Dec. 10, 1935. D. W. ELLIS 2,023,672

TENNIS BALL COVER

Filed Feb. 9, 1934

Fig. 1.

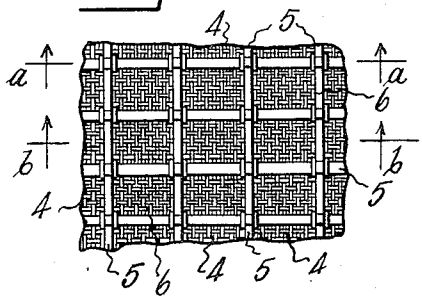


Fig. 4.

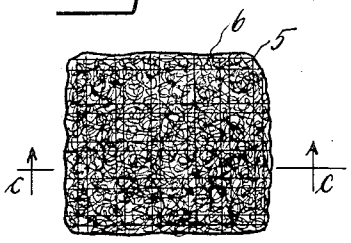


Fig. 2.

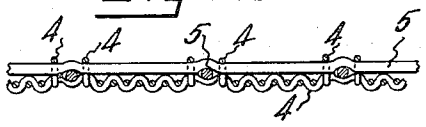


Fig. 5.



Fig. 3.

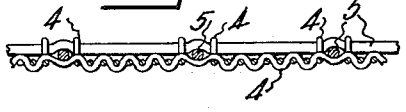
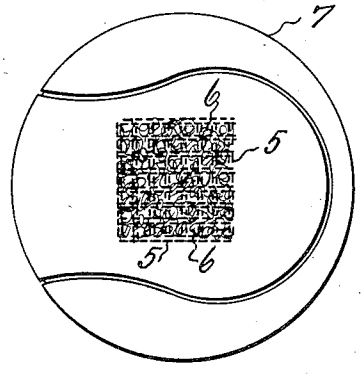


Fig. 6.



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TENNIS BALL COVER

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Application February 9, 1934, Serial No. 710,481

2 Claims. (Cl. 273—61)

This invention relates to an improvement in cloth covers for tennis balls.

I will describe the way to make the improved cover. As the description proceeds, the purpose of the changes in cover construction will be made apparent and the characteristic features of the invention will be pointed out in their various combinations by the claims.

Referring to the accompanying drawing,

Fig. 1 shows a portion of the improved cover fabric so far as it is made up on the loom;

Fig. 2 is an enlarged cross-section of the fabric shown in Fig. 1, taken on line *a*—*a*;

Fig. 3 is an enlarged cross-section taken on line *b*—*b*;

Fig. 4 is a view of the same cover fabric after it has been put through a fulling or milling process;

Fig. 5 is a cross-section taken on line *c*—*c* of Fig. 4; and

Fig. 6 is a view of my improved cover on a tennis ball as it will appear after hard play through many sets.

The fabric of Fig. 1 is woven in a loom. It consists of a body fabric made of yarn **4** and a wearing fabric made of yarn **5** laid or "floated" on one side of and tied into the body fabric yarn during the weaving.

As will be seen from the drawing, yarn **4** is woven in an ordinary closely formed square weave. Yarn **5** is simply laid on top of the weave formed by yarn **4**. The large yarn **5** running in one direction merely intersects with the large yarn **5** running at right angles, see Figs. 1, 2, and 3. There is a top layer of yarn **5** and a bottom layer of yarn **5**. And the yarn **5** of the top layer nowhere passes under the yarn **5** of the bottom layer. But the top layer is tied down to the bottom layer of yarn **5** by yarn **4** passing over the top yarn **5** on each side of every intersecting point of top yarn **5** with bottom yarn **5**. Thus both layers of yarn **5** are, at the same time and by the same means, tied together at their points of intersection and tied to body fabric yarn **4** by the particular weaving. This arrangement makes the yarns **5** everywhere, except at their substantially spaced points of intersection, free of the weaving ties. Between the points of intersection the large yarn **5** rides free and can stay fluffed up to form skeleton-like ribs. This is clearly apparent from the drawing, particularly Figs. 1, 2, and 3.

The yarn **4** is a fine (for example, 6400 yards per pound) single woolen yarn. The yarn **5** is a much heavier (for example, 2400 yards per pound) two-ply, hard twisted woolen yarn. These different yarns **4** and **5** are woven in different ways into the same covering cloth as shown, so as to function differently, not only on account of the individual character of each yarn, but also on account of the respective position of each yarn in the cover construction, as will be pointed out.

Yarn **4** is tightly woven. That is to say, the yarn **4** is preferably woven with all the warp and weft threads as close together as can be arranged and still permit good weaving in the loom. In any event such yarns are arranged much closer together than are yarns **5**. The heavier yarn **5** is loosely laid on yarn **4**. It is all laid practically on one side only of the body fabric made of yarn **4**. Yarn **5** is preferably laid with one series of its cross yarns merely intersecting the other series (rather than interweaving therewith), and the top series of heavier yarn **5** is tied to yarn **4** only at the points of intersection between warp and weft of loosely woven yarn **5**. This is one preferred arrangement that will be understood by a skilled weaver, and may be called "floating" the heavy yarn on the smaller woven yarn. Other arrangements can be made by the skilled weaver to give the same effect with variations in weave. In any event, yarn **5** is laid on the wearing side of the tennis ball cover and tied to the body fabric of yarn **4** to a sufficiently small extent as to avoid the two kinds of yarn occupying substantially the same plane when the cover comes from the loom as an intermediate product, and to definitely lay yarn **5** on a higher level than yarn **4** for the outer side of the cover.

Yarn **5** is woven with yarn **4** loosely enough to provide coarse, screen-like openings of rectangular shape, as indicated in Fig. 1. These openings are preferably made, in the weaving operation, of greater length in the direction of the weft, to compensate for a shrinking operation to be described in connection with the fulling step. The closely woven yarn **4** or body fabric serves as a bottom closure for all the screen-like openings made by the superposed and heavier yarn **5**. The result in the composite fabric is that one of its surfaces, as it comes from the loom, is effectively covered with pits **6**. The bottoms of these pits are closed by closely woven yarn **4** and the sides are bounded by yarn **5** "floated" on top of woven yarn **4**. One purpose of this arrangement is to provide pits **6** in the cover that are to be filled with felted fibers. The way in which such pits are filled with felted fibers will now be described.

The fabric woven with the yarn construction and in the manner described is subjected to a fulling or milling operation. This operation is well understood in woolen manufacture. It ordinarily consists in working the fabric (as delivered from the loom) in a machine to compact and felt the cloth. During the operation the fabric is wet with a soap solution.

According to my invention the fulling operation is carried on with the plan to have the yarn **4** of the closely woven body fabric supply all the woolen fiber necessary to compact and felt the composite cloth. Of course the yarn **5** may supply some fiber entering into the felting of the cloth, but such additional fiber is preferably made an incident to the adequate supply of fiber from yarn **4** for felting purposes. To accomplish my desired results it is necessary to have the yarn **5** retain its characteristic identity of loosely laid form and of position in respect to the composite fabric sheet, throughout the fulling operation.

To bring this about I make yarn **5** with a hard twist. It is twisted hard enough to prevent its fibers from spreading out and supplying the felted area of the cloth between the interstices of the spun yarn. And so the yarn **5** is kept to a far greater degree in the same form it had when it left the loom than is yarn **4** of the body fabric. Yarn **5** is preferably two-ply hard twisted yarn; while yarn **4** is a single yarn and soft spun with the plan that it shall supply the fibers necessary in the fulling step to make the desired felted and compacted area of the cloth, not only between its own interstices, but also to fill up the pits **6** formed and bounded upon the sides by the laying of yarn **5** on the body fabric.

The result of this arrangement is that the composite cloth is felted and smooth on both sides, as indicated in Fig. 5. The closely woven body fabric of yarn **4** is located much closer to the felted surface on the bottom than it is to the top surface. The wearing fabric of yarn **5** is located or "floated" above the body fabric and buried in the thicker felted surface on the top side. It should be understood that the composite cloth is completely felted in the sense that it is a solid, smooth sheet with yarns **4** and **5** buried in it and all interstices between woven yarns filled up smoothly with felted fiber. This is indicated in Fig. 5, where the thickness of the body fabric is generally indicated at *d*—*e* and the thickness of the wearing yarn **5** buried in the felted fibers from yarn **4** is indicated at *e*—*f*. The latter is substantially larger than the former.

The composite smooth and solid felted fabric in the form given after the fulling operation is shown in Figs. 4 and 5. Getting this desired consolidated form is greatly helped by the fact that the fulling operation results in a shrinkage of the fabric, and I operate the fulling step to give a large degree of shrinkage. For example, a fabric woven at 94-inch width can be shrunk to advantage down to 55 inches; and there can, with advantage, be a substantial shrinkage in length. This large shrinkage makes it desirable for me to lay yarn **5** with its interstices of dimensions (indicated in Fig. 1) that will shrink to approximately balanced or square dimensions (indicated in Fig. 4). The length and width shrink in different percentages and I prefer the pits **6** in the cover fabric filled with felted fiber to be substantially square.

A common standard for tennis ball covers requires a cloth weight of 31/32 oz. per yard of 54-inch width. In my improved cover for this standard, the weight of yarn **5** with respect to the entire weight of the cover may vary considerably; for example, I have found a variation from 30% to 40% of the entire weight not objectionable for my purposes.

With the tennis ball cover made as described, it is fastened on the tennis ball in completing its manufacture. The advantages of the manufacture according to my invention are as follows:

The composite cloth of two kinds of yarn can be cut and applied to cover the ball with the same equipment and facilities as the ordinary square woven cloth cover heretofore so widely used. No substantial change in manufacturing equipment is necessary for the new cover, either in the cloth mill or the ball factory.

When the improved cover is applied to the ball with the same well chosen character of attachment and seaming operations as the old square woven cover, it provides a smooth surfaced felted cover for play with a fuzzy nap, and without any readily apparent difference as compared to the best prior tennis ball cover. This is of advantage in getting the new tennis ball cover on the market where its superior advantages will be best proved to players by actual use.

In use, hard play will wear off the original outside nap of the ball. But, by reason of the peculiar cover construction, the desired fuzzy nap will be constantly renewed by the wearing action of the cover on the ground and against the player's racket. In wearing off the original nap the top sides of yarn **5**, arranged in a great number of squares, will be exposed. The pits **6**, bounded by the squared ribs of yarn **5**, are filled with felted fiber from yarn **4**. Further and hard wear on yarn **5** will work up its fiber for a fuzzy nap on the ribs and the fiber filling pits **6** will be gradually worked out on the surface of the cover to act with the wearing yarns **5** to give the desired nap over cover surface. The yarn **5**, arranged in small open squares, will prevent the fiber from pits **6** being torn out too rapidly and leaving flat spots on the ball. The arrangement of yarn **5** consolidated and compacted into the felted portion of the cover will act to keep the cover round to a remarkable degree. It should be noted that yarn **5** is not fastened or tied down tightly into the body fabric of yarn **4** but lies altogether on top and loosely, except at the corners of pits **6**, where yarn **5** is tied to yarn **4**. Between these corners yarn **5** is free to stand out on the cover for keeping the wear uniform, permitting gradual renewal of the nap during wear, and preventing any part of the cover wearing down to smooth spots which would spoil the desired action of the ball in play. It is not until yarn **5** is worn down to the level of yarn **4** that the ball cover can lose its desirable surface. This is indicated in Fig. 6, showing the improved cover after enough play to wear down the old standard form of square woven cover perfectly smooth and without nap. The same play with the improved ball **7** leaves the ball with nap supplied by loose lying yarn **5** and nap from fiber in pits **6**.

For many reasons it is desirable to have a tennis ball cover made of square woven fabric. My invention has been planned to get an improved square woven fabric cover without the faults of prior art square woven covers. It might seem that the solution could be found in making a cover of felted fibers alone, without weaving; but much tennis play is too severe for a pure felt cover.

The improvement made, considered from the skilled tennis player's standpoint, goes beyond the mere economy of making a longer wearing cover. Even with new balls of the old form there is a mental hazard in playing a single set as to whether the ball will "float" instead of act as it should when hit. This "float" of a tennis ball is caused by a cover without enough nap or surface for the racket and air resistance to act upon properly. An accidental "float" with the improved ball cover is impossible at any time during a long service or until the yarn **5** is all worn down.

Having disclosed my invention, what I claim is:

1. A tennis ball having a cover made of two kinds of woolen yarns woven together and fulled to consolidate the fibers in a felted cloth with a nap, one of said yarns forming a body fabric made up of closely woven fine single woolen yarns in both the warp and weft, the other of said yarns forming a wearing fabric made up of heavier two-ply hard twisted woolen yarn in an open mesh form superposed on one side only of the body fabric and tied to the latter by weaving the two fabrics together only at the points of intersection of the heavier yarn, the felted fibers of the body fabric being sufficient to close up the open mesh in the wearing fabric and present a smooth surface on the wearing side of the cover, whereby the heavier and hard twisted yarn lies buried in the felted fibers of the body fabric and a smooth surface is presented on the outside of the cover, said felted fiber and heavier yarn together forming a deep layer of wearing material for the cover on the outside of its body fabric which layer is adapted to resist rapid wear of the felted fibers and to renew the nap on the ball as the cover wears down to the plane of the closely woven body fabric.

2. In a tennis ball structure a composite fabric for the cover comprising in combination, a closely woven layer of fine single woolen yarns adapted to felt heavily in a fulling operation, an open mesh loosely woven layer of much heavier and hard twisted woolen yarns adapted to prevent heavy felting in a fulling operation, the latter layer being laid on top of the former layer with the upper layer having its threads spaced a plurality of times as far as the under layer and attached thereto only enough to hold the two layers together one on top of the other, whereby a fulling operation on the fabric may cause it to consolidate with the heavy felting from the fine yarns filling the open mesh of the heavier hard twisted yarn and make a cover cloth of a smooth felted wearing surface reenforced in the felted body by a skeleton of hard twisted heavy yarns.

DWIGHT W. ELLIS.