and goes over the thirteenth weft yarn of the upper layer 113.

**[0051]** An end of the fifth warp yarn of the upper layer 155 goes under the first weft yarn of the upper layer 101, and the other end of the fifth warp yarn of the upper layer 155 along the length direction goes over the second weft yarn of the upper layer 102, goes under the third weft yarn of the upper layer 103, goes over the fourth weft yarn of the upper layer 104, goes under the fifth weft yarn of the upper layer 105, goes over the sixth weft yarn of the upper layer 106, goes under the seventh weft yarn of the upper layer 107, goes over the eighth weft yarn of the upper layer 108, goes under the ninth weft yarn of the upper layer 109, goes over the tenth weft yarn of the upper layer 110, goes under the eleventh weft yarn of the upper layer 111, goes over the twelfth weft yarn of the upper layer 112, and goes under the thirteenth weft yarn of the upper layer 113.

**[0052]** An end of the sixth warp yarn of the upper layer 156 goes over the first weft yarn of the upper layer 101, and the other end of the sixth warp yarn of the upper layer 156 along the length direction goes under the second weft yarn of the upper layer 102, goes over the third weft yarn of the upper layer 103, goes under the fourth weft yarn of the upper layer 104, goes over the fifth weft yarn of the upper layer 105, goes under the sixth weft yarn of the upper layer 106, goes over the seventh weft yarn of the upper layer 107, goes under the eighth weft yarn of the upper layer 108, goes over the ninth weft yarn of the upper layer 109, goes under the tenth weft yarn of the upper layer 110, goes over the eleventh weft yarn of the upper layer 111, goes under the twelfth weft yarn of the upper layer 112, and goes over the thirteenth weft yarn of the upper layer 113.

**[0053]** An end of the seventh warp yarn of the upper layer 157 goes under the first weft yarn of the upper layer 101, and the other end of the seventh warp yarn of the upper layer 157 along the length direction goes over the second weft yarn of the upper layer 102, goes under the third weft yarn of the upper layer 103, goes over the fourth weft yarn of the upper layer 104, goes under the fifth weft yarn of the upper layer 105, goes over the sixth weft yarn of the upper layer 106, goes under the seventh weft yarn of the upper layer 107, goes over the eighth weft yarn of the upper layer 108, goes under the ninth weft yarn of the upper layer 109, goes over the tenth weft yarn of the upper layer 110, goes under the eleventh weft yarn of the upper layer 111, goes over the twelfth weft yarn of the upper layer 112, and goes under the thirteenth weft yarn of the upper layer 113.

**[0054]** An end of the eighth warp yarn of the upper layer 158 goes over the first weft yarn of the upper layer 101, and the other end of the eighth warp yarn of the upper layer 158 along the length direction goes under the second weft yarn of the upper layer 102, goes over the third weft yarn of the upper layer 103, goes under the fourth weft yarn of the upper layer 104, goes over the fifth weft yarn of the upper layer 105, goes under the sixth weft yarn of the upper layer 106, goes over the seventh weft yarn of the upper layer 107, goes under the eighth weft yarn of the upper layer 108, goes over the ninth weft yarn of the upper layer 109, goes under the tenth weft yarn of the upper layer 110, goes over the eleventh weft yarn of the upper layer 111, goes under the twelfth weft yarn of the upper layer 112, and goes over the thirteenth weft yarn of the upper layer 113.

**[0055]** An end of a first amphi-positioning warp yarn 11 is placed outside of the first warp yarn of the upper layer 151 and goes under the first weft yarn of the upper layer 101, and the other end of the first amphi-positioning warp yarn 11 moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the second weft yarn of the upper layer 102; the first amphi-positioning warp yarn 11 moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the third weft yarn of the upper layer 103; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the fourth weft yarn of the upper layer 104; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the fifth weft yarn of the upper layer 105; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the sixth weft yarn of the upper layer 106; moves transversely to the outside

of the first warp yarn of the upper layer 151 and goes under the seventh weft yarn of the upper layer 107; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the eighth weft yarn of the upper layer 108; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the ninth weft yarn of the upper layer 109; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the tenth weft yarn of the upper layer 110; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the eleventh weft yarn of the upper layer 111; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the twelfth weft yarn of the upper layer 112; and moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the thirteenth weft yarn of the upper layer 113.

**[0056]** An end of a second amphi-positioning warp yarn 12 is placed outside of the fourth warp yarn of the upper layer 154 and goes under the first weft yarn of the upper layer 101, and the other end of the second amphi-positioning warp yarn 12 moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the second weft yarn of the upper layer 102; the second amphi-positioning warp yarn 12 moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the third weft yarn of the upper layer 103; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the fourth weft yarn of the upper layer 104; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the fifth weft yarn of the upper layer 105; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the sixth weft yarn of the upper layer 106; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the seventh weft yarn of the upper layer 107; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the eighth weft yarn of the upper layer 108; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the ninth weft yarn of the upper layer 109; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the tenth weft yarn of the upper layer 110; moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the eleventh weft yarn of the upper layer 111; moves transversely to the outside of the first warp yarn of the upper layer 151 and goes under the twelfth weft yarn of the upper layer 112; and moves transversely to the outside of the fourth warp yarn of the upper layer 154 and goes under the thirteenth weft yarn of the upper layer 113.

**[0057]** In the present invention, since a three-dimensional mapping software cannot achieve a mapping of twisting, twisting is replaced by "bind" which is a common knowledge in the art of the skein process of the woven science. The first amphi-positioning warp yarn 11 and the second amphi-positioning warp yarn 12 gather, twist and bind the first warp yarn of the upper layer 151, the second warp yarn of the upper layer 152, the first connecting yarn 31, the second connecting yarn 32, the third warp yarn of the upper layer 153 and the fourth warp yarn of the upper layer 154 at the amphi-position joints.

**[0058]** An end of a third amphi-positioning warp yarn 13 is placed outside of the fifth warp yarn of the upper layer 155 and goes under the first weft yarn of the upper layer 101, and the other end of the third amphi-positioning warp yarn 13 moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the second weft yarn of the upper layer 102; the third amphi-positioning warp yarn 13 moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the third weft yarn of the upper layer 103; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the fourth weft yarn of the upper layer 104; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the fifth weft yarn of the upper layer 105; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the sixth weft yarn of the upper layer 106; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the seventh weft yarn of the upper layer 107; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the eighth weft yarn of the upper layer 108; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the ninth weft yarn of the upper layer 109; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the tenth weft yarn of the upper layer 110; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the eleventh weft yarn of the upper layer 111; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the twelfth weft yarn of the upper layer 112; and moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the thirteenth weft yarn of the upper layer 113.

**[0059]** An end of a fourth amphi-positioning warp yarn 14 is placed outside of the eighth warp yarn of the upper layer 158 and goes under the first weft yarn of the upper layer 101, and the other end of the fourth amphi-positioning warp yarn 14 moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the second weft yarn of the upper layer 102; the fourth amphi-positioning warp yarn 14 moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the third weft yarn of the upper layer 103; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the fourth weft yarn of the upper layer 104; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the fifth weft yarn of the upper layer 105; moves transversely to the outside of

the fifth warp yarn of the upper layer 155 and goes under the sixth weft yarn of the upper layer 106; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the seventh weft yarn of the upper layer 107; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the eighth weft yarn of the upper layer 108; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the ninth weft yarn of the upper layer 109; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the tenth weft yarn of the upper layer 110; moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the eleventh weft yarn of the upper layer 111; moves transversely to the outside of the fifth warp yarn of the upper layer 155 and goes under the twelfth weft yarn of the upper layer 112; and moves transversely to the outside of the eighth warp yarn of the upper layer 158 and goes under the thirteenth weft yarn of the upper layer 113.

**[0060]** In the present invention, since a three-dimensional mapping software cannot achieve a mapping of twisting, twisting is replaced by "bind" which is a common knowledge in the art of the skein process of the woven science. The third amphi-positioning warp yarn 13 and fourth amphi-positioning warp yarn 14 gather, twist and tie the fifth warp yarn of the upper layer 155, the sixth warp yarn of the upper layer 156, the third connecting yarn 33, the fourth connecting yarn 34, the seventh warp yarn of the upper layer 157 and the eighth warp yarn of the upper layer 158 at the amphi-position joints.

**[0061]** In the upper layer fabric texture 1 of the present invention, the gathering and twisting of the first warp yarn of the upper layer 151, the second warp yarn of the upper layer 152, the third warp yarn of the upper layer 153 and the fourth warp yarn of the upper layer 154 by the first amphi-positioning warp yarn 11 and the second amphi-positioning warp yarn 12 at the amphi-position joints achieves the binding of the first warp yarn of the upper layer 151, the second warp yarn of the upper layer 152, the third warp yarn of the upper layer 153 and the fourth warp yarn of the upper layer 154, thereby many warp yarns being gathered in the length direction into larger grid. In the upper layer, by the use of the binding by the amphi-positioning warp yarn, it makes that warp yarns not slide relative to weft yarns, thereby ensuring stable mesh structure in the upper layer fabric texture. An eyelet-array arrangement is formed in the same plane, i.e. the upper layer fabric texture, so as to facilitate the filling of a filler. The first amphi-positioning warp yarn 11 and the second amphi-positioning warp yarn 12 move transversely in the width direction and go under the weft yarns, thereby the amphi-positioning warp yarns twisting and spanning to form stable longitudinal strips of the grid.

**[0062]** In the upper layer fabric texture of the present invention, the gathering and twisting of the fifth warp yarn of the upper layer 155, the sixth warp yarn of the upper layer 156, the seventh warp yarn of the upper layer 157 and the eighth warp yarn of the upper layer 158 by the third amphi-positioning warp yarn 13 and fourth amphi-positioning warp yarn 14 at the amphi-position joints achieves the binding of the first warp yarn of the upper layer 151, second warp yarn of the upper layer 152, third warp yarn of the upper layer 153 and the fourth warp yarn of the upper layer 154, thereby many warp yarns being gathered in the length direction into larger grid. In the upper layer, by the use of the binding by the amphi-positioning warp yarn, it makes the warp yarns not slide relative to weft yarns, thereby ensuring stable mesh structure in the upper layer fabric texture. An eyelet-array arrangement is formed in the same plane, i.e. the upper layer fabric texture, so as to facilitate the filling of a filler. The third amphi-positioning warp yarn 13 and fourth amphi-positioning warp yarn 14 move transversely in the width direction and go under the weft yarns, thereby the amphi-positioning warp yarns twisting and spanning to form stable longitudinal strips of the grid.

**[0063]** In the present invention, lateral and longitudinal grid configurations make the upper layer fabric texture 1 as a rectangular frame fabric. The length of the rectangular frame fabric is donted by *a*, and the width thereof is donted by *b*. Generally, $a$ = 2mm ~ 200mm, and $b$ = 2mm ~ 200mm. With regard to the mesh (also referred as rectangular frame) in the upper layer fabric texture, the number of the eyelets (i.e. the number of the rectangular frames) per unit area is 1500~3000 (eyelets/per square meter). To bind with the amphi-positioning warp yarn can form eyelets with larger size, and can make warp yarns and connecting yarns not slide left or right relative to the weft yarns.

2. LOWER LAYER FABRIC TEXTURE 2

**[0064]** Referring to Fig.1 and Fig.1A, the lower layer fabric texture 2 in the present invention comprises the first warp yarn of the lower layer 251, the second warp yarn of the lower layer 252, the third warp yarn of the lower layer 253, the fourth warp yarn of the lower layer 254, the fifth warp yarn of the lower layer 255, the sixth warp yarn of the lower layer 256, the seventh warp yarn of the lower layer 257, the eighth warp yarn of the lower layer 258, the first weft yarn of the lower layer 201, the second weft yarn of the lower layer 202, the third weft yarn of the lower layer 203, the fourth weft yarn of the lower layer 204, the fifth weft yarn of the lower layer 205, the sixth weft yarn of the lower layer 206, the seventh weft yarn of the lower layer 207, the eighth weft yarn of the lower layer 208, the ninth weft yarn of the lower layer 209, the tenth weft yarn of the lower layer 210, the eleventh weft yarn of the lower layer 211, the twelfth weft yarn of the lower layer 212, the thirteenth weft yarn of the lower layer 213, the fourteenth weft yarn of the lower layer 214, the fifteenth weft yarn of the lower layer 215, the sixteenth weft yarn of the lower layer 216, the seventeenth weft yarn of the lower layer 217, the eighteenth weft yarn of the lower layer 218, the nineteenth weft yarn of the lower layer 219,

the twentieth weft yarn of the lower layer 220, the twenty-first weft yarn of the lower layer 221, the twenty-second weft yarn of the lower layer 222, the twenty-third weft yarn of the lower layer 223, the twenty-fourth weft yarn of the lower layer 224 and the twenty-fifth weft yarn of the lower layer 225.

**[0065]** The first warp yarn of the lower layer 251, the second warp yarn of the lower layer 252, the third warp yarn of the lower layer 253, the fourth warp yarn of the lower layer 254, the fifth warp yarn of the lower layer 255, the sixth warp yarn of the lower layer 256, the seventh warp yarn of the lower layer 257 and the eighth warp yarn of the lower layer 258 are arranged in the width direction at a lower layer equidistance $H_{lower}$; $H_{lower}$ =1 $D_{lower}$~5 $D_{lower}$.

**[0066]** The first weft yarn of the lower layer 201, the second weft yarn of the lower layer 202, the third weft yarn of the lower layer 203, the fourth weft yarn of the lower layer 204, the fifth weft yarn of the lower layer 205, the sixth weft yarn of the lower layer 206, the seventh weft yarn of the lower layer 207, the eighth weft yarn of the lower layer 208, the ninth weft yarn of the lower layer 209, the tenth weft yarn of the lower layer 210, the eleventh weft yarn of the lower layer 211, the twelfth weft yarn of the lower layer 212, the thirteenth weft yarn of the lower layer 213, the fourteenth weft yarn of the lower layer 214, the fifteenth weft yarn of the lower layer 215, the sixteenth weft yarn of the lower layer 216, the seventeenth weft yarn of the lower layer 217, the eighteenth weft yarn of the lower layer 218, the nineteenth weft yarn of the lower layer 219, the twentieth weft yarn of the lower layer 220, the twenty-first weft yarn of the lower layer 221, the twenty-second weft yarn of the lower layer 222, the twenty-third weft yarn of the lower layer 223, the twenty-fourth weft yarn of the lower layer 224 and the twenty-fifth weft yarn of the lower layer 225 are arranged in the length direction at a lower layer equidistance $D_{lower}$; $D_{lower}$= 0.5mm~200mm.

**[0067]** The lower layer fabric texture 2 is such structured that the first weft yarn of the lower layer 201, the second weft yarn of the lower layer 202, the third weft yarn of the lower layer 203, the fourth weft yarn of the lower layer 204, the fifth weft yarn of the lower layer 205, the sixth weft yarn of the lower layer 206, the seventh weft yarn of the lower layer 207, the eighth weft yarn of the lower layer 208, the ninth weft yarn of the lower layer 209, the tenth weft yarn of the lower layer 210, the eleventh weft yarn of the lower layer 211, the twelfth weft yarn of the lower layer 212, the thirteenth weft yarn of the lower layer 213, the fourteenth weft yarn of the lower layer 214, the fifteenth weft yarn of the lower layer 215, the sixteenth weft yarn of the lower layer 216, the seventeenth weft yarn of the lower layer 217, the eighteenth weft yarn of the lower layer 218, the nineteenth weft yarn of the lower layer 219, the twentieth weft yarn of the lower layer 220, the twenty-first weft yarn of the lower layer 221, the twenty-second weft yarn of the lower layer 222, the twenty-third weft yarn of the lower layer 223, the twenty-fourth weft yarn of the lower layer 224 and the twenty-fifth weft yarn of the lower layer 225 are arranged in array in the length direction at a lower layer equidistance $D_{lower}$.

**[0068]** An end of the first warp yarn of the lower layer 251 goes over the first weft yarn of the lower layer 201, and the other end of the first warp yarn of the lower layer 251 along the length direction goes under the second weft yarn of the lower layer 202, goes over the third weft yarn of the lower layer 203, goes under the fourth weft yarn of the lower layer 204, goes over the fifth weft yarn of the lower layer 205, goes under the sixth weft yarn of the lower layer 206, goes over the seventh weft yarn of the lower layer 207, goes under the eighth weft yarn of the lower layer 208, goes over the ninth weft yarn of the lower layer 209, goes under the tenth weft yarn of the lower layer 210, goes over the eleventh weft yarn of the lower layer 211, goes under the twelfth weft yarn of the lower layer 212, goes over the thirteenth weft yarn of the lower layer 213, goes under the fourteenth weft yarn of the lower layer 214, goes over the fifteenth weft yarn of the lower layer 215, goes under the sixteenth weft yarn of the lower layer 216, goes over the seventeenth weft yarn of the lower layer 217, goes under the eighteenth weft yarn of the lower layer 218, goes over the nineteenth weft yarn of the lower layer 219, goes under the twentieth weft yarn of the lower layer 220, goes over the twenty-first weft yarn of the lower layer 221, goes under the twenty-second weft yarn of the lower layer 222, goes over the twenty-third weft yarn of the lower layer 223, goes under the twenty-fourth weft yarn of the lower layer 224, and goes over the twenty-fifth weft yarn of the lower layer 225.

**[0069]** An end of the second warp yarn of the lower layer 252 goes under the first weft yarn of the lower layer 201, and the other end of the second warp yarn of the lower layer 252 along the length direction goes over the second weft yarn of the lower layer 202, goes under the third weft yarn of the lower layer 203, goes over the fourth weft yarn of the lower layer 204, goes under the fifth weft yarn of the lower layer 205, goes over the sixth weft yarn of the lower layer 206, goes under the seventh weft yarn of the lower layer 207, goes over the eighth weft yarn of the lower layer 208, goes under the ninth weft yarn of the lower layer 209, goes over the tenth weft yarn of the lower layer 210, goes under the eleventh weft yarn of the lower layer 211, goes over the twelfth weft yarn of the lower layer 212, goes under the thirteenth weft yarn of the lower layer 213, goes over the fourteenth weft yarn of the lower layer 214, goes under the fifteenth weft yarn of the lower layer 215, goes over the sixteenth weft yarn of the lower layer 216, goes under the seventeenth weft yarn of the lower layer 217, goes over the eighteenth weft yarn of the lower layer 218, goes under the nineteenth weft yarn of the lower layer 219, goes over the twentieth weft yarn of the lower layer 220, goes under the twenty-first weft yarn of the lower layer 221, goes over the twenty-second weft yarn of the lower layer 222, goes under the twenty-third weft yarn of the lower layer 223, goes over the twenty-fourth weft yarn of the lower layer 224, and goes under the twenty-fifth weft yarn of the lower layer 225.

**[0070]** An end of the third warp yarn of the lower layer 253 goes over the first weft yarn of the lower layer 201, and

the other end of the third warp yarn of the lower layer 253 along the length direction goes under the second weft yarn of the lower layer 202, goes over the third weft yarn of the lower layer 203, goes under the fourth weft yarn of the lower layer 204, goes over the fifth weft yarn of the lower layer 205, goes under the sixth weft yarn of the lower layer 206, goes over the seventh weft yarn of the lower layer 207, goes under the eighth weft yarn of the lower layer 208, goes over the ninth weft yarn of the lower layer 209, goes under the tenth weft yarn of the lower layer 210, goes over the eleventh weft yarn of the lower layer 211, goes under the twelfth weft yarn of the lower layer 212, goes over the thirteenth weft yarn of the lower layer 213, goes under the fourteenth weft yarn of the lower layer 214, goes over the fifteenth weft yarn of the lower layer 215, goes under the sixteenth weft yarn of the lower layer 216, goes over the seventeenth weft yarn of the lower layer 217, goes under the eighteenth weft yarn of the lower layer 218, goes over the nineteenth weft yarn of the lower layer 219, goes under the twentieth weft yarn of the lower layer 220, goes over the twenty-first weft yarn of the lower layer 221, goes under the twenty-second weft yarn of the lower layer 222, goes over the twenty-third weft yarn of the lower layer 223, goes under the twenty-fourth weft yarn of the lower layer 224, and goes over the twenty-fifth weft yarn of the lower layer 225.

**[0071]** An end of the fourth warp yarn of the lower layer 254 goes under the first weft yarn of the lower layer 201, and the other end of the fourth warp yarn of the lower layer 254 along the length direction goes over the second weft yarn of the lower layer 202, goes under the third weft yarn of the lower layer 203, goes over the fourth weft yarn of the lower layer 204, goes under the fifth weft yarn of the lower layer 205, goes over the sixth weft yarn of the lower layer 206, goes under the seventh weft yarn of the lower layer 207, goes over the eighth weft yarn of the lower layer 208, goes under the ninth weft yarn of the lower layer 209, goes over the tenth weft yarn of the lower layer 210, goes under the eleventh weft yarn of the lower layer 211, goes over the twelfth weft yarn of the lower layer 212, goes under the thirteenth weft yarn of the lower layer 213, goes over the fourteenth weft yarn of the lower layer 214, goes under the fifteenth weft yarn of the lower layer 215, goes over the sixteenth weft yarn of the lower layer 216, goes under the seventeenth weft yarn of the lower layer 217, goes over the eighteenth weft yarn of the lower layer 218, goes under the nineteenth weft yarn of the lower layer 219, goes over the twentieth weft yarn of the lower layer 220, goes under the twenty-first weft yarn of the lower layer 221, goes over the twenty-second weft yarn of the lower layer 222, goes under the twenty-third weft yarn of the lower layer 223, goes over the twenty-fourth weft yarn of the lower layer 224, and goes under the twenty-fifth weft yarn of the lower layer 225.

**[0072]** An end of the fifth warp yarn of the lower layer 255 goes under the first weft yarn of the lower layer 201, and the other end of the fifth warp yarn of the lower layer 255 along the length direction goes over the second weft yarn of the lower layer 202, goes under the third weft yarn of the lower layer 203, goes over the fourth weft yarn of the lower layer 204, goes under the fifth weft yarn of the lower layer 205, goes over the sixth weft yarn of the lower layer 206, goes under the seventh weft yarn of the lower layer 207, goes over the eighth weft yarn of the lower layer 208, goes under the ninth weft yarn of the lower layer 209, goes over the tenth weft yarn of the lower layer 210, goes under the eleventh weft yarn of the lower layer 211, goes over the twelfth weft yarn of the lower layer 212, goes under the thirteenth weft yarn of the lower layer 213, goes over the fourteenth weft yarn of the lower layer 214, goes under the fifteenth weft yarn of the lower layer 215, goes over the sixteenth weft yarn of the lower layer 216, goes under the seventeenth weft yarn of the lower layer 217, goes over the eighteenth weft yarn of the lower layer 218, goes under the nineteenth weft yarn of the lower layer 219, goes over the twentieth weft yarn of the lower layer 220, goes under the twenty-first weft yarn of the lower layer 221, goes over the twenty-second weft yarn of the lower layer 222, goes under the twenty-third weft yarn of the lower layer 223, goes over the twenty-fourth weft yarn of the lower layer 224, and goes under the twenty-fifth weft yarn of the lower layer 225.

**[0073]** An end of the sixth warp yarn of the lower layer 256 goes over the first weft yarn of the lower layer 201, the other end of the sixth warp yarn of the lower layer 256 along the length direction goes under the second weft yarn of the lower layer 202, goes over the third weft yarn of the lower layer 203, goes under the fourth weft yarn of the lower layer 204, goes over the fifth weft yarn of the lower layer 205, goes under the sixth weft yarn of the lower layer 206, goes over the seventh weft yarn of the lower layer 207, goes under the eighth weft yarn of the lower layer 208, goes over the ninth weft yarn of the lower layer 209, goes under the tenth weft yarn of the lower layer 210, goes over the eleventh weft yarn of the lower layer 211, goes under the twelfth weft yarn of the lower layer 212, goes over the thirteenth weft yarn of the lower layer 213, goes under the fourteenth weft yarn of the lower layer 214, goes over the fifteenth weft yarn of the lower layer 215, goes under the sixteenth weft yarn of the lower layer 216, goes over the seventeenth weft yarn of the lower layer 217, goes under the eighteenth weft yarn of the lower layer 218, goes over the nineteenth weft yarn of the lower layer 219, goes under the twentieth weft yarn of the lower layer 220, goes over the twenty-first weft yarn of the lower layer 221, goes under the twenty-second weft yarn of the lower layer 222, goes over the twenty-third weft yarn of the lower layer 223, goes under the twenty-fourth weft yarn of the lower layer 224, and goes over the twenty-fifth weft yarn of the lower layer 225.

**[0074]** An end of the seventh warp yarn of the lower layer 257 goes under the first weft yarn of the lower layer 201, and the other end of the seventh warp yarn of the lower layer 257 along the length direction goes over the second weft yarn of the lower layer 202, goes under the third weft yarn of the lower layer 203, goes over the fourth weft yarn of the

lower layer 204, goes under the fifth weft yarn of the lower layer 205, goes over the sixth weft yarn of the lower layer 206, goes under the seventh weft yarn of the lower layer 207, goes over the eighth weft yarn of the lower layer 208, goes under the ninth weft yarn of the lower layer 209, goes over the tenth weft yarn of the lower layer 210, goes under the eleventh weft yarn of the lower layer 211, goes over the twelfth weft yarn of the lower layer 212, goes under the thirteenth weft yarn of the lower layer 213, goes over the fourteenth weft yarn of the lower layer 214, goes under the fifteenth weft yarn of the lower layer 215, goes over the sixteenth weft yarn of the lower layer 216, goes under the seventeenth weft yarn of the lower layer 217, goes over the eighteenth weft yarn of the lower layer 218, goes under the nineteenth weft yarn of the lower layer 219, goes over the twentieth weft yarn of the lower layer 220, goes under the twenty-first weft yarn of the lower layer 221, goes over the twenty-second weft yarn of the lower layer 222, goes under the twenty-third weft yarn of the lower layer 223, goes over the twenty-fourth weft yarn of the lower layer 224, and goes under the twenty-fifth weft yarn of the lower layer 225.

**[0075]** An end of the eighth warp yarn of the lower layer 258 goes over the first weft yarn of the lower layer 201, and the other end of the eighth warp yarn of the lower layer 258 along the length direction goes under the second weft yarn of the lower layer 202, goes over the third weft yarn of the lower layer 203, goes under the fourth weft yarn of the lower layer 204, goes over the fifth weft yarn of the lower layer 205, goes under the sixth weft yarn of the lower layer 206, goes over the seventh weft yarn of the lower layer 207, goes under the eighth weft yarn of the lower layer 208, goes over the ninth weft yarn of the lower layer 209, goes under the tenth weft yarn of the lower layer 210, goes over the eleventh weft yarn of the lower layer 211, goes under the twelfth weft yarn of the lower layer 212, goes over the thirteenth weft yarn of the lower layer 213, goes under the fourteenth weft yarn of the lower layer 214, goes over the fifteenth weft yarn of the lower layer 215, goes under the sixteenth weft yarn of the lower layer 216, goes over the seventeenth weft yarn of the lower layer 217, goes under the eighteenth weft yarn of the lower layer 218, goes over the nineteenth weft yarn of the lower layer 219, goes under the twentieth weft yarn of the lower layer 220, goes over the twenty-first weft yarn of the lower layer 221, goes under the twenty-second weft yarn of the lower layer 222, goes over the twenty-third weft yarn of the lower layer 223, goes under the twenty-fourth weft yarn of the lower layer 224, and goes over the twenty-fifth weft yarn of the lower layer 225.

**[0076]** In the present invention, the ratio of the number of the weft yarns of the upper layer in the upper layer fabric texture 1 to the number of the weft yarns of the lower layer in the lower layer fabric texture 2 can be 1:1, 1:2, 1:3, 1:4 or larger proportion.

**[0077]** In the present invention, up and down of the warp and weft yarns in the lower layer fabric texture 2 forms a plain weave fabric.

3. SUPPORTING FABRIC TEXTURE 3

**[0078]** Referring to Fig.1 and Fig.1A, the supporting fabric texture 3 in the present invention comprises a first connecting yarn 31, a second connecting yarn 32, a third connecting yarn 33 and a fourth connecting yarn 34; the first connecting yarn 31 is placed outside of the first warp yarn of the lower layer 251, the second connecting yarn 32 is placed outside of the fourth warp yarn of the lower layer 254, the third connecting yarn 33 is placed outside of the fifth warp yarn of the lower layer 255, and the fourth connecting yarn 34 is placed outside of the eighth warp yarn of the lower layer 258; the second connecting yarn 32 and the third connecting yarn 33 are disposed to be adjacent.

**[0079]** The supporting fabric texture 3 is such structured that an end of the first connecting yarn 31 goes under the first weft yarn of the lower layer 201, and the other end of the first connecting yarn 31 along the length direction goes over the second weft yarn of the lower layer 202, goes under the third weft yarn of the lower layer 203, goes over the fourth weft yarn of the lower layer 204, goes under the fifth weft yarn of the lower layer 205, goes over the fourth weft yarn of the upper layer 104, goes under the fifth weft yarn of the upper layer 105, goes over the sixth weft yarn of the upper layer 106, goes under the thirteenth weft yarn of the lower layer 213, goes over the fourteenth weft yarn of the lower layer 214, goes under the fifteenth weft yarn of the lower layer 215, goes over the sixteenth weft yarn of the lower layer 216, goes under the seventeenth weft yarn of the lower layer 217, goes over the tenth weft yarn of the upper layer 110, goes under the eleventh weft yarn of the upper layer 111, goes over the twelfth weft yarn of the upper layer 112, and goes under the twenty-fifth weft yarn of the lower layer 225; and when the first connecting yarn 31 is guided from the lower layer fabric texture 2 to the upper layer fabric texture 1, the first connecting yarn 31 is placed between the second warp yarn of the upper layer 152 and the third warp yarn of the upper layer 153.

**[0080]** An end of the second connecting yarn 32 goes under the first weft yarn of the lower layer 201, and the other end of the second connecting yarn 32 along the length direction goes over the second weft yarn of the lower layer 202, goes under the third weft yarn of the lower layer 203, goes over the fourth weft yarn of the lower layer 204, goes under the fifth weft yarn of the lower layer 205, goes over the fourth weft yarn of the upper layer 104, goes under the fifth weft yarn of the upper layer 105, goes over the sixth weft yarn of the upper layer 106, goes under the thirteenth weft yarn of the lower layer 213, goes over the fourteenth weft yarn of the lower layer 214, goes under the fifteenth weft yarn of the lower layer 215, goes over the sixteenth weft yarn of the lower layer 216, goes under the seventeenth weft yarn of the

lower layer 217, goes over the tenth weft yarn of the upper layer 110, goes under the eleventh weft yarn of the upper layer 111, goes over the twelfth weft yarn of the upper layer 112, and goes under the twenty-fifth weft yarn of the lower layer 225; and when the second connecting yarn 32 is guided from the lower layer fabric texture 2 to the upper layer fabric texture 1, the second connecting yarn 32 is placed between the second warp yarn of the upper layer 152 and the third warp yarn of the upper layer 153.

**[0081]** An end of the third connecting yarn 33 goes under the first weft yarn of the upper layer 101, and the other end of the third connecting yarn 33 along the length direction goes over the second weft yarn of the upper layer 102, goes under the fifth weft yarn of the lower layer 205, goes over the sixth weft yarn of the lower layer 206, goes under the seventh weft yarn of the lower layer 207, goes over the eighth weft yarn of the lower layer 208, goes under the ninth weft yarn of the lower layer 209, goes over the sixth weft yarn of the upper layer 106, goes under the seventh weft yarn of the upper layer 107, goes over the eighth weft yarn of the upper layer 108, goes under the seventeenth weft yarn of the lower layer 217, goes over the eighteenth weft yarn of the lower layer 218, goes under the nineteenth weft yarn of the lower layer 219, goes over the twentieth weft yarn of the lower layer 220, goes under the twenty-first weft yarn of the lower layer 221, goes over the twelfth weft yarn of the upper layer 112, and goes under the thirteenth weft yarn of the upper layer 113; and when the third connecting yarn 33 is guided from the lower layer fabric texture 2 to the upper layer fabric texture 1, the third connecting yarn 33 is placed between the sixth warp yarn of the upper layer 156 and the seventh warp yarn of the upper layer 157.

**[0082]** An end of the fourth connecting yarn 34 goes under the first weft yarn of the upper layer 101, and the other end of the fourth connecting yarn 34 along the length direction goes over the second weft yarn of the upper layer 102, goes under the fifth weft yarn of the lower layer 205, goes over the sixth weft yarn of the lower layer 206, goes under the seventh weft yarn of the lower layer 207, goes over the eighth weft yarn of the lower layer 208, goes under the ninth weft yarn of the lower layer 209, goes over the sixth weft yarn of the upper layer 106, goes under the seventh weft yarn of the upper layer 107, goes over the eighth weft yarn of the upper layer 108, goes under the seventeenth weft yarn of the lower layer 217, goes over the eighteenth weft yarn of the lower layer 218, goes under the nineteenth weft yarn of the lower layer 219, goes over the twentieth weft yarn of the lower layer 220, goes under the twenty-first weft yarn of the lower layer 221, goes over the twelfth weft yarn of the upper layer 112, and goes under the thirteenth weft yarn of the upper layer 113; and when the fourth connecting yarn 34 is guided from the lower layer fabric texture 2 to the upper layer fabric texture 1, the fourth connecting yarn 34 is placed between the sixth warp yarn of the upper layer 156 and the seventh warp yarn of the upper layer 157.

**[0083]** In the present invention, since the first connecting yarn 31 and the second connecting yarn 32 are placed between the second warp yarn of the upper layer 152 and the third warp yarn of the upper layer 153 in the upper layer fabric texture 1, when the first amphi-positioning warp yarn 11 and the second amphi-positioning warp yarn 12 gather and twist, the first connecting yarn 31 and the second connecting yarn 32 are also gathered and twisted, so that the first connecting yarn 31 and the second connecting yarn 32 in the upper layer fabric texture 1 cannot slide relative to weft yarns and thus ensure a stable mesh structure of the upper layer fabric texture.

**[0084]** In the present invention, since the third connecting yarn 33 and the fourth connecting yarn 34 are placed between the sixth warp yarn of the upper layer 156 and the seventh warp yarn of the upper layer 157 in the upper layer fabric texture 1, when the third amphi-positioning warp yarn 13 and the fourth amphi-positioning warp yarn 14 gather and twist, the third connecting yarn 33 and the fourth connecting yarn 34 are also gathered and twisted, so that the third connecting yarn 33 and the fourth connecting yarn 34 in the upper layer fabric texture 1 cannot slide relative to weft yarns and thus ensure a stable mesh structure of the upper layer fabric texture.

**[0085]** In the present invention, the connecting manner of the first connecting yarn 31 in the upper layer fabric texture 1 and lower layer fabric texture 2 is the same as that of the second connecting yarn 32, and the connecting manner of the third connecting yarn 33 in the upper layer fabric texture 1 and lower layer fabric texture 2 is the same as that of the fourth connecting yarn 34.

**[0086]** Referring to Fig.2, the first connecting yarn 31 and the second connecting yarn 32 overlap, and the third connecting yarn 33 and the fourth connecting yarn 34 overlap; the connection of the first connecting yarn 31 and second connecting yarn 32 in the upper layer fabric texture 1 and the lower layer fabric texture 2 constitutes a continuous Ω shape (simply referred as a first front Ω shape), and the connection of the third connecting yarn 33 and the fourth connecting yarn 34 in the upper layer fabric texture 1 and the lower layer fabric texture 2 constitutes a continuous Ω shape (simply referred as a second front Ω shape). The first front Ω shape and the second front Ω shape offset in the lower layer fabric texture 2 by three weft yarns; the first front Ω shape and the second front Ω shape offset in the upper layer fabric texture 1 by one weft yarn.

**[0087]** In the present invention, height of the woven three-dimensional interval grid fabric with a crossed warp structure is defined as $H_{height}$. The height $H_{height}$ indicates the spacing between the weft yarn in the upper layer fabric texture 1 and the weft yarn in the lower layer fabric texture 2. The height $H_{height}$ is also the guiding height of the connecting yarn. $H_{height}$=20mm~300mm.

**[0088]** Referring to Fig. 3, the first connecting yarn 31 and the second connecting yarn 32 are placed between the

second warp yarn of the upper layer 152 and the third warp yarn of the upper layer 153 in the upper layer fabric texture 1, with the first connecting yarn 31 placed outside of the first warp yarn of the lower layer 251 in the lower layer fabric texture 2 and the second connecting yarn 32 placed outside of the fourth warp yarn of the lower layer 254 in the lower layer fabric texture 2; the connection of the first connecting yarn 31 and second connecting yarn 32 in the upper layer fabric texture 1 and the lower layer fabric texture 2 constitutes a continuous triangular shape; the third connecting yarn 33 and fourth connecting yarn 34 are placed between the sixth warp yarn of the upper layer 156 and the seventh warp yarn of the upper layer 157 in the upper layer fabric texture 1, with the third connecting yarn 33 placed outside of the fifth warp yarn of the lower layer 255 in the lower layer fabric texture 2 and the fourth connecting yarn 34 placed outside of the eighth warp yarn of the lower layer 258 in the lower layer fabric texture 2; the connection of the third connecting yarn 33 and the fourth connecting yarn 34 in the upper layer fabric texture 1 and the lower layer fabric texture 2 constitutes a continuous triangular shape.

**[0089]** In the woven three-dimensional interval grid fabric with a crossed warp structure designed by the present invention, four connecting yarns are in a triangular shape in the width direction and in an Ω shape in the length direction. The combination of the triangular shape and Ω shape in these two directions supports the upper layer fabric texture 1 and the lower layer fabric texture 2. In a woven three-dimensional interval grid fabric of this kind, the upper layer fabric texture 1 (rectangular frame fabric) is also referred to as the upper layer, the lower layer fabric texture 2 (plain wave fabric) is also referred to as the lower layer, the intermediate triangular shape and Q shape are also referred to as the intermediate layer. In a broad sense for the structure of the upper and lower layers, the lower layer (lower layer fabric texture 2) may be transformed into the structure of the upper layer (upper layer fabric texture 1); both of the upper and lower layers may be the structure of the upper layer (upper layer fabric texture 1).

**[0090]** Referring to Fig.1, Fig.1A, Fig.2 and Fig.3, the first structure of the woven three-dimensional interval grid fabric with a crossed warp structure designed by the present invention is such that the upper layer fabric texture 1 is a rectangular frame fabric, the lower layer fabric texture 2 is a plain wave fabric, the supporting fabric texture 3 is in a triangular shape in the width direction, and four connecting yarns are in an Ω shape in the length direction.

**[0091]** Referring to Fig.1, Fig.1A, Fig.2 and Fig.3, the second structure of the woven three-dimensional interval grid fabric with a crossed warp structure designed by the present invention is such that the upper layer fabric texture 1 is a rectangular frame fabric, the lower layer fabric texture 2 is a rectangular frame fabric, the supporting fabric texture 3 is in a triangular shape in the width direction, and four connecting yarns are in an Ω shape in the length direction.

**[0092]** In the woven three-dimensional interval grid fabric with a crossed warp structure of the present invention, the fiber material adopted in the upper layer fabric texture 1, the lower layer fabric texture 2 and the supporting fabric texture 3 may be one of metal fiber, inorganic fiber, synthetic fiber and plant fiber, or a combination thereof.

**[0093]** Specifically, material of the fiber may be the combination of two or more of the polyethylene fiber, polyarnide fiber, polyolefin fiber, ceramic fiber, carbon fiber, aramid fiber, PBO fiber, M5 fiber, basalt fiber, glass fiber, polypropylene fiber, polyester fiber, spandex fiber, dimensional acrylic fiber, nylon fiber, polyvinyl alcohol fiber, polyvinyl chloride fiber, hemp, sisal fiber, flax fiber, bamboo fiber, jute fiber, which are similar to the metal fiber, inorganic fiber, synthetic fiber and plant fiber.

**[0094]** More specifically, material of the fiber may be E glass fiber roving having a linear density of 68 tex-2400 tex (unit: tex), or be IK-12K carbon fiber in which K is refered to as the number of the carbon fibers in one bundle of fiber yarn.

**[0095]** In the woven three-dimensional interval grid fabric with a crossed warp structure of the present invention, material of the warp and weft yarns in the upper layer fabric texture 1 and the lower layer fabric texture 2 is 600 tex high strength polyethylene, material of the amphi-positioning warp yarns in the upper layer fabric texture 1 is 200 D(unit: denier) stretch nylon or 168 tex glass fiber, and the connecting yarns in the supporting fabric texture 3 are made of 900tex E glass fiber roving.

## Claims

1. A woven three-dimensional interval grid fabric with a crossed warp structure, **characterized in that**: the fabric comprises an upper layer fabric texture (1), a lower layer fabric texture (2) and a supporting fabric texture (3);
   the upper layer fabric texture (1) is such structured that the first weft yarn of the upper layer (101), the second weft yarn of the upper layer (102), the third weft yarn of the upper layer (103), the fourth weft yarn of the upper layer (104), the fifth weft yarn of the upper layer (105), the sixth weft yarn of the upper layer (106), the seventh weft yarn of the upper layer (107), the eighth weft yarn of the upper layer (108), the ninth weft yarn of the upper layer (109), the tenth weft yarn of the upper layer (110), the eleventh weft yarn of the upper layer (111), the twelfth weft yarn of the upper layer (112) and the thirteenth weft yarn of the upper layer (113) are arranged in array in the length direction at an upper layer equidistance $D_{upper}$;
   an end of the first warp yarn of the upper layer (151) goes under the first weft yarn of the upper layer (101), and the other end of the first warp yarn of the upper layer (151) along the length direction goes over the second weft yarn

of the upper layer (102), goes under the third weft yarn of the upper layer (103), goes over the fourth weft yarn of the upper layer (104), goes under the fifth weft yarn of the upper layer (105), goes over the sixth weft yarn of the upper layer (106), goes under the seventh weft yarn of the upper layer (107), goes over the eighth weft yarn of the upper layer (108), goes under the ninth weft yarn of the upper layer (109), goes over the tenth weft yarn of the upper layer (110), goes under the eleventh weft yarn of the upper layer (111), goes over the twelfth weft yarn of the upper layer (112), and goes under the thirteenth weft yarn of the upper layer (113);

an end of the second warp yarn of the upper layer (152) goes over the first weft yarn of the upper layer (101), and the other end of the second warp yarn of the upper layer (152) along the length direction goes under the second weft yarn of the upper layer (102), goes over the third weft yarn of the upper layer (103), goes under the fourth weft yarn of the upper layer (104), goes over the fifth weft yarn of the upper layer (105), goes under the sixth weft yarn of the upper layer (106), goes over the seventh weft yarn of the upper layer (107), goes under the eighth weft yarn of the upper layer (108), goes over the ninth weft yarn of the upper layer (109), goes under the tenth weft yarn of the upper layer (110), goes over the eleventh weft yarn of the upper layer (111), goes under the twelfth weft yarn of the upper layer (112), and goes over the thirteenth weft yarn of the upper layer (113);

an end of the third warp yarn of the upper layer (153) goes under the first weft yarn of the upper layer (101), and the other end of the third warp yarn of the upper layer (153) along the length direction goes over the second weft yarn of the upper layer (102), goes under the third weft yarn of the upper layer (103), goes over the fourth weft yarn of the upper layer (104), goes under the fifth weft yarn of the upper layer (105), goes over the sixth weft yarn of the upper layer (106), goes under the seventh weft yarn of the upper layer (107), goes over the eighth weft yarn of the upper layer (108), goes under the ninth weft yarn of the upper layer (109), goes over the tenth weft yarn of the upper layer (110), goes under the eleventh weft yarn of the upper layer (111), goes over the twelfth weft yarn of the upper layer (112), and goes under the thirteenth weft yarn of the upper layer (113);

an end of the fourth warp yarn of the upper layer (154) goes over the first weft yarn of the upper layer (101), and the other end of the fourth warp yarn of the upper layer (154) along the length direction goes under the second weft yarn of the upper layer (102), goes over the third weft yarn of the upper layer (103), goes under the fourth weft yarn of the upper layer (104), goes over the fifth weft yarn of the upper layer (105), goes under the sixth weft yarn of the upper layer (106), goes over the seventh weft yarn of the upper layer (107), goes under the eighth weft yarn of the upper layer (108), goes over the ninth weft yarn of the upper layer (109), goes under the tenth weft yarn of the upper layer (110), goes over the eleventh weft yarn of the upper layer (111), goes under the twelfth weft yarn of the upper layer (112), and goes over the thirteenth weft yarn of the upper layer (113);

an end of the fifth warp yarn of the upper layer (155) goes under the first weft yarn of the upper layer (101), and the other end of the fifth warp yarn of the upper layer (155) along the length direction goes over the second weft yarn of the upper layer (102), goes under the third weft yarn of the upper layer (103), goes over the fourth weft yarn of the upper layer (104), goes under the fifth weft yarn of the upper layer (105), goes over the sixth weft yarn of the upper layer (106), goes under the seventh weft yarn of the upper layer (107), goes over the eighth weft yarn of the upper layer (108), goes under the ninth weft yarn of the upper layer (109), goes over the tenth weft yarn of the upper layer (110), goes under the eleventh weft yarn of the upper layer (111), goes over the twelfth weft yarn of the upper layer (112), and goes under the thirteenth weft yarn of the upper layer (113);

an end of the sixth warp yarn of the upper layer (156) goes over the first weft yarn of the upper layer (101), and the other end of the sixth warp yarn of the upper layer (156) along the length direction goes under the second weft yarn of the upper layer (102), goes over the third weft yarn of the upper layer (103), goes under the fourth weft yarn of the upper layer (104), goes over the fifth weft yarn of the upper layer (105), goes under the sixth weft yarn of the upper layer (106), goes over the seventh weft yarn of the upper layer (107), goes under the eighth weft yarn of the upper layer (108), goes over the ninth weft yarn of the upper layer (109), goes under the tenth weft yarn of the upper layer (110), goes over the eleventh weft yarn of the upper layer (111), goes under the twelfth weft yarn of the upper layer (112), and goes over the thirteenth weft yarn of the upper layer (113);

an end of the seventh warp yarn of the upper layer (157) goes under the first weft yarn of the upper layer (101), and the other end of the seventh warp yarn of the upper layer (157) along the length direction goes over the second weft yarn of the upper layer (102), goes under the third weft yarn of the upper layer (103), goes over the fourth weft yarn of the upper layer (104), goes under the fifth weft yarn of the upper layer (105), goes over the sixth weft yarn of the upper layer (106), goes under the seventh weft yarn of the upper layer (107), goes over the eighth weft yarn of the upper layer (108), goes under the ninth weft yarn of the upper layer (109), goes over the tenth weft yarn of the upper layer (110), goes under the eleventh weft yarn of the upper layer (111), goes over the twelfth weft yarn of the upper layer (112), and goes under the thirteenth weft yarn of the upper layer (113);

an end of the eighth warp yarn of the upper layer (158) goes over the first weft yarn of the upper layer (101), and the other end of the eighth warp yarn of the upper layer (158) along the length direction goes under the second weft yarn of the upper layer (102), goes over the third weft yarn of the upper layer (103), goes under the fourth weft yarn of the upper layer (104), goes over the fifth weft yarn of the upper layer (105), goes under the sixth weft yarn of the

upper layer (106), goes over the seventh weft yarn of the upper layer (107), goes under the eighth weft yarn of the upper layer (108), goes over the ninth weft yarn of the upper layer (109), goes under the tenth weft yarn of the upper layer (110), goes over the eleventh weft yarn of the upper layer (111), goes under the twelfth weft yarn of the upper layer (112), and goes over the thirteenth weft yarn of the upper layer (113);

an end of a first amphi-positioning warp yarn (11) is placed outside of the first warp yarn of the upper layer (151) and goes under the first weft yarn of the upper layer (101), and the other end of the first amphi-positioning warp yarn (11) moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the second weft yarn of the upper layer (102); the first amphi-positioning warp yarn (11) moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the third weft yarn of the upper layer (103); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the fourth weft yarn of the upper layer (104); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the fifth weft yarn of the upper layer (105); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the sixth weft yarn of the upper layer (106); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the seventh weft yarn of the upper layer (107); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the eighth weft yarn of the upper layer (108); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the ninth weft yarn of the upper layer (109); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the tenth weft yarn of the upper layer (110), moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the eleventh weft yarn of the upper layer (111); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the twelfth weft yarn of the upper layer (112); and moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the thirteenth weft yarn of the upper layer (113);

an end of a second amphi-positioning warp yarn (12) is placed outside of the fourth warp yarn of the upper layer (154) and goes under the first weft yarn of the upper layer (101), and the other end of the second amphi-positioning warp yarn (12) moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the second weft yarn of the upper layer (102); the second amphi-positioning warp yarn (12) moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the third weft yarn of the upper layer (103); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the fourth weft yarn of the upper layer (104); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the fifth weft yarn of the upper layer (105); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the sixth weft yarn of the upper layer (106); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the seventh weft yarn of the upper layer (107); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the eighth weft yarn of the upper layer (108); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the ninth weft yarn of the upper layer (109); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the tenth weft yarn of the upper layer (110); moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the eleventh weft yarn of the upper layer (111); moves transversely to the outside of the first warp yarn of the upper layer (151) and goes under the twelfth weft yarn of the upper layer (112); and moves transversely to the outside of the fourth warp yarn of the upper layer (154) and goes under the thirteenth weft yarn of the upper layer (113);

an end of a third amphi-positioning warp yarn (13) is placed outside of the fifth warp yarn of the upper layer (155) and goes under the first weft yarn of the upper layer (101), and the other end of the third amphi-positioning warp yarn (13) moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the second weft yarn of the upper layer (102); the third amphi-positioning warp yarn (13) moves transversely in the length direction in such a cycle manner that moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the third weft yarn of the upper layer (103); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the fourth weft yarn of the upper layer (104); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the fifth weft yarn of the upper layer (105); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the sixth weft yarn of the upper layer (106); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the seventh weft yarn of the upper layer (107); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the eighth weft yarn of the upper layer (108); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the ninth weft yarn of the upper layer (109); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the tenth weft yarn of the upper layer (110); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the eleventh weft yarn of the upper layer (111); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the twelfth weft yarn of the upper layer (112); and moves

transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the thirteenth weft yarn of the upper layer (113);

an end of a fourth amphi-positioning warp yarn (14) is placed outside of the eighth warp yarn of the upper layer (158) and goes under the first weft yarn of the upper layer (101), and the other end of the fourth amphi-positioning warp yarn (14) moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the second weft yarn of the upper layer (102); the fourth amphi-positioning warp yarn (14) moves transversely in the length directioni in such a cycle manner that moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the third weft yarn of the upper layer (103); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the fourth weft yarn of the upper layer (104); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the fifth weft yarn of the upper layer (105); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the sixth weft yarn of the upper layer (106); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the seventh weft yarn of the upper layer (107); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the eighth weft yarn of the upper layer (108); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the ninth weft yarn of the upper layer (109); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the tenth weft yarn of the upper layer (110); moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the eleventh weft yarn of the upper layer (111); moves transversely to the outside of the fifth warp yarn of the upper layer (155) and goes under the twelfth weft yarn of the upper layer (112); and moves transversely to the outside of the eighth warp yarn of the upper layer (158) and goes under the thirteenth weft yarn of the upper layer (113);

the lower layer fabric texture (2) is such structured that the first weft yarn of the lower layer (201), the second weft yarn of the lower layer (202), the third weft yarn of the lower layer (203), the fourth weft yarn of the lower layer (204), the fifth weft yarn of the lower layer (205), the sixth weft yarn of the lower layer (206), the seventh weft yarn of the lower layer (207), the eighth weft yarn of the lower layer (208), the ninth weft yarn of the lower layer (209), the tenth weft yarn of the lower layer (210), the eleventh weft yarn of the lower layer (211), the twelfth weft yarn of the lower layer (212), the thirteenth weft yarn of the lower layer (213), the fourteenth weft yarn of the lower layer (214), the fifteenth weft yarn of the lower layer (215), the sixteenth weft yarn of the lower layer (216), the seventeenth weft yarn of the lower layer (217), the eighteenth weft yarn of the lower layer (218), the nineteenth weft yarn of the lower layer (219), the twentieth weft yarn of the lower layer (220), the twenty-first weft yarn of the lower layer (221), the twenty-second weft yarn of the lower layer (222), the twenty-third weft yarn of the lower layer (223), the twenty-fourth weft yarn of the lower layer (224) and the twenty-fifth weft yarn of the lower layer (225) are arranged in array in the length direction at a lower layer equidistance $D_{lower}$;

an end of the first warp yarn of the lower layer (251) goes over the first weft yarn of the lower layer (201), and the other end of the first warp yarn of the lower layer (251) along the length direction goes under the second weft yarn of the lower layer (202), goes over the third weft yarn of the lower layer (203), goes under the fourth weft yarn of the lower layer (204), goes over the fifth weft yarn of the lower layer (205), goes under the sixth weft yarn of the lower layer (206), goes over the seventh weft yarn of the lower layer (207), goes under the eighth weft yarn of the lower layer (208), goes over the ninth weft yarn of the lower layer (209), goes under the tenth weft yarn of the lower layer (210), goes over the eleventh weft yarn of the lower layer (211), goes under the twelfth weft yarn of the lower layer (212), goes over the thirteenth weft yarn of the lower layer (213), goes under the fourteenth weft yarn of the lower layer (214), goes over the fifteenth weft yarn of the lower layer (215), goes under the sixteenth weft yarn of the lower layer (216), goes over the seventeenth weft yarn of the lower layer (217), goes under the eighteenth weft yarn of the lower layer (218), goes over the nineteenth weft yarn of the lower layer (219), goes under the twentieth weft yarn of the lower layer (220), goes over the twenty-first weft yarn of the lower layer (221), goes under the twenty-second weft yarn of the lower layer (222), goes over the twenty-third weft yarn of the lower layer (223), goes under the twenty-fourth weft yarn of the lower layer (224), and goes over the twenty-fifth weft yarn of the lower layer (225);

an end of the second warp yarn of the lower layer (252) goes under the first weft yarn of the lower layer (201), and the other end of the second warp yarn of the lower layer (252) along the length direction goes over the second weft yarn of the lower layer (202), goes under the third weft yarn of the lower layer (203), goes over the fourth weft yarn of the lower layer (204), goes under the fifth weft yarn of the lower layer (205), goes over the sixth weft yarn of the lower layer (206), goes under the seventh weft yarn of the lower layer (207), goes over the eighth weft yarn of the lower layer (208), goes under the ninth weft yarn of the lower layer (209), goes over the tenth weft yarn of the lower layer (210), goes under the eleventh weft yarn of the lower layer (211), goes over the twelfth weft yarn of the lower layer (212), goes under the thirteenth weft yarn of the lower layer (213), goes over the fourteenth weft yarn of the lower layer (214), goes under the fifteenth weft yarn of the lower layer (215), goes over the sixteenth weft yarn of the lower layer (216), goes under the seventeenth weft yarn of the lower layer (217), goes over the eighteenth weft yarn of the lower layer (218), goes under the nineteenth weft yarn of the lower layer (219), goes over the twentieth

weft yarn of the lower layer (220), goes under the twenty-first weft yarn of the lower layer (221), goes over the twenty-second weft yarn of the lower layer (222), goes under the twenty-third weft yarn of the lower layer (223), goes over the twenty-fourth weft yarn of the lower layer (224), and goes under the twenty-fifth weft yarn of the lower layer (225); an end of the third warp yarn of the lower layer (253) goes over the first weft yarn of the lower layer (201), and the other end of the third warp yarn of the lower layer (253) along the length direction goes under the second weft yarn of the lower layer (202), goes over the third weft yarn of the lower layer (203), goes under the fourth weft yarn of the lower layer (204), goes over the fifth weft yarn of the lower layer (205), goes under the sixth weft yarn of the lower layer (206), goes over the seventh weft yarn of the lower layer (207), goes under the eighth weft yarn of the lower layer (208), goes over the ninth weft yarn of the lower layer (209), goes under the tenth weft yarn of the lower layer (210), goes over the eleventh weft yarn of the lower layer (211), goes under the twelfth weft yarn of the lower layer (212), goes over the thirteenth weft yarn of the lower layer (213), goes under the fourteenth weft yarn of the lower layer (214), goes over the fifteenth weft yarn of the lower layer (215), goes under the sixteenth weft yarn of the lower layer (216), goes over the seventeenth weft yarn of the lower layer (217), goes under the eighteenth weft yarn of the lower layer (218), goes over the nineteenth weft yarn of the lower layer (219), goes under the twentieth weft yarn of the lower layer (220), goes over the twenty-first weft yarn of the lower layer (221), goes under the twenty-second weft yarn of the lower layer (222), goes over the twenty-third weft yarn of the lower layer (223), goes under the twenty-fourth weft yarn of the lower layer (224), and goes over the twenty-fifth weft yarn of the lower layer (225); an end of the fourth warp yarn of the lower layer (254) goes under the first weft yarn of the lower layer (201), and the other end of the fourth warp yarn of the lower layer (254) along the length direction goes over the second weft yarn of the lower layer (202), goes under the third weft yarn of the lower layer (203), goes over the fourth weft yarn of the lower layer (204), goes under the fifth weft yarn of the lower layer (205), goes over the sixth weft yarn of the lower layer (206), goes under the seventh weft yarn of the lower layer (207), goes over the eighth weft yarn of the lower layer (208), goes under the ninth weft yarn of the lower layer (209), goes over the tenth weft yarn of the lower layer (210), goes under the eleventh weft yarn of the lower layer (211), goes over the twelfth weft yarn of the lower layer (212), goes under the thirteenth weft yarn of the lower layer (213), goes over the fourteenth weft yarn of the lower layer (214), goes under the fifteenth weft yarn of the lower layer (215), goes over the sixteenth weft yarn of the lower layer (216), goes under the seventeenth weft yarn of the lower layer (217), goes over the eighteenth weft yarn of the lower layer (218), goes under the nineteenth weft yarn of the lower layer (219), goes over the twentieth weft yarn of the lower layer (220), goes under the twenty-first weft yarn of the lower layer (221), goes over the twenty-second weft yarn of the lower layer (222), goes under the twenty-third weft yarn of the lower layer (223), goes over the twenty-fourth weft yarn of the lower layer (224), and goes under the twenty-fifth weft yarn of the lower layer (225); an end of the fifth warp yarn of the lower layer (255) goes under the first weft yarn of the lower layer (201), and the other end of the fifth warp yarn of the lower layer (255) along the length direction goes over the second weft yarn of the lower layer (202), goes under the third weft yarn of the lower layer (203), goes over the fourth weft yarn of the lower layer (204), goes under the fifth weft yarn of the lower layer (205), goes over the sixth weft yarn of the lower layer (206), goes under the seventh weft yarn of the lower layer (207), goes over the eighth weft yarn of the lower layer (208), goes under the ninth weft yarn of the lower layer (209), goes over the tenth weft yarn of the lower layer (210), goes under the eleventh weft yarn of the lower layer (211), goes over the twelfth weft yarn of the lower layer (212), goes under the thirteenth weft yarn of the lower layer (213), goes over the fourteenth weft yarn of the lower layer (214), goes under the fifteenth weft yarn of the lower layer (215), goes over the sixteenth weft yarn of the lower layer (216), goes under the seventeenth weft yarn of the lower layer (217), goes over the eighteenth weft yarn of the lower layer (218), goes under the nineteenth weft yarn of the lower layer (219), goes over the twentieth weft yarn of the lower layer (220), goes under the twenty-first weft yarn of the lower layer (221), goes over the twenty-second weft yarn of the lower layer (222), goes under the twenty-third weft yarn of the lower layer (223), goes over the twenty-fourth weft yarn of the lower layer (224), and goes under the twenty-fifth weft yarn of the lower layer (225); an end of the sixth warp yarn of the lower layer (256) goes over the first weft yarn of the lower layer (201), the other end of the sixth warp yarn of the lower layer (256) along the length direction goes under the second weft yarn of the lower layer (202), goes over the third weft yarn of the lower layer (203), goes under the fourth weft yarn of the lower layer (204), goes over the fifth weft yarn of the lower layer (205), goes under the sixth weft yarn of the lower layer (206), goes over the seventh weft yarn of the lower layer (207), goes under the eighth weft yarn of the lower layer (208), goes over the ninth weft yarn of the lower layer (209), goes under the tenth weft yarn of the lower layer (210), goes over the eleventh weft yarn of the lower layer (211), goes under the twelfth weft yarn of the lower layer (212), goes over the thirteenth weft yarn of the lower layer (213), goes under the fourteenth weft yarn of the lower layer (214), goes over the fifteenth weft yarn of the lower layer (215), goes under the sixteenth weft yarn of the lower layer (216), goes over the seventeenth weft yarn of the lower layer (217), goes under the eighteenth weft yarn of the lower layer (218), goes over the nineteenth weft yarn of the lower layer (219), goes under the twentieth weft yarn of the lower layer (220), goes over the twenty-first weft yarn of the lower layer (221), goes under the twenty-second weft yarn of the lower layer (222), goes over the twenty-third weft yarn of the lower layer (223), goes under the twenty-

fourth weft yarn of the lower layer (224), and goes over the twenty-fifth weft yarn of the lower layer (225);
an end of the seventh warp yarn of the lower layer (257) goes under the first weft yarn of the lower layer (201), and the other end of the seventh warp yarn of the lower layer (257) along the length direction goes over the second weft yarn of the lower layer (202), goes under the third weft yarn of the lower layer (203), goes over the fourth weft yarn of the lower layer (204), goes under the fifth weft yarn of the lower layer (205), goes over the sixth weft yarn of the lower layer (206), goes under the seventh weft yarn of the lower layer (207), goes over the eighth weft yarn of the lower layer (208), goes under the ninth weft yarn of the lower layer (209), goes over the tenth weft yarn of the lower layer (210), goes under the eleventh weft yarn of the lower layer (211), goes over the twelfth weft yarn of the lower layer (212), goes under the thirteenth weft yarn of the lower layer (213), goes over the fourteenth weft yarn of the lower layer (214), goes under the fifteenth weft yarn of the lower layer (215), goes over the sixteenth weft yarn of the lower layer (216), goes under the seventeenth weft yarn of the lower layer (217), goes over the eighteenth weft yarn of the lower layer (218), goes under the nineteenth weft yarn of the lower layer (219), goes over the twentieth weft yarn of the lower layer (220), goes under the twenty-first weft yarn of the lower layer (221), goes over the twenty-second weft yarn of the lower layer (222), goes under the twenty-third weft yarn of the lower layer (223), goes over the twenty-fourth weft yarn of the lower layer (224), and goes under the twenty-fifth weft yarn of the lower layer (225);
an end of the eighth warp yarn of the lower layer (258) goes over the first weft yarn of the lower layer (201), and the other end of the eighth warp yarn of the lower layer (258) along the length direction goes under the second weft yarn of the lower layer (202), goes over the third weft yarn of the lower layer (203), goes under the fourth weft yarn of the lower layer (204), goes over the fifth weft yarn of the lower layer (205), goes under the sixth weft yarn of the lower layer (206), goes over the seventh weft yarn of the lower layer (207), goes under the eighth weft yarn of the lower layer (208), goes over the ninth weft yarn of the lower layer (209), goes under the tenth weft yarn of the lower layer (210), goes over the eleventh weft yarn of the lower layer (211), goes under the twelfth weft yarn of the lower layer (212), goes over the thirteenth weft yarn of the lower layer (213), goes under the fourteenth weft yarn of the lower layer (214), goes over the fifteenth weft yarn of the lower layer (215), goes under the sixteenth weft yarn of the lower layer (216), goes over the seventeenth weft yarn of the lower layer (217), goes under the eighteenth weft yarn of the lower layer (218), goes over the nineteenth weft yarn of the lower layer (219), goes under the twentieth weft yarn of the lower layer (220), goes over the twenty-first weft yarn of the lower layer (221), goes under the twenty-second weft yarn of the lower layer (222), goes over the twenty-third weft yarn of the lower layer (223), goes under the twenty-fourth weft yarn of the lower layer (224), and goes over the twenty-fifth weft yarn of the lower layer (225);
the supporting fabric texture (3) is such structured that an end of the first connecting yarn (31) goes under the first weft yarn of the lower layer (201), and the other end of the first connecting yarn (31) along the length direction goes over the second weft yarn of the lower layer (202), goes under the third weft yarn of the lower layer (203), goes over the fourth weft yarn of the lower layer (204), goes under the fifth weft yarn of the lower layer (205), goes over the fourth weft yarn of the upper layer (104), goes under the fifth weft yarn of the upper layer (105), goes over the sixth weft yarn of the upper layer (106), goes under the thirteenth weft yarn of the lower layer (213), goes over the fourteenth weft yarn of the lower layer (214), goes under the fifteenth weft yarn of the lower layer (215), goes over the sixteenth weft yarn of the lower layer (216), goes under the seventeenth weft yarn of the lower layer (217), goes over the tenth weft yarn of the upper layer (110), goes under the eleventh weft yarn of the upper layer (111), goes over the twelfth weft yarn of the upper layer (112), and goes under the twenty-fifth weft yarn of the lower layer (225); and when the first connecting yarn (31) is guided from the lower layer fabric texture (2) to the upper layer fabric texture (1), the first connecting yarn (31) is placed between the second warp yarn of the upper layer (152) and the third warp yarn of the upper layer (153);
an end of the second connecting yarn (32) goes under the first weft yarn of the lower layer (201), and the other end of the second connecting yarn (32) along the length direction goes over the second weft yarn of the lower layer (202), goes under the third weft yarn of the lower layer (203), goes over the fourth weft yarn of the lower layer (204), goes under the fifth weft yarn of the lower layer (205), goes over the fourth weft yarn of the upper layer (104), goes under the fifth weft yarn of the upper layer (105), goes over the sixth weft yarn of the upper layer (106), goes under the thirteenth weft yarn of the lower layer (213), goes over the fourteenth weft yarn of the lower layer (214), goes under the fifteenth weft yarn of the lower layer (215), goes over the sixteenth weft yarn of the lower layer (216), goes under the seventeenth weft yarn of the lower layer (217), goes over the tenth weft yarn of the upper layer (110), goes under the eleventh weft yarn of the upper layer (111), goes over the twelfth weft yarn of the upper layer (112), and goes under the twenty-fifty weft yarn of the lower layer (225); and when the second connecting yarn (32) is guided from the lower layer fabric texture (2) to the upper layer fabric texture (1), the second connecting yarn (32) is placed between the second warp yarn of the upper layer (152) and the third warp yarn of the upper layer (153);
an end of the third connecting yarn (33) goes under the first weft yarn of the upper layer (101), and the other end of the third connecting yarn (33) along the length direction goes over the second weft yarn of the upper layer (102), goes under the fifth weft yarn of the lower layer (205), goes over the sixth weft yarn of the lower layer (206), goes under the seventh weft yarn of the lower layer (207), goes over the eighth weft yarn of the lower layer (208), goes

under the ninth weft yarn of the lower layer (209), goes over the sixth weft yarn of the upper layer (106), goes under the seventh weft yarn of the upper layer (107), goes over the eighth weft yarn of the upper layer (108), goes under the seventeenth weft yarn of the lower layer (217), goes over the eighteenth weft yarn of the lower layer (218), goes under the nineteenth weft yarn of the lower layer (219), goes over the twentieth weft yarn of the lower layer (220), goes under the twenty-first weft yarn of the lower layer (221), goes over the twelfth weft yarn of the upper layer (112), and goes under the thirteenth weft yarn of the upper layer (113); and when the third connecting yarn (33) is guided from the lower layer fabric texture (2) to the upper layer fabric texture (1), the third connecting yarn (33) is placed between the sixth warp yarn of the upper layer (156) and the seventh warp yarn of the upper layer (157); an end of the fourth connecting yarn (34) goes under the first weft yarn of the upper layer (101), and the other end of the fourth connecting yarn (34) along the length direction goes over the second weft yarn of the upper layer (102), goes under the fifth weft yarn of the lower layer (205), goes over the sixth weft yarn of the lower layer (206), goes under the seventh weft yarn of the lower layer (207), goes over the eighth weft yarn of the lower layer (208), goes under the ninth weft yarn of the lower layer (209), goes over the sixth weft yarn of the upper layer (106), goes under the seventh weft yarn of the upper layer (107), goes over the eighth weft yarn of the upper layer (108), goes under the seventeenth weft yarn of the lower layer (217), goes over the eighteenth weft yarn of the lower layer (218), goes under the nineteenth weft yarn of the lower layer (219), goes over the twentieth weft yarn of the lower layer (210), goes under the twenty-first weft yarn of the lower layer (221), goes over the twelfth weft yarn of the upper layer (112), and goes under the thirteenth weft yarn of the upper layer (113); and when the fourth connecting yarn (34) is guided from the lower layer fabric texture (2) to the upper layer fabric texture (1), the fourth connecting yarn (34) is placed between the sixth warp yarn of the upper layer (156) and the seventh warp yarn of the upper layer (157); the connecting manner of the first connecting yarn (31) in the upper layer fabric texture (1) and the lower layer fabric texture (2) is the same as that of the second connecting yarn (32), and the connecting manner of the third connecting yarn (33) in the upper layer fabric texture (1) and the lower layer fabric texture (2) is the same as that of the fourth connecting yarn (34).

**2.** The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the first weft yarn of the upper layer (101), the second weft yarn of the upper layer (102), the third weft yarn of the upper layer (103), the fourth weft yarn of the upper layer (104), the fifth weft yarn of the upper layer (105), the sixth weft yarn of the upper layer (106), the seventh weft yarn of the upper layer (107), the eighth weft yarn of the upper layer (108), the ninth weft yarn of the upper layer (109), the tenth weft yarn of the upper layer (110), the eleventh weft yarn of the upper layer (111), the twelfth weft yarn of the upper layer (112 and the thirteenth weft yarn of the upper layer (113) in the upper layer fabric texture (1) are arranged in array in the length direction at an upper layer equidistance $D_{upper}$; $D_{upper}$ =2mm~200mm.

**3.** The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the upper layer fabric texture (1) is the longituial strips of the grid.

**4.** The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the upper layer fabric texture (1) is a rectangular frame fabric having a length donted by a and a width donated by b, wherein $a$ = 2mm~200mm, $b$ = 2mm~200mm, and the number of the rectangular frames in the upper layer fabric texture (1) per unit area is 1500~3000 /per square meter.

**5.** The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the first warp yarn of the lower layer(251), the second warp yarn of the lower layer (252), the third warp yarn of the lower layer (253), the fourth warp yarn of the lower layer (254), the fifth warp yarn of the lower layer (255), the sixth warp yarn of the lower layer (256), the seventh warp yarn of the lower layer (257) and the eighth warp yarn of the lower layer (258) in the lower layer fabric texture (2) are arranged in the width direction at a lower layer equidistance $H_{lower}$; $H_{lower}$ = 1 $D_{lower}$ ~5 $D_{lower}$; the first weft yarn of the lower layer (201), the second weft yarn of the lower layer (202), the third weft yarn of the lower layer (203), the fourth weft yarn of the lower layer (204), the fifth weft yarn of the lower layer (205), the sixth weft yarn of the lower layer (206), the seventh weft yarn of the lower layer (207), the eighth weft yarn of the lower layer (208), the ninth weft yarn of the lower layer (209), the tenth weft yarn of the lower layer (210), the eleventh weft yarn of the lower layer (211), the twelfth weft yarn of the lower layer (212), the thirteenth weft yarn of the lower layer (213), the fourteenth weft yarn of the lower layer (214), the fifteenth weft yarn of the lower layer (215), the sixteenth weft yarn of the lower layer (216), the seventeenth weft yarn of the lower layer (217), the eighteenth weft yarn of the lower layer (218), the nineteenth weft yarn of the lower layer (219), the twentieth weft yarn of the lower layer (220), the twenty-first weft yarn of the lower layer (221), the twenty-second weft yarn of the lower layer (222), the twenty-third weft yarn of the lower layer (223), the twenty-fourth weft yarn of the lower layer (224) and the twenty-fifth weft yarn of the lower layer (225) in the lower layer fabric texture (2) are

arranged in the length direction at a lower layer equidistance $D_{lower}$; $D_{lower}$= 0.5mm~ 200mm.

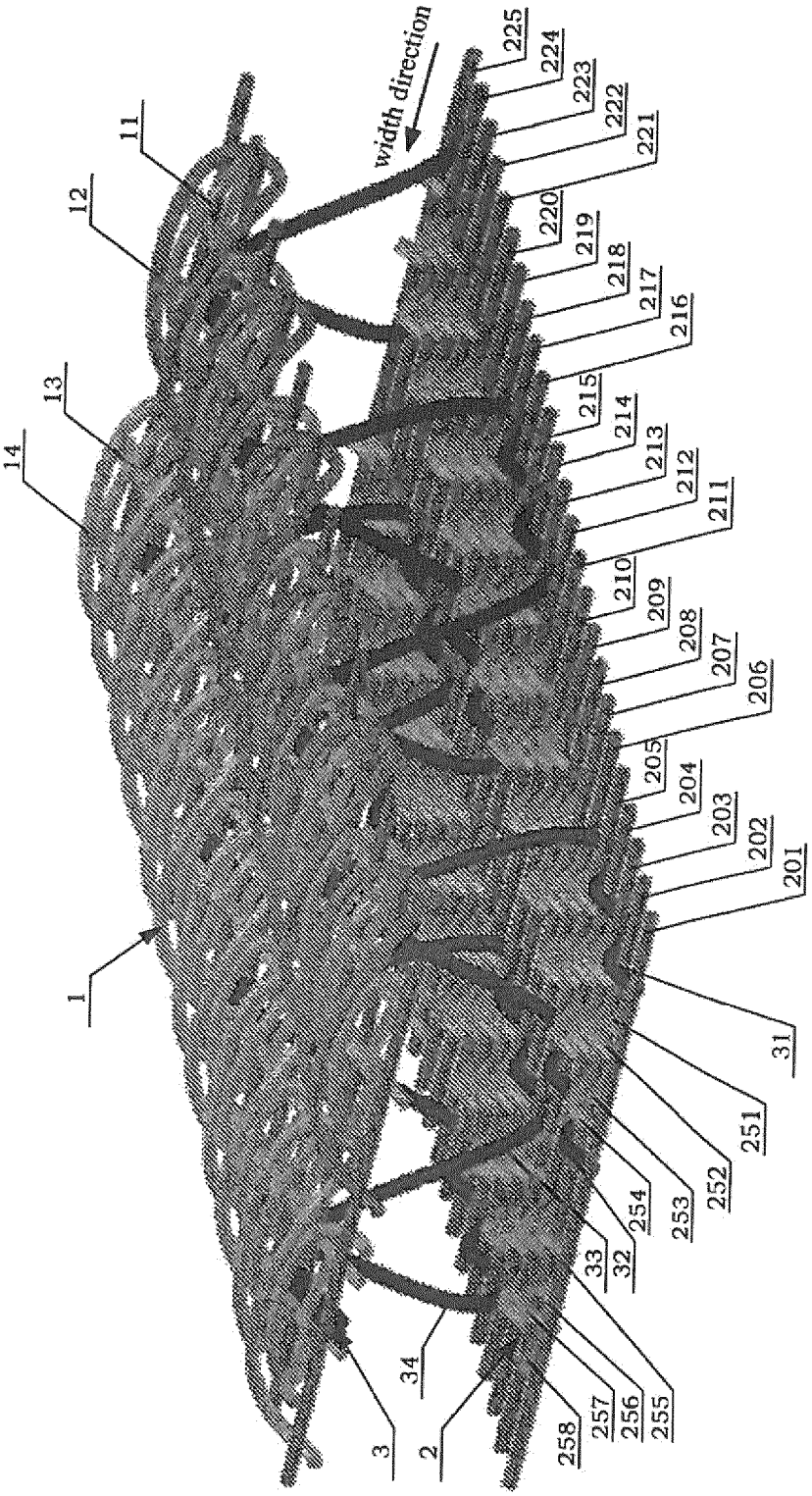
6. The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the ratio of the number of the upper weft yarns in the upper layer fabric texture (1) to the number of the lower weft yarns in the lower layer fabric texture (2) is 1:1, or 1:2, or 1:3 or 1:4.

7. The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the height of the woven three-dimensional interval grid fabric with a crossed warp structure is defined as $H_{heigh}$ ; $H_{height}$ = 20mm~ 300mm.

8. The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the first connecting yarn (31) and the second connecting yarn (32) in the supporting fabric texture (3) are placed between the second warp yarn of the upper layer (152) and the third warp yarn of the upper layer (153) in the upper layer fabric texture (1), with the first connecting yarn (31) placed outside of the first warp yarn of the lower layer (251) in the lower layer fabric texture (2) and the second connecting yarn (32) placed outside of the fourth warp yarn of the lower layer (254) in the lower layer fabric texture (2); the connection of the first connecting yarn (31) and the second connecting yarn (32) in the upper layer fabric texture (1) and the lower layer fabric texture (2) constitutes a continuous triangular shape; the third connecting yarn (33) and the fourth connecting yarn (34) is placed between the sixth warp yarn of the upper layer (156) and the seventh warp yarn of the upper layer (157) in the upper layer fabric texture (1), with the third connecting yarn (33) placed outside of the fifth warp yarn of the lower layer (255) in the lower layer fabric texture (2) and the fourth connecting yarn (34) placed outside of the eighth warp yarn of the lower layer (258) in the lower layer fabric texture (2); the connection of the third connecting yarn (33) and the fourth connecting yarn (34) in the upper layer fabric texture (1) and the lower layer fabric texture (2) constitutes a continuous triangular shape;
the first connecting yarn (31) and the second connecting yarn (32) in the supporting fabric texture (3) overlap, and the third connecting yarn (33) and the fourth connecting yarn (34) in the supporting fabric texture (3) overlap; the connection of the first connecting yarn (31) and second connecting yarn (32) in the upper layer fabric texture (1) and in the lower layer fabric texture (2) constitutes a continuous first front Ω shape, and the connection of the third connecting yarn (33) and the fourth connecting yarn (34) in the upper layer fabric texture (1) and in the lower layer fabric texture (2) constitutes a continuous second front Ω shape; the first front Ω shape and the second front Ω shape offset in the lower layer fabric texture (2) by three weft yarns; the first front Ω shape and the second front Ω shape offset in the upper layer fabric texture (1) by one weft yarn.

9. The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** in the woven three-dimensional interval grid fabric with a crossed warp structure, the four connecting yarns are in a triangular shape in the width direction and in an Ω shape in the length direction; the combination of the triangular shape and the Ω shape in these two directions supports the upper layer fabric texture (1) and the lower layer fabric texture (2); the lower layer fabric texture (2) in the woven three-dimensional interval grid fabric with a crossed warp structure is transformed into the structure of the upper layer fabric texture (1); the upper layer fabric texture (1) and the lower layer fabric texture (2) in the woven three-dimensional interval grid fabric with a crossed warp structure is a rectangular frame fabric structure respectively.

10. The woven three-dimensional interval grid fabric with a crossed warp structure according to Claim 1, **characterized in that** the fiber material adopted in the upper layer fabric texture (1), the lower layer fabric texture (2) and the supporting fabric texture (3) is one or more of the metal fiber, inorganic fiber, synthetic fiber and plant fiber, or a combination thereof; the fiber material is the combination of two or more of the polyethylene fiber, polyarnide fiber, polyolefin fiber, ceramic fiber, carbon fiber, aramid fiber, PBO fiber, M5 fiber, basalt fiber, glass fiber, polypropylene fiber, polyester fiber, spandex fiber, dimensional acrylic fiber, nylon fiber, polyvinyl alcohol fiber, polyvinyl chloride fiber, hemp, sisal fiber, flax fiber, bamboo fiber, jute fiber, inorganic fiber, synthetic fiber and plant fiber; the fiber material is E glass fiber roving having a linear density of 68 tex-2400 tex or 1 K-12 K carbon fiber; and more specifically, material of the warp and weft yarns in the upper layer fabric texture (1) and the lower layer fabric texture (2) its 600 tex high strength polyethylene, material of the amphi-positioning warp yarn in the upper layer fabric texture (1) is 200 D stretch nylon or 168 tex glass fiber, and the connecting yarn in the supporting fabric texture (3) is 900tex E glass fiber roving.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3
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12
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32
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34
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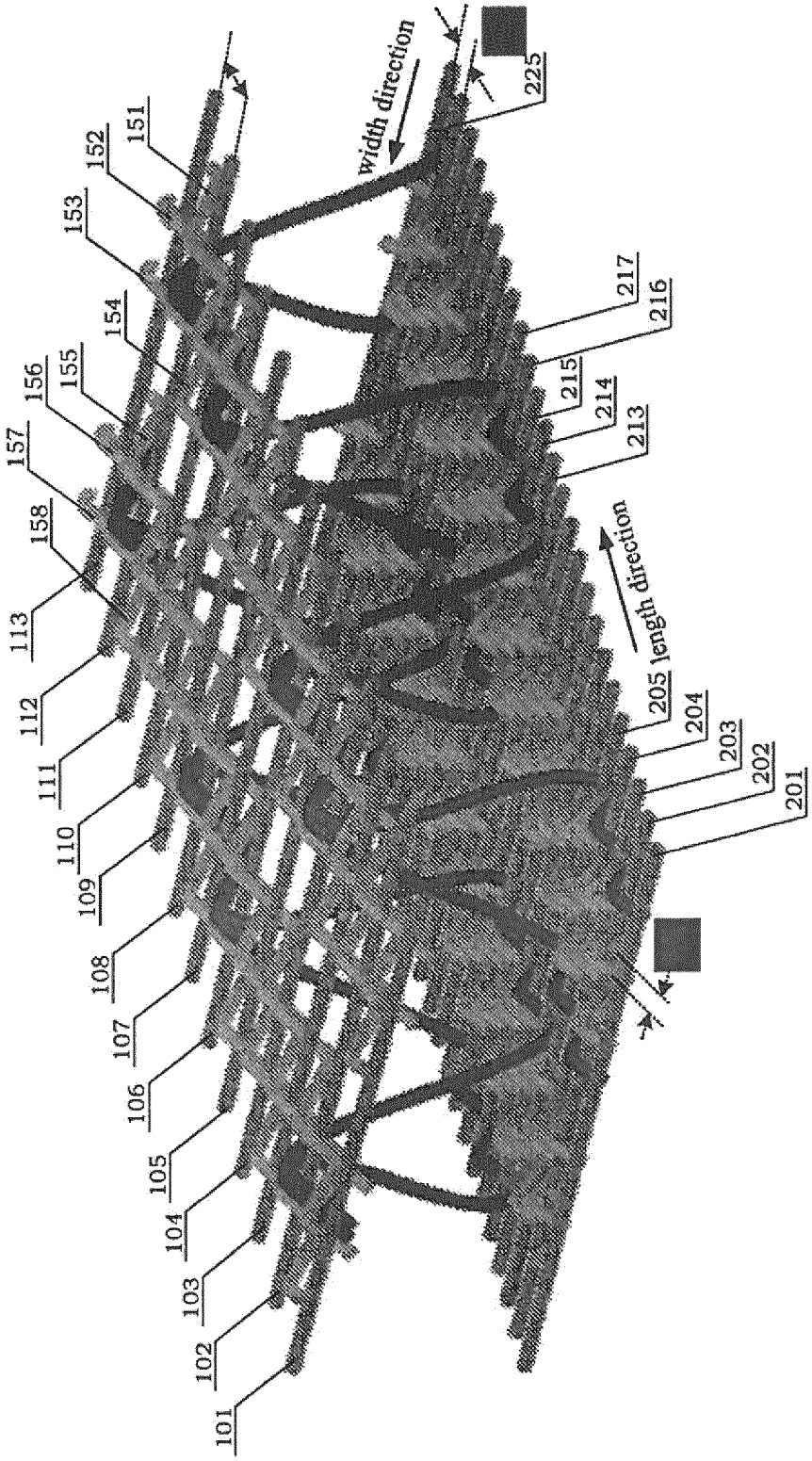
258

FIG. 1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length direction
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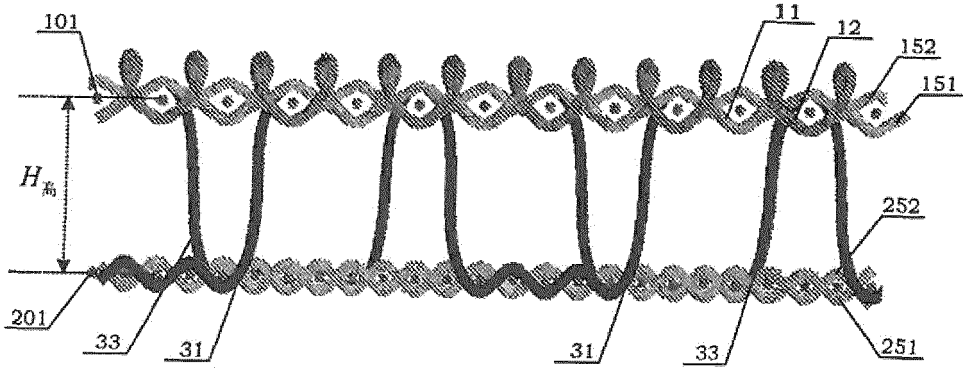
202
201

FIG. 1A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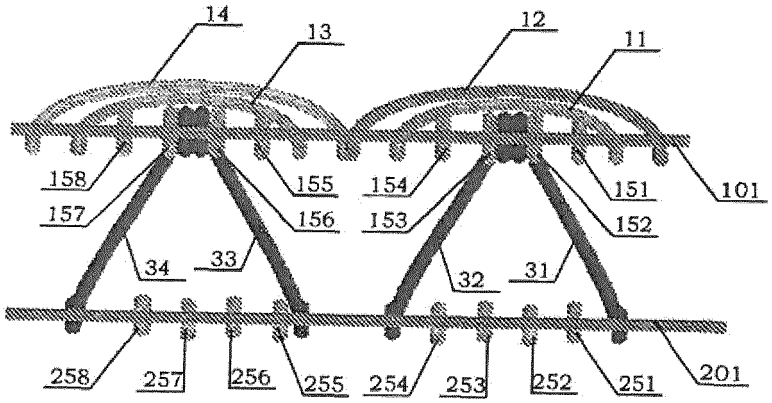
152
151
$H_{高}$
252
201
33
31
31
33
251

FIG. 2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155
156
154
153
151
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32
31
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255
254
253
252
251
201

FIG. 3

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/CN2012/080835**

**A. CLASSIFICATION OF SUBJECT MATTER**

See the extra sheet

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)

IPC: D03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNPAT, CNKI: doping warp, skein, three dimensional, stereoscopic, three-layer, net, grid, hole

EPODOC, WPI: DOUP???, CROSS???, THREE W DIMENSIONAL, STEREOSCOPIC, SOLID, GRID?, CELL?, HOLE?, NET+

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | CN 201395738 Y (HENAN HUAFENG FABRIC TECHNOLOGY CO., LTD.), 03 February 2010 (03.02.2010), description, particular embodiments, and figure 1 | 1-10 |
| A | CN 102560830 A (CHANGZHOU TOPWEAVING NEW MATERIAL TECH CO., LTD.), 11 July 2012 (11.07.2012), the whole document | 1-10 |
| A | US 6283168 B1 (3TEX INC.), 04 September 2001 (04.09.2001), the whole document | 1-10 |

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 16 April 2013 (16.04.2013) | **25 April 2013 (25.04.2013)** |
| Name and mailing address of the ISA/CN:<br>State Intellectual Property Office of the P. R. China<br>No. 6, Xitucheng Road, Jimenqiao<br>Haidian District, Beijing 100088, China<br>Facsimile No.: (86-10) 62019451 | Authorized officer<br>**LIU, Liyan**<br>Telephone No.: (86-10) **62085534** |

Form PCT/ISA/210 (second sheet) (July 2009)

**INTERNATIONAL SEARCH REPORT**
Information on patent family members

International application No.
**PCT/CN2012/080835**

| Patent Documents referred in the Report | Publication Date | Patent Family | Publication Date |
|---|---|---|---|
| CN 201395738 Y | 03.02.2010 | None | |
| CN 102560830 A | 11.07.2012 | None | |
| US 6283168 B1 | 04.09.2001 | WO 0244095 A2 | 06.06.2002 |
| | | AU 2703202 A | 11.06.2002 |

Form PCT/ISA/210 (patent family annex) (July 2009)

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/CN2012/080835**

**CONTINUATION: CLASSIFICATION OF SUBJECT MATTER**

D03D 9/00 (2006.01) i

D03D 13/00 (2006.01) i

Form PCT/ISA/210 (extra sheet) (July 2009)