Feb. 19, 1935. G. H. WOOD 1,991,534

TENNIS BALL

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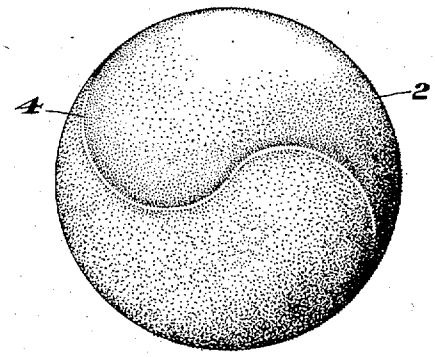


Fig. 1

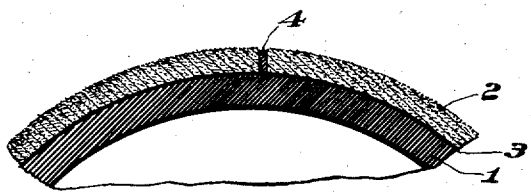


Fig. 2

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TENNIS BALL

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8 Claims. (Cl. 273—61)

Tennis balls have for a great many years, if not always, consisted of a hollow rubber body or "center" of spherical form, containing air under pressure, and a cover of fabric having a fuzzy or napped surface. From time out of mind the cover has been made of a woven all wool fabric known in the weaving industry as "melton", but more commonly referred to in the sporting goods trade as "felt". It is a very high-grade and expensive piece of goods and has been used universally by the tennis ball manufacturers.

The reason for this practice is that a tennis ball must necessarily be relatively light in weight and if it has a smooth surface it tends to "float" or "sail" while in flight, its action in the air is extremely erratic, and consequently is a difficult ball to control. If, however, such a ball is covered with a fabric having a suitable nap or fuzzy surface which will react properly on the air through which it travels, the ball then behaves very differently, its flight is relatively true, and it is a far easier ball to control. In addition, it is much easier to make the ball spin during flight by properly "cutting" it or stroking it with the racket, and the spin or cut so imparted to it will change the flight of the ball in ways well understood by those familiar with this sport. A smooth surfaced ball when so "cut" or spun behaves very differently. The melton fabric is a firm but pliable piece of goods with a short but thick and closely compacted nap. Consequently, cover sections cut from it have the necessary flexibility to fit the curvature of the ball, while at the same time being sufficiently strong to effectually resist the impact of the racket and the friction of its contact with the surface of the court. But, in addition to these mechanical characteristics, melton is superior to other fabrics in having the thick coarse nap which gives to the ball the desired surface characteristics and those playing qualities which tennis players demand. It is because of these properties and characteristics that this fabric has been used universally for a period of at least half a century and probably much longer.

The chief objection to a tennis ball covered with melton, however, is the fact that the ball is at its best when it is first put into play and that it deteriorates very rapidly while in use. This is chiefly due to the fact that the fiber of the nap is worn off rapidly by the friction of the racket and the sliding contact of the ball with the playing surface, so that the ball soon becomes relatively smooth and the functions of the cover, in a large measure, disappear. While the rate at which the nap will be lost will vary with the type of game played, and more especially with the characteristics of the court on which the balls are used, nevertheless, it is well known that even under the best of conditions, as for example those under which the national tournaments are played, a dozen or more new balls may be used in playing a single match and will be practically useless for match play by the end of that period. The less experienced players wear out the balls almost as rapidly, usually because of the fact that while their game is not as severe as that of the better players, they play on courts which are not so well cared for and therefore are harder on the balls. In any event, the wear on the balls is such that in a very few sets the nap is greatly reduced in length and may even be so worn down as to expose the warp and weft threads of the fabric. As soon as, and even before, this occurs the ball begins to act erratically, the players notice that it feels "light", it begins to sail or float, and it no longer takes the cut of the racket properly or reacts in a normal manner on the air. In other words, normal control of the ball is lost since it cannot be served nor stroked in the same manner and with the same speed as can a new ball and still keep it within bounds.

These facts have long been well recognized by those familiar with this sport and they have been regarded simply as necessary evils. It is the chief object of the present invention, however, to overcome these difficulties and to produce a tennis ball which will retain the desired surface characteristics and its normal playing properties substantially unchanged for a much longer period of play than do the tennis balls heretofore used.

I have found that a tennis ball having a cover of unwoven wool felt made to proper specifications satisfies these requirements and is definitely superior to the melton covered balls heretofore used. It may here be pointed out that the term "felt" is generally used in a very loose sense to include a great variety of products in most of which the fibers are simply bonded to each other by an adhesive binder, although it has also been used, as above stated, to include melton and similar woven fabrics. The term "felt" will hereinafter be used, however, in its true sense to designate a fabric composed essentially of wool and in which the fibers are so interlaced and interlocked with each other by shrinking and the various felting operations that they give strength, firmness and character to the goods without weaving, knitting, or other similar mechanical operations. In other words, a true felt is characterized by the inter-

locking of wool fibers with each other due fundamentally to the fulling and shrinking operations to which it is subjected.

In order to produce a fabric suitable for this purpose, some changes in the usual methods of making felt are necessary. The bat of carded wool which is built up at practically the beginning of the felt making operation may be produced in the usual manner, the web from one carding machine being folded transversely upon that delivered from another. It is preferable, however, to make the folded web slightly heavier than the straight web so that the strength of the ultimate fabric will be very nearly as great transversely of the bat as lengthwise of it. Any good grade of wool except the very fine grades can be used. The fibers should, however, be strong and have a tendency to be somewhat coarse or harsh, as distinguished from being too fine and soft. No short fiber should be used. In fact, the wool should be combed to eliminate short fibers before it goes to the carding machines. No fiber less than half an inch long should be used, and it is preferable to have all of the fiber at least an inch and a half in length. It is also desirable to have both webs of substantially the same grade of wool so that they will felt securely to each other. A bat of a typical size may be in the neighborhood of forty yards in length and have a width of perhaps eighty inches.

Such a bat is put through the usual hardening processes and then is fulled. During the fulling operation it shrinks greatly, and for the purposes of this invention the shrinkage should be so controlled that no substantial stretching of the fabric after it has been fulled will be required. This can be done by subjecting the hardened bat to several fulling operations and measuring its length and width between them until the bat finally is brought down to the desired dimensions. The felt also should be fulled transversely as well as longitudinally so that it will shrink substantially the same amount in both directions. Preferably this shrinkage should be at least thirty per cent. of both dimensions. I have found that satisfactory results are produced by shrinking a bat of the dimensions above described until its length is reduced from forty yards to approximately twenty-five yards and its width from eighty inches to about fifty-four inches. Such a shrinkage produces a vigorous curling and interlocking movement of the wool fibers and "felts" them securely together.

After the fulling operations have been completed the fabric is washed, neutralized and dried in the manner common in the manufacture of felt, any substantial stretching of the web, such as those to which felt commonly is subjected preferably being avoided, and the goods next go to the finishing operations. The finishing process also is different from those commonly used on felt. A process which gives entirely satisfactory results consists in first shearing the felt, then sanding one face to bring the goods down to a uniform thickness and to produce a better surface, and subsequently shearing the sanded face. This last shearing operation is performed chiefly for the purpose of reducing the fibers of the nap on the face of the goods to a substantially uniform length since the sanding operation has a tendency to leave a nap of very irregular length. It is preferable not to calender the felt and it is not necessary to sand the back.

A felt made in the manner above described from stock such as that previously stated to be preferable, and having a thickness of from seventy to eighty-thousandths of an inch, and more preferably between seventy-two and seventy-eight thousandths, and weighing from twenty-five to twenty-six ounces to the running yard of fifty-four inches in width, has proved to be an exceptionally satisfactory material from which to make tennis ball covers. In such a fabric the fibers are distributed with an unusually high degree of uniformity and they extend in all directions so that the variation in strength of the fabric in different directions is greatly reduced and nearly the same degree of stretch in one direction as in another. This result is due not only to the nature of the stock and the way in which the fibers were originally brought together in making the bat, but also to the fact that the bat has been shrunk equally in both directions, thus felting the stock into a substantially homogeneous body. The strength of the fiber is further preserved by avoiding the calendering operation and preferably, also, by omitting the carbonizing operation which usually is performed on the fiber as a preliminary step to making a good grade of felt. The object of this latter operation is to remove the few incidental vegetable fibers which may be present in the wool, but it usually is performed with weak acids and consequently it has some incidental weakening effect on the wool fiber. For a tennis ball cover the added strength and resilience obtained by omitting this operation is highly desirable and the occasional vegetable fibers which may be left in the wool after the carding operation are so infrequent that they can be disregarded. In other words, any benefit derived from eliminating these fibers is more than offset by the loss in mechanical strength and elasticity of the wool fiber produced by this operation. By omitting this carbonizing or "processing" step, the entire strength and resilience of the virgin wool fiber is retained.

Tennis ball covers may be cut from this wool felt and applied to the rubber centers by exactly the same method customarily used heretofore in cutting and applying melton covers. The sanded face of the felt should be placed outward and the back face against the rubber center.

In the accompanying drawing a tennis ball embodying this invention is shown in Figure 1 and a cross-section through a portion of the ball is illustrated in Figure 2. In the drawing the rubber body of the ball is designated at 1, the felt cover at 2, the layer of cement joining the cover to the body is shown at 3, and the cement in the seam is illustrated at 4.

Tests of these balls and their use in actual play has demonstrated that they are superior in important respects to the melton covered ball. The most important of their points of superiority is the fact that as the ball wears it maintains substantially the same surface characteristics until the cover is almost worn out. This is in marked contrast to the experience with balls covered with melton in which, as above stated, a very rapid deterioration of the surface characteristics of the ball takes place. Apparently the difference in results is due very largely to the fact that practically all of the fibers in the nap of the melton cover have ends exposed at the outer surface of the ball. These fibers necessarily wear off rather rapidly with the result that the length of the fiber progressively decreases, and the surface of the ball loses its rough and fibrous characteristics and progressively becomes smoother. In the felt covered ball, how-

ever, the wool fibers throughout the cover are interlocked and interlaced firmly with each other, and as the surface wears down and fibers break off such wear automatically releases additional fibers or other portions of fibers already exposed at the surface but which have been held firmly bound in the fabric by their interlocking engagement with other fibers, and these fibers so released constantly renew the nap surface as wear proceeds. The surface characteristics of the ball, therefore, remain substantially unchanged until the cover is nearly worn out.

In addition to this advantage, certain other important advantages which were not contemplated have been found to attend the use of this felt cover. Among these may be mentioned particularly the fact that the cement by which the cover is secured to the rubber center penetrates the felt more readily than it does the melton, and this is true at the edges as well as at the back or rear surface of the cover. Consequently, a firmer union of the cover to the rubber body is produced, and better seams are made.

The fact, also, that the felt has a more nearly uniform stretch in all directions, whereas the melton stretches much more readily on the bias than in the direction of either the warp or weft, is an advantage in reducing the strain on the seams when the ball is in play. Apparently the reason for this effect is the fact that the more uniform stretch of the felt enables the felt to stay with the rubber when the ball is distorted upon being struck by the racket or on striking the court, whereas the greater resistance to stretch offered by the melton in certain directions than others, does not permit this movement and therefore tends to open the seams at certain points, the location of which will depend upon the direction in which the threads are run away from the point at which the ball is struck. This more uniform stretch in all directions is also an advantage in "ironing" the cover on the ball to close up the seams.

The tests to which the balls have been subjected in the course of these experiments have demonstrated that when a tennis ball is in play there is a strong tendency to pull the fibers out of the cover when a hard hit ball strikes the surface of the court and tends to skid on said surface. In covers made of melton this tendency is strongly resisted by the fact that practically every fiber present in the nap is anchored in the woven structure of the fabric. Such an impact or skid of a ball, therefore, results chiefly in breaking or shearing off some of the fibers. But in a ball covered with some felts this tendency actually results in pulling small bunches of fiber out of position and leaving them clinging to the surface of the ball. Any effect of this character can, however, be effectually overcome by making the felt in the manner above described. Features of this process which have a particular bearing on this result are the selection of a suitable grade of wool from which to make the felt, the high shrinking of the stock in the fulling operations, and those steps previously described which are designed to produce a uniform distribution of the fiber and to promote a high degree of tensile strength and a good directional distribution of that strength. In other words, the fibers are so interlocked with each other in the felt produced by the method above described that any slipping or migration of the fibers is definitely prevented. Consequently, when a ball skids on the surface of a court the only effect on the cover is to break or shear off some of the fibers.

With regards to the quality of the wool used, it may be stated that good results have been produced with the grade known as "sixty-four's", although other grades of long fiber wool having a somewhat harsh feel and good felting properties may also be used with entirely satisfactory results. The presence of non-felting fibers such as cotton, linen, rayon, and the like, should, however, be avoided because these fibers do not interlock with their neighbors in the manner characteristic of wool fiber, or, in other words, they do not "felt" with the other fibers, and consequently, a sliding impact or skid can drag such fibers out of place or produce a migration of them from one part of the cover to an adjacent part which would be impossible with wool fibers properly shrunk into position. While the degree of tensile strength required in an article of this character may vary considerably, I consider it preferable for a fabric of the thickness and weight above described to have a tensile strength of at least forty pounds per inch of width in any direction. It is almost impossible to have the tensile strength the same both lengthwise and transversely of the goods and it is not necessary that they should be for the purposes of this invention. Usually the strength of the fabrics which have proved satisfactory for these purposes have run in excess of the figure above given.

Having thus described my invention, what I desire to claim as new is:

1. A tennis ball comprising a hollow rubber body, and a cover secured to the surface of said body and made from a sheet of unwoven wool felt which maintains its surface characteristics substantially unchanged as it wears down, said cover having an outer nap surface.

2. A tennis ball comprising a hollow rubber body having secured to the surface thereof a cover of unwoven wool sheet felt in which the fibers are so interlocked with each other as to hold them securely against any substantial slippage, one relatively to another, out of interlocked relationship, said cover having an outer nap surface.

3. A tennis ball comprising a hollow rubber body having secured to the surface thereof a cover of unwoven wool sheet felt of substantially uniform thickness and in which the fibers extend in all directions and are distributed with a high degree of uniformity so that approximately the same number of fibers extend in one direction as in another.

4. A tennis ball comprising a hollow rubber body having secured to the surface thereof a cover of unwoven wool sheet felt of substantially uniform thickness and composed substantially exclusively of long wool fibers felted into a firm, approximately homogeneous body weighing from approximately twenty-five ounces to about twenty-six ounces per running yard of fifty-four inches in width.

5. A tennis ball comprising a hollow rubber body having secured to the surface thereof a cover of unwoven wool sheet felt in which the fibers are so interlocked with each other as to hold them securely against any substantial slippage, one relatively to another, out of interlocked relationship, said body having an outer nap surface, and having the characteristic that wear of said surface produces a new surface having a

nap of substantially the same length and character as the previous surface.

6. A tennis ball comprising a hollow rubber body, and a cover of unwoven wool sheet felt secured to the outer surface of said body, said cover having a nap surface and including a layer of fibers of considerable thickness to which the fibers of said surface nap are anchored and in which the wool fibers are so interlocked with each other and with the surface fibers that the wearing away of the surface nap releases underlying fibers and previously locked portions of fibers which progressively renew the napped surface on the cover as they are so released.

7. A tennis ball comprising a hollow rubber body, and a cover of unwoven wool sheet felt secured to the outer surface of said body, said cover having sufficient mechanical strength and firmness to prevent any substantial slippage of the fibers out of interlocked relationship to each other when the ball is in play, the fibers in said cover being so interlocked that the wearing of the surface fibers releases underlying fibers which serve to renew the nap and thus to maintain the surface characteristics of the ball substantially unchanged as the cover wears down.

8. A tennis ball comprising a hollow rubber body, and a cover of unwoven wool sheet felt secured to the outer surface of said body, said cover having sufficient mechanical strength and firmness to prevent any substantial slippage of the fibers out of interlocked relationship to each other when the ball is in play, said felt cover having a thickness of from approximately seventy to eighty-thousandths of an inch and weighing from approximately twenty-five to twenty-six ounces per running yard of fifty-four inches in width.

GORDON H. WOOD.

CERTIFICATE OF CORRECTION.

Patent No. 1,991,534. February 19, 1935.

GORDON H. WOOD.

It is hereby certified that error appears in the printed specification of the the above numbered patent requiring correction as follows: Page 3, second column, line 73, claim 5, for "body" read cover; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of March, A. D. 1935.

Leslie Frazer

(Seal)

Acting Commissioner of Patents

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6. A tennis ball comprising a hollow rubber body, and a cover of unwoven wool sheet felt secured to the outer surface of said body, said cover having a nap surface and including a layer of fibers of considerable thickness to which the fibers of said surface nap are anchored and in which the wool fibers are so interlocked with each other and with the surface fibers that the wearing away of the surface nap releases underlying fibers and previously locked portions of fibers which progressively renew the napped surface on the cover as they are so released.

7. A tennis ball comprising a hollow rubber body, and a cover of unwoven wool sheet felt secured to the outer surface of said body, said cover having sufficient mechanical strength and firmness to prevent any substantial slippage of the fibers out of interlocked relationship to each other when the ball is in play, the fibers in said cover being so interlocked that the wearing of the surface fibers releases underlying fibers which serve to renew the nap and thus to maintain the surface characteristics of the ball substantially unchanged as the cover wears down.

8. A tennis ball comprising a hollow rubber body, and a cover of unwoven wool sheet felt secured to the outer surface of said body, said cover having sufficient mechanical strength and firmness to prevent any substantial slippage of the fibers out of interlocked relationship to each other when the ball is in play, said felt cover having a thickness of from approximately seventy to eighty-thousandths of an inch and weighing from approximately twenty-five to twenty-six ounces per running yard of fifty-four inches in width.

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