Nov. 27, 1962 H. F. SCHMIDT 3,065,520

TENNIS BALL FABRIC

Filed Jan. 8, 1959

FIG. 1

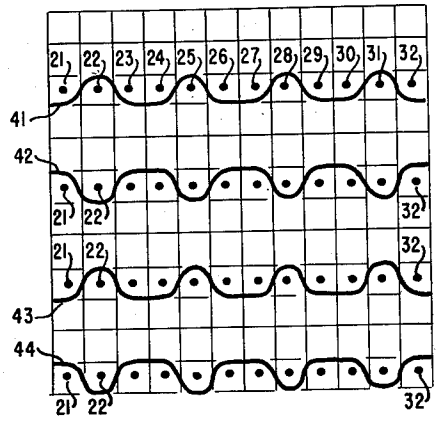


FIG. 2

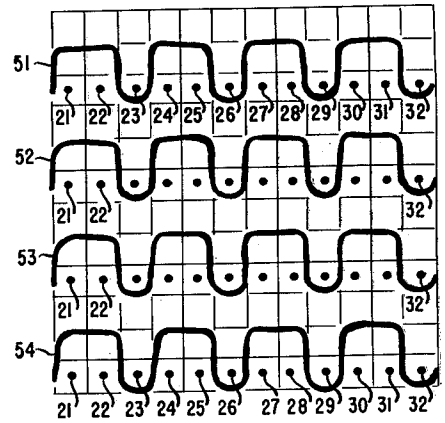


FIG. 3

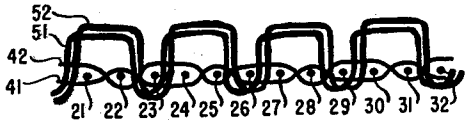
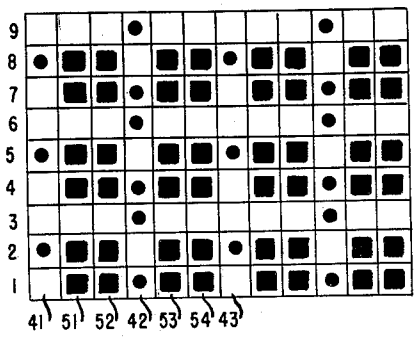


FIG. 4



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TENNIS BALL FABRIC

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This invention relates in general to mechanical fabrics and in particular to an improved fabric for covering tennis balls and a method of making that improved fabric.

To begin with, my invention is concerned primarily with fabrics of wool, synthetic material, or combinations of the two. Although other materials may be used, the greatest benefits are obtained by using the cited materials, for reasons which I shall explain in greater detail below.

The problems encountered in producing so-called mechanical fabrics, as distinguished, for example, from clothing fabrics, are numerous. This fact is nowhere better illustrated than in the production of tennis ball coverings. A tennis ball is inevitably exposed to abrasive action continuously during its normal use. Yet, the maintenance of a nap or "beard" on the surface of the ball is considered essential by skilled players of the game of tennis. Control of the flight of the ball becomes increasingly difficult as the beard is abraded away, the ball having a tendency to "sail" as its outer surface becomes smooth. Too, of course, a smooth ball tends to skid rather than bounce accurately. When the nap is substantially reduced, the ball is usually discarded, particularly in tournament play.

As long ago as 1935 I recognized this problem and, as a consequence, I invented a fabric for a tennis ball cover fabric and a method of producing that fabric on which U.S. Patent No. 2,109,233 was issued to me. Briefly, that fabric constituted an improved version of the then current materials made by using a single system of warp and a single system of weft or filling Floats were provided on one side of the ground and ultimately the floats were formed into a stiff felt containing more than half the total body of the wool. The yarns of the covering lay substantially flat on the outer ball surface.

This fabric and production method have met with wide acceptance. Nevertheless, there remained room for improvement in the matter of durability of the nap and, accordingly, useful life of the tennis ball. It is with just such an improvement that my present invention is concerned.

In general, my present invention consists in a fabric and a method of producing that fabric of upstanding loops forming a nap or beard which continues to develop for a considerable period as normal use of a tennis ball having a cover made of the fabric ensues. I obtain this highly desirable result by providing a ground or base of relatively small diameter yarns on one warp system and a pile of relatively large diameter yarns on a second warp system with only a single weft system. The ground may be, but need not necessarily be, a plain weave which forms the back surface of my fabric. Such a surface is highly suitable for attachment as by cementing to the underlying rubber or composition of the tennis ball. The front or exposed ball surface is a pile, controllable as to

height in the weaving step of my process. The pile consists of upstanding terry-like loops, similar in many respects to those of a single-sided terry cloth. The fabric is, of course, subjected to additional processing until a relatively stiff material having a heavy compacted pile upon one surface results. The looped pile structure remains, however, and a nap continues to develop as wear cuts the outer loop ends. For a better understanding of the invention, together with its other features, objects and advantages one should read the following description of a preferred embodiment of the invention referring to the appended drawing in which:

FIG. 1 is a diagram illustrating the relation of the warp and weft threads of the ground in successive picks of the weave,

FIG. 2 is a diagram illustrating the pile warp threads and successive picks of the weave,

FIG. 3 is a diagram illustrating the combination of warp and weft thread of the ground with the pile, and

FIG. 4 is a diagram of the pattern of the weave developed.

In FIG. 1, the warp and weft threads of the ground are shown in typical diagrammatic fashion. The dots 21, 22, 23 . . . 32 indicate the weft threads. The lines 41, 42, 43 and 44 indicate the warp threads. As is clear from the diagram the first ground thread of the warp passes under the weft thread 21, over the weft thread 22, under the weft threads 23 and 24, thence over the weft thread 25, under the weft threads 26 and 27, over the weft thread 28, under weft threads 29 and 30, over the weft thread 31, under the weft thread 32; and so on.

The second ground warp thread follows the same pattern, but here the warp thread 42 follows a course precisely opposite to that of the warp thread 41. That is, the warp thread 41 is under the weft thread 21, whereas the warp thread 42 is over the weft thread 21. The warp thread 41 is over the weft thread 22, whereas the warp thread 42 is under the weft thread 22. Similarly, and continuing the opposing pattern, the warp thread 41 is under the weft threads 23 and 24, and the warp thread 42 is over the weft threads 23 and 24,

With the third ground warp thread, the pattern of the first thread is repeated and in the fourth thread the pattern of the second warp is repeated.

Now, in FIG. 2, for purposes of simplicity, only the pile warp threads are illustrated. Again, weft picks or threads 21 through 32 are indicated by the dots. The pile threads are indicated by lines 51, 52, 53 and 54. In all four of the successive warp threads illustrated, the path of the pile thread is the same. It passes over the weft threads 21 and 22, under the weft thread 23, over the weft threads 24 and 25, under the weft thread 26, over the weft threads 27 and 28, under the weft thread 29, over the weft threads 30 and 31, under the weft thread 32; and so on.

The significance of the illustrated interweaving of the pile with the ground is apparent from a consideration of FIG. 3. In FIG. 3, I have shown two of the ground warp threads 41 and 42 as they are interwoven with the weft threads 21 through 32, and I have also shown two of the pile threads 51 and 52 as they are interwoven. In the illustrated case of doubled pile warp thread, as for example where the ground warp thread 41 underlies the two

weft threads 23 and 24 and the ground warp thread 42 overlies the two weft threads 23 and 24, the pile threads pass between the pair of weft threads. In other words, pile threads 51 and 52 pass between weft threads 23 and 24, 26 and 27, 29 and 30; and so on. Conversely, pile threads 51 and 52 are drawn upwardly in loops over the combination of interwoven weft threads 21 and 22, 24 and 25, 27 and 28, 30 and 31; and so on.

The disposition of the pile threads in the weave is somewhat difficult to visualize in the illustration of FIG. 3. In FIG. 4, therefore, I indicate diagrammatically the weave or pattern which is developed. In this figure, the face of the fabric is depicted, and as is the convention, the blank squares are filling or points where the weft is visible. Taking the left-hand vertical column and considering only the ground warp thread 41, the blank in the lower left-hand corner of the diagram indicates the point at which the thread 41 passes under the weft 21. Continuing upwardly in the first column, the dot in the second square indicates the ground warp thread 41 theoretically visible on the face of the fabric. Then the warp thread 41 goes under weft threads 23 and 24, indicated by the third and fourth blank squares in the left-hand column. This sequence is repeated with the warp thread 41 overlying the weft thread 25 as indicated by the dot in the fifth square of the left-hand vertical column. Continuing upward in the first column, the sixth and seventh blank squares indicate that ground warp thread 41 underlies weft threads 26 and 27; the dot in the eighth square indicates the warp thread 41 passing over the weft thread 28; the blank in the ninth square indicates the warp thread 41 underlying the weft thread 29; and so on.

In the second and third vertical columns from the left of the diagram, the pile is illustrated. The doubled threads 51 and 52 appear as loops passing over the weft threads 21 and 22 as indicated by the filled-in first and second squares. The pile threads then pass under the weft thread 23 as indicated by the blank third squares of columns 2 and 3. This sequence is of course repeated through the length of the fabric as indicated in the diagram.

In the fourth column from the left of the diagram, the ground weft thread 42 is illustrated. Thus, in the first square of the fourth column a dot appears indicating that the warp thread 42 passes over the weft thread 21. Following the same convention, it is obvious that the weft thread 42 underlies the weft thread 22, overlies the weft threads 23 and 24, and so on throughout the fabric as depicted in the diagram. The sequence is repeated for the warp threads 43 and 44 and pile threads 53 and 54 in an identical manner as is suggested by the further columns of the diagram.

Achieving a pattern such as that described and illustrated hereinabove is possible on a loom utilizing two separate warp beams. The ground warp is wound on a conventional warp beam, and the pile warp is wound on an extra warp beam as is customary in the manufacture of terry cloth. In this instance, however, the similarity lies between the weave of the cloth of the fabric of the present invention and a single-sided terry cloth inasmuch as the loops are maintained on only one side.

It is necessary that separate beams be utilized for ground and pile warp because a different "let-off" and "loose reed motion" are required for each loom. The warp pile fabric may be constructed by raising the pile threads from the ground cloth and interlacing them back into the cloth. The usual technique for such weaving on woolen looms is the use of wires for raising the entire pile or a stuffing pick. The apparatus which I prefer to use in the weaving of my fabric includes the so-called let-off and loose reed motion, the let-off motion being quite similar to that employed in weaving terry toweling.

After weaving the fabric, I carry it through additional process steps necessary to convert the fabric into one useful as a tennis ball covering. The first step in processing after weaving is that of fulling. In the fulling operation, apparatus and machinery of conventional design may be employed. The material as it comes from the loom has an appearance similar to that of terry cloth on one side, the individual loops being clearly apparent. In the fulling operation, by an application of moisture, pressure and heat, the fabric is shrunk in width and in length by running it in an alkaline soap solution and passing it between rollers. The pressure of the rollers is adjustable by means of hydraulic or spring pressure, and the amount of pressure applied to the fabric as it passes between the rollers controls the width shrinkage. A trap pressure device which is also adjustable is set up to control the length shrinkage of the fabric. For convenience in carrying out this operation, the ends of a length of fabric are sewn together to form an endless belt. To obtain the desired degree of firmness in the finished fabric, I prefer to continue the fulling operation for a period of one and one-half to two hours.

Following the fulling operation, the materal is scoured and washed to remove the fulling solution as well as oil and foreign matter from the fabric. The machinery for scouring may also be of conventional nature, consisting of a tub with hot and cold water connections and a pair of heavy rollers. The material is still maintained in the form of an endless belt, and run through the scouring solution, after which it is rinsed several times, and when clean, it is removed from the machine.

After the scouring or washing operation, the material is placed in an extractor to remove excessive moisture. The extractor may be of the centrifugal or vacuum type. Under normal circumstances twelve to fifteen minutes are required for this operation. The fabric is then passed through a tenter or drying machine in which the selvages of the fabric are fastened on the tenter pins to maintain the desired width of the fabric. The temperature within the housing of the tenter may be from 170° F. to 190° F., and the speed of passage of the fabric through the tenter may be controlled to obtain complete drying.

As a final step, the material is sheared. In particular, the back of the material is cropped to remove any fibers of excessive length, thus leaving a smooth back surface. Shearing on the face of the fabric is seldom necessary, but in some instances a light cropping is carried on, care being taken to retain the desired bearded surface.

In a typical process the material may run to about 32 ounces per yard coming off a 92–inch loom. The combination of the loss in weight from the removal of oil and foreign matter in the scouring operation may subtract as much as 12 to 15 percent from the weight. The shrinkage incident to fulling will bring the weight up to about 37 ounces per running yard. The final product will run about 58 inches in width out of the dryer, and the finished weight is about 37–38 ounces per running yard.

The height of the pile on the fabric is controllable in the weaving operation. For optimum results as a covering for a tennis ball, I prefer to limit that height in the weaving operation to about 5 or 6 millimeters.

Although what I have disclosed constitutes a preferred embodiment of my invention, other pile or ground weaves may also be used with a degree of success. I believe that the invention resides in a tennis ball covering fabric with more than one system of warp, which fabric continues to develop a beard during normal use, and the method of manufacturing such fabric. Therefore, my invention should be limited only by the spirit and scope of the appended claims.

What I claim is:

1. A fabric for covering tennis balls comprising a ground composed of relatively small diameter yarns on a first wrap system and on a single weft system, a pile composed of relatively large diameter yarns on a second warp system interwoven with said single weft system, said ground being a plain weave forming a back surface of said fabric, said pile consisting of heavily compacted up-

standing loops forming a front terry-like surface of said fabric.

2. A method of manufacturing a fabric for covering tennis balls comprising weaving a ground of yarns of relatively small diameter on a first warp system and yarns of relatively small diameter on a weft system, simultaneously interweaving a pile of yarns of relatively large diameter with said weft system to form a pile of upstanding terry loops on one side of said ground, fulling and shrinking said fabric to form a heavy compact pile on said one side of said fabric, scouring said fabric, and cropping the other side of said fabric to remove fibers of excessive length to prepare said fabric for application to a tennis ball.

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