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BE-A- 533 696

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Description

The subject invention concerns a multi-layer dewatering medium for forming paper sheets. Each layer of the medium comprises polymer material strands at least in the machine direction. These strands may consist of interwoven thread material but could also be extruded strands alone or combined with woven thread materials.

In the forming of paper sheets two different kinds of techniques are used today. The conventional and most common technique involves discharging an acqueous suspension of cellulose fibers onto a forming fabric which travels horizontally and in a flat condition during the forming phase proper. The water flows through the forming fabric and the restricted mesh size of the fabric prevents the fiber material from penetrating into and through the forming fabric. The fibers remain on the surface of the fabric, evenly distributed thereon, whereas the dewatering elements, such as suction boxes and foils, facilitate the water through-flow. At the end of the flat, horizontal part of the forming fabric loop the fibers have formed a continuous fibrous web. This type of forming is generally referred to as Fourdrinier forming.

According to the second applied technique a jet of fibrous suspension is discharged into the gap between two moving forming elements at least one of which consists of a forming fabric. The water is removed by the forming elements whereas the fiber material is retained by said elements. This type of formation is generally referred to as twin wire forming.

In both forming methods multilayer forming fabrics are generally used as the forming elements. The stability of multi-layer forming fabrics is largely superior to that of single-layer fabrics and particularly in Fourdrinier machines it is desirable to be able to combine a fine-mesh forming surface layer with a bottom surface layer having sufficient wearability. These properties are difficult to combine in a single-layer fabric. In double-layer forming fabrics the layer closest to the material to be formed could be made from a fine-diameter thread material, resulting in a fine mesh density whereas the layer closest to the dewatering elements may be made from a coarser and thus more abrasion-resistant material.

In the bottom layer of the fabric which is intended to travel in contact with the dewatering elements of the machine, it is also customary to use a weave pattern of a kind which improves the wearability of the fabric.

To improve wearability, it is suggested in SE 74 12 722-6 to bring the warp knuckles or lengthwise knuckles to a position interiorly of the weft knuckles, i.e. the transverse knuckles. Thus, it is the latter transverse knuckles which form the contacting layer against which the dewatering elements exert an abrasive effect.

Also EP 0 046 899 discloses a double-layer forming fabric the weft layer or transverse layer of which forms the outer layer which is in contact with the dewatering elements.

A number of German Patent Publications describe double-layer forming fabrics, e.g. DE 30 36 409, DE 31 46 385, DE 32 24 187, DE 42 24 236, DE 33 01 810, DE 33 05 713. From all of these publications it is apparent that the weft or transverse yarn forms the outer layer against which the dewatering elements exert their abrasive effect.

The technique of designing and constructing multi-layer fabrics has always resided in exposing the transverse weft threads on the rear face to the abrasive effects. The purpose of the lengthwise threads is to absorb the wire tension and for this reason these threads may be worn only to a limited degree. However, as no load is exerted on the fabric in the transverse direction, abrasion of the transverse threads may continue until close to the wear-through point of these threads before the fabric is considered to be worn out. This is the reason why all modern forming fabrics are manufactured with transverse bottom threads serving as the abrasive medium. Identical structures have also been used in the twin-wire forming method although in this case the abrasion is not quite so strong.

When the speed of twin-wire machines is increased, minute holes may form in the paper web at a certain speed level. This has long been a problem in certain types of twin-wire machines and has reduced the production speed of such machines. A large number of experiments, none of them successful, were made before the conventional fabric structure was replaced by the fabric structure in accordance with the teachings of the subject invention.

The dewatering medium for forming paper sheets in accordance with the subject invention is of multi-layer type and consists of strands of polymeric material, which medium has on its one side a first surface constituting the forming surface of the medium, which surface in position of use of the medium faces the material to be formed, and on its opposite side a second surface. The dewatering medium is characterized therein that at least in the machine direction the layer closest to the second surface is made up from strands, that in the machine direction continuous or discontinuous lengths (floats) of said strands abut on said second surface, that the longest ones of said lengths of strands in the machine direction are longer than discontinuous lengths (floats) of strands which are repeated in the cross-machine direction and which abut on said second face of the medium.

The above problem of hole formation in the paper web in twin-wire machines is entirely eliminated in the dewatering medium in accordance with the subject invention and the machine speed may be increased without difficulty. An analysis of the reasons for the

hole formation found in prior-art technology medium has proved to be that the transverse knuckles, between the forming roller and the separation roller,act as "water wheel buckets" and splash water between the separation roller and the fabrics. The water, which is in the form of droplets, is forced through the fabrics by the separation roller and into paper sheet, causing holes to form therein. At lower machine speeds the splashing is less pronounced and does not cause any noticeable problems but the splashing increases with increasing machine speeds.

Once the problem had been solved in twin-wire machines attemps were made to find out whether a corresponding structural change would affect the forming process in Fourdrinier machines. For this reason a forming fabric was manufactured in the conventional manner with the abutment knuckles extending transversely. From the same piece of fabric was cut a fabric extending in the other direction, i.e. such that the former transverse abutment knuckles became lengthwise abutment knuckles. Quite unexpectedly, it was found that the paper sheet which was formed on the latter fabric exhibited less marking. Also in this case the elimination of the splashing caused by the "water wheel phenomenon" is believed to be the reason for the improvement. The transverse "water wheel knuckles" splash water back against the rear side of the fabric, thus disturbing the paper sheet forming process. The problem will be discussed in full in connection with the following description of the drawing figures.

The invention will be described in closer detail in the following with reference to the accompanying drawings, wherein

Fig. 1 is a general schematical view showing a twin-wire papermaking machine of roll-former type,

Fig. 2 is a general schematical view showing a Fourdrinier-type of papermaking machine,

Fig. 3 is a perspective view of a forming medium in the form of a forming fabric comprising two transversely extending thread systems which are interconnected by one lengthwise extending thread system,

Fig. 4 is a plan view of the bottom face of the forming fabric of Fig. 3,

Fig. 5 is a perspective view of a second forming medium in the form of a forming fabric comprising double thread systems in its lengthwise as well as in its transverse direction,

Fig. 6 is a plan view of the bottom face of the forming fabric in accordance with Fig. 5, and

Fig. 7 illustrates a forming medium consisting of an extruded bottom layer on which is superposed a woven forming layer.

Fig. 1 illustrates a twin-wire machine 11 of roll-former type. From the head box 12 the fiber stock is discharged into the gap between the upper fabric 13 and the bottom fabric 14. The fabrics 13 and 14 with the fiber stock between them is carried over part of the cylinder face of a forming roller 15 for removal of the water through the bottom fabric 14 down into the vat 16. When the fabrics leave the forming roller 15, the forming process should, in principle, have been completed. The moist paper sheet, still positioned intermediate the two fabrics, is then carried to a separation roller 17. When a bottom fabric 14 of a conventional type is used, this system operates without problem up to a certain speed limit. At higher speeds, however, a certain amount of water accompanies the fabric up to the separation roller 17. This has proved to be due to the "water wheel bucket effect" of the transverse threads on the rear face of the bottom fabric 14. These transverse threads "splash" water against the separation roller 17. When the two fabrics move into contact with the face of the separation roller 17, the water droplets on the rear face of the bottom fabric 14 are forced through the fabric 14 and against the paper sheet intermediate the fabrics, causing minute holes to form in the paper sheet. When the bottom fabric 14 is manufactured in accordance with the invention with predominantly lengthwise extending strands the "water wheel splashing effect" will be eliminated and the rear face of the fabric will be free of water droplets when the two fabrics are carried into contact with the separation roller 17. In case a small amount of water should nevertheless accompany the fabric this water will collect intermediate the lengthwise strands without being forced through the fabric and against the paper web.

The problem caused by the above "water wheel splashing effect" has been discovered and remedied by the subject invention primarily with regard to twin-wire machines. However, it has been found that a similar "water wheel splashing effect" may cause problems also in machines of Fourdrinier type. This will be explained in the following with reference to Fig. 2. In a Fourdrinier-type of machine 21 an endless fabric 22 travels in a continuous path around a series of rollers. From the head box 23 the stock is discharged onto a horizontally travelling part of the fabric 22. The paper web forming process takes place on this horizontal part of the fabric loop. The fabric 22 travels in contact with dewatering elements such as table rolls 24, foils 25 and suction boxes 26. Owing to the "water wheel splashing effect" water is thrown in between these elements and the forming fabric. Water may then be forced back through the fabric and against the paper sheet being formed. Thus, the forming process is disturbed, resulting in marking of the paper web.

The forming medium in the form of the forming fabric 30 shown in Fig. 3 consists of one system of threads 32 which extend at right angles to the direction of travel 31 of the fabric and which threads 32 abut on the first surface 33 of the fabric facing the paper web. A second, system of cross-machine direc-

tion threads 34 extend in parallel with the system of threads 32 and abut on the second surface 35 of the fabric. A third system of threads 36 extend in the machine direction 31 and at right angles to the systems of cross-machine direction threads 32 and 34, interconnecting the latter in to a weave and alternately running between the first surface 33 facing the paper web and the second surface 35 facing in the opposite direction.

The invention is restricted to the layer closest to the second surface 35. As appears from the plan view of Fig. 4 each machine-direction thread 36 extends externally across four consecutive cross-machine direction threads 34, forming discontinuous strand lengths (floats) 37 in the machine direction of the forming medium. Each cross-machine direction thread 34 extends externally across one or two machine-direction threads 36, forming discontinuous short strand lengths 38 and slightly longer strand lengths 39 in the cross-machine direction of the forming fabric.

In accordance with a second embodiment the forming fabric 40 comprises a system of cross-machine directions threads 42 which extend at right angles to the direction of travel 41 of the fabric and which system of threads abut on the first surface 43 of the fabric which faces the paper web being formed. A second system of cross-machine direction threads 44 extend in parallel with the first system of threads 42 and abut on the second surface 45 of the wire. The forming fabric also comprises two systems of threads 46 and 47 which extend in the lengthwise direction of the machine. The system of threads 46 faces the first surface 43 of the fabric and the system of threads 47 faces the second fabric surface 45.

The plan view of Fig. 6 illustrates the layer of threads which abut on the second surface 45 of the fabric. Each machine-direction thread 47 extends externally across three consecutive cross-machine direction threads 44, forming discontinuous lengths (floats) of strands 48 in the machine direction 41 of the forming fabric. Each cross-machine direction thread 44 extends externally across only one machine-direction thread 47, forming discontinuous strand lengths (floats) 49 in the cross-machine direction of the forming medium.

A further embodiment is illustrated in Fig. 7. The forming medium 50 shown in this drawing figure consists of a weave 51 comprising machine direction threads 52 and cross-machine direction threads 53 which, when interwoven, make up the first forming fabric surface 54 which faces the paper web. The other side of the fabric exhibits continuous strands 55 which are extruded in the machine direction and which abut on the second surface 56 of the medium. These continuous lengthwise strands may be interconnected by means of transversely extending interconnection strands 57.

The invention is not limited to the embodiments which are illustrated and described herein but a number of modifications are possible within the scope of the appended claims. The invention is applicable to other types of dewatering media than weaves, e.g. to a structure comprising a perforated foil and underlying strands.

Claims

1. A multi-layer dewatering medium (30, 40, 50) for forming paper sheets, said medium comprising strands of a polymeric material and having on its one side a first surface (33, 43, 53) constituting the forming surface of the medium, which surface in position of use of the medium faces the material to be formed, and on its opposite side a second surface (35, 45, 56), **characterized** therein that at least in the machine direction (31) the layer closest to the second surface (35, 45, 56) is made up of strands, that in the machine direction continuous or discontinuous lengths (floats) of said strands abut on the second surface (35, 45, 56), that the longest ones of said lengths (floats) (37, 48) in the machine direction are longer than discontinuous lengths (floats) (39, 41) of strands (34, 44) which are repeated in the cross-machine direction and which abut on said second surface (35, 45, 56).

2. A multi-layer dewatering medium as claimed in claim 1, **characterized** therein that the strands of polymeric material consist of thread material.

3. A multi-layer dewatering medium as claimed in claim 1, **characterized** therein that the strands of polymeric material are extruded strands.

Ansprüche

1. Mehrschichtiges Entwässerungsmedium (30, 40, 50) zur Bildung von Papierbogen, wobei dieses Medium Stränge aus einem polymeren Material umfasst und auf der einen seiner Seiten eine erste, die bildende Fläche des Mediums darstellende, in der Verwendungslage des Mediums dem zu bildenden Material gegenüberliegende Oberfläche (33, 43, 53) und auf seiner entgegengesetzte Seite eine zweite Oberfläche (35, 45, 56) aufweist, dadurch gekennzeichnet, dass mindestens in Maschinenrichtung (31) die der zweiten Oberfläche (35, 45, 56) am nächsten liegende Schicht aus Strängen gebildet ist, dass kontinuierliche oder diskontinuierliche Längen (Flotten) dieser Stränge in Maschinenrichtung bis zur zweiten Oberfläche (35, 45, 56) reichen, dass die längsten dieser Längen (Flotten) (37, 38) in Maschinenrichtung länger sind als sich quer zur Maschinenrichtung wiederholende und bis zur zweiten Oberfläche (35, 45, 56) reichende diskontinuierliche Längen (Flotten) (39, 41) von Strängen (34, 44).

2. Mehrschichtiges Entwässerungsmedium gemäss Anspruch 1, dadurch gekennzeichnet, dass die Stränge aus polymeren Material aus fadenförmigen bestehen.

3. Mehrschichtiges Entwässerungsmedium gemäss Anspruch 1, dadurch gekennzeichnet, dass die Stränge aus polymeren Material extrudierte Stränge sind.

Revendications

1. Milieu de drainage multi-couches (30, 40, 50) pour la formation de rames de papier, ce milieu comportant des chaînes en un matériau polymère et présentant sur l'un de ses côtés une première surface (33, 43, 53) qui constitue la surface de formation du milieu et se trouve vis-à-vis du matériau à former lorsque le milieu est dans sa position d'utilisation, et sur son côté opposé une deuxième surface (35, 45, 56), caractérisé en ce qu'au moins dans la direction (31) de la machine la couche la plus proche de la deuxième surface (35, 45, 56) est faite de chaînes, en ce que dans la direction de la machine des longueurs continues ou discontinues de ces chaînes (flottes) vont jusqu'à la deuxième surface (35, 45, 56), en ce que les plus longues de ces chaînes (flottes) (37, 38) sont plus longues dans la direction de la machine que des longueurs (flottes) (39, 41) discontinues de chaînes (34, 44) qui se répètent transversalement à la direction de la machine et vont jusqu'à la deuxième surface (35, 45, 56).

2. Milieu de drainage multi-couches selon la revendication 1, caractérisé en ce que les chaînes en matériau polymère sont en matériau filiforme.

3. Milieu de drainage multi-couches selon la revendication 1, caractérisé en ce que les chaînes en matériau polymère sont des chaînes extrudées.

Fig.1

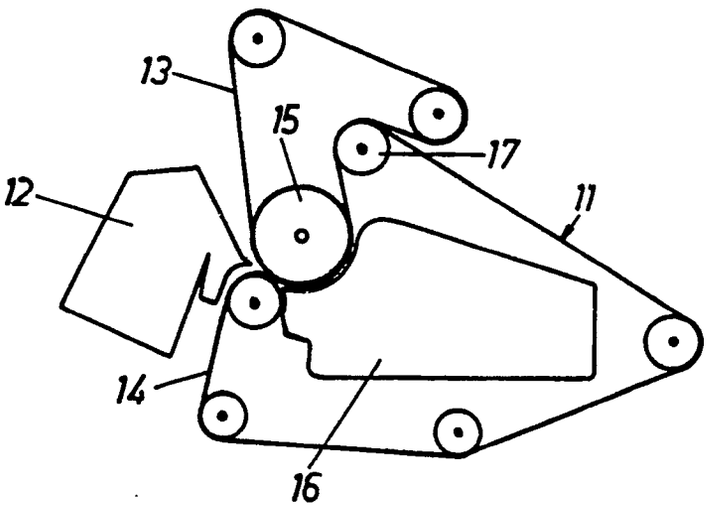

Fig.2

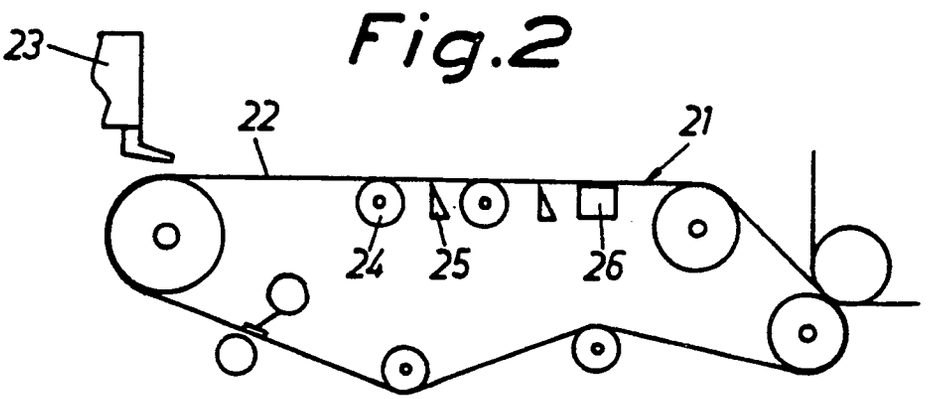

Fig.3

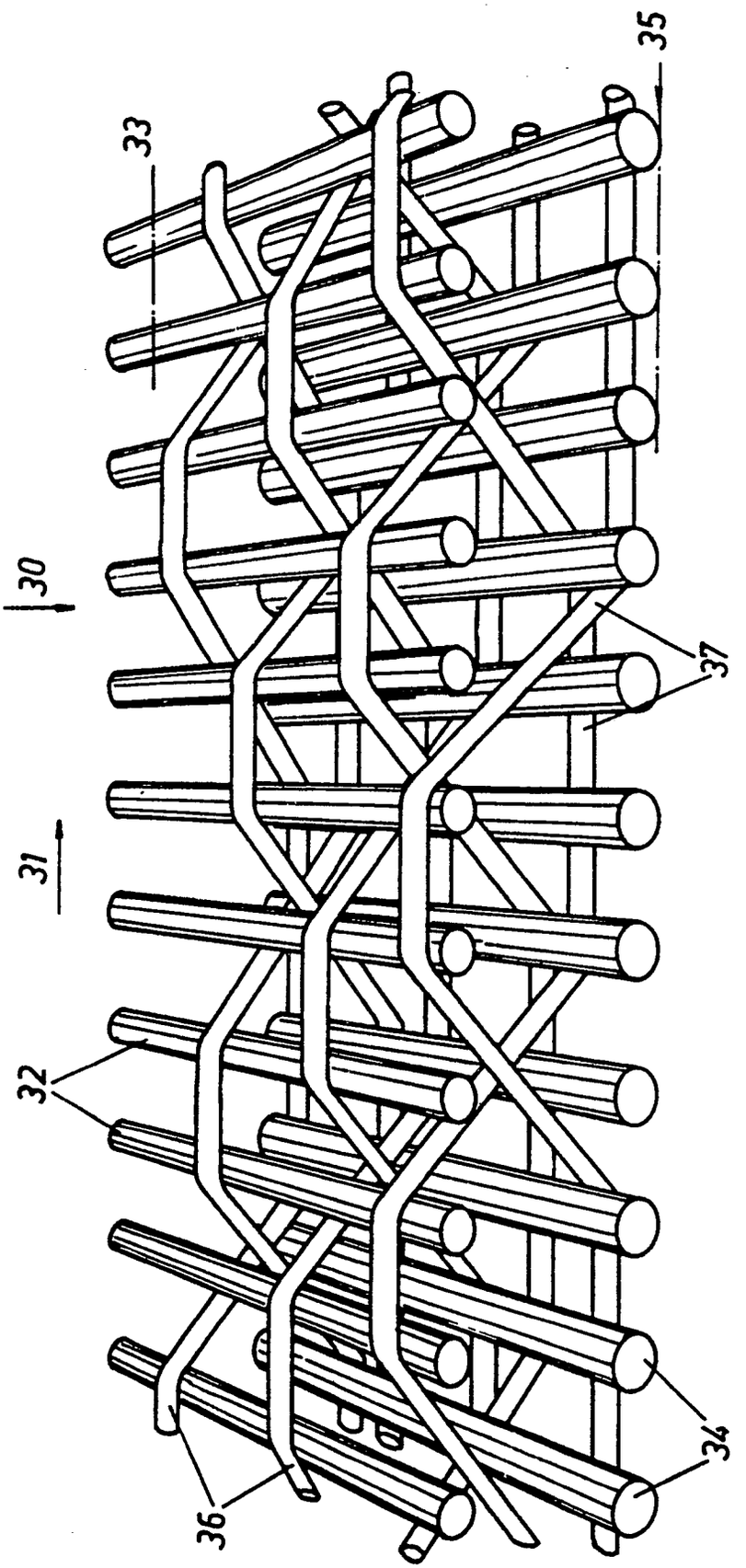

Fig.4

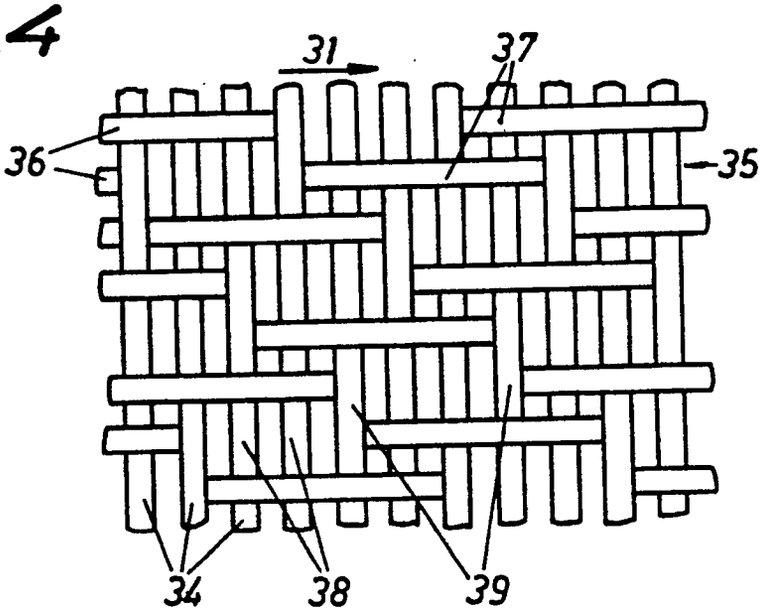

Fig.6

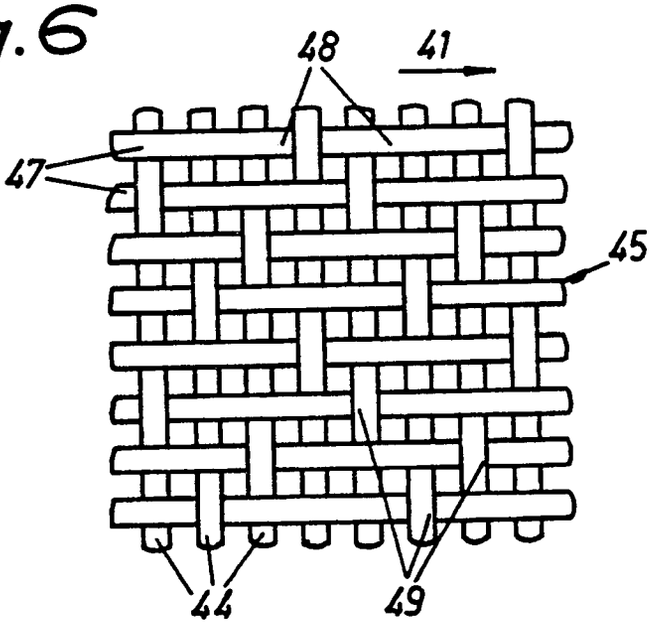

Fig.7

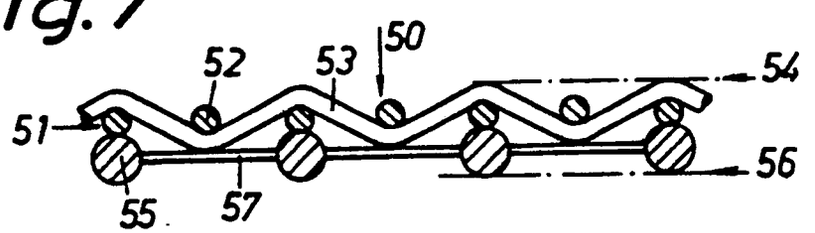

Fig.5