Oct. 27, 1942. G. S. RADFORD 2,300,062

BALL

Filed April 20, 1940

Fig. 1

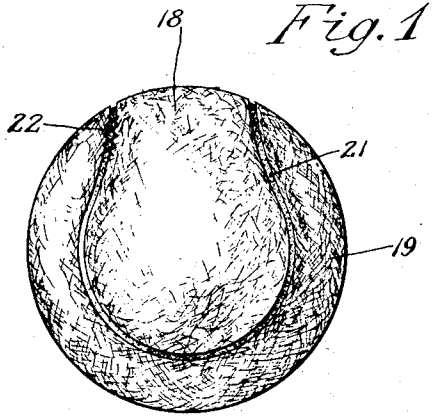
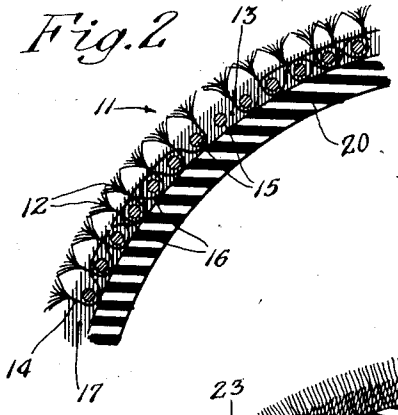


Fig. 2



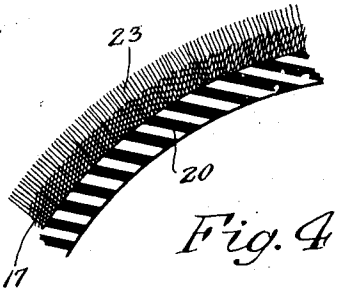


Fig. 4

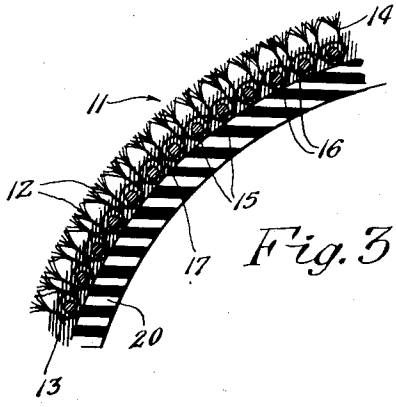
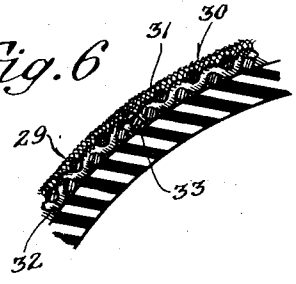


Fig. 3

Fig. 6



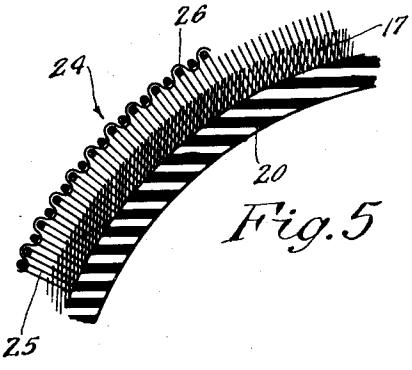


Fig. 5

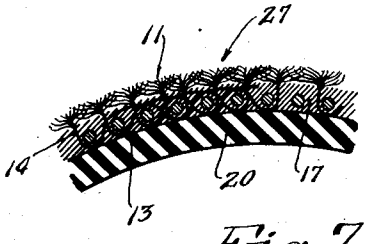


Fig. 7

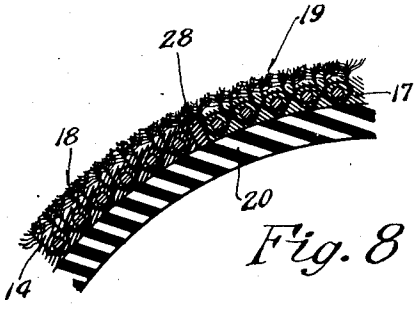


Fig. 8

INVENTOR
George S. Radford
BY Fraser and Mack
ATTORNEYS

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2,300,062

BALL

George S. Radford, Norwalk, Conn., assignor to A. G. Spalding & Bros. Inc., Chicopee, Mass., a corporation of Delaware

Application April 20, 1940, Serial No. 330,734

6 Claims. (Cl. 154—16)

The present invention relates to improvements in balls for tennis and similar games, and particularly to the external covering of such balls. This application is a continuation in part of an application, now abandoned, Serial No. 213,392, filed June 13, 1938, in the names of the present inventor and William F. Reach, but since changed to an application in the name of only the present inventor.

Balls of the type commonly used for tennis and similar games usually are provided with a cover consisting of a woolen nap fabric, for example, that known as "melton." When such a fabric is molded on the ball in a hydraulic press, or the like, the nap is flattened down and the ball becomes quite smooth. Since a hairy or rough outer surface is highly desired particularly in tennis balls for obtaining sufficient friction between the ball and the striking object, for examble a tennis racket, or, during the flight of the ball, between the ball and the air, and to obtain proper control of the ball at all times, the melton cover on the ball is usualy steamed or otherwise treated to re-establish the nap.

Since the nap fibers of such previously proposed ball covers are rather thin and an integral part of the base fabric, and since the nap itself is produced by repeated felting or fulling the fabric and napping the surface thereof by brushing or scratching the same, the thin nap fibers are easily damaged and some of them may even be torn or pulled from the base fabric during the manufacture of the cover. Inasmuch as the felting or fulling operations require relatively long fibers projecting from the base fabric and prevent the fibers from standing upright on the base fabric, the wear by the ground or striking object is not confined solely to the extreme outer ends of the fibers but to a considerable part of their length. Since spinning or skidding of the ball on the ground produces a scuffing or dragging action on the relatively long fibers of the nap and such drag is borne by a large part of the length of the fibers, a considerable tension is produced which tears or pulls the fibers apart and from the base fabric so that the nap is worn off after a short time and the ball has lost its good aerodynamic properties.

It is an object of the invention to provide a cover for balls which overcomes the disadvantages inherent with ball covers made heretofore and which maintains the aerodynamic properties of the ball by preserving the same degree of roughness of its outer surface until the cover is worn off completely or almost completely.

Another object is to provide a cover for a ball which wears so slowly and slightly that its rough outer surface retains its original appearance and aerodynamic properties substantially undiminished for a considerably longer time than the covers of similar balls made heretofore.

Another object is to provide a cover for a ball the material or texture of which is resilient so that when the ball is hit and the texture of the cover deformed to some degree, it will immediately thereafter assume its original rough but uniform appearance.

The invention has for a further object the provision of a ball cover in which, although the outer surface during use wears down appreciably, the friction on the respective sporting implement, the player's hands or the ground maintains said surface in its original degree of roughness, or even increases the same.

A feature of the invention resides in the use of a covering material for a ball consisting of fibrous texture in which the individual fibers are so arranged that their extreme outer ends mainly can come in contact with the sporting implement or the ground so that they are shortened only gradually.

Another feature of the invention is the production of a fibrous texture or surface for ball covers consisting of a plastic, plasticized or adhesive backing which is mixed with or in which are embedded a mass of fibers, flock, short bristles or the like which are in erect position to said backing to produce a pilelike surface.

Another important feature consists in the provision of a pile or nap fabric for ball covers in which an adhesive substance is applied to the base weave, or to the base weave and at least a part of the pile or nap adjacent the base weave to secure the nap to the base weave or to increase the securement of the nap on the base weave. Any pile fabric may be used but warp pile is preferred.

Another feature of the invention consists in the particular manner of applying the cover sections of such pile or nap fabric to the ball and securing the adjacent edges of such sections to each other preferably by a combination of means, such as cementing and stitching.

A further feature of the invention consists in the provision of a rubber ball, particularly for tennis or similar games, in which the adhesive substance is applied directly to the ball and the loose fibers are embedded in the adhesive while still in a liquid state, or in which a pile fabric is molded on the layer of adhesive covering the

rubber ball so that a part of the adhesive penetrates into or through the base of the pile fabric before the adhesive has dried.

Another object of the invention is the provision of a ball having a seamless cover.

A feature of the invention resulting in the attainment of the above object resides in providing a ball in which a napped or pile like surface of ball cover sections is so treated that the napped or pile like surface is felted across the seams between adjacent cover sections.

Another feature of the invention resides in providing a ball having a pile of pile like cover in which the individual projecting threads or fibers are felted or matted together so that the fibers interengage each other at various points to form a close feltlike outer surface on the ball.

Another feature of the invention resides in the provision of a pilelike outer surface on a ball by adhesively securing a pile fabric on the ball with the backing thereof on the outside and then removing the backing.

Further objects, features and advantages of the invention will be apparent to those skilled in the art from the following detail description and the drawing, in which:

Figure 1 is a view of an entire ball.

Fig. 2 is an enlarged diagrammatic section of a fraction of a tennis ball embodying one form of the present invention.

Fig. 3 is a view similar to Fig. 2, but showing a modification of the present invention.

Fig. 4 shows another modification of the present invention.

Fig. 5 is a view similar to Fig. 4, but showing in an intermediate stage one manner of effecting a result similar to the one illustrated in that figure.

Fig. 6 digrammatically illustrates another modified form of the present invention.

Fig. 7 is a view similar to Figs. 1 and 2, but showing a modification of the invention.

Fig. 8 is a view similar to Figs. 6 and 7 but illustrating another modification of the present invention.

Before describing the present improvements and mode of operation thereof in detail it should be understood that the invention is not limited to the details of construction and arrangement of parts shown in the accompanying drawing, which are merely illustrative of the present preferred embodiments, and the phraseology employed is for the purpose of description and not of limitation.

A pile fabric 11 shown for example in Figs. 2 and 3 and having tufts 12 interwoven with the base 13 may be manufactured in any suitable manner. Preferably for the purpose of the present invention, and as shown in Fig. 2, the pile threads 14 should be secured to the base 13 by being looped at least twice below and twice above the base threads 15, or pile threads 14 may be V-shaped, as shown in Fig. 3, and secured to the base 13 by being looped only below one or more base threads 15. The fabric may be woven in any suitable manner, for example, two layers may be produced at the same time by weaving the pile threads 14 from one to the other base and subsequently separating the two layers by cutting through the connecting pile threads and thereby obtaining a cut pile on both layers of fabric simultaneously.

After thus producing a pile fabric 11, at least the base or backing 13 including the looped portion 16 of the pile threads is impregnated with a layer 17 of liquid adhesive material, such as rubber cement, latex or the like, preferably through the back of the base layer 13. For example, the adhesive may be applied in an amount depending on the desired thickness of the layer of elastic material when dry, and the liquid material is allowed to penetrate and sink into the fabric. Thereupon, the adhesive is dried either by letting it stand or by passing the fabric through a suitable drying apparatus. For obtaining a closer pile, the fabric 11 may also be subjected to any well-known shrinking process, either prior to or after the impregnation with adhesive material.

After the adhesive has been dried at least to some extent, the fabric is cut into cover sections 18 and 19, preferably having substantially the form of the numeral 8, and a pair of such sections are placed around a rubber ball body 20 to envelop the same completely, the adhesive which has penetrated through the backing 13 still being sufficiently sticky to hold these sections to the ball body. The ball body 20 with its cover is then inserted into a mold which may be heated and in which the sections are firmly pressed to the ball whereby some of the adhesive will be forced to the edges of the sections to form a connecting ridge to secure the two sections of the cover to each other. If desirable, a separate layer of adhesive 21, shown in Fig. 1 for example, may also be applied to the edges of the sections, either prior to or after the molding operation, to join the sections more securely to each other.

In order to avoid fraying of the edges of the pile fabric cover sections, and to secure the sections more securely to each other, it has been found according to the invention that a combination of securing means consisting of an adhesive layer 21, and cross-stitching 22, also indicated in Fig. 1, produces the most beneficial result. However, either the adhesive layer 21 or a cross-stitching 22 or the like may be used, if the application of both types of securing means together is not desired. Obviously, any other suitable type of stitching may be used in place of the cross-stitching 22.

If it should be desired that only the base or backing 13 be impregnated with adhesive, such impregnation may also be performed prior to weaving the pile threads 14 thereto, or the threads of the backing 13 may be impregnated prior to weaving the same. After cutting the finished pile fabric into proper sections and applying the same to the ball body 20, the heat of the mold will melt the adhesive 17, which will thus impregnate the looped portion 16 also and bind the pile threads securely to the backing 13.

A ball provided with a pile fabric cover, according to any of the forms described above, has the advantage that the pile or nap consists of radially extending or projecting tufts of threads which are spaced very closely to each other, and each of which is individually and positively secured to the base or backing. When a ball of this type strikes the ground, racket or other implement, the brunt of the force is taken up mainly by the extreme outer ends of the brushlike pile threads which, because of their radial positioning and relative stiffness, have the tendency to pierce or stab into the respective object and to resist being bent or flattened thereby. Thus, a friction of greatest magnitude is obtained, while at the same time the wear on the cover is restricted mainly to the extreme outer ends of the tufts 12 so that the cover is worn only very slowly and gradually, retains its roughness uniformly until

it is worn off almost completely, and preserves the perfect aerodynamic properties of the ball because of such uniform roughness.

By impregnating at least the base of the fabric and the looped portions **16**, as described above, the pile threads **14** are securely anchored to the base **13** and positively prevented from coming loose despite the hardest wear thereon. If, according to the present invention, an elastic material such for example as rubber, rubber cement or other rubberlike material, is used for such impregnation, the additional advantage is obtained that a certain amount of resiliency is imparted to the base fabric **13** as also to that portion of the pile threads **14** which is embodied within the adhesive layer **17**. This resiliency also tends to release the stresses on the pile threads **14** and to transmit them gradually to the base or backing **13** itself. Thus, the resilient adhesive layer **17** constitutes a cushion for the pile threads **14** which increases the life of the ball, and particularly of the cover, considerably.

According to the modification shown in Fig. 4, the coating or layer of preferably resilient or elastic adhesive **17** may be applied directly to the ball body **20**, the mass of fibers **23** or the like dispersed on the adhesive, the ball then inserted into a suitable mold to embed the fibers into the adhesive, and the fibers raised to an erect position by combing or the like to form a pile.

The form of the invention shown in Fig. 4 may also be attained by pouring the adhesive on a smooth surface or a suitable backing, applying and straightening the fibers, separating the fiber-covered layer of preferably resilient or elastic adhesive from the surface of the backing, cutting **8**-shaped sections therefrom, and molding said sections to the ball body **20**.

The effect of an upright pile without the necessity of a fabric backing also may be achieved by adhesively securing a pile fabric **24** to the ball body **20** as shown in Fig. 5, with the pile side **25** of the fabric facing the ball and the backing **26** of the fabric on the outside, and then removing the backing by any suitable means.

Thus, with this latter form of the invention, after a pile fabric has been cut in a usual manner to provide a pair of sections of conventional numeral **8** shape, the sections are applied to the ball body face down. A layer **17** of adhesive similar to the layer of adhesive shown in Fig. 4 preferably is applied to the ball body prior to the application of the fabric sections, but it may be applied first to the pile side of the fabric, as by coating the same, and the adhesively coated fabric then applied to the ball body. In either event, after the pile fabric has been applied to the ball body, the fibers or threads making up the pile side, as seen in Fig. 5, are firmly embedded in the adhesive layer and thus secured to the ball body and relative to each other. Preferably, the ball body, with the pile fabric **24** applied thereto upside down, is placed in a suitable mold in order to achieve a more effective bond between the adhesive and the ball and between the adhesive and the pile side of the fabric.

One particularly satisfactory method of removing the backing **26** after the pile side **25** has been secured to the ball body involves the utilization of a carboning process. Thus, through the use of dilute sulfuric acid and also preferably heat, the backing **26**, which may be of cotton, is removed while the fibers or threads of the pile side, which may be of wool, are not affected by the carbonizing treatment. After removal of the backing, ends of the pile which project outwardly from the adhesive layer may, if desired, be suitably trimmed or otherwise finished.

A completed ball made in the above manner, it is seen, like the ball shown in Fig. 4, presents an advantageous pilelike surface, but may be provided in an even more efficient and controlled manner.

If desired and as indicated for example in Fig. 7, the projecting threads or fibers of the pile or pilelike fabric may be felted or matted together so that the individual fibers interengage each other at various points and form a close feltlike cover **21** on the ball body **20**. Obviously, such felting may be performed not only with the pile threads **14** shown in Figs. 2 and 3, but also with the rubber-embedded fibers shown in Figs. 4 and 5.

To provide a ball that has particularly advantageous control characteristics, especially when striking the playing surface, has a substantially complete and uniform covering and which is adapted to maintain a satisfactory outer surface for a very considerable period of time under actual playing conditions, the surface nap or projecting fibers on the sections of the ball cover may be felted, completely or partially, across the seam between adjacent marginal edges of the cover sections.

Thus, for example and as illustrated in Fig. 8, projecting pile threads or fibers **14** in cover sections **18** and **19**, initially formed and applied to the ball body **20** in the manner described above in connection with Figs. 1, 2 and 3, may be felted together in the manner shown in Fig. 7 and in such a way that a seam **28** initially defined between adjacent marginal edges of the cover sections is concealed. This felting across the seam of the pile threads or fibers provides an advantageous seamless outer surface on the ball which renders the latter susceptible of exceptionally fine control and which substantially or entirely eliminates the adverse and unpredictable sidewise rebound from the playing surface which has been often encountered in the case of conventional seamed tennis balls.

One satisfactory method of felting a ball cover, such for example as shown in Figs. 1, 2, 3 or 4, after it has been applied to a ball body, merely involves placing in a tumbling barrel with soap and preferably hot water, a ball having projecting feltable threads or fibers extending from the outer surface thereof and continuing the tumbling until the desired uniform and feltlike cover surface has been effected.

If desired, and as shown in Fig. 6, an advantageous seamless cover effect also may be achieved in the case of a ball having cover sections **29** and **30** of usual tennis ball covering material such as melton cloth. In such a case and as a first step surface fibers **31** may be napped up, as by brushing, after the cover sections have been applied and secured to the ball body as by an adhesive **32**. Then, following the napping up step, the surface fibers may in any suitable manner, as by the tumbling process described above in connection with Fig. 8, be felted down and across a seam **33** defined between the adjacent marginal edges of the cover sections.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

Having thus described the invention, what is claimed as new is:

1. A ball comprising a main ball body of rub-

ber; a layer of elastic adhesive material directly on said body; and a plurality of pile fibers having outer end portions extending upright from said body and having inner end portions firmly embedded in and connected to each other and to said main ball body only by said adhesive layer.

2. A method of making a ball comprising the steps of adhesively securing to a ball body with the pile side thereof facing the ball body, a woven pile fabric; and then removing the backing from the pile fabric.

3. A method of making a ball comprising the steps of applying a layer of adhesive to a ball body; placing on the ball body with the pile side thereof facing and embedded in said adhesive layer, a fabric having a backing and a pile of unlike material; and then carbonizing off the backing.

4. A method of making a ball comprising the steps of adhesively securing to a ball body, with the pile side thereof facing the ball body, a pile fabric having a backing; and then removing the backing from the pile fabric.

5. A method of making a ball comprising the steps of applying a layer of adhesive to the ball body; placing on the ball body, with the pile side thereof facing and embedded in said adhesive layer, a pile fabric; molding the pile fabric on the ball body; and then removing the backing from the pile fabric.

6. A method of making a ball comprising the steps of adhesively securing to a ball body, with the pile side thereof facing the ball body, a pile fabric having a backing of cotton and a pile of wool; and then carbonizing off the backing by applying sulfuric acid.

GEORGE S. RADFORD.