(No Model.) 2 Sheets—Sheet 1.

G. H. ELLIS & J. F. STEWARD.

BALL OR COP OF TWINE.

No. 601,771. Patented Apr. 5, 1898.

Fig. 1.

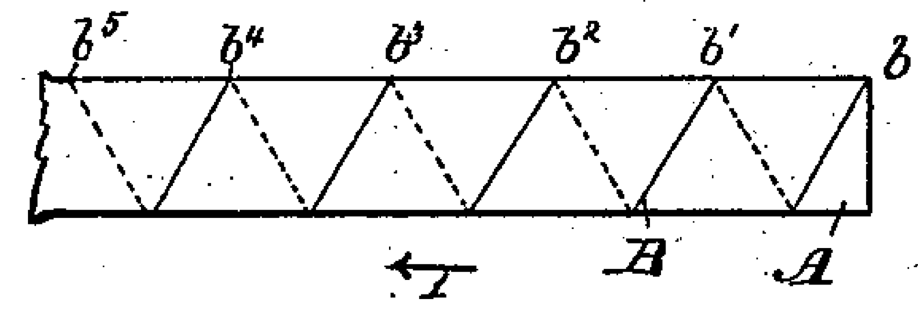


Fig. 2.

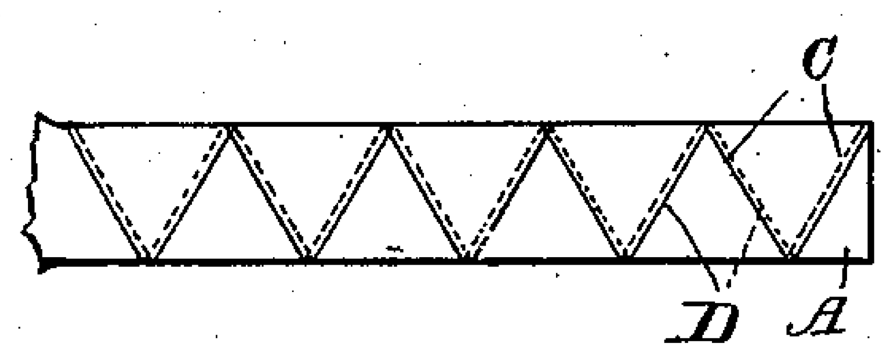


Fig. 3.

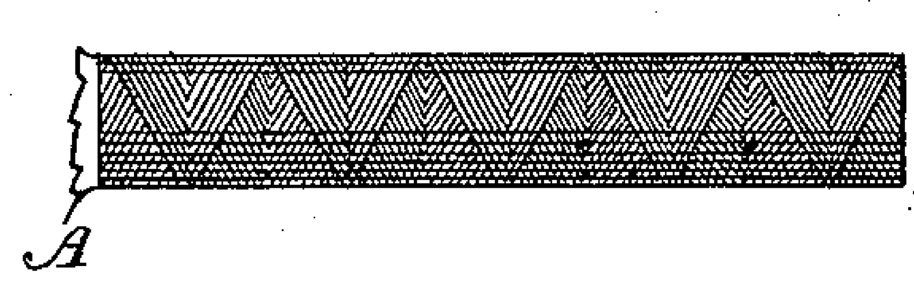


Fig. 4.

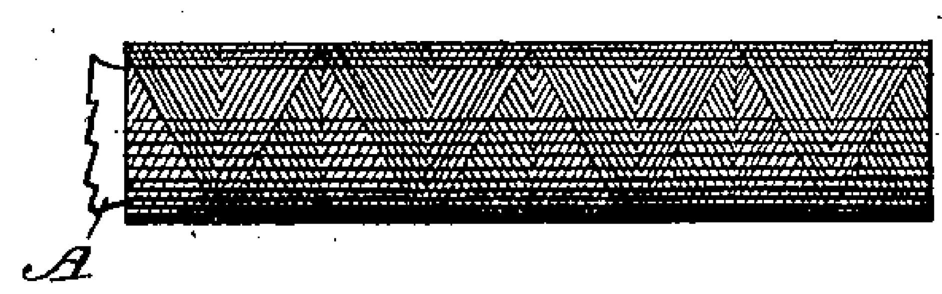


Fig. 5.

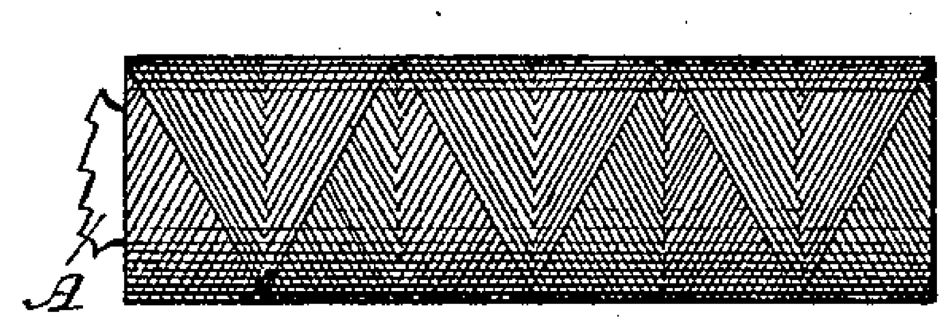


Fig. 7.

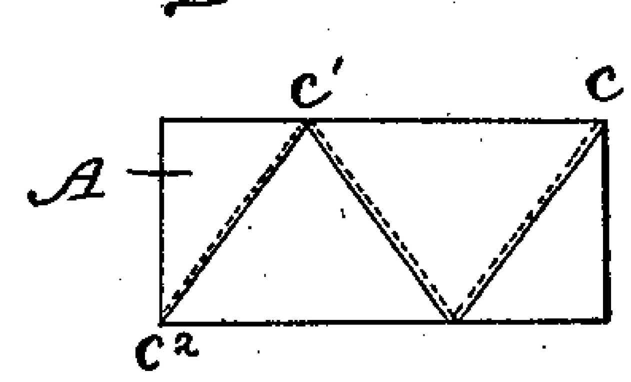
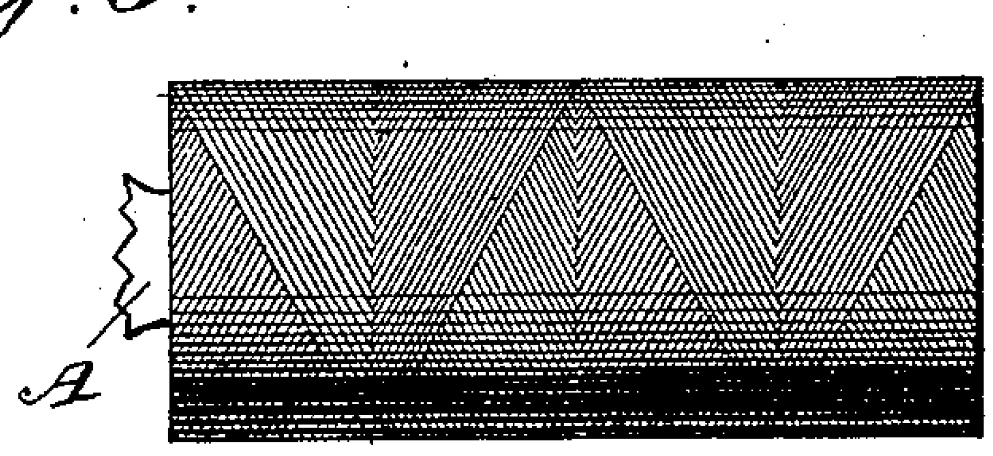


Fig. 6.



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(No Model.) 2 Sheets—Sheet 2.

G. H. ELLIS & J. F. STEWARD.

BALL OR COP OF TWINE.

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Fig. 8.

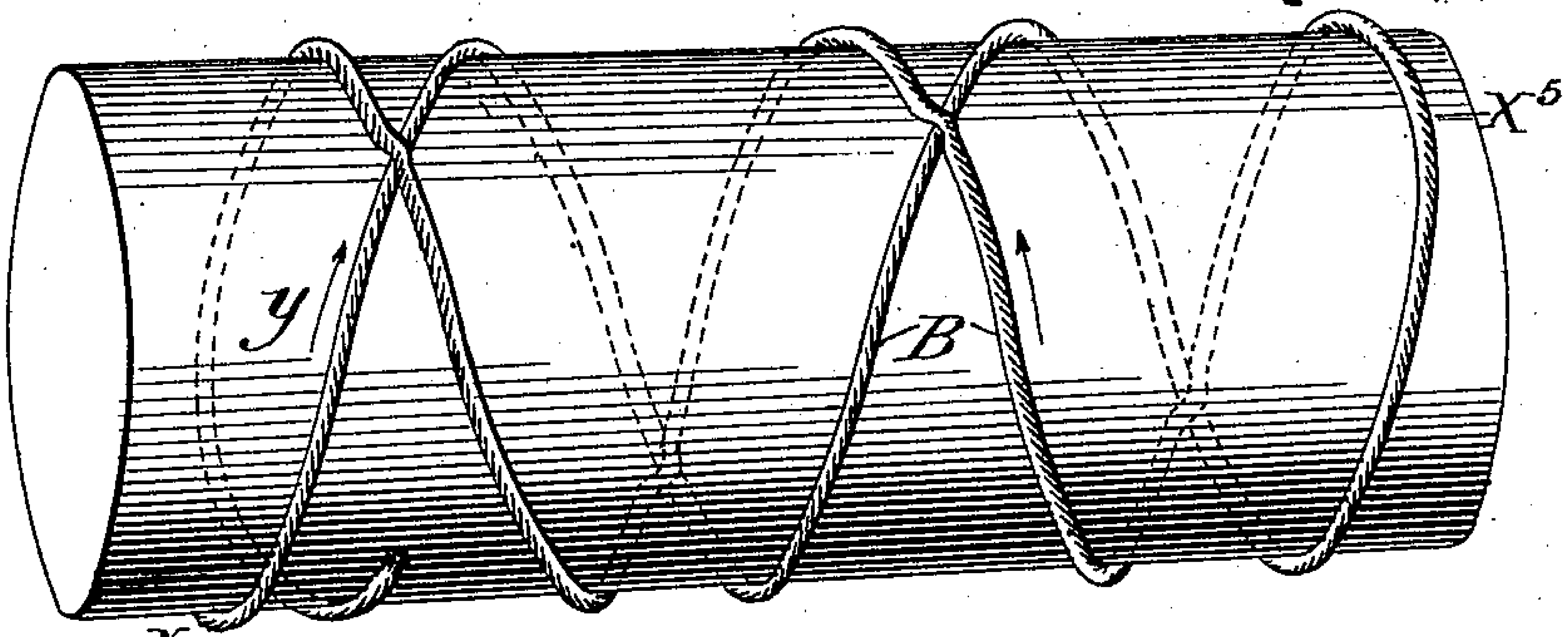


Fig. 9.

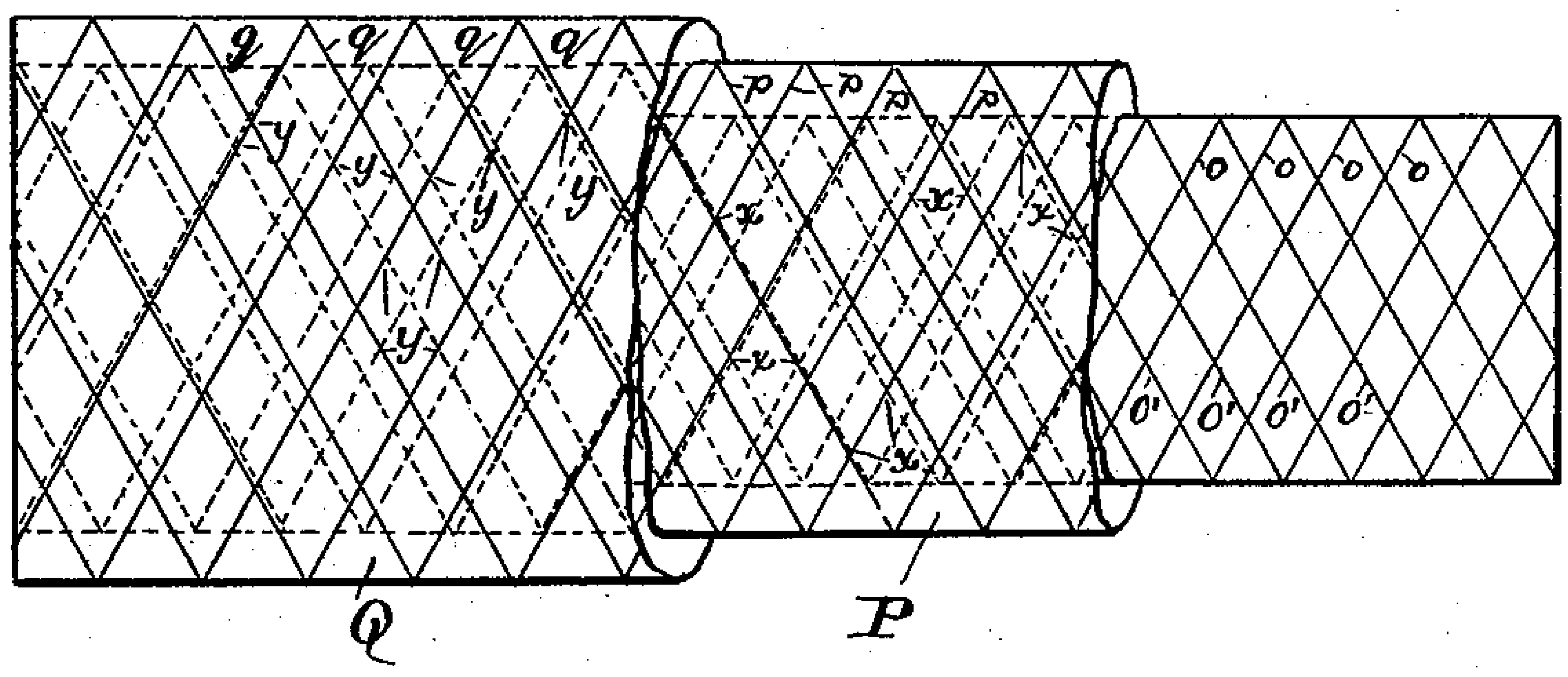
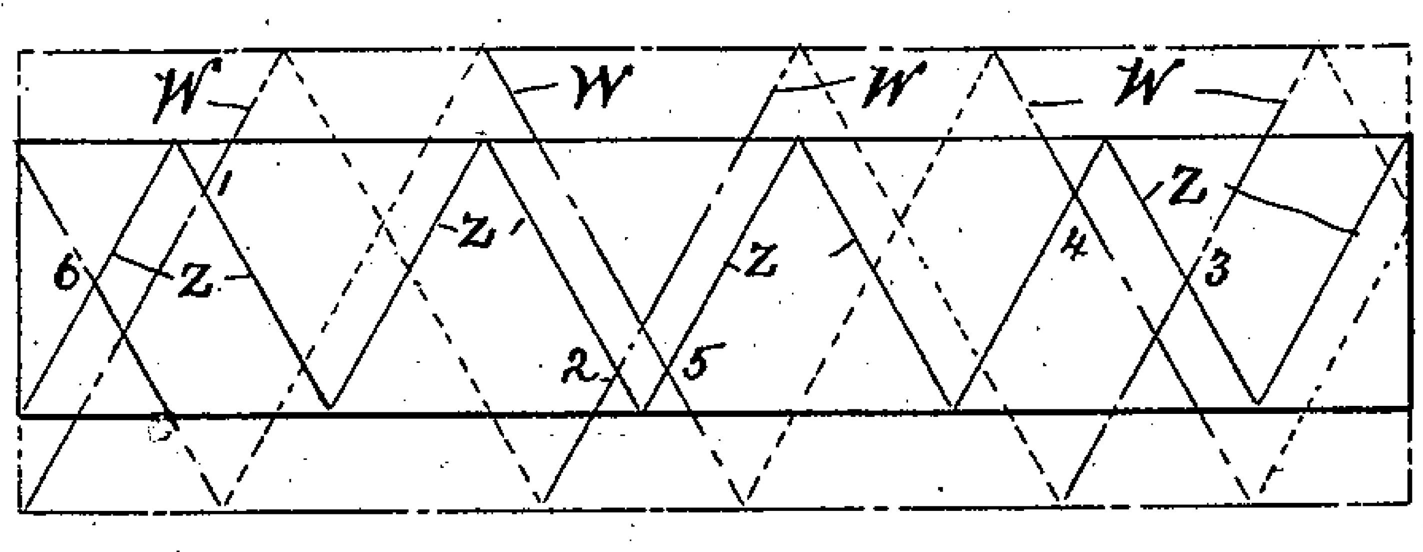


Fig. 10.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GEORGE H. ELLIS AND JOHN F. STEWARD, OF CHICAGO, ILLINOIS.

BALL OR COP OF TWINE.

SPECIFICATION forming part of Letters Patent No. 601,771, dated April 5, 1898.

Application filed April 29, 1895. Serial No. 547,485. (No model.)

To all whom it may concern:

Be it known that we, GEORGE H. ELLIS and JOHN F. STEWARD, of the city of Chicago, county of Cook, and State of Illinois, have invented a new and useful Ball or Cop of Twine, of which the following is a full description.

Our invention relates to balls or cops of cylindrical form made of twine or cord suitable for binding grain and similar purposes; and it consists in a cylinder or cop of twine built up in courses or layers composed of coils, one course over or outside of the other and the coils of all the courses having a constant angle relative to the axis of the cylinder, but the pitch of the coils of each course being greater than the one within it, or, in other words, the number of complete turns around the cop in each course being less than in the course beneath, whereby each succeeding course from the center outward becomes a binding-course for those within, and also in a cylindrical cop of twine in which the pitches of the coils of the finishing or outer course have a definite correspondence with the length of the ball or cylinder.

Our invention may also be said to consist in a cylindrical cop formed of threads of twine coiled spirally from end to end in courses, the coils of the outer courses having greater pitch than those of the inner course; but the coils having a constant angle to the axis of the cop in all the courses, whereby at successive steps from center to circumference the courses are definitely wound to form a finish and whereby a suitable diameter of the said ball may be chosen and the said ball have a finished surface.

In the drawings, Figure 1 is a side view of the mandrel upon which the ball is to be wound with twine laid thereon after the traversing guide has passed once thereacross. Fig. 2 is a similar view of the mandrel after the traversing guide has passed once thereacross and back again. Fig. 3 is also a similar view showing a course of twine after the guide has made a sufficient number of completed movements to cover the mandrel with coils of twine. Fig. 4 is a side elevation of the ball, showing the increased diameter of an intermediate finish. Fig. 5 is a view similar to Fig. 4, showing a successive step in the formation of the ball, in which the second intermediate finish is obtained. Fig. 6 is a side elevation of the finished ball. Fig. 7 is a diagrammatic view. Fig. 8 is a perspective view showing an "open winding" or the manner in which the coiling is begun. Figs. 9 and 10 are diagrams illustrating the method of laying the twine.

A is the mandrel upon which the ball or cop is to be wound.

B is the twine.

Referring to Fig. 1, the ball is started at the point b upon the mandrel, and as the traversing guide proceeds in the direction indicated by the arrow 1 it coils the said twine upon the mandrel in an open spiral. It will be noticed that the coils end at b^5 at the opposite end of the mandrel and at a point on the circumference corresponding to the point b and that there is a definite number of completed pitches, (shown as b' b^2 b^3 b^4 b^5.) As shown, the twine has made five completed revolutions or pitches around the mandrel in passing from points b to b^5.

In Fig. 2 is shown the mandrel after the traversing guide has returned to the starting-point, thus making a complete movement, and there are two spirals shown, one, C, a right-hand spiral, and D a left-hand spiral.

It is to be understood when referring to Figs. 1, 2, and 3 that the mandrel has a certain speed relative to the speed of the traversing guide, and that this relative speed is maintained until one course of the twine is laid completely over the mandrel, as in Fig. 3, because the actual speed of rotation of the mandrel remaining the same and the diameter of the cop not being increased during the formation of a single course the circumferential speed of the twine as it is being fed around the mandrel remains substantially the same.

When the process of building up the ball proceeds past the laying of the first course, (which point is shown in Fig. 3,) its diameter gradually increases; but the axial rotation of the cylinder having been reduced the circumferential speed of the twine therearound remains the same. In this connection it will be understood that if the circumferential speed were increased the angle that the twine assumes relative to the mandrel or its axis would be changed, which is not what we wish to accomplish.

We lay each course of the twine, as before stated, upon the mandrel at the same rate of speed, and by means of friction-pads and similar mechanism, as shown, for instance, in the application filed by us, dated January 12, 1895, and numbered 534,686, we maintain a constant relation between the circumferential speed of the cop and the speed of the traversing guide, thereby laying the twine upon the mandrel or upon a forming-bale with its coils at the same angle. As before stated, if this definite angle is maintained the number of pitches will be gradually lessened as the diameter increases, and when the pitch cannot be divided into the length of the ball in half or whole numbers the characteristic finish shown in the figures will be departed from.

Between the intermediate or successive courses in which the finish is obtained the coils of twine are still laid at the definite angle spoken of before; but owing to the fact that the pitch is not divisible into the length of the ball in whole or half numbers the end coil of twine when the guide is traversing in one direction will not terminate at a point upon the periphery of the ball corresponding to that from which it started, and hence will be irregularly placed upon the ball, and the pitches will not be divisible into the length of the cop, or, in other words, the coils will be in an open formation until, owing to increase in the diameter of the said ball, the pitch has increased until it can again be divided into the length of the ball in half or whole numbers. The open formation will be understood by referring to Fig. 8, in which the twine B is shown as coiled upon a cylinder of a diameter in which the pitch of the coils is not divisible into the length of the cylinder in half or whole numbers. Commencing at X and coiling around the cylinder in the direction of the arrow Y the twine reaches X^5, where it reverses. As shown, there are about two and three-fourths complete turns from X to X^5, and hence the pitch of the coil is not divisible into the length of the cylinder in half or whole numbers. The twine in continuing its course back and around the cylinder to the left reaches that end of the ball at a point upon its periphery other than that point from which the twine started. This results in the succeeding coil being laid with a space between it and the first one. Each coil binds its predecessor. The coils of each layer or course bind those of the preceding one, as shown in Fig. 9, in which *o o o o* are coils extending in one direction and *o' o' o' o'* are coils extending in the opposite direction.

P represents a succeeding course, its coils *p p p p* crossing those *o* and *o'*, (shown in dotted lines at *x x x x*,) and Q represents a second succeeding course, its coils *q q q q* crossing coils *p p p p* at *y y y y y*. The coils of each succeeding course, having a greater pitch, overtake, as it were, the coils of the preceding course that started from the same point on the periphery of the forming-ball before they return back from the end of the ball from which they started.

In the diagram of Fig. 10, Z represents the first coil, extending from end to end and there reversed and extending back to the end from which it started, and W represents the succeeding coil, extending from end to end in the same manner, crossing its predecessor at points 1, 2, 3, 4, 5, and 6.

As shown in Fig. 4, the number of pitches has been decreased from five to four. The angle that the twine assumes upon the ball remains the same. For the second time the finish or the regular characteristic pattern made by the laying of the twine is obtained.

The process goes on as the forming of the ball proceeds from that stage shown in Fig. 4 to the stage shown in Fig. 5, where the number of pitches is again reduced, this time to three, and the same occurs in the process of winding the ball from the stage shown in Fig. 5 to that shown in Fig. 6. Here the number of pitches has bee[illegible]duced to two and the characteristic finish [illegible]n appears.

It will be understood that the length of the ball, the angle that the twine assumes upon the ball, the diameter of the ball, and the number of pitches may be varied to an almost unlimited extent without departing from the principles involved in our invention.

The advantage obtained in this method of winding the ball or cop over the previous methods is that what may be called a "bond" is obtained—that is to say, owing to the method in which the twine is laid each course or layer serves to bind its neighbor together, so that the ball is self-supporting, thereby obviating the ordinary necessity of placing in the center of the ball a core or tube, which core or tube adds to the weight, to the space, and to the cost, and also permits a cylinder of greater length to be made without sacrificing its power of self-support or the power of resisting the tendency to elongate in handling or unwinding from the center by a pull in the direction of its length. As a consequent advantage the ball is particularly adapted for use in self-binders and a characteristic finish is obtained, making the ball more merchantable.

One advantage, and when practically considered the most important one, is that such a ball can be supported on end and unwound from the inside without having its courses become tangled and snarled, thus making it capable of being used in all styles of grain-binders, and without the use of a twine-ball-holding apparatus different from those now in use.

The long form of ball has been recognized as superior to the globular form in its use upon grain-binders, in that the twine is more compact, easier to handle, and provides for a less frequent necessity for resupplying twine to an automatic binder; but this has never, to our knowledge, come into use, because such a form of ball has never before been made which could be unwound from the inside.

Referring to the above description regarding the process of building up the ball to the stage shown in Fig. 3, where it is stated that the circumferential speed remains the same up to that stage because the diameter of the forming-ball has not been increased, it will be understood that in each successive movement of the traversing guide from the stage shown in Fig. 2 to that shown in Fig. 3 the twine being laid crosses additional and previously-laid coils. This requires a slight decrease in the axial speed of rotation of the mandrel sufficient to allow the traversing guide to lay the succeeding coil alongside of that last laid.

Fig. 7 shows that the same characteristic finish can also be obtained when the length of the ball is divisible in half-numbers by the pitch. In that figure c is the starting-point, the twine running around the mandrel once to c' and half around to c^2, when the traversing guide is reversed and the twine runs half around the mandrel in the opposite direction, coming back to the point c' and continuing its course around the mandrel back to the point c.

Having thus described our invention, what we claim is—

1. A cylindrical cop or ball made up of superposed layers or courses, each layer consisting of coils wound spirally from end to end of the cop in reverse directions, the angle of the coils relative to the axial line of the cop being the same in all the layers, and the pitches of the coils being so arranged in the several layers as that the coils in each layer will form a bond for those in the layer beneath.

2. A cylindrical cop or ball made up of superposed layers or courses, each layer consisting of coils wound spirally from end to end of the cop in reverse directions, the angle of the coils relative to the axial line of the cop being the same in all the layers, and the pitches of the coils of any given layer being greater than those of the layer beneath it so as to form a bond for the latter.

3. A cylindrical cop or ball made up of superposed layers or courses, each layer consisting of coils wound spirally from end to end of the cop in reverse directions, the angle of the coils relative to the axial line of the cop being the same in all the layers, and the pitches of the coils in any given layer being greater than those of the underlying layer, and the number of pitches in the several layers diminishing as the diameter of the cop increases.

4. A cylindrical cop or ball made up of superposed layers or courses, each layer consisting of coils wound spirally from end to end of the cop in reverse directions, the angle of the coils relative to the axial line of the cop being the same in all the layers, and the pitches of the coils in any given layer being greater than those of the underlying layer, and the number of pitches in the several layers diminishing as the diameter of the cop increases, the number of pitches in the outer or finishing layer being divisible into the length of the cop in whole or half numbers only.

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