Oct. 4, 1955 J. A. MacINTYRE 2,719,542

MULTIPLE PLY FABRIC

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Fig. 1.

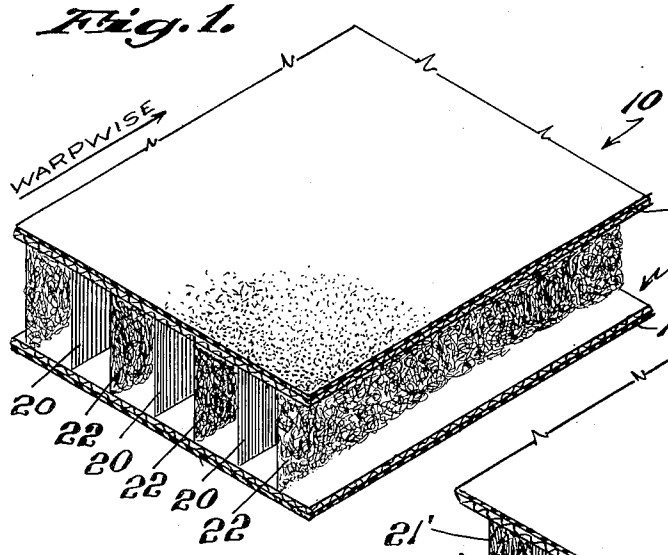


Fig. 2.

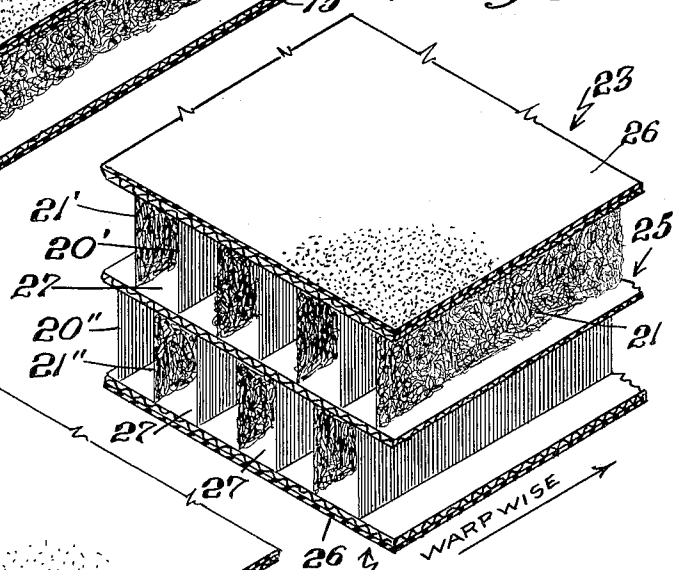


Fig. 3.

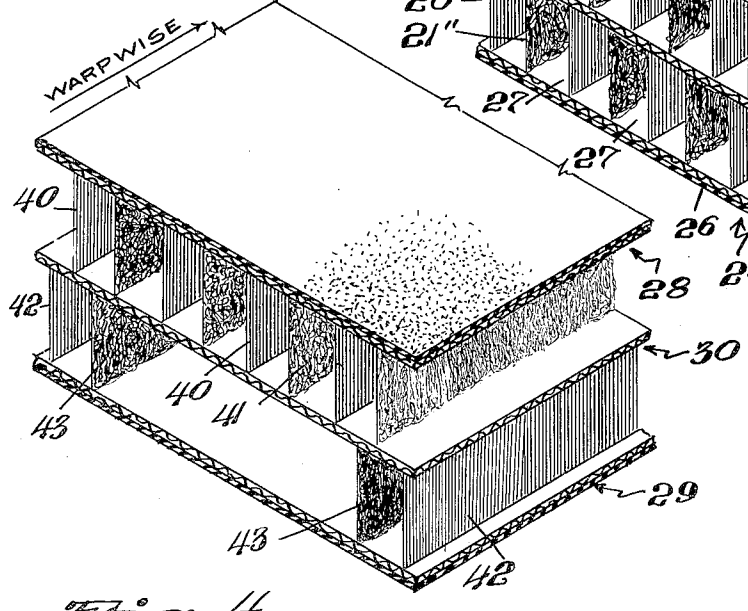
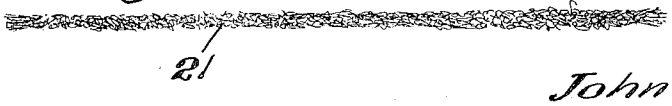


Fig. 4.



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Fig. 5.

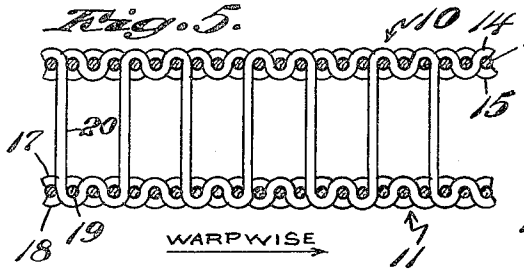


Fig. 6.

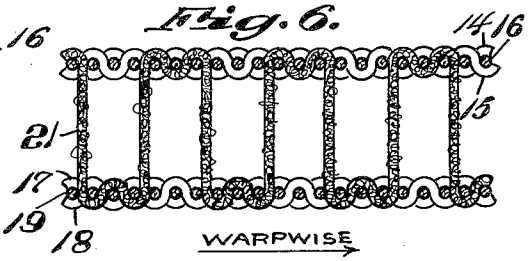


Fig. 7.

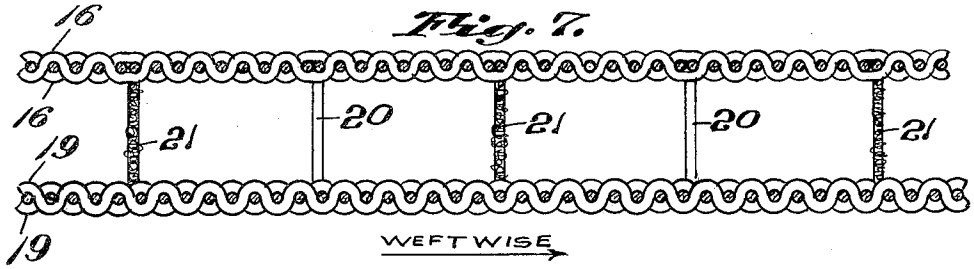


Fig. 8.

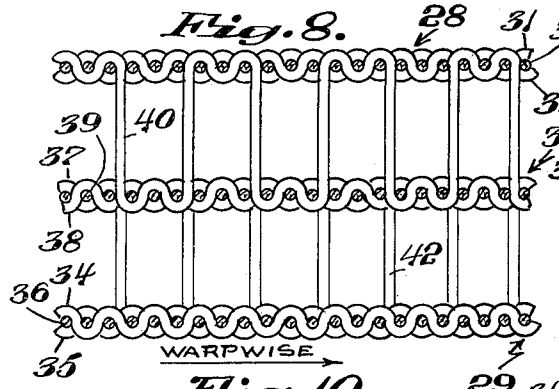


Fig. 9.

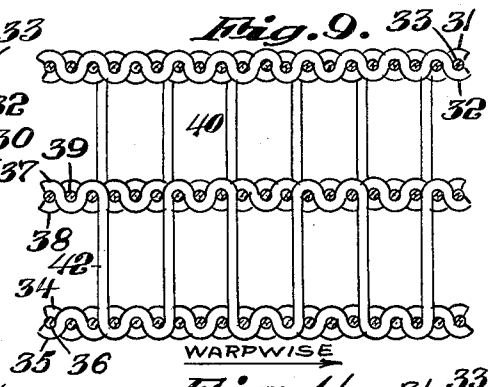


Fig. 10.

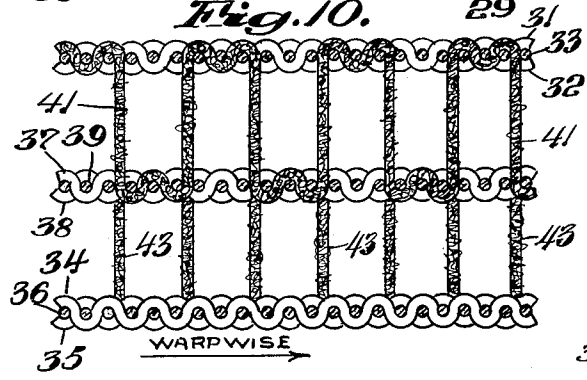
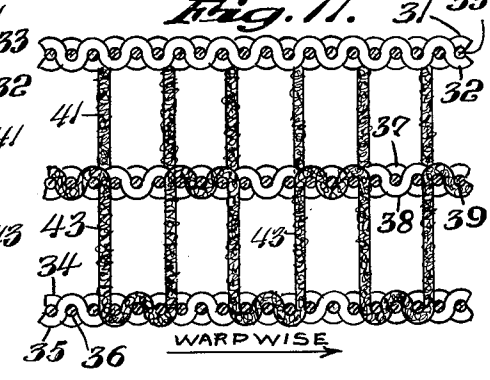


Fig. 11.



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Fig. 12.

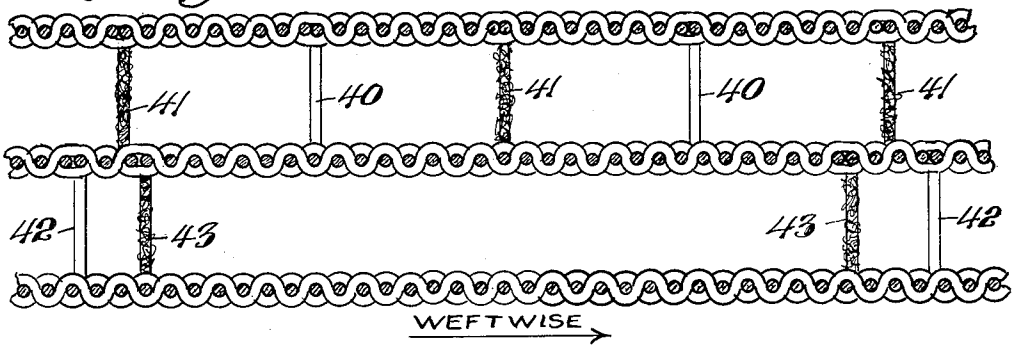


Fig. 13.

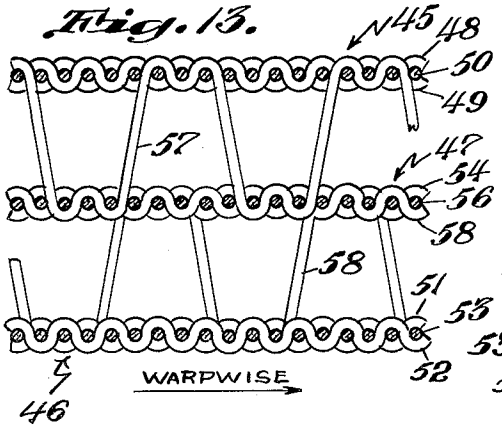


Fig. 14.

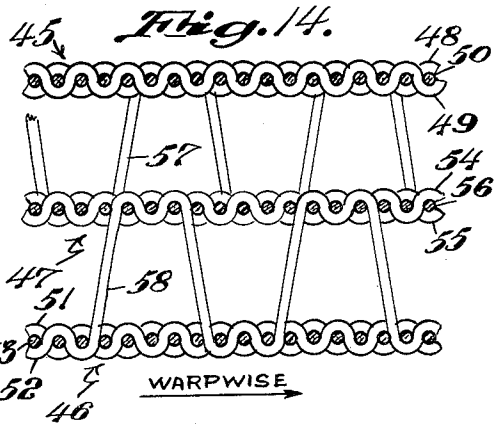
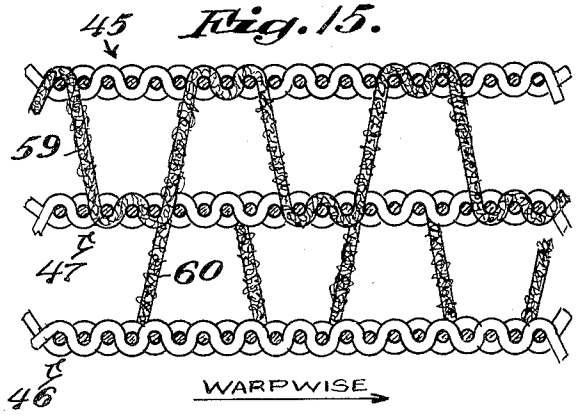


Fig. 15.



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United States Patent Office

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MULTIPLE PLY FABRIC

John A. MacIntyre, Bristol, R. I., assignor to U. S. Plush Mills, Inc., a corporation of Rhode Island

Application February 18, 1955, Serial No. 489,020

10 Claims. (Cl. 139—409)

This invention relates to a multi-ply woven fabric, particularly an inflatable multi-ply fabric which is adapted to be employed for heat insulation and for making sleeping garments and/or the like.

It has been found that in prior art inflatable multi-ply fabric wherein the plies are connected in spaced relation by pile or connector warps, when made into a sleeping garment, the motion of the body will cause a movement of air between the plies. This movement of air between plies is not as efficient a heat insulator as where the air is maintained more or less static or stationary. Various means have been proposed in attempts to prevent this movement of air between plies, such as by a filler of feathers. This has proved unsatisfactory in that the pile warps fail to maintain the feathers in a set position and when deflating the fabric, the feathers follow the air flow to crowd and foul the air valve. In other instances small particles of sponge rubber have been used in an attempt to restrain this movement of air under pressure of the body.

An object of the invention is to improve generally on a fabric of the above character in a manner wherein a filler will be maintained in relatively fixed position to restrain the movement of the air between plies.

Another object of the invention is to provide a multi-ply fabric wherein air chambers will be formed by pile threads in a manner to restrain, to a great degree, the movement of air between chambers.

A more specific object of the invention is to provide a multi-ply fabric so constructed that two alternating pile warps will be fed into the fabric in a manner wherein one of said pile warps will be a tie warp and the other pile warp will be a filler to form a barrier against movement of air and also provide for additional filler material to be held more or less in desired place.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figures 1 to 3 are perspective views illustrating diagrammatically three different fabrics embodying the present invention;

Figure 4 illustrates diagrammatically and on a very enlarged scale a pile warp thread shown in the above figures, which acts as a filler;

Figure 5 illustrates diagrammatically a warpwise section taken along the connector warp of the fabric of Figure 1;

Figure 6 is a similar sectional view taken along the filler warp of the fabric;

Figure 7 is a diagrammatic weftwise section of the fabric of Figure 1;

Figure 8 illustrates diagrammatically a warpwise section taken along the upper connector warp of the fabric of Figure 3;

Figure 9 is a similar sectional view of the lower connector warp;

Figure 10 is a similar sectional view taken along the upper filler warp;

Figure 11 is a similar sectional view taken along the lower filler warp;

Figure 12 is a diagrammatic weftwise section of the fabric of Figure 3;

Figures 13 to 15 show diagrammatically further weave structures embodying the invention.

The fabric according to the present invention comprises a plurality of plies of woven fabric interconnected in spaced relation by separate sets of pile or interconnecting warp. These interconnecting warp are arranged in alternate fashion across the width of the fabric and interlaced with the warp and weft of one ply, then cross over to be likewise interlaced with the warp and weft of the opposite ply of the fabric. One set of these pile warps is fed to the fabric at a rate such as to determine the distance of the spacing between the plies of the fabric. That is, the length of the cross-over stretch or portion of this warp which extends between plies has its terminals fixed in said plies and thus limits the distance of the spacing between plies. This pile warp which will hereinafter be referred to as a connector warp may be of a non-stretchable material such for example as cotton, or may be made of some material having slight elasticity as for example nylon, or may be covered rubber thread, the covering of which will limit its stretch, all depending upon the particular use for the fabric. The other pile warp to be hereinafter referred to as a filler warp is fed or advanced to the fabric at a faster rate than the connector warp such as to produce a greater length of cross-over warp portion than the distance of maximum spacing between the plies of the fabric. This cross-over filler warp portion will form warpwise rows of closely adjacent loose threads so as to form walls to obstruct the free movement of air and also a barrier against movement of additional filler such as poultry down which may be inserted between rows of said filler warps such as by blowing the down in the space between said rows.

I have found warp made of crimped yarn, preferably of an elastic nature, as for example, so-called "Helanca" yarn to be satisfactory. "Helanca" yarn is a soft, fluffy yarn having great elasticity and is a filament nylon crimped and processed in a manner as by way of example described in Patents Nos. 2,463,619 and 2,463,620. As above mentioned, the filler warp is advanced at a faster rate than the connector warp; that is, the filler warp is overfed into the fabric, and this produces rows of lengths of filler warp in contracted condition thereof which extend in a more or less soft, fluffy tangled mass of kinky filaments.

Preferably, the outer plies of the fabric are coated in the known manner to make the same impervious to air. When the fabric is to be employed for making a sleeping garment and/or the like, the edges of the fabric are sealed and the fabric may be inflated.

The fabric of Figure 1 has two plies **10** and **11**, the outer surfaces of which are rubberized or coated as at **12** and **13** in the known manner so as to make the plies impervious to air. The ply **10** (see Figure 5) is composed of warp **14**, **15** which are interlaced with weft **16**. The interlacing of warp and weft may be in the basic order of over one, under one. The number of picks per inch is dependent upon the particular use for the fabric. The number of picks per inch, however, should not be such as to produce a relatively loose woven fabric which would require an excessive coating to close interstices between the warp and weft in making the fabric impervious to air. I have found that forty-nine picks per inch is satisfactory. The ply **11** is similarly composed of warp **17** and **18** interlaced with weft **19**.

A connector warp **20** which may be composed of cotton threads, nylon threads, or covered rubber threads, is preferably equally spaced across the fabric and is interlaced with the weft **16** of ply **10** in the order of under one, over

one for three consecutive picks and thence crossed over to ply **11** to be similarly interlaced with the weft **19** thereof, thence crossed over back into ply **11** to repeat. Thus, there is formed warpwise rows of connector warp lengths extending between plies, the terminals of which lengths of warp are fixed in opposite plies to determine the spacing between said plies.

A separate filler warp **21** (see Figures 6 and 7) composed of crimped yarn or thread, preferably "Helanca" yarn, is equally spaced across the fabric in alternate fashion with the warp **20**. The filler warp **21** extends from a separate supply source but moves with the shed of the warp **20** so that it is interlaced with the wefts of plies **10**, **11** at the same picks in the order as the warp **20** and is crossed over from one ply to the other also at the same time as the crossing over of warp **20**. Thus, there is provided weftwise rows of alternate connector warps and filler warps. The filler warp **21** is advanced or overfed to the fabric so as to produce loose lengths of filler warp portions extending between plies in warpwise rows. The characteristic of the "Helanca" yarn and the juxtaposition of the cross-over portions of the "Helanca" warp will cause a tangling of the cross-over portions so as to produce warpwise rows of soft, fluffy tangled mass **22** (see Figure 1) of kinky filaments to restrain the free movement of air between the plies of the fabric.

In Figure 2 there is shown a three-ply fabric having outer plies **23**, **24**, and an intermediate or central ply **25**. The outer surfaces of plies **23** and **24** are coated as at **26** to make the same impervious to air. The upper connector warp indicated **20'** are equally spaced weftwise and form warpwise rows of connector warps which alternate with rows of filler warp **21'**. The connector warps between plies **24**, **25** are indicated **20''** and the filler warps **21''**.

In Figure 3 there is shown a fabric having outer plies **28**, **29**, and **30**. The weave structure of this fabric is illustrated in Figures 8 to 12. Referring to Figure 8, it will be seen that the ply **28** is composed of warp **31**, **32** interlaced with weft **33** in the basic order of under one, over one. The ply **29** is composed of warp **34**, **35** interlaced with weft **36** in a similar manner. The central ply **30** is likewise composed of warp **37**, **38** interlaced with weft **39**. The connector warp **40** connecting plies **28**, **30** is interwoven in the said plies in the manner similar to the interweaving of connector warp **20** of Figure 1. The filler warp **41** (see Figure 10) between these plies **28**, **30** is similarly interwoven in the said plies so as to produce warpwise rows of connector warp **40** alternating with rows of filler warp **41** similar to the fabric of Figure 1. The connector warp **42** between plies **29**, **30** (see Figure 9) is similarly interwoven between the plies and the filler warp **43** between these plies **29**, **30** are also similarly interwoven in said plies.

Now referring to Figure 12, it will be seen that the filler warp **43** form rows of filler warp which are spaced a much greater distance apart than the filler warp **41**. A spacing of these filler warp three inches apart weftwise has been found satisfactory so as to provide a chamber in which is received an additional filler as for example poultry down and the like so as to additionally provide a barrier against the free movement of air between the plies **29** and **39**.

In Figures 13 to 15 there is illustrated a three-ply fabric having outer plies **45**, **46** and a central ply **47**. The ply **45** is composed of warp **48**, **49** which are interlaced with weft **50**. The outer ply **46** is similarly composed of warp **51**, **52** which is interlaced with weft **53**. Ply **47** is likewise composed of warp **54**, **55** interlaced with weft **56**. One set of connector warp **57** which are equally spaced across the fabric are interlaced with the weft **50** of ply **45** in the order of over one, under one for three consecutive picks of weft **50**, thence the warp **57** are crossed over to be similarly interlaced with the weft **56** of ply **47**, and thence crossed back to ply **45** for a repeat. During the interlacing of the connector warp **57** with the

weft **56** of ply **47**, five picks of weft **50** are interlaced with the warps **48**, **49**. Likewise during the interlacing of connector warp **57** with three consecutive picks of weft **50**, five picks of weft **56** are interlaced with the warp **54**, **55**. Thus, the cross-over portion of warp **57** is angularly disposed between plies. The other set of connector warp **58** (see Figure 14) are likewise interlaced with the wefts of the plies of the fabric. The filler warps **59** and **60** are interlaced with the wefts of the plies and cross over in a very similar manner (see Figure 15). The spacing between the connector warp and filler warp may be also spaced weftwise as in Figure 12 or as shown in Figure 2.

It will be observed that in the various weave structures illustrated, the filler warp is arranged in warpwise rows so as to form chambers or cells between the rows, the walls of which restrain to a considerable degree the free movement of air between the plies of the fabric so as to provide for better heat insulation. It will also be apparent that additional filler placed between the rows of filler warp will be prevented from shifting out of position at such times as the fabric may be deflated.

It is here pointed out that in each of the various weave structures disclosed, the filler warp is overfed in the cross-over portion thereof so that the said cross-over portion will be of greater length than the pile or connector warp which ties the plies together and determines the spacing between plies of the fabric. Thus, the rows of filler warp between plies will be a compact, more or less tangled mass of threads extending from one ply to the other.

I claim:

1. An inflatable multiple ply fabric comprising spaced plies of woven fabric interconnected one to the other by warpwise rows of pile warp extending between said plies and interwoven therewith, and a plurality of rows of a second pile warp extending between said plies and interwoven therewith, the portions of said second pile warp extending between said plies being of greater length than the portion of the first pile warp extending between the plies.

2. A multiple ply fabric as set forth in claim 1 wherein said pile warps alternate across the fabric.

3. A multiple ply fabric as set forth in claim 1 wherein said second pile warp is made of kinky yarn.

4. A multiple ply fabric as set forth in claim 1 wherein said second pile warp is made of a kinky fluffy yarn.

5. A multiple ply fabric as set forth in claim 1 wherein said pile warp is made of "Helanca" yarn.

6. A multiple ply fabric as set forth in claim 1 wherein said first pile warp is nylon.

7. An inflatable multiple ply fabric comprising three plies of woven fabric interconnected in spaced relation by first pile warp interlaced with the wefts of said plies and crossed over from one ply to another, a second pile warp interlaced with the wefts of said plies and crossed over from one ply to the other, said cross-over portions of the said pile warps extending in warpwise rows across said fabric with the crossed-over portions of the said second pile warp being of greater length than the crossed-over portion of the first said pile warp and extending in a more compact mass.

8. A multiple ply fabric as set forth in claim 7 wherein said second pile warp is made of "Helanca" yarn.

9. A multiple ply fabric as set forth in claim 8 wherein said pile warps alternate weftwise of the fabric.

10. A multiple ply fabric as set forth in claim 8 wherein said pile warps are spaced weftwise of the fabric, and the second pile warp between one of the outer plies and middle ply weftwise is spaced a greater distance than the spacing of the second pile warp between the other outer ply and middle ply so as to form warpwise extending chambers and an additional filler inserted into said chambers.

No references cited.