April 4, 1939. B. BOGOSLOWSKY 2,153,408

METHOD OF MAKING GOLF BALLS

Filed Jan. 29, 1937 2 Sheets-Sheet 1

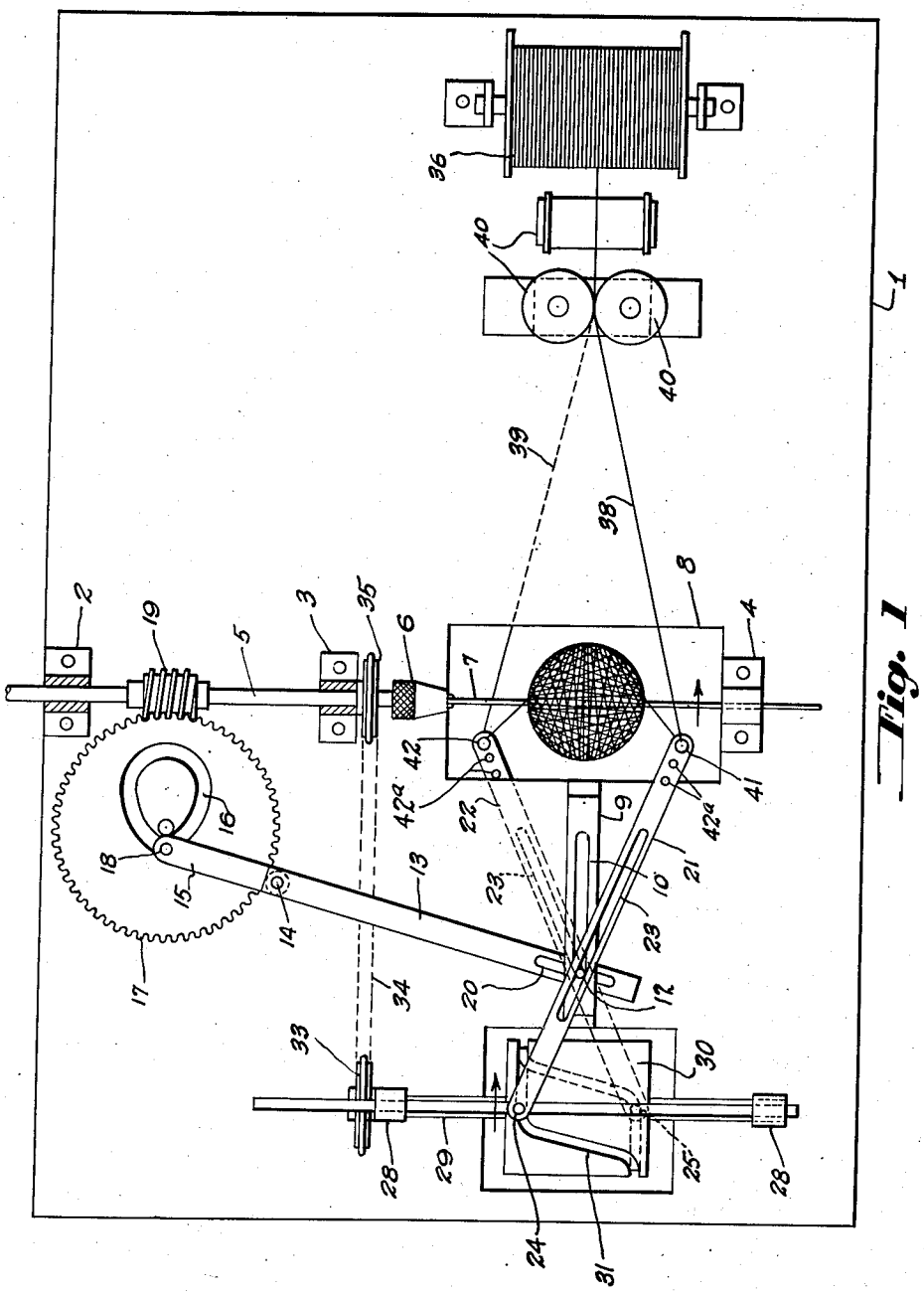

Fig. 1

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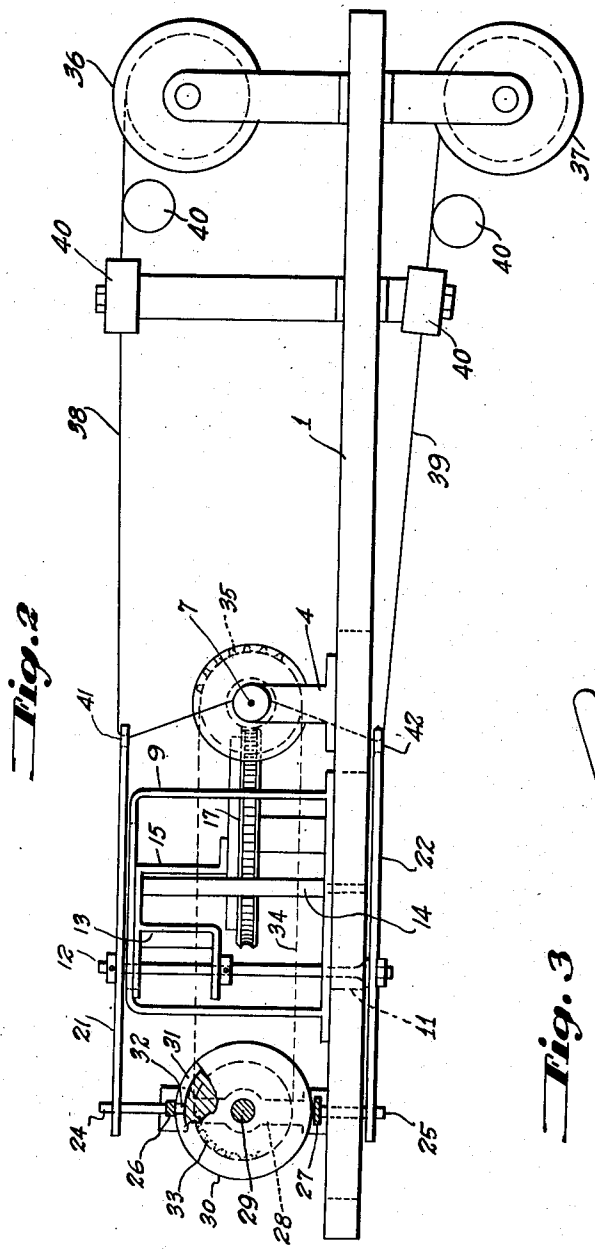

Fig. 2

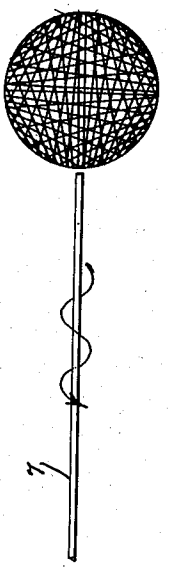

Fig. 4

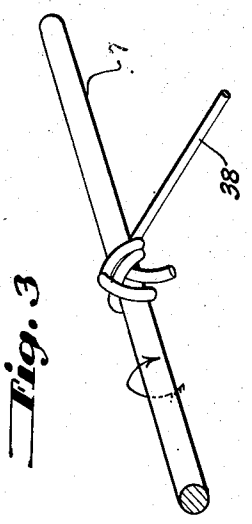

Fig. 3

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METHOD OF MAKING GOLF BALLS

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10 Claims. (Cl. 154—19)

This invention relates to golf balls and a method of making the same and is directed more particularly to that type of golf ball which is formed by the wrapping of a strand of rubber to form a ball body adapted to be encased in a cover or envelope of gutta percha or other appropriate material.

Balls of this general character have heretofore been made by a process which consists in generally wrapping a single strand of rubber about an appropriate core, usually in the form of a solid which may or may not subsequently become a liquid. In some cases the core about which the winding is formed is in the form of a small rubber sphere, while in other cases the core is made in the form of a relatively small rubber envelope containing a frozen composition which, at ordinary temperatures, becomes liquid. The method is so carried on, however, that liquefication does not occur until after an appreciable portion of the ball body has been formed.

In carrying out prior processes the winding of balls in the manner described has generally been accomplished by winding a rubber strip about a core supported between a plurality of rollers rotating on different axes and producing a gyratory movement of the core and ball body, as it is progressively wound. The disadvantage with this practice is that it cannot be carried out in the absence of a core which is a source of trouble in manufacturing and generally is an inactive part of the ball. The core is essential under prior practice, for there is no method known of wrapping a rubber band about a void with the apparatus of the character heretofore in common use. It therefore follows that prior wrapped balls have, of necessity, a core and this core is relatively inactive, so far as reactive resiliency is concerned. It simply serves in effect as the neutral nucleus about which the active wrapped part of the ball is wound and it is not uncommon that this inactive core be an inch or more in diameter. As a result, the major portion of the diameter of the ball is neutral and the resiliently effective portion of the ball is less than half its diameter.

It is clear that, if the ball can be wrapped without a core or with an extremely small core, as compared to prior practice, a more effective ball will result through a corresponding increase in the wrapped portion of the ball body. It is the wrapped portion of the ball body which, because of the great radial pressure and circumferential tension, reacts to the drive of a golf club and, if the amount of this reactive mass can be increased, the efficiency of the ball to travel increased distances will be correspondingly increased. Furthermore, inasmuch as the resilient part of the ball is the real live part thereof, the increase in proportion of this live part present will correspondingly increase the life of the ball and render it correspondingly immune to permanent deformation under externally applied force.

With the foregoing considerations in mind, one object of the present invention is to provide a method whereby it is made possible to wrap substantially the entire ball body by progressively wrapping one or more strands of rubber about a geometrical center to superimpose progressive portions thereof until the desired external diameter of the ball body is obtained.

An important feature of the method of this invention resides in the simultaneously wrapping of a plurality of strands of rubber in such relation to one another that said strands will be, in effect, interwoven with respect to one another, as they are applied to the ball, and will thus progressively lock one another in place during the process of winding. I have found that this is a highly important factor because it permits progressive winding of a plurality of strands of rubber in such a way that each convolution locks the preceding convolution of each strand so that there cannot possibly be any slipping between successive layers of the ball body during the winding process. In the event that one strand breaks during the winding operation, the remaining strand or strands lock the broken end and keep it from unwinding.

According to the prior practice of wrapping a ball, while the same is supported by a plurality of rollers, the gyratory movement imparted to the ball is accomplished by friction between the rollers and the ball and there is always bound to be slippage where friction of this character is involved. Consequently there can be no geometrical accuracy in the gyratory movements described and at best the operation can only be approximate. The importance of this will be understood when it is borne in mind that at each point where successive convolutions of the strand cross one another, there is formed increased thickness of the rubber applied to the ball body and unless these points of increased thickness are properly distributed throughout the ball body, there results an unequal distribution of the weight throughout the body and also a tendency to form bumps. These bumps are of course of small dimension, but if too many of them are superimposed directly over one another, there is an accumulated error which must be taken up in the

final analysis by irregularities in the thickness of the gutta percha cover. Consequently with balls which are not accurately wrapped, the center of weight will not correspond to the geometrical center of the ball and the ball will not carry true to the line when driven by a club. It is a fact that, even though the ball may have a truly spherical form when finished, the inaccuracies of wrapping may affect the core in such a way as to so distort it that the center of mass of the finished ball may be appreciably spaced from the geometrical center thereof. Such a ball cannot have a true trajectory.

A further object of this invention, therefore, is to wrap one or more strands with geometrical accuracy or at least with a minimum amount of error and the method of this invention provides for the accomplishment of this result in an automatic manner.

Speaking generally, the method of this invention may be carried out by winding around a predetermined center point in the axis of a mandrel one or more strands of elastic material. This mandrel may be stationary or may rotate around a fixed axis, or may rotate around its own axis and at the same time gyrate around said center point. In all cases one or more strands of elastic material are wound about the said center point from the corresponding point or points of feed and under continuously varying angles of incidence between the said axis and the strands which are wound around it.

In the preferred manner of practising the method of this invention, it is carried out by rotating a mandrel about a fixed axis and by forming the ball body about a center point in this axis, by feeding thereto one or more strands from a corresponding number of points of feed which will be hereinafter termed feeding points. The rubber strand or strands are fed from this point or these points as the mandrel is rotated and the feeding points are caused to change position in a positive manner through appropriate mechanical control to bring about uniform distribution of the points of crossing of successive convolutions of the strand or strands, so that they are properly distributed throughout the entire body of the ball and are not consecutively superimposed upon one another. Each feeding point for each strand may be shifted about a fulcrum from one terminal position to another in a direction substantially parallel to the axis of rotation of the ball body, while the fulcrum is progressively moved toward and away from said axis of rotation in order to obtain proper distribution of the points of crossing of the consecutive convolutions of the strand.

An important feature of this invention resides in the fact that each feeding point is oscillated with varying amplitude between opposite terminal positions, with periods of rest or dwell at each terminal position and with each period of oscillation in each direction corresponding to more than 180° of rotation of the mandrel and preferably less than 270°. The period of time during which the amplitude varies between each maximum and minimum corresponds to a plurality of complete revolutions of the mandrel. This prevents slipping of the strand during the formation of the ball body and further insures proper distribution of the overlapping points of successive convolutions as will be hereinafter more fully explained.

In the preferred embodiment of this invention, the ball is formed about a mandrel, as stated, and the mandrel is mounted on a fixed axis of rotation and is so constituted that, at the conclusion of the wrapping of the ball, the mandrel can be withdrawn therefrom. This makes it possible to form the entire ball body through a wrapping operation and obviates the necessity of a core in the center of the finished ball, although a core may be incorporated if desired.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and claims, when read in conjunction with the accompanying drawings.

In the accompanying drawings I have illustrated, in more or less diagrammatic manner, one form of apparatus which may be employed to carry out the method of the present invention, but inasmuch as widely different apparatus may be employed for this purpose, the invention is to be understood as not limited to the apparatus features which I have herein disclosed.

Figure 1 is a plan view of one form of apparatus for carrying out the method of this invention.

Figure 2 is a side elevation of the apparatus of Figure 1.

Figure 3 shows one method of starting the wrap about a mandrel according to this invention.

Figure 4 shows the finished ball with the mandrel removed.

In the apparatus shown in the accompanying drawings, 1 indicates a suitable table on which are mounted bearings 2, 3 and 4. The bearings 2 and 3 support a spindle 5 driven from any suitable source of power and carrying at one end a chuck 6. The chuck 6 is adapted to support and grip one end of a mandrel 7, the outboard end of which is supported by the bearing 4. Directly below the mandrel the table is provided with an opening 8. Secured rigidly to the table is an upstanding inverted U-shaped bracket 9 which constitutes a fulcrum guide and this fulcrum guide is provided with a slot 10 which extends perpendicular to the vertical plane of the axis of the mandrel and directly below this slot 10 the table is formed with a similar slot 11, similarly disposed. Extending vertically so as to project through both of these slots is a fulcrum rod 12 supported in vertical position by means of a bracket 13. This bracket is pivoted for oscillatory movement on a post 14, the lower end of this post is rigidly secured to the table, while the upper end of the post is reduced to pass through an aperture in the bracket 13 and to provide for pivotal movement of the latter on this post.

The bracket 13 has a tail 15 which extends into cooperative relation with a cam track 16 formed in a gear 17, as shown best in Figure 1, and the tail has a follower 18 entering into said cam track so that, through rotation of the gear, the bracket 13 is oscillated about the pivot post 14. The gear 17 is in the nature of a worm wheel and cooperates with the worm 19 fixed on the spindle 5 so that the oscillations of the bracket 13 are synchronized with the rotation of the mandrel 7 and the fulcrum rod 12 is thus caused to rectilinearly traverse the slots 10 and 11 in timed relation to the rotary movement of the mandrel. To permit of this rectilinear movement of the fulcrum rod 12, as stated, the bracket is slotted as shown at 20.

Associated with each end of the fulcrum rod 12 are upper and lower feed levers 21 and 22, respectively, for rubber strands. The upper lever 21 is positioned above the fulcrum guide, as

shown in Figure 1, while the lower lever 22 is positioned below the table 1. Both of these levers are slotted as shown at 23, so that they may be moved rectilinearly with respect to the fulcrum rod and the fulcrum rod is headed over or provided with any suitable means which will hold the levers against inadvertent displacement from the rod. Both levers extend forwardly from the fulcrum rod to points above and below the mandrel and adjacent thereto, while their rear ends are perforated to receive pins 24 and 25.

The pin 24 is rigid with and projects upwardly from a transverse guide 26, while the pin 25 is rigid with and projects downwardly from a similar guide 27. These guides extend slidably through standards 28 rigidly secured to the table and in which are formed bearings for an interposed transverse shaft 29. On the shaft 29 is fixed a cam 30 having therein a cam track 31 and associated with each of the slides 26 and 27 are cam followers 32 which extend into the cam track 31.

On the outboard end of the shaft 29 is a sprocket wheel 33 connected by a sprocket chain 34 to a similar sprocket wheel 35 on the shaft 5, but these sprocket wheels are so constituted that the mandrel 7 is rotated somewhat faster than the cam 30. The cam track is so formed that, through a portion of each 180° of rotation of the cam, each follower will change position from one terminal of its operation to the other terminal thereof, and, during the remainder of 180° of rotation of the cam, such follower will remain stationary. In other words, these followers have two distinct termini of movement, with the cam track so formed as to give equal shifting from one terminus to the other.

As a result of this arrangement the followers 32 are caused to oscillate between predetermined termini with constant amplitude. However, inasmuch as the cam track 16 causes a progressive movement of the fulcrum 12 toward and away from the axis of the mandrel 7, it follows that the free ends of the levers 21 and 22 will oscillate between predetermined termini which progressively move between maximum and minimum amplitudes according to the position of the fulcrum and the gearing relation between the cam 30 and the mandrel 7 is such that the change from maximum to minimum amplitude, or vice versa, will occur through a predetermined plurality of complete revolutions of the mandrel. Furthermore by virtue of the shaping of the cam track 31, the outer end of each of the levers 21 and 22 will have a period of rest or dwell followed by a relatively quick shifting, so that each oscillation will comprise a shifting movement followed by a period of rest or dwell at the termini of each amplitude of oscillation.

In the apparatus, as thus far described, the parts are so arranged as to simultaneously wind two strands of rubber and consequently provision is shown in the drawings for the feeding of two strands. These two strands are fed from upper and lower rolls. These rolls are indicated at 36 and 37, and the strands of rubber, designated 38 and 39, respectively, are adapted to be fed from these rolls over and between directional rolls 40 to the respective feed levers 21 and 22 which are perforated at 41 and 42, respectively. The strands are fed through these perforations to the mandrel 7.

The feed of two strands is illustrated in the drawings, but one strand may be fed or more than two strands may be fed simultaneously by providing additional perforations 41*a* and 42*a*, respectively, in the feed levers. In any event the operation of the apparatus will be mechanically the same.

To start the operation of wrapping a ball, the mandrel 7 is associated with the chuck 6 and the bearing 4, the desired number of strands 38 and 39 are threaded through the openings in the feed levers and said strands are given three or four twists manually about the mandrel, so as to lock successive convolutions of these twists and anchor the ends of the strands to the mandrel at substantially the center of the latter. Power is then applied to the shaft 5 which is caused to rotate, while a suitable braking action through any appropriate means is applied to the rolls 36 and 37. A friction brake or friction clutch may be employed in this connection.

As the apparatus operates, the mandrel is rotated at a constant speed which may be at a relatively high velocity, while all of the other parts of the apparatus are operated in timed relation to the rotation of the mandrel. The operation is in detail as follows:

By reference to Figure 1, both the mandrel and the cam 30 will be rotating in the same direction, indicated by the arrows. Here, an appreciable portion of the ball body has been wrapped and the feed levers are stationary, but are about to change position. As the cam moves from the position of Figure 1, the follows 32 will enter and traverse the position-changing phases of the cam track 31, so as to rapidly shift the lever 21 in a counterclockwise direction and the lever 22 in a clockwise direction, and thereupon immediately render said levers stationary in these new positions where they will remain stationary to feed the strands from substantially fixed points of feed. This shifting of the follows, followed by a period during which they are held stationary, constitutes an oscillation or one-half cycle of one complete operation thereof, and occurs while the mandrel rotates a little more than 180°. Meanwhile the bracket 13 will be shifted by the cam track 16 to move the fulcrum in the direction of the mandrel, but slowly so that it will require a number of turns of the mandrel to complete the movement of the fulcrum in a direction radially of the mandrel, but there is a relative slow movement of the fulcrum at substantially all times, which will change the throw of the levers under the operation of the cam 30.

It is of importance that the mandrel rotate relative to each point of feed of each strand more than 180° and preferably less than 270° during each half cycle of the operations of the cam 30, for it is this fact which causes the points of crossing of the successive convolutions of the strands to be progressively spaced from one another.

If the point of feed were changed from one terminal of its travel to the other terminal of its travel for exactly each 180 degrees of rotation of the mandrel, the points of crossing of successive convolutions of the strand would be improperly distributed. However, by causing the mandrel to rotate more than 180° for each oscillation or half cycle described, I obtain a so-called lead or pitch, which spaces these points of crossing successively away from one another in accordance with the amount of lead and thus insure a proper distribution at such points of crossing. In other words, the amount which the ball overtravels one-half of one complete rotation, measured in angle of rotation of the ball, is the pitch or lead, and controls the spacing

apart of consecutive points of crossing of the strands. The so-called pitch or lead is utilized to insure that the over-lapping of successive convolutions of each strand will be progressively spaced from one another and the amplitude of feed is controlled by radial movement of the fulcrum 12, so that the points of overlapping will proceed in a direction circumferentially of the ball and in a circumferential direction and also in a direction longitudinally of the axis of rotation.

In the finished ball it is found that in practically every point in the surface of the ball, there is substantially the same number of crossings of the convolutions. In other words, the crossing points are distributed in substantially uniform manner throughout the body of the ball, so that the center of weight of the ball is at the geometrical center thereof and a truly spherical ball body is obtained.

It should be remembered in this connection that each particular point of feed is held substantially in fixed position during an appreciable part of one-half revolution of the mandrel. It is true that there is at the same time a slow movement of the fulcrum in a radial direction, but this is so relatively slow, that, to all intents and purposes, the point of feed is relatively stationary. The slight movement of the fulcrum merely distributes the points of crossing in an axial direction, while the so-called pitch or lead distributes said crossings in a circumferential direction. It is the combination of this axial lead, together with the circumferential lead, that produces distribution of the points of crossing of successive convolutions and insures a uniformity which has never before been possible. The uniformity of winding, according to this process, is obtained in an extremely accurate manner, because the apparatus permits of this accuracy through positively operated driving connections in which friction is not depended upon except that friction which the strand has with respect to previously wound strands and which serves to hold it in position. The winding of the strand, however, in a diagonal way, as specified, does not tend to make the strand slip, but lays it onto the ball body during the formation of the latter in a thoroughly natural way, where the forces of tension on the strand serve to promote maximum radial pressure at the center of the ball without promoting a tendency of the strands to slip with respect to one another.

In the description of the operation thus far advanced, I have dealt primarily with the winding of a single strand, but when two strands are wound as shown in the accompanying drawings in such a manner as to wind from the opposite sides of the mandrel at the same time, it is found that these two strands are interwoven with respect to one another, so that each strand crosses the other twice in each complete convolution and serves as a lock for the other strand. Furthermore through the interweaving of strands as stated, I obtain, what may be accurately defined as an interwoven ball body, and this interweaving of the strands effectually guards against slippage and results in a ball body, every portion of which is interwoven at each convolution. Such an arrangement has been hitherto unknown to the art.

In carrying out the invention as described with a mandrel I have found it satisfactory to employ, as a mandrel, a relatively light wire about which the ball is wrapped until the ball body is complete and, after the ball body is complete, I withdraw the mandrel wire from the ball body by holding the body stationary in a suitable holder and then withdrawing the wire by the application of a longitudinal pull thereto, preferably with accompanying rotation, as indicated in Figure 4. As the wire is of small diameter and all the stresses in the ball are uniform throughout the small space occupied by the wire, this space is immediately closed to leave a truly spherical ball, all portions of the body of which are of the wrapped interwoven character described. I have also found it possible to use a small wire mandrel having thereon a bead from which the mandrel may be withdrawn, after the ball has been wound, to leave the bead within the ball body as a core. This bead may be made large or small as may be desired and it may be made of any suitable material, metallic or otherwise. I have also found it possible, if a core is desired in the ball, to secure the core to coaxial mandrel sections by a weakened joint which may be broken away by rotating the mandrel, while the finished ball is held stationary, and the mandrel sections withdrawn, leaving the core in the ball. I have obtained remarkable results, however, by winding the ball around the mandrel and then withdrawing the entire mandrel, so that the ball body is completely formed from the interwoven rubber strands extending from the geometrical center of the ball to the outside surface thereof.

In some cases the wrapping of a ball, as described, without a weighted core, may produce a ball slightly under weight. This can be compensated for in various ways, such, for example, as by weighting the rubber strands with some material of relatively high specific gravity, such as lead oxide or by impregnating the ball or its surface with a weighting material.

It will of course be understood that the ball body, upon completion, is provided with an appropriate cover, such, e. g., as gutta percha, which may be applied in the conventional way.

The advantages of making a ball, according to the method of this invention, are many. For example, this method provides for the accurate winding; it provides for the formation of a completely woven ball without a core which is impossible under prior conventional methods; it provides a ball, all portions of the body of which are live or re-active to the maximum extent to the impact of a golf club; it permits the elastic strands to be woven under greater tension than is possible under prior procedure and consequently permits of the manufacture of a more lively ball; it provides for the accurate wrapping of rubber strands in a way to insure proper distribution of points of crossing of consecutive convolutions of the wrap and it provides a wrapped ball of a truly spherical form and wherein the center of weight is at the geometrical center of the ball.

The foregoing detailed description sets forth the invention in its preferred practical form, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of forming a resilient ball, which comprises rotating a mandrel about its axis, winding an elastic strand under tension about a center point in said axis from a feed point which oscillates with varying amplitude in relation to said center point and in timed relation to the rotating mandrel with each oscilla-

tion of said feed point corresponding to more than 180° of rotation of the mandrel, and removing the mandrel after the ball is formed.

2. The method of forming a resilient ball, which comprises rotating a mandrel about its axis, winding an elastic strand under tension about a center point in said axis from a feed point which oscillates with varying amplitude in relation to said center point and in timed relation to the rotating mandrel with each oscillation of said feed point corresponding to more than 180° and less than 270° of rotation of the mandrel, and removing the mandrel after the ball is formed.

3. The method of forming a resilient ball, which comprises rotating a mandrel about its axis, simultaneously winding a plurality of elastic strands under tension around a center point in said axis from respective feed points each of which oscillates with varying amplitude in relation to said center point and in timed relation to the rotating mandrel, with each oscillation of said feed point corresponding to more than 180° of rotation of the mandrel, and removing the mandrel after the ball is formed.

4. The method of forming a resilient ball, which comprises rotating a mandrel about its axis, winding an elastic strand around a center point in said axis from a feed point oscillating with varying amplitude in relation to said center point and in timed relation to the rotation of the mandrel, with each oscillation of said feed point corresponding to more than 180° of rotation of the mandrel, and the time of variation of the amplitude between maximum and minimum corresponding to a plurality of revolutions of the mandrel, and removing the mandrel from the ball thus formed.

5. The method of forming a resilient ball, which comprises rotating a mandrel about its axis, simultaneously winding a plurality of elastic strands around a center point in said axis from respective feed points, each of which oscillates with varying amplitude in relation to said center point and in timed relation to the rotation of the mandrel with each oscillation of said feed point corresponding to more than 180° of rotation of the mandrel, and with the time of variation of the amplitude of oscillation of each feed point between maximum and minimum corresponding to a plurality of revolutions of the mandrel, and removing the mandrel from the ball thus formed.

6. The method of forming a resilient ball, which comprises rotating a mandrel about its axis, winding an elastic strand around a center point in said axis from a feed point oscillating with varying amplitude in relation to said center point with periods of rest or dwell at the termini of such oscillations, and in timed relation to the rotation of the mandrel, with each oscillation of said feed point corresponding to more than 180° of rotation of the mandrel, and the time of variation of the amplitude between maximum and minimum corresponding to a plurality of revolutions of the mandrel, and removing the mandrel from the ball thus formed.

7. The method of making a golf ball body which comprises winding an elastic strand under tension around a center point in the axis of a mandrel, and varying the angle of incidence between said strand and said axis in such manner that said strand crosses a plane passing through said center point at right angles to said axis once for each increment of winding of more than 180° and less than 270°.

8. The method of making a golf ball body which comprises winding an elastic strand under tension around a center point in the axis of a mandrel, varying the angle of incidence between said strand and said axis in such manner that said strand crosses a plane passing through said center point at right angles to said axis once for each increment of winding of more than 180° and less than 270°, and varying the amplitude of variation of said angle of incidence.

9. The method of making a golf ball body which comprises rotating a mandrel about its axis, feeding an elastic strand to said mandrel under tension through a movable feed point, and oscillating said feed point in timed relation to the rotation of said mandrel in such manner that each oscillation of said feed point continues during more than 180° of rotation of said mandrel but less than 270°.

10. The method of making a golf ball body which comprises rotating a mandrel about its axis, feeding an elastic strand to said mandrel under tension through a movable feed point, oscillating said feed point in timed relation to the rotation of said mandrel in such manner that each oscillation of said feed point continues during more than 180° of rotation of said mandrel but less than 270°, and varying the amplitude of oscillation of said feed point.

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