

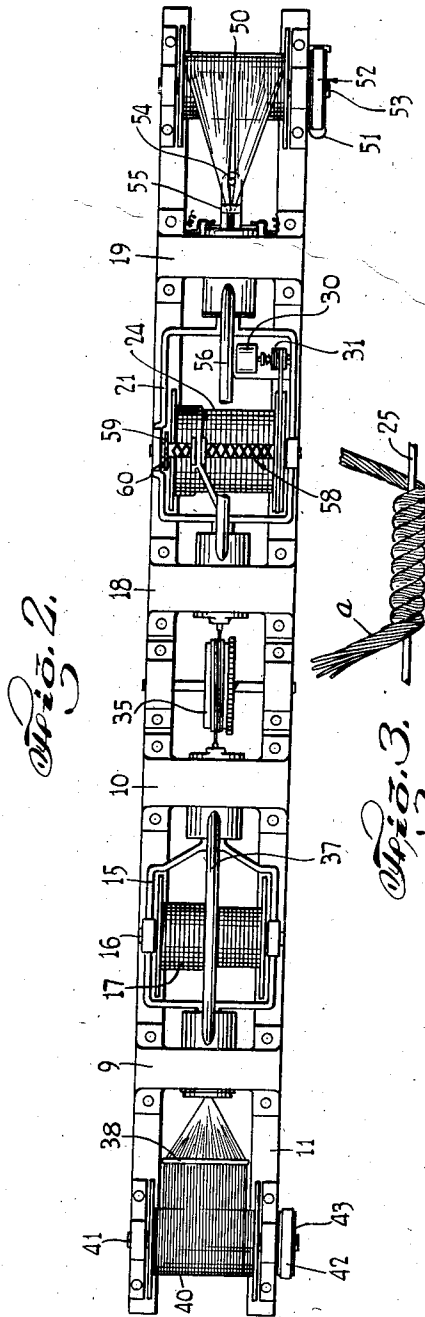
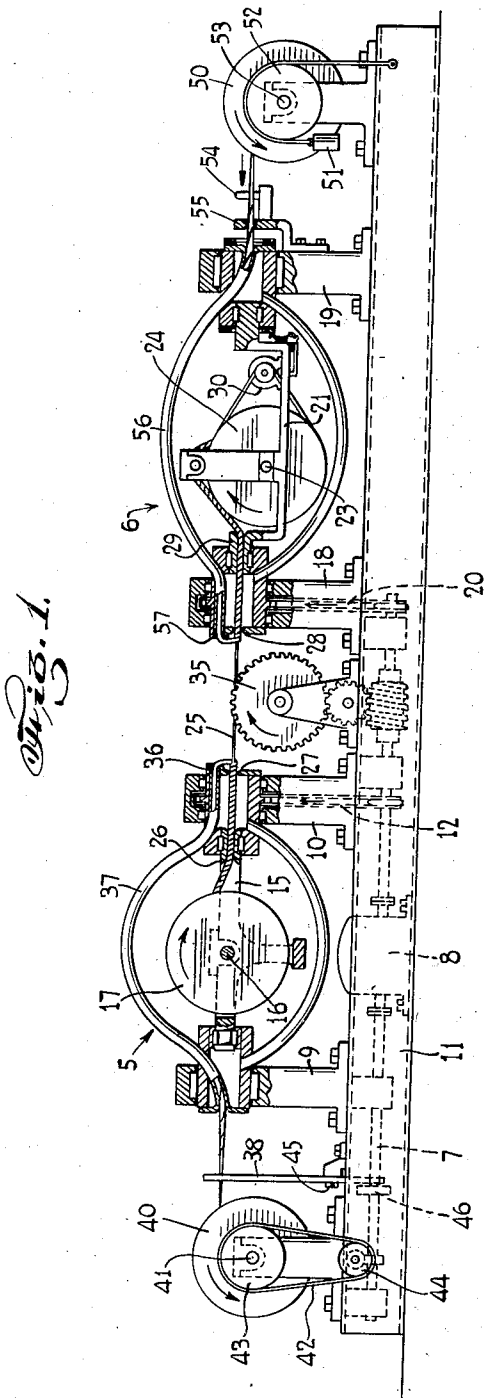
Oct. 7, 1941.

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2,258,139

APPARATUS FOR CURLING YARN

Filed June 26, 1941



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UNITED STATES PATENT OFFICE

2,258,139

APPARATUS FOR CURLING YARN

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Application June 26, 1941, Serial No. 399,883

15 Claims. (Cl. 57—3)

The present invention relates to apparatus for use in producing a substantially permanent curl or kink in yarn and like materials.

The method heretofore most commonly employed commercially for curling yarn consists in combining a number of yarns as, for example, twenty to fifty, into a bundle, twisting the bundle under not too great tension until, as the twist increases, the bundle forms into a nearly continuous helix. The yarn so twisted is steeped ("boiled off") in boiling water or steam or other solvent with or without the addition of setting agents to set the curl. In the case of mohair yarn, which is practically the only yarn curled on a commercial scale, this steeping requires from six to eight hours at substantially boiling temperature to produce a permanent set of the curl. Ordinarily the yarn is dried while still twisted and then untwisted, the whole process requiring some ten or twelve separate operations. The long steeping required in this process to set the curl causes a considerable deterioration of the yarn, reducing the tensile strength about 20% during the first hour and about 5% for each additional hour. The elongation properties suffer an even greater deterioration and after a seven hours steeping, the physical properties of the yarn are depleted to the extent of 50% and this is reflected in the wearing quality of the woven fabric. Furthermore, the yarn shrinks to the extent of 5% or more, thus correspondingly increasing the amount of yarn necessary to produce a given yardage.

In the operation of the aforesaid process, the limit to the length which it is practicable to curl is about 1200 yards, requiring tying where greater lengths are required in weaving. All things considered, the speed of production is decidedly limited, the product is inferior and the cost is high. These disadvantages limit the sale of curled yarn fabrics.

The present inventor has provided an improved process for curling yarns which will produce a superior product and which can be operated expeditiously and economically. This process is described in Patent No. 2,254,895, granted September 2, 1941. The present application is a continuation in part of the application on which said patent was granted.

The present invention has for an object to provide an improved apparatus for use in curling yarn.

The invention aims to provide an apparatus which can be operated effectively with yarns of great length in order that the number of knots

necessarily tied during the weaving process can be correspondingly reduced.

The invention aims also to provide an apparatus in which yarn is held under tension during treatment in order to inhibit shrinkage.

Another object is to provide an arrangement whereby the yarn is given that amount of twist during curling which will cause the final product to be of the best quality.

The nature and objects of the invention will be better understood from the following discussion and description of illustrative apparatus.

The invention provides an apparatus whereby a bundle of yarns is curled and while held under tension is steeped and dried and thereafter the tension is removed and the yarns uncurled. In the operation of the apparatus to be more particularly described for the purposes of illustrating the principles of the invention, a bundle of yarns is twisted and simultaneously wound about an incompressible mandrel which conveniently may be in the form of a wire large enough to serve the purpose of a substantially rigid mandrel for winding the yarn on, and yet sufficiently small and flexible to be conveniently wound about a spool or formed into a coil for convenience in further handling. In this form there is no tendency to tangle and great lengths can therefore be effectively and conveniently handled. The yarn thus twisted and coiled is steeped as in previous processes with this difference, that during the steeping operation it is so held on the wire mandrel as to prevent substantial shrinkage and as it is thereafter dried, it stretches somewhat so that its final length is about 5% greater than before its original treatment.

It is impossible to wrap a bundle of parallel strands of yarn around a mandrel with satisfactory uniformity due to the varying circumferential lengths of the yarn so wrapped, causing puckering of the yarn and excessive strain on the outer or shorter affected lengths of the strands in the bundle. Therefore, before winding the yarn on the mandrel, it is preferable to twist the yarn in the bundle sufficiently so that the relative position of the yarn around the mandrel is varied. To effect such twisting of the yarn would normally require a separate operation and apparatus for twisting the yarn prior to wrapping and, similarly, for untwisting the yarn after process curling, whereas the apparatus here disclosed simultaneously imparts the necessary twist to the bundle as the yarn is applied to the mandrel and likewise removes the twist as it is

taken off. Further, this apparatus insures synchronism of these two operations, which would be difficult to obtain if they were accomplished in separate machines.

The degree of stretch or elongation can be controlled to some extent by varying the tightness of the twist and the degree of tension with which the yarn is wound about the wire mandrel.

The degree and character of the curl produced can be considerably modified to suit requirements by varying the number of yarns in the bundle, the degree of twist and the diameter of the wire mandrel.

The optimum degree of twist and direction of twist can be determined by experiment. Tests made demonstrate that for most yarns the direction of twist should be such as to reduce the twist which is imparted to the yarn in the doubling operation, that is to say, the twist for curling should tend to untwist the yarn.

Certain definite advantages such as relative uniformity of character and size of the curl of the several yarns in one bundle are obtained by twisting the bundle once for each turn or wrap around the wire.

Actual practice of the invention has demonstrated that the maintenance of tension on the yarn during the steeping operation with the tendency to shrink, which attends steeping, causes an ultimate stretching of the yarn to the extent of about 5% and this improves the ultimate strength of the curled yarn. The extent of stretch of the yarn and the strength of the yarn after curling will vary as the tension applied is greater or less and as the tension is maintained constant or is increased or decreased during the steeping operation. Practically satisfactory results are conveniently obtained when the yarn is wound on a wire mandrel with such tension as can readily be applied and the yarn steeped as herein described.

It is to be noted that the 5% gain in the length of the yarn when treated in accordance with applicant's process is to be contrasted with the 5% loss in length of the yarn treated by the process of the prior art and produces an effective gain in length of weavable yarn of about 10%.

The new apparatus, furthermore, produces a superior yarn in that when the yarn is maintained under tension, as described, the several fibres of the yarn shrink evenly, thus avoiding the condition previously obtained in which some fibres of the yarn shrink excessively, and, in use, take more than their share of the tension and are readily broken.

Comparative abrasive wear tests of fabric woven from yarn curled by the new process and similar fabric woven from yarn of the same count curled by the process of the prior art has shown the former to have far better wearing qualities. The yarn curled by the new process also shows a considerably superior coverage of the pile due to the superior type of curl produced. In other words, the stretching of the yarn, thus producing a curled yarn of slightly less weight per thousand yards, is more than compensated for by the superior character of the curl obtained.

It has been found that the curl can be set in a considerably shorter time by use of the apparatus embodying the present invention than when the yarn is curled by the methods heretofore used. Furthermore, yarns which could not heretofore be satisfactorily curled by the commercial process are given a satisfactory permanent curl by the improved process. Mohair yarn can be curled by steeping for about one-

third or one-half the time previously found necessary, for example, for 2 to 4 hours. The curl in cellulose acetate yarn can be set by steeping in boiling water for about fifteen minutes.

Ordinary wool yarn should be steeped about 2 to 4 hours.

Cotton and regenerated cellulose (as viscose) yarns are preferably impregnated or at least coated with a resinous solution or other agent to fix the curl.

It is believed that the principal reason that the set of the curl can be produced effectively by steeping for a shorter time is that the yarn is under tension in curled form and, in effect, the fibres are stretched during the shrinking. It is believed also that the tension caused by steeping as the yarn tends to shrink while wrapped firmly on the wire core causes a squeezing pressure on the fibre and, at the same time, causes, in effect, a stretching of the fibre which tends to force out the fluid in the minute cell pockets in the fibres of such yarns as have this structure, thus collapsing them and causing the yarn quickly to assume a permanent curl or kink. The provision whereby the yarn is given the correct twist, that is to say the better direction and the best degree of twist before steeping, also contributes materially to the efficiency of the steeping and reduces the time necessary. Whatever the reason for the results obtained, careful tests have demonstrated that the time of steeping is greatly reduced, the deterioration of the yarn is correspondingly reduced and a curled yarn of better physical properties is obtained by the new process. Comparative tests have shown a thirty to forty per cent greater tensile and elongation strength in yarn curled by the new process as compared with the prior art process hereinabove described.

The entire lot of yarn as wrapped on the wire can be introduced at one time into the steeping tank and treated for the desired period of time, or the yarn on the wire may be fed slowly through a steeping tank, the length of wire in the tank and the speed of feed being such as to provide the desired treatment. As the wire leaves the steeping tank it may be passed through a drying chamber and immediately unwound in a suitable machine, thus providing a continuous operation. It can even be unwound before drying to advantage in some variations of the process.

The method of twisting the yarn and wrapping it uniformly on the wire mandrel avoids tangling of the yarn and resultant difficulties in untwisting.

The invention provides apparatus for effectively twisting the bundle of yarns, winding the twisted bundle on the wire mandrel for treatment, and after treatment unwinding and untwisting the same and rewinding the separated yarns on a suitable spool or spindle. The separated yarns may be wound directly on a warp beam for use.

For the purposes of disclosure an apparatus embodying principles of the invention and adapted for use in practicing the process will be described, for the purposes of which description reference should be had to the accompanying drawing forming a part hereof and in which—

Figure 1 is a view partly in side elevation and partly in central longitudinal section showing the illustrative apparatus,

Fig. 2 is a plan view of the same, and

Fig. 3 is an enlarged detail view showing the

wire core with a bundle of yarn twisted and wound thereon.

The drawing is largely diagrammatic and intended only to illustrate principles of the apparatus without an attempt to provide an optimum mechanical construction.

The apparatus shown for the purposes of illustration comprises an unwinding cradle 5 for removing curled and treated yarn from the wire mandrel and a winding cradle 6 for applying a fresh charge of yarn to the wire for treatment.

A shaft 7 driven by the motor 8 supplies power to the machine. The cradle 5 is rotatably mounted in the pillow blocks 9 and 10 secured to the main casing 11 and is positively driven from the shaft 7 by a chain gearing 12. A yoke 15 is rotatably or floatingly mounted in the cradle 5 in bearings which are co-axial with the bearings of the cradle. The cradle, therefore, may rotate while the yoke can remain at rest. This yoke carries a transverse shaft 16 to support a spool 17 carrying a wire mandrel with the curled and treated yarn thereon.

The cradle 6 is rotatably mounted in two pillow blocks 18 and 19 carried by the main casing and is driven from the shaft 7 by a chain gearing 20. A yoke 21 is rotatably mounted in the cradle 6 in bearings which are co-axial with the bearings of the cradle. A transverse shaft 23 provides support for a spool 24 upon which the wire mandrel 25 with a fresh charge of curled yarn is wound. Both cradles rotate in the same direction and both yokes are weighted to prevent rotation thereof with the cradles. This arrangement is simpler than and has certain advantages over a gearing positively controlling relative rotations. The wire mandrel is led from the spool 17 through guides 26, 27, 28 and 29 to the spool 24 on which it is wound. The spool 24 is driven by the motor 30 through a suitable friction belt gearing which will maintain sufficient tension on the wire but which will yield to prevent excessive tension. As shown, a yieldable friction clutch 31 is provided for the purpose of permitting adjustment of the tension.

The wire mandrel 25 is fed in accurate timed relation to the speed of rotation of the cradles by means of a capstan drum 35 positively driven from the shaft 7 and about which the wire is wrapped once or several times to maintain the required traction.

The cradle 5 unwinds the yarn from the wire and simultaneously untwists it. As shown, the yarn passes from the point of unwinding to the eccentric guide 36 and through the tube 37 to exit at a point co-axial with the cradle and whence it passes through a traverse, conventionally illustrated at 38, which can have one guiding eye for each yarn, and thence to the spool 40 on which the several yarns are wound as is common practice in winding warp beams. The spool 40 is carried on the shaft 41 which is driven from the shaft 7 through belt gearing which will maintain the desired tension on the yarn but will slip to prevent excessive tension. In the arrangement shown, the tension of the belt 42 on the pulleys 43 and 44 is such as to suitably drive the spool but permit slip when necessary to avoid excessive tension. The traverse 38 is conventionally indicated as mounted on a pivot 45 about which it is given a rocking movement by a cam 46 on the shaft 7.

A fresh supply of yarn is twisted and wound upon the mandrel from which the curled and treated yarn has been removed. For this pur-

pose, a charge of yarn is drawn from the spool 50 from which it is guided to the winding cradle 6. Suitable tension on the yarn is maintained by means of a brake 51 engaging a brake drum 52 secured to the shaft 53 on which the spool 50 is mounted. This form of support for the yarn to be curled is illustrative merely as obviously the several separate yarns can be supported in any suitable manner, as by separate spools or spindles suitably arranged.

In order that the twisting of the yarn, if it be a bundle of yarns, may be confined to a reasonably short length, a dividing pin 54 is positioned at a suitable distance from the end of the winding cradle 6. The several yarns are separated by this pin into two groups and from the dividing pin they pass through a guide 55 and thence to the tubular element 56, which serves as the yarn guide of the cradle 6.

The yarn leaves the tube 56 through an eccentric guide 57 from which it is wrapped about the wire. Fig. 3 indicates the condition of the yarn as twisted and wound on the wire 25. A reverse twist of the bundle is indicated, that is to say, a twist of the bundle which will tend to untwist the yarn.

A traverse mechanism for controlling the winding of the wire with its load of yarn on the spool 24 is conventionally indicated at 58. This traverse comprises a star wheel 59 which is engaged by a pin 60 projecting axially from the spool 24.

In the arrangement shown the cradle 6 is designed to give one twist to the bundle of yarn as it winds the twisted yarn once around the wire mandrel. This arrangement has been found to provide a satisfactory curl for the yarns with which experiments have been made. Obviously, however, any desired number of twists per wind may be obtained by a suitable gearing arrangement.

Various modifications of the apparatus shown obviously may be made without departing from the spirit of the invention.

The direction of twist shown is such as to untwist the yarn and this has been found preferable in curling most yarn, but obviously the direction of twist and the extent of twist may be varied to suit the particular yarn treated and the optimum conditions are readily ascertained by experiment. When analyzing the conditions of twist, not only the twist of the yarn as a whole, but the effect on the twist of the strands making up the yarn should also be considered. In order to obtain greater or less twist the yarn carrying spools can be mounted in rotatable cradles driven to provide any desired twist. Obviously, it is a simple matter in view of the state of the art to devise gearing including, for example, planetary gearing for providing the necessary rotations and drive for the spools.

If it is found desirable to adjust the speed of the drive of the wire automatically more accurately to accommodate the drive of the wire to the pitch of the previously wound yarn, a variable speed drive may be substituted for the capstan drive shown and the speed may be controlled in response to a feeler mechanism having a yarn guide closely adjacent the wire at the point of unwinding.

The wire may be made of any suitable material resistant to the action of moisture or any treating solution which may be used in the processing of the yarn, such, for example, as stainless steel. If the wire is to be heated by an electric current during the treatment or drying of the yarn, the

composition of the wire may be selected with this purpose in mind. The wire should be sufficiently stiff to serve as a relatively rigid mandrel but as flexible as is necessary for winding on the spools used.

The foregoing particular description is illustrative merely and is not intended as defining the limits of the invention.

I claim:

1. Apparatus for curling yarn comprising two rotatable cradles, a spool supporting bracket carried by each cradle and rotatable relative thereto, means for inhibiting rotation of said brackets with the cradles, means for feeding a wire from one spool to the other, one cradle having yarn guiding means to which the yarn passes at a substantially axial point at one end of the cradle and from which at the opposite end of the cradle, the yarn passes and is wound about the wire as the cradle rotates, the other cradle having yarn guiding means to which the yarn passes at one end of the cradle as the cradle rotates to unwind the yarn from about the wire and from which the yarn passes at a substantially axial point at the opposite end of the cradle.
2. Apparatus for curling yarn comprising two coaxial rotatable cradles, a spool supporting bracket carried by each cradle and rotatable relative thereto, an incompressible wire wound on and extending between said spools, means for preventing rotation of said brackets with the cradles, means for feeding the wire from one spool to the other at a rate bearing a predetermined ratio to the rate of rotation of the cradles, yarn supports beyond the respective cradles, one cradle having a yarn guide to which the yarn passes from one yarn support and from which the yarn passes and is wound about the wire as the cradle rotates, the other cradle having a yarn guide to which the yarn passes from about the wire as the cradle rotates to unwind the yarn from about the wire and from which the yarn passes to the other yarn support.
3. Apparatus for use in curling yarn comprising a rotatable cradle, a wire mandrel extending axially of said cradle, a yarn support positioned beyond one end of said cradle, said cradle having a yarn guide terminating substantially axially of the cradle at the end toward the yarn support and terminating at its opposite end eccentric to said cradle at one side of the wire mandrel and means for rotating the cradle and feeding the wire mandrel at predetermined relative speeds.
4. Apparatus for use in curling yarn comprising a rotatable cradle, a wire mandrel extending axially of said cradle, a yarn support positioned beyond one end of said cradle, said cradle having a yarn guide to which yarn passes from the yarn support and from which the yarn passes to and is wound around the wire mandrel, and means for rotating the cradle and feeding the wire mandrel at predetermined relative speeds to draw yarn from the yarn support, twist the yarn and wind it on the wire mandrel.
5. Apparatus for use in curling yarn comprising a rotatable cradle, a wire mandrel extending axially of said cradle, a yarn support positioned beyond one end of said cradle, said cradle having a yarn guide to which yarn passes from around the wire mandrel and from which it passes to the yarn support, and means for rotating the cradle and feeding the wire mandrel at predetermined relative speeds to unwind yarn from the wire, untwist the yarn and guide it to the yarn support.
6. Apparatus for use in removing curled yarn from a wire on which it is wound comprising a rotatable cradle, a support for a wire within said cradle rotatable relative to said cradle and substantially co-axial therewith, means for feeding said wire axially from one end of said rotatable cradle, a yarn guide to which yarn is led from about said wire and from which the yarn is led to a point beyond the cradle and axial thereof at the end of the cradle opposite that from which the wire is fed.
7. Apparatus for use in removing curled yarn from a wire on which it is wound comprising a rotatable cradle, a wire supported within said cradle rotatable relative to said cradle and substantially co-axial therewith, means for feeding said wire axially from one end of said rotatable cradle, a yarn support beyond one end of the cradle, a yarn guide to which yarn is led from about said wire and from which the yarn is led to said yarn support.
8. Apparatus for use in curling yarn comprising a rotatable cradle, a wire guide coaxial of said cradle, feeding mechanism for feeding a wire through said guide at a predetermined rate, a yarn guide carried by said cradle eccentric to said wire guide for winding yarn about the wire adjacent said wire guide during rotation of the cradle, a yarn support and means for causing relative rotation between said yarn support and yarn guide to produce a twist in the yarn bearing a definite predetermined relation to the rate of rotation of the cradle before the yarn is wound upon the wire.
9. Apparatus for use in curling yarn comprising a rotatable cradle, a yarn support co-axial therewith, a wire mandrel co-axial with said cradle, a yarn guide in said cradle to which the yarn is led from such yarn support and means to rotate the cradle to draw yarn from the yarn support to twist the yarn and to wind the yarn on the wire mandrel.
10. Apparatus for unwinding curled yarn from a wire mandrel and for untwisting the yarn which comprises means for feeding a wire mandrel, a rotatable cradle mounted to rotate concentrically about said wire mandrel, said cradle having a yarn guide leading axially of said cradle from a point eccentric to the axis thereof, to which yarn guide the yarn passes from about said wire mandrel to a point concentric to the axis of rotation beyond the end of the wire and means to draw the yarn from said yarn guide.
11. An apparatus for use in curling yarn comprising a pair of spaced spools, a wire mandrel wound on said spools and extending therebetween, means for feeding the wire from one spool to the other, a cradle rotatable about said wire mandrel, a yarn support for a number of yarns positioned axially beyond the rotatable cradle, said cradle having a yarn guide to which a number of yarns are led from said yarn support and by which the yarns are combined into a bundle and twisted together as the cradle rotates and from which yarn guide the bundle of yarns passes to and is wound about the wire mandrel during rotation of the cradle, whereby a bundle of yarns is twisted and wound upon the wire mandrel during rotation of the cradle about the wire mandrel.
12. Apparatus for use in curling yarn comprising a rotatable cradle, a wire mandrel extending axially of said cradle, a rotatable drum arranged to receive a plurality of separate yarns wound in parallel thereon, a traversing mechanism for

guiding a number of separate yarns to said drum, said rotatable cradle having a yarn guide to which a twisted bundle of yarns passes from about the wire mandrel as the cradle rotates and from which the yarns of the bundle pass to the traversing mechanism, the rotation of the cradle serving to untwist the yarns as the same pass to the traversing mechanism.

13. Apparatus for use in curling yarn comprising a rotatable cradle, a wire mandrel extending axially of said cradle, a yarn support positioned beyond one end of said cradle adapted to support a number of separate yarns, said cradle having a yarn guide to which the several yarns pass from said yarn support and by which said yarns are combined into a bundle and from which yarn guide the bundle of yarn passes to and is wound about the wire mandrel during rotation of the cradle, the rotation of the cradle serving also to twist the bundle of yarns as the same is wound upon the wire mandrel.

14. Apparatus for use in curling yarn compris-

ing a rotatable cradle, a support within said cradle for a wire and means for preventing the support from rotating with the cradle, means for feeding the wire axially of the cradle, a yarn support independent of said cradle, said cradle having a yarn guide to lead yarn from a point substantially axial of the cradle to a point of delivery eccentric to the wire and means for rotating the cradle to twist the yarn and wind it about the wire as the wire is fed.

15. Apparatus for use in curling yarn comprising a rotatable cradle, a wire supported within said cradle and means for preventing the wire from rotating with the cradle, means for feeding the wire axially of the cradle, a yarn support independent of said cradle, said cradle having a yarn guide to lead yarn from a point substantially axial of the cradle to a point of delivery eccentric to the wire and means for rotating the cradle to twist the yarn and wind it about the wire as the wire is fed.

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